



Smart cities and Academia
towards Action and Research

75+ Case Studies of Innovative Projects of Smart Cities Mission

Part C

Urban Infrastructure



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Smart cities and Academia towards Action and Research

Part A: Urban Management

Part B: Climate Change and Resilient Cities

Part C

Urban Infrastructure

Institutes:





National Institute of Urban Affairs

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STAY CONNECTED

Message from the Minister

Hardeep S Puri

Minister,

Ministry of Housing & Urban Affairs

हरदीप एस पुरी
HARDEEP S PURI



आवासन और शहरी कार्य मंत्री
पेट्रोलियम एवं प्राकृतिक गैस मंत्री
भारत सरकार
Minister of
Housing and Urban Affairs; and
Petroleum and Natural Gas
Government of India



Foreword

I am happy to note that the Ministry of Housing and Urban Affairs and the National Institute of Urban Affairs (NIUA) is releasing a set of best practices in the book 'SAAR: A compendium of 75 Smart Cities Projects'. It is pleasing to know that this compendium has been compiled by our partners in academia, with students and professors from 15 premier institutes contributing innovative studies on urban policies and reforms in 47 Indian cities.

Under the leadership of the Hon'ble Prime Minister Shri Narendra Modi ji, urban development has assumed central importance in India's growth story. It is seen as a means to accelerate economic growth even as it aims to provide urban dwellers with a better quality of life. Initiatives such as the Smart Cities Mission were launched with the purpose of unlocking the potential of urban areas through technology and citizen-friendly reforms.

R&D institutions, led by the enterprising zeal of their young researchers, are playing a crucial role in supporting urban development programmes. As India looks to become a developed nation by 2047, it is important to encourage research, and promote a scientific and technological bent-of-mind among the younger generations towards the field of urban development.

This compendium is a stellar example of the potential of the 'demographic dividend' that lies within India. More than 65% of the country's population is younger than 35 years of age today. It is imperative that we provide opportunities to our youth to engage with development processes and conceptualise solutions to India's emergent problems.

I congratulate the Smart Cities Mission, NIUA, and above all, the students and professors who prepared this compendium. It will surely be a useful addition to the growing discourse on urban development in India.

New Delhi
07 March 2023


(Hardeep S Puri)

Message from the Secretary

Manoj Joshi

Secretary,

Ministry of Housing & Urban Affairs



The partnership between Government, Industry and Academia is often referred as the triple helix. It is an important part of the national innovation system which supports achievement of national outcomes.

In this perspective, SAAR: Smart cities and Academia towards Action and Research is an important step undertaken by the Smart Cities Mission. The Mission's projects are lighthouses for other aspiring cities. Since the start of the Mission in 2015, the 100 Smart Cities have undertaken around 7,700 projects. Under the umbrella of SAAR, am proud to note that the Mission, NIUA, and 15 premier institutes of the country have created 75+ case studies which have been documented into this compendium.

This collaboration provided opportunities to students from these institutions to learn on the ground and enabled real-time information flow between urban practitioners and academia.

As we celebrate 75 years of India's Independence, I wish this compendium becomes the harbinger of a much bigger engagement between the triple helix thereby leading to development of cutting edge research, inflow of well-trained urban professionals, adoption of context-specific curricula in academia and much stronger flow of information between practitioners and academic institutions.

I want to commend the team of Smart Cities Mission, NIUA, and the 15 Premier institutes for their efforts and hard work in developing this compendium.

Message from the Joint Secretary

Kunal Kumar

Joint Secretary, Ministry of Housing and Urban Affairs

Mission Director, Smart Cities Mission

Vice President, National Institute of Urban Affairs



Perspectives, skills, and energy of the youth are essential ingredients for a prosperous city. The idea of a smart city has emerged at the confluence of increasing urbanization and the emergence of new technologies to address its consequences. Over 8000+ Smart City projects are either being developed or have got completed in the 100 Smart Cities.

In this background, we launched the Smart Cities and Academia Towards Action & Research (SAAR) program. It is a joint initiative of MoHUA, NIUA, and leading Indian academic institutions of the country, I am delighted to see the fruits of our combined labor. The hard work put in by partner institutions along with NIUA and the SCM team in MoHUA has been exemplary. Professors and students who documented the case studies on the ground, the cities which supported them need to be commended for forging such an enriching partnership and creating new pathways for holistic learning. The 75 case studies from 47 smart cities covered in the compendium will contribute to the discourse on urban development amongst all relevant stakeholders. My congratulations to the team and appeal to everyone in the urban sector to grab a copy as soon as possible!

Foreword by the Director - NIUA

Hitesh Vaidya

Director,

National Institute of Urban Affairs



Nearly four billion of the world's population under the age of 30 lives in urban areas. In less than a decade from today, 60% of the world's urban residents will be less than 18 years old. In India also, more than 50% of population is below 30 years. These numbers point to the fact that even though our cities are growing, they are also getting younger. Keeping this in consideration youth impact is a key factor in the discourse of our transforming agenda. NIUA is dedicated to bridging the gap between policy and practice by creating and disseminating knowledge, building the long-term capacities of practitioners, and supporting ground-level work that contributes to national and global commitments. This compendium, created as part of the Smart Cities and Academia Towards Action & Research (SAAR) program, was an opportunity for us to engage young minds in this endeavour. The 75 case studies in this volume reflect the research and analytical skills of scholars from 15 academic institutions in India. However, while I believe that the youth needs to be proactive and explore new solutions to the problems of a rapidly urbanising world, it is also our responsibility to nurture their ideas and guide them in making meaningful contributions to the urban discourse.

These case studies draw valuable lessons from projects under the Government of India's Smart Cities Mission. From the vertical gardens in Jammu to smart streetlights in Nashik, and from the use of bio-CNG to fuel Indore to improving pedestrian paths in Gangtok, these projects provide rich insights into how urban infrastructure and management can be innovative, effective and sustainable. I hope the learnings from these cases transcend the pages of this book and become a part of the curriculum in colleges and institutes across the country, inspiring the next generation of urban planners.

I am delighted that NIUA had the chance to not only evaluate and encourage their work, but also provide them with a platform to present it. I convey my thanks to the team from Ministry of Housing & Urban Affairs and my team Arvind Varshney, Purva Sharma, Himani Verma, Deep Pahwa, Bhavnesh Bhanot, Devender Rawat, Ambika Malhotra and Kapil Kumar- for putting together this compendium and supporting this effort.

Message from HOD

“

We are very delighted to be the part of such thoughtful project of NIUA and congratulates the whole team including all institutes in making it a great success. The reviews of the studies are very insightful, and it has further given great scope of innovation in the current projects. Hope to see further continuations in such initiatives with impactful collaboration.

”

Prof. Aarati Petkar

*Coordinating Professor,
Town Planning Section, Department of Civil Engineering, College of Engineering,
Pune*

“

A pragmatic initiative by MoHUA and NIUA which facilitated students to do in-depth investigation of the projects done by Smart City Mission. The whole process was an eye opener for students as it involved stakeholder meetings and public interactions to understand ground reality on how such development programmes influence and inspire daily lives of citizens.

”

Dr. Bejene S Kothari

*Professor and Head of the Department,
Department of Architecture College of Engineering Trivandrum*

“

The compendium projecting uniqueness of these projects, highlighting observed and targeted physical and socio-economic impact along with recommendations based on global benchmarks, will be an extremely relevant reading material for future professionals and students.

”

Prof. (Dr.) Subrata Chattopadhyay

Coordinating Head from IIT Kharagpur

“

The initiative like SAAR should be taken more often, which has excelled as a platform to learn, build connections, acquire skills and gain recognition for the participating academic institutions, students, scholars and researchers.

”

Dr. Nand Kumar

Head of the Department, and Associate Professor, MNIT, Jaipur

“

It has been an honour to participate in a remarkable partnership initiative involving students, practitioners and policy-makers. A compendium of case studies will immensely help us all, especially students, to understand the experience of project implementation, actor practices and institutional perspectives in the working of Smart City Mission.

”

Dr. Nandineni Rama Devi

*Director Professor, Manipal School of
Architecture and Planning, MAHE Manipal, Udupi, Karnataka.*

“

Bhopal Students have been benefitted immensely from the site visits, consultations, and documentation. The initiative we feel has met its objective of making YOUNG URBANISTS learn, share and shape India's Urban Development Journey. Congratulations Team SAAR.

”

Prof. (Dr.) Jagdish Singh

HOD, MANIT, Bhopal

“

The assessment of the projects post implementation and completion was an important learning for the students. The critical thinking thus developed will bridge the gap between academia and urbanity to make cities resilient to address future challenges.

”

Prof. Ainsley Lewis

*Dean, Kamla Raheja Vidyanidhi
Institute of Architecture and Environmental Studies*

“

Experience of working with smart city project immensely benefited the team of faculty and students

”

Dr. O P Bawane

Principal RV College of Architecture, Bangalore

“

This project gave the students and faculty exhilarating learning experience on real world diversified projects of Smart city. We hope to continue our association with Ministry of Housing and Urban Affairs and National Institute of Urban Affairs in years to come.

”

Dr. K. Pratheep Moses

*Professor and Head, Department of Planning,
SAP Campus, Anna University, Chennai*

“

SAAR gave the golden opportunity to our young minds to experience the on-ground challenges, successes, and pitfalls from ideation to implementation, role of leadership, feedback from users and way forward.

”

Prof. Hina Zia

Dean of Faculty of Architecture and Ekistics, Jamia Millia Islamia

“

I am sure that the compendium will be instrumental in learning from the on-ground experience and will lead the way forward in the successful development of infrastructure as per the aspiration of citizens.

”

Prof. Chandra Charu Tripathi

Director, School of Planning and Architecture, Bhopal

“

In the SAAR Compendium which has diverse urban infrastructure projects across the geography, the planning students got involved to develop case studies under the guidance of the Professors, which is great opportunity to create robust interface between the Academia and Industry interaction to gain the urban vision on real world.

”

Dr. Ramesh Srikonda

*Director and Professor,
SDept. of Planning, SPA, Vijayawada*

“

Exchanges with the stakeholders and beneficiaries at the grassroots level have elucidated momentous insights into the implementation of the flagship Smart City projects. This interface has immense potential for knowledge transfer to urban practitioners, planning professionals, and academia at large. We are delighted as our joint efforts come to fruition with this publication and look forward to more opportunities like this.

”

Gaurav Raheja

*Ph.D., DAAD Fellow Head, Department of Architecture & Planning Professor,
Department of Architecture & Planning Joint Faculty,
Department of Design, Indian Institute of Technology (IIT), Roorkee*

“

The SAAR compendium will have far reaching impact on the urban development sector in India and academia at large. CEPT University is happy to be a part of this initiative and we look forward to meaningful collaboration with MOHUA in near future.

”

Tridip Suhrod

Professor and Provost, CEPT University

“

The Department is proud of its active participation in five research projects of New Town (Kolkata) under the prestigious programme on “Smart cities and Academia towards Action & Research (SAAR)” conceptualized by Smart Cities Mission (SCM) and National Institute of Urban Affairs (NIUA), India. The faculty members (advisors and mentors) and the students (PhD and PG scholars) were deeply involved in providing critical appraisals on the functioning of the projects in line with the envisaged objectives of SCM. The exercise adds to the researchers’ knowledge on the processes, contents and outcomes of smart city applications in New Town (Kolkata). The Department wishes for long-term association in such research.

”

Dr. Subrata Kr. Paul

*Associate Professor & Head
Indian Institute of Engineering Science and Technology (IIEST),
Shibpur*

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This compendium would not have been possible without the shared effort, research and analysis by the students of planning. We thank all 15 institutions, their students and professors for contributing and cooperating in this project.

I would like to express my gratitude towards Shri Kunal Kumar, Joint Secretary, Ministry of Housing and Urban Affairs, for giving this opportunity to the young leaders of the country and for giving his guidance, constant supervision, and encouragement, which helped in completion of the project. I am also thankful to Mr. Vikas Chandra, programme team leader, management unit of SCM for all the kind support and conceptualizing the project. I would like to acknowledge and give my warmest thanks to Mr. Saswat Bandyopadhyay, Project Director, Centre of Urban Planning and Policy (CUPP), CEPT for ideating the project and to the whole working group for their continuous technical and coordination support.

Special thanks to Gargi Roy, Aman Singh Rajput, Saivarsha Akavarapu and Amit Kumar Sharma for their contribution and coordination with the universities for collating data for compiling this compendium.

I also want to express special gratitude to the team at NIUA for their complete support till the end, specifically Arvind Varshney and Purva Sharma, who helped take this project from conception to completion. I would also like to extend my gratitude to other institute members- Himani Verma, Ambika Malhotra, Anusha Sharma, Mehak Bakshi, Anirban Bera, Deep Pahwa, and the whole editorial and design team for lending their time and ideas. They helped by structuring the plan, developing the website and brochures supporting this voluminous compendium.

This handbook would not have been possible without the shared effort, research and analysis by the students of the 15 partner institutes documenting the projects-

1. Anna University, Chennai
2. Center for Environment Planning and Technology, Ahmedabad
3. College of Engineering, Pune
4. College of Engineering, Trivandrum
5. Department of Architecture & Planning, Manipal University
6. Indian Institute of Engineering Science and Technology, Shibpur
7. Indian Institute of Technology, Kharagpur
8. Indian Institute of Technology, Roorkee
9. Faculty of Architecture and Ekistics, Jamia Millia Islamia, Delhi
10. Kamla Raheja Vidyanidhi Institute for Architecture and Environmental Studies, Mumbai
11. Malaviya National Institute of Technology Jaipur
12. Maulana Azad National Institute of Technology (MANIT), Bhopal
13. R V College of Architecture, Bangalore
14. School of Planning and Architecture, Bhopal
15. School of Planning and Architecture, Vijayawada

In the month of January to February 2022; the team of students, and mentors from these premier institutions visited the above-mentioned 47 smart cities to conduct a field investigation. This was followed by a series of data analysis & documentation, a national research methodology workshop for the participating students, a peer review of the first draft, a final submission made by research students to their respective institutions, and then the institutes submitted the final draft of the research paper to NIUA. All these efforts culminated in to develop a compendium of 75 urban projects that are impacting the lives of urban citizens.

Throughout the process, the Smart Cities Mission, MoHUA, and NIUA acted as the linkage between the Institutions and the Smart Cities to facilitate the documentation of specific landmark projects under the Mission.

I hope this compendium will serve as a valuable “lessons learned” document for architecture/ planning students and universities and a springboard for practical future courses and disciplines across India.

Executive Summary

'Smart cities and Academia Towards Action & Research (SAAR)' program, is a joint initiative by MoHUA, the National Institute of Urban Affairs (NIUA), and leading Indian academic institutions of the country. Under the program, 15 premier architecture and planning institutes of the country worked with Smart Cities to document the landmark projects undertaken under the Smart Cities Mission. This document captures the learnings from best practices, provides opportunities for engagement on urban development projects to students, and enables real-time information flow between urban practitioners and academia.

The Smart Cities Mission's urban projects are lighthouse projects for other aspiring cities. Since the start of the Mission in 2015, the 100 Smart Cities have been developing a total of 7,742 projects with an investment of Rs. 1,81,500 crore. Under the SAAR program, it is envisaged to prepare a compendium of 75 landmark urban projects of the Smart Cities Mission. These 75 urban projects are innovative, multi-sectoral, and have been implemented across different geographies across India.

This compendium will act as a first point of reference for future research in the field and will help to disseminate learnings from projects under the Mission, thus enhancing peer-to-peer learning.

The 75 urban projects covered in this SAAR compendium are distributed across 47 Smart Cities. The cities include: Agra, Ajmer, Chandigarh, Dehradun, Dharamshala, Faridabad, Jaipur, Jammu, Kanpur, Saharanpur, Shimla, Srinagar, Belgavi, Bengaluru, Chennai, Coimbatore, Erode, Kakinada, Kochi, Manguluru, Shivamogga, Thanjavur, Thiruchirapalli, Thiruvananthapuram, Tumakuru, Ahmedabad, Dahod, Nagpur, Nashik, Pune, Surat, Thane, Vadodara, Bhubaneswar, New Town Kolkata, Ranchi, Vishakhapatnam, Bhopal, Gwalior, Indore, Raipur, Sagar, Ujjain, Jabalpur, Agartala, Gangtok, and Namchi.

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C1

Restoration of Surat Castle: Critical Review of an Indian Smart City Project

Name of the project: Restoration of Surat Castle

Location: Surat, Gujarat

Year of Project Implementation: Phase 1: 2018 and Phase 2: 2022

Sector: Heritage

SDG: SSDG 8: Decent Work and Economic Growth (8.9) SDG 11: Sustainable Cities and Communities (11.4)

Project Cost: Rs 55.49 crore

Institute: Center for Environment Planning and Technology (CEPT), Ahmedabad

Advisors: Dr. Saswat Bandyopadhyay, Dr. Sejal Patel

Students: Pratyusha Jain

Keywords: Smart cities, smart heritage, culture, tourism, smart technologies.

Abstract:

The paper is part of the SAAR program under which the project “Restoration of Surat Castle” has been critically reviewed. The paper aims to discuss the concept of Smart heritage under the Smart Cities Mission. The paper adopts a bottom-up approach to analyse the entirety of the Surat Castle project in the context of spatial development of Surat city and various tangible and intangible heritage sites across the city. The project is evaluated based on a few best practices across the world and one case study of Digital Hampi. The paper discusses a detailed research design, analytical tools and research matrix required to thoroughly study the project. The paper zooms into the project which is situated along the river Tapi in the core city. The paper also discusses the whole project which is followed by an analysis based on various stakeholder interviews and economic impact surveys of local business owners. Certain indicators are identified based on which the performance of the project is reviewed. As the castle is currently not operational, the tourist/user impact could not be gauged and serves as the limitation of the research. The paper discusses the project’s current and future impact assessment based on five impact domains: Value addition, physical and spatial impact, economic impact, socio-cultural impact and tourism impact. Based on the findings from the analysis, challenges are identified and recommendations suggested.

1. Introduction

Surat Smart City

The Smart Cities Mission (SCM) along with the Ministry of Housing and Urban Affairs (MoHUA) and the National Institute of Urban Affairs (NIUA) has launched “Smart cities and Academia towards Action and Research” (SAAR) in which 15 premier academic institutes are documenting various landmark projects developed under SCM. The idea behind SAAR is to capture learnings and impact from key projects and provide real-time information and data flow between practitioners and academia. The projects undertaken are multi-sectoral, innovative and spread across the country. This research paper is part of the SAAR initiative and the project under review is ‘Restoration of Surat Castle’, the pride of Surat Smart City. The research paper aims to study the in-depth development of this project and understand its impact on the city and its people.

1.1 Topic and Context

“People of a city and their cultural heritage are inextricably linked to the present and future of the city. Hence, if a city is on the path of becoming ‘Smart’, why should its heritage remain static and frozen?” (Piplani & Mehta, 2017). One such initiative taken by Surat Municipal Corporation (SMC) under SCM’s heritage sector is the restoration of Surat Castle. “Restoration, Re-Use and Development of Surat Castle under Development of Heritage Square at Chowk, Part-A” (Surat Smart City, p. 1, 2) is a pan-city project that has been successful in showcasing the historical layers and prevalent construction techniques of the castle. Located on the edge of river Tapi and the core city area of Surat, the castle was restored over 12 years. Project objectives for the Surat Castle and the moat around it are:

- i. Re-instating and acknowledging the precinct’s relevance and importance in Surat’s history.
- ii. Establishing a point of reference for the city and all

its citizens and bringing about a sense of pride.

- iii. Establishing a precinct appropriate to the promotion of tourism.
- iv. Establishing centres/sources for generating funds.

1.2 Significance of the Project

- i. The SCM has actively involved citizens through its city and state performance rankings, Smart City challenges and citizen involvement in Smart City proposals. Hence, reviewing the Smart City project, its implementations and its impact on citizens’ lives is very crucial.
- ii. b. As we aim to urbanise our cities with Smart Solutions leading to futuristic development, it becomes necessary to develop our heritage as well. Studying this project can offer an insight into incorporating heritage with SCM and which help in understanding the problems faced and provide ideas that worked well.



Figure 1: Aerial view of Surat castle during phase-1 implementation (2018)
Source: Surat Smart City

1.3 Aim and Objectives

The aim of the study is to critically review Smart City's restoration project of Surat Castle. The aim is to study the overall cycle of the project, identify various bottlenecks that can be omitted in similar future projects and understand the concept of Smart Heritage.

The objectives of the study are:

- i. To review the detailed project proposal for the restoration of Surat Castle under Surat Smart City.
- ii. To conduct a qualitative survey and assessment of the impact through involvement of stakeholders.
- iii. To provide specific recommendations for heritage restoration projects under the Smart City initiative.

1.4 Scope and Limitations

The scope is to identify the shortcomings, the positive points, the impact of the project along with the concept of Smart Heritage that can be used as a guide to enhance the performance of similar future projects and area development. The limitation lies in the specificity of the project as each city and its heritage would be different. Due to Covid-19, the castle is closed. Hence, limited tourist data is available and tourist surveys were not possible. Details about operation and maintenance are available for only one year of the functioning of the castle.

2. Contextual Background

MoUHA defines Smart Cities simply as cities that work i.e., cities that are formed by their people and their interactions. Smart governance, Smart education, Smart living, Smart energy, Smart mobility, Smart health care, Smart environment and Smart residents are all critical sectors for the development of a Smart City. In the list of smarts, heritage also plays a vital role as can be seen by numerous projects taken under the Smart City Mission to preserve and enhance the vast heritage of India. Currently, India has 40 internationally recognised

heritage sites. Despite a vast historical landscape there seems to be a disregard for this sector in terms of Smart implications. It is precisely in this light that the Historic Urban Landscape approach has surfaced. It is a new concept of urban planning and design that integrates territorial and local values and historic layers with today's environment, uniting culture and nature with intangible values. Integrating heritage in today's city development will not only preserve our heritage values but also result in value-based economic, social and cultural development.

Till we reach the concept of integrative planning, individual heritage conservation and management can be made smart to match the pace of development without losing its essence. With various technological advancements, the way we interact and perceive a heritage can be enhanced making it more engaging to the common public. Through various international case studies, it is identified that VR, AR, AV, mobile applications, LiDAR, 3D scanning, UAVs, and sensors are some of the technologies that are being widely used worldwide to significantly improve the interaction and experience of tourists with a heritage site or an intangible culture. These practices have not only demonstrated the use of Smart technologies to make heritage smart but have also shown the increased interest, engagement and learning of visitors about the specified heritage site.

Smart Heritage and involvement of technologies are particularly important for communities and places where the physical historic fabric is missing or has been lost. One such initiative taken in India is 'Digital Hampi'. With its rich culture and heritage, Hampi is recognised as a World Heritage Site by UNESCO. The goal of Digital Hampi is to collaborate technology and culture for a research-based digital revival of the site. The project aimed at digitally recreating missing

parts, capturing the Vijayanagar architecture style and technologically advancing the temple complexes for better understanding, interaction, navigation and participation of heritage with its visitors and creating a knowledge bank for the transformational development of Hampi. Some of the technological applications and systems used in digital Hampi are LiDAR, 3D printing, 3D virtual reconstruction, texture wrapping, unity 3D, interactive walk-through, virtual tour, artistic rendering and restoration of paintings and mobile application. Some of the key learnings from Digital Hampi are:

- i. The knowledge database can be used for further research.
- ii. The project brought together practitioners, researchers and scientists for holistic development and incubation of new ideas.
- iii. Commoners can understand the art and architecture of the built structures through interactive and engaging mediums.
- iv. The replicability of the project is a concern as each project is unique.
- v. Customisation is the key.

2.1 Conceptual Framework/Research Design

The study is broadly divided into five phases:

- Phase 1 is research formulation
- Phase 2 is a thematic study/literature study (secondary study)
- Phase 3 is a primary on-site study
- Phase 4 is the analysis of data collected from Phases 2 and 3
- Phase 5 is the conclusion

Refer to Figure 3 for a detailed framework.

2.2 Key features of the Project

Surat Castle contains different layers of history starting from 1372 the Tughlaq era, 1546 Gujarat Sultanate era, 1573 Mughal era, 1800 British era, Dutch era and



Figure 2: Reconstruction of deteriorated structure through texture mapping.;
Source: Mallik, A, Chaudhury, S, Chandru, V, & Srinivasan, S 2017. Digital Hampi: Preserving Indian Cultural Heritage

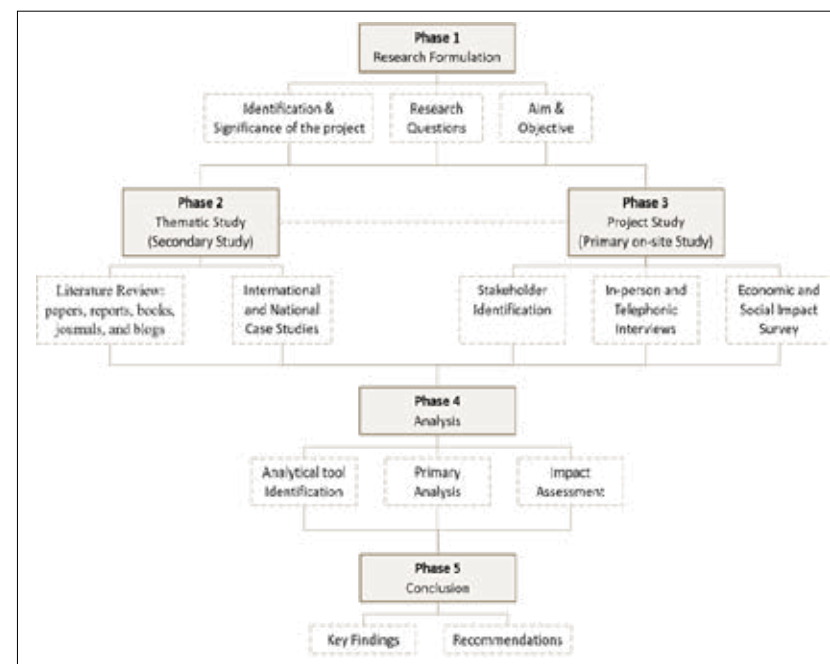


Figure 3: Phase-wise research framework
Source: Author

1947 Post Independence era as shown in Figure-4. The construction style and layer addition to the castle are unique for each era. The castle has huge walls and four bastions to safeguard the city and has an ancient system for measuring the water level of Tapi. The castle is one of the chief ancient monuments and is a standing representation of the historic significance of the city. Some of the initiatives planned include:

- i. Value-based Authentic Restoration:** Emphasis has been given to archival research, on-site study of construction techniques, study of historical maps, investigative research to look for footprints, etc. so as to conduct authentic restoration.
- ii. Open Restoration:** It is important to make history visible through construction layers.
- iii. Integration of New Technology:** New structural system to reduce the superstructure load from the original fragile wall which is coherent with the original architectural language and does not compete with the overall original fabric.
- iv. Scientific Cleaning:** Before the reconstruction work was undertaken, scientific and careful cleaning of each wall of the castle was carried out to eradicate vegetation, remove unwanted loose plaster and unwanted unsympathetic materials such as concrete.
- v. Adaptive Re-use:** The castle incorporates a museum, gallery, conference room, library and a British tea-room among many more activities.

2.2.1 Challenges in the Project

The project faced few conflicts because of the dedicated involvement of the corporation and the consultant but it has its fair share of challenges. Some of the major challenges faced by the project are:

- i. Lack of Expert Training:** There is a need for capacity-building and expert training programs customised for the project.
- ii. Citizen Engagement:** Before and during the implementation of the project, citizen engagement was not conducted in its full capacity and community needs in the vicinity of the castle were not considered.
- iii. Negotiations:** Negotiation with SBI and HP petrol pump located near the forecourt of the castle has been left.
- iv. Site Management:** The project of such scale and significance requires special attention to be given to the management as increased tourism might have a harmful impact on the heritage.
- v. Public Awareness:** The architecture, research and education community might know about the project but reaching out to each citizen is required.
- vi. Self-sustainability:** The project is entirely dependent on funding from SCM. Certain cost recovery schemes have been placed for future implementation but they still do not bridge the gap between cost and revenue.
- vii. Accessibility and Parking:** The access roads are narrow in a high-density area with high traffic share. Provisions need to be made to manage the increased traffic once the castle is operational. The forecourt of the castle is currently in use as an alternate parking provision.
- viii. Slum Rehabilitation:** The slum adjoining the castle is still in its primary stage. Though negotiations have been made no relocation

area has been specified yet which would retain the economic and social fabric of the community.

2.2.2 Risks involved in the Project

As the process of development of a heritage site is critical in itself, the risk involved during and after the project implications are also high. Some of the risks involved in the project are:

- i. Greater chances for theft and vandalism.
- ii. Chances of misinterpretation if the displays are not explained or understood properly.
- iii. The other components of Chowk development are facing issues due to construction of the metro line. This also poses risk when the castle will finally open to the public as its entrance will be blocked by the ongoing metro work.
- iv. The project will need funding as the SPV will be dissolved by 2023.
- v. If self-sustainability of the project does not work out, the services might face deterioration.

2.2.3 Features and Benefits to the city

The restoration of Surat Castle is the first heritage recognition and restoration project of this scale in the city. The project has and will result in many benefits to the city, such as:

- i. Social Benefits:** Surat is known for its textile and diamond industry. Restoration of Surat Castle will help Surat to be recognised as a historical city. The project has and will create a sense of pride among the citizens and will educate them about the importance and significance of our heritage.
- ii. City Administration Level:** The success of this project has resulted in many discussions about the development of other heritage sites in the city. SMC is now considering heritage development as an important development tool.

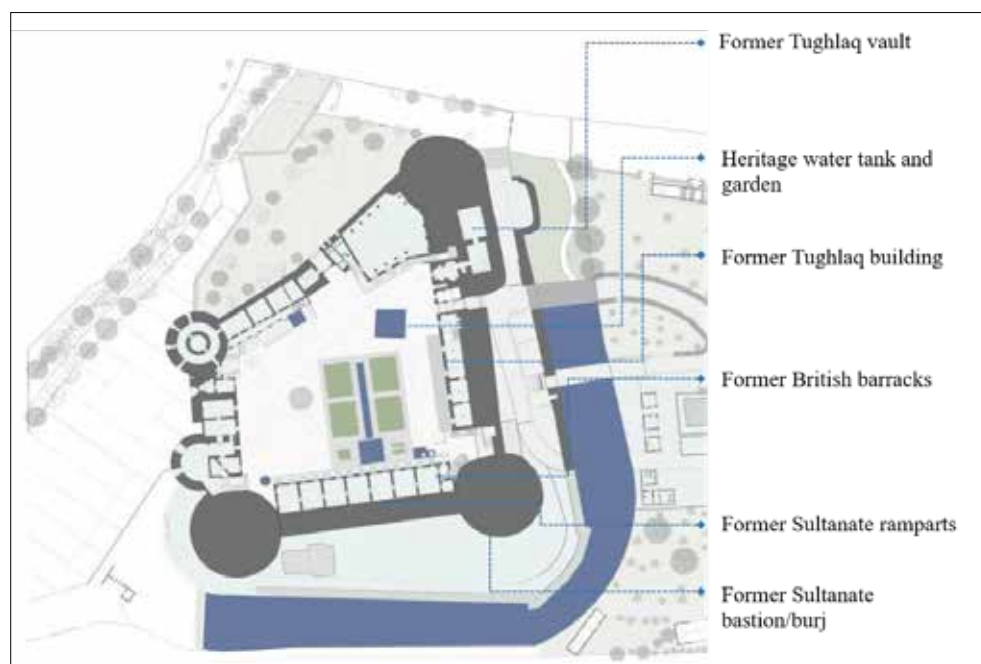


Figure 4: Surat Castle Plan Depicting Historical Layers of Different Eras
Source: Surat Smart City and PHC

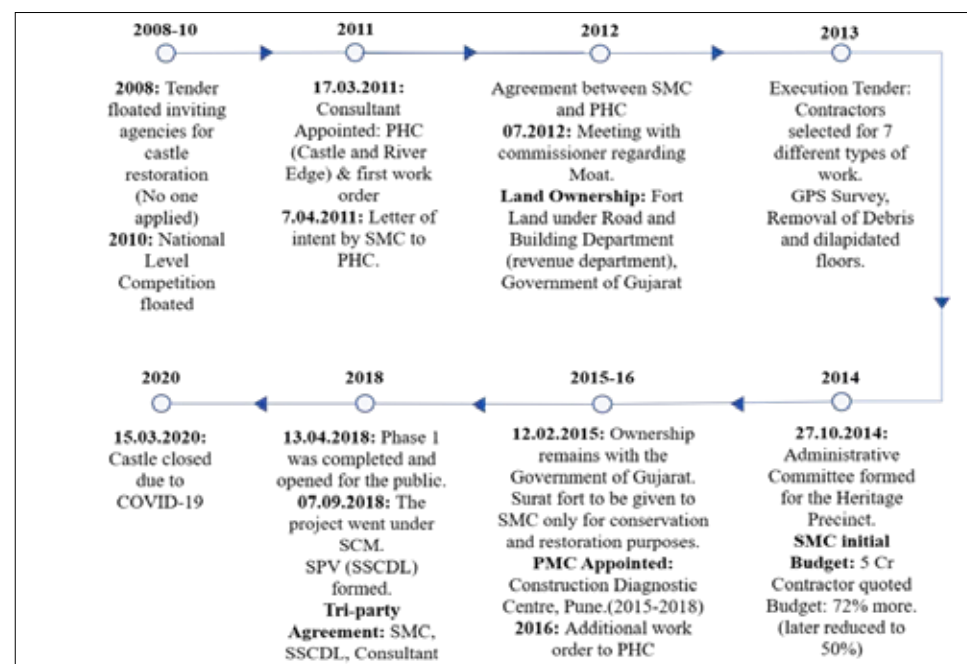


Figure 5: Surat Castle restoration project timeline
Source: Author

iii. **Economic Impact:** The local economy will be uplifted because of increased tourism. The real estate sector is also expected to be impacted.

2.3 Key findings from interviews, surveys and primary/secondary data collection

Stakeholder Interviews:

Total 18 stakeholders were consulted who were broadly divided into four categories. Key findings from each category are:

a. Project Initiation and Proposal (Stakeholders: SMC and PHC): The land, negotiations and finding contractors with experience in a similar scope of work resulted in delays in implementation. Also, there was no capacity building or expert training before implementation. Citizen engagement was limited and not very frequent. The local community and their needs were also not incorporated into the consultations. A slum is located next to the castle and they were also not consulted during the initial stages of the project.

b. Project Implementation (Stakeholders: PHC, SSCDL): The project implementation process was swift and efficient however, managing the project on-site posed a challenging issue. Such projects require

professional supervision. The project timelines need to incorporate the unforeseen and be flexible. The establishment of SPV resulted in smooth flow of funds and faster implementations. At this stage as well citizen participation and local community consultations were minimum.

c. Project Management post-implementation (Stakeholders: Curator): So far the project is dependent on funding from Surat Smart City Development Limited (SSCDL). The castle is currently spending an approximate Rs 1.2 lakh per year on housekeeping. Hence, exploring opportunities to work on a PPP base to restore historical and important buildings to reduce a huge chunk of investments is imperative.

d. Key Performance Indicators (KPIs): The primary (SMC, SSCDL, consultants), secondary and tertiary (NGO and heritage experts) stakeholders were consulted to score certain crucial indicators, as shown in Figure-9. The indicators selected are only till the implementation of the project and customer satisfaction index has not been considered as the project is not yet functional. As per analysis, the project has to be scalable. However, there is a need to address the self-sustainability of the project and larger masses have to be made aware of the project and its related aspects.

e. Overall Project: Though SMC has spent a lot on this project, national and international recognition is still limited. The project needs to effectively incorporate tourism and needs to be more engaging with people. Tourism is the future of this project and hence it needs to be advertised better.

Stakeholders' Survey (Economic Impact):

Chowk area has been selected to study the economic impact. Only the shops that lie within a 250-m radius of the castle have been taken for the study. Within the selected area, 20 shops have been surveyed under simple random selection as shown in Figure-10.

i. Survey Findings: Due to Covid-19, the castle opened only for a small duration hence, no major visitor impact was seen on the economic activities of the area. This emerged as one of the limitations of the project. However, a few shopkeepers felt the impact of the project when the castle opened from 2018 to 2020 and are hopeful for the future. As per the survey, none of the shopkeepers were consulted in any manner regarding the project. Almost 65% of shopkeepers feel that they might require additional amenities such as a location for vendors, parking provisions for increased traffic, designated provisions for food stalls and increased safety

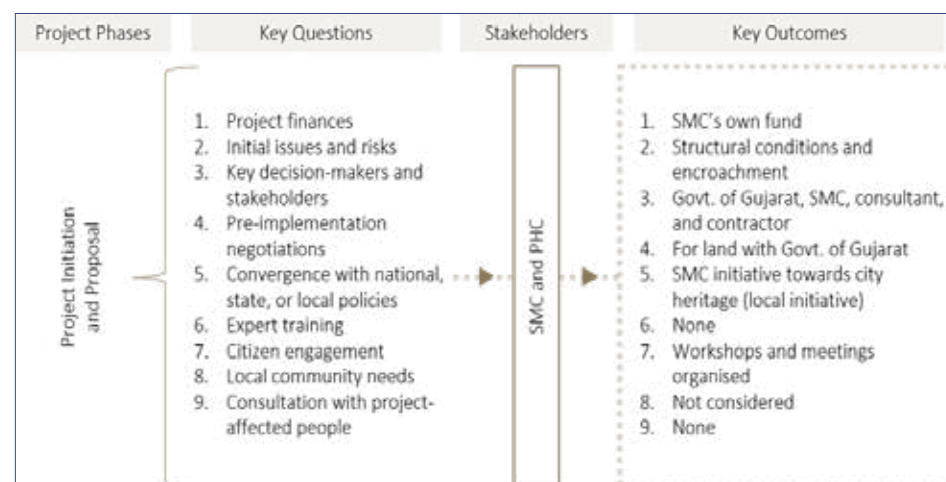


Figure 6: Project initiation and proposal analysis framework
Source: Author

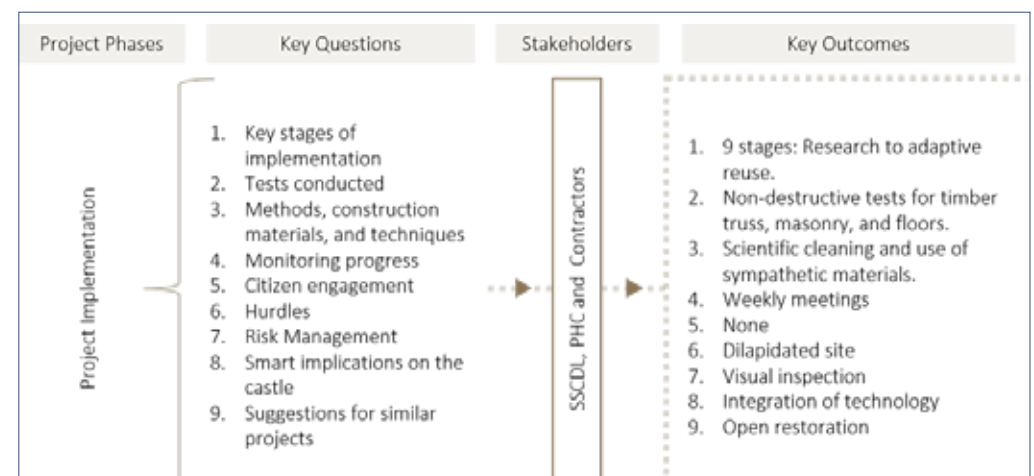


Figure 7: Project implementation analysis framework
Source: Author

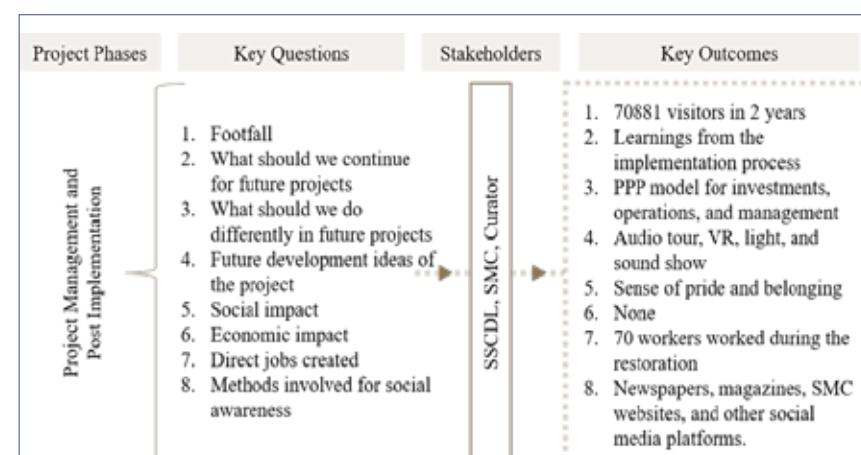


Figure 8: Project management and post-implementation analysis framework.
Source: Author

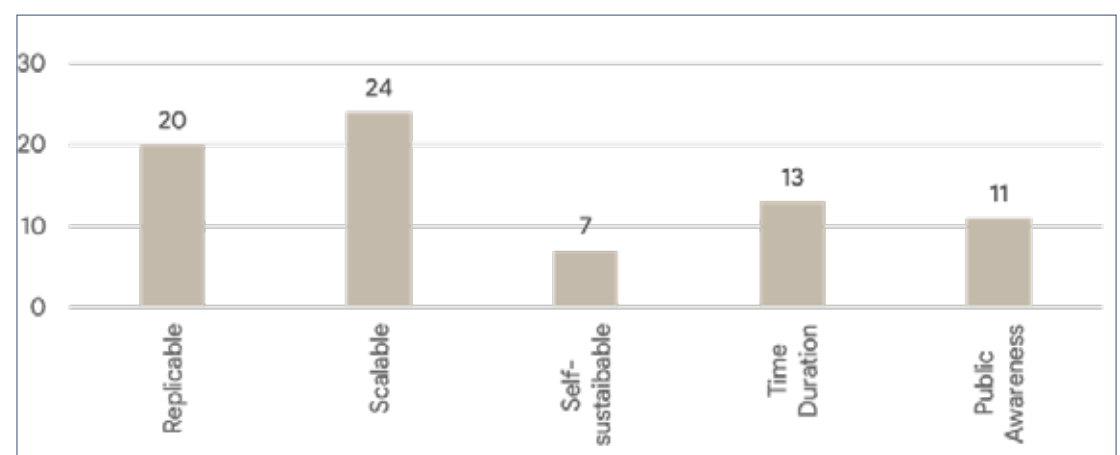


Figure 9: Stakeholder's response to Key Performance Indicators.
Source: Author

when tourism increases. However, all respondents expressed that the project has not been advertised enough.

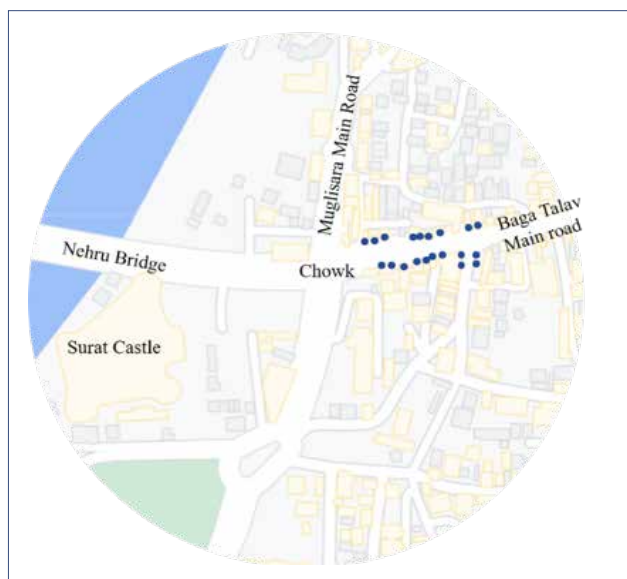


Figure 10: Economic impact survey sample location
Source: Author

ii. Key Performance Indicators (KPIs): Efficiency of services, sustainability, safety and security, economic growth and city reputation are the key indicators that respondents were asked to score on. Though meant for the project, upon learning the limitation of the castle being closed, these indicators were used to describe the performance of the surrounding area as a result of the project. As per the responses, city reputation and safety and security are the most affected.

Current Impact Assessment:

The physical and spatial, economic, socio-cultural and tourism impacts of the project were studied along with the value addition. The impact area selected for understanding the physical and spatial impact originates from the castles' forecourt and covers a radius of 500-m.

i. Value Addition: Both Surat Castle and Smart City Mission have benefitted from the inclusion of the project under Smart Cities. Addition of the Surat

Castle project to the mission resulted in adding value to it as it was the first historical restoration project of this scale in the city. It has been restored in an open restoration style for better communication of layers of different eras of construction. It is a Smart restoration with the use of optimal excavation, construction and structural techniques. It adds to the tourism of the city and has resulted in economic, social and cultural impacts. Though the project was an initiative of SMC and a large part of Phase-1 is covered by its supervision, the addition of this project under the Smart City Mission resulted in many benefits such as smooth flow of funds through SSCDL, national recognition of the project through the mission and award competitions and a considerable boost for Phase-2 of the restoration process in terms of enthusiasm and manpower.

ii. Physical and Spatial Impact: The castle is located in a dense built fabric that developed with the origin of the city itself. Between 2012 to 2022, only 23 new developments were identified, however, the buildings in the area seem to be under constant redevelopment and renovation. Special characteristics of the impact zone contain 24% of built area, 22% of area under both roads and water, 20% un-built area and only 12% of open and green spaces. A high percentage of un-built area lies under institutional land and hence cannot be accessed for private development. The area has 15% land under commercial and 15% under residential use indicating the presence of both the economic centre and the real estate. The built-use of the impact zone consists of 31% commercial development. The area has 23% residential buildings and 21% of mixed-use buildings. The area also has 12% of institutional buildings, 2% of religious buildings and 1% of public utility buildings.

iii. Economic Impact: The Castle helped in generating daily employment opportunities by involving an average of 70 skilled/semi-skilled workers. Around eight technical staff members as well as around 14 administrative staff members perform their duties exclusively at the castle. Six computer operators and 12 security guards are presently working at the

castle. Direct employment will increase once the castle will be open to public.

iv. Socio-cultural Impact: The castle curators have received many requests to host various academic talks, cultural events, school visits and films/ advertisements/television program shoots at the castle. The citizens take pride in the project and are eager to learn more about the history of the castle and Surat. Over time, a Dargah was established in the ruins of the castle which has now been restored and incorporated into the Castle Restoration project, keeping the socio-communal profile of the surrounding area in mind. Since the castle has not yet become functional, there has been no significant spatial impact in the vicinity.

v. Tourism Impact: On 13th April 2018, the Phase-1 of the restoration work was over in three buildings and 1 Burj. The castle was closed from 15th March 2020 on a preventive basis for public visits due to Covid-19. During this period a total of 70,881 visitors visited the castle. Nearly 6824 persons have done photography/videography here. After completion of restoration work of the entire castle, 6 buildings, 4 Burj, 2 partial Burj, a moat, and a draw bridge will be available for public visits. This is expected to increase the footfall manifold and become a centre for tourism-based activities.

Future Impact Assessment:

As the castle remained functional for a short duration with minimum impact to its vicinity, the future impact assessment was also done presuming the changes that will occur as a result of the functional project:

i. Value Addition: The project will act as a stimulator for the development of various other projects in city. With increased tourism, footfalls are also expected to increase in the surrounding institutional buildings, Gandhi Baug and public utility buildings. Increased tourism will help the local market get national and international recognition and currencies. The project will also facilitate heritage walks and help other monuments and buildings of historical importance to be recognised by the citizens and

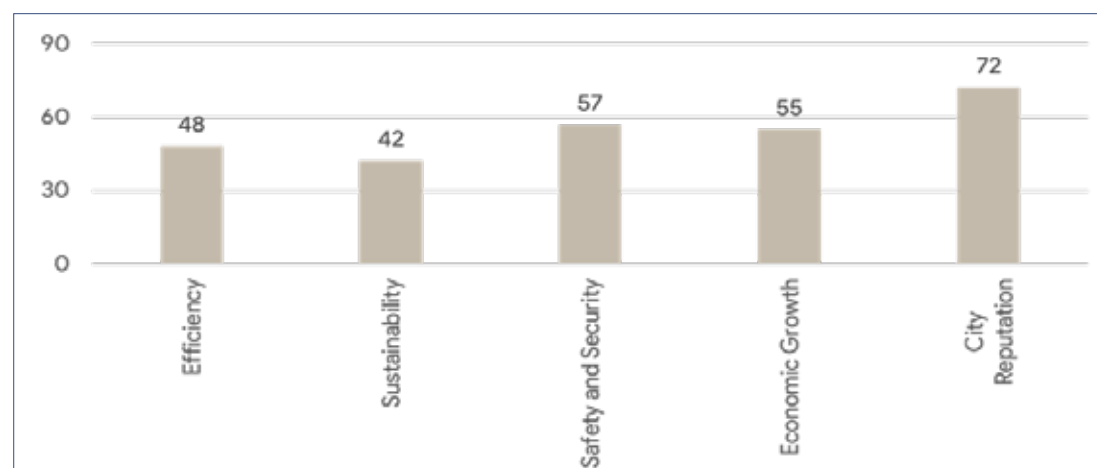


Figure 11: Locals' response to Key Performance Indicators
Source: Author

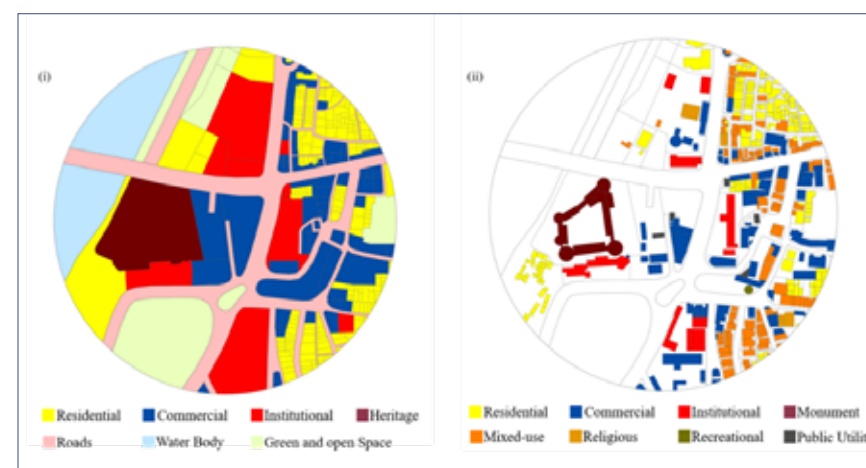


Figure 12: (i) Land use map of the impact zone.
(ii) Built-use map of the impact zone.

tourists.

ii. Physical and Spatial Impact: As the impact zone contains a high-density area, there is a huge opportunity for redevelopment and the rental real estate market. Most of the commercial or mixed-use buildings along the roads are in dilapidated conditions, with need and high demand for redevelopment. The area will also observe the emergence of the hospitality sector. The land and real-estate prices are expected to increase along with the development of the castle and the Chowk. The area is also planned to be connected with a metro route.

iii. Economic Impact: The Surat Castle in itself will act as an economic centre with a British tea-room, food courts, Art gallery cum exhibition hall, conference rooms and professional photography/videography on rental basis. The project will help in promoting various professional services in the surrounding area such as restaurants, cabs and auto services, shared public transportation systems, etc. With national and international recognition, footfall of all segments of tourists will increase which will help in boosting the local economy of not just the vicinity area but also the hospitality industry. International tourism will result in an exchange of foreign currencies as well.

iv. Socio-cultural Impact: When fully functional, the castle can establish Surat as a city with historical significance. This will instil a sense of pride and honour in the citizens and generate a sense of ownership and responsibility towards the castle and other significant tangible and intangible heritage sites of the city. This could further help the government agencies to incorporate informing the public about the future redevelopment practices. The project will have a direct impact on the adjoining slum area, which is proposed to be relocated. This will result in breaking the social and economic fabric of the slum dwellers.

v. Tourism Impact: The direct impact of increased tourism will be on the economy of the area and the city. The project has the potential to attract national and international tourists. This is seen in the adaptive reuse plan of the castle set forth when it reopens. This includes 35 new themed galleries, built attractions such as Hamam, a British tea-room, court, Dutch-period room, mobile app-based audio-guided tour, VR-based interactive map of Surat, light and sound show and a reference library available to explore books and archives.

3. Discussion and Conclusion

This section of the report discusses the implications, limitations and key lessons learned by the research; it also includes recommendations pertaining to the challenges identified.

3.1 Implications

The castle is located in a dense fabric of the old city of Surat with mixed-use structures in the vicinity. Two of the oldest and largest markets are located within a kilometer's distance from the castle. With increase in

footfall and tourism, the local economy of the area will experience a considerable boost. Since it is not only the castle but the entire Chowk is proposed to be developed, the area will experience improved infrastructure and services. As a result, new hotels, lodges, restaurants

S. No.	Conflict/ Challenges	Recommendations
1.	Interdepartmental conflicts	During the inception of the project, other projects being constructed in the area and their timelines should be thoroughly reviewed to avoid future conflicts.
2.	Local Community	Local communities should be involved as stated in the Historic Urban Landscape approach.
3.	Increased timelines	Project timeframes must account for unforeseen time costs and should be flexible.
4.	Lack of expert Training	All the stakeholders involved in the project should undergo basic training for a better understanding of the work and its development. Capacity building is a must in corporations regarding smart heritage.
5.	Citizen Engagement	This could be done through the use of various technologies such as mobile applications, VR, VR, etc. Citizens can be engaged through various social media accounts.
6.	Site Management	Site management should be considered an integral part of the inception of the project. Heritage project needs specialized individuals, groups, or organizations that can carry out this task with efficiency. Hence they should be incorporated from the beginning.
7.	Public Awareness:	People need to be made more aware of the project. The project needs to be advertised enough to attract tourists from other cities and states. Cultural events involving the intangible cultures of Surat can be organized in the court of the castle to make people more aware of the intangible and tangible heritage. City buses can incorporate route maps highlighting Surat Castle.
8.	Self-sustainability	To achieve this, the operation of various rentable spaces and revenue generating activities could be carried out in a public-private partnership model or by leasing out commercial operations to the private agencies. The agency can carry out a detailed cost-benefit analysis and propose interventions with reduced operating costs and increased revenue. Crowdfunding could also be used as a tool for managing costs.

Table 1: Recommendations for Identified Conflicts and Challenges
Source: Author

and shops will start mushrooming. This project will help citizens understand and respect heritage across the city and country. The success of this project will help in initiating the restoration of other historical sites in the city. This will also give a boost to the heritage walks in the old city in which all the heritage sites could be connected.

To critically review the project, rigorous research and detailed methodology were followed. However, the study faced certain limitations:

- i. The castle was functional for a very short duration and hence did not make a huge impact on its immediate surroundings.
- ii. During the duration of the study, the castle was closed and hence visitor survey was not conducted.
- iii. Data on the operation and maintenance of the project was obtained from the curators of the castle and not from the on-ground functionality of the project.
- iv. Due to limited impact in the vicinity, the future impact has been presumed based on various case studies.

3.2 Key lessons learned

- i. **City Image:** A project of such scale and historical importance has instilled a feeling of pride in the hearts of the citizens of Surat. This has resulted in a wave of learnings about the history of Surat among the young and elderly alike. Hence, such projects should be promoted as they result in a significant socio-cultural impact.
- ii. **Value Addition to City Heritage of Surat:** The project has helped in increased footfalls.
- iii. It has had a positive impact on the culture and local economy of the city. Since its inception under the Smart City Mission, there has been a smooth flow of funds and execution support.

3.3 Recommendations

- i. **Castle's Development and Functional Plan:** The set yearly objectives to be achieved and the funding requirements have to be taken care of. Need to identify available funds and sources of funding for that year. This will help in optimally distributing the funds for various activities to enhance user experience and the identity of the castle.

- ii. **Specialist Team:** An on-site team of experts including architects, historians, curators, economists, etc should be formed to ensure sympathetic functioning of various proposed activities in the castle. The team could propose timely interventions to have enhanced physical, social, cultural and tourism impact in and around the castle.

- iii. **Citizen Participation and Outreach Program:** The slum dwellers around the castle can act as volunteers for the castle. With proper training and supervision, they can manage the visitors and the parking and get an opportunity to work in the formal sector. The local community can also be involved in heritage walks, maintenance of the surrounding area of the Castle and uplift the local economy.

- iv. **Digital Initiatives:** Surat Castle can be included in the Incredible India mobile application to get the project and the city national and international recognition. QR codes can be installed on billboards or on medians near traffic light junctions which when scanned can provide a tourism trailer of the castle.

- v. **Risk Mitigation:** Currently visual inspections are done to mitigate risk on the built structure. For this LiDAR, UAVs and 3D scanning can be used to develop a system that can be updated regularly and detect damages that are not visible to the naked eye.

- vi. **City-wide Heritage Management:** An integrated approach to urban development with heritage helps in creating cultural capital with a distinctive identity, the emergence of small, value-added creative industries, reduces gender and cultural disparities and impacts the quality of life of the urban poor. This can be achieved through:

Inclusive Heritage-based City Development in India (Demonstration Program by World Bank, 2011):

It is a bottom-up, demand-driven approach to the communities' aspirations and heritage values. It is developed through participatory methods and involves area-based interventions. Its focus is multi-sectoral such as service provision, livelihood promotion, heritage rehabilitation and institutional strengthening.

Historic Urban Landscape Approach (UNESCO, 2011):

UNESCO provides six steps to implement the approach such as mapping, consensus (what values to conserve), vulnerability (to socio-economic strains and climate change), integration (urban cultural values in a broader framework of urban planning), prioritise (conservation and development initiatives) and partnership. There are four implementation tools provided - Civic engagement tool, knowledge and planning tool, regulatory tool and financial tool.

3.4 Conclusion

The Restoration of Surat Castle is one of the pilot heritage projects of the city to initiate conversation about built and un-built heritage and its importance in city development. The project has completed both phases of construction and will soon open for the public. One of the unique styles used in the project is an open restoration which highlights all the relevant historic layers on the monument. This concept provides visitors with a clear idea of the development of the monument over time. The moat around the castle is also being restored with a draw bridge over it. The project is envisioned for great economic, social and tourism impact in the vicinity. However, when it comes to self-sustainability, the project is facing serious challenges. With SSCDL closing down in 2023, the project is looking for funding from other sources. Though many activities are curated in the castle, the predicted cost-to-revenue ratio does not match. The project also faces setbacks when it comes to public awareness and engagement as it has not been advertised enough. Currently, the project does not seem to have much economic or social impact on its surroundings but locals believe that it has helped in improving the reputation of the city. The project has been started with great intent and has initiated a dialogue among the citizens but as it is not operational, the direct impacts are very few. The project is scalable and replicable but the actual impact will only be known when the castle is resumed to its full capacity.

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Annexure 1:

Objective 1 Research Matrix

Objective 1: To review the detailed project proposal for the restoration of Surat Castle, under Surat Smart City. The detailed matrix is shown in Table 2.

S.No.	Objective	Questions	Methodology	Literature Reviewed	Stakeholders		
					Stakeholders	Designation	Mode of Interview/Survey
2	To conduct a qualitative survey and assessment of impacts through the involvement of stakeholders.	Identify various stakeholders involved. Study the impact on all the stakeholders. Identify and understand social, cultural, physical, and economic impacts.	Primary study	Detailed Project Reports, Documents, Presentations.	-	-	-
			Secondary study	Reports, papers, articles, blogs, journals, etc.	-	-	-
			Primary Study	Detailed Project Reports, Documents, Presentations.	-	-	-
			Secondary study	Reports, papers, articles, blogs, journals, etc.	-	-	-
			Documentation	Photographic and Videographic Documentation	-	-	-
			Key Informant Interview	Surat Tourism SPV (SSCDL)	-	-	In-person Interview
				SMC	-	CEO, Surat Smart City Assistant Engineer @ SMC	In-person Interview
		Consultant		-	Conservation Architect @ People for Heritage Concern (Consultant)	In-person Interview	
		Curator		-	Chief Curator @ Surat Castle	In-person Interview	
		Survey	Locals/ Residents	-	-	Stratified Survey	
			Business Owners	-	-	Stratified Survey	
			Tourists Hawkers	-	-	-	
		Expert Consultation	Institution (SCET)	-	Professor @ SCET	-	
			NGO	-	Founder of Dharohar Foundation (NGO)	Telephonic Interview	
SMC	-		Town Planner and Executive Engineer	In-person Interview			
Identify a framework for impact assessment.	Secondary study	Reports, papers, articles, blogs, journals, etc.	-	-	-		
	Expert Consultation	-	Institution (SCET)	Professor @ SCET	-		
			NGO	Founder of Dharohar Foundation (NGO)	Telephonic Interview		

Table 2: Objective 1 Research Matrix
Source: Author

Annexure 2:

Objective 3 Research Matrix

Objective 1: To provide specific recommendations for heritage restoration projects under Smart City. The detailed matrix is shown in Table 4.

S.N o.	Objective	Questions	Methodology	Literature Reviewed	Stakeholders				
					Stakeholders	Designation	Mode of Interview/Survey		
3	To provide specific recommendations for heritage restoration projects under the Smart City.	Workability of the Project	Secondary study	Reports, papers, articles, blogs, journals, etc.	-	-	-		
			Expert Consultation	-	-	-	Heritage Conservation Expert	In-person Interview	
						SMC	Town Planner and Executive Engineer	In-person Interview	
			Identify various bottlenecks in the implementation.	Primary Study	Detailed Project Reports, Documents, Presentations.	-	-	-	
				Key Informant Interview	-	-	SMC	Assistant Engineer @ SMC	In-person Interview
							Consultant	Conservation Architects @ Azmi & Sarosh Wadia Architects and Faculty @ SCET (Consultant)	In-person Interview
		Contractor					Contractor @ Surat Castle		
		Expert Consultation		-	-	Institution (SCET)	Professor @ SCET		
						INTACH	Convenor @INTACH Surat Chapter		
						NGO	Founder of Dharohar Foundation (NGO)	Telephonic Interview	
		Identify the challenges pre- and post-implementation.		Primary Study	Detailed Project Reports, Documents, Presentations.				
			Secondary Analysis	Observation and documentation					
			Key Informant Interview			SMC	Assistant Engineer @ SMC	In-person Interview	
						Consultant	Conservation Architects @ Azmi & Sarosh Wadia Architects and Faculty @ SCET (Consultant)	In-person Interview	
Contractor	Contractor @ Surat Castle								

Table 3: Objective 2 Research Matrix
Source: Author

Annexure 3: Site Images



C2

Smart Streets Design

Name of the project: Smart Streets Design

Location: Pune

Sector: Urban Infrastructure

SDGs: SDG 3, SDG 11, SDG 13

Institute: College of Engineering, Pune

Advisors: Dr. Arati S. Petkar, Ms. Lisha. C. Bendre

Students: Sanket Bhalekar

Keywords: Smart City, Smart Street, Non-motorized transport, Sustainable Development

Abstract:

In recent years, India has seen massive urban agglomerations, which have created major challenges to the infrastructure and growth of the city. Cities have to become smart to provide core infrastructure and provide a decent quality of life for its citizens, as well as a clean and sustainable environment, in order to maintain pace with the country's development. Considering India's and the world's rapid urbanization, improving walkability is an important factor to consider. Walkability has been related to better health outcomes and the completeness of the transportation network as an outcome of the built environment. The Smart Cities Mission is a creative attempt by the Indian government to develop smart cities across the country in order to promote economic growth and improve people's quality of life by enabling local development and deploying smart technology. The Smart City Mission in India has explored improving non-motorized transportation through programmes such as Smart Streets. This study looks at such smart streets in Area Based Development in Pune, where major roads were redesigned to make pedestrian movement better. As this is a pilot attempt for future street redesigning, a qualitative assessment of the pros and cons of the same is presented here. A focused walkability and Smart Street infrastructure is a positive step toward developing future smart cities that are sustainable, equitable, and inclusive.

1. Introduction

About Pune:

Pune is India's seventh-most populated city and the second-largest in Maharashtra state. It is located on the Deccan Plateau, 560 meters (1,837 feet) above sea level, on the right bank of the Mutha River. Pune is the administrative capital of the Pune district and was previously the center of the Maratha Empire's supremacy. Pune is Maharashtra's cultural center and is also known as the 'Queen of the Deccan.' The city has been marked by various forts and historical places. It is known for manufacturing, especially automobiles; as well as government and private sector research institutes for information technology (IT) education, management and training that attracts immigrants, students and professionals from across India, south east Asia, the middle east, SAARC and Africa. According to the 2011 census, Pune has a population of more than 9.4 million people, with a density of 603 people per sq. km. During 2001 to 2011, the decadal rate of population growth was 30.34 %.

About Pune Municipal Corporation & Pune Smart City Development Corporation Limited:

Pune aims to become India's most livable city by capitalizing on its rich cultural and natural heritage, strong human capital, and vibrant employment market by solving its major infrastructural challenges in a "Future-Proof" way. To achieve this, PMC (Pune Municipal Corporation) established the Pune Smart City Development Corporation Limited, a special purpose vehicle dedicated solely to the implementation of Smart City Projects. PSCDCL's (Pune Smart City Development Corporation Limited) aim to achieve the specified objective by identifying citizens' true needs and priorities; focusing on creating more with less investment; creating self-sustaining infrastructure; devising low-cost information, communication, and technology-based solutions; and developing implementation strategies that ensure each project can be implemented in real life.

1.1 Smart Streets

Streets perform certain basic functions in the built environment such as providing routes for vehicles and public transport, and accommodating utility services and drainage systems. The design of a street affects how successful it is in performing these functions, and it can also vitally affect the urban character of a neighborhood and influence how people use the street and interact with each other on it. The quality of a street and its connections can affect whether people choose to walk or cycle, or take the car. It can affect whether people feel safe. Thus, the character of the street needs to be developed in such a way so that along with the functions

which it has to perform, other purposes could also be served such as encouraging public transport, creating interactive neighborhood etc.

Streets have traditionally been a place for kids to play and for people to come together and interact within communities. Indian cities always had significant open spaces like maidan, the river, the neighborhood park, and the street, which have all played an important role in the urban social fabric. Open or green spaces in any city are not just lungs but have also acted as social public areas. In the built environment, streets provide a variety of functions, such as providing routes for vehicles and public transportation, as well as accommodating utility services and drainage systems. So, the streets and arterial roads need to be carefully designed, nurtured and transformed into open spaces with landscaping and various public activities. The design of streets affects how well it performs these functions and it can also affect the character of the neighborhood, how people utilize the street and interact with each other. So, in order to make Smart Cities inclusive, the Smart City Mission aims to improve the quality of life of citizens.

The Smart Street project is a tool for creating walkable or pedestrian friendly streets. This project falls under the non-motorized transport and mobility which aims to minimize traffic congestion, pollution, and resource depletion, as well as improving the local economy, promoting interactions and providing security for pedestrians.

With the emergence of Smart City initiative by the Government of India, Pune Smart City Development Corporation Ltd. & Pune Municipal Corporation (PMC) identified Aundh-Baner-Balewadi (ABB) area as an area-based development which included retrofitting, redevelopment and greenfield development. In the selected local area, Pune Smart City intends to develop a neighborhood model of livability and sustainability that meets global standards for the 4 times population growth by 2030 (from 40,000 to 1,60,000).

The Smart City has carried out the development of smart streets under the themes like a) fix hard infrastructure and make it future ready as the population grows 4 times, b) create social infrastructure as per benchmark standards, c) enhance livability quotient considerably on top of fixing infrastructure. These themes redefine roads in the Aundh-Baner-Balewadi area as 'complete streets,' with the comfort, convenience, and safety of all road users in mind. The network of streets is designed by giving preference to walkability, universal accessibility & cycling.

1.2 Significance of the Project

The Smart Street project serves as a place for social interaction and better walkability. The health of the city can easily be linked to spaces for walking and cycling. If cities are made walkable within the neighborhoods, where people can walk a kilometer or two and cycle safely for three to four kilometers as a part of their daily routine, it will improve the overall quality of health. One of the most key benefits of walkability is that it reduces the society's vehicle footprint. Thus, carbon emission can be minimized if more people choose to walk.

Increased walkability through Smart Streets provides many individual and community benefits, such as opportunities for social interaction, increased civic sense and reduced crime rates. In addition, there are many economic benefits also, both for individuals and to the public, with increased efficiency of land use including accessibility, better livability, transport cost saving, etc. which stimulates economic growth.

The Smart Street project encourages the improvement of non-motorized and public transport infrastructure and shows how important this project is for the city. If the project is not designed as per walkability or pedestrian safety, then there will be more pedestrian injuries and fatalities due to accidents.

1.3 Aim and Objectives

Aim: The aim of the study is to assess the impact of Smart Streets on citizens and the city.

Objectives: The objectives of the study are:

- To realize the true potential of the Smart Street Project.
- To study the level of satisfaction that the citizens feel about the initiatives in these areas.
- To assess the positive and negative impact of the project.
- To give recommendations towards such initiatives taken by the Government of India.

2. Contextual Background

Traffic and transportation were the key civic concern in Pune. The Pune Municipal Corporation (PMC) has taken steps for improving transportation system. The PMC General Body approved the Comprehensive Mobility Plan (CMP) in 2012 with the goal of pedestrian safety by promoting non-motorized transportation. Improvements to footpaths, investments in public transportation, parking regulation, public education on transportation issues, and improved implementation of traffic regulations are some of the measures outlined in the City Mobility Plan. In 2015, PMC, through Smart City Mission identified Aundh, Baner, Balewadi (ABB) as the region for the area-based development component

of the Pune Smart City proposal. Figure 1 shows the mapping of various smart streets of the ABB region developed under the Smart City Mission.

The ABB area has the old settlements of Aundh gaon, Baner gaon and Balewadi gaon, which are now surrounded by modern residential and commercial buildings. The area is bounded by two arterial roads, a highway and the Mula River. Segments of the arterial roads and the streets within the area have multiple types of uses and users, apart from mobility. These include cultural artifacts, temples, statues, amenities like public toilets, utility lines, and on-street parking. Street vending and waste sorting are two significant informal economic activities.

2.1 Conceptual framework / Research design

The purpose of this research is to investigate citizens' perspectives of Smart City projects in the Aundh, Baner and Balewadi (ABB) region of Pune city. The data is collected from respondents residing in the ABB area, who are in the age group of 18 to 76 years. The respondents are selected through a simple random sampling. The data is collected with the help of structured questionnaires and through unstructured interviews and discussions with citizens from these areas. The qualitative analysis of the Smart Streets is done by using different parameters of walkability such as footpath width & condition, disability infrastructure, pedestrian safety and security, pedestrian amenities, landscape and parking facilities, etc. Pedestrians were asked to rate the selected street on a scale 1 to 5 for each parameter with 1 being the lowest and 5 being the highest. The collected data and rating given by stakeholders were used to calculate the walk score. Based on the walk score, the walkability index was calculated for the Smart Streets.

2.2 Key features of the project

Pune holds an important place as it has ranked second in the Smart Cities competition organized by the Government of India. A 4D strategy – Document, Design, Discuss and Demonstrate is adopted for the Smart Street project while interpreting the meaning of SMART as Simple, Manageable, Affordable, Responsive and Technological. Demonstration being the final 'D' included project management, consultation, material selection, selection of contractors and lastly execution.

The street design is based on the principles of Universal Accessibility and Equitable distribution of road- right where apart from Motorized Vehicle MV Lane and parking, equal priority is given to pedestrians, cyclists and hawkers while saving the natural layer of existing trees and improving urban aesthetics. Some design policies were mutually agreed upon by the Municipal Corporation and were elementary in the success of the project. These policies are included in the Smart Street Project:

- Walkability with equity and dignity, to facilitate uninterrupted movement.
- Universal Accessibility as per the Act, for the persons with disabilities to ensure their safe passage.
- Cycle-friendly-Safe-Environment, by a dedicated

- and demarcated right of way for the cyclists.
- 'Hawker's and Vendor's policy as per the Act, to restore the vibrancy and eyes of the streets.
- Public transport at the neighborhood level to maintain connectivity and ease of access.
- Organized parking with a policy that initiates paid parking and results in revenue generation.
- Public realm that is people friendly by conserving green cover, providing seating and street lights.
- Technology to incorporate free Wi-Fi, CCTV cameras for surveillance, sensors and traffic count.

Some of the challenges, risks and features in the projects are as follows:

2.2.3 Challenges in the project

- Improve universal accessibility for elderly and physically challenged.
- Increased focus on pedestrians and bicycle users.
- Future-proofing infrastructure by constructing adequate provisions for underground utilities.
- Beautify streets with elegant street lights, seating and sculptures.

2.2.4 Risks involved in the project

- Execution risk: Significant governance and competency is required to execute development ideas in a seamless manner.
- Land-use change risk: Few important land-use changes are required to achieve the mission.

2.2.5 Features and Benefits (social, technical, city administration level, impact on environment and economy) to the city (expected and observed)

- New & retrofitted footpaths along with curb ramps increases walkability.
- Walkability is improved with smart streets which promotes shopping and supports businesses.
- The elderly, children and persons with disabilities are all better served with smart street design that allows them to safely get around.
- Air quality will improve as people choose to walk or bicycle rather than drive for short trips.
- Walking and riding a bicycle are a great way to exercise. Smart streets provide improved access for pedestrian activities.

2.6 Key findings from the interviews, surveys, and primary/secondary data collection

2.3.1 Study Street: D P Road from Bremen Chowk to Parihar Chowk (S1 A)

As this is a Pilot Demonstrative Project, the street is designed as an ideal street & follow all acts & guidelines prepared by the Government of India & other Statutory Bodies, such as Pune Urban Street Design Guidelines, Smart City Guidelines, National Disability Act, Hawkers & Vendors Act, National Urban Transport Policy etc. The design includes universal accessibility as a key component. On either side of the street, the 3.5m-wide shaded footpath has been developed to create separate places for different users. It has a cycle track with cycling stands, vibrant public spaces, well-designed parking bays, and pedestrian comfort and convenience facilities.

The numerous existing trees along the stretch, included into the design, have been carefully demarcated with soft spaces around them to allow for growth, as well as

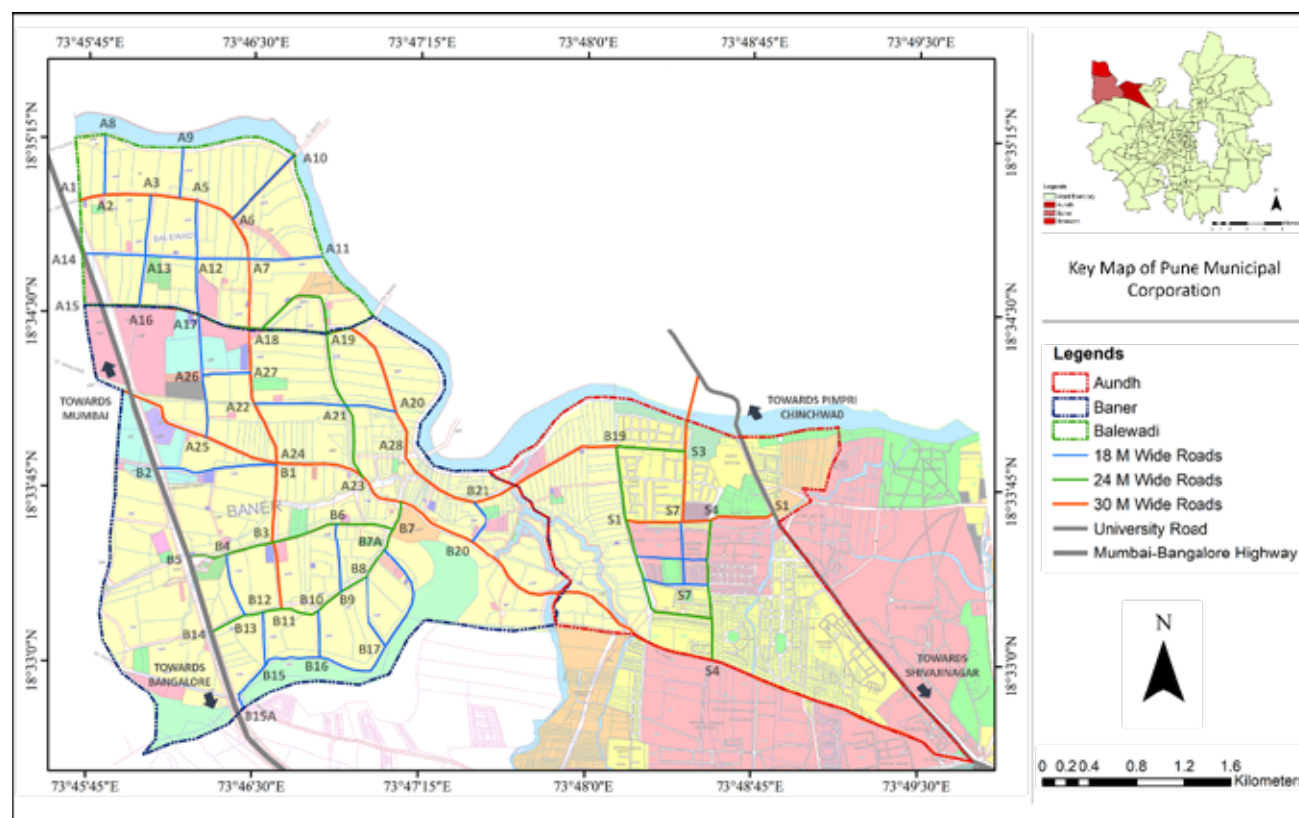


Figure 1 Mapping of Smart Streets developed under Smart City Mission (Source: Primary Data)

the perimeter forming seating. Also, all the underground services have been redesigned to meet the future demand & will be maintained only through designed & designated service-ducts provisions and not by digging the road or pavement. In addition, benches have been installed along the footpath to compliment the shops and contribute to the liveliness of the street. The street is beautifully illuminated with newly installed pedestrian and street lights.

The data collected from the survey interviews and ratings given by stakeholders were used to calculate

A. Large footpaths and seating spaces



C. Maintenance is required for soft landscape areas



the walkability index of the street. Figure 2 shows the survey photographs of DP Road, Aundh while table 1 shows the average rating of pedestrian facilities given by stakeholders for DP Road, Aundh.

So, the Walkability Index of DP Road, Aundh is 4.2

2.3.2 Study Street 2: ITI Road from Bremen Chowk to Baner Phata (S4)

ITI Road is 24 meters wide, having institutional and mixed land use zones. Segregated footpaths, dedicated cycle tracks, on-street parking, not more than two lanes

B. Large footpaths leading to traffic congestion



D. Parking facilities are not enough



Figure 2 Survey photographs of DP Road, Aundh
(Source: Primary Survey)

Table 1 Average Rating of Pedestrian Facilities on DP Road, Aundh

No	Parameters/Facilities	Rating				Walk Score
		1	2	3	4	
1	Footpath	■	■	■	■	4.6
2	Disability Infrastructure	■	■	■	■	4.5
3	Pedestrian Safety	■	■	■	■	4.2
4	Pedestrian Security	■	■	■	■	4.0
5	Pedestrian Amenities	■	■	■	■	4.2
6	Landscape Facilities	■	■	■	■	4.3
7	Junction Improvement	■	■	■	■	4.0
8	Parking Facilities	■	■	■	■	3.6

(Source: Primary Survey)

of carriageway on each side, at-grade crossings, and public transportation stops are all observed as per the design. On one side, an additional area is also provided along with a footpath which includes an open gym, placemaking sites, sit-out areas, sculptures, etc.

On the sidewalk, there are two children's play areas with soft surfaces. Benches are also provided that are especially useful for the elderly, those with disabilities, and women. The bicycle lane that runs parallel to the sidewalk is marked separate but not guarded and therefore it is unsafe and dangerous. On the sidewalks, there are bollards placed at regular intervals to inspect the vehicle transgressions. The street is aesthetically appealing, promotes social interaction and activity, and is generally safe to walk along. Figure 3 shows the survey photographs of ITI Road, Aundh while table 2 shows average rating of pedestrian facilities given by stakeholders for ITI Road, Aundh.

So, the Walkability Index of ITI Road, Aundh is 4.0

2.3.3 Study Street 3: Baner Road, Baner (B1)

Baner Road is 30 meters wide and acts as the entry point from Mumbai-Bangalore highway to Pune City. The adjacent land use of the street is mixed land use. It has a 2.85 meters wide footpath, 2 meters wide cycle track with cycling stands on both the sides, well-designed parking bays, and pedestrian comfort and convenience facilities. Due to the presence of streetlights and sidewalk lamps on both sides of the road, the sidewalks are well illuminated, boosting the security and safety of the stretch. Some of the work is under process on this road. There is unavailability of hawkers' facilities, so there is encroachment on footpaths by local vendors. Some of the respondents are happy about sufficient parking facilities because of the dedicated parking lanes, while at some places there is discontinuity of the footpath and disability infrastructure, so maintenance is required.

So, the Walkability Index of Baner Road is 3.5

2.3.4 Study Street 4: Pan card club Road, Baner (B5 to B6)

Pan card club Road is 24 meters wide, having an adjacent area with mixed land use. It has wide footpaths on both sides. Separate cycle lane is marked with hot paint parallel to the footpath but it is not guarded or raised, which is unsafe for cyclists. Because of land acquisition or DP issues, a lot of work is under process on this road. Also, there is discontinuity of the footpath and disability infrastructure and maintenance is also required for the same.

Figure 5 shows the survey photographs of the street while table 4 shows average rating of pedestrian facilities given by stakeholders for Pan card club Road, Baner.

So, the Walkability Index of Pan card club Road, Baner Road is 3.2

3. Discussion and Conclusion

3.1 Implications

Pune is India's leading example in the field of sustainable transportation, particularly in terms of transforming streets into dynamic public spaces. The Smart Street project is based on a 3 S (Safety, Shade and Society) concept, which helps citizens to move safely in the shade of trees while also creating a socially vibrant neighborhood. Using the Universal Accessibility Act, all the footpaths are designed at one level. This helps people to walk with pull-along baggage, trolleys, etc. throughout the neighborhood with ease and help citizens to carry their day-to-day heavy household purchases like grocery, vegetables, etc. This automatically leads to reduction in the use of vehicles for short trips and need for parking spaces within the neighborhood.

All the trees along the road have been saved and provided with a grating- or maximum possible soil pit created by some stone-work which acts as seating, thus giving a unique historic character to the street. In addition to the seating around trees, the street also has lighting, music, sculptures, games, etc., which acts as a vehicle free shopping experience, as good as a mall in a natural environment. Distinct entry and exit points of every property, controlling the parking and creating spaces to accommodate signages and dust bins are some of the key elements of design.

Findings of the study shows that most of the respondents were satisfied with the smart city initiatives taken up in their area, which were as per the way they had envisaged the construction quality used in the execution of project was good. Some of the respondents also mentioned certain initiatives like beautification of roads, Smart Public Bicycle Sharing as great initiatives undertaken in the Smart City. However, other respondents were not satisfied because of the delay in execution work, parking of vehicles, slow pace of work, theft of cycles, etc.

3.2 Limitations of the research

The study is limited to specific smart city area (ABD Area Based Development) in Pune Smart City. The financial aspect of the project is not included in this study.

3.3 Key lessons learnt

By supporting local development and integrating technology as a tool to achieve smart outcomes for citizens, the smart city intends to improve the quality of life of all residents in the area. Pune Smart City Development Corporation Limited has launched a number of initiatives, some of which are still in the execution stage because of some development plan issues and delay in metro work. The development of a network of pedestrian-friendly streets is important in order to promote walkability and other non-motorized modes of transportation.

In the Indian context, various scientific studies are required for developing smart street infrastructure at the neighborhood or ward level, nodal level, pan-

A. Sculptures at ITI Road, Aundh



B. Open Gym & Placemaking Site



Figure 3 Survey photographs of ITI Road, Aundh
(Source: Primary Survey)

Table 2 Average Rating of Pedestrian Facilities on ITI Road, Aundh

No	Parameters/Facilities	Rating				Walk Score
		1	2	3	4	
1	Footpath	■	■	■	■	4.6
2	Disability Infrastructure	■	■	■	■	4.0
3	Pedestrian Safety	■	■	■	■	4.2
4	Pedestrian Security	■	■	■	■	4.1
5	Pedestrian Amenities	■	■	■	■	4.2
6	Landscape Facilities	■	■	■	■	4.0
7	Junction Improvement	■	■	■	■	4.0
8	Parking Facilities	■	■	■	■	3.2

(Source: Primary Survey)

A. Large footpath with cycle track & street lights



B. In process work of tree plantation on median



Figure 4 Survey photographs of Baner Road, Baner.
(Source: Primary Survey)

Table 3 Average Rating of Pedestrian Facilities on Baner Road, Baner

No	Parameters/Facilities	Rating				Walk Score
		1	2	3	4	
1	Footpath	■	■	■	■	4.2
2	Disability Infrastructure	■	■	■	■	3.9
3	Pedestrian Safety	■	■	■	■	4.0
4	Pedestrian Security	■	■	■	■	3.8
5	Pedestrian Amenities	■	■	■	■	2.5
6	Landscape Facilities	■	■	■	■	2.8
7	Junction Improvement	■	■	■	■	2.7
8	Parking Facilities	■	■	■	■	4.2

(Source: Primary Survey)

city level, regional and national level. The street is a common space used by motor vehicle commuters, non-motorized vehicle commuters, persons with disabilities, children, older adults, pedestrians, and street vendors. The Smart Cities Mission's smart street projects give us the opportunity to recalibrate how we commute in cities and integrate it with our goals of reducing emissions, fighting climate change, and promoting a sustainable and healthy lifestyle for urban residents, reclaiming the right to the city for everyone. Such projects can provide non-motorized transportation a value by providing cost savings in monetary terms, as well as lower emissions as success stories that can be replicated across the country as a feedback mechanism. Enhanced walkability and nonmotorized transportation also help in the creation of an equitable society in the public sphere, as individuals from all walks of life have equal access to the street space, and vehicle owners are not given preference over pedestrians and cyclists. It makes our roads and footpaths more inclusive, especially when the demands of persons with disabilities, children, women, and the elderly are considered while developing smart street projects.

According to the study, most of the respondents were aware of the Government's Smart City initiative. Although citizens in the Aundh neighborhood reported several problems with various initiatives taken in this

area, residents in Pune felt that some of the steps taken towards smart city were appropriate. Citizens in the Aundh area face a number of challenges, which were identified in this study.

3.4 Recommendations

- i. PSCDCL has provided ramps and tactile paving for persons with disabilities as per disabilities act, but at some places it is absent or not maintained. Also, there is no infrastructure provision for street vendors and hawkers, so encroachment was seen on the footpath by local vendors, which is causing obstacle for pedestrians. So, the PSCDCL should consider the persons with disabilities and street vendors while designing the streets.
- ii. PSCDCL has provided all the good quality materials as per specifications but one of the major issues observed in the framework was that of the operations and maintenance of the sites, especially after the completion. Therefore, the project should be developed on a PPP basis, so that the authority looks into the operation and maintenance of the project sites after completion. The operational audit should be conducted for measuring performance against standards, taking corrective actions.
- iii. Media and forms used for dissemination, monitoring, accessibility and usability of information are not updated and showing blank results. The PSCDCL

shall ensure that their websites are updated and all information about the project is available in the public domain, through free downloadable electronic forms. A report on financial audit, operational audit and social audit should be prepared and published every year to the public.

- iv. Stakeholders are not satisfied because of the delay in project execution work. Due to delays in the Pune Metro Project, some of the metro aligned streets are on hold. Because of land acquisition and DP issues, many of the streets are also incomplete. So, the local authority (PMC) should start land acquisition work and metro related work as soon as possible, so that the smart city projects will complete within time and there should be a fine or penalty for contractors if the work is not completed within the timeline.
- v. Due to the policy of transfers of Government officers, especially Chief Executive Officers (CEO's), the leadership of the said projects changes within short spans. vision of the leadership must remain constant throughout to increase efficiency of the project.
- vi. At the Smart city level, there should be a Vigilance and Monitoring Committee. Members of the Vigilance Monitoring Committee should be selected from among local school teachers, Self Help Groups, volunteers, members of CBO's, youth clubs etc.



A. Incomplete Road due to DP Issues



B. Bicycle Lane is not guarded or raised

Figure 5 Survey photographs of Pan card club Road, Baner.
(Source: Primary Survey)

No	Parameters/Facilities	Rating				Walk Score
		1	2	3	4	
1	Footpath					4.1
2	Disability Infrastructure					3.2
3	Pedestrian Safety					3.0
4	Pedestrian Security					3.1
5	Pedestrian Amenities					2.6
6	Landscape Facilities					3.1
7	Junction Improvement					3.0
8	Parking Facilities					4.2

Table 4 Average Rating of Pedestrian Facilities on Pan card club Road, Baner
(Source: Primary Survey)

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Annexure-1

Area:	
Street:	



CITIZENS SURVEY FOR SMART STREETS UNDER SAAR INITIATIVE

(This survey is being carried out as a part of research work. You are required to contribute in this survey)

Personal Details:

Name: _____

Age: ____ Yrs. Sex: Male Female Other

Contact No: _____

Physically Disabled: Yes No

Workplace: _____

1. Are you aware of the smart city initiative taken by the Government of India? Yes No

2. Have you taken part in the Streets4People challenge initiated by the smart cities mission?

Yes No

3. How far do you generally walk in your neighborhood each day?

Less than 1 KM

1 KM to 2 KM

More than 2 KM

4. What would most likely make you walk in your neighborhood more often?

Better sidewalks (footpaths)

Better Crosswalks

Better lighting

Improved Signals

Cleaner Streets

More stores within walking distance

Landscape/Vegetation

Other (Specify) _____

5. Are the maintenance and conservation conditions of the footpaths suitable for walking?

Yes No

Rate the footpath condition.

1 2 3 4 5

Worst Best

6. Is there any disability infrastructure (ramps, tactile paving, etc.)? Yes No

Rate the footpath condition.

1 2 3 4 5
Worst Best

7. Is it possible to cross the streets safely? Yes No

Rate pedestrian safety.

1 2 3 4 5
Worst Best

8. Is the street safe to walk during the day and night? Yes No

Rate pedestrian security.

1 2 3 4 5
Worst Best

9. Is there enough street furniture present on the street (seating, dustbins, signages)? Yes No

Rate the pedestrian amenities.

1 2 3 4 5
Worst Best

10. Are there enough landscape facilities/climatic considerations present on the streets (Trees, pergolas, covered arcades, etc.)? Yes No

Rate the landscape facilities.

1 2 3 4 5
Worst Best

11. Are the pedestrian crossings well signalized? Yes No

Rate the junction improvement (Raised crossing, zebra crossing, signals, etc.)

1 2 3 4 5
Worst Best

12. Do the streets have enough parking facilities/dedicated parking lanes? Yes No

Rate the parking facilities.

1 2 3 4 5
Worst Best

13. Is there anything else you would like to say about walking in your neighborhood? (Specify)

C3

Marine drive Walkway - NMT Project (Urban beautification), Smart City Kochi.

Name of the project: Marine drive walkway - NMT project (Urban beautification)

Location: Kochi

Sector: Urban Infrastructure

SDG: SDG 11, SDG 13

Project Cost: Rs 7.85 crores

Institute: College of Engineering Trivandrum

Advisors: Dr. Bejene S Kothari, Dr. Priyanjali Prabhakaran, Prof. Lakshmi S R, Ar Alok Dinesh and Ar Abhishek Xavier

Students: Yasmin A, Aleena Mariya S, Liya Paul, Divya Ros Davis, Nilofer J, Kalindi P S, Lalithambika N S, and Rakhi Dev

Keywords: Urban beautification, Blue-green network, Open space corridor, Inclusive city

Abstract:

The smart city Mission was launched in India by Prime Minister Narendra Modi on June 25, 2015. Kochi is at an early stage of building its unique version of the smart city. The main objective of the mission is to promote cities that provide core infrastructure and give a decent quality of life to their citizens, a clean and sustainable environment and application of 'Smart' Solutions.

In the case of Kochi, 20 percent of the city region is covered by water bodies consisting of backwaters and canals. Open spaces constitute only about 0.5 percent, which denotes that the strengthening of this blue-green network is vital in the faster growing urban scenario of Kochi. The KCR draft Development Plan 2031 of Kochi points out that the existing land uses have not been subjected to creative planning strategies concerning recreational waterfronts.

In this scenario, the Kochi Smart City proposal envisioned an open space corridor to link DH Ground, prominent public space in the heart of the city, to Mangalavanam, an ecologically sensitive site. The project was proposed under the theme 'A City with a Vibrant Identity', under Parks and Open Spaces of its Area Based Development component. The project included the renovation of the already existing Marine drive walkway and also the extension of a second stretch joining it.

This research paper explores the documentation of this urban beautification project - Marine drive walkway named as "Open space corridor linking DH ground to Mangalavanam", and tries to find out the impact of the project among various stakeholders through questionnaire surveys and semi-structured interviews. It also attempts to discuss the implementation of the project and its scalability or replicability in other waterfront areas inside and outside of Kochi. The paper throws light upon the factors that can make this smart city initiative a successful project.

Case Study: C3

1. Introduction

1.1 Topic and Context

Kochi, geographically situated between Northern Latitude 90 47' and 100 17' and eastern longitude 760 9' and 760 47', is one among the first 20 cities selected under Government of India's smart cities mission. Cochin Smart Mission Limited (CSML) is the Special Purpose Vehicle (SPV) formed to plan, design, implement, coordinate and monitor the smart city projects in Kochi in coordination with Kochi Municipal Corporation (KMC).

The vision of CSML is "to transform Kochi into an inclusive, vibrant city of opportunities with efficient urban services, sustainable growth and ease of living". CSML aims at a planned and integrated development of the Central Business District and Fort Kochi-Mattancherry area by improving the civic infrastructure with the application of smart solutions thereby improving access to city amenities, clean and sustainable environment and livelihood promotion.

Smart city projects are classified under two categories, which are Area Based Development (ABD) projects and PAN City projects. ABD projects consists of parts of five wards of West Kochi (1,2,3,4 and 5) and parts of three wards of the Central City (62,66 & 67), with a total area of 1024.16 acres. The key sectors identified in Kochi were urban transportation and mobility, solid waste and sewerage management, rejuvenation of water bodies (canals), public spaces/open spaces, economic opportunity and intelligent government services.

The key thematic areas of CSML are:

- Connected and Accessible City
- A City with a Vibrant Identity
- A Clean, Green, Safe and Healthy City
- An Inclusive and Smartly Governed City

The project "Marine drive walkway", named as "Open space corridor linking DH ground to Mangalavanam" in the Smart city proposals of Kochi, was implemented under the theme of "A City with a Vibrant Identity". The major goals of the theme were Strengthen Kochi's positioning as Kerala's Tourist Gateway, Revitalization of City areas and Green neighbourhoods.

And the key outcomes of the theme were:

- i. Growth in tourists' arrivals; Increase in average days of stay; Growth in tourism earnings
- ii. Improvement in Safety and hygienic conditions of the urban spaces
- iii. Increased economic activity
- iv. Increase in green cover and the reduction in carbon footprint

Initially the project was conceived as a part of the proposal of a larger NMT network of the ABD area. Map 2 shows the proposed open space corridor from A to B, prepared during the initial stages of the project. But due to the constraints of connecting an active and busy transportation network of the CBD to the green corridor and the shortage of budget allocated for the development, the project was implemented as an open space corridor linking two open spaces in the ABD area. But even after the completion of the Marine drive walkway project, its seamless connectivity with the open spaces at DH ground and Mangalavanam is not achieved. From the discussions with stakeholders, it is known that they are still figuring out the solutions to ensure connectivity towards these open spaces.

1.2 Significance of the project

Green corridors in cities can be defined as linear natural infrastructure, such as trees and plants, that link up other green and open spaces to form a green urban network.

These networks provide both ecological services, such

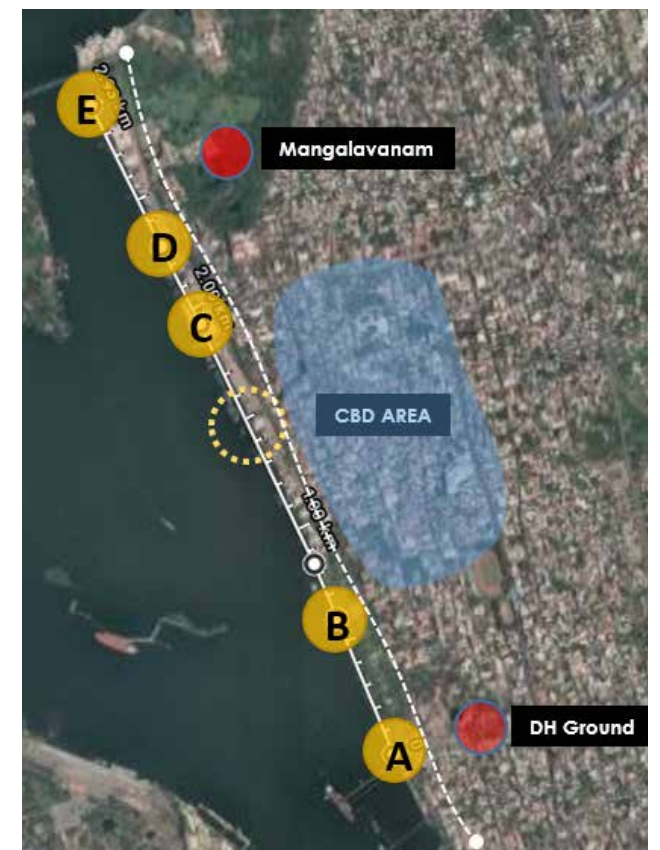
as habitats and resources for urban wildlife; whilst also provide services to urban populations such as mobility networks and access to green spaces through the provision of sustainable and active transport routes that link transport with mixed land use (residential, commercial, education, recreation etc) and open spaces.

Improvement in Quality of Life

- Green open corridors within a city acts as a major social gathering space, promoting community well being
- Increases in levels of walking, cycling and public transport use as modes of transport and that promote physical activity
- Enhances in social interaction in urban populations is more likely to occur as they link green spaces
- Green corridors can protect pedestrians from harmful pollution on open roads if planted strategically
- Increase positive levels of interaction for urban citizens with nature
- The shade of tree canopies in tropical climate provides much needed walking infrastructure and protection from the sun
- The trees planted in close proximity to each other



Map 1: Geographical area of the project.
Source: Author



Map 2: Proposed open space corridor from A to B, during the conceptual stage of the project
Source: Author

can reduce both air pollution and the urban heat island effect

1.3 Aim and Objectives

The aim of the study is to understand the role of green and open public spaces in Kochi city and its impact on the lives of the citizens, through the case of the urban beautification project of Marine drive walkway.

The objectives of the study are:

- To understand and document the key components and services implemented in Open space corridor linking from DH Ground to Mangalavanm (Marine drive walkway - Urban beautification)
- To understand the positive and negative impacts of the project on various stakeholders through site study and surveys.
- To identify the potentials, challenges and issues of the project that needs to be addressed.
- To arrive at findings, recommendations and suggestions to improve the project.

2. Contextual Background

2.1 Conceptual framework / Research design

The research methodology was formulated in two phases for the collection of data, Pre-site and On-site. During the pre-site phase, literature review from secondary sources like handouts, official documents and case studies of green corridors in urban areas were carried out. Based on the case studies, project components and envisaged project outcomes, parameters like Public awareness, safety and Social security, Inclusivity, Accessibility and Efficiency were set.

On-site phase consisted of on-ground data collection and stakeholder's consultation. Main stakeholders identified were beneficiaries/ general public, decision makers (CSML, KMC, GCDA), service providers (Consultants and service providers) and city officials (KSINC, KMRL). Samples from the site were collected in the form of maps, photographs etc. and tools that were adopted were semi structured interviews, both face to face and telephonic. Questionnaires in the form of google survey forms were prepared and circulated to the general public to obtain the impacts of the project. Collected data was then analysed and the impact of the project was assessed from which we were able to derive key findings and recommendations.

2.2 Key features of the project

The Marine drive walkway project intends to renovate and interlink the open-space corridor linking Rajendra Maidan in the south of the corridor up till Tata Canal to the north of the corridor. Total implemented walkway project stretch is 2.2 Km.

The project aims at revitalising all the open/ public spaces, along the western water edge of Ernakulam mainland, by improving the accessibility, introducing various activities and linking the same with each other to create an active corridor for recreational facilities. This

would involve components such as streetscaping, street lighting and landscaping, vending kiosk, advertisement provision, & play equipment. Periodic maintenance of the walkway shall be ensured for its effectiveness .

Following design criteria were proposed for the Open Space corridor:

- A unified streetscape pattern, adaptable to the adjoining land uses, to improve the walkway's place identity
- A muted and monochromatic hardscape palette to emphasise the richness of surrounding environment and landscape, with uncluttered views of waterfront
- Primary function as a walkway should not be obstructed by incidental activity areas; installation of surveillance cameras to enhance security levels and social cohesion
- Treated water of adjoining sewage treatment plant to be reused for landscape purposes, to improve the biodiversity and ecosystem

The proposed project components were:

- Pathway beautification
- Street lights
- Street furniture

- Landscaping elements
- Surveillance cameras
- Open air gym
- Street Signages
- Vending kiosks
- Bollards and barricades

While comparing the proposed and implemented components of the project, a gap could be observed between the stretch of the walkways. Initially at the project conception stage, the officials targeted to renovate the stretch between A (In map 3: Start point in front of DH ground) to B (End point near Mangalavanam bird sanctuary). But due to the budget constraints, the project was implemented from B to E (Starting from Ernakulam Boat jetty to sunset point of marine drive). In the proposed structure plan of the area (Map 4, produced by PMC), it is clear that a seamless connectivity was envisaged from the DH ground and Mangalavanam bird sanctuary.

As per Map 5 (Drawing published in the tender document), the total stretch of the walkway was divided into 3 stretches.

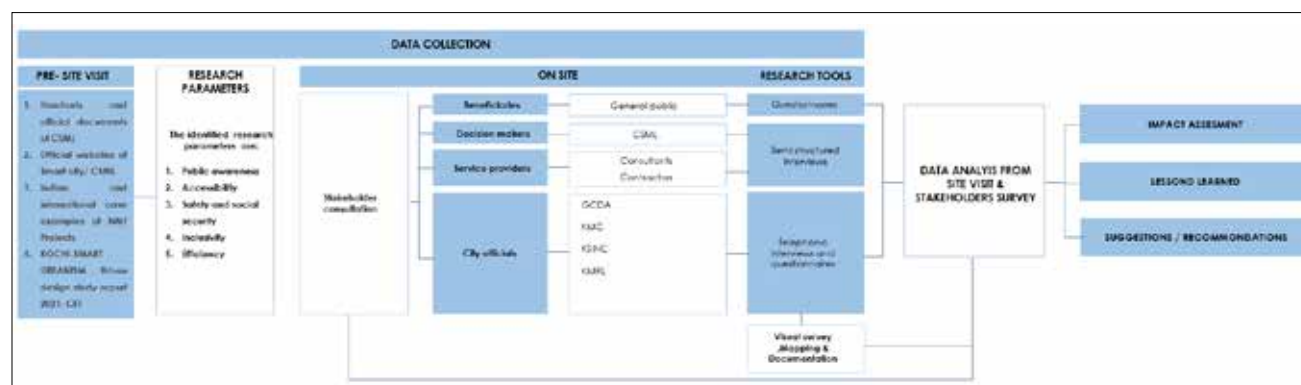
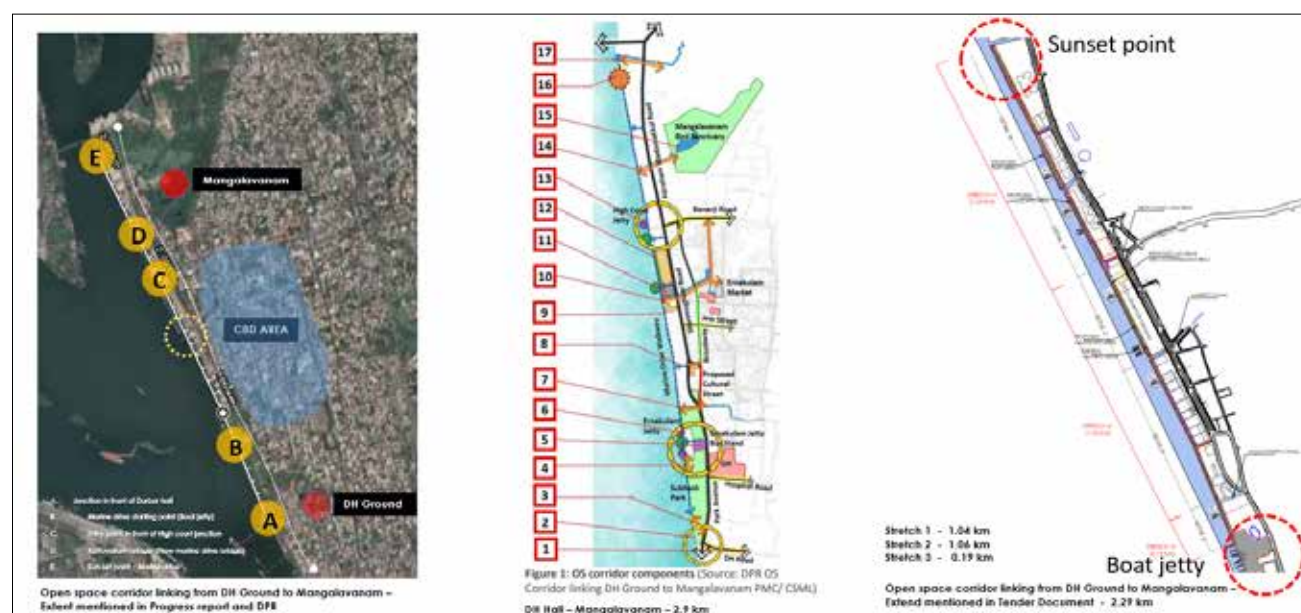


Figure 1: Research methodology framework.
Source: Author



Map 3,4,5: Proposed open space corridor project.
Source: Author

1. Stretch 1 of 1km length from Tata Canal to High court junction
2. Stretch 2 of 1 km between High court junction and Children's park
3. Stretch 3 of 0.19 km between Children's park and Ernakulam Boat Jetty

2.2.3 Challenges in the project

1. The absence of a comprehensive framework for the project with respect to the existing urban fabric, can result only in its partial fulfilment
2. Budget constraints and cost escalations can occur, when the project duration from conception stage to implementation stage takes more time to be executed
3. Difficulties in intervening an active urban corridor as Marine drive existed as one of the busy promenades in Kochi city.
4. Proper maintenance of active public open spaces, as it caters to a wide range of user groups.

2.2.4 Risks involved in the project:

1. Efficient shore line protection of the backwater edge along the walkway
2. Disturbance in the ecological balance of the area, as

Marine drive was already developed on reclaimed land.

2.2.5 Features and Benefits (social, technical, city administration level, impact on environment and economy) to the city (expected and observed)

Expected benefits of the project

Environmental/ ecological benefits

- Positive impact of the urban green space on air quality, noise or urban heat exposure
- Enhance biodiversity
- Better contact with nature
- Lifestyle benefits
- Increase in the physical activity levels of people
- Active recreation
- Psychological well-being of the people
- Social benefits
- Enhancing social cohesion
- Promoting social interaction and exchange
- Economic benefits
- Residential and commercial properties overlooking green urban corridors are valued around 5-7 percent higher than equivalent properties elsewhere.

The Marine drive in Kochi features a scenic walkway that encourages and strengthens the social fabric of the society. Places like these across the city are very important to improve walkability in the city.

2.6 Key findings from the interviews, surveys, and primary/secondary data collection

From the survey and site visits, it was understood that the majority of the urban population is using the Marine drive walkway efficiently and the majority of the people are satisfied with the transformations. But still the walkway lacks better toilet facilities in and around the spaces. And some of the entry points to the walkway needed more interventions. The entry from High court junction has greater potential for development as a major entry point, but was not considered under this project. And positioning of the utility services should consider more visual and aesthetic aspects. The frequent maintenance of the walkway was one of the major challenges faced in this particular project.

Based on the case studies, project components and envisaged project outcomes, parameters like Public awareness, Accessibility, Safety and social security, Inclusivity and Efficiency were set for conducting the

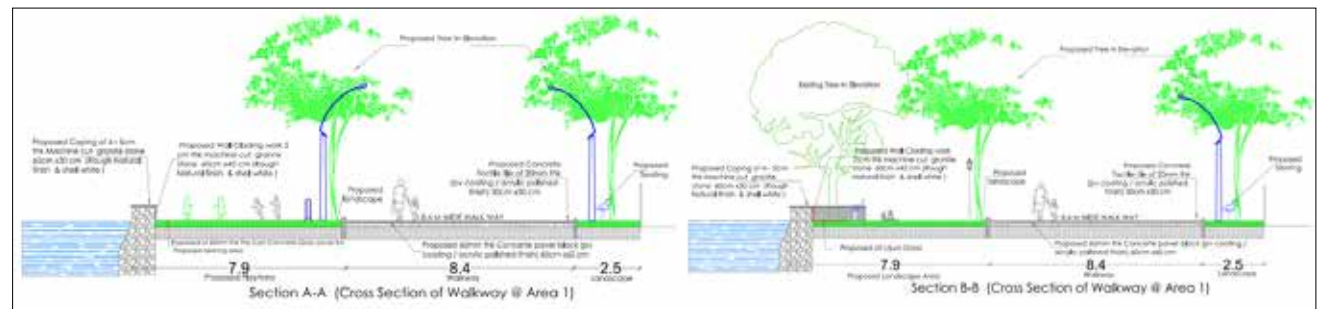


Figure 2: Proposed cross sections of walkway
Source: Author



Site Photographs
Source: Author

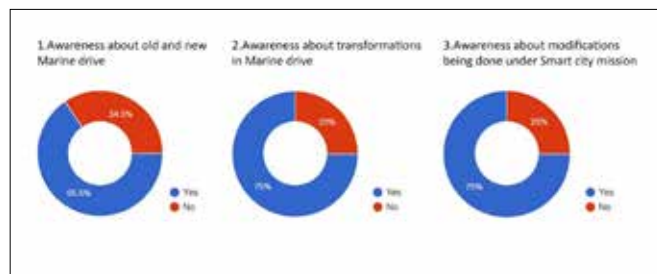
online survey was carried out to understand the impact of the project on the citizens. Our inferences were that, the majority of the urban population is using the walkway effectively and the people are satisfied with the transformations. But still the walkway lacks better toilet facilities in and around the spaces. And some of the entry points to the walkway needed more interventions.

3.4 Implications

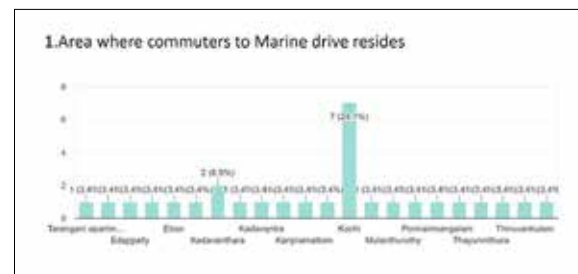
The Marine drive walkway acts as a vibrant public space in the heart of Kochi city. The renovations done to the old walkway and extensions done to it as part of the Smart city proposal, enhanced the space and increased the footfall to the area. Being situated within the CBD, the area invites a wide range of user groups which include the citizens, frequent visitors to the city and tourists.

3.5 Limitations of the research

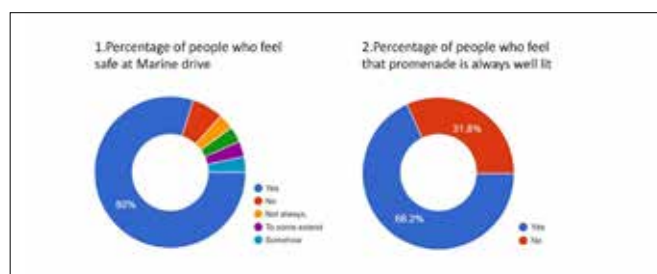
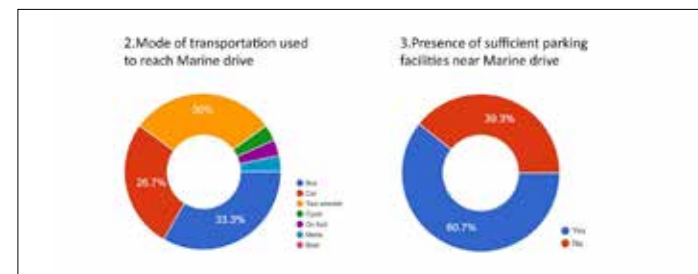
- Unavailability of the detailed project report
- 3.3 Recommendations
- A better comprehensive and integrated approach towards the project might give a better result.
- Basic infrastructure facilities like sanitation and restrooms should be improved more for the efficient functioning of the recreational corridor.



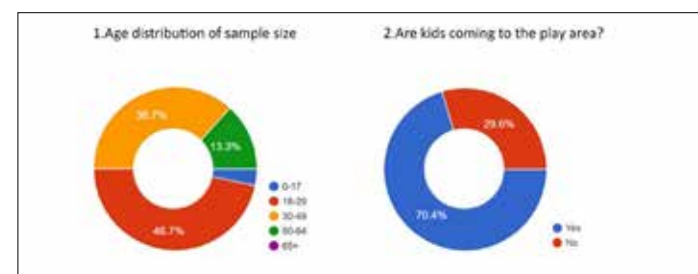
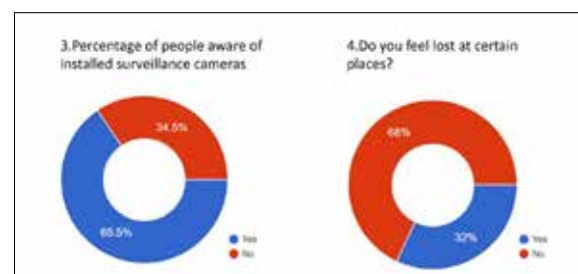
Parameter 1: Public awareness



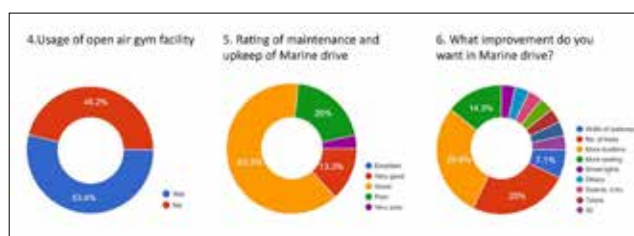
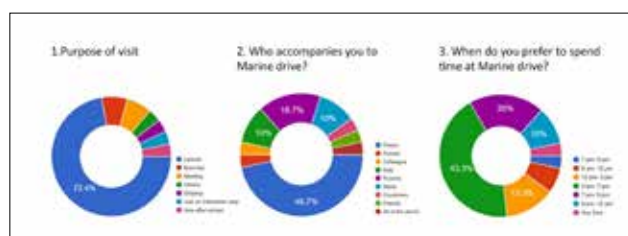
Parameter 2: Accessibility



Parameter 3: Safety and Social security



Parameter 4: Inclusivity



Parameter 5: Efficiency

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C4

Renovation and Conservation of Old Collector Office Building

Name of the project: Renovation and Conservation of Old Collector Office Building

Location: Thanjavur, Tamil Nadu

Year of Project Implementation: March 2022 In Progress

Sector: Area Development

SDG: No Poverty (SDG 1), Gender Equality (SDG 5), Decent work and Economic growth (SDG 8),
SDG 11.4

Project Cost: Rs 9.9 Crores

Institute: Department of Planning, Anna University

Advisors: Dr. K. Pratheep Moses, Mr. P. Sudharsanamurthy, Ms. K. Madhivadhani

Students: Padmapriya B, Bavithra K

Keywords: Collectorate, Restoration, Conservation, Heritage, Culture

Abstract:

The report primarily focuses on outcomes of the conservation project carried out in Thanjavur as a part of the Smart cities mission to enhance the identity of the city. By studying the need, significance, approach, proposals and implementation of these works, and by documenting the outcomes of this project and how it has impacted the various stakeholders. The project approach is to conserve and retain the heritage character and importance of the built fabric, with a vision to respect the original urban fabric of the building and its heritage construction detailing. The Collectorate complex at Thanjavur is an art and architectural manifestation of the legacies, deeds and accomplishments of the past. The British began developing Thanjavur's infrastructure to assist their administration better. The Old Collector's building was one such establishment that was initiated by the British, which is now being converted into a museum featuring various stalls, highlighting the historical and cultural importance of Thanjavur district. The restoration and conservation encompasses all the processes of looking after a place so as to retain its cultural significance. The Old collector building is one of the standing examples of the splendid Indo saracenic-architecture which was an administrative centre throughout its time hosting a technological wonder within the building.

The Conservation works envisaged for the heritage structures are categorized in to three phases based on prioritization of works as Immediate, Necessary and Desirable respectively, by considering appropriate parameters. The policy recommendations and conservation strategies proposed take into account the cultural dynamism of Thanjavur while making the new interventions to fit into the functional frame of the future envisioned for this place. It further reinforces the sensitivity of the whole approach towards Reuse, Restoration and Renovation for the sustainable development of the entire heritage precinct, to encourage the preservation and efficient reuse of the heritage structures that have historic, architectural and cultural value.

Case Study: C4

1. Background

Thanjavur Smart City

Thanjavur is situated in the heart of the Cauvery delta region, surrounded by agricultural land. It is 56 kilometers east of Trichy and 350 kilometers southeast of Chennai. Thanjavur is located in latitude 100 47', longitude 190 08', and elevation 57 metres above mean sea level. It is the administrative centre of Thanjavur District. The city is known as the Rice Bowl of Tamil Nadu and is an important agricultural centre in the Kaveri river Delta. Thanjavur city has an area of 128.02 km² (49.43 sq mi) and a population of 290,720. It is governed by a municipal corporation. Highways, along with railways form the major mode of transportation. The nearest airport to this city is Tiruchirapalli International Airport, which is 59.6 kilometres (37.0 miles) away. Karaikal, which is 94 kilometres (58 miles) from Thanjavur, is the nearest harbour.

Thanjavur contains over 90 temples, as it was favoured by the Chola rulers between the 1st - 12th centuries, the Nayakas between the 16th century, and the Marathas between the 17th and 18th centuries. Thanjavur is home to one of the grandest and greatest Chola temples, the Brihadeswara Temple. At over a thousand years old, this temple's brilliant architecture continues to amaze engineers of our time. Music, art and dance

have also thrived within the city, making it a hub of cultural activities. The Grand Anicut Canal irrigates the land around the city of Thanjavur with water from the Kaveri. Even today, the district of Thanjavur is known for its sprawling paddy fields.

Thanjavur is known for being home to some of the most famous historic structures in Tamil Nadu, including a UNESCO World Heritage Site. But this town in the state's centre has much more to offer than just architectural marvels. In fact, for anyone with an interest in South Indian art, music and dance forms, Thanjavur is nothing short of a pilgrimage and thoroughly deserves the title of being 'South India's Cradle of Arts'.

1.1 Topic and Context

Thanjavur, is a city that is the result of the blending of three distinct Indian cultures: Tamil Cholas, Pandyas, Vijayanagar Nayakas, and Marathas. Finally, the influence of the British added to this. Thus, the complex has variety of architectural influenced from different periods, that have been studied and documented from case studies to undertake such a conservation project.

Thanjavur though known as the 'The Rice Bowl of Tamil Nadu' because of its rich agricultural activities in the delta region of the river Cauvey, the city has a rich

heritage of art and architecture dating back to different eras. The old collectorate was built in 1896 and served as the Headquarters of composite Thanjavur district as well as the collector office of the present bifurcated district till June 2015 until it was shifted to the new District Collectorate office located near Thanjavur-Trichy expressway, mainly due to space constraints in the old building premises. It is an impressive colonial building that was built in the Indo-Sarcentic architecture style. Since, the building has been the administrative headquarters of that era, many political leaders, social activists' and other British officials etc. were closely associated with the building.

In the later years many new structures were built within the site and annexured to the existing ones to host other government offices for ease of administration. But these were not added in a planned manner thus, creating clutter within the site and diluting the architectural style of the building. After 2015, due to space constraints in the old building the collector's office was shifted to the new District Collectorate office.

In order to boost the local identity and economy of the city, this project, namely Tourism Development - "Conservation of Built Heritage: Old Collectorate and Palace" in Thanjavur is being implemented. After



Figure 1: Location of Thanjavur City

renovation, the building will be used as a museum displaying exhibits from 10 diverse departments, representing the heritage and culture of the city. It shall also host other tourist attractions such as light & sound show, 5D theater to boost the local economy.

1.2 Significance of the project

Conservation based decisions use an articulation of heritage values (often called “cultural significance”) as a reference point, whether they are concerned with giving a building “heritage” status, deciding which building to invest in, planning for the future of a historic site, or applying a treatment to a monument. The evaluation of heritage values forms a critical component of any conservation endeavour, as these values have a significant impact on the decisions that are taken. This building has a number of values adding it for conservation such as Historical, Administrative, Architectural, Technological and Associational Value. The building hosts a beautiful spiral staircase supported by arches, which is of an excellent technological engineering as well as architecture wonder.

The Collectorate is nearly 150 years old and contains vast amounts of heritage and cultural artefacts. The architectural character present in the site illustrates the region’s history, legacy and heritage. Being at the heart of the city and a historic location, it is surrounded by growing commercial and residential areas and is approachable from all parts of the city. Thus, encouraging the proposal of renovations of this complex to be a part of a greater tourist circuit.

The proposed museum in the main hall will have a host of facilities, including a 5D theatre to exhibit the grandeur of Thanjavur and will display various artifacts, etc., of heritage value. The museum will be beneficial to the children and the elders alike.

1.3 Aim and Objectives

The aim of the study is to understand the significance of the renovation and conservation undertaken of the collector office complex in Thanjavur

The objectives of the study are:

1. To understand the importance of the project
2. To study the process of implementation of a conservation project
3. To study the methods adopted to undertake conservation.
4. To examine the social and economic impacts the project will have.
5. To study the impact of the project on both public and administrative stakeholders.

2. Contextual Background

Culture and heritage shapes the human society. It is important to protect our heritage as it adds character and distinctiveness to a certain place, region or community and hence provides a sense of identity. The



Figure 2: Location of Collector office complex highlighting the office building
Source: The Smart City Challenge Stage 2: Smart City Proposal Agra (Agra Annexures)

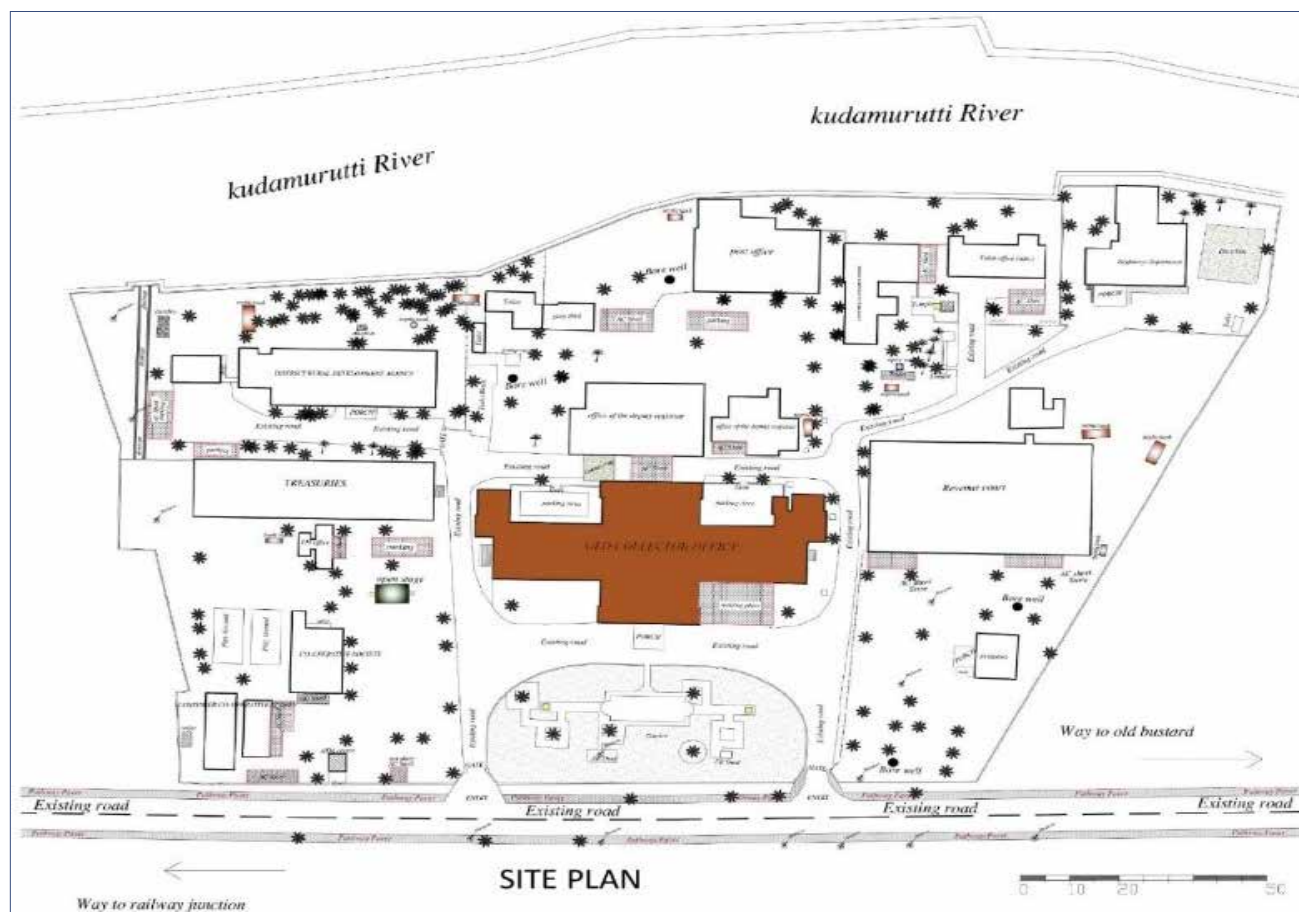


Figure 3: The site map of the highlighted location from figure 2

17 SDGs have a number of targets embedded within them that focus on heritage conservation themes and issues. Goal 11 aims to “Make cities and human settlements inclusive, safe, resilient and sustainable.” This goal envisions sustainable, livable urban centres with universal access to green spaces. There are a total of 10 targets to be achieved under this Goal. Target 11.4 specifically calls for “Strengthening efforts to protect and safeguard the world’s cultural and natural heritage”

Heritage tourism is often deeply rooted to historic buildings. These intriguing and tangible connections to our past spurs interest for tourists to soak in its distinct ambience and this in turn helps attract business. Statistics have also shown that heritage visitors have a greater per trip economic impact, as they tend to stay for a longer duration and spend more a day. Effective conservation of heritage resources not only helps in preserving and safeguarding the resources, but also in revitalizing local economies, and in bringing about a sense of identity, pride and belongingness to the residents.

A good heritage conservation strategy requires the following -

- i. better appreciation of the value of heritage assets (both tangible and intangible), and
- ii. integration of such strategies with the larger processes of planning and development of a city or urban area.

2.1 Conceptual Framework/Research Design

2.1.1 Scheme of the project

A comprehensive conservation plan was prepared by consulting with the stakeholders and the Conservation Experts by assessing and analysing the project by identifying and describing the Intent and purpose. The assessment of the structure’s state, includes inspection, diagnosis, and cause analysis, which was based on papers and physical evidence.

Finally, following the analysis, The Response or Conservation Intervention was created, influenced by applicable costing and specifications. The examination revealed unique concerns with respect to physical condition, management, and cultural importance. The issues were organised, based on the conservation team’s Policies and Objectives, which were developed in consultation with the stakeholders.

As a result, a strategy for carrying out the planned activities was prepared in accordance with the time period, money available, and the necessity of the Conservation Intervention. The method to be used and the extent of the changes to be performed are determined by the structure’s class/type, level of degradation, extent of transformation, relevance of the building in contributing to the overall heritage value of the heritage precinct, the budget available, and the time period, as explained in Figure 2.

2.1.2 Conservation

According to central public works department Handbook of Conservation of Heritage Buildings, “Conservation” means all the processes of looking after a place so as to retain its historical and/or architectural and/or aesthetic and/or cultural significance and includes maintenance, preservation, restoration, reconstruction and adoption or a combination of more than one of these.

The goal of conservation is to conserve as much of the original material as possible in as unmodified a state as feasible. Any repairs or additions must not delete, change, or cross-link any original material permanently. All repairs and modifications must be reversible and removable, both now and in the future, without harming the original material’s state.

2.1.3 Adaptive Reuse

Heritage buildings are crucial in terms of transferring the cultural identity to the coming generations. Where,

heritage buildings can no longer function with its original use, proposing a new function is inevitable in order to preserve the significance of the heritage building.

The Adaptive Reuse of heritage buildings is a complex process, which aims to preserve the values of heritage buildings while adapting them for use in the present. Adaptive reuse of heritage buildings helps promoting sustainable environments by using the existing building stock. On the other hand, it ensures the conservation of cultural identity by preserving the heritage buildings and giving them a new lease of life. The collector office once renovated would be used as a museum displaying a wide range of exhibits representing the heritage and culture of the city.

2.1.4 Relevant Literature/ Best Practices/ Case-Studies Architectural characteristics

The building under consideration has indo-saracenic character with arched openings which ranges from gothic to semi-circular styled arches. Ornate works are less except for the running brackets under the sunshade. Figure 3 illustrates a few elements present in the project.

Indo-Saracenic architecture is an architectural style formed in the late 19th century. It holds various elements from native Indo-Islamic and Indian architecture, combined with the Gothic revival and Neo-classical styles. Indo-saracenic buildings are symmetrically designed. Public and Government buildings are often created on a grand scale which resembles this architectural style. The public buildings are long structures with arcades spanning walls and colonnade balconies. They have broad corridors and wide staircase. These buildings usually have giant dome.

General Code of Principles in Heritage Conservation
When planning a work related to heritage structures and it’s elements, the following principles should

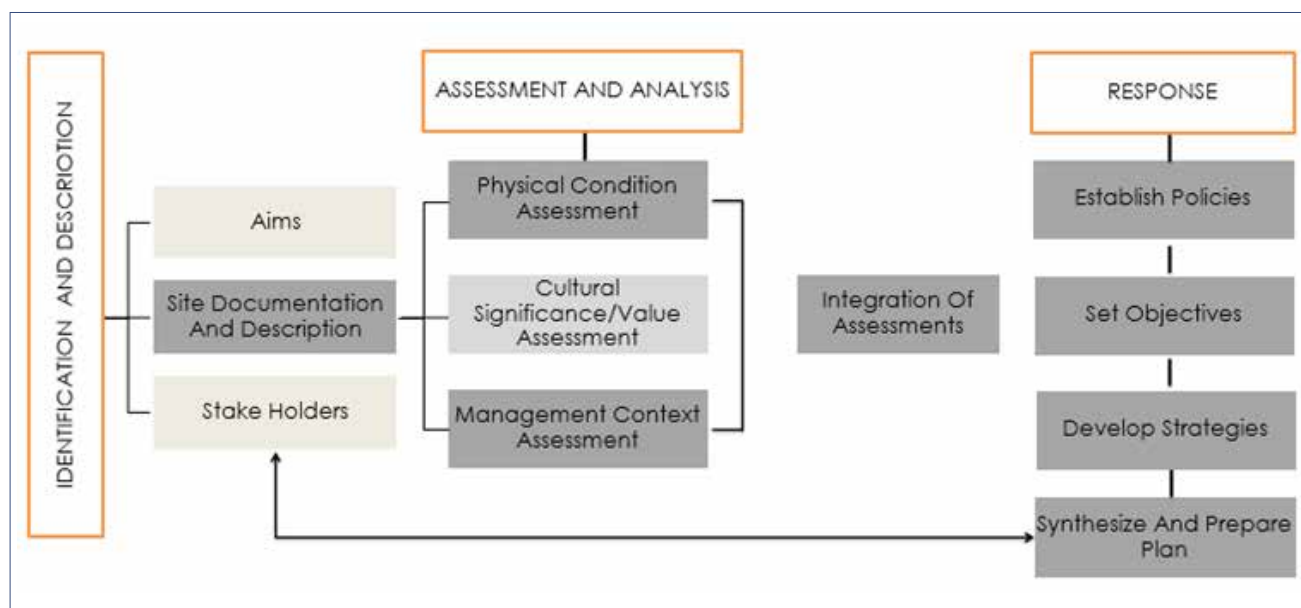


Figure 2: Methodology for comprehensive conservation plan

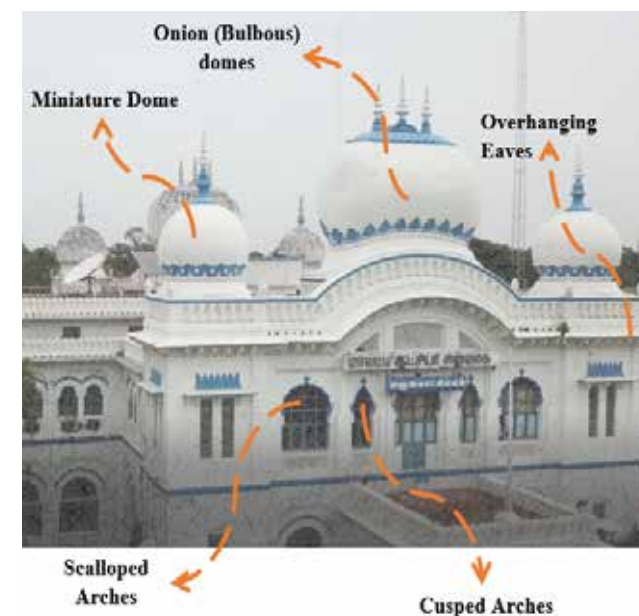


Figure 3: Indo-Saracenic elements on the old collectorate building

be considered. They should also be addressed if a conservation management plan is being prepared.

- i. Continue to Use the Place
- ii. Repair Rather than Replace
- iii. Make Reversible Alterations
- iv. Make a Visual Distinction between Old and New
- v. Avoid Precise Imitation of Architectural Detail
- vi. Ensure Alterations are Sympathetic
- vii. Respect the Ageing Process
- viii. Respect Previous Alterations
- ix. Discontinue Previous Unsound Practices
- x. Stabilise Problem Areas
- xi. Respect the Building's Context and Location
- xii. Ensure New Buildings fit into the Streetscape
- xiii. Maintain Views
- xiv. Respect Contents
- xv. Seek Design Excellence

2.1.5 Need for a Museum

Recording everyday life within a culture is one of the most important pieces of preserving it. With the rate at which cultures are disappearing, careful preservation of daily life is the only hope a heritage precinct has for preserving and conserving its culture. Daily life encompasses rituals, religion, foods, art, and any other facets that make a culture unique. In order for a culture to be respected and to survive globalization, those from the dominant culture must be educated about the minority cultures and their way of life.

The best way to do this is through a respectful display of local culture in a museum. With an educated populace that respects minority cultures, culture loss suddenly finds itself decreasing. Furthermore, museums are a wonderful place to take children for both fun and education. There is a need to collect and preserve our objects and materials of religious, cultural, and historical value. They help to preserve and promote our cultural heritage and act as a storehouse for old artifacts, sculptures, objects, history, etc.. In addition, museums help in conducting research and studies. Well preserved museums and heritage precincts can help attract more tourists in to the already famous heritage city.

2.1.6 Assessment

The renovation and conservation of old collectorate building at site level involved removal of unwanted debris from the office complex. The lack of maintenance of the office complex led to haphazardly scattered open spaces which were cleared to create a pleasing environment. The new structures developed at the site which were unused, were removed considering the value of the heritage structures.

The additional structures added to the old collector building disrespected the heritage value of the site and hence removed. Renewing the canal area made the canal safe and active through canal front development. The basic amenities were enhanced without disturbing the existing structure.

At the building level, the biological growth due to moisture and less maintenance should be treated such that it doesn't affect the major stability. The original external surface is regained by removing the brick treatment. There were many incompatible additions to the original collectorate building that were removed as indicated in Figure 4. The damaged and new joineries are replaced to its original style. The original granite flooring too is restored and the damaged timber rafters are replaced with new ones.

2.1.7 Proposal

The space within the collectorate building is reused for various purposes like exhibition halls, seminar/lecture halls, etc. along with the museum zone. The proposal of space usage within old collector building is zoned such that the ground floor holds the administrative segment, along which the other spaces correlated to museum

such as exhibition hall, audio visual centre, etc are zoned. The first floor majoritarily houses the museum which is divided into various zones. Few of the delineated zones are that of Art & Culture, Heritage & Architecture as illustrated in Figure 5 & 6.

Truly called as 'South India's Cradle of Arts', this museum would hold exhibits from 10 diverse departments representing the rich heritage and culture of the city as elaborated in Figure 5.

The art of Indian doll-making goes back centuries, but one of the prominent varieties are the Tanjore Bobblehead Dolls, which are native to this region. The tradition of making and displaying these dolls is closely associated with the Indian festival of Navaratri. The souvenir is an important component of the tourist experience, with most tourists bringing back mementos

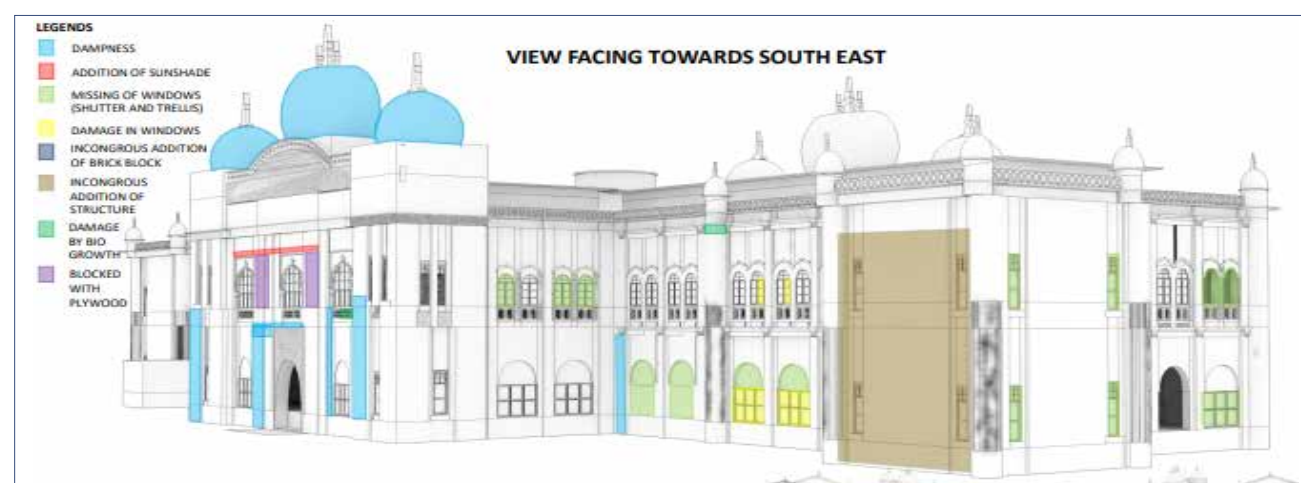


Figure 4: View of existing structural condition of the collectorate building

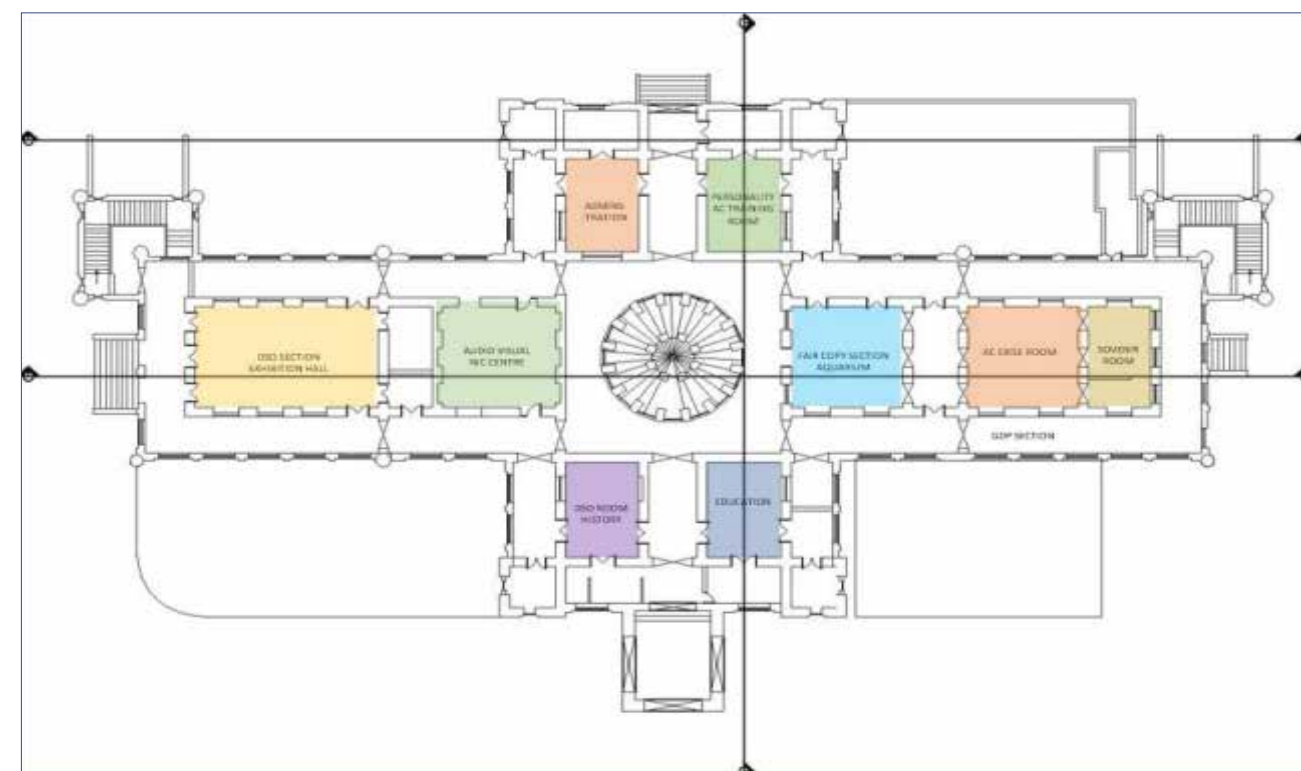


Figure 5: Proposals of space usage within old collector building

and souvenirs as evidence. People like to be reminded of the special moments in their lives. A separate hall has been allocated to hold evidence of those special items and moments.

In the same way, the hall of festivities includes a depiction of some unique celebrations such as the Melattur Bhagavata Mela in the annals of South Indian performance art tradition in more ways than one. With a rich history going back to the 16th century, this theatrical performance has been held annually, without break for more than 300 years in the tiny hamlet of Melattur in Thanjavur district.

The Thanjavur district is famously known as the “Granary of South India”, since the rule of the Chola dynasty. This district lies at the river Kaveri delta region, the most fertile region in the Tamil Nadu state. This district is the main rice producing region in the state and therefore known as “Rice Bowl of Tamil Nadu” and hence a separate section is allocated for agriculture.

2.2 Key features of the project

- i. Recreating the identity of the place
- ii. 5D theatre to be one of the highlights, exhibiting the grandeur of Thanjavur.
- iii. District administration organizes folk performances during Saturdays.
- iv. Light and sound show to attract a large gathering for an immersive cultural experience.
- v. This conservation project would play a pivotal role by being part of a larger tourism circuit.

2.2.1 Challenges in the project

- i. Many historic structures are in urgent need of repair and conservation.
- ii. Lack of maintenance of existing heritage structures due to low awareness.
- iii. No firm policy or guidelines issued for retrofitting or refurbishment of heritage structures in the campus.
- iv. Services for buildings are retrofitted without regard for original building techniques and materials causing harm to overall ambience.
- v. Inadequate awareness about local culture and history.
- vi. Lack of incentives and/or financial funding to maintain heritage structures.
- vii. Architectural character of heritage buildings being neglected.
- viii. Amenities are inadequate and improperly marked leading to disuse and low visitor stay time.

2.2.2 Risks involved in the project

- i. The buildings are dilapidated and decaying at a rapid pace.
- ii. Historic layers of architecture have been modified or erased without proper background work/ studies.
- iii. Retrofitting services and amenities are causing damage to the existing heritage structures.
- iv. Increasing number of different stakeholders in all parts of the campus threaten to disturb the original planning integrity.

2.2.3 Features and Benefits

- i. **Social:** Excitement amongst the people to visit the place once opened post renovation. The proposed museum, includes a 5D theatre to exhibit the grandeur of Thanjavur, which would be beneficial to the children and the elders.
- ii. **Technical:** Very few people work on conservation projects and it is difficult to find the right material, craftsman for execution of each and every detail. In the same way, these projects consume more time than others, as even the most minute articulations and detailing consume a lot of time.
- iii. **City administration level:** Heritage conservation projects are taken as a priority as they generate revenue and are planned to be opened before the summer vacation ends.
- iv. **Economic:** As soon as it is open for public access it would boost the local economy.

2.3 Impact study

In order understand the level of attention and enthusiasm the conservation projects have created in Thanjavur, a random sample survey was carried out. Though the collectorate office building is yet to be completed, the resultant efforts of other renovated structures in the town brings a lot of old memories amongst the townsmen. The excitement amongst the younger generation about the sound and light show, 5D theatre and the water fountain are an added plus besides boosting the local economy.

For this study a sample size of 100 were, surveyed which included 15 international tourists, 37 domestic tourists and 48 local residents as shown in Chart 1, of different

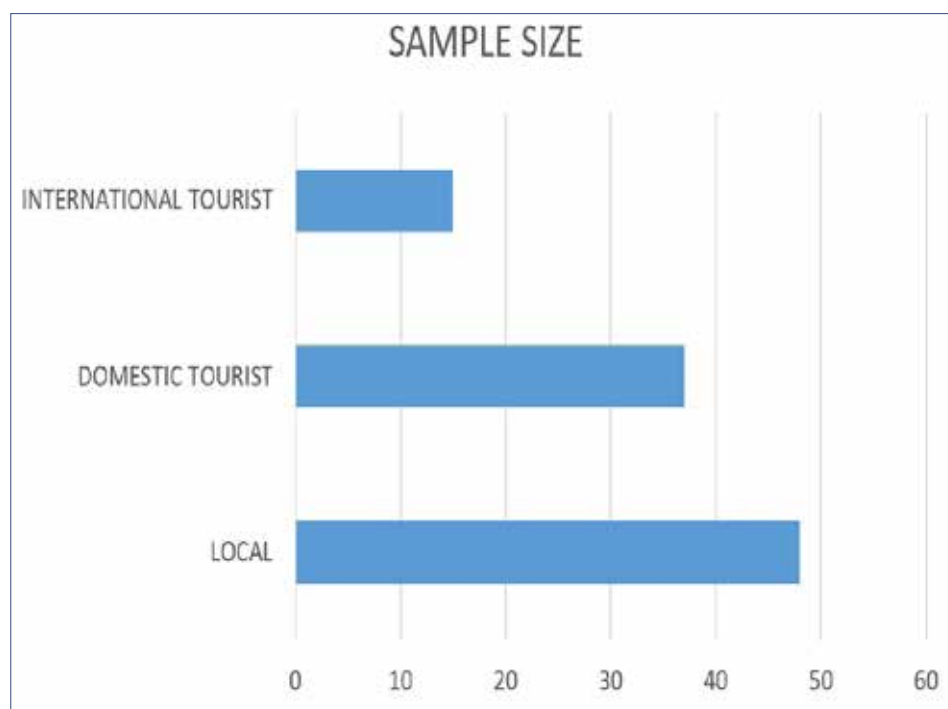


Chart 1

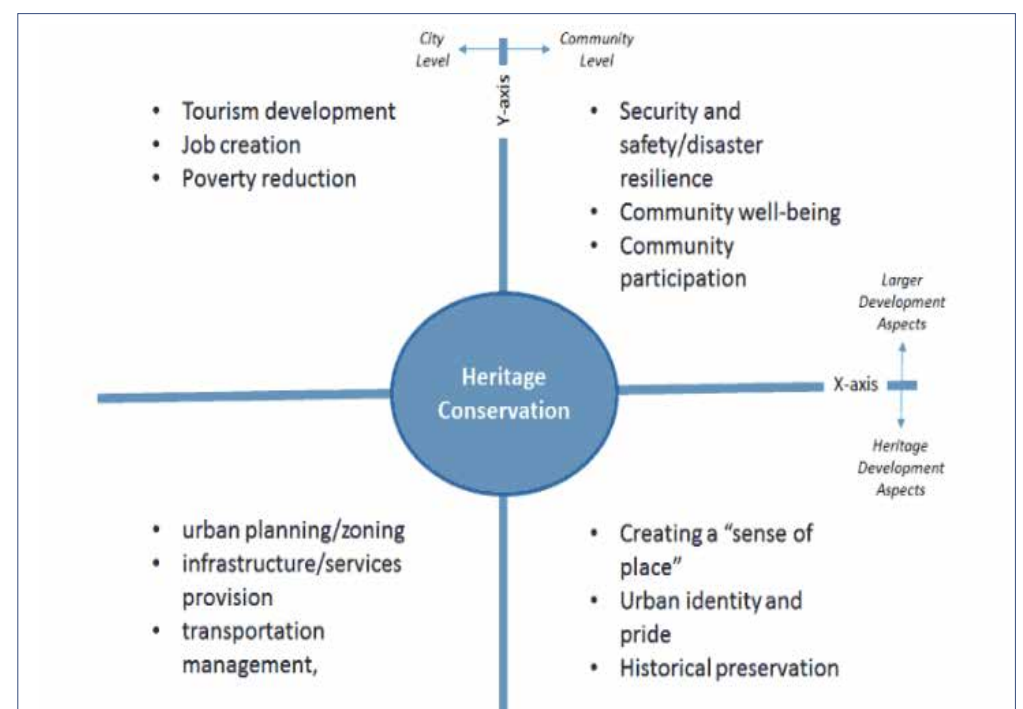


Figure 7: Heritage conservation policy dimensions the office building
Source: The Smart City Challenge Stage 2: Smart City Proposal Agra (Agra Annexures)

age category, including some street vendors as it will be an indirect economic boost for them.

Chart 1: Random sample survey – sample size

- i. The results of the study indicate that more than 40% of the samples are interested in visiting the collector office once opened for the new features such as the 5D theatre and water fountain.
- ii. About 30% of the people wanted to visit the place to experience the rich heritage and appreciate the articulation and detailed works of indo-sarcenic architecture.
- iii. More than 75% of the street vendors are looking forward to the place opening to boost the existing economic situation.
- iv. In terms of the impact, that this project has on administrative stakeholders, the officials are looking forward to the project's opening day and ensuring that it is completed and open to the public before the summer sets in, so that they can be the first ones to welcome children and tourists during their summer vacation.

3. Discussion and Conclusion

3.1 Implications

Preserving, showcasing the identity of the city and conserving the heritage has to be done not only to remind us of the past legacy, but also comes with the side benefit of a major tourist attraction that it draws

because of the same reason. Even though the results of implementing this project couldn't be assessed, as the work is in progress and had not been open to public access yet, it is clear through the random sample survey conducted that the people of different age groups were interested and are expected to visit the museum once it was open. This project can be hailed as a pilot project in terms of preservation and conservation of heritage buildings and its outcomes and learnings can be used by other cities in their own way.

Figure 7 above illustrates the dimensions of heritage conservation that accrue not only for heritage assets, but also to larger development aspects (across the x-axis). Distinctions across the y-axis on the other hand show the benefits at the community level, and at the city levels.

3.2 Limitations of the research

Since the project is still under renovation, the surveys conducted on public experience, economy generated, levels of maintenance were not considered and was limited to the expected awareness, involvement of the stakeholders at both public and at administrative level

3.3 Key lessons learnt

It is important for every individual to pass on their city's ancestral legacy to the future generation. The responsibility is of its residents to conserve and showcase the rich heritage that they possess.

Conservation projects are time consuming, and thus factors such as materials, craftsmen should be comprehensively taken into account during estimation, and funds allocation.

3.4 Recommendations

- i. At the city level, larger developmental aspects such as heritage protection policies include tourism development, employment creation, and poverty alleviation.
- ii. Priorities to shift towards ensuring security and safety (including disaster resilience), community well-being, and community participation at the community level.
- iii. Issues such as urban planning/zoning, infrastructure/services provision, and transportation management to be taken into account at all levels of heritage precinct revival planning.
- iv. At the community level, historical conservation aids in the creation of a "feeling of place," urban identity and pride, as well as unique community preservation.

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2. Smart city website - <https://smartcities.gov.in/node/142>
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C5

Micro Compost Centres-Erode

Name of the project: Micro Compost Centre

Location: Erode, Tamil Nadu

Year of Project Implementation: 2019

Sector: Solid Waste Management

SDG: SDG 1.4, SDG 6.3 SDG 11.6, SDG 12.3, SDG 12.4, SDG 12.5

Project Cost: Rs 1543.51 crores

Institute: Department of Planning, Anna University

Advisors: Dr.K.Pratheep Moses, Mr.P.Sudharsanamurthy, Ms.K.Madhivadhani

Students: Rajshree K R, Manoj G R, Gayatri S, Jeya Shalini

Keywords: Solid waste Management, Source segregation, Environmental Benefits, Smart City Mission

Abstract:

In the rapidly urbanizing world, the crisis in waste management and plastic pollution is a reflection of our unsustainable lifestyles. (reference?) We are consuming and producing at a mind boggling rate. Globally, 2 billion people lack the access to solid waste collection and 3 billion people are left without access to controlled solid waste disposal facilities. Urban dwellers, especially in low to middle income countries, are exposed to severe threats to public health due to the mismanagement of solid waste. However, if our waste is managed appropriately and effectively, not only will it be a resource for a prosperous circular economy, but it will help create green jobs and enhance the livelihood and income of the urban poor. Erode, under the Smart city mission, has constructed 24 micro compost centres at 12 locations with the combined capacity of 72 metric tons per day for disposing organic waste through aerobic composting methods. The decentralized scientific disposal of organic waste has been immensely successful because of the implementation of door to door collection and source segregation.

This report will look at micro compost center, implemented under the Smart city mission in Erode. The research focuses on the thematic area while presenting the overall status of municipal solid waste management. The report aims at exploring the functioning of these micro-compost centres in addition to answering the following queries-

- What triggered the change in the city to ameliorate solid waste management by adopting appropriate measures for addressing the challenges?
- What was the implementation strategy and operational elements that has helped the city to emerge as a model on the thematic area?
- What specific actions were taken by the city government in line with the adopted strategy and plan that has been pivotal to drive the change?
- What were the key learnings that emerged from the study in terms of inclusivity, strategy, plan and implementation model for practitioners to improve their waste management systems?
- Whether the model instituted by the city is replicable – what are the prerequisites to replicate the model in any city?

Case Study: C5

1. INTRODUCTION

1.1 Topic and Context

Over the past few years, Indian cities have witnessed a steady departure from the traditional practice of managing municipal solid waste to a more environment-friendly and financially sustainable system. There is greater emphasis on source segregation for sustainable solid waste management and to moving from 'linearity' to 'circularity'. (reference?) The focus is on:

- i. Remediation of legacy dumpsites;
- ii. The well-being of sanitation and informal waste-workers;
- iii. The opportunity to introduce technological innovation; and
- iv. Most importantly, on the absolute need for source segregation as the way for material recovery and recycling.

Erode is one of the 11 smart cities in Tamil Nadu recognised for its best practice in smart waste management. Located on the banks of the River Cauvery, this city is famous for its turmeric and textile industry. Erode City Municipal Corporation is divided into four zones and consists of 60 wards. The city generates around 165 metric tons of solid waste every day out of which 75 metric tons is biodegradable wet waste, 6 metric tons of saleable dry waste, 72 metric tons is non saleable dry waste, 5 metric tons of e-waste and one metric ton of domestic hazardous waste.

1.2 Significance of the project

Before the year 2017, waste was dumped in 2 major compost yards at Vendipalayam and Vairapalayam, which comprised of Legacy waste dating back to more than 60 years. The accumulated legacy of 5,60,000 cu.m occupies 19.60 acres of Compost land. This legacy waste has resulted in unwanted health issues, pollution

of water bodies and release of toxic gases. (reference?) Moreover, there was no scientific disposal of waste in the city resulting in rotting garbage being piled up on roadsides, and canals resulting in environmental degradation and pest problems.

1.3 Aim and Objectives

The aim of the study is to analyze the process and impact of micro compost centres in alleviating the solid waste issues faced by Erode city.

The objectives of the study are as follows:

- i. To understand the functioning of the solid waste management system
- ii. Analysing the role of various stakeholders in the implementation of the project.
- iii. To determine the key learnings and establish the replicability of the project.

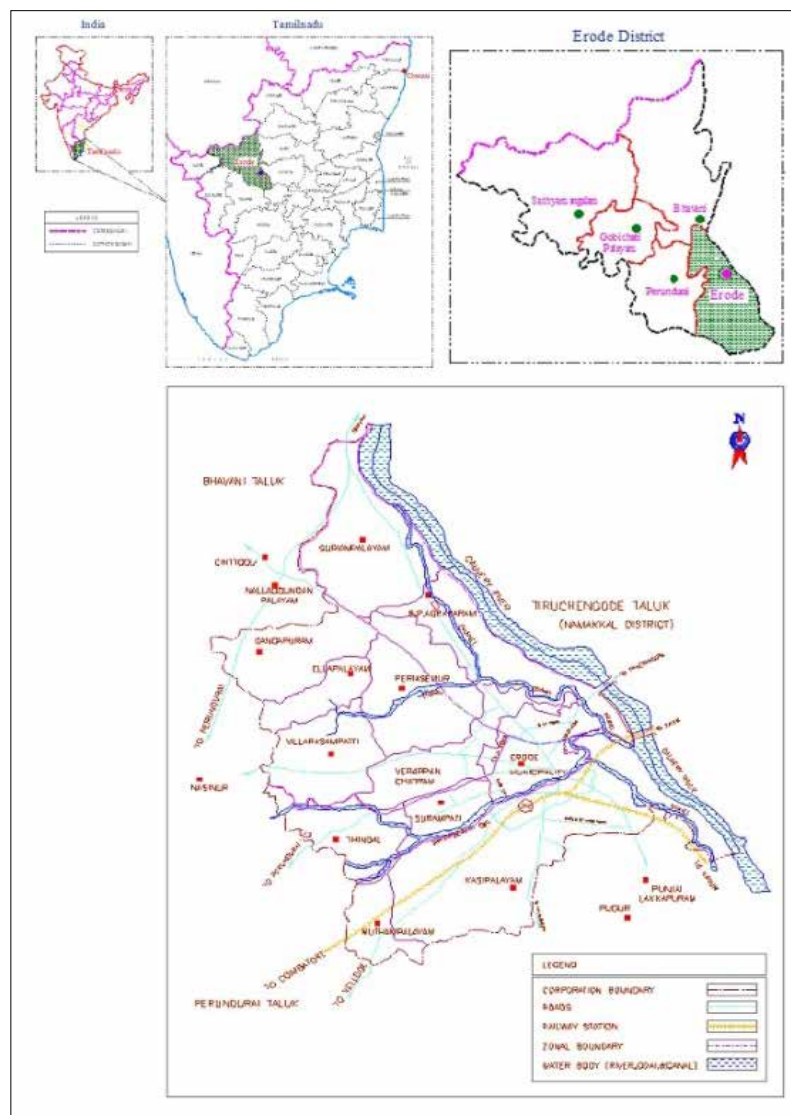


Figure 1: Location of Erode city

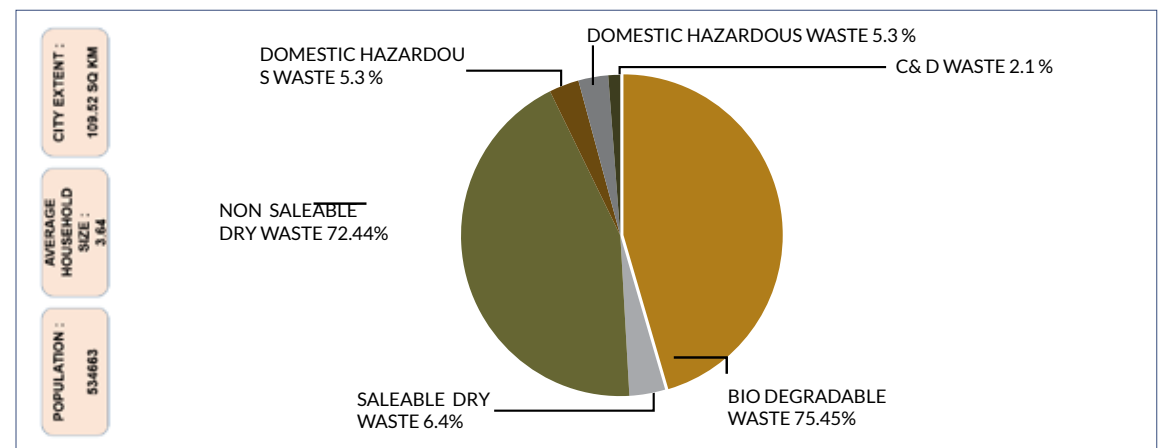


Figure 2 - Demographic statistics and waste composition
Source: Detailed Project Report



Figure 3: Vendipalayam Landfill site
Source: Author, taken on?

2. CONTEXTUAL BACKGROUND

2.1 Conceptual framework / Research design

The report focuses on the thematic area of municipal solid waste management. The structure of the report comprises of the following key elements:

- The implementation strategy and operational elements that has helped the city in emerging as a model city.
- Specific actions taken by the city government in line with the adopted strategy and plan that have been pivotal in driving the change.
- Key learnings that have emerged from the study in terms of inclusivity, strategy, plan and implementation model for practitioners to improve their waste management systems.
- The elements to substantiate whether the model instituted by the city is replicable – what are the prerequisites needed to replicate this model in any other city.

2.2 Key features of the project

Vision:

“GARBAGE FREE AND BIN FREE CITY”

A strategy that focusses on source segregation, processing of waste (biodegradable and non-biodegradable), and minimizing the waste that is sent to landfill sites has been adopted. Each of the process has been analyzed below.

i. Source segregation and door to door collection:

Source segregation is a fundamental and non-negotiable condition for sustainable waste management. Cities been able to treat their waste scientifically and reduce dumping in landfills; prevent land, water and air pollution; and realise economic benefits from processing waste through efficient segregation of waste at source. Source segregation of waste helps in recovering and utilising a higher percentage of recyclable waste. Waste is segregated at source with the help of different covers in light commercial vehicles.

As shown in figure 5, the two categories of waste segregated are biodegradable waste and non-biodegradable waste. Biodegradable waste which is wet waste is sent to the micro compost Centre and wet waste from the kitchen is processed in aerobic process of composting or bio-methanation. The end product of organic manure which contains plant nutrients (Nitrogen, Phosphorous and Potassium) as well as micro nutrients are given to the farmers free of cost. The non-biodegradable waste is separated into saleable, non-saleable and hazardous wastes. Saleable waste includes dry waste such as paper, plastic, glass and metal for recycling and reuse. The non-saleable wastes are sent for incineration. The hazardous waste is handed over to the agencies authorized by Tamil Nadu pollution control board.

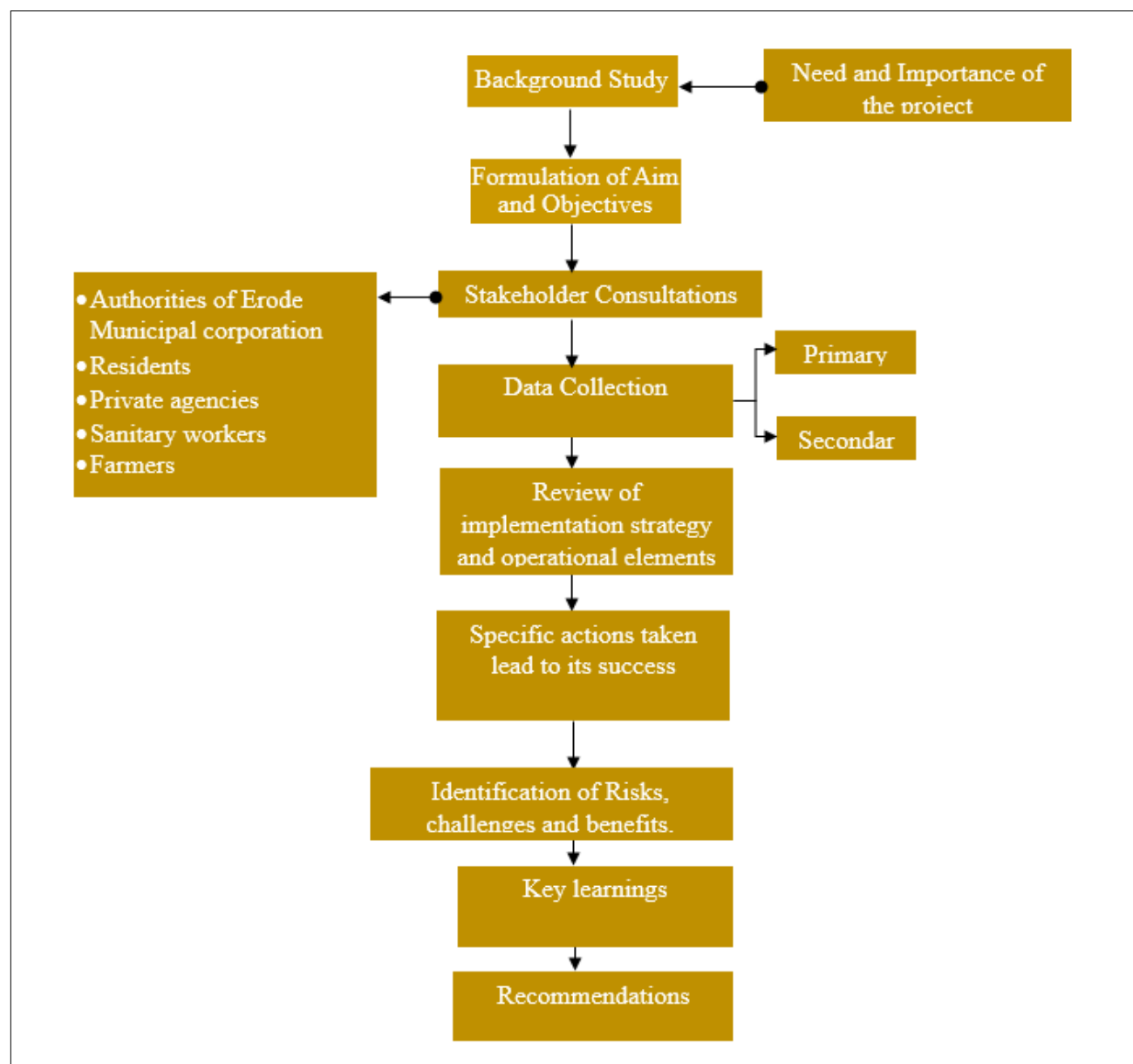


Figure 4: Vendipalayam Landfill site
Source: Author, taken on?

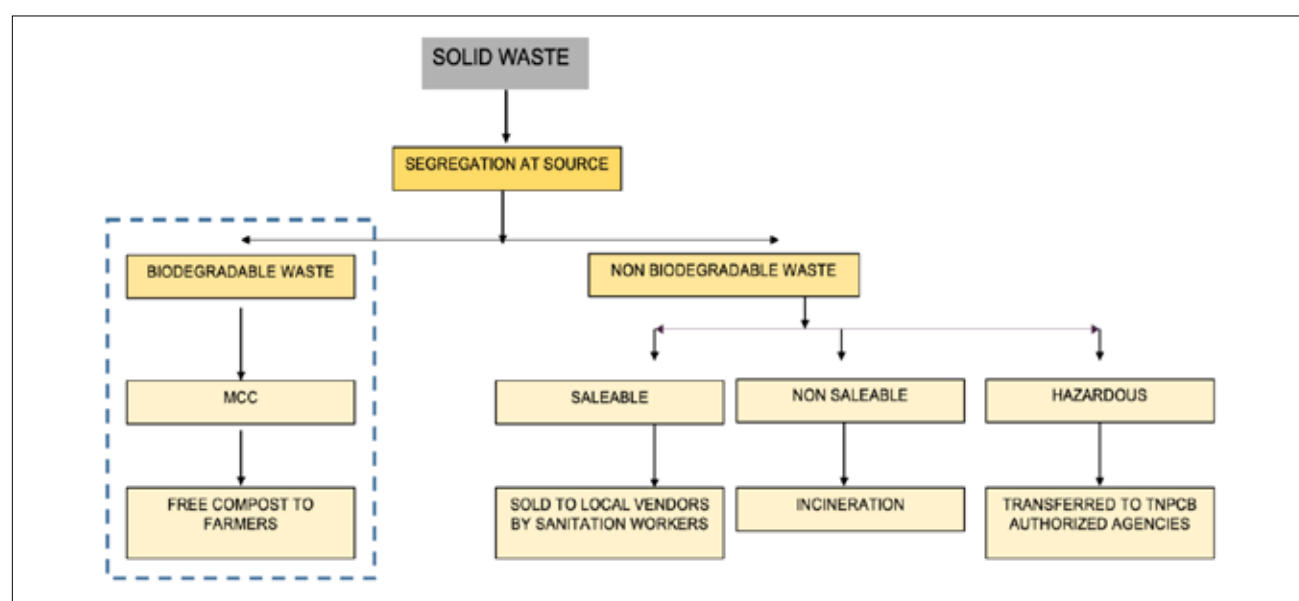


Figure 5: Process of solid waste management
Source: Author, taken on?

Collection mechanism of different type of solid waste:

The collection mechanism and the type of vehicle and route chart, collection time are mainly based on the location of waste collection centres and the processing facilities.

Domestic Wet waste collection:

Solid waste is collected from every household in morning from 6.30 am -11.30 am via door to door collection from the site as shown in figure 6. It is decided to establish Wet waste processing centers at local level by earmarking the service area of 17,730 Households. This decentralized approach eliminates the need for secondary collection and cost incurred for secondary transportation. Particularly in the domestic areas, the wet waste collection is achieved using the Primary Collection (D2D) utilizing the Push cart, BOV (full form ?) and LCV.

Commercial area, Market area Wet waste Collection:

As shown in figure 7, the wet waste from the commercial and market areas and industrial areas are collected by keeping the waste collection bins at the required earmarked locations and are then transported through secondary collection mechanism by engaging lorries

and other high capacity vehicles and then disposed of at the nearby processing centres. Commercial waste is collected separately in the night from 7 pm to 9 pm with door to door collection and segregation at source. Waste is then separated in same process as discussed above.

The details of the source of waste, collection efficiency achieved, and the segregation efficiency achieved are tabulated below:

Table 1. Waste generated from different source of waste

Source of Waste	No.of HH/ Assessment	Quantity of Waste generated /Day (MT)	Wet waste (MT)	Dry Waste (MT)
Domestic	35077	35077	21050	14027
Commercial	2714	3392	2035	1357
Silt	-	3000	-	-
Total		41.469	23085	15384

Source: Detailed Project Report

Waste Generation	41.469 MT
Door to Door Collection in %	100 %
Segregation achieved in %	68 %

Table 2. Solid waste segregation efficiency
Source: Detailed Project Report

ii. Route Mapping

As per table 2 above, the present solid waste segregation efficiency stands at 68 percent. In order to implement 100 per cent door-to-door collection of segregated waste, an identification study was carried out to find out the amount of waste generated in each ward and the population of each ward.

On the basis of the data collected, a detailed route plan, such as shown in figure 8, was prepared to cover all wards. Based on this route plan, an extensive vehicle and staff deployment plan was implemented. The Route chart for collection and disposal of wet waste to the earmarked local collection centre is prepared by classifying the collection area based on the area adjoining to the processing centre. The trip chart, the worker in charge, supervisor in charge were finalized and disclosed to the public for their cooperation.



Figure 6: Domestic wet Waste collection
Source: Author



Figure 7: Night Collection of Commercial Waste
Source: Author



Figure 8. Route map of a ward in Zone 4
Source: Erode Municipal Corporation

S.No.	Type of vehicle	Capacity of vehicle in Metric ton	No. of Trip	Quantity handled per day	Purpose of vehicle
Primary collection available					
1	Pushcart	0.04 MT	520	20.08 MT	Door to Door collection
2	Tri-Cycle	0.06 MT	66	3.96 Mt	
3	BOV	0.1 MT	12	1.2 Mt	
4	LCV	1.0MT	2	2.0MT	
Secondary collection available					
1	Tipper lorry	1.2 MT	2	2.4 MT	Garbage Collection
2	Dumber Placer	1 MT	30	30 MT	
3	Tractor	0.8 MT	8	6.4 MT	
4	Compactor	4Mt	1	4.0 MT	

Table 3 vehicle type and collection capacity
Source: Erode Municipal Corporation.

WHAT HAS WORKED

- 1. Bringing behavioral change at a mass level is not an easy task. EMC took multiple steps to spread awareness among people and motivate them to embrace waste segregation.**
- 2. Vehicles used for door-to-door collection of garbage were utilised to promote the campaign. The campaign was carried out in all residential and commercial areas, including public places.**
- 3. Garbage bins were removed from residential neighbourhoods and public spots where waste was dumped were regularly cleared and converted to recreational spots with wall paintings and rangolis.**
- 4. Prioritization of target groups: Door to door collection timings were based on target groups. For example, collection in slums were carried out as early as 6.30 AM as most of the residents were labourers and tend to leave for work early.**

Level of service in segregation of solid waste

- 100% Source segregation and Door to door collection of MSW is implemented.
- Entire collection of solid waste is being mechanized by introducing light commercial vehicles.
- Door-to-door collection is done in partitioned vehicles. There are six separate spaces for biodegradable, non-biodegradable, plastic, sanitary, domestic hazardous and electronic waste in each tipper. These tippers carry waste from households to transfer stations.
- GPS has been installed in all waste collection and transportation vehicles. A special cell monitors the GPS. Penalties are imposed on drivers they are found deviating from their designated routes. This monitoring has helped save fuel as well as ensure 100 percent solid waste management.

iii. What is an MCC?

A Micro Composting Centre is a facility where wet waste is processed to compost, with basic infrastructure as listed below:

- Steel framed Galvalum sheeted roof Shed with an adequate area.
- 14 numbers of Cubical tubs of size 3.60m x 1.80m x 0.90m, each having the capacity to accommodate two/ three day's collection material
- Moving area equal to the area occupied by the tubs
- Wet waste receiving Platform
- Manure Storage room
- Shredder cum conveyor arrangement
- Rest room facility with toilet & bathroom
- Electrical and water supply facility
- Incinerator
- Siever

How the system works?

Step 1 - unload the wet waste in the waste receiving area.

Step 2 - transfer the wet waste on the conveyer belt of the waste shredding machine

- Waste is passed through the shredding machine to shred it into smaller pieces.

Step-3 Preparation of compost tub to receive shredded waste

Compost tubs are typically 3.0m x 2.0m x 1.0m in size. Cow dung slurry within this tub helps accelerate the composting process. As seen in figure 10, the shredded waste is then added in to the tubs.

Step - 4 Addition of EM (full form ?) solution

Materials required for EM solution:

- As shown in figure 11, a mix of water, jaggery and curd in made in a container. The container is closed and the solution is let to ferment for 7 days.
- After 7 days, add rice bran to the solution and make balls from this EM solution. As an alternative to rice bran, one can add husk and dried leaves
- These EM balls are then crushed to convert into powder form and is added to the compost tubs after 4 to 5 days of adding shredded waste.

Step 5 - Add leachate to the waste in compost tub

- Each compost tub has a leachate pit connected to a common leachate collection tank



Figure 9: Wet waste received (left) and shredded (right)
Source: Author



Figure 10: Shredded waste transferred to compost tubs
Source: Author

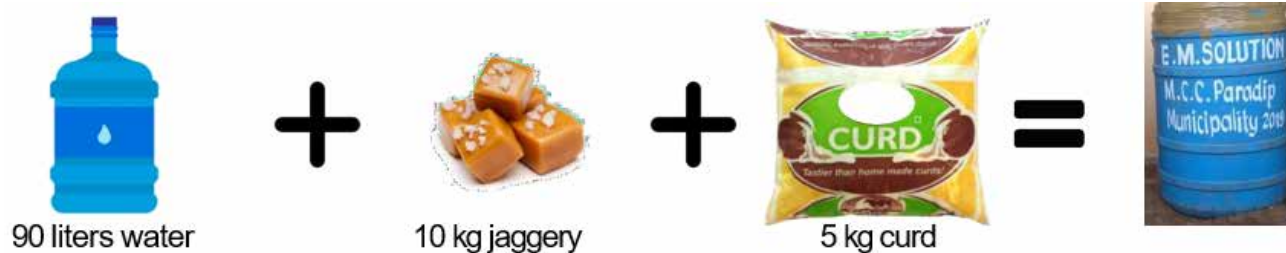


Figure 10: Shredded waste transferred to compost tubs
Source: Author



Figure 11. Preparation of EM solution
Source: Author

- Leachate is added to the waste in the compost tub for retention of moisture during the composting process as seen in Figure 12.

Step 6 - Preparation of compost

- The compost will be ready in 42 days after which it is removed and sieved for uniform size.
- The rejects from the sieve are put back in the compost tub
- As shown in figure 13, the sieved compost is then left to dry under the sun to dry for seven days.

Impact:

Till now, 6600 MT of manure has been distributed to the farmers for free. The manure generated from wet waste is on an average 23.22 % of the initial wet waste used for processing.

Compost waste to manure

The organic content of Municipal Solid Waste (MSW) tends to decompose leading to various smell and odour problems. It also leads to pollution of the environment. To ensure a safe disposal of the MSW it is desirable to reduce its pollution potential and processing in composting centre and making it a farmers useful manure. Best composting conditions are usually attained when the material's particle size ranges from 1 to 2 inches in diameter. The rate at which aerobic decomposition takes place increases as the particle size decreases. However, extremely small particles may



Figure 12. Leachate pit adjacent to the compost tub
Source: Author



Figure 13. Manure left for sun drying
Source: Author

reduce the oxygen movement within the pile, thereby reducing the composting rate.

Compost is particularly useful as an organic manure which contains plant nutrients (Nitrogen, Phosphorous and Potassium) as well as micro nutrients which can be utilized for the growth of plants. Moisture is a key factor that supports the metabolic activities of microbes. The moisture content for composting materials should be maintained between 10 – 15%.

Parameters	Bio digesters	Onsite composting centers
Moisture	11.34	13.10
Total nitrogen content %	1.87	0.61
Total phosphorous %	0.24	0.37
Total potassium %	0.49	0.85

Table 5. Plant nutrients in samples in %
Source: Erode Municipal Corporation.

i. Bio-digester

Bio-digester systems may be introduced in any urban area where trash is dumped on the side of the road as shown in figure below. A biodigester is a container made of high-density polyethylene that is activated by microorganisms in the trash which has a capacity of 5000 litres. Processed manure is a nitrogen, phosphorous, and potassium-rich organic, pathogen-free fertilizer. The items are mostly intended for farm self-consumption.



Figure 14. Zone 3 on site compost -bio digester
Source: Author



Figure 15. Methane gas balloons
Source: Author

Economic and ecological Benefits of Biodigester

This approach decreases the requirement for agricultural inputs by using nutrient-rich fertilizer. Soil degradation is reduced and production is increased when this manure is added.

This has positive effects for the health of the users and the ecosystem by converting a dumping site in to bio digesters tanks.

Key learnings

- It is critical not to exceed the bio digester's maximum suggested organic matter capacity in order to guarantee that the manure stays in the container long enough for pathogens to be eliminated.
- Proper operation requires an average temperature to undergo decomposition hence it is on site.

ii. Bio methanation

Erode has taken multi-dimensional approach to overcome the challenges of urbanization and solid waste management by using bio methanation plants. Bio-methanation is the microbiologic conversion of organic material to biogas under anaerobic circumstances. Solids in the wet organic waste decompose rapidly and can be treated by this process as shown in figure below.

Economic and ecological benefits of bio methanation plant

- Bio-methanation offers a lot of potential for generating energy from organic wastes and residues. It will assist in reducing the dependency on fossil fuels and consequently CO2 emissions.
- This process reveals the practical and theoretical values of methane generation. This helps in arriving at an assessment of the region's and plant's methane potential. This is important for optimizing processes, resources, plant design, and configuration. Conducting such an analysis will also reveal the plan's economic feasibility.
- The electricity so generated would be utilized for various purposes.

Key learnings

Bio-methanation is a good urban waste management solution as it produces a variety of end products that may be utilized for a variety of purposes.

- Valuable Bi-Products such as Biogas and Manure is generated using the bio methanation method
- Bio-methanation plants don't require significant investment and can be set up on a smaller scale. Unlike other waste treatment methods, this one is totally self-contained and does not require any external input. This system is totally enclosed and sealed, and it gathers every last bit of gas for use. This includes a slew of dangerous greenhouse gas emissions.

iii. Timeline:

The first MCC was constructed in the Vairapalayam dumpyard in 2019. The awareness campaign and successful implementation of 100% source segregation and collection required 6 months. Currently there are

24 MCCs in 12 locations each serving around 17714 households.

- i. Role of private consultants
 - Use of Bio-methanisation plants to collect large quantities of wet waste generated in markets to produce methane as an energy source.
 - Bio-mining undertaken in Landfill sites. – ZIGMA Consultants
- ii. Role of Urban Local Body
 - Awareness programmes to promote source segregation.
 - Prioritizing certain target groups.
 - Provision of well-lit MCCs.
 - Efficient route maps. (Each LCV serves 1000 households).
 - Vehicle tracking with fuel management sensors. (Saves 1 – 1.5 crores).
 - Use of Bio-Digesters in vacant government lands to avoid dumping of wastes.

2.2.3 Challenges in the project

- i. Making the public aware of the process and making them dispose the segregated waste at source can be tedious and time consuming in the initial stage of the project.
- ii. To ensure regular day to day collection, demand gap assessment needs to be done with efficient route maps and simultaneously deploying the correct number of vehicles.

2.2.4 Risks involved in the project

- i. Improper segregation of waste affects the technical process of micro composting.
- ii. The process of manuring needs to be carefully carried out in well-lit MCCs as any deviation might result in negative impacts such as pests and odour issues which in turn impacts the neighbourhood.

2.2.5 Features and Benefits

- i. Social

Residents have become more aware about management and disposal of waste. The informal sector engaged in waste picking and SHGs integrated into the system have resulted in an increase of 25% employment in the sector. The saleable wastes are disposed of in a way that workers could earn an income of Rs 300–500 per day by selling them to local vendors. The compost generated is being given to local farmers free-of-cost resulting in better yield.
- ii. Economy

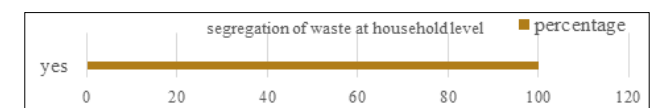
One of the main advantages of decentralized waste management is reduction in transportation cost. Once the micro units are in place, transportation and labour costs can be reduced by one-third. Employment opportunities to the workers through proper training results in better access to waste, more regular and assured income sources and reduces their business risk.

- iii. Environmental:

A huge amount of mixed waste that could have been hazardous to the land or river has now been treated and recycled, and a potential hazard to the environment remediated. The bio-mining of legacy wastes in the existing dump yard has resulted in rejuvenating the water bodies in the vicinity. The Door to Door collection of waste reduced the odour nuisance from the garbage bins. Due to the reduction in the transportation, the carbon emissions from lorries is also reduced.

2.6 Key findings from the interviews, surveys, and primary/secondary data collection

- i. Do you separate different types of waste at your home?



Inference: 100 % of household segregate their waste within the household. The awareness created by the corporation workers and voice over speakers from the LCV vehicle enabled the user to efficiently separate waste as bio-degradable and non-biodegradable at home.

- ii. Do you have regular garbage collection in your area? If so, how often?

Solid waste collection is 100 % efficient in Erode corporation. The waste is collected regularly on a

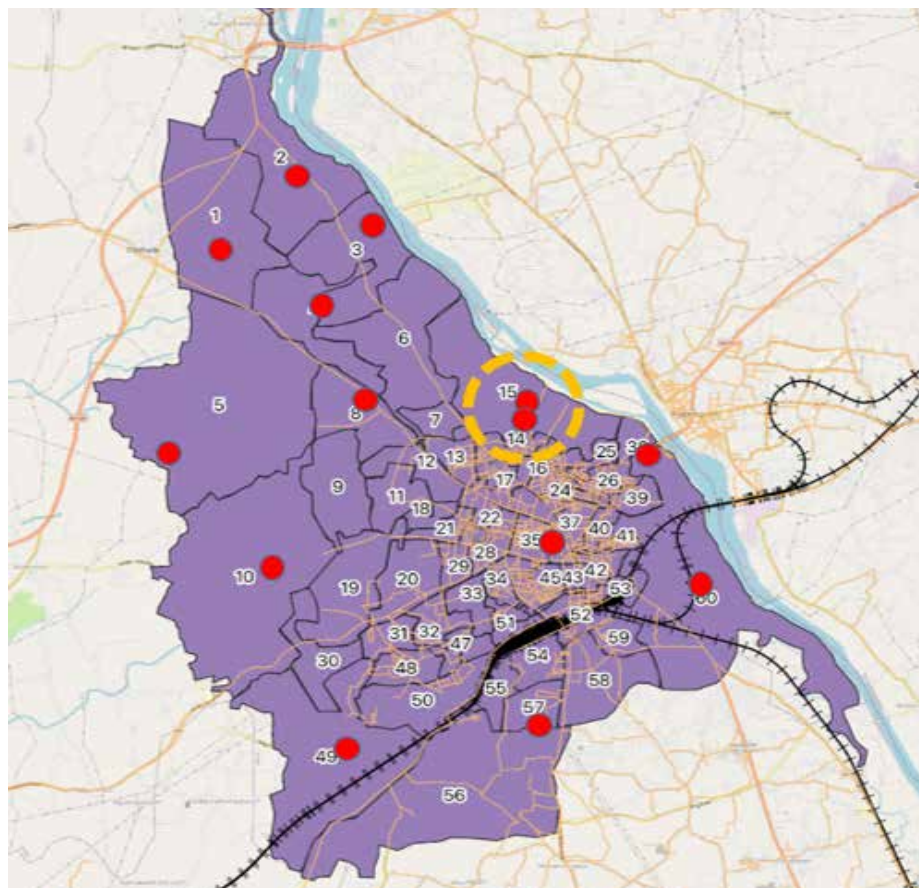


Figure 16. Location of MCCs
Source: Author



Figure 17. Compost manure used by farmers
Source: Author



Figure 18. Employees undergoing training
Source: Author

daily basis. Door to door collection starts from 6.30 am and goes up to 11.30 a.m.

iii. Are you satisfied with your current waste collection service?

People in all the four zones in the corporation consider this project as a success. People say that the issues of mosquitoes and drainage clogging problems have solved with regular collection of waste.

iv. Are there any odour issues due to the presence of micro compost centres in your locality?

The micro compost centre area located in open areas of corporation and surrounded by agricultural fields or barren land and 200 meters away from residents thus the odour issues are less due to strategically locating the micro compost centre.

v. What were the major challenges faced during implementation?

Theoretical and practical phase of implementation are different from each other. The bio mining of land fill site has been a major challenge for the

corporation. At present, the site is cleared from pollution. Implementation of micro compost centre in each ward, and route mapping for wards were made with technical consideration.

vi. How effective is community participation in the field of Solid Waste Management?

Community participation is effective in case of segregation of waste door to door. Garbage littering area are cleared and rangolis are made at street level. The residents are aware of segregation and motive of a garbage free city. Hence, apartment buildings have more households, so they have their own waste segregation bucket to easily transfer the segregated waste in to the collection vehicle on in daily basis.

vii. On what basis is the location for micro compost centre chosen?

Ward location and total households numbers are considered for the decentralization of micro compost centre. Strategic location areas were identified for MCC with technical and ecological considerations. The implementation capacity of plants were based on the

quantum of wet solid waste generated in each ward.

viii. Whether the present Micro compost centres for all households in the corporation are sufficient?

At present the wet waste processed and generated in each zone is said to be 60.2 MT and the quantity of wet waste generated is 62.71 MT. About 96 percent of the wet waste is processed effectively. Composting methods include micro compost, bio digester and Bio - Methanation.

ix. How micro compost of solid waste is effective in commercial and institutional waste?

Commercial wastes are collected separately in the night from 7 pm to 9 pm with source segregation and door to door collection. The wet waste from the commercial and market areas and industrial areas are collected by keeping the waste collection bins at the prescribed locations and are transported through secondary collection mechanism by engaging the available lorries and other high capacity vehicles and disposed of to the nearby processing centres.



Figure 19. Transformation of landfill sites
Source: Erode Municipal Corporation



Figure 20. Door to door collection
Source: Author



Figure 21. Survey on site
Source: Author



x. Benefits from micro compost as fertilizer?

The compost so produced is particularly useful as an organic manure which contains plant nutrients (Nitrogen, Phosphorous and Potassium) as well as micro nutrients which can be utilized for the growth of plants.

3. Discussions and Conclusions

In the recent years, the importance of composting has been recognized, and waste segregation, composting, and waste-to-energy generation have all been highlighted as opportunities. Erode Municipal Corporation's approach towards smart waste management, was successfully implemented with the help of private and public participation. This project was made feasible for the small-scale city without compromising on the security and health aspects.

3.1 Recognition

Erode Corporation, which is implementing the various smart city projects has bagged the third place in the 'India Smart Cities Award Contest (ISAC) 2020', for effectively implementing micro-compost projects. In the 'Built Environment' project theme, Erode has been selected for its micro-composting networks and got recognition for its performance.

3.2 Implications

Changes in the weather and seasons will have little impact on onsite composting. Small adjustments can be made when changes especially when the rainy season approaches.

About 96 percentage of wet waste is processed effectively. Composting methods include micro compost, bio digester and Bio - Methanation. This has resulted in scientific disposal of waste with greater emphasis on source segregation for sustainable solid waste management and to moving from 'linearity' to 'circularity'

3.3 Limitations of the research

The research focuses mainly on the environmental consideration in the vision of garbage free city.

3.4 Key lessons learnt

The success of Erode's waste management derives its success in achieving 100 per cent segregation of waste

at source into six categories. Door-to-door collection of segregated waste is possible in every city, town and village of India as long as the local governing bodies are committed to achieving it.

Erode has been successful because the municipal authority showed the willingness to earn the trust of citizens and make them active participants in cleaning up of their city.

Community engagement is absolutely necessary to replicate this model. Yield produced by the compost manure is of the same quantity production in field where rich fertilizer were used before. The issues of mosquito and drainage clogging problem have been solved with regular collection and proper treatment of wet organic wastes.

3.5 Recommendations

To seek unique Partnership proposals in which companies may share their technology achievements with Erode corporation and securely collect, run, and manage micro-composting facilities as a result of their partnership.

A partner is anticipated to put in the necessary technological know-how, infrastructure, and marketing for optimal collecting space use in the designated locations. For example in, Andhra Pradesh, by integrating Internet of Things (IoT) and Information and Communication Technology tools, the state government

launched a Real Time Monitoring System – an analytical dashboard that has set a benchmark in micro-planning with pinpoint details of source segregation, gate-to-gate collection, collection routes, transfer points and weight of the waste before it is loaded into trucks – in 89 urban local bodies, including Bobbili. Under the Real Time Monitoring System, every household and apartment, Smart waste management: Garbage collection as per the Real Time Monitoring System 57 termed a 'gate', is given a radio frequency identification (RFID) tag. Sanitary workers carry an electronic scanner and share real-time information about household waste with the city-wide monitoring system. Waste collected from each micro-pocket is digitally measured. Garbage trucks are fitted with GPS devices to track their movement. Attendance of sanitary workers is monitored by an Aadhaar-based facial recognition system. This feature can be added to the existing model for better efficiency.

The officials in-charge of the micro-compost centers in on site of parks and playgrounds should ensure the facility does not fall into disuse, resulting in the place becoming a dumping yard of garbage.

Composting on-site requires relatively little time and equipment. The key to success is education. The aim is to encourage households and businesses to compost on their own premises, local communities may host composting demonstrations and seminars.



Figure 22: Commercial and industrial area waste collection
Source: Author

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Annual Report

1. Solid waste management report from erode corporation 2022

C6

Pedestrianisation, Gangtok

Name of the project: Pedestrianisation

Location: Gangtok, Sikkim

Year of project implementation: 2019

Sector: Mobility/NMT

Project Cost: Rs 25.94 crore

SDGs: SDG 3: Good Health and Well-being, SDG 11: Sustainable Cities and Communities, SDG 13: Climate Action

Institute: Indian Institute of Technology, Kharagpur

Advisors: Prof. Subrata Chattopadhyay, Prof. Haimanti Banerji, Asst. Prof. Arjun Mukerji

Students: Mithilesh Mandal

Keywords: Pedestrian infrastructure, Integrated Urban Utilities, walkability, Safety, Hill Area

Abstract:

The improvement of the pedestrian footpath of a 12-km stretch in Gangtok, from Vajra/Baluwakhani to Ranipool, was implemented in 2019 under the Smart City Mission. The project identified the lacunas in the pedestrian infrastructure and implemented designed interventions resulting in improved safety for all user groups and a pleasant street environment. Key components included segregation of vehicular and pedestrian traffic, installation of railings, tactile tiles, solar studs along the kerb and utility lines for telecom and internet through underground HDPE (High Density Polyethylene) pipes. Special features addressing the hilly topography of the town included plumb concrete retaining walls and overhanging footpaths on steel props. Reflecting contextual cultural iconography in the designed features was an important urban design consideration. This research studies and documents the various aspects of the project with reference to available standards and guidelines, similar national and international projects and findings from field visits, interviews and surveys. The key findings are expected to help facilitate further improvement of the existing pedestrian infrastructure as well as highlight future design of pedestrian facilities in similar contexts.

1. Introduction

Indian cities accommodate more than 30% of the current population and the numbers are expected to reach 40% by 2030, and the Smart City Mission (SCM), launched in 2015, is an important initiative to provide better physical, economical, social and institutional infrastructure to improve the quality of life of the urban populace. It is worthwhile to note that walking is an active and primary mode of travel in India. As per Census 2011, ninety per cent of trips made by women were on foot or public transportation. The shorter the trip, the more is the propensity to use a cycle or walk to the location, and for the last mile connectivity, users are more dependent on walking or cycling. The absence of safe, comfortable, continuous and enjoyable footpaths discourages people from using the pedestrian facilities (Indian Road Congress, 2020). The Pedestrianisation project at Gangtok addresses this issue and relates to the 'efficient urban mobility and public transport' sector of SCM.

1.1 Topic and Context

Gangtok, at an altitude of 1,650-m, is the biggest city and capital of Sikkim which is situated in the Eastern Himalayas. The name 'Gangtok' means hilltop and the city is one of India's most serene hill stations. There are 17 wards covering 19 sq km under the Gangtok Municipality, accommodating a total population of 1,00,286 (Census, 2011).

Gangtok participated in the third round of the Smart City Mission, and the Gangtok Smart City Development Ltd (GSCDL) was launched in 2018. The four key modules under Area-Based Development (ABD) for Gangtok Smart City were identified as:

- i. Prosperity
- ii. Cleanliness
- iii. Liveability
- iv. Mobility

Improvement of pedestrian infrastructure along the 12-km stretch of road from Vajra/Baluwakhani to Ranipool, a part of NH-10, was one of the ABD projects under the mission, relating to Mobility.

1.2 Scope of Project

The Mobility module is targeted towards improvement of transportation-related infrastructure to enhance a city's accessibility and connectivity. The concept of Smart City promotes eco-friendly transportation like walking and cycling to create a safe and pollution-free environment. Accordingly, the current project addresses the importance of pedestrian walking space throughout the city for creating a healthy and sustainable environment. The primary objective of providing dedicated walking space is to enable an uninterrupted

access to pedestrians of different categories throughout the Gangtok Municipal Area. The footpath network shall be linked with proper traffic calming measures such as road crossing and foot-over-bridges or sky-walks with related safety bollards, traffic signage, traffic signals, street lights and street furniture. The Detailed Project Report (DPR) was prepared in 2018, and the project commenced on August 30, 2019. It is expected to be completed by March 1, 2023.

The aim of the project is to improve the existing pedestrian facilities for better walkability through enhanced comfort, safety and visual experience for all user groups, while overcoming challenges of the terrain through appropriate design solutions. In turn, the idea is to promote Non-Motorised Transport (NMT), improve health, reduce dependency on fuel consumption and decrease air pollution.

Objectives of Pedestrianisation are as follows:

- i. Segregating vehicular and pedestrian traffic for safety through grade separation and appropriate railings
- ii. Improving existing steps, introducing ramps wherever possible and improving the existing footpath surface for better universal accessibility
- iii. Integrating footpath design with utility lines through underground HDPE pipes
- iv. Maintaining continuity of footpath by constructing overhanging footpaths at required stretches supported on steel props over the plumb concrete retaining walls
- v. Maintaining proper stormwater drainage
- vi. Employing a uniform design vocabulary and material palette reflecting contextual cultural iconography wherever relevant

1.3 Significance of the project

In a mountainous region like Gangtok, the major part of the city lies along the central road which connects the major activities (linear city). The locals, as well as tourists are primarily dependent on the footpath along the central spine for accessing different locations. Therefore, a safe and pleasant footpath is of significant importance for improving the liveability of the city. The project focuses on improving the existing pedestrian infrastructure along the central spine of the city, with enhanced safety, comfort and visual experience thereby, improving connectivity for pedestrians and the overall quality of life of the citizens.

1.4 Aims and Objectives of the Research

This research aims to *study and document the various aspects of the project with reference to available standards and guidelines, similar national and international projects and findings from field visits, interviews and surveys.*

The objectives of the research are:

- i. To understand the project requirements and components adopted in response
- ii. To identify the issues faced by the stakeholders and the steps taken to resolve them
- iii. To study the method of planning and implementation adopted for the mountainous terrain of Gangtok
- iv. To study the relevant standards and guidelines and understand the technical requirements (Components, Dimensions, Material Specifications, etc.)
- v. To study relevant cases where these standards and guidelines have been applied

The research will help facilitate further improvement of the existing pedestrian infrastructure as well as inform future design of pedestrian facilities in similar contexts.

2. Contextual Background

The streets are the nervous system of a city through which users, i.e. the residents, visitors and commuters, traverse and move from place to place. The movement is through either motorised or non-motorised mode. In Indian cities many people mostly walk to different locations. Among these, the women, children and elderly are the most vulnerable to safety and security issues on the streets. Lack of proper infrastructure forces walkers to use the carriageway, leading to conflict. Thus, the lack of pedestrian infrastructure impacts both the walkers and the users of vehicular transport.

Gangtok is a small city, only 19.2 sq km in area and spanning less than 10-km from North to South. Given the short distances, walking is a very effective mode of daily transport for the citizens. In addition, Gangtok is a tourist city so a footpath is of utmost importance for increased tourist accessibility. However, the existing footpaths in the project area have been constructed in phases over 15 years (Grant Thornton India LLP, 2018), leading to non-standard footpath construction and resulting in poor walkability. Also, the mountainous terrain of the city poses specific challenges to the design and construction of proper pedestrian facilities.

2.1 Conceptual Framework/Research Design

The research methodology can be articulated through four major stages:

- i. Literature Review
- ii. Data Collection
- iii. Analyses and inferences
- iv. Conclusion

The various components of each stage are presented in Figure 1.

2.2 Literature Review (Case Studies)

To assess the solutions provided for improving the footpath, the research reviewed similar projects adopted in Indian and International cities as outlined Table 1:

2.3 Key features of the project

The following features of the project were identified from 12th to 16th March, through fieldwork by the IIT Kharagpur research team at Gangtok:

- Motorised transport and pedestrian flow are segregated by installing properly designed railings and grade separation with kerbstones
- The challenges posed by the terrain have been addressed through steps, ramps and overhanging footpaths
- The footpath surface has been improved by using paver blocks and tactile tiles
- Underground HDPE pipes are integrated into the footpath design to accommodate utility wires thereby, de-cluttering the visual environment and generating revenue for the Urban Development Department, which would collect fees from private communication service providers using the HDPE conduits
- The cultural identity of Gangtok is reflected through the use of Buddhist iconography of 'palbheu' (the endless knot) in the railing design

2.3.1 Challenges in the project

- The land along the road is privately owned thus, acquiring land for increasing the Right of Way (ROW) was a challenge
- The construction is often interrupted because of blockage and damage caused due to landslides
- The columns of the existing foot-over-bridges block the footpath below and it is not feasible to remove them
- The ROW is not uniform, due to which it is difficult to maintain constant uniform width of the footpath and transitions are not smooth
- The steps along the footpath make it very difficult to lay the HDPE pipes

2.3.2 Risks involved in the project

- Sometimes, landslides cause blockage of the footpath or at times, the road and footpath collapses. This can result in damage to life and hamper the project's progress
- Installation of HDPE pipes requires dismantling the PCC of the existing footpath embedded with electric cables. This may cause safety issues and wire damage, adding to the construction cost and time

2.3.3 Features and Benefits to the city

- The new railing design is stronger and taller than the older railing thus, increasing the safety of pedestrians
- Installation of solar studs along the kerb of the footpath has increased safety at night

- Installation of protective works such as plumb walls has strengthened the road against landslides and increased the width of the roads
- Introducing tactile tiles has made the footpath accessible for visually challenged and has raised awareness among the public and the administration to include it in other projects
- Installation of HDPE pipes as ducts for telephone/optical fibre cables will improve the city's aesthetics and generate revenue
- Use of the eternal knot, a sacred symbol of Buddhism, connects the citizens and tourists to the local cultural identity

2.4 Key findings from interviews, surveys and primary/secondary data collection

The stakeholders in the project are the residents, commercial outlets along the stretch, local pedestrians, tourists, project managers and line departments. The primary data collection (March 12–16, 2022) included

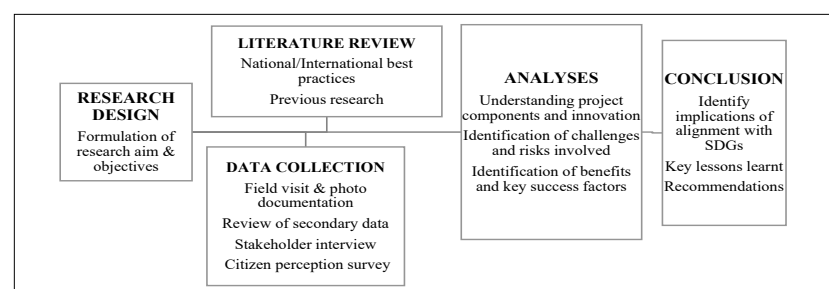


Figure 1: Research Methodology



Figure 2: Improved footpath at Zero Point, Baluwakhani

	Indore	Chennai	Seoul
Issues Identified	<ul style="list-style-type: none"> Inadequate effective width on most of the stretches Failed to cater to the street activities Obstructed footpath due to parked vehicles Lack of street lights and shading Crossing the road was not safe and the distance to cross was longer Poorly located streets Encroachment by shops onto the footpaths 	<ul style="list-style-type: none"> Street Design Workshops 60% of the Municipal Corporation's transport budget was allocated for developing NMT Pedestrian plazas, up-gradation of existing infrastructure and pedestrian loops Cycle networks, Skywalks Parking Management Systems 	<ul style="list-style-type: none"> Lack of crosswalks, short time for crossing and no pedestrian refuge areas Sidewalks were not properly provided. The utility boxes, street lights and electric poles obstructed the available sidewalks No clear separation between pedestrians and vehicles Sidewalks occupied by drivers and tenants No sidewalks on majority of streets
Proposals	<ul style="list-style-type: none"> Bulb outs Bollards and street furniture Refuge Medians Raised and textured colourful crosswalks Tight curb radii Recognising and regulating hawkers 	<ul style="list-style-type: none"> Public awareness programs Rights of pedestrians through relevant legal systems Implementation of Street Environment Improvement Schemes over the next 15 years, led by national and local governments Projects included: Pedestrian Priority Zone, Car-free Streets, Transit Malls and Green Parking 	
Outcomes			<ul style="list-style-type: none"> Restoration and increasing crosswalks resulted in increased crosswalks all over the city Satisfied pedestrians, as revealed by a survey of the residents. The score rose from 3.63 out of 10 in 1997 to 6.0 out of 10 in 2010 Increased footfall in pedestrian-friendly areas Decrease in pedestrian fatalities

Table 1: Case Studies

Sources: (EMBARQ, 2010; Urban Design Collective, 2020; Sam-Jin, et al., 2019)

- c. A time frame of 18 months was proposed to complete the project which had to be increased by another 6 to 8 months due to the exigencies of the pandemic.
- ii. Niranjana Kapil (Urban Planner, GSCDL)
 - a. The execution of the project started with a survey of the entire stretch whereby issues were identified, leading to a DPR
 - b. The plumb concrete retaining walls are being constructed under the 'Road-end Junction Project', which focuses on increasing the road's width at the junctions to counter traffic congestion. CCTVs installed at selected intersections were funded by the ICCC project
 - c. The electric poles and lines could not be removed since they come under the Power Department
- iii. Vandana Kaushik (Urban Planner, Team Leader, PDMC):
 - a. Work started with demolishing the existing footpath and necessary excavations, then laying the HDPE pipes with adequate inspection chambers
 - b. The pavers were selected through several trials and cast iron covers for the manholes were provided. Finally, the kerbstones were laid followed by new railings
 - c. The continuity of the footpath was ensured through overhanging stretches supported by plumb concrete retaining walls and props
- iv. Aswin Nirola (Assistant Engineer, GSCDL) & Dorjee Lepcha (Junior Engineer, GSCDL):
 - a. Paver blocks, 30mm thick were replaced by 60mm thicker sturdier paver blocks and 40mm thick tactile tiles

- b. Dilapidated railings of round sections were replaced with taller and sturdier railings of rectangular MS Steel sections with a design depicting the endless knots
- c. Provision of kerbstones in the new footpath design prevents vehicles from hitting the railings in case of an accident
- d. Composite steel structure is used for the overhanging footpaths with props underneath to increase strength
- e. During the laying of HDPE pipes, tackling the existing PHE lines was challenging
- f. Most houses have their entrances from NH-10 and residents find it challenging to negotiate the level difference caused by the raised footpath (to accommodate the HDPE pipes) while driving in.

During field visit, the IIT Kharagpur team undertook roadside interviews at the three locations where the project was near completion (Baluwakhani, Sisagolai and Near Mayfair Hotel), employing the method of convenience sampling. Perception-based data was acquired from 30 pedestrians (locals and tourists), 12 residents and 14 commercial outlets along the road.

Pedestrian survey involved two distinct sections, namely:

- ii. Respondent profile
- iii. Perception of the footpath

Nearly 63% of respondents belonged to the 20-40 year age bracket.

The key findings from the pedestrian survey are as follows:

- i. More than 86% are satisfied with the cleanliness of the street, and more than 80% rarely find any waste on the street

- ii. More than 70% feel safe on the streets at night
- iii. More than 60% opined that the infrastructure is inadequate for specially-abled people
 - a. Other issues raised were the absence of garbage bins along the road, lack of zebra crossings and lack of street lights, which made some tourists feel unsafe at night

The adjacent resident and commercial outlet survey collected:

- iv. Respondent profile
- v. The perceived impact of the improved footpath during and after construction
- vi. Suggestions for betterment.

The key findings are:

- i. Almost 83% of the residents surveyed identified the significant positive outcomes of the project. These include
 - ii. Improved safety for women, kids and the elderly
 - iii. Lesser accidents due to the less-slippery surface of the thicker and sturdier pavers, offering better grip, and the railings
 - iv. Increased footpath width at specific stretches
 - v. Visually more pleasant than before.

None reported any significant adverse outcomes of the project.

- i. The residents (75%) and commercial outlet owners (64%) suggested further improving of the tile material to make them even less slippery, as it is very difficult to walk in a mountainous terrain during rains
- ii. The owners of shops, hotels and other commercial outlets did not report any significant negative impact on their business, except for the rubble and



Figure 3: Meeting at Gangtok Smart City Development Ltd.

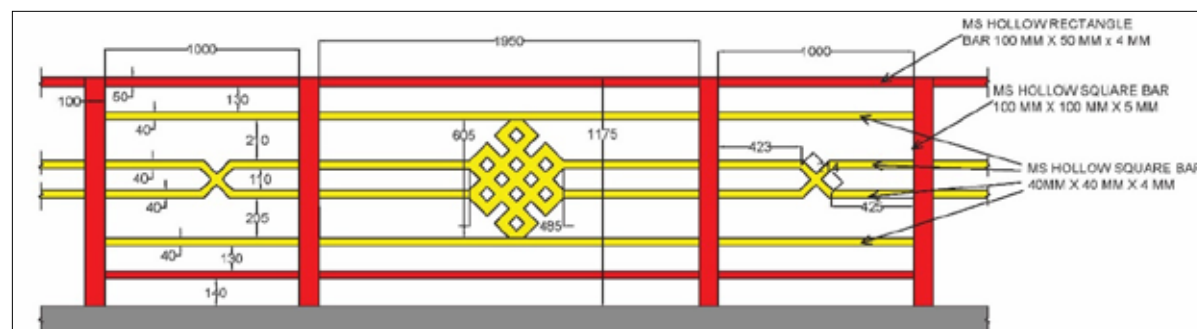


Figure 4: Design of new railing
Source: GSCDL

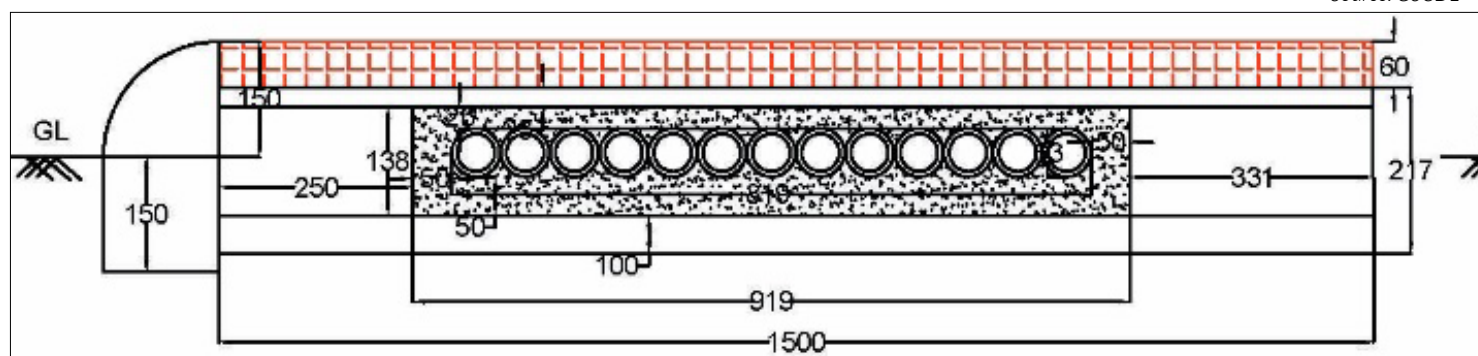


Figure 5: Cross Section of the footpath surface
Source: GSCDL

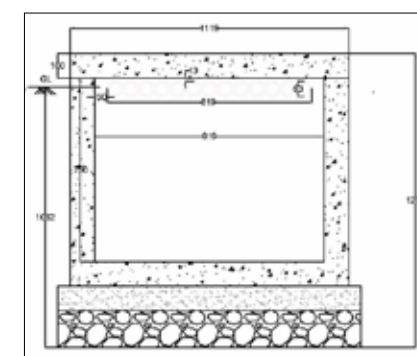


Figure 6: Cross Section of Manhole
Source: GSCDL

dust generated due to the dismantling of the existing footpath. However, some residents (41%) said that the noise and dust impacted their daily lives

- iii. Only 30% of the residents reported congestion and difficulty in vehicular movement at specific stretches during the construction.

3. Discussion and Conclusion

3.1 Field Survey

Three stretches of the road are studied: Zero Point at Baluwakhani, Sisagolai and Near Mayfair hotel. The footpath had a clear width of a minimum of 900mm, with most of the part stretching from 1200-1500mm. The findings from the field survey are as follows:

- i. The railings are not provided at the entrances of the residences, as shown in Figure 13, and
- ii. the parked vehicles are at times parked on the footpath, thus decreasing the effective width

- iii. of the footpath.
- iv. The tactile tiles are present on most of the improved stretches. However, the layout and
- v. execution of the tiles have room for improvement.
- vi. The stairs for accessing the footpath do not have railings, as shown in Figure 14.
- vii. The old streetlight and electricity poles block the footpath (Figure 15)
- viii. The utility wires along the footpath are exposed at most locations.
- ix. Specific stretches are entirely dark after sunset, and such locations need to be identified and
- x. provided with streetlights.
- xi. Smart infrastructures such as public WiFi and charging points are unavailable.
- xii. No vending is allowed on the street; spaces for vending are designated on the ground floor of public buildings.
- xiii. The overhanging footpaths are now supported on plum walls with props underneath for

- xiv. increased strength and stability.
- xv. The city has no traffic signals
- xvi. There are specific stretches near Ranipool where the slope is too high to provide ramps.
- xvii. Therefore, the steps are provided

The conclusions drawn from the research have been summarised in the following sections. These involve identification of key implications of the project's impact, defining limitations of the research, highlighting key lessons learnt and finally, formulating a set of recommendations for taking the project forward towards a smarter future.

The project adopted a systematic sequence for planning and execution as outlined below, which could serve as a benchmark for similar projects in hilly areas:

- i. The entire stretch of the road was surveyed and the details were noted and analysed. The major issues identified were discontinuities in the footpath, worn-



Figure 7: Field Survey Near Mayfair Hotel (Left) & Baluwakhani (Right)

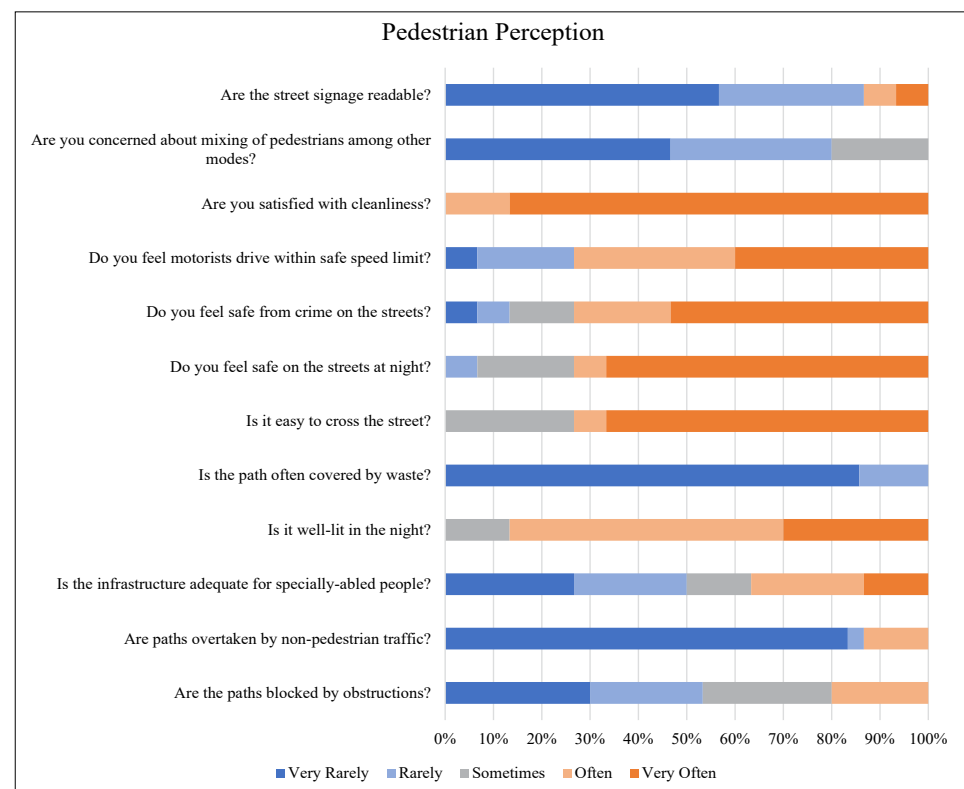


Figure 8: Pedestrian Perception
Source: IIT Kharagpur Survey



Figure 9: Selection of Pavers
Source: GSCDL



Figure 10: Laying of HDPE pipes
Source: GSCDL

out, uneven, and slippery surface of the pavement, damaged and weak railings not ergonomically designed, absence of universal design features like tactile pavers. The overhead utilities were visually cluttering and less safe

- ii. The DPR addressed all the issues identified in an integrated manner e.g. underground HDPE pipelines for utilities were integrated with the new footpath design and the recommended standard cleared the design width of 1500mm which was achieved by combining 200 x 200mm square pavers with the 300 x 300 mm square tactile pavers, in pleasing patterns. The pavers were selected through several trials. (Figure 9: Selection of pavers, Source: GSCDL).

- iii. For implementation, the existing footpath was first demolished and HDPE pipes were laid through excavation with manholes at planned intervals, followed by laying the kerbstones and railings and finally, the pavement surface and relevant installations like manhole covers were fitted.

3.1 Implications

The improvement of the existing footpath had a considerable impact on users. Based on the issues identified and inferences from field observations and surveys, the following implications may be highlighted:

- i. The pavement surface is even and smooth compared to the earlier conditions, utility boxes have been shifted and utility manholes are now flushed with the surface ensuring smooth and unobstructed

flow. The new pavers provide a better grip.

- ii. The users feel safer due to the more substantial railing, and the new design reflects the culture
- iii. The earlier issue of parked motorcycles on the footpath is not found at the surveyed locations, indicating the interventions facilitate uninterrupted pedestrian movement
- iv. The overhanging footpaths are now supported on plumb walls with props underneath for increased strength and stability, making them less susceptible to landslides, ensuring safety.
- v. No vending is allowed on the street, spaces for



Figure 11: Manhole construction (left) & executed section with HDPE pipes (right)
Source: GSCDL



Figure 14: Shifting utility boxes before shifting (left) and after shifting (right)
Source: DPR, 2018 (left) & IIT Kharagpur Survey (right)



Figure 12: Laying of Kerbstones and Railings
Source: GSCDL



Figure 15: Old footpath surface & railings (Left) & new footpath surface & railings (Right)
Source: DPR, 2018 (left) & IIT Kharagpur Survey (right)



Figure 13: Surface of footpath
Source: DPR, 2018 (left) & IIT Kharagpur Survey (right)



Figure 16: Parking of vehicles along the footpath
Source: DPR, 2018 (left) & IIT Kharagpur Survey (right)

vending are designated on the ground floor of public buildings.

- vi. The ground slope is too steep at places to accommodate a ramp. Presently, the continuity is preserved only through steps. More innovative and hi-tech solutions are required for universal accessibility in such mountainous terrain

The Pedestrianisation project of Gangtok can be aligned with three of the United Nation's Sustainable Development Goals, as illustrated in the figure below:

- SDG 3: Good Health and Well-being

The project addresses outcome target of 3.6 which calls for action towards reducing deaths and injuries

from traffic accidents by implementing grade separated footpaths, strong railings and less slippery paver blocks. Also, walking has a positive impact on the health of the people.

- SDG 11: Sustainable Cities and Communities

With the vision of securing the city's future sustainability, the project interventions ensure access to safe,



Figure 17: Overhanging footpaths: Sisagolai (left) & Specially-abled user on the footpath (right)
Source: IIT Kharagpur Survey



Figure 20: Stepped footpath near Ranipool
Source: IIT Kharagpur Survey



Figure 18: Old overhanging footpath (left) & new overhanging footpath on plumb concrete retaining walls
Source: DPR, 2018 (left) & IIT Kharagpur Survey (right)



Figure 20: Stepped footpath near Ranipool
Source: IIT Kharagpur Survey



Figure 19: Stretches without streetlights
Source: IIT Kharagpur Survey

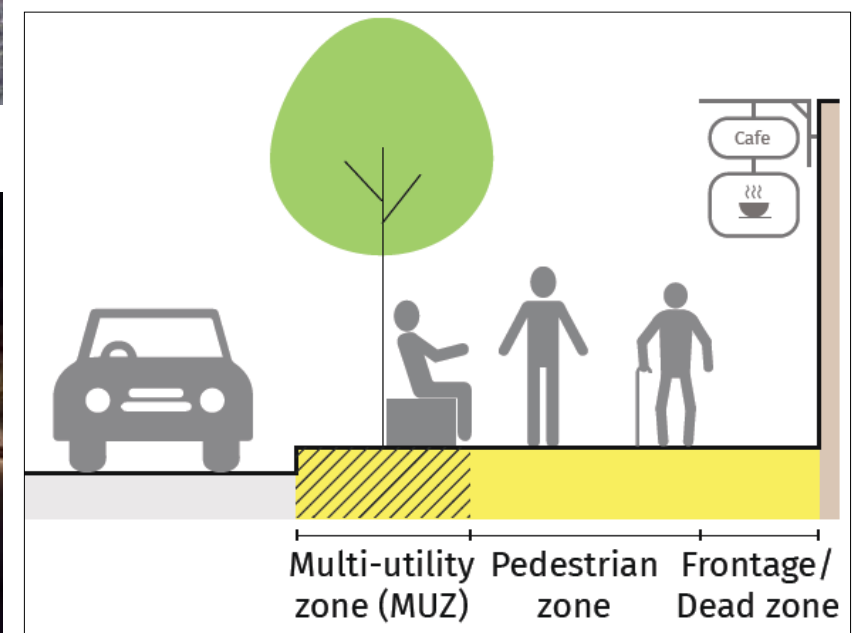


Figure 22: Zones of a footpath
Source: (Ministry of Housing and Urban Affairs, ITDP, 2019)

affordable, accessible and sustainable transport system (walking) for all and improve road safety with special attention to the needs of the vulnerable group of people such as the elderly, children and people with disabilities.

- SDG 11: Climate Action

With an urgent need to combat climate change and its impact, prioritising non-motorised transport would decrease the dependency on fossil fuels and reduce greenhouse gas emissions. Improving the pedestrian infrastructure enables people to walk more frequently since they feel comfortable and safe, which in turn, would help mitigate climate change.

3.2 Limitations of the research

Of the entire project stretch of 12-km of road, field observations and surveys were limited to three locations where the project was near completion. Given the time constraints and nature of the target survey population, the respondents of the respective user groups have been conducted through convenience sampling.

3.3 Key lessons learnt

The key takeaways from the project which can be applied to similar projects in hilly regions are as follows:

- The PHE lines, power lines and CCTV cameras are either under different departments or projects; hence, while executing the project there has been a delay at the excavation stage due to lack of coordination during the laying of utility lines
- The terrain in hilly regions is a matter of concern for laying ramps for wheelchair users and innovative hi-tech solutions need to be explored
- Threat from landslides should be an integral consideration for designing the roads and utility lines
- Creating and allocating designated vending spaces help to prevent encroachment on the streets
- Lack of street lighting might not impact the locals but it discourages tourists from using the streets at night. Perception of all stakeholders should be taken into account while making design decisions
- Users may misinterpret the tactile pavers that are not laid as per norms, leading to undesirable outcomes

3.4 Recommendations

In conclusion, based on the analysis conducted and necessary research, the key recommendations are as follows:

- The footpath must be of uniform width and wherever possible it must provide three designated zones: Pedestrian Zone, Frontage/

dead Zone and Multi-utility Zone (Figure 24). The space required for various zones differs with respect to the adjacent land use and must be provided as per Table 2. The design considerations need to be in coordination with the pedestrian flow on the footpath.

S. No.	Land Use	Pedestrian Zone (m)	Frontage/Dead Zone (m)	Multi-utility Zone (m)
1	High-Intensity Commercial	4	1	1.5
2	Commercial	2.5	1	1.5
3	Residential	1.8	0.5	1
4	Narrow Streets	1.8	0.5	Optional & Discontinuous

Table 2: Zones of Footpath
Source: (Ministry of Housing and Urban Affairs, ITDP, 2019; Indian Road Congress (a), 2012)

- Materials with more grip and longevity can be explored to meet user expectations. Also, environment-friendly options may be considered
- The Tactile Ground Surface Indicators (TGSi) are present on most of the improved stretches. However, the layout and execution of the tiles do not conform to all standard requirements. The design and implementation must follow the IRC: SP-117:2018 Guidelines

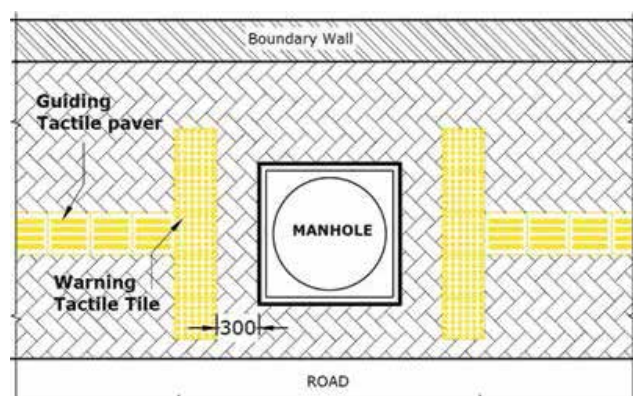


Figure 23: Tactile tile layout at intersections and warning tiles
Source: (Indian Road Congress, 2018)

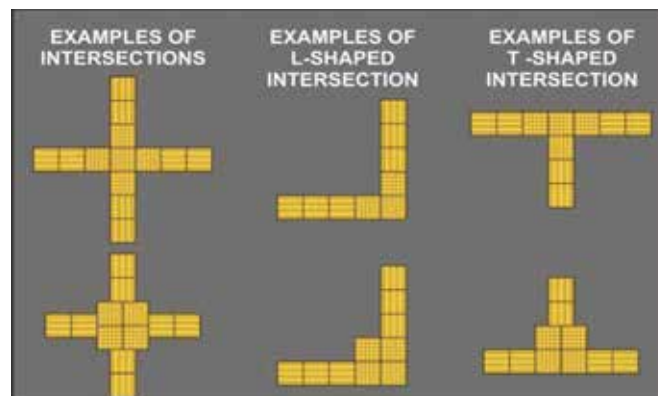


Figure 25: Street light poles blocking the footpath
Source: IIT Kharagpur Survey



Figure 24: Stairs for accessing the footpath without railings
Source: IIT Kharagpur Survey

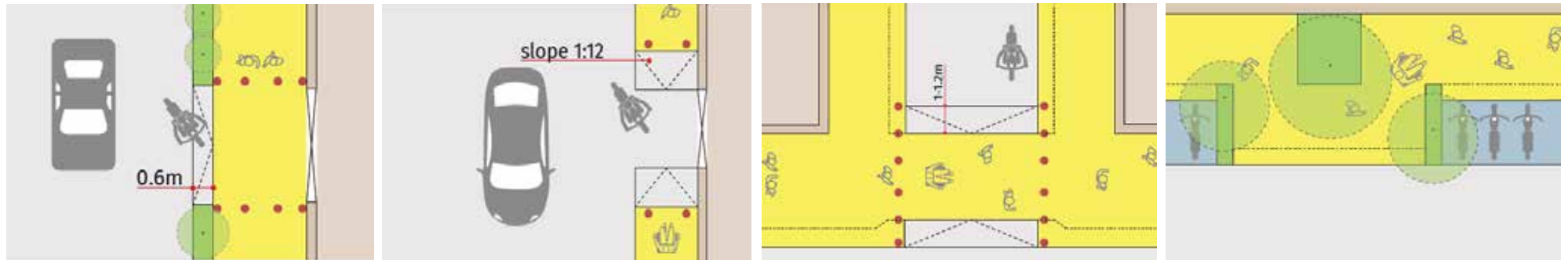


Figure 26: Entrance to properties: Wide footpath (Left) & Narrow footpath (Right)
Source: (Ministry of Housing and Urban Affairs, ITDP, 2019)

Figure 27: Table top crossing (Left) & Bulb-outs (Rights)
Source: (Ministry of Housing and Urban Affairs, ITDP, 2019)



Figure 28: Entrance to properties
Source: IIT Kharagpur Survey

S. No.	Location of Street lights	Spacing (m)	Height (m)	Length of outreach arm (m)	Intensity of light (Lux)
1	On footpath for pedestrians	15	6.5	1-1.5	20
2	In between footpath and motor-vehicle lane	25-30	9-15	2-4	30
3	Local/ Neighbourhood Streets	25-27	8-10	1-1.5	25

Table 3: Details of street lights as per location
Source: (Pune Municipal Corporation, 2016)

- d. Presently, the railing ends abruptly at places (Figure 28) which create unsafe conditions. Continuity of the railing should be maintained.
- e. Pre-existing street lights or electricity poles which block the footpath at certain places (Figure 25) may be relocated for improved safety, efficiency and visual experience. This would also provide for the necessary clear width (900-mm) for wheelchairs. A tactical marking of at least 600-mm width must be provided around free-standing obstructions which cannot be moved.
- f. The issue of negotiating the height difference at the entrance to properties could be resolved by adopting case specific solutions based on Complete Street Design Guidelines (Figure 22). The entrance ramps to properties must be inside the property line for all new constructions, and a clear width of 1.8-m must be provided.
- g. The footpath is continuous at the improved stretches except at intersections, with no provision for at-grade crossings. The footpaths should continue at intersections through table top crossings.
- h. Certain stretches are entirely dark after sunset and such locations need to be identified and provided with street lights. Spacing of street lights must be three times the height of the fixture, avoiding trees and signage that might impede illumination. No street light must be higher than 12-m to prevent undesirable illumination.
- i. Since railings are not provided at the entrances of residences, as shown in Figure 28, the access from the road allows vehicles to be parked on the footpath, decreasing its effective width. This indicates a rising parking demand which needs to be assessed and proper parking solutions like a Multi-Level Car Parking (MLCP) should be considered.
- j. Smart infrastructure such as public WiFi and charging points should be provided as a public convenience, especially for tourists. CCTV cameras linked to the ICCC must be installed at all strategic locations for enhanced surveillance and perception of safety.

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C7

Palace Rejuvenation: Gangtok

Name of the Project : *Palace Rejuvenation*

Location: *Gangtok*

Sector: *Urban Infrastructure*

SDGs: *SDG 4, SDG 6, SDG 8, SDG 11*

Institute: *Indian Institute of Technology, Kharagpur*

Advisors: *Prof. Subrata Chattopadhyay, Prof. Haimanti Banerji, Asst. Prof. Arjun Mukerji*

Students: *Ankit Kumar Senapati*

Keywords: *Built heritage, intangible heritage, traditional Sikkimese architecture, heritage complex, heritage tourism, Sikkimese culture, restoration, conservation, renovation.*

Abstract:

The Rejuvenation, Retrofitting and Redevelopment Project at Tsuklakhang Palace, Gangtok, is an area-based development proposal under the Smart City Mission for Gangtok Smart City. This aims to promote, preserve and safeguard the unique Sikkimese heritage for posterity, and improve economic opportunities for the region by adding to the tourist attractions in Sikkim. The Palace complex primarily consisted of the Royal Palace, Royal Chapel, the Yabring (Pavilion for high lamas and dignitaries), entrance gate, monk quarters and a school building. Most of the structures were commissioned by the ninth Chogyal Thutob Namgyal. The complex is a symbol of royalty and royal heritage for the Sikkimese. The project involves restoration of the Yabring, and renovation of parts of the Royal Palace, Royal Chapel and the entrance gate. The old monk quarters were demolished to improve the spatial organization of the premises. The new monk quarters, along with a Dukhang (assembly hall), Chimey Lhakhang (temple), a guest house and a new floor to the school building have been retrofitted into the heritage ensemble. Conservation of the intangible heritage-like traditional knowledge and craftsmanship are also integral parts of the project. This research studies and documents the project's approach to conserve the heritage while contributing to development, as well as the methodologies adopted and outcomes of the initiative with reference to similar local and global case studies. The research involves review of records and literature, site-visits and interviews with stakeholders. The key findings are expected to inform about the planning and execution of similar projects in future.

Case Study: C7

1. Introduction

The Smart City Mission enables the reimagining of cities as centres of economic exchanges, a melting pot of regional culture and inheritance for future generations. As one of the identified Smart cities in Round III, the main direction of development for Gangtok is to be a tourist destination, while taking into account the ecological balance and the socio-cultural uniqueness of the residents (Hall, 2000; Thornton, 2020).

The project 'Palace Rejuvenation, Retrofitting and Redevelopment' is one of the many projects envisioned by the Gangtok Municipal Council (GMC) and carried out by the Gangtok Smart City Development Limited (GSCDL), addressing the heritage, culture and recreation sectors. It aims at conserving the cultural heritage through restoration, renovation, retrofitting and redevelopment of built heritage. It will help in fostering the intangible heritage practices, while at the same time strengthening the revenue generation from tourism.

1.1 Topic and Context

Tsuklakhang Palace lies in the city of Gangtok, the capital of Sikkim, on the Eastern Himalayan range. Sikkim's monarchy was founded in 1642 by Phuntsog Namgyal, when he was consecrated as the first Chogyal, or priest-king, of Sikkim by the three venerated lamas at Yuksom. In 1894, the ninth Chogyal Thutob Namgyal transferred the royal capital from Tumlong to Gangtok and set up the Palace complex and Royal Chapel on top of a hill (1898). The Chogyal and his queen Yeshe Dolma were the first residents of this Palace (Namgyal Institute of Tibetology, 2012; Tamang, 2021).

On 16 May 1975, Sikkim became the 22nd state of the Indian Union and the monarchy was abolished, though the Royal family remained an important element of Sikkimese culture and identity. After the merger with India, the ownership of the temple and the palace grounds was given to the newly-created charitable trust, the *Tsuklakhang Trust* (Alexander, 2011). Presently, the

Tsuklakhang Palace overlooks the State Civil Secretariat and the official residence of the Chief Minister of Sikkim.

The royal legacy is one of the many tourist attractions of this beautiful Himalayan state. Tourism is one of the major drivers of economy and the hospitality sector is the largest industry. According to the Sikkim tourism department, more than 14 lakh tourists visited the state in 2019, of which 1,33,388 were foreign tourists (Ministry of Tourism, 2020). Tourist inflow has always been on a rise in the state. The tourism sector employs the residents directly or indirectly in hotels, restaurants and other tourism related services (Government of Sikkim, 2016).

The current project, with an area of 14 acres, was conceptualized prior to the inception of the Smart City Mission by the Building and Housing Department, Sikkim, in consultation with the *Tsuklakhang Trust* and the present Chogyal, with the intention of cultural preservation of Sikkimese identity in the region. In the process, it is also expected to add to the tourism potential and generate revenue. The gap in funding and expertise was provided by the Gangtok Smart City Development Limited. The project has an approved funding of Rupees 54.01 crores and is in the final stages of completion.

1.2 Scope of the Project

As one of the Area-Based Development (ABD) projects (Figure 2), it aims to promote, preserve and safeguard the unique built heritage and cultural practices of the Sikkimese for posterity and improve economic opportunities by generating jobs and revenue for the region (Thornton, 2020).



Figure 3 Panoramic view (looking south) of the Palace Complex



Figure 1: Site Plan and Location of the project in Gangtok, Sikkim
Source: GSCDL

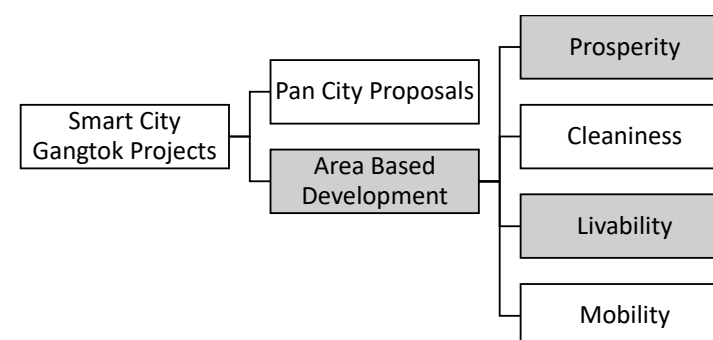


Figure 2: Area Based Development Modules for Gangtok Smart City (Thornton, 2020)

The objectives of the project include:

- To restore, renovate, retrofit and redevelop the *Tsuklakhang Palace* heritage complex, adapting it for compatible usages
- To strengthen the importance of historic structures as prominent centres of culture and learning
- To encourage heritage tourism through conservation of authentic Sikkimese architecture and cultural practices
- To encourage rebuilding of the original and authentic Sikkimese structures in the region, and to act as a benchmark for future projects that involve fusion of both new proposals and conservation of old structures

1.3 Significance of the Project

The cultural significance of the *Tsuklakhang Palace* complex is profound and held in high regard by any Sikkimese. However, this heritage asset was hitherto inaccessible to the public. For tourists particularly interested in heritage tourism, this Palace complex will provide an insight into the Sikkimese royalty and culture.

The intricacies of art, architecture and culture depicted by the historic buildings of the Palace complex have a long imprint of the Sikkimese. The intricate iconography on wood and the paintings on the walls are unique. These are done by skilled artisans known as 'Laripa', who could read and understand Buddhist scriptures to depict the local tales on the surface of buildings. Effectively, the historic structures are an embodiment of traditional craftsmanship which is an intangible cultural heritage.

Other intangible cultural heritage is in the domains of:

1. Oral traditions and expressions including language,
2. Social practices, rituals and festive events,
3. Knowledge and practices concerning nature and the universe which will be conserved by this project through fostering monks of the Tibetan Buddhist tradition.

Free primary education is provided to young monks in the school attached to the monastery. More than 300 pupils are enrolled in the school with food, lodging and

other daily needs being taken care of by the Trust. Thus, the project supports quality education and cultural practices under one roof.

This project is a unique blend of conservation of old structures and construction of new buildings that do not compromise the splendour and grace of the past while meeting the needs of the future. This project is the first of its kind in the region and can act as a benchmark for similar future projects.

1.4 Aim and Objectives of the Research

This study aims to document the process carried out for the 'Palace Rejuvenation, Retrofitting and Redevelopment' of the Tsuklakhang Palace at Gangtok, Sikkim. This includes various interventions carried out to address threats, fulfil the needs of new functions and provide suggestions for similar projects in the future.

The objectives of the research are:

1. To identify issues and understand the aspirations of users
 2. To understand the variety of conservation strategies adopted, their suitability and the lessons learnt
 3. To study relevant case studies to help identify recommendations for the betterment of this project
- The key findings to give methodological interventions that can improve future similar projects.

2. Contextual Background

The uniqueness of the 'Palace Rejuvenation' project lies in its components. The restoration, renovation, retrofitting of the heritage structures, along with introduction of new buildings which respects the heritage setting of the precinct, while meeting the functional needs and aspirations of the stakeholders, is a significant achievement.

2.1 Conceptual Framework/Research Design

The methodology adopted for the research can be articulated through four major components:

1. Literature review,
2. Data collection,
3. Analyses,
4. Conclusion

The various components of each stage are presented in Figure 4.

2.2 Case Studies

Two international and two national conservation projects were studied, three of which were palace complexes. They are outlined as follows:

The conservation of the Forbidden City (UNESCO WHS, 1987), Beijing. This involved inter-disciplinary expert teams who carried out phase-wise assessment, repairs and restoration of all buildings within the complex, as well as reconstruction of some of the destroyed sections. The Palace Museum was in charge of the preservation and restoration activities and played a significant role of an interpretation centre. Virtual tour

facilities have been developed in collaboration with IBM Corporation which supports an impactful presentation of the heritage (Hongkui, 2005; The Palace Museum, 2002).

The restoration of Tugendhat Villa (UNESCO WHS, 2001), Brno. This also involved a number of inter-disciplinary experts who carried out the historical, scientific, technological, and empirical studies, and employed digital documentation (Figure 5). The materials and threats were analysed, and appropriate methods of conservation and restoration were adopted. Skill development needs were identified and capacity building was carried out to implement the proposals. An International Expert Advisory Committee was formed which gave inputs at various stages of the project (Hammer, 2011; Tostões, 2018).

For the conservation of the Mubarak Mandi Heritage Complex, Jammu, the Mubarak Mandi Heritage Society and INTACH (Indian National Trust for Art and Cultural Heritage) carried multiple inter-disciplinary studies of the architectural features, murals, and 'Pahari' paintings in the complex, and documented them for proper restoration. A 'Statement of Cultural Significance' was articulated which is the foundational premise of all conservation related activities (Sahni, 2019; Sawhney & Sehgal, 2017).

Tipu Sultan's Summer Palace, Bangalore, has seen restoration attempts by the ASI in 2013 and 2019. Initially, restoration of just the paintings was carried out followed by water proofing, lime-plastering and addressing the cracks on walls. Eventually, chemical cleaning of paintings was employed along with

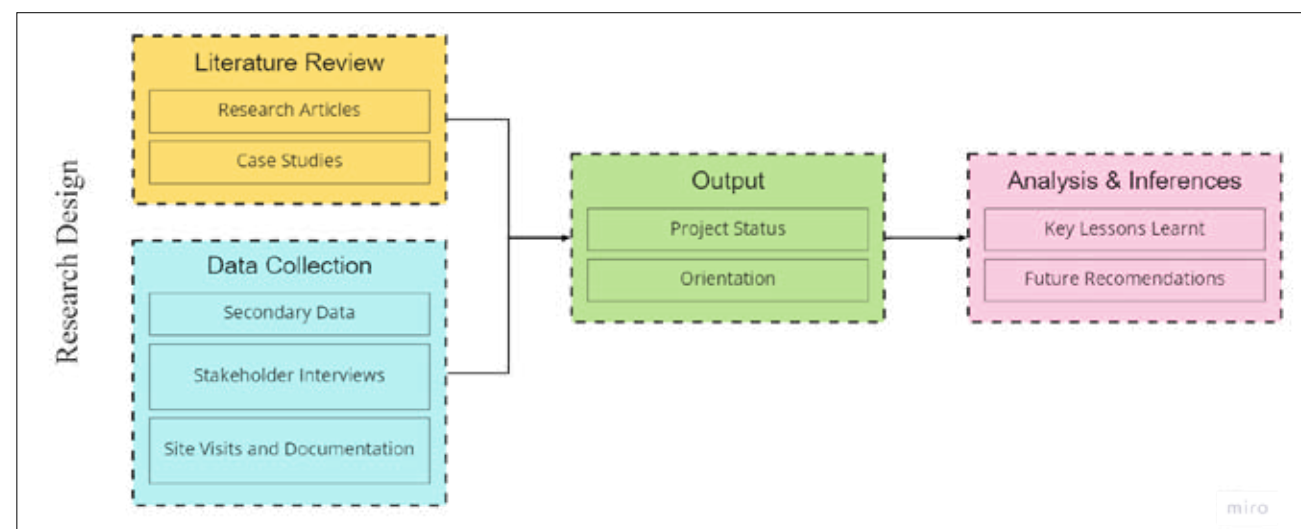


Figure 4: Research Methodology

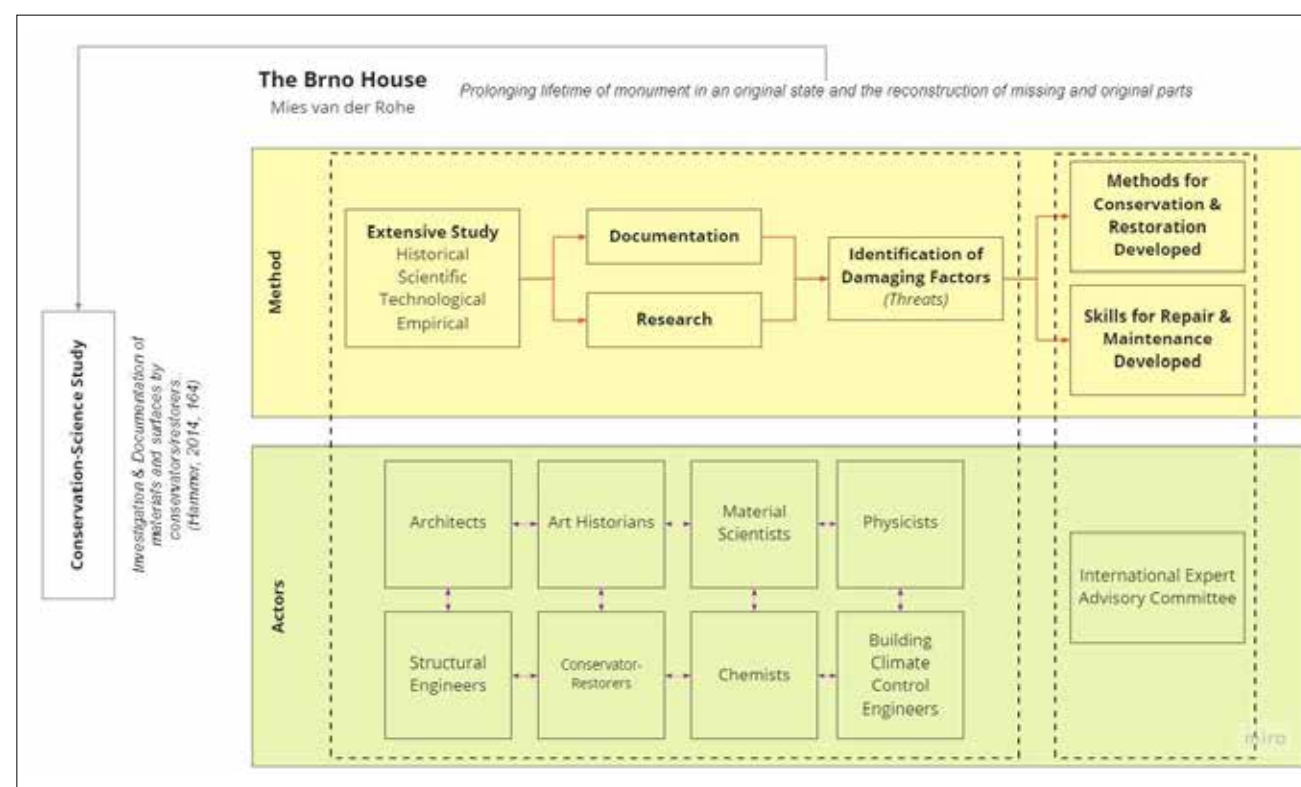


Figure 5: The Brno House Restoration: Methods & Actors

traditional methods to preserve the essence (Mehrotra, 2019; Srivatsa, 2013).

The case studies reviewed highlight the engagement of inter-disciplinary experts to assess, document and articulate heritage, identify various threats and mitigation strategies and adopt appropriate conservation methods, including interpretation and presentation.

2.3 Key features of the project

The Tsuklakhang Palace complex consists of significant Sikkimese built heritage such as the Royal Palace, the Royal Chapel, the main gate and the Yabring, embodying traditional art and architecture.

The Royal Palace or the residence of the Chogyal of Sikkim is the only residential royal structure of the past that stands even today. Wood, stone and lime-mortar was used for its construction because of easy availability. It exemplifies a significant historic stage in the evolution of architecture in the region, with a unique blend of Colonial British influence in the layout and Tibetan visual art and architectural vocabulary. The project involved restoring the plaster and painting of the façade, the damaged parts of the old wooden flooring with new seasoned wooden planks and replacing the GI

sheets in the roofing to prevent leakages. Landscaping was introduced in front of the palace.

The Tsuklakhang Royal Chapel is the prayer hall where

the Buddha, Bodhisattvas and Tantric deities are worshipped. It houses a large collection of Buddhist scriptures and literature. The wall-paintings on the interior walls, bearing iconographic influences from central Tibet, remain in pristine state at the chapel, while largely destroyed elsewhere. The architecture of the chapel followed traditional Tibetan temple style – facing east, four-storey tall with a typical gabled roof, whitewashed stonewalls, mud plaster and an internal timber frame (Alexander, 2011). The project primarily involved restoration of the painting of the façade. However, the historic wooden flooring on the ground floor was also renovated by tile flooring.

The main entry gate, also built in the Tibetan style, mostly stands in its original condition. This aesthetically pleasing and well-proportioned structure, often regarded as the image of Sikkim, has undergone minor restoration as part of the project.

The Yabring is a beautiful and intricately detailed structure where the monks perform various rituals during religious programs held throughout the year. As a large portion of the structure had collapsed due to soil settlement during the earthquake of 2013, it had to be reconstructed. It continues to retain two front columns from the original structure.

Other existing structures that were added at different phases such as the classrooms and accommodation for monks, kitchen and office building, have received face-lifts and minor changes to be harmonious with the

heritage buildings.

Additionally, the old monk quarters were demolished to improve the spatial organisation of the premises. New monk quarters have been constructed to house 600 monks. Additional floors were added to the school and office buildings to accommodate the increased demand for educational facilities. The existing flat roofs of these buildings were retrofitted with sloping roofs to maintain visual harmony in the heritage complex.

The Dukhang, a new building introduced in the heritage setting, is a single-storey prayer hall with a capacity of more than 450 devotees that is solely used for religious events and sermons in presence of senior lamas. Clearstory lighting and intricate modular decorative motifs enhance the interior space, while exterior decorations have been kept minimal.

Three blocks of monk quarters were made by creating a retaining wall and taking the structure along the slope below the ground level, so that the height of the buildings does not exceed the height of the Royal Chapel.

The Chimey Lakhang is another new structure which houses one thousand butter-lamps as offerings to the deity. Effectively, it fosters traditional rituals which are significant intangible heritage.

A visitor's complex was built near the entrance which has ticket counters, souvenir shops, drinking water and toilet facilities. A guesthouse has also been constructed



Figure 6: The Royal Palace (L Top), The Royal Chapel (R Top), and details of restoration at Chapel (bottom)

Figure 7: The entrance gate (L) and the Yabring (R)

to be leased by the Trust in future. Parking in the Palace complex has been increased. Landscaping of the whole site has been planned and it is in the final stages of execution. Rainwater harvesting has been prioritised with paved areas that collect storm water run-off to storage wells under the landscaped lawns.

While the project directly addresses the conservation of Sikkimese built heritage, it also effectively contributes to the conservation of intangible heritage like traditional craftsmanship, cultural practices and knowledge systems. Previously, the Palace complex was the private property of the Chogyals. The project will open it to

the public and is expected to become a popular tourist destination, highlighting various aspects of Sikkimese culture and Sikkimese Royalty. Figure 11 shows the old site plan and the new site plan after the intervention.

2.3.1 Challenges in the Project

The challenges associated with the project are:

- i. Adopting a strategy of minimal intervention for the historic structures, the following established principles of conservation
- ii. Carrying out reversible changes that do not alter the built fabric permanently

- iii. Designing new buildings in a historic setting that would be harmonious with the context
- iv. Carrying out deep excavations in a hilly terrain for monk quarters, guesthouse, etc
- v. Carrying out construction in a region with water scarcity

2.3.1 Risks involved in the Project

- i. Improper conservation practices which might hamper the authenticity of the heritage
- ii. Possibility of land subsidence due to low soil bearing capacity in certain areas



Figure 8: School buildings (L) and new Monk Quarters (R)



Figure 9: The Dukhang (L) and the Chimey Lakhang (R)



Figure 10: (Clockwise from Top) Panoramic view of Visitor's complex, pedestrian walkway, Construction phase of pedestrian walkway, Metalled road for vehicles



Figure 11: Old and new buildings in the Palace Complex (1. The Royal Chapel, 2. The Royal Palace, 3. Entrance Gate, 4. The Yabring, 5. The Dukhang, 6. New Monk Quarters, 7. Chimey Lakhang, 8. Guesthouse, 9. Visitor's Complex, 10. School Building, 11. Tsuklakhang Trust Office, 12. School Office)

2.3.2 Features and Benefits to the city (expected and observed)

There are a number of social and technical benefits of the project along with the city administration level impact on the environment and economy. Some of these include:

1. This restoration, renovation, retrofitting and redevelopment project is a flagship attempt at conserving Sikkimese built heritage as well as appropriate introduction of new buildings in a historic setting. This will act as a benchmark for similar projects in the region in future.
2. The project is also an important step towards conservation of Sikkimese intangible cultural heritage like traditional craftsmanship (Laripa), oral traditions and expressions, including language as a vehicle, social practices, rituals & festive events and knowledge & practices concerning nature and the universe (Tibetan Buddhist tradition).
3. The hitherto private Royal Palace complex is being opened to the public, offering an insight into the Sikkimese Royalty. This is expected to have a visible positive impact on the heritage tourism landscape of Gangtok.
4. Retaining the wall structures which were created for various buildings so the site can be a reference for future projects dealing with land subsidence.
5. Levelling of premises for rainwater harvesting is an environmentally sustainable practice that can be adopted in future projects.

2.4 Key findings from interviews, surveys and primary/secondary data collection

Primary data collection during field visits (March 12-16, 2022) conducted by the IIT Kharagpur team involved meeting representatives of key implementing organisations like the Gangtok Smart City Development Limited (GSCDL), Grant Thornton – the Project Development Management Consultant (PDMC), architects of Team Design Workshop (TDW), and the key implementing agency M/s Sukhim Construction Pvt Ltd.

Interviews were also conducted with other stakeholders like the Estate Manager of the Tsuklakhang Trust and the lamas present in the complex. But, since the project has not yet been opened to public, the feedback of citizens or tourists could not be collected.

The following sections highlight the key points of the interviews:

A Interview with Officials

- i. Bhupendra Kothari (Chief Executive Officer, GSCDL)
 - a. The Palace Rejuvenation project was conceptualised prior to the inception of the Smart City Mission by the Building and Housing Department, Sikkim, in consultation with the Tsuklakhang Trust and the present Chogyal, with the intent of cultural preservation of Sikkimese identity.

- b. The project is one of its kind in the region which would create employment for the youth while conserving heritage.

- ii. Binay Lama (Divisional Engineer, GSCDL)
 - a. Palace Rejuvenation is a dream project for the Sikkimese that will showcase royalty to the tourists. However, as the Royal Palace is a restricted property, the positive impact of the project will be visible only after it is open to the public.
- iii. Nirajan Kapil (Urban Planner, GSCDL)
 - a. The old monk quarters (housing 300 monks) were demolished to improve the spatial organisation of the premises, and new monk quarters were constructed with a capacity of 600.
 - b. A new floor has been added to the school building, increasing its capacity.
- iv. Tsheten Sherpa (Assistant Engineer Civil I, GSCDL), and Kunzang Bhutia (Junior Engineer Civil I, GSCDL)
 - a. Re-evaluation of design and drawings had to be done according to the site conditions and challenges faced during execution.
 - b. Cracks in the walls of the Royal Chapel were non-structural and thus filled with epoxy grout.
- v. Vandana Kaushik (Urban Planner, Team Leader, PDMC)
 - a. The project involved multiple stakeholders and



Figure 12: IIT Kharagpur team at the Palace with GSCDL officials, TDW architects, and members of the Tsuklakhang Trust



Figure 13: (Clockwise from top left) Restored wooden flooring at the Royal Palace, Exterior paint and plastering of the Royal Palace, Restoration of the wooden flooring at the Royal Palace

needed dynamic planning inputs at various stages owing to the heritage value and site conditions.

- b. Restoration of paintings on the interior walls of the Royal Chapel which were covered in soot from butter lamps used during rituals, had previously been carried out in 2013 by trained professionals.
 - vi. Jayesh Bhusari (Structural Engineer, PDMC) and Pragyan Nayak (Associate Engineer, PDMC)
 - a. The column in the palace was deflected by almost 4 inches. Excavation was carried out and the column was jacketed from the footing level. Pneumatic grouting was done and HIBOND was used for bonding the old and new concrete.
 - b. The wooden flooring in the Royal Palace and the Royal Chapel had deteriorated due to weathering and termite action which were replaced with new seasoned timber (Figure 13).
- Figure 13 (Clockwise from top left) Restored wooden flooring at the Royal Palace, Exterior paint and plastering of the Royal Palace, Restoration of the wooden flooring at the Royal Palace
- vii. Gary Chopel, Dorji N Bhutia and Naresh Pradhan (Architect, TDW)
 - a. After the project was handed over to GSCDL, the architects were retained at the request of the Tsuklakhang Trust. There were no major changes

made to the site plan, which had been finalised after numerous discussions with the Trust and the Chogyal.

- b. There was a need for official documentation of the vernacular architecture style in the region that could be a source of reference for future projects.
- c. As sunlight is premium in the hills, the new buildings have been oriented to receive maximum sunlight during the day through multiple openings.

Figure 14 One of the older columns in the Yabring restored (L), the restored Yabring (R)

B Interview with Users

- i. Adup T Bhutia (Estate Manager, The Tsuklakhang Trust)
 - a. Currently, no one uses the Royal Palace as the Chogyal has adopted a monastic lifestyle and donated all his belongings and properties to the Trust, and he intends that all the monks be well versed in general sciences and also know about their faith.
 - b. The restoration of the Yabring from a dilapidated state and the involvement of 'Laripa' to paint the ornamentation is a very welcome step.
- ii. Lama, Tsuklakhang Monastery
 - a. The new quarters are spacious and will be an

improvement on the current living conditions.

- b. The new Chimey Lakhang was a necessary addition as now the devotees have a place to light lamps and offer prayers.

3. Discussion and Conclusion

The conclusions drawn from the research have been summarised in the following sections. They involve identification of key implications of the project's impact, defining limitations of the research, highlighting the lessons learnt and finally, formulating a set of recommendations for taking the project towards a smarter future.

Various stakeholders involved in the project were identified as shown in Figure 16. The directly involved stakeholders include GSCDL, Tsuklakhang Trust and the Royal family who were consulted during various phases of the project. Lamas, monks, and the Palace complex staff will be directly involved after completion of the project. Indirectly involved stakeholders, who are majorly a part of the local and regional tourism industry, are a link between the tourists and the Palace complex.

3.1 Implications

The Palace Rejuvenation project undertaken by GSCDL can be aligned with four of United Nation's Sustainable Development Goals as illustrated in Figure 17.



Figure 14: One of the older columns in the Yabring restored (L), the restored Yabring (R)



Figure 15: (Clockwise from top left) The Yabring in dilapidated state, Removal of the walls of the Yabring, Painting works by 'Laripa'

1. SDG 4: Quality Education

Through the project, there will be an increase in the capacity of the existing Tsuklakhang Monastery School, which provides free and equal access without discrimination to primary education for monks and adheres to targets 4.1, 4.2 and 4.5 of the SDG.

The young monks get primary education as well training in understanding Buddhist scriptures. The newly added floors to the school will accommodate more learning spaces for the monks. Besides education, the Trust looks after the food, lodging and other day-to-day requirements of these monks. The Trust requisitions teachers (lamas) from other centres on a contract basis, generally for a period of two years, They stay in the Palace complex and teach the monks with minimum pay. The increased accommodation facilities will ensure proper living standards for more monks and lamas.

2. SDG 6: Clean Water and Sanitation

Rainwater harvesting has been prioritised in the Palace Rejuvenation project by creating paved areas that will improve water collection. Storage tanks placed under landscaped areas will provide water to the Palace complex throughout the year. This will reduce the Palace's dependency on municipal water supply in a water-scarce region. Targets 6.1 and 6.3, which aim at provision of safe and affordable drinking water

and improvement of water quality, would have been achieved. Toilet and drinking water facilities for tourists also meet a part of Target 6.2, by providing access to sanitation and hygiene.

3. SDG 8: Decent Work and Economic Growth

At both local and regional levels, various stakeholders will draw direct economic benefits from the project. Figure 19 shows the impact that the one-time investment from the Smart City fund has on the economic cycle at the local and regional scale. The tourism industry in Sikkim has always seen a rising trend, with more tourists interested in the Sikkimese culture and art form. As monasteries and temples form the backbone of the heritage tourism sector in Sikkim, the Royal Chapel in the Tsuklakhang Palace complex will be an important addition to the existing Buddhist circuit. As Baycan & Girard observed, 'Heritage visitors stay longer, visit twice as many places and spend 2.5 times more than other visitors' (Baycan & Girard, 2011). Tourism pours in money to the locals through services availed in the form of transport, accommodation, food and local commerce. Direct gains to the Palace from tourists are collected by the Trust that further looks after the operation and maintenance of the complex. A number of locals will be engaged directly with the Palace operations and functioning post this investment. Thus, Target 8.9, promoting beneficial and sustainable tourism, will be achieved.

4. SDG 11: Sustainable Cities and Communities

Traditional art and architecture in the Himalayan region have been unique expressions of human interaction with nature that has evolved over the ages. 'Lamaist' painting, dance, music and architecture has been a regional specialty, as contact of the settlements with the outside world has been minimal due to physical isolation (Karan & Mather, 2010). The project effectively conserves the associated built heritage that exemplifies a significant historic stage in the evolution of architecture in the region. The iconography in the Royal Chapel, influenced by the central Tibet region, while largely destroyed elsewhere, is preserved here in pristine form. It also furthers conservation of significant intangible cultural heritage in the domains of:

- Oral traditions and expressions, including language as a vehicle,
- Social practices, rituals and festive events,
- Knowledge and practices concerning nature and the universe.
- The project thus achieves Target 11.4 by protecting the cultural heritage.

3.2 Limitations of the research

This report was compiled based on the data shared by GSCDL and TDW. However, the technical drawings were not available which might have helped in further

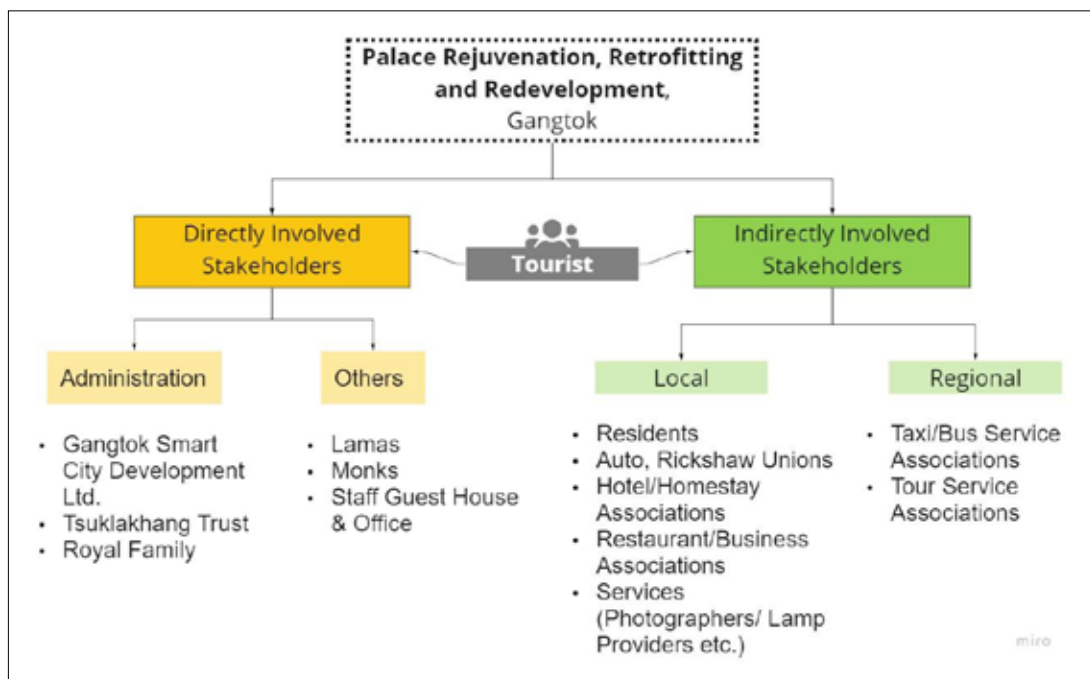


Figure 16: Various Stakeholders involved in the project



Figure 17: Project alignment with UN's Sustainable Development Goals



Figure 18: Young monks who study and stay in the Palace Complex

analysing the particular strategies adopted for material conservation.

As the project is not yet handed over to the Tsuklakhang Trust, and has not yet opened to the tourists, the impact assessment on the indirect stakeholders and tourists could not be studied.

3.3 Key lessons learnt

Various methods such as topographical and physical surveys, quality control and quality assurance plans, geotagging and regular updates of the project's progress on geo-spatial management information systems and public consultations with stakeholders has been carried out to ensure smooth progress and implementation.

The appropriate use of the hilly terrain for placing the three blocks of monk quarters by creating a retaining wall and taking the structure along the slope below

ground level, is noteworthy. It also helps in preserving the visual integrity of the Royal Chapel.

Material authenticity was preserved at certain places, for example, the stones in the footpath connecting the Royal Chapel and Palace have been retained, and two columns in the Yabring were also retained.

The mouldings on windows and doors, and the wall paintings in the interiors of the Royal Chapel are quite unique and done by skilled artisans known as 'Laripa' who were consulted during various phases of the project. The colour, material combination and the inscriptions of this unique art form have passed on for generations. However, contemporary innovations were adopted through the use of prefabricated, moulded parts made of Glass Fibre Reinforced Concrete (GFRC) in the interiors of the new Dukhang, effectively reducing the time and cost of execution.

The excavated soil has been reused in the Palace complex to level the ground and landscape (Figure 21) which reduced the cost to a large extent. No trees were cut for the project. Rainwater harvesting and proposed solar panels will ensure provision of green energy to the Palace complex. These concepts of sustainable, green and smart building methods makes the project noteworthy.

The main source of revenue for the Trust is the amount earned by leasing out properties of the Chogyal across Gangtok. The proposed guesthouse will also be leased out, and will be a constant source of income in future, making the project more financially self-sustaining.

3.4 Recommendations

In conclusion, this research leads to the identification of specific areas of action needed as a way-forward for similar projects in future:

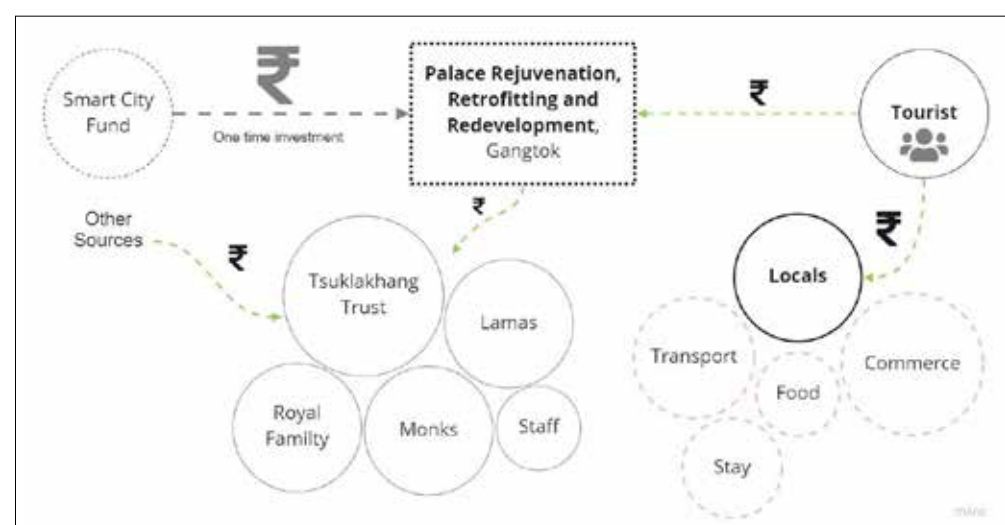


Figure 19: Economic Cycle & benefits from the project

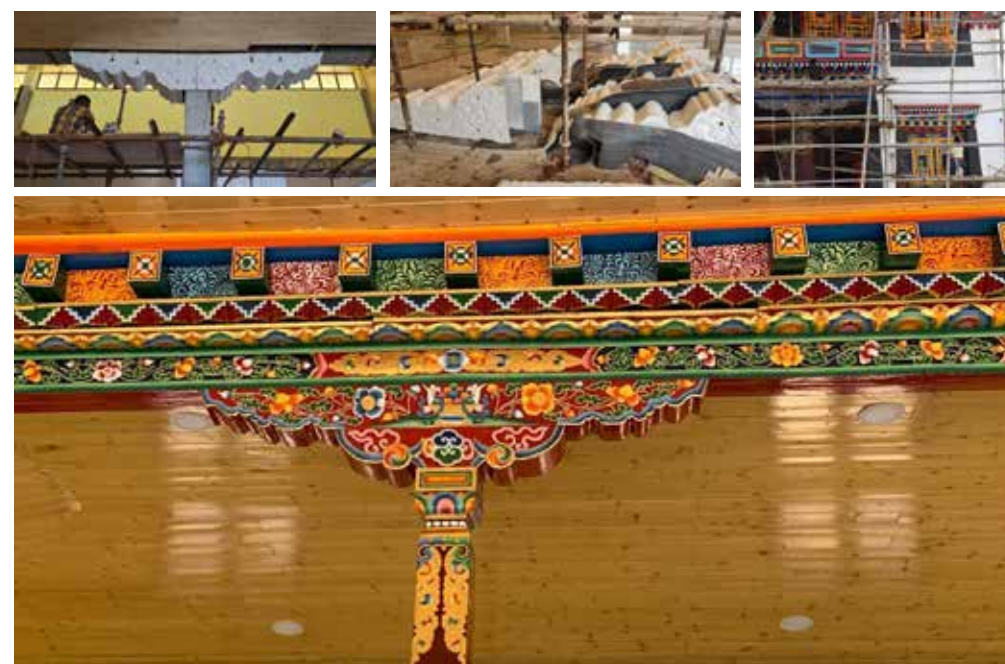


Figure 20: (Clockwise from top left) GFC moulded column top in the Dukhang, GFC moulded motifs, Modular ornamentations painted in traditional colours, 'Laripa' repainting at the Royal Chapel exteriors



Figure 21: Excavated soil used at the site for levelling

- Proper documentation of built heritage and intangible cultural heritage practices should be carried out according to internationally acceptable standards, and be given legal statute. Contemporary digital documentation methods should be applied, as in the case of Tugendhat Villa.
- At the inception of any such project dealing with heritage, an inter-disciplinary team of experts should be formed to assess the heritage value, significance and threats, as exemplified in all the case studies.
- A 'statement of significance' which would be the foundational premise of conservation related activities should be clearly articulated for all the associated heritage resources.
- Traditional methods should be adopted for restoration, along with contemporary techniques where necessary. The use of GFRC for prefabricating parts of the decorative work is resource-efficient, but this might pose a threat to the intangible cultural heritages like 'Laripa', which if not simultaneously promoted and supported, could lead to extinction over time. Capacity building for heritage preservation, where locals can be trained in traditional craftsmanship and art restoration, would be meaningful.
- Project located in a region frequented by landslides and earthquakes should follow earthquake resistance designs. As seen in The National Museum of Western Art in Tokyo, seismic base isolation can be introduced to existing buildings and should be explored for heritage buildings in the region.
- Meaningful conservation of heritage should consider methods and techniques for interpretation and

presentation, involving a variety of interpretation infrastructure and media and even interpretation centres.

Some of the specific recommendations for the Tsuklakhang Palace complex are as follows:

- The Palace complex should be included in the present tourist circuits at a formal level through the state tourism portal, and informally by collaborating with local travel associations. Interpretation and presentation material like leaflets and posters, activities like guided heritage walks and the inclusion of multi-media and digital technologies is recommended.
- Site landscaping could be re-imagined with drought resilient greens which require less water, to reduce future water requirement. The pathways should preferably be shaded by lining it with trees.
- Landscape furniture such as benches and garbage bins should be installed to enhance tourist experience.
- Universal design elements like ramps, tactile tiles and braille signage should be introduced.
- The ground floor wooden flooring of the Royal Chapel, now replaced by contemporary tile flooring which compromises material authenticity and diminishes the visual and haptic experience, should be restored with 'locally sourced' and treated wooden flooring that would uphold the sanctity of the Chapel.
- The eaves of the Royal Chapel have become home to pigeons, and bird droppings have damaged the mud-and-stone walls (Figure 22(L)). Pigeon repellent

sprays may be applied at the earliest to check further deterioration. Installation of nets that protect, but do not compromise the visual experience of the Chapel, is a necessary step.

- Plaques may be installed for identifying significant heritage elements and increasing awareness, thereby preventing any unintentional damage by users.



Figure 22: Excavated soil used at the site for levelling

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C8

Smart Bus and Traffic Infrastructure, Bhubaneswar

Name of Project: Smart Bus and Traffic Infrastructure

Location: Odisha

Year of Project Implementation: 2017-18

Sector: Transportation & Communication

Linkages to SDG: SDG 3: Good health & well-being, Outcome targets 3.6

SDG 5: Gender equality, Outcome targets 5.1, 5.2, 5.5

SDG 7: Affordable & clean energy, Outcome target 7.3

SDG 9: Industry, Innovation & Infrastructure, Outcome targets 9.1, 9.4

SDG 11: Sustainable cities & communities, Outcome targets 11.2, 11.6

Project Cost: Rs. 442 crore (Bhubaneswar Smart City Proposal, 2015)

Institute: Indian Institute of Technology, Kharagpur

Advisors: Prof. Subrata Chattopadhyay, Prof. Haimanti Banerji, Asst. Prof. Arjun Mukerji

Students: Kasturi Palit

Keywords: Smart city, Smart mobility, Smart transport system, Smart bus service

Abstract:

Bhubaneswar's pan-city proposals under the Smart Cities Mission involved injecting technology-enabled smart solutions to the existing city-wide infrastructure, with the aim of using information and data analytics to improve civic services. The city's 'Smart Bus and Traffic Infrastructure' was established in 2018, which involved establishing smart traffic management, parking management, emergency response & incidence management, and improvements in public transit operations through the realisation of a bus modernisation plan. With the objective of ensuring an affordable, comfortable, and environment-friendly mode of mobility for the citizens, the Mo Bus system was launched. This research studies and documents the various components and innovations involved in the implementation of smart mobility in Bhubaneswar with reference to similar national and global practices, as well as findings from field visits, interviews, and surveys. The key findings are expected to help in enhancing the operational strategies of Bhubaneswar's smart transportation system along with setting an example for other cities to follow.

Case Study: C8

1. Introduction

India's 'Smart Cities Mission' was launched in 2015 with an aim to boost the efficient development of its urban centres and the vision of bringing them at par with global smart cities. The major objectives in place that guide the Mission forward are to drive economic growth along with ensuring inclusive and sustainable development in cities with an enhanced quality of life for its citizens. (Wave City, 2020)

Although the concept of smart cities has not been bound by fixed definitions, Figure 1 illustrates six fields of action for success. (Cohen, 2012) One of these fields of action that significantly impacts the quality of life of citizens is establishing 'smart mobility', which involves enhancing access to intermodal mobility, prioritising efficient modes of transport, and integrating IT in transportation infrastructure.



Figure 1: Adopted from Boyd Cohen's Smart City Wheel (Cohen, 2012)

The following research highlights the case of Bhubaneswar, which, in 2016, topped the list of the 20 cities selected to be funded for smart city developments. Under the Mission, the city had implemented a bus modernisation plan backed by the establishment of a pan-city IoT network, paving the way for smart mobility.

1.1 Topic and Context

Bhubaneswar, the capital and the largest city of Odisha, displayed a rapid pace of urbanisation since the 1950s owing to high levels of economic growth. This imposed myriad challenges on the city's sustainable development. Through participatory decision-making, responsible governance, and open access to information and technology (BPTS, 2017), the city took on the Smart City Challenge and adopted several visions (Figure 2).

The formulation of smart city solutions involved soliciting the feedback of citizens through the 'Citizen's Connect Initiative', which provided a platform for citizens co-creating and shaping the city's future.



Figure 3: Bhubaneswar Pan-City Smart Traffic Infrastructure Proposal (BMC, 2015)

Bhubaneswar's proposals for smart developments are categorized as (i) area-based interventions and (ii) pan-city interventions. 'Smart bus and traffic infrastructure' are part of Bhubaneswar's pan-city proposals for establishing a smart traffic management system and improving transit operations across the BMC area (Figure 3). The project involves injecting technology-enabled smart solutions to existing city-wide infrastructure with the aim of using information and data analytics to improve civic services.

1.2 Scope of the Project

A city-wide IoT-based smart transport plan was established for Bhubaneswar, involving smart traffic management, smart transit operations (Mo Bus), smart parking management, common payment cards, emergency response & incidence management, and a command and control centre. Relevant details of the projects are given in Table 1.

S. No.	Project	Implementing Agency	CAPEX (Rs. Cr.)
1	Smart Traffic Management System	M/s Honeywell Automation India Limited (HAIL) M/s Envoy Electronics (P) Ltd,	214
2	Smart Transit Operations (Mo Bus)	Capital Region Urban Transport (CRUT)	72
3	Smart Parking Management	M/s Honeywell Automation India Limited (HAIL)	16
4	Common Payment Cards	ICIC Bank in collaboration with BMC & BSCL	26
5	Emergency Response and Incidence Management	M/s Honeywell Automation India Limited (HAIL)	30
6	Command & Control Centre	M/s Honeywell Automation India Limited (HAIL)	84

Table 1 Project Details



Figure 2: Smart City Vision, Bhubaneswar (BSCL, 2017)

Improvement in city-wide public transit operations was a major focus. The state launched the first phase of the Mo Bus service in 2018. It was designed to provide safe, smart, and affordable amenities to passengers and facilitate easy commute throughout Bhubaneswar. (OdishaNow, 2020)

1.2.1. Project Aim & Objectives

With the vision of becoming a Transit-Oriented City and Eco-City, Bhubaneswar endeavours to strengthen the bus service, move towards cleaner technologies to minimise its carbon footprint, and include the application of pan-city smart solutions that involve the use of technology, information, and data-enabled improvement of infrastructure and services. (BPTS, 2017)

In order to realise its goals, the 'Smart Bus and Traffic Infrastructure' was guided by the following objectives. (BSCL, 2022)

- Enhance the efficiency of future mobility by providing centrally controlled transportation facilities and services in the city that improve traffic flow and multi-modal connectivity while reducing congestion
- Support automated enforcement systems to enhance discipline and improve the safety of pedestrians, cyclists, and other vulnerable road users
- Establish low-impact carbon-neutral development using innovations in transportation and green infrastructure that protects and enhances air quality
- Enable stakeholders and citizens to be abreast with all the latest traffic updates in real-time including regular and critical travel advisories
- Involve the use of technology, information, and data analytics to help city authorities understand city-

wide traffic patterns and make informed decisions for service-level improvements

1.3 Significance of the Project

Just like any other urban centre that experiences high levels of economic growth, Bhubaneswar also witnessed the inevitable rise in private vehicles, and in the decade between 2004 and 2014, it increased almost three-fold. Auto-rickshaws, which were the only and most sought-after mode of public transport, contributed to only 24% of the total trips in the city (BPTS, 2017). For supporting the thriving economic environment of Bhubaneswar, there was a need for ensuring safe, easy, affordable, and equitable access to mass and public transport services across the city, backed by an efficient and seamless traffic management system. The 'Smart Bus and Traffic Infrastructure' project was significant in terms of addressing this need.

1.4 Aim and Objectives of the Research

The aim of the study is to establish an understanding of the methods of implementation, operations, and monitoring of the centrally-controlled smart bus system and traffic infrastructure of Bhubaneswar, and thereby identify its key impacts on the city's mobility flows.

The objectives of the study are as follows:

- To understand the components, innovations and functioning of the IoT ecosystem and how it facilitates efficient management of city-wide transportation facilities
- To understand how smart bus services have enhanced usage of public transport within the city
- To identify key success factors and drawbacks in implementation, operations and management of such smart infrastructure solutions
- To explore the acceptability of the project amongst the citizens

2. Contextual Background

"In the past ITS were often infrastructure reliant. Today great emphasis is placed on data collection, analytics and the availability of relevant information on the move."

- Chew Hock Yong, Chief Executive, LTA, Singapore, 2014

Developing smart mobility solutions has become indispensable for future smart cities and mobility forms one of the core parameters under the 'quality of life' indicator in India's Ease of Living Index Framework (IFC, 2020). Smart Transportation System (STS) aims to minimise traffic problems and achieve efficient mobility, leveraging commuter citizens with prior information about real-time traffic scenario, seat availability on public transport systems, etc. This enhances convenience, safety, comfort, and overall transport experience.

The essential processes that form STS are as shown in Figure 4.

Integration of IoT with public transport systems like the city bus services has the potential to provide concerned agencies with immense data resources for improving overall operational efficiency. Data analytics based on passenger counts, GNSS tracking, or driver and fuel monitoring can be used by bus operators for rationalising bus route planning, or to take concrete decisions in service-level improvements (illustrated in Figure 5).

2.1 Research Design

The methodology adopted for the research can be articulated through four major components: (i) Literature review, (ii) Data collection, (iii) Analyses, and (iv) Conclusion. The various components of each stage are presented in Figure 6.

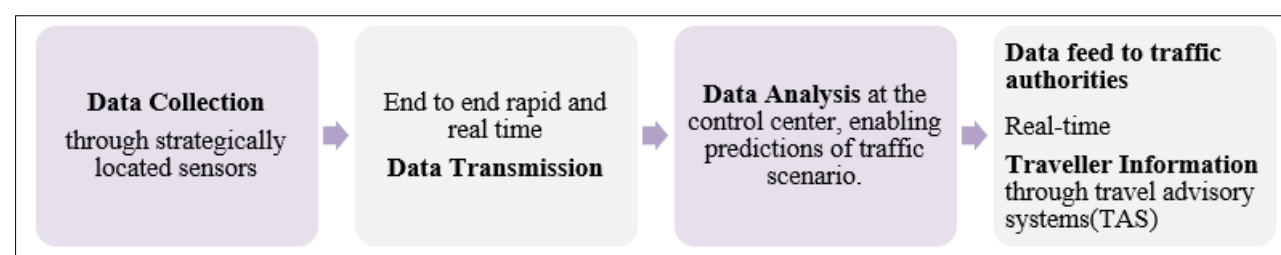


Figure 4: STS Procedures Framework (Choudhary, 2019)

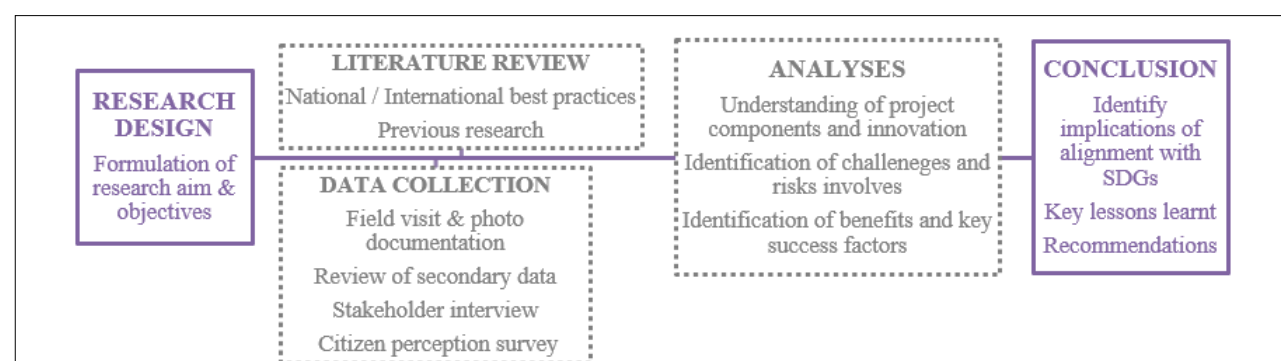


Figure 6: Research Methodology

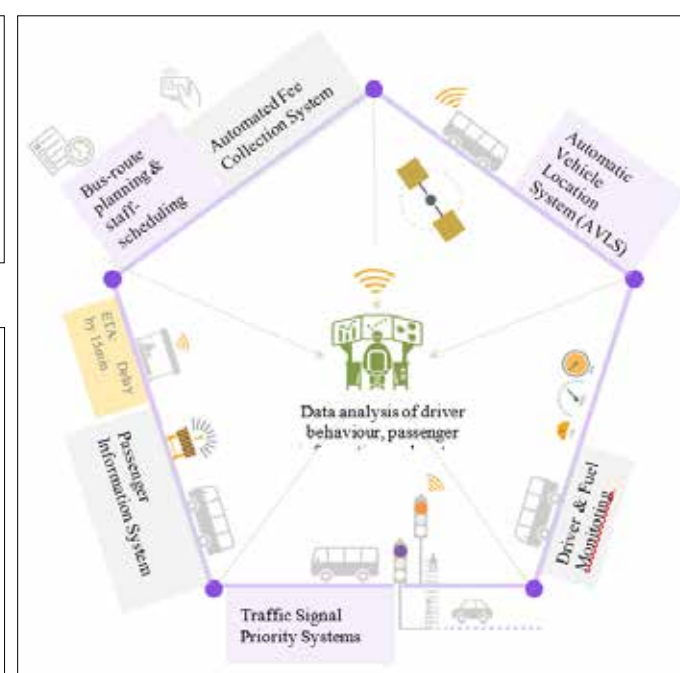


Figure 5: Integration of IoT with city bus operations (EMBARQ, 2014)

2.1.1 Case Studies

To assess Bhubaneswar's city-wide smart transport solutions, the research reviewed similar innovative practices adopted in several Indian and global cities, as outlined below (Figure 7, Table 2 & 3).

- IoT Integration in Bus Service – Case Examples from India
- Innovations in STS – Case Examples Worldwide

2.2 Key features of the project

A comprehensive understanding of the project's conception, implementation and outcomes was obtained through meeting representatives of key stakeholder organisations like Bhubaneswar Smart City Limited (BSCL), Bhubaneswar Development Authority (BDA), CRUT, during field-visits conducted by the IIT,

Kharagpur Research Team (February 22-27, 2022). Two bus depots at Patrapada and Patia and the bus terminal at Market Canteen were also visited. Primary surveys were conducted at various locations across the BMC area by the team accompanied by Santosh Kumar (HAIL employee) and the city-wide IoT network was taken cognizance of (February 25, 2022).

A. Smart Transit Operations

The forming of the Capital Region Urban Transport (CRUT), a special purpose vehicle under the Housing and Urban Development Department (HUDD), Government of Odisha, was followed by launching of the Mo Bus service on November 6, 2018. With an aim of introducing a bus fleet size of 300, in three phases, the project involved refurbishing existing vehicles and

introducing new ones. Currently, 225 Mo Buses are operational, including non-AC midi buses (28 capacity) and both AC & non-AC standard buses (42 capacity), running along 25 routes across the capital region of Odisha (Bhubaneswar, Cuttack, Puri, Khorda and Konark).

Both the bus depots at Patrapada and Patia were visited by the team, and the various processes behind the public bus service at the pre-operations, during operations and post-operations stages, were observed and noted. The following section gives an account of the various smart features that have been integrated with the Mo Bus service at various stages (Figure 8).

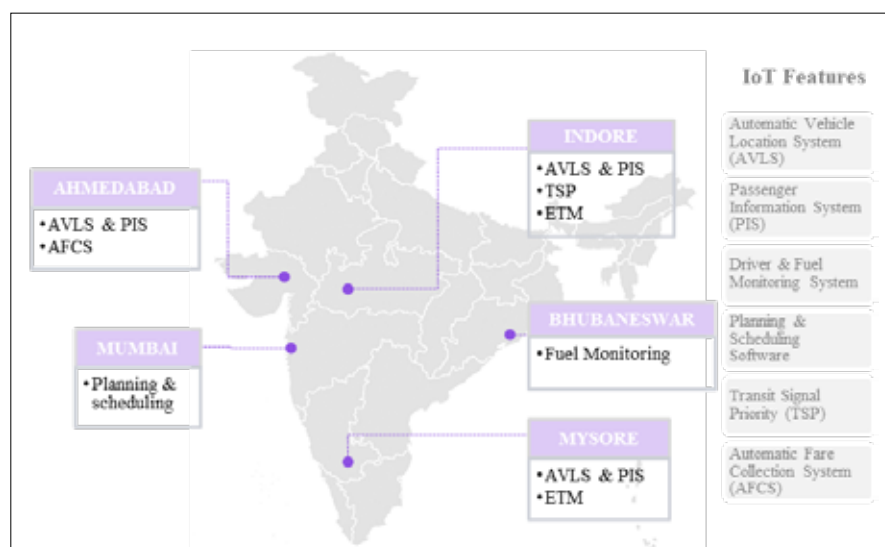


Figure 7: Prevalent IoT components integrated with bus services in various Indian cities (EMBARQ, 2014)

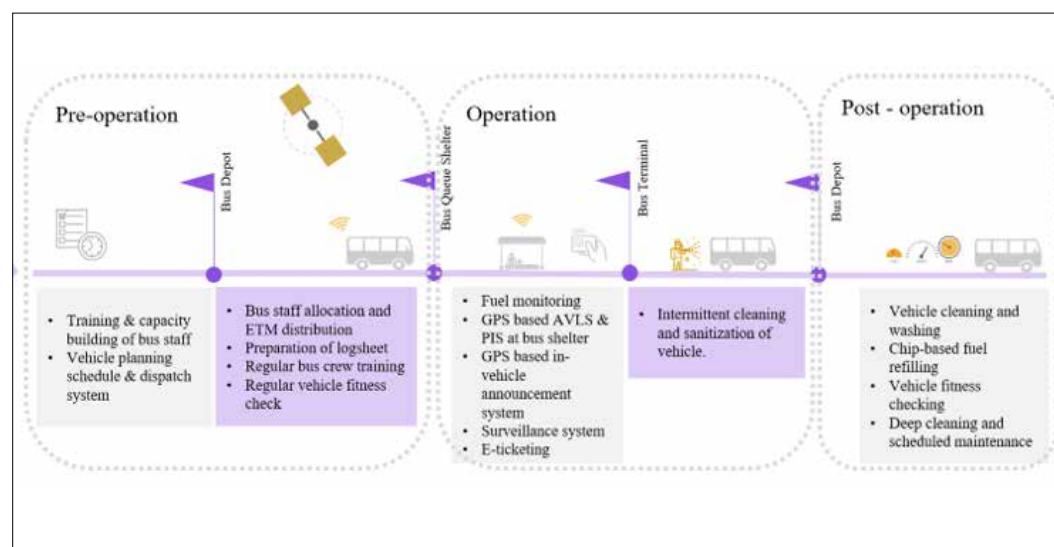


Figure 8: Smart features and highlights of Mo Bus
Source: Author

S. No.	Case Study	ITS Features	Application
1	Singapore	Automated driverless MRT	Centrally operated through a control room, auto-MRT ensures enhanced safety, increased reliability, efficiency, and maintenance friendly functioning.
		Contactless e-Purse Application Standard (CEPAS)	Enabled common payment methods for all transport and non-transport related services.
		Electronic Parking System (EPS) & Parking Guidance System (PGS)	Enabled automated revenue collection, and information provision on parking lots availability in real-time to commuters.
2	Pilot test by Movia, Copenhagen, Denmark	Sensor-based occupancy detection of buses	IoT sensors in buses used to detect occupancy, based on cell phone signals. Information would then determine the additional number of pick-ups possible, which is then notified through PIS.
3	ATM, Milan, Italy	GPS-based Mobility as a Service (MaaS) reco.	MaaS is a joint digital channel that facilitates the exchange of data for travel information and enables users to plan, book and pay for multiple types of mobility services.
4	London	Driver monitoring system	An in-vehicle monitoring system for bus drivers with embedded telematics, real-time video analytics and artificial intelligence (AI), used for reducing the risk of fatigue related accidents.

Table 3: Selected Smart Features in Bus Services, India

S. No.	Case Study	Smart Features	Application
1	Indore BRTS	Traffic Signal Priority (TSP)	Working in conjunction with the bus priority lane TSP relieves BRT systems from the delay faced at signals by expediting the green phase and prioritising bus movement. Indore reduced the waiting time of buses at signals from 45 seconds to 14 seconds.
2	Ahmedabad BRTS	Automated Fare Collection Service (AFCS)	Enables cashless transaction using smart cards. Communicated transaction information simplifies record keeping processes for the operator, and the data can be efficiently collated for analysis and thereby formulate service level improvements.
3	BEST, Mumbai	Staff scheduling	For improved service reliability, route planning and staff scheduling are often done manually. In 2013, BEST adopted a scheduling software to transfer to a computerised system which enabled a 4% reduction in crew requirements with more uniform headways between buses.

Table 2: Selected Smart Features in Bus Services, India, Table 3
Source: (EMBARQ, 2014)

i. *Pre-Operations Period*

Bus depots equipped with amenities like workshop building, bus-parking bays, fuel-station, mechanised washing system, effluent treatment plant, sewage treatment plant, rainwater harvesting system, scrapyard, and solar-powered yard lighting system (Figure 9).

Prior planning and scheduling of bus crew deployment is done for efficient resource utilisation. Daily fitness check of each vehicle is ensured.

ETM distribution to guides followed by the preparation of logsheets helps keep track of bus operations (Figure 10).

ii. *Operations Period*

Vehicles are equipped with advanced amenities such as in-vehicle surveillance system, emergency call button, GPS-based station announcement system, radio communication system for bus captains, first aid provisions and Public Information System (PIS).

Installed bus queue shelters involve provisions for PIS, Wi-fi, nearby accessible toilet booths, e-cycle (Mo cycle) stations, and bus route information map.

The Mo Bus application provides citizens with bus route information, real-time tracking of buses, daily notifications and journey planning aids.

GPS-based AVLS used for real-time tracking of buses facilitates central monitoring of driver-efficiency and tracking delays.

Reservation in employment of 50% female bus crew has been made for promoting women's workforce participation as well as enhanced safety of female bus users. Currently 40% of Mo Bus guides are women (Figure 11).

iii. *Post-Operation Period*

Bus undergo routine-checking of vehicle parts followed by washing.

Waste-water is reused for landscaping purposes on the depot site after being passed through an effluent treatment plant.

Scheduled maintenance at an interval of ten days ensures the long-term fitness of vehicles (Figure 12).



Figure 9: Provisions at Patrapada Bus Depot (IIT, Kharagpur Research Team, 2022)

Figure 10: Features of Mo Bus service at pre-operations stage (IIT, Kharagpur Research Team, 2022)

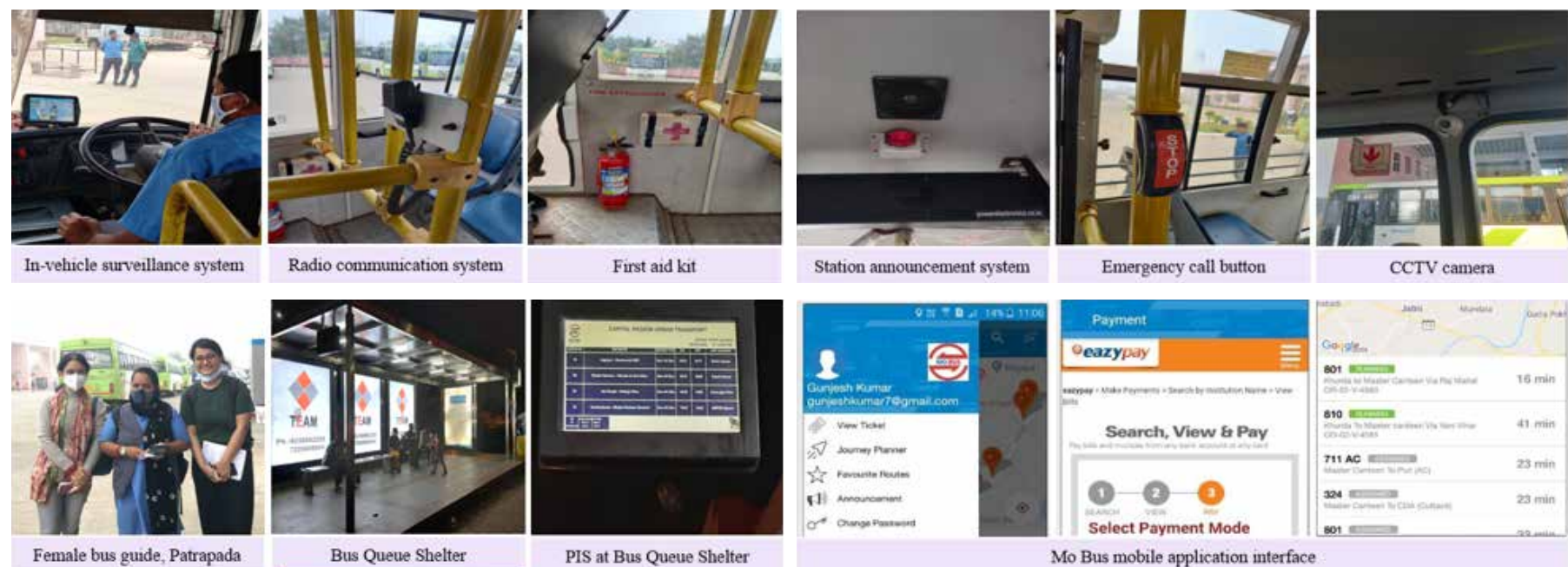


Figure 11: Features of the Mo Bus service at the operations stage (IIT, Kharagpur Research Team, 2022)



Figure 12: Features of Mo Bus service at the post-operations stage (IIT, Kharagpur Research Team, 2022)

B. Smart Traffic Management System

An overview of the key features of the various smart traffic components that ensure real-time data support and responsive traffic operations in Bhubaneswar is presented as follows (Figure 13 & 14).

- Installation of surveillance cameras equipped with ANPR technology for traffic violation detection. Currently, 13 Red Light Violation Detection System (RLVD) are strategically located at major signals and 12 Speed Violation Detection System (SVDS) at mid-blocks.
- The e-challan system ensures easy issuance and payment of tickets through cashless transactions.
- Automatic Traffic Counting and Classification System (ATCC) is installed at major cordon points of the city, for counting vehicles, automatically categorised by PCU.
- Provisions for an Adaptive Traffic Signal Control (ATSC) system have been made at 50 squares across the city, for relieving traffic congestion.
- Traffic Accident Recording System (TARS), operated by the traffic police department, in order to record daily traffic accidents. Currently 10 TARS devices are in use.
- Provisions of pelican crossings have been made for prioritising pedestrian movements across busy corridors.
- 414 Public Address System (PAS) are installed at 30 signalised intersections for making prompt public announcements
- Dynamic Message Signboards (DMS) are installed at 20 locations for displaying warnings related to road traffic conditions or making commuters aware of speed limits and traffic rules.
- Environmental Monitoring System (EVMS) installed at 10 identified pain points across the city involving sensor stations for real-time monitoring and measuring temperature, humidity, air quality index, noise level and rain gauge along with digital display systems for public viewing.

C. Smart Parking Management System

5000 on-ground parking occupancy sensors and 1500 ultra-sonic sensors, installed at on-street parking areas and multi-level car parks, respectively, enable the detection of occupied parking spots and generate parking availability information on the Mo Parking app. The app also enables commuters to do prior booking of spots and make online payments. Hand-held POS controlled by on-ground operators have also enabled cashless transactions (Figure 15).

D. Emergency Response & Incidence Management

450 fixed CCTVs and 150 PTZ cameras installed pan-city along with video management system located at the CCC ensure 24x7 surveillance for incidence detection. 50 integrated multi-services kiosks and 25 standalone kiosks strategically located along roads and public spaces with high visibility have provisions for emergency call buttons and PTZ cameras (Figure 16).

ICCC acts as the facilitator in multi-agency collaboration for prompt and efficient emergency response and



Figure 13: Components of Smart Traffic Management System (IIT, Kharagpur Research Team, 2022) (BSCL, 2022)



Figure 14: Components of Smart Traffic Management System (IIT, Kharagpur Research Team, 2022) (BSCL, 2022)



Figure 15: On-ground parking occupancy sensors (left), Mo Parking app interface (right) (BSCL, 2022)

Figure 16: Digital kiosk, Janpath (left & centre), provisions of emergency call button at digital kiosks (right) (IIT, Kharagpur Research Team, 2022)

incidence management. Computer-aided dispatch and tracking of first responders through radio communication is also undertaken at the centre.

E. Common Payment Cards

The Odyssey smart card, the common city payment card launched through a public private partnership with ICICI bank, enables cashless transactions for citizen services across multiple sectors, such as public transport, parking, utility payment, shopping, and recreation (Figure 17).

F. Intelligent City Operations & Management Centre (ICOMC)

At the existing ICOMC, 8000 sq. ft. of space has been dedicated to the CCC shown in Figure 18. A final operation centre of 32,000 sq. ft. has been designed at the new BMC office, which is under construction

It is the nerve centre of the pan-city IoT network, equipped with robust IT infrastructure, hosting multiple city subsystems on individual operator workstations integrated by a common smart city and GIS platform.

G. Communication Network

The backbone of the IoT is the 680 km city wide sub-surface fibre optic network. A wireless network has also been established city-wide, through 1800 Wi-Fi access points covering 518 locations.

2.2.1 Challenges in the Project

- i. Preventing time overruns in project implementation due to signing off and on-boarding of new

stakeholders necessitating re-engineering for integration with existing IoT installed under different contracts.

- ii. Improving awareness among people about the various digital interfaces, such as digital kiosks that have been developed for citizen-centric services to ensure their adequate utilization.

2.2.1 Risks Involved in the Project

- i. Smart installations such as digital kiosks and controller boxes at pelican crossings, etc. are vulnerable to vandalism during the night as well as wreckage in case of cyclonic events or other natural disasters, leading to high cost implications.
- ii. Digital networks are susceptible to hacking, leading to data manipulation and corruption, and failures in dependent physical systems.
- iii. The financial viability of the Mo Bus system is a subject to be considered.
- iv. Disruptions in wireless networks causing delay in relaying information may confuse commuters, especially with the high dependency on app-based information.

2.2.2 Features and Benefits for the City

- i. The TVDS has enabled efficient traffic management and detection of violators with reduced need for on-ground crew.
- ii. The EVMS installations with display boards for easy visualisation of real-time environmental data has increased transparency and awareness of

environmental issues among citizens and decision-makers.

- iii. Provisions of smart features such as surveillance cameras and on-board Wi-Fi, restrictions on overcrowding, and training given to bus crew for treating passengers with courtesy make the Mo Bus system safer, more secure, and comfortable for daily bus users, when compared with private buses.
- iv. An extensive route network of the Mo Bus system, incorporation of demand-based replanning and scheduling and a 'telescopic fare system' make it a convenient and affordable public transport alternative for citizens, ensuring equitable access to transportation services across the city.
- v. Training of bus crew for passenger management with special focus on assisting the specially-abled, senior citizens and female passengers contributes greatly to the bus user's experience.
- vi. The sensor-based smart parking management system has enhanced commuter experience in finding on-street parking spots along with enabling efficient revenue collection.

2.3 Key Findings from Interviews, Surveys, and Data Collection

Interviews with officials at key stakeholder organisations (BSCL, BDA & CRUT), traffic guards, bus operators and technical inspectors at Mo Bus depots and terminals revealed insightful details on daily operations of the smart bus and traffic infrastructure of the city, thus adding value to the research and documentation. Through undertaking road-side interviews at various

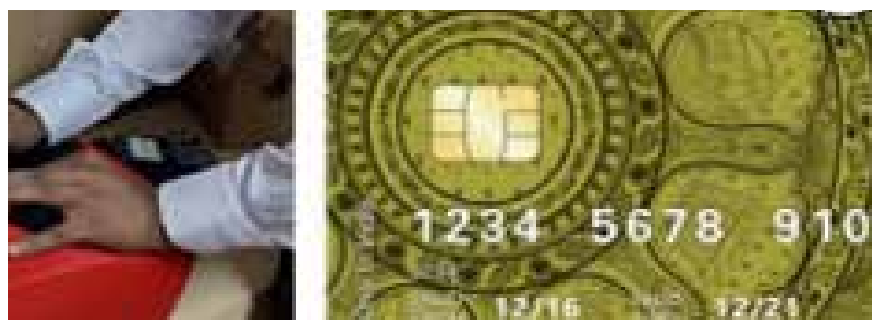


Figure 17: Dual interface POS machine (left), Odyssey Smart Card (right) (BSCL, 2022)



Figure 18: CCC, Bhubaneswar (IIT, Kharagpur Research Team, 2022)



Figure 19: City-wide optical fibre network (left), Wi-Fi access points (right) (BSCL, 2022)



Figure 20: Meeting with BSCL (left) and Shri Sanjay Kumar Singh (IAS), CEO, BSCL (right), and IIT Kharagpur Research Team

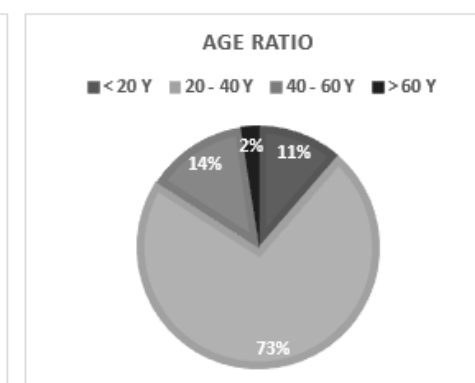
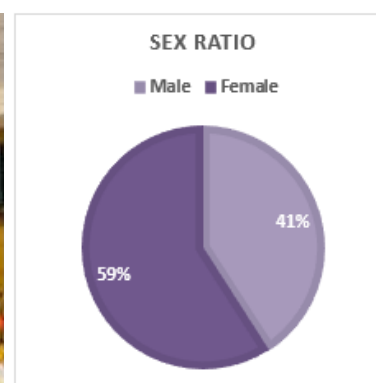


Figure 21: Demographic features of surveyed citizens (IIT, Kharagpur Research Team, 2022)

locations and online surveys (February 2022), employing the method of convenience sampling, perception-based data of 44 citizens (Figure 21) of Bhubaneswar was acquired.

The key findings can be summarised as follows:

a) Smart Traffic Infrastructure

- i. Ashit Kumar Rajhans (Bhubaneswar Smart City Limited):
 - a. The data obtained through ATCC is shared with the traffic police for further analysis and strategising traffic operations.
 - b. Use of TARS facilitates analysis of historic trends in traffic accidents, thus strategising improvements at identified hotspots.
 - c. The ATSC enables better use of overall traffic capacity of the road network by adjusting the signal timing parameters in real time according to the fluctuations in traffic demand. It also enables coordinating green corridors during emergencies.
- ii. Santosh Kumar (HAIL employee):
 - a. Although the smart traffic components are designed as disaster-resistant, in case of any failure, the HAIL team ensures retrofitting within a stipulated time period, as per the contract.
- iii. Traffic Guard Rupali Square:
 - a. The TVDS has been of great aid to the police in catching over-speeding and red light violations. Previously, greater man power was required for on-ground traffic management. It has also helped detect traffic violations during night time, when certain areas remain unsupervised.

The opinions of 32 citizens, who were also vehicle owners, were collected in order to understand the multi-dimensional impacts that the STS had on the city's mobility pattern.

It was found out that improved safety, both for pedestrians and commuters, was deemed to be a major success (Figure 22).

b) Smart Transit Operations

- i. Shri. Sanjay Kumar Singh, IAS (CEO at BSCL, Commissioner of BMC, Vice Chairman, BDA) and Shri. Kamaljit Das, OAS (GM, Administration and Technology):
 - a. All parking spaces are managed by people of the third gender to promote employment among a marginalised section of society.
 - b. CRUT staff members are designated as 'Bus Guides' and 'Captains' in order to incite a feeling of self-respect.
 - c. Dipti Mohapatra, OAS, General Manager (P & A), CRUT:
 - d. CRUT has an average daily ridership of 1.5 lakhs with the highest ridership achieved being 1.7 lakhs in its fleet of 225 Mo Buses. 57% of passengers have shifted from other modes of transport to Mo Bus.

The Mo Bus project has observed huge success over the years since 2019. It has become one of the prime public transit facilities in the capital region of Odisha and has won Awards of Excellence under MoHUA in 2019, 2020 and 2021.

Notable findings, based on citizen perception surveys conducted, implied that, when compared to private buses in Bhubaneswar, factors such as greater on-board safety and security, comfort, affordability of fare, and a greater coverage of Mo Bus routes across the city and peripheral areas make it the most desired mode of transport for the citizens (Figure 23). There has also been an increase in female bus users, which account for 30% of the total number of commuters at present.

3. Discussion and Conclusion

The conclusions drawn from the research have been summarised in the following sections. It involves identification of the facets of improvements, key implications of project impacts, defining the limitations of the research, highlighting the key lessons learnt, and finally formulating a set of recommendations for taking the project forward towards a smarter future.

Bhubaneswar's STS includes six major facets of improvement in pan-city mobility, as illustrated in Figure 24. The figure also shows the various components and processes involved in ensuring inter-agency and inter-sectoral collaborations for service delivery. The Command and Control Centre (CCC) located at the Integrated City Operations and Management Centre (ICOMC) provides a digital platform for integrating multiple city sub-systems, running on server computers at individual system operator workstations and administered by concerned departments.

Well-organised and effective operations of the ICOMC is ensured through automatic data collection with

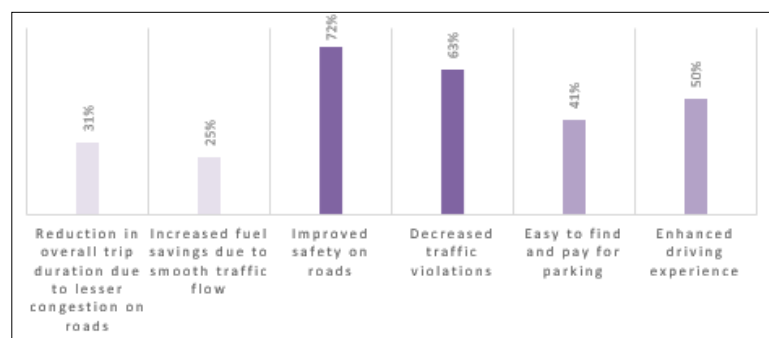


Figure 23: Citizen's perception of smart bus facilities, 2022 (IIT, Kharagpur Research Team, 2022)

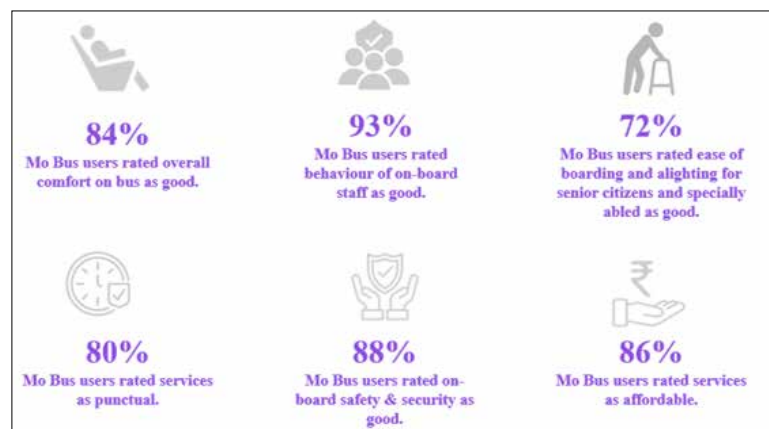


Figure 22: Perception of improvements in mobility conditions (IIT, Kharagpur Research Team, 2022)

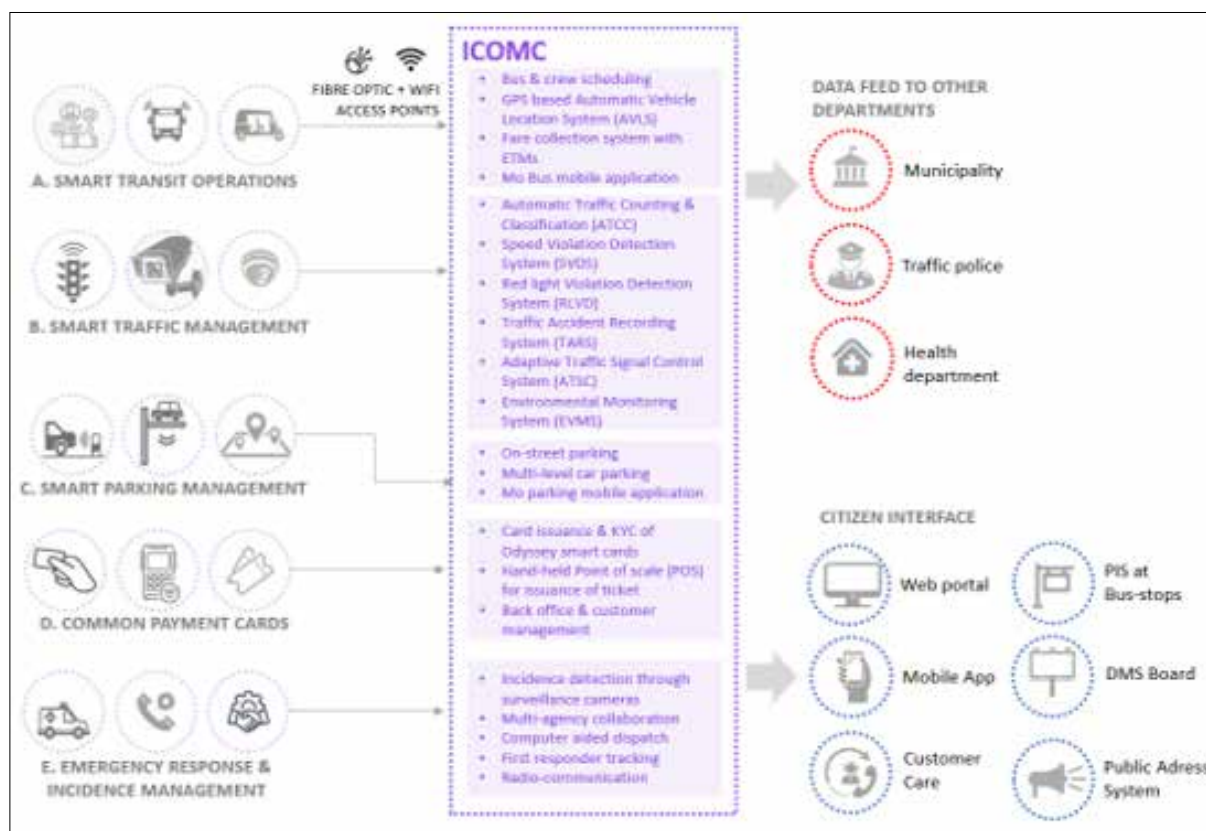


Figure 24: Pan-city STS architecture, Bhubaneswar (BSCL, 2022) (BMC, 2015)

precise location information, followed by analysis of such data in order to generate accurate information feed for concerned city authorities and commuters through a variety of interfaces.

In order to improve the operational efficiency and performance levels of mass transit system, CRUT has invested in and committed to meticulous and consistent high-quality training programmes for its bus staff (Figure 25). The 'Bus Captains' and 'Bus Guides' are given training on diverse topics such as safe and efficient driving habits, gender-sensitive passenger management, handling adverse situations, and assisting differently-abled citizens on a regular basis.

CRUT aspires to achieve end-point connectivity through a fleet of e-rickshaws that will be available at important Mo Bus depots and stations. (Figure 26) These will employ 100% women and transgender individuals as drivers.

3.1 Implications

The 'Smart Bus and Traffic Infrastructure' project of Bhubaneswar can be aligned with five of the United Nation's Sustainable Development Goals, as illustrated in Figure 27.

a) SDG 5: Good Health & Well-being

Following outcome goal 3.6, which calls for action towards reducing deaths and injuries from traffic accidents, the project successfully instils in people a sense of increased safety on roads, through implementation of smart solutions like pelican crossings along busy corridors prioritising pedestrian movements.

b) SDG 5: Gender Equality

The project targets to achieve outcome goals 5.1 (ending discrimination), 5.2 (elimination of violence) and

5.5 (ensuring equal opportunities). Through integrating multiple smart provisions in public transport systems, it promotes a safe and secured environment for women commuters. Reservations made for the employment of women and people of the third gender in multiple spheres of the city's services ensure equal opportunities.

c) SDG 5: Affordable & Clean Energy

The success of the Mo Bus system in significantly increasing daily ridership and boosting a modal shift evidently enhances sustainable mobility patterns in Bhubaneswar. The city's future plans for strengthening its smart transit operations also involve introducing e-mobility, thus targeting sub goal 7.3 (energy efficiency).

d) SDG 9: Industry Innovation & Infrastructure

An integral part of the project is the technological innovations employed in mobility service enhancement (Outcome goal 9.1, 9.4) such as the following.

- i. The CCC facilitates prompt and efficient co-ordination between multiple city agencies for decision-making and incidence response.
- ii. Smart communication network enables flexibility in future expansion of smart infrastructure without the creation of visible clutter or need for significant retrofitting.
- iii. Automated traffic data-collection and record-keeping through ATCC, TARS and ETM ticketing would enable the analysis of historic trends in traffic data, thereby facilitating further decision-making processes regarding required service-level improvements

e) SDG 11: Sustainable Cities & Communities

With the vision of ensuring future sustainability of the rapidly urbanising city of Bhubaneswar, the smart city proposals were formulated in order to ensure access to safe, affordable, accessible and sustainable transport

systems for all, and improving road safety with special attention to the needs of vulnerable groups of people. A significantly positive increase in Mo Bus ridership also implies a shift towards sustainable mobility patterns in Bhubaneswar (Outcome goal 11.2). Project strategies also inherently target a reduction in adverse per-capita environmental impacts, by paying special attention to pollution control and fuel efficiency of transit systems (Outcome goal 11.6).

3.2 Limitations of the Research

Due to time constraints, the assessment of the smart traffic system was based on understanding its influence on limited user categories like private-vehicle users, bus users and pedestrians.

Field visits were restricted to the BMC boundary, hence, the influence of the Mo Bus system on peripheral areas could not be assessed.

3.3 Key Lessons Learnt

"The Smart Cities Mission is not a panacea for Bhubaneswar's urban problems, however, it has the capacity to play a primary role in alleviating Bhubaneswar's transformation as envisioned through flexible planning measures that involves its citizens."

– Dr Krishan Kumar, Commissioner, Bhubaneswar Municipal Corporation and

Vice-Chairman, Bhubaneswar Development Authority

Bhubaneswar's 'Citizen's Connect Initiative' sets forth the conceptualisation of a new generation of smart cities, with citizen co-creation at its core.

Smart mobility in Bhubaneswar is being achieved by looking beyond technology-enabled smart solutions. The success of the project lies in five key areas of smart action.



Figure 25: Training & capacity-building of bus staff (IIT, Kharagpur Research Team, 2022)



Figure 27: Project alignment with UN's Sustainable Development Goals



Figure 26: Banner of Mo E-ride promoting workforce participation of women and transgender (left), E-rickshaws at Patrapada bus depot (right) (IIT, Kharagpur Research Team, 2022)

- i. Optimised use of existing mobility infrastructure and employing data driven solutions.
 - ii. Ensuring sustainable infrastructure through incorporating holistic service-level improvements.
 - iii. Promoting inclusive transportation services through securing safe access to public transport facilities for all.
 - iv. Ensuring energy-efficient transportation and communication through innovations in design and technology.
 - v. Instilling awareness among people about civic concerns and empowering citizens with a new community perspective.
- 3.4 Recommendations**
- In conclusion, this research leads to the identification of specific areas of action needed as a way forward towards strengthening Bhubaneswar’s ‘Smart Bus and Traffic Infrastructure’.
- i. A lack in considerations for universal accessibility at public transit facilities such as in buses, bus queue shelters, at bus depots and terminals poses barriers for specially-abled individuals and senior citizens. A comprehensive approach towards ensuring barrier-free access to city-wide transportation services must be undertaken.
 - ii. Sensitively designed citizen interfaces with special provisions catering to vulnerable users, which includes people with physical, vision or sensory impairments as well as children and the elderly, should be considered as an essential aspect of smart mobility services.
 - iii. Bus movements may be prioritised to some degree along busy urban corridors at peak hours to reduce delay. This may be in the form of traffic signal priority or dedicated bus lanes, etc.
 - iv. Sensor-based occupancy monitoring of buses may be employed in order to regulate overcrowding and passenger discomfort.
 - v. Installation of a driver monitoring system in buses may be considered to ensure further safety on roads by reducing the risk of fatigue-related accidents.
 - vi. A computerised system may be adopted for efficient bus route planning and staff scheduling.
 - vii. Alongside the Mo Parking app, provisions for an on-ground parking guidance system may be considered for more convenience of commuters.
 - viii. The Mo Bus app can be further developed as a MaaS interface, which would then cater to multi-modal transport services.
 - ix. Installation of park-and-ride facilities at transit terminals may be considered in order to promote the ridership of public transport.
 - x. Adoption of e-vehicles supported by adequate city-wide charging stations is the way towards the realisation of a clean, green future in smart urban mobility.

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Open-Air Gymnasium: An initiative for Swastha Kanpur

Name of the project: Open-Air Gymnasiums

Location: Kanpur: Uttar Pradesh

Year of project implementation: 2019

Sector: Heritage & Open Spaces

Project Cost (Rs. Crore): 1 Crore

Linkage to SDGs: SDG 3 - Good Health & Well-Being, SDG 11 - Sustainable Cities & Communities

Institute: Indian Institute of Technology, Roorkee

Advisors: Faculty Coordinator: Dr. Arindam Biswas, Mentor: Ms. Nikita Ranjan

Students: Mr. Lalit Kumar

Keywords: Open-Air Gymnasiums, Kanpur Smart City, Swastha Kanpur, Health infrastructure

Abstract:

Parks, which were the centre of recreational spaces, open breathing space, a place for social interaction, and a healthy environment, are now becoming the gymnasiums of the city. In a country where lifestyle problems are a growing concern, easy and accessible Open-Air gymnasiums with free fitness equipment sound too good to be true.

Kanpur Smart City Limited (KSCL), under Smart City Mission of India and project umbrella of 'Swastha Kanpur,' had proposed to set up Open-Air Gymnasiums in 6 different locations in Kanpur and cater to their "Smart City Goal 28: Develop infrastructure in parks and open spaces to improve citizen health". The idea of the project was to develop Open-Air Gymnasiums in already built public parks to provide the health benefits of exercising in a natural environment. After the pandemic, people have become more cautious about their health and fitness and are avoiding working in closed spaces with other people. In that situation, open-air gymnasiums have attracted more citizens and have provided a safer exercise option than conventional gymnasiums (The Times of India, 2020).

This study analyzes the efficiency of the open-air gymnasiums in Kanpur and measures the benefits to the users. It also examines the design of these gymnasiums by using a questionnaire survey of different stakeholders of the project and on-site visual observations. It is found that the users get benefits from the open-air gymnasiums. Awareness among the people about their health has increased as the gymnasiums have attracted a significant number of first-time users, who were not exercising regularly before their construction. The primary issue that emerged in this study is the proper maintenance of the gymnasiums and their equipment. Instructions for using the equipment were found to be missing. This study also seeks to recommend improvements that can be made in the gymnasiums and their administration to enhance the user experience.

Case Study: C9

1. Introduction

The World Health Organization (WHO), in Global Recommendations on Physical Activity for Health, has recommended that adults who are above 18 years of age should engage for at least 150 minutes in moderate-intensity or at least 75 minutes in vigorous-intensity aerobic exercises in a week (WHO, 2010). Physical inactivity level among the population is rising with the advancement in technology. It is linked with the risk of various non-communicable diseases (NCDs) - mainly cardiovascular diseases, chronic respiratory diseases, diabetes, and cancers, which are the world's biggest killers. Every year, more than 36 million people worldwide die from NCDs, which account for about 63% of global deaths, including more than 14 million people who die at a young age between 30 and 70. Insufficient physical inactivity is a significant health threat for India as well. The physical inactivity level in India is at an alarming 34%, which is the highest in South Asia, and the insufficient physical activity level is even higher in women (43%) as compared to men (23.5%) (Guthold, et al., 2018). Most of these NCDs can be prevented by effective health systems and by increasing physical activity in the lifestyle of the people (WHO, 2013).

Specific interventions in the urban green spaces that promote physical activity have positively impacted and are widely recognized nowadays (Hunter, et al., 2015). Outdoor gymnasiums are among such interventions, consisting of a variety of exercise equipment located in public parks that require no power to operate. These equipment are modified configurations of conventional indoor gym equipment and are constructed of steel. Outdoor gyms generally allow free-of-cost access to

various exercise equipment that may help one challenge and improve their aerobic fitness, body balance, flexibility, and muscular strength (Hua-Ho, 2018).

Studies have demonstrated that the physical inactivity level among the users is increased in open-air gymnasiums (Cohen, et al., 2012). These gymnasiums have also grown park use, attracting new park visitors and promoting social engagement within the community and the health benefits (Kweon, et al., 1998).

1.1 Topic and Context

In India, the need to increase the physical activity level among the urban population has been felt, and the intervention in the form of open-air gymnasiums has been acknowledged. Open-air gymnasiums first started to appear in big cities like New Delhi, Jaipur, and Gurugram (The Times of India, 2015; The Times of India, 2017; The Times of India, 2018). The public response to these facilities was overwhelming, and the demand for the construction of more outdoor gymnasiums has also increased (Mishra & Chitlangia, 2019). Citing the health benefits, various cities under the smart city mission have included open-air gymnasiums in their proposals and installed them in already built public parks of the cities. People are enjoying these facilities with great enthusiasm (Express, 2019; The Times of India, 2019; The Times of India, 2021).

Kanpur Smart City Limited (KSCL) had also proposed constructing open-air gymnasiums under their Smart city proposal and identified 6 locations in the entire city where the facilities would be built (Kanpur Municipal Corporation, 2016).

The Open-Air gymnasiums have been installed in these Six different public parks of Kanpur:

- i. Kargil Park
- ii. Nana Rao Park
- iii. Water Park
- iv. Geeta Nagar Park
- v. Nagar Mahapalika Park
- vi. Ramlila Park,

The location of these parks has been marked on the city map given in figure 1.

Figure 1 Locations of Parks where Open-Air Gymnasiums have been installed in Kanpur

In each of these Open-air gymnasiums, 15 nos. of equipment are installed. The type and nos. of each piece of equipment are given in Table 1.

Sl. No.	Equipment	Quantity
1	Parallel Bar	1 Nos.
2	Chin-up and Dipping Bars	1 Nos.
3	Standing Waist Trainer	1 Nos.
4	Shoulder Wheel	1 Nos.
5	Spacewalker	2 Nos.
6	Bicycle	2 Nos.
7	Leg Press (Double)	1 Nos.
8	Rowing Machine	1 Nos.
9	Pull Chair	1 Nos.
10	Chest Press (Double)	1 Nos.
11	Scaling Ladder	1 Nos.
12	Sit Up Bench	1 Nos.
13	Abdomen Bench	1 Nos.
	Total	15 Nos.

Table 1. Equipment types and nos. installed in each gymnasium. Source: Kanpur City Smart Limited, 2018

The project was started in 2018 and was completed in February 2019. The target population of the project is the regular users of the public parks and those looking for cheaper, safer, and more attractive alternatives to privately owned closed gymnasiums.

This study has been conducted to check the efficiency of projects and quantify the benefits to the beneficiaries. This study also critically examines the design attributes of implemented projects.

1.2 Significance of the project

Open-air Gymnasiums are an essential part of the smart city mission and have various health benefits, which are deemed important and significant such as

- i. It attracts new users, as it provides a chance to participate in outdoor physical activities and attracts

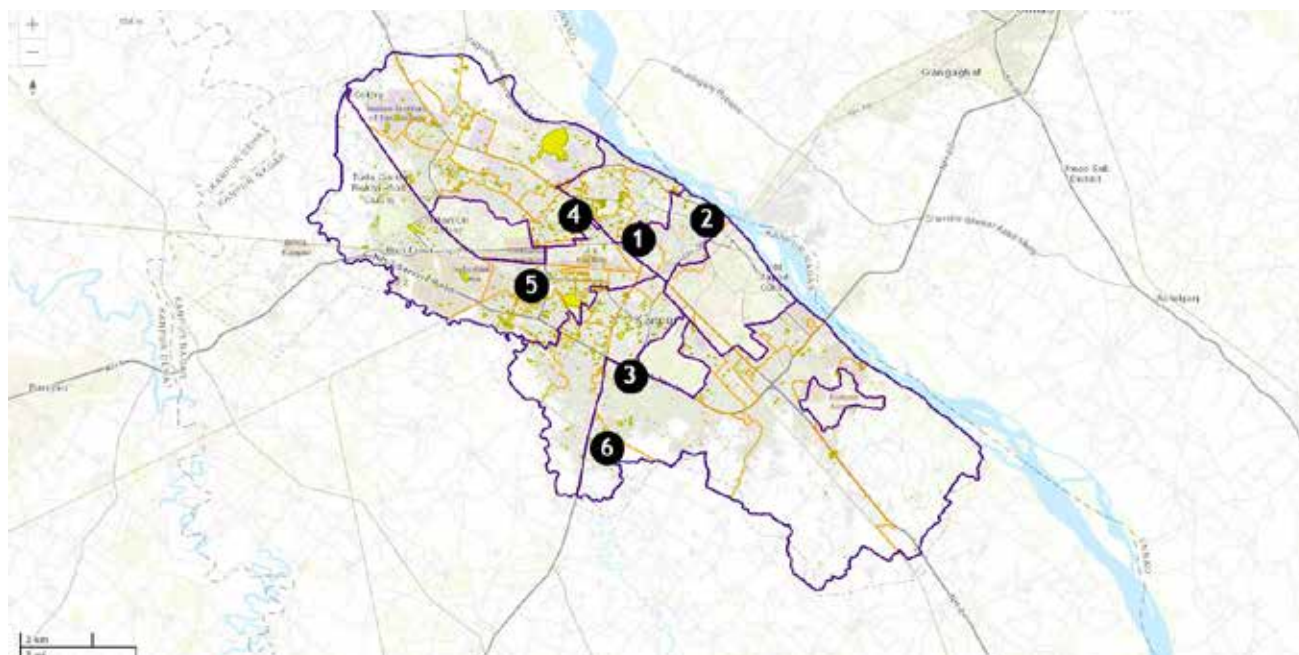


Figure 1 Locations of Parks where Open-Air Gymnasiums have been installed in Kanpur. Source: Authors

people who like working out regularly.

- ii. It provides training opportunities as it provides a place for people like firefighters, police teams, college athletes, etc., to set up training exercises in adverse weather.
- iii. It increases social interaction by providing a chance to get trained together and promoting friendship.
- iv. It saves money on gym membership and is available for exercising at any time of the day. People who could not afford a private gym subscription can opt for it.
- v. Open-Air Gymnasium has low installation and maintenance costs as it does not require electricity, and equipment is relatively affordable.
- vi. Many people are not aware of the health problems due to physical inactivity; it will popularize and advertise the use of gymnasiums.
- vii. Open-Air Gymnasiums are safer alternatives than closed gymnasiums as women are safer in crowded and open spaces, as suggested by Jane Jacobs in her book “The death and life of great American cities.”

1.3 Aim and Objectives

This study aims to analyze the benefits of newly constructed Open-air gymnasiums on beneficiaries’ health and examine the design of the project. The other aim is to observe all the stakeholders’ viewpoints and satisfaction and recommend changes for improvement if any.

The objectives of the research are

- i. To quantify and measure the benefit(s) of the project to the beneficiaries.
- ii. To check the efficiency of the project.
- iii. To conduct a critical examination of the design attributes of the implemented project.

2. Contextual Background

2.1 Conceptual framework / Research design

Qualitative and analytical research has been selected as the appropriate method for this study. On-site visual observation and questionnaire-based surveys of various stakeholders were conducted. The aims & objectives of the study guide the primary and secondary study (see Table 2 and Figure 2). The study was undertaken in five of the six public parks installed with open-air gymnasiums in Kanpur, built under the smart city mission.

The Research framework for the whole study including data collection, analysis and conclusion is given in figure 2.

The detailed attributes of the projects and information regarding the public perception, satisfaction, and project efficiency are collected. The methodology adopted for collecting the data can be divided into three categories: on-site visual observations, interviews of the

city administration, and on-site, in-depth interviews of beneficiaries. The data collected by these three methods are given below.

a. Visual Observations

It includes on-site data collection that records the following elements:

- i. Location, time, number of users, and weather conditions
- ii. Participant details such as age, gender, equipment usage type, time spent at the site, and if an industry professional is present.
- iii. Details of equipment, their number, most used equipment, conditions assessment of the equipment

- iv. Site provisions and supporting amenities at the time of the observation, for example, Gymnasium size, cleanliness, surface type, accessibility, lighting, condition for safety and security, and toilet amenities.

b. Undertaking interview of city administration

An interview of the city’s administration has been conducted to collect data and analyze it from the administrative point of view. It includes the following data collection:

- Initial and O&M costs of the project.
- Basis of choosing the locations for open-air

Table 2. Indicators and analysis techniques for different objectives. Source: Authors

Objectives	Data required (specific indicators with source and tools/ techniques of obtaining the data)	Analysis technique
Objective a	<ol style="list-style-type: none"> 1. The number of first-time users 2. Different user groups and their percentage. 3. Are proper exercising methods being followed or not? 4. Are Facilities comparable to paid gymnasiums or not? 5. Are people getting benefited from the facilities or not? 	Through on-site visual observations and questionnaires for beneficiaries.
Objective b	<ol style="list-style-type: none"> 1. Waiting time for using the equipment. 2. Obvious signs of use. 3. Do people want more such facilities in the city? 4. Are city authorities planning to implement more such projects in the city? 	Through on-site visual observations, beneficiary’s and city official’s interviews.
Objective c	<ol style="list-style-type: none"> 1. Number and type of equipment. 2. Is all the equipment working properly or not? 3. Availability of instruction on each piece of equipment. 4. Site cleanliness, accessibility & safety. 5. Are the amenities available on site? 	Through on-site visual observations.

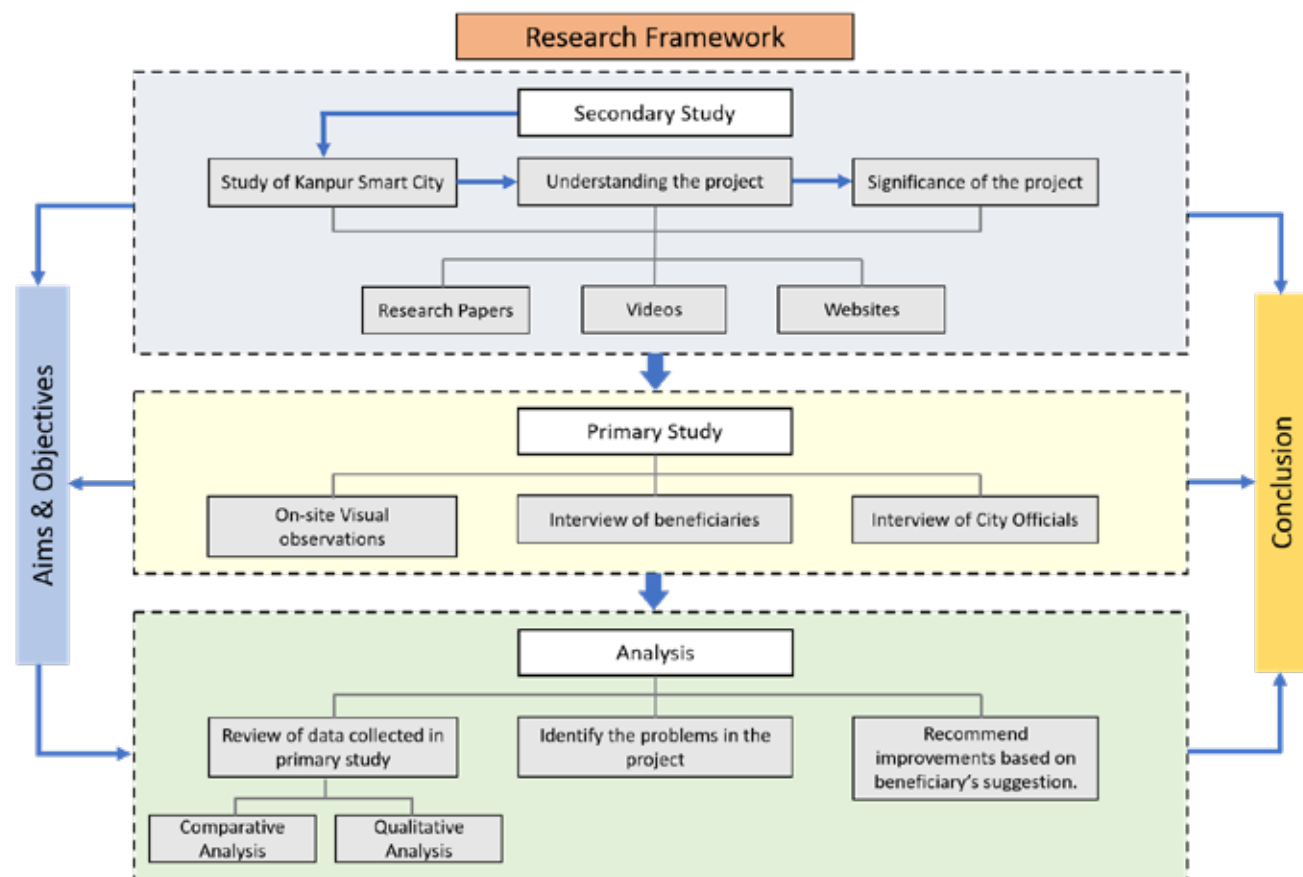


Figure 2 Research Framework for the study of Open-air gymnasium in Kanpur. Source: Authors

- gymnasiums.
- Design guidelines that were followed for the construction of gymnasiums.
- The administration's future plan in order to make more open-air gymnasiums in the future.

c. Undertake onsite interview of beneficiaries

Beneficiary interviews are conducted to gauge the community's satisfaction with the project. Survey questions may cover user satisfaction and problems in the following key areas:

- Whether the site location, equipment type, and supporting amenities are adequate?
- Frequency of use and any barriers affecting ongoing participation.
- Are facilities comparable to privately paid gymnasiums or not?
- Any problem being faced by the beneficiaries.
- Collecting ideas for improvements that the beneficiaries think could improve their experience.

Based on these methods, a proforma for unobtrusive visual observation of open-air gymnasiums and their users were prepared. Two questionnaires (one for each) for in-depth interviews of the stakeholders, the users, and city administration were prepared. Nominal and Matrix questions were asked to the beneficiaries and administration, with some open-ended questions about the gymnasiums. Based on the beneficiary's responses, a comparative analysis has been made.

2.2 Key features of the project

2.2.3 Challenges in the project

- Identification of locations where new Open-Air

Gymnasiums need to be installed.

- Encouraging the first-time users to use the facilities.
- Provide instructions to the users on how to use the equipment properly.

2.2.4 Risks involved in the project

- Some public parks do not have security guards or other security features, so protecting the equipment can be difficult there.
- If equipment is not used properly, it can injure or harm users (Hlentjaris, n.d.).

2.2.5 Features and Benefits

- Since physical inactivity level is higher in women as compared to men, these gymnasiums are helping them by providing equipment in their nearby parks (WHO, 2013).
- Increase in social interaction and footfall of the park.
- Safer for women and children as they are public spaces and usually crowded.

2.6 Key findings from the interviews, surveys, and primary/secondary data collection

The results of the study from primary and secondary data, and key findings of the interviews of various stakeholders and on-site visual observations are presented below in tabular and narrative formats.

2.3.1 Interview of the City Administration

Kanpur city is divided into six administrative zones, KSCL planned to construct one open-air gymnasium in each zone under the smart city mission. These projects were started as a pilot project and were not on a revenue

model, the entry for all the users were kept free and open for all. KSCL spent 1 crore on the project, out of which 81% that is 0.81 crore was for the construction of open-air gymnasiums and 19%, that is 0.19 crore was for operation & maintenance for next 5 years, after that KSCL will bear the operational cost of all open air gymnasiums.

The user capacity for each gymnasium was not estimated, number of zones in the city and the parks having greatest footfall within that zone were selected for construction of open air gymnasium. The design and number of equipment in each gymnasium have been kept similar, and are following the design guidelines provided by the government in different orders, not any single comprehensive design guideline.

We asked the city officials if they have any service level benchmark for evaluation of these gymnasiums to do a comparative analysis between them, but their response was negative. No special event has been organized by the administration till date to advertise the gymnasiums and increase participation of the users, as the number of users in the gymnasiums are already very high, so they never felt the need to do so.

The city administration is overwhelmed with the feedback they are getting from the public. They are getting requests for construction of more such gymnasiums in other parks of the city as well. KSCL is planning to construct at least 20 more open air gymnasiums, and these gymnasiums, unlike the existing ones, will have a user charge. KSCL will try to keep the user charge as low as possible, it could be maximum 100 rupees per month, or 5 rupees per hour.

2.3.2 On-site visual observations

On-site visual observations have been recorded in five open-air gymnasiums of the city in the early morning as the number of users is higher. The observations are cross-sectional and were recorded during our visit to the outdoor gymnasiums.

As per our observation, the number of elderly citizens and adult men are equal with 32% share in total users, followed by women having 19% share and children having the smallest percentage of 17%. Nana Rao Park and Water park have the most footfall, and the users have to wait sometimes for using the equipment, while in other parks, there is no waiting time for using the equipment.

From the observation, it is found that the Bicycle and Space Walker are the favorite equipment and are, therefore, the most used equipment in the gymnasium. In most parks, at least one bicycle is either not functioning correctly or broken. The equipment condition in Nana Rao Park and Water park is poor as shown in figure 3, and Figure 4, while in Geeta Nagar Park, it is found to be best of all.

All open-air gymnasiums are of roughly equal size and similar in design with dimensions of 22m x 10m except

Park/Gymnasium Name	Number of Users at the time of visit	Elder Citizen	Children	Women	Adult Men
Nana Rao Park	15	5	2	4	4
Water Park	20	3	6	4	7
Geeta Nagar Park	4	0	2	0	2
Kargil Park	8	4	0	1	3
Mahapalika Park	12	7	0	2	3
% share		32 %	17 %	19 %	32 %

Table 3: Details of Users in the open-air gymnasiums. Source: Authors

Park/Gymnasium Name	Waiting time for using equipments	Most Used Equipment	Equipments which were not functioning
Nana Rao Park	Yes	Bicycle	1. Abdomen Exercise 2. Standing Waist Trainer 3. Bicycle 4. Chest Pull
Water Park	Yes	Bicycle, and Space Walker	1. Chest Press 2. Bicycle
Geeta Nagar Park	No	Bicycle	
Kargil Park	No	Bicycle	1. Bicycle 2. Standing Waist Trainer
Mahapalika Park	No	Bicycle	1. Bicycle

Table 4: Details of Equipment. Source: Authors

for Kargil Park. Kargil Park is 44m x 5m in dimension due to space constraints as this park also has Moti Jheel (lake) inside it. Trash/Dust bins are not installed in Geeta Nagar and Mahapalika park; in the other three parks, the required number of trash/dust bins are installed. The open-air gymnasium site in Water park (figure 5) and Mahapalika park is higher than the ground level and is not connected with the park's walking/ jogging track, posing a problem in universal accessibility. Geeta Nagar Park and Mahapalika park do not have security guards and toilet amenities within the park. In contrast, the access is controlled in the other three parks and has proper security. In terms of design, the Kargil Park is best and fulfills all the design-related criteria we have considered in our study.

2.3.3 On-site Beneficiary's interview

In our on-site surveys, we interviewed 40 beneficiaries of the open-air gymnasium in different parts of the city. 70% of the beneficiaries interviewed are male, and 30% are female. The average distance the users travel to reach the open-air gymnasium is 1238 m and varies between 100 m to 4 km. 20 users (50%) admitted that they exercise every day, and 10 users (25%) exercise 6 days a week in the open-air gymnasiums. Out of all 40 beneficiaries, 31 (77.5%) used to exercise regularly before constructing the open-air gymnasium.

In contrast, 9 (22.5%) are first-time users who started exercising after the parks installed gymnasiums. 36 (90%) users chose morning as their preferred time to exercise, and 4 (10%) users like to exercise in the evening. All 40 users admitted that they haven't got any instruction on how to use the equipment properly, and no instructions are available on equipment either. 34 (85%) beneficiaries felt that their social interaction has increased due to exercising regularly in the gymnasium. In comparison, 6 (15%) beneficiaries do not feel that open-air gymnasiums impact their social interaction. All 40 (100%) beneficiaries believe they have benefitted from the open-air gymnasiums, improving their health after exercising there. Only 12 (30%) beneficiaries find the number of equipment in the gymnasium to be sufficient, and the rest 28 (70%) opined that the number of equipment in the gymnasium should be increased.

We asked the beneficiaries whether they would like to pay for exercising in the open-air gymnasium if the city administration imposes a user charge to analyze the satisfaction level of beneficiaries with the gymnasiums compared to privately owned indoor gymnasiums. 26 (65%) beneficiaries agreed that they would like to pay for using the open-air gymnasium, while 14 (35%) beneficiaries disagreed. We also asked the beneficiaries who agreed to pay the user charge they think would be sufficient for using an open-air gymnasium. The average user charge that the beneficiaries suggested is about 122 rupees per month. All 40 (100%) beneficiaries opined that the number of open-air gymnasiums in the city is significantly less and should be increased.

To measure the satisfaction of the beneficiaries with the

services and facilities of the open-air gymnasiums, we asked them questions that required them to give a score on a 5-point scale, where 0 represents "poor" and 5 illustrates "excellent." For each question, we recorded 40 responses, which constitutes a maximum of 200 possible points for each question. In the question about the amount of space/size of a gymnasium, users assigned 137 (68.5%) scores, while in the question about the quality of equipment installed, users gave 124 (62%) scores out of 200. In questions about the proper maintenance of the equipment, users gave 75 (37.5%) scores, and 16 (40%) users dissatisfied with the maintenance gave only either 0 or 1 score. We asked questions about the cleanliness of the gymnasium, and for that, beneficiaries gave 131 (65.5%) scores. In questions about the safety of women & children in the gymnasium, users gave 156 (78%) scores. We asked the beneficiaries about their overall experience in the gymnasium, for which they gave 144 (72%) score out of 200.

3. Discussion and Conclusion

This study sought to add to the evidence regarding the beneficiaries' experience in exercising in the green and open areas. To develop infrastructure in parks and open spaces to improve citizen health, KSCL implemented this project under the umbrella of 'Swastha Kanpur' in the Smart City Mission of India. After looking at the overall user experience and health benefits that the beneficiaries are getting from these gymnasiums, it can be said that this project has been a success in spreading awareness about the importance of health and enhancing the physical activity level. The open-air gymnasiums provide a fun and easy way of exercising in green and open spaces, attracting first-time users, as is evident from this study. As the gymnasiums are free to use, users who do not want to spend on private gym memberships are also attracted.

The number of male users is still significantly higher than the number of females, and there is a need to encourage women to use the gymnasiums. The average distance

Table 5. Details of Gymnasium's design. Source: Authors

Park/ Gymnasium Name	Park size	Trash/ Dust Bins Availability	Site accessible to disabled users	Lighting provision for exercising at night	Cameras or security available or not	Toilet amenities in park
Nana Rao Park	22 x 10M	Yes	Yes	No	Yes	Yes
Water Park	22 x 10M	Yes	No	Yes	Yes	Yes
Geeta Nagar Park	22 x 10M	No	Yes	No	No	No
Kargil Park	44 x 5M	Yes	Yes	Yes	Yes	Yes
Mahapalika Park	22 x 10M	No	No	Yes	No	No



Figure 3. Broken Bicycle Equipment in Nana Rao Park. Source: Authors

traveled by users to reach the gymnasium is very high, which can be lowered by increasing the number of open-air gymnasiums in the city. All the beneficiaries that were interviewed also desired the same. The instructions to use the equipment properly are not available on equipment. It could pose a danger to the user who is not using equipment properly due to improper limb movement. Some equipment in the gymnasiums is faulty. It can injure users rather than provide health benefits.

The number and type of equipment in gymnasiums are kept similar regardless of the number of visitors in those parks. In gymnasiums having greater footfall, the users have to wait sometimes to use the equipment, while in Mahapalika Park and Geeta Nagar Park, which have lesser occupancy, there is no waiting time. The number of equipment should be in proportion to the number of visitors. From our on-site visual observation, it is evident that the Bicycle is the most used equipment in the gymnasium, which could be why at least one bicycle piece of equipment was broken in 4 out of 5 gymnasiums visited.

In our discussion with the users, the primary concern was the maintenance of the equipment. The parks like Nana Rao Park, Kargil Park, and Water park, which have higher footfall, are the worst hit by the maintenance issues. Users are disappointed as the issue could not be resolved, and problems were sustained even after complaining to the concerned authorities. In Water park, users themselves collected some money for the maintenance of the broken equipment. The contractor who installed and supplied the equipment is responsible for the operation & maintenance of the equipment for five years. Still, the equipment condition suggests that the operation & maintenance has been neglected.

The beneficiaries of the gymnasiums support the installation of more such open-air gymnasiums in other public parks of the city. The majority of them (65%) are willing to pay for services if the administration asks them, but with the condition that the proper maintenance of the equipment will be ensured and cleanliness of the gymnasium will be maintained. The average amount that the users suggested that should be appropriate for using the gymnasiums is Rs. 122 per month. The administration is also convinced that more gymnasiums

are required in the city. These new gymnasiums will be on a revenue model and introduce user charges. The administration plans to implement at least 20 more such gymnasiums in the future with user charges as less as Rs. 100 per month or Rs. 5 per hour tentatively. It is essential to keep the user charges lower so that the attractiveness of the gymnasiums as an affordable alternative could be maintained.

In her book “The Death and Life of American Cities,” Jane Jacobs suggested that crowded and open public spaces are often safer than closed spaces. This statement also holds for the safety of women and children in the open-air gymnasiums. In our survey, 78% of the users find open-air gymnasiums safer for women and children as these are crowded places, always filled with park visitors.

In our survey, we asked users regarding their overall experience of the open-air gymnasiums, to which people rated it with a 72% score. It suggests that despite several shortcomings and issues of maintenance, the citizens are satisfied with these facilities and are in favor of increasing the number of open-air gymnasiums in the city. The user’s satisfaction and the city administration’s plan to implement more such open-air gymnasiums in the future can be regarded as the project’s success. KSCL, who had executed this project under their “Smart City Goal 28: Develop infrastructure in parks and open spaces to improve citizen health”, can be held successful in achieving their mission, with some concerns about the operation and maintenance, which requires immediate attention.

3.4 Limitations of the research

The limitations of the research are listed as below:

- i. We could visit only 5 out of 6 open-air gymnasiums of the city due to time constraints. The key findings and conclusion of the research are based on the on-site visual observation and beneficiary’s responses recorded in these five open-air gymnasiums only.
- ii. The on-site visual observations and beneficiary survey has been done at different times at different locations, which could affect the occupancy of the open-air gymnasiums.
- iii. The observations are cross-sectional and could vary with the day and time.
- iv. Since the capacity of open-air gymnasiums was not

estimated by the administration, it was not possible to gather information about the number of visitors in the whole day due to the shortage of time. The efficiency of the open-air gymnasiums could not be analyzed for user occupancy.

3.5 Key lessons learnt

- i. Understanding the research methodology and processes involved in writing a research paper.
- ii. The procedure of making questionnaires and conducting interviews of various stakeholders; Reflecting their viewpoints and findings in the research paper.
- iii. Carry out Primary and Secondary studies, and develop a research framework.
- iv. Users are willing to pay for the services if they get good quality equipment with proper maintenance, which suggests that the quality of the services is the priority of the users rather than the attraction of freebies.
- v. Operation & maintenance are the biggest hurdles in the success of a project.

3.6 Recommendations

- i. Special events should be organized with the help of local women to increase the number of female users in the gymnasium.
- ii. Instructions in local languages guiding the users for using the equipment properly should be provided. A QR code with links to video tutorials can also be provided with each piece of equipment.
- iii. The number of equipment in parks having greater footfall should be increased. As Bicycle and Space Walker is the most used equipment, their numbers should be increased in the gymnasiums.
- iv. (d) The contractor who supplied and installed the equipment should be held responsible for maintenance of the equipment and strict action should be taken against them for not fulfilling their obligations.
- v. As the equipment is prone to be used roughly without proper instruction, good quality equipment should be installed, which could sustain the impact of occasional rough uses.
- vi. Proper lighting and security should be ensured in all gymnasiums so that users could exercise in the evening or night also.

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C10

Strengthening and renovation of the existing street by using Shredded waste plastic

Name of the project: Strengthening and renovation of the existing street by using Shredded waste plastic with Bituminous mix and preparation of two number rams on the service road abutting to Mela Ground Action Area-1

Location: New Town Kolkata

Sector: Heritage and Open Spaces

SDGs: SDG8, SDG9, SDG11, SDG 13

Institute: Indian Institute of Engineering, Science, and Technology, Shibpur

Advisors: Dr. Souvanic Roy, Project Mentor : Dr. Soumen Mitra

Students: Mr. Pranoy Kr. Mondal, Ms. Trisha Barui

Keywords: Monility, connectivity, Passenger Information System (PIS).

Abstract:

The smart city mission for New Town Kolkata Development Area (NKDA) was targeted for improvement on mobility and connectivity, creating economic opportunity, to enhance safety, security, surveillance and better quality of living. Considering the mobility and accessibility of NKDA, the smart city development plan has encouraged cycleability in the city. Since, the land use is sectoral, trip lengths are not so small to be managed by walking only. Therefore, the authority envisaged the following projects for improvement of cycleability – (a) smart cycle stand, (b) dedicated bicycle lanes, (c) e-cycle docking stations, (d) mobile cycle repair clinic and (e) private-public collaboration to introduce app-based e-cycle and e-bike rental systems.

The Smart Cycle stand, installed near DLF, is equipped with CCTV, Passenger Information System (PIS) display board, advertisement boards, mobile charging points and security person at the basement. The authority has installed 30 e-cycle stands among them 21 are currently operational. These docking centers are under surveillance CCTV for 24x7 along with Wi-Fi connections, and, mobile phone charging facilities. Around 40 Km of Cycle track has been provided by NKDA (both at grade and grade separated). All the cycle tracks are characterized by adequate signage, directions, curb and connectivity.

The survey, conducted among the stakeholders during March 2022 regarding operation and maintenance of the installed systems, reveals the following issues – (a) There is a lack of awareness among the people of New Town, especially in Action Areas II and III, (b) Smart cycle stand has been installed appropriately; however, it lacks adequate supply for parking and drinking water. Many a time, the people are compelled to park their cycles outside the designed area which is unprotected. (c) The cycle tracks and ramps are designed perfectly however, all these pathways should be cleaned regularly. Considering the harshness of the climate, necessary facilities and infrastructure (seats, trees, drinking water facilities and public toilets) should be installed in appropriate locations.

Case Study: C10

1. Relevance of the project in the urban context of New Town

Plastic has become an indispensable commodity in our daily life especially for urban people. It has permeated every level of our daily life whether it is garments, furniture, electrical and electronic appliances, medical appliances, food packets, automobile parts and many more [1]. During 2019 – 2020, around 35 lakh tonnes of plastic waste were generated in India. Toxic Plastic Waste in different forms is found to be almost 9% to 12% in municipal solid waste. Non-biodegradability of plastic in the environment has created numerous challenges for both urban and rural India. Common problems are choking of drains, stagnation of water, and release of toxic gases upon open incineration [2].

Across the world different researchers have conducted various studies and experiments to find out the most appropriate solutions to reuse plastic waste. In this context, India has played a vital role in finding out the solution of reuse waste plastic in construction of roads. Roads using plastic waste have been constructed through simple process innovation in various states and union territories like Tamil Nadu, Karnataka, Himachal Pradesh, Goa, Maharashtra, Andhra Pradesh and Delhi. The concept of “*Use of Plastic Waste in Road Construction*” was implemented in 2001 as a solution to the serious problem of disposal of Plastic Waste in India [3].

Recently in West Bengal, under the supervision of New Town Kolkata Development Authority (NKDA) a 400 meter stretch of service road adjacent to the large Mela (fair) ground in Action area-1, has been renovated and strengthened by using shredded plastic waste.

The major constituent of flexible pavement construction is the bitumen binder. It plays an important role in binding the aggregate together by coating over the aggregate thereby imparting strength to the road. However, due to poor resistance towards water and high costs involved, there is a requirement for quality bitumen at low costs. This can be achieved by modifying the rheological properties of bitumen by using additives such as plastic or rubber [4].

Generally, the shredded plastic is mixed with pre-heated coarse and fine aggregate mixture before mixing with hot bitumen. Due to this activity, a coating is formed around those aggregates, which forms a much stronger bond between aggregates and bitumen binder. Because of negligible water affinity, a water proof layer is created over the pavement causing defects like stripping of bitumen, raveling, fatigue failures, formation of potholes etc., to be reduced drastically.

Normally thermoplastics like Polyethylene Terephthalate (PET), Low Density Poly Ethylene (LDPE), High Density Poly Ethylene (HDPE), Polypropylene (PP), Polystyrene (PS) are preferred as raw material for road construction. Waste plastic that can be used include cups, carry bags, polythene and polypropylene foams and thermocol. Polyvinylchloride cannot be used as it is toxic in nature. Also, care must be taken while processing plastic at a standard temperature mentioned in the process as different plastic material releases toxic gases at different temperatures, which is only slightly higher than the processing temperature [4].

In the following table (Table 1), the different plastic materials used for road construction with the threshold temperature above which toxic gases may be released into the environment are shown:

2. Objectives of the project

Major objectives of the project are:

- To reduce the accumulation of waste plastic in the dumping areas
- To reuse plastic waste in road construction purpose
- To encourage and highlight projects that reuse plastic waste

3. Aspects of the project

3.1 Technology

Managing waste plastic by using it as construction material for pavements and roads serve the dual purposes of imparting stability and durability to the roads and resolving the issue of environmental hazard due to ever increasing waste plastics. Plastic waste can be used in hot mix to improve physical properties of bituminous aggregate mix by ‘Dry Process’ or ‘Wet

Process’. The technology as developed and explained by Dr Vasudevan, a Chemistry Professor at Thiyagaraja College of Engineering, Madurai, incorporates the use of ‘Plastone’, a mixture of stone chips and waste plastic bags (thickness 40-70 µm) which is heated at 150-170°C during production, in laying roads, pavements and flooring purposes as an alternative to interlocking paver blocks. At this processing temperature, the plastic waste is heated enough to act as an adhesive in binding stone chips and not generating any toxic gases. The aggregate becomes water proof after getting coated with molten plastic. This step is followed by the addition of hot plastic-aggregate mix to hot bitumen while maintain the process temperature. This approach is known as ‘Dry Process’. The ‘Wet Process’ involves mixing of plastic to hot bitumen followed by mixing with hot aggregate. Both the processes lead to the formation of plastic modified bituminous aggregate mix with enhanced properties imparting strength, stability and durability to the roads.

Recently, a new method called ‘Cold Mix’ has been developed which incorporates mixing of materials at lower temperatures [4].

The dry process employing 6-8% plastic waste as a partial replacement of Optimum Bitumen Content

(OBC) in Conventional Mix (CM) has been found to enhance the fatigue, strength, stiffness and hence the performance of the road pavements in comparison to wet process. For these reasons, dry process (Figure 1) has been widely accepted as a standard method for blending plastic into bituminous mix to be used for constructing road pavements [5].

In the project, implemented by NKDA, a pre-mix carpet wearing the course layer and a seal coat is laid over the existing road where 1.46 kg/m² and 0.6 kg/m² of waste plastic is utilized for construction of the wearing course and the seal coat respectively. 6% of total bitumen content has been replaced by shredded waste plastic. Generally, plastic bags (PET) of thicknesses less than 40 microns have been mixed with shredded PET bottles as the raw material.

3.2 Data

The 400 m. stretch of road, which has been renovated and strengthened using plastic waste, is also provided with various ICT-based technological installations like free Wi-Fi, charging points for e-vehicles, smart cycle docking stations, smart signage with emergency panic buttons etc. Other essential facilities like drinking water points (Water ATM), solar lighting facilities, a separate footpath and cycle track, a bus stop provided with a real-time bus information system, etc.

Plastics	Toxic Gases Released	Threshold Temperature (o C)
Polyethylene Terephthalate (PET)	Lighter hydrocarbons (C5-C10)	>200
Polypropylene (PP)	C ₂ H ₆	270-300
Polystyrene (PS)	C ₆ H ₆	300-350
Low Density Polyethylene (LDPE)	CH ₄ , C ₂ H ₆	270-350
High Density Polyethylene (HDPE)	CH ₄ , C ₂ H ₆	270-350

Table 1. List of Plastic Materials used For Road Construction with the Threshold Temperature above which Toxic gassed get released

3.3 Planning

The strengthening and renovation work done on this service road portion is certainly a sustainable work implemented by the authority.

The plan was to construct a plastic road in the area to find out the level of performance so that in the future other roads in the planning area can be treated with a plastic coating of bitumen aggregate mix. Different studies revealed that the performance life of plastic roads is longer than that of ordinary bituminous and cement concrete pavements [6].

Primarily the dry waste, collected from every household in New Town, was dumped at the Pathuriyaghata sorting yard. From where plastics like PET carry bags, bottles and other plastic materials as suggested by IRC: SP 98 2013 were separated, crushed and shredded to the size which passes through 2.36 mm IS sieve and retained on 600 microns IS sieve. Finally, it is added to the hot aggregate mixture [7].

In this project, two ramps were prepared by using the plastic paver blocks along with the plastic bitumen aggregate mix. The ramps are constructed with the objective to serve persons with disabilities to reach Swapna bhor ground and Mela ground respectively from the closest bus stops. NKDA has installed smart benches fitted with solar panels and LED screens to show different smart city projects taken up by them to increase public awareness.

Maintenance is a crucial factor in the initial phases for these roads which is not done adequately on the existing road because of which patchworks have been carried out.

Smart facilities installed here have not been taken care of, thus showing poor services. The following figure (Figure 2) shows the actual location of the smart street in Action Area I.

3.4 Stakeholders

The project was implemented solely by the NKDA. A thorough tendering process was adopted where two construction companies were given the responsibility (each of 50% shares) to do the construction work under the supervision of NKDA.

4. Project implementation

4.1 Implementation/ Installation till date

The road stretch was opened to the public on the 26th of January 2021.

4.2 Quality of implementation

The data regarding the Marshall Flow value test is not provided from which quality of implementation can be found. This project was completed in the year 2021. Yet this is early to provide critical comments on the quality of implementation.

However, the reconnaissance study in March 2022 has not revealed any seasonal issues regarding the quality of implementation. As observed, the stretch where the plastic has been re-used is satisfactory. The surveyors observed a sign of ignorance in allied facilities and services. For example, the water ATM, an important facility for the people, is not functional. In some areas, construction is going on for the development of footpaths.

The major strengths of the implementations are as follows:

- The waste collection bins provided on the street are regularly emptied
- The road is cleaned regularly

The weaknesses are:

- The smart furniture present in the road is not maintained adequately
- The footpaths alongside the smart street that were earlier damaged are replaced by plastic pavers in low pace
- The drinking water facilities are not operational
- The at-grade cycle track connecting the smart street with the service road leading to BF block requires proper renovation
- Some smart signages have been removed from the street.

All the observations have been illustrated in figures 3-4.

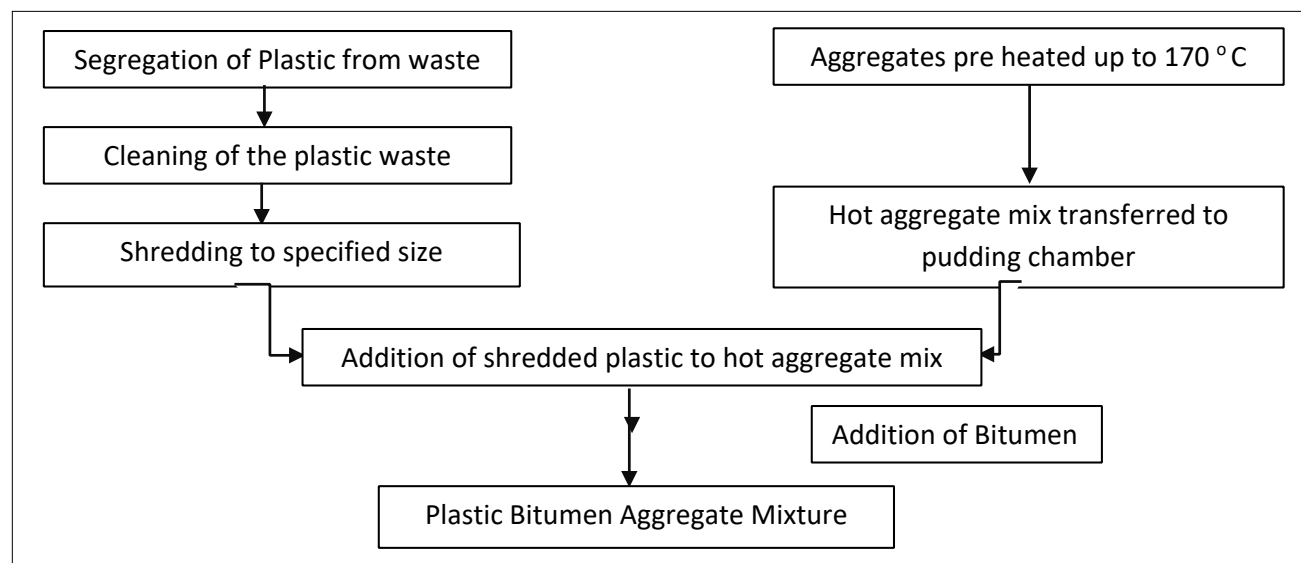


Figure 1 : Flow Chart of Dry Process of Preparation of Plastic Bitumen Aggregate Mixture

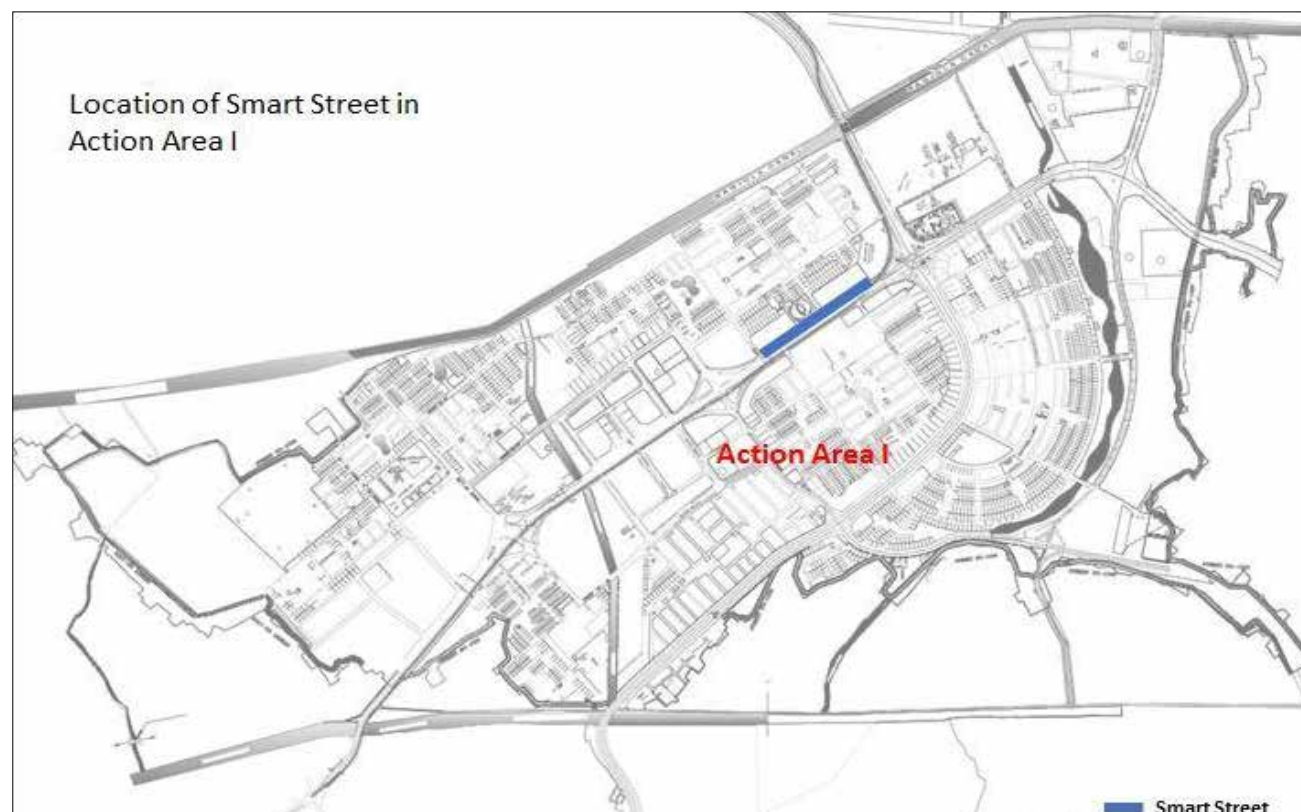


Figure 2: Location of Smart Street in Action Area I, New Town (Source: NKDA)

4.3 Operational and maintenance issues

During the reconnaissance study of this road, various issues regarding maintenance and operation have been found that were validated through public perception as provided in section 6.

5. Level of utilization

The bituminous pavement was strengthened using plastic mixed bituminous pre-mix carpet wearing course and seal coat is of length 400m of each lane and widths 10.2 m and 7.5 m respectively. Two ramps using plastic paver blocks were also constructed along with the road.

An estimated amount of Rs. 57, 07,588.00 (Rupees fifty-seven lakh seven thousand five hundred and eighty-eight) including 12% GST, 1% Cess and 3% Contingencies were spent on project implementation.

6. Feedback from users and other stakeholders

According to the implementing agency NKDA, the project cost was comparatively less than the conventional strengthening and renovating process adopted normally. The agency also expressed that this road till now has not required any considerable maintenance works like the bituminous pavements.

To assess the quality of the street as well as the performance of these facilities public opinion was collected. According to the public opinion gathered around 67% of the inhabitants prefer the street for walking and 33% prefer biking on the street on daily basis (Figures 5 and 6). Actually, at the time of any fair taking place in the New Town Mela ground, this stretch of the road becomes filled with lots of people and paratransit modes. The rest of the time of the year does not experience this kind of public gathering.

The pavement had already been gone through several patch works rendering an uneven riding surface for the users. On the other hand, the riding quality of the footpath and cycle track is far better than the road pavement although in some parts maintenance works is still going on.

When the participants were asked about their experience of using the ICT installations on the road the picture of negligence got revealed. The entire street is covered under CCTV surveillance, but the charging points of electronic devices installed are currently non-operational and damaged. The open access for Wi-Fi presently is restricted. Charging points of E-vehicles are installed at the end of the street are found to not be operating properly. The drinking water facility installed here was found fully closed at the time of the

study. Street lights and sitting/resting areas were found adequate but not properly maintained. To document the public perception a five-point scale was formulated (Very good/Good/Moderate/Poor/Very poor) (Figure 7).

7. Gaps in the project

Re-use of plastic in the development of roads is a successful practice. New Town, as a smart city, has successfully adopted and implemented the practice. It was informed by the NKDA authority that a 400 m. stretch of road near the mela ground has been developed by re-using plastic, however, the experiment may be repeated in some suitable areas of New Town. Although, the surveyors hardly found any planning or fiscal gap of the project, still, there is a lack of maintenance in the area.

8. Inferences and Recommendations

NKDA may venture to recreate similar project, if possible, in suitable areas of New Town. Moreover, the experiments may be done where there are more accumulations of pedestrians. Appropriate street furniture, as well as smart appliances, may be installed along with proper maintenance. The operation and maintenance may be done through a public-private partnership model. Additionally an awareness generation campaign may be organised for the inhabitants.



Figures 3 & 4 showing the patchwork conducted in Smart Street and undergoing construction of the footpath.
(Source: Team of IEST Shibpur)

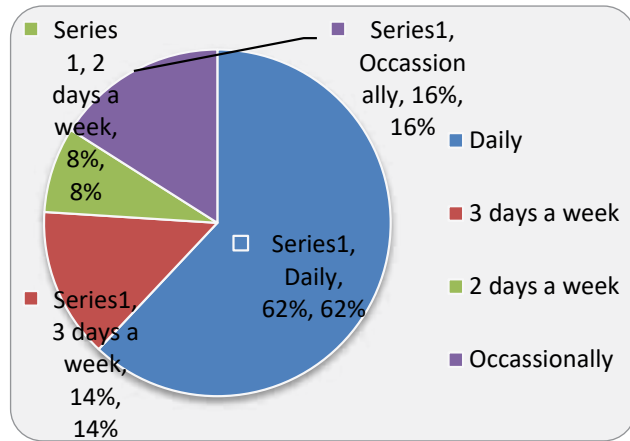


Figure 5 Frequency of Use of Smart Street

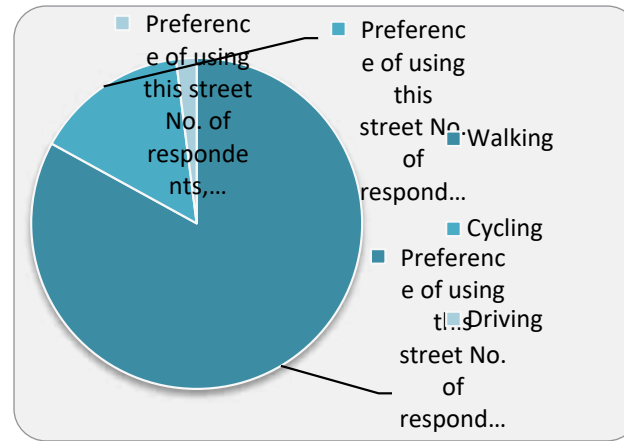


Figure 6 Mode of transportation preferred by the respondents

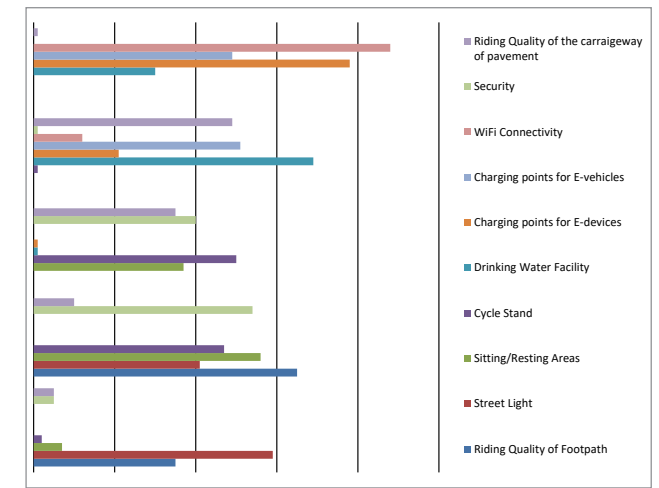


Figure 7 Level of Satisfaction of the users regarding the performance of the Street and its Utilities

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C111

A critical appraisal of Real-Time Passenger Information Display System (RPIDS) for public bus stops in New Town Area

Name of the project: A critical appraisal of Real-Time Passenger Information Display System (RPIDS) for public bus stops in New Town Area

Location: New Town Kolkata

Year of project implementation: 2020

Sector: Heritage and Open Spaces

SDGs: SDG 3, SDG 8, SDG 9, SDG 11

Institute: Indian Institute of Engineering, Science, and Technology, Shibpur

Advisors: Dr. Souvanic Roy, Dr. Soumen Mitra

Students: Mr. Pranoy Kr. Mondal, Ms. Trisha Barui

Keywords: Solar Panels, LEDs

Abstract:

The NKDA authority targeted to provide the Real Time Passenger Information Display System (RPIDS) in various bus-stands to make people aware about the route-wise real time bus timings, arrival and departure as a part of Smart City Mission. It was also felt that the display system would improve real time information system by reducing uncertainty in waiting time well as tracking the bus operations digitally. In spite of the unprecedented COVID-19 pandemic during 2020-2021, NKDA has successfully installed smart PIS in 29 bus stops. The reconnaissance survey in March 2022 revealed that the implementation of the project in most of the bus stands was appreciable based on the budgets approved. NKDA took also a smarter approach in providing some other facilities and accessories in some of the bus stops. The displays are working 24X7. The bus stops are also used all day long. There is no such evidence that people complain about the system.

Case Study: C11

1. Relevance of the project in the urban context of New Town

New Town of Kolkata is primarily characterized by sectoral land use development and intense connectivity with wide arterial and sub-arterial roads. Buses act as the major spine for intra- as well as inter-regional trips. Due to longer trip lengths within the city, paratransit modes are often infrequent and inadequate.

Since the commuters primarily rely on bus services, the New Town Kolkata Development Authority proposed for a real-time passenger information display system (RPIDS) for public bus stops in the New Town Area to facilitate the passengers waiting in the stop by updating the operational timing like arrival or departure of a particular bus. The introduction of the dynamic display system adds value in making the system smart and prompt.

In 2019, the project was offered to Webel Technology Ltd. (Government of West Bengal undertaking) for proposing the features of the system and developing the technical details. A detailed report was submitted to NKDA by Webel Technology Ltd. [1].

The proposal covered installation of robust LED displays along with audio systems in 30 bus stops across New Town to provide predictive real-time bus availability. The initial smart bus stops were inaugurated in November 2020 [2].

2. Objectives of the project

The authority targeted to provide real-time display system in various bus-stands for people to be aware about the route-wise real-time bus timings. It was also observed that the display system would improve real

time information system by reducing uncertainty in waiting time well as tracking the bus operations digitally.

3. Major aspects of the project

3.1 Technology and Data

As per the technical report of Webel Technology Ltd. – “A passenger information system (PIS) is an automated system for supplying users of public transport with information about the nature and state of a public transport service, through visual, voice or other media. Real time information is an advance on schedule-only information, which recognizes the fact that public transport services don’t always operate exactly according to the published time table. By providing real time information to travelers, they are better able to conduct their journey confidently, including taking any necessary steps in the event of delays. This helps to encourage greater use of public transport.”

While developing the system mechanism, issues like data availability and accuracy, the delivery of optimum information to the passengers and latency or response time were considered. Major technical features of the display unit comprised of the following:

- Large rectangular LED format has been installed above 8’ from the floor level to enable clear view to all passengers waiting at the stop
- Five lines have been fitted in the display with font size 2”
- Hard casings have been provided to reduce threats
- The real-time bus running data have been accurately incorporated with a localized compute engine.

- Intelligent decision making algorithms have been adapted to display 5 rows with an auto overwrite feature.
- Automated vandalism detection system
- Auto-location based geo-fencing systems
- Auto-detection of power outing

The analytics of the data collection and storage incorporated – (a) day to day analysis and storage of data, (b) collection of bus-stop wise report, (c) cross referenced analytical report with citizen feedback system and (d) auto alters mechanism.

The smart display systems that are audio enabled are installed in different bus stops in New Town. There are sensors placed at all bus stops, as soon as a bus enabled with the tracker crosses the sensor the next bus stops’ display units get updated with the expected time of arrival of that particular bus.

3.2 Other design issues

Apart from the display units installed at the bus stops, the authority has also planned to embed adequate solar panels on the roof to reduce the overall electricity load. The designed bus stops also have plans for incorporating smart benches and relevant advertisement boards.

4. Project implementation

4.1 Implementation till date

Despite the unprecedented COVID-19 pandemic in last two years, NKDA has successfully installed 29 smart PIS in various bus stops (mentioned below, source: NKDA).



Figure 1: Display board installed at a bus stop
Source: Team of IEST Shibpur



Figure 2: Bus Stand at Alia University
Source: Team of IEST Shibpur

1.	DLF-I (end of bridge)	16.	Prakriti Tirtha-II
2.	DLF-I (subway)	17.	Westin
3.	DLF-I (subway)- opp. Side	18.	Rabindra Tirtha-I
4.	Nazrul Tirtha-1	19.	Tata Cancer
5.	Novotel	20.	TCS
6.	Swapnabhor	21.	Alia 1
7.	Rabindra Tirtha-I	22.	Alia 2
8.	Prakriti Tirtha-I	23.	TCS
9.	Mishti Hub	24.	Unitech Gate-1
10.	Akankha	25.	Eye Hospital
11.	City Center-II	26.	Newtown P.S.
12.	7th Rotary	27.	Techno India College
13.	Akankha	28.	Rabindra Tirtha-II
14.	Mishti Hub	29.	1st Rotary
15.	Owl More		

Source: NKDA

Figures 1 and 2 indicate the condition of various bus stops in action area I of New Town along with installed PIS display boards.

4.2 Quality of implementation

The reconnaissance survey reveals that the implementation of the project in most of the bus stands were appropriately done as per the budgets approved. While NKDA has also suitably provided service facilities and accessories in some of the bus stops, the following are the details: :

- 13 new bus stops have been remodeled with RPIDS & water ATMs all over New Town.
- 3 smart bus stands developed with smart benches, water ATMs, RPIDS, nearby toilets/ food kiosk. Two of them are located near Aliah University based on the demand, and one has been installed near Coal India office.

- All the bus stops on Biswa Bangla Sarani, a major Arterial road at New Town, have RPIDS installed.
- The 13 new bus stops have space allocated for water ATMs that are yet to be installed..

4.3 Operational and maintenance issues:

- A few of the RPIDS at bus stops along the Biswa Bangla Sarani are not functioning.
- The systems that are not functional are not repaired immediately.
- Street sweeping and bus stop cleaning happens regularly but only in the ground/ floors The displays and sensors and solar panels are exposed to dust and dirt decreasing their efficiency.
- There was no evidence of malpractice or theft of any display units

5. Level of utilization

The displays are working 24X7. The bus stops are also used all day long. There has not been any complains/ grievances from people about the system.

6. Feedback from users and other stakeholders

The service providers are anticipating the implementation of more new bus stops. A plan to remodel all the bus stops in the long run is currently under consideration.

The citizens are satisfied with the service as it is still new and well-maintained. While it is observed from stakeholder's interaction that a few of the aged people preferred the conventional system of public bus boarding, a lot of the younger generation considered the new system to be smart and effective. A survey questionnaire was developed to get the feedback of operation and utility of the RPIDS. The survey had

factual as well as perception based questionnaire. Overall impression are as below:

- More than 80% of the respondents visit bus stops regularly or thrice a day.
- The age of the respondents varies between 25 to 58. Most of the passengers stay in action area 1 of New Town.
- 90% of the respondents sh\ rated the quality of the system as average. Respondents were asked four questions on their level of satisfaction on the performance of the service. These are – quality of the bus stands, accuracy of the bus timings, display quality and availability of the information. More than 60% answers were 'moderate to good'.
- A small number of respondents shared that they want audio information in some other language, preferably in Hindi. Many also shared that they do not prefer English as an audio language.
- A few in viewing the display boards during rainy seasons and crowded situation.
- Respondents shared that there are problems in regularity of bus operations. Sometimes, the frequency of buses plying in a route decreases.
- Respondents shared that there needs to be better last mile connectivity such as auto and rickshaw stands by the bus stands

7. Gaps in the project

The buses do not have live trackers because of which there is a latency in the display of information. h

8. Inferences / Recommendations

Buses need to have live trackers enabled for the system to function smoothly.

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C12

Smart Cycle Stand(s) and App-based Bicycle Sharing System at New Town (Rajarhat), Kolkata

Name of the project: Smart Cycle Stand(s) and App-based Bicycle Sharing System

Location: New Town (Rajarhat), Kolkata

Year of project implementation: 2022

Sector: Mobility/NMT

Project Cost (Rs. Crore): 34 Lacs

SDGs: SDG 11

Institute: Indian Institute of Engineering, Science, and Technology, Shibpur

Advisors: Dr. Souvanic Roy, Dr. Soumen Mitra

Students: Mr. Pranoy Kr. Mondal, Ms. Trisha Barui

Keywords: Bicycle Sharing, cycleability, Smart Cycle Stand.

Abstract:

The smart city mission for New Town Kolkata Development Area (NKDA) was targeted for improvement on mobility and connectivity, creating economic opportunity, to enhance safety, security, surveillance and better quality of living. Considering the mobility and accessibility of NKDA, the smart city development plan has encouraged cycleability in the city. Since, the land use is sectoral, trip lengths are not so small to be managed by walking only. Therefore, the authority envisaged the following projects for improvement of cycleability – (a) smart cycle stand, (b) dedicated bicycle lanes, (c) e-cycle docking stations, (d) mobile cycle repair clinic and (e) private-public collaboration to introduce app-based e-cycle and e-bike rental systems.

The Smart Cycle stand, installed near DLF, is equipped with CCTV, Passenger Information System (PIS) display board, advertisement boards, mobile charging points and security person at the basement. The authority has installed 30 e-cycle stands among them 21 are currently operational. These docking centers are under surveillance CCTV for 24x7 along with Wi-Fi connections, and, mobile phone charging facilities. Around 40 Km of Cycle track has been provided by NKDA (both at grade and grade separated). All the cycle tracks are characterized by adequate signage, directions, curb and connectivity.

The survey, conducted among the stakeholders during March 2022 regarding operation and maintenance of the installed systems, reveals the following issues – (a) There is a lack of awareness among the people of New Town, especially in Action Areas II and III, (b) Smart cycle stand has been installed appropriately; however, it lacks adequate supply for parking and drinking water. Many a time, the people are compelled to park their cycles outside the designed area which is unprotected. (c) The cycle tracks and ramps are designed perfectly however, all these pathways should be cleaned regularly. Considering the harshness of the climate, necessary facilities and infrastructure (seats, trees, drinking water facilities and public toilets) should be installed in appropriate locations.

1. Relevance of the project in the urban context of New Town

In 2015, the Government of India launched one of the most acclaimed Mission “Smart Cities”. Under the mission, it was announced that 100 cities would be developed as smart cities by 2024. The Ministry of Housing and Urban Affairs (MoHUA) was tasked with the responsibility of implementing the smart city mission in collaboration with the respective cities. Under the Smart City Mission (SCM), three types of development were identified—area-based components for converting a city into a smart one were city improvement (retrofitting); city renewal (redevelopment); and city extension (Greenfield development). In West Bengal, four cities, namely New Town Kolkata, Bidhannagar, Durgapur and Haldia, were selected under the Smart City Mission in two phases [1].

Among others, New Town (Rajarhat), Kolkata was selected during the first round of smart cities selection in 2018. A total of INR 1532 crores were approved for the development of around 7000 acres covering action areas I, II and III of New Town Kolkata. The city, under the mission, targeted improvement of mobility and connectivity, creating economic opportunity, enhancing safety, security, surveillance and quality of living [1].

As a planned city with articulated land use development,

New Town possessed sectoral developments for residential, commercial and institutional areas. The network exhibited wide arterial and sub-arterial roads along with footpaths and necessary pedestrian facilities. Considering the mobility and accessibility, the smart city development plan for New Town encouraged cyclability in the city. Since land use positioning is sectoral, trip lengths are not so short to be managed by walking only. Therefore, a smart app-based cycle system was proposed along with adequate docking stations all over the town.

In 2018, World Bicycle Day was observed in Kolkata. Thereafter, HIDCO under the Ministry of Housing and Urban Affairs awarded the entire scheme of cyclability to NKDA in the urban transport category [2]. The authorities of NKDA initially envisaged the planning in the following three ways:

- A smart cycle stand adjacent to the DLF subway: This would be characterized by bicycle parking with lockable docking stations, amenities like vending kiosks, seating, drinking water facilities, tree beds etc., smart components like PIS, CCTV, advertisement panel, mobile charging points etc. The stand was proposed for the people coming from remote areas of New Town for jobs/businesses near and around the urban areas.
- Introduction of a public bicycle sharing scheme where 4500 cycles could be floated and rolled out in 400 pick-up points. The system was planned to

be app-based along with a GPS tracking system and linked to the ‘Paytm’ account. The app-based system was planned for the local people to travelling intra-zones of the city without any liability for carrying personal vehicles.

- The authority initially planned for an 11 km dedicated cycle track which formed an integrated network with arterial and sub-arterial roads of the city. The cycle tracks were planned with proper signages and markings, ramps and connections at the property entrances.

The project was discontinued in 2019 due to some management issues and later resumed in October 2020 after the notification of the Chief Executive Officer to provide free bicycle parking. Since the Smart Cities Mission announced ‘India Cycles4change Challenge’ as the global cycling movement for a sustainable post-COVID-19 green recovery, the authority of NKDA inaugurated a programme of cycling as well as, the opening of a smart cycle stand near DLF [3].

On October 12, 2020, it was reported by Millenniumpost [4] – “New Town Kolkata Development Authority (NKDA) has set up a smart cycle stand for the people to park their cycles. These people come from the villages that are situated off New Town. In the late afternoon or evening they collect their cycles and leave for their homes. The cycle stand has CCTVs, shed to protect the cycles, docking for 70 cycles, charging facility for cell phones, and e-bikes and LCD screen where they will be given information on weather and distance of various places from the smart cycle stand. All the facilities are given free of cost. There will be two security guards to look after the cycles. It has come up close to the pedestrian sub way off Nazrul Tirtha.” [4]

2. Objectives of the project

In the report of the India Smart City Mission for New Town, Kolkata developed by Urban Development, Government of India, the following objectives were envisaged:

- To develop a smart cycle stand at DLF for docking of 70 cycles along with charging facilities and resting areas
- To develop dedicated bicycle lanes along all roads of the area (120 km) and to develop ramps along bicycle tracks for the benefit of the differently abled,
- To develop 20 bicycle stands/shelters near to the bus stands, metro stations and major crossings where e-cycles and e-bikes would be docked for rental purpose
- To introduce a Mobile Cycle Repair Clinic and app-based rental cycling and biking system.
- To partner with private agencies in providing bicycles on a rental basis to citizens for commuting based on an hourly charge on the condition.



Figure 1: The Smart Cycle Stand near DLF
(source: authors)

3. Aspects of the project

3.1 Technology and Data

Smart Cycle Stand

The Smart Cycle stand, installed near DLF, is a large rectangular area on the plan. Three RCC curved roofs are placed separately. There are dividers to park cycles and the stand is proposed for the people working in the informal sector and coming to New Town on regular basis for their livelihood. The stand is equipped with CCTV, a Passenger Information System display board, advertisement boards, and mobile charging points. A security person stays in the basement. Figure 1 describes the cycle stand.

E-Cycle Docking Stations

- To promote a cycle-friendly environment, the authority has installed 30 e-cycle stands or docking stations in the city. Among them, 21 are currently operational
- These docking centres are under surveillance CCTV for 24x7 along with with Wi-Fi connections, and, mobile phone charging facilities.
- Here, only the pedal e-cycles and e-bikes, provided by NKDA, are allowed to park.
- An integrated renting app-based system has been developed for it. As a key stakeholder, Zoomcar developed the mobile application software for allocating rental e-bicycles and e-bikes
- Overall, 400 pedal e-cycles and 100 e-bikes are currently servicing inside Newtown.
- For providing repair and maintenance to these cycles during service Mobile Cycle Repairing van has been allocated by the agency.

Cycle Track

Around 40 Km of Cycle track has been provided by NKDA (both at grade and grade separated). All the cycle tracks are characterised by adequate signages, directions, curb ramps and connectivity.

3.2 Planning

An amount of Rs. 46.18 lakh has been estimated as the probable cost of expenditure for the development of the Smart Cycle stand. The Authority of WB HIDCO decided to construct the smart cycle stand adjacent to the DLF subway. To maintain systematically maintain stand the cycle in proper line without any hazard. In connection with above one kiosk was proposed to be constructed also for resting and refreshment purpose for the cyclist.

3.3 Stakeholders

The authority is looking after the maintenance of the cycle stand, docking stations and cycle tracks. The survey indicates that lots of people are using the smart cycle stand every day. The tendency of using e-bikes is rising high in New Town.

4. Project implementation

4.1 Implementation to date

There is high usage of the Smart Cycle Stand. As per the NKDA personnel, the system has been made smart with its integrated design with footpaths, service line and subway for safe pedestrian mobility. A strong vigilance on the movement of people at the stand is observed in the subway.

The following Figure (No. 2) indicates the map (source: NKDA) showing the status of ongoing and completed cycle tracks in the city.

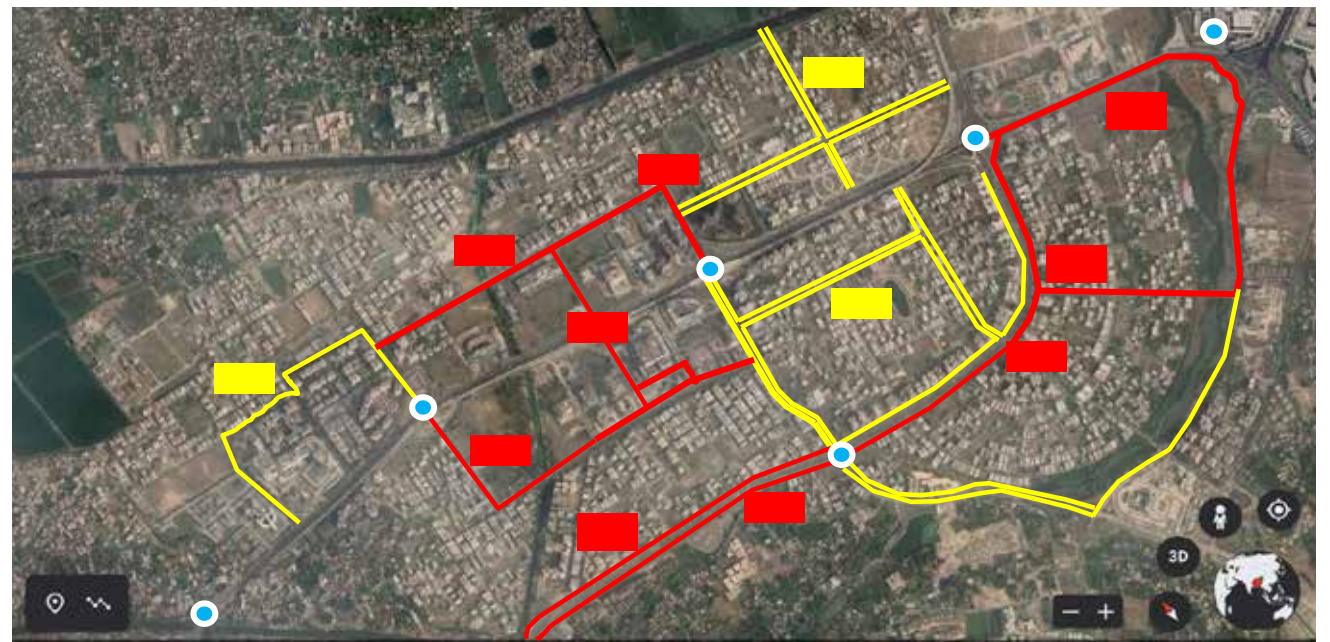


Figure 5: ABD area in the city base map
Source: Author

Table 1: Implementation of work in connection with Graded Cycle Track

Sl. No.	Location	Total Length	Completed
A.	MAR 2222 (Lohar Pool-bound Lane) from Street Number 306 Crossing to Lohar Pool	2.00 KM	2.00 KM
B	Street No. 70, 97 & 144	1.38 KM	1.38 KM
C1.	Street Number 106 & Street Number 175	8.80 KM	8.80
C2	MAR 2222 (Narkelbagan-bound lane) from Lohar Pool to NTTIDCO Crossing		
C3	MAR 2222 (Narkelbagan-bound lane) from Lohar Pool to NTTIDCO Crossing		
	Total	12.18 KM	12.18 KM

Table 2: Implementation of work in connection with At-Grade Cycle Track

Sl. No.	Location	Total Length	Completed
1.	MAR 2222 (Narkelbagan-bound lane from NTTIDCO Crossing to Narkel Bagan)- Street Number 256- Street Number 199- Street Number- 240	4.957 KM	4.957 KM
2.	Street Number 165 & Street Number 166	3.076 KM	3.076
3.	Street Number 30- Street Number 41- Street Number 46, Street Number - 70	3.210 KM	3.210
	Total	11.243 KM	11.243 KM

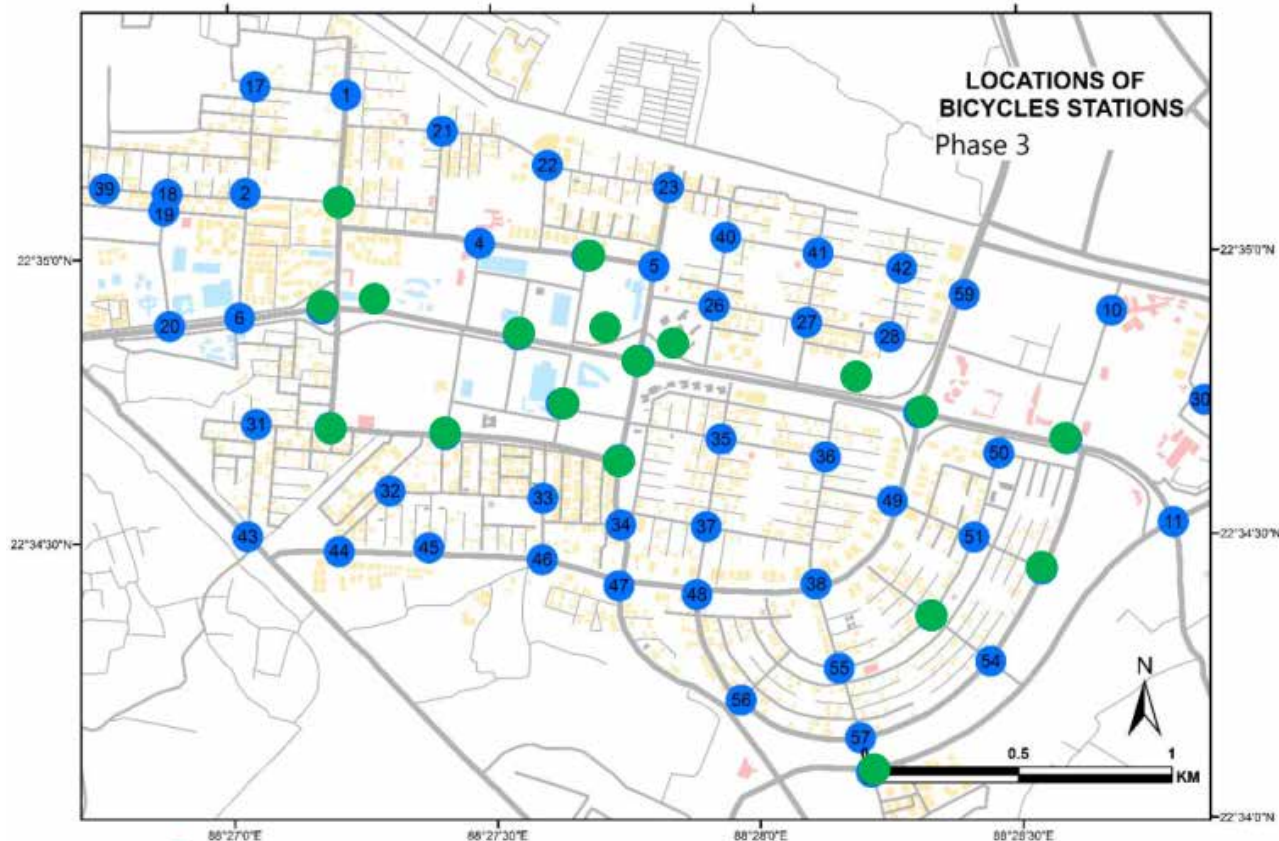
Till date, the implementation on graded and at-grade cycle stand are provided in tables 1 and 2 (source: NKDA).

Following figure (No. 3, source NKDA) indicates the current locations of cycle docking stations (implemented) in phase 3 of Action area I.

4.2 Quality of implementation

There is no such grievance observed in the quality of implementation of smart cycle stand, cycle docking station as well as cycle tracks. However, the tasks are mostly concentrated in action area I, while, many people staying in action areas II and III are unaware about the smart projects.

Cycle Docking Stations in Action Area I



● Location of Cycle Docking Stations in Action Area I (Indicative Location)

(In addition to this there are 4 Docking stations in Action Area II, near Coffee House, Eco Urban, Pencha-r More & Akankha More)

Table 3: Utilization

City	Date	Month	Total Trips	Total Distance(km)	Carbon Offset (kg)
Kolkata	2022-03-01T00:00:00	Mar-22	20076	42210.75	10541.70
Kolkata	2022-02-01T00:00:00	Feb-22	12507	27562.36	6815.19
Kolkata	2022-01-01T00:00:00	Jan-22	4241	12286.26	3016.64
Kolkata	2021-12-01T00:00:00	Dec-21	9027	20829.46	5161.15
Kolkata	2021-11-01T00:00:00	Nov-21	12795	22272.54	5396.38
Kolkata	2021-10-01T00:00:00	Oct-21	19291	31844.44	7555.39
Kolkata	2021-09-01T00:00:00	Sep-21	6489	14166.15	3559.72
Kolkata	2021-08-01T00:00:00	Aug-21	5050	18288.57	4454.66
Kolkata	2021-07-01T00:00:00	Jul-21	4864	14307.45	3583.53
Kolkata	2021-06-01T00:00:00	Jun-21	898	1166.31	289.88
Kolkata	2021-05-01T00:00:00	May-21	2412	5440.16	1337.07
Kolkata	2021-04-01T00:00:00	Apr-21	4059	6057.47	1489.14
Kolkata	2021-03-01T00:00:00	Mar-21	4345	7424.69	1834.27
Kolkata	2021-02-01T00:00:00	Feb-21	3638	8755.78	2176.41
Kolkata	2021-01-01T00:00:00	Jan-21	5739	11840.05	2933.45
Kolkata	2020-12-01T00:00:00	Dec-20	5453	9935.06	2425.22
Kolkata	2020-11-01T00:00:00	Nov-20	5050	13180.71	3253.51
Kolkata	2020-10-01T00:00:00	Oct-20	4536	8475.61	2071.75
Kolkata	2020-09-01T00:00:00	Sep-20	100	87.7	20.63

4.3 Operational and maintenance issues

Although the quality of implementation is appreciable, however, there is a lack of maintenance of the smart cycle stands. The survey reveals that there are problems in regards to cycle security many more cycles are parked in nearby areas, especially near large trees. A row of paratransit vehicles is dominating the movement in this area. There is no such water facility in and around the smart cycle stand. Some respondents opined that there are problems in docking the cycles during rainy seasons.

E-bikes are much preferred over e-cycles. However, proposals on increasing the number of cycles were not heard.

The maintenance of cycle tracks is moderate. The signages help pedestrians to move safely and easily. However, it cycling can become tiring during summers or hot days, which highlights the need for incorporation of shading (trees) along the cycle tracks.

5. Level of utilization

The smart cycle stand is overutilised thus requiring more parking units, more e-bikes, and more security features in the stands.

Table 3 (source: NKDA) indicates the utilisation of app-based cycling and e-biking since its inception (September 2022):

6. Feedback from users and other stakeholders

A reconnaissance survey including a structured questionnaires conducted in March 2022. People moving/working near the smart cycle stand were asked questions on facts and figures as well as their perceptions regarding the subject.

Initially, the questions were framed on their trip characters. It has been observed that most of the respondents stay in action area I or II. Age ranges between 22 and 58.

Further, eight questions were asked on facts and figures regarding service, maintenance, space utilization, climate responsiveness, security, facilities and financial implications. Lastly, people were asked to scale their perception regarding 'level of utilization' through cleanliness, repair and maintenance, level of security and attitude of security personnel. The answers are summed up in table 4.

About cleanliness, the smart cycle stand on the scale of moderate to bad. This is the same for repair and maintenance. There is no adequate security in the stand, as shared by the respondents.

The primary survey has revealed that except for the smart cycle docking stations, and other smart cycle

stands where people park their own bicycles, the status of security is very poor. Facilities like Wi-Fi, and mobile charging points are not operational in the majority of the stands.

7. Gaps and Inferences

Following gaps were identified upon interaction with the NKDA personnel as well as respondents on the streets:

- There is a lack of awareness among the people of New Town. It covers specifically in action area I. People from the action area II and III are less aware about the projects. Even the utilities of the smart systems are not clear to the people.
- Smart cycle stand has been installed appropriately; however, it lacks adequate supply of parking space. Many a time, the people are compelled to park their cycles outside the designed area that are not under surveillance. The strategic location of the cycle stand make the movement easy for the people, however, more numbers of similar stands are required. The design is modern and contemporary, however, the utility in rainy seasons / adverse situations must be considered. A functional drinking water facility is necessary at the stand.
- More e-cycle docking stations are required in action

area II and III and those are yet to be implemented. Only 21 out of 30 are functioning. A survey can be conducted to explore the demand of e-bikes. A separate proposal may be given in connection with e-bikes.

- The cycle tracks and ramps are well designed

however, all these pathways needs to be cleaned regularly. Considering the harshness of the climate, necessary facilities and infrastructure (seats, trees, drinking water facilities and public toilets) can be installed in appropriate locations.

Table 4: Responses of the users

Sl.	Questions	Yes	No
1.	Do you face the issue of unavailability of space while parking in peak hours?	60%	40%
2.	Do you require display information regarding availability of space?	100%	0%
3.	Do you pay any money for availing the service?	0%	100%
4.	Are there any security personnel present to look after the cycles parked?	0%	100%
5.	Have you faced issues like damage or theft of cycles from this stand?	40%	60%
6.	Do you face any problem during monsoon season?	100%	0%
7.	Is there any repairing facility for emergency?	20%	80%
8.	Do you require facilities like drinking water points, public toilet etc. adjacent to the stand?	90%	10%

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C13

Urban mobility - Wayfinding Signage and Vertical Gardens

Name of the project: Vertical Gardening under flyover from Dogra Chowk to KC Chowk.

Location: Jammu, Jammu & Kashmir

Year of Project Implementation: 2020

Sector: Mobility

SDG: SDG 11 (sustainable cities and communities)

Project Cost: Rs. 1074.36 lakhs

Institute: Jamia Millia Islamia, Delhi

Advisors: Dr. Hina Zia, Dr. Nisar Khan

Students: Anand Khatri, Nitesh Dogne, Anam Ibraheem

Keywords: Urban Mobility, Vertical gardens, Way Findings, Signages, City Imageability

Abstract

With an aspiration of the city of Jammu to be a world-class city--a city for the people of Jammu, and in line with its image as a historic centre, trade route, capital city, and a union territory--two projects were identified from the commuter's view of the city. These are the wayfinding signs and a small area where vertical gardens were constructed for Smart mobility. Any city of the 21st century is alive and aware. 'Signages and beautification' is the administrative wakefulness and helps direct the commuters to their destinations and improve the aesthetics of the pillars of elevated roads and highways that had punctured the connection of the two parts of the city that appear as a fan across the plains of the river Tawi. Signages across the highways and peripheral roads help commuters reach their destinations in the engaging geography of Jammu. These have been executed as per the Indian Road Congress (IRC:67-1977) and the NHAI. The vertical garden project under the Smart City project in Jammu contributed to the rejuvenation of deteriorating spaces under flyovers which were initially filled with stench as they worked as a garbage dumping area. The civic and administrative authorities identified this as a Smart thinking change over. It carried an aesthetic and a makeover agenda as a message to the residents of Jammu. Since the green was not just the conventional green but vertical and was accompanied by creating a place for the people in the night with fountains, and night-lighting, which aided in creating a bright spot in a dingy patch. It was a strong message of involvement of technology and better decision-making. The Spirit of reducing pollution with the help of green cover, environmental sustainability, and increasing green cover is the undercurrent of this work along the stretch of Dogra chowk - KC chowk flyover. The heavy vehicular traffic due to the proximity of the city bus stand, Jewel chowk car park, and adjacent commercial, along with the neglected spaces causing a blight under the flyover needed this inventive intervention. Its aesthetic tries to compensate for the heavy concrete visibility in the city. Due to the shortage of space for large-scale intervention, the vertical garden project provided a small-scale effective solution for the city. To further reduce pollution throughout the flyover, stretch water curtains with changing light features were implemented.

Case Study: C13

1. Introduction

1.1 Topic and Context

Jammu is the winter capital of the Indian union territory of Jammu and Kashmir. Jammu is known as the City of Temples for its ancient temples and Hindu shrines; therefore, it is the most visited place in the union territory.

The site selected for implementation of the Vertical Garden project under the Smart City project is a flyover stretch from Dogra chowk to KC chowk. The flyover begins from the first Tawi bridge, passes Dogra chowk, KC chowk, and ends about 100m from Indira Chowk. The stretch from Dogra chowk to KC chowk is about 1km, with sporadic breaks at various chowks.

The city has JKSRTC city buses and mini-buses for local transport, which run on some defined routes. These mini buses are called “Matadors”. Other interstate buses are present throughout this 1km stretch, which shuttle from Dogra chowk/Jewel chowk to Katra, Nagrota, SMVDU etc.

Jammu, a major transit city, has a total population of 5,02,197 (2011) and around 20% of the city population falls under the floating population. Due to its location, it assumes importance on the linkage to Kashmir, Ladakh, Doda, Rajouri, and Poonch. Jammu is also well connected by road and rail to the major cities of Punjab and Himachal Pradesh. Hence, the stretch from Dogra chowk to KC chowk was taken up for the vertical garden project under the Smart City project due to its major role as a transit hub.



Fig.1 Map of Jammu

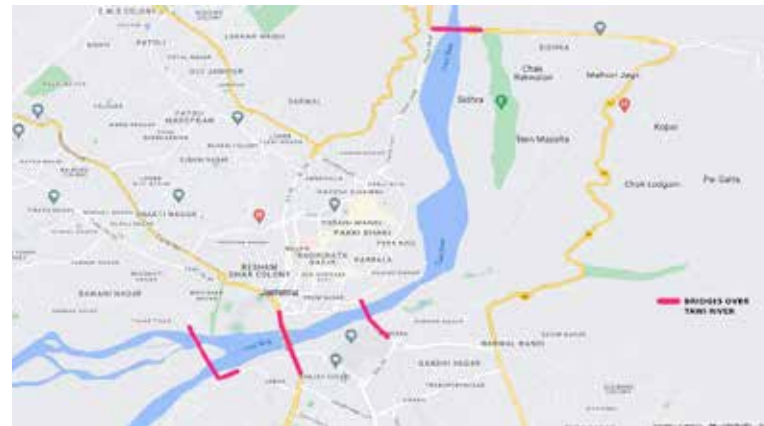


Fig.2 Map of Jammu with bridges and road network

Source: Google Map Accessed Dated on 27 March 2022 IST19.00hrs Compiled by (Author,2022)

1.2.A Significance of the project Vertical Garden

The Jammu flyover, from Dogra chowk to KC chowk is the busiest stretch with heavy vehicular traffic due to proximity to the city bus stand, Jewel chowk, and the commercial area along it. The spaces under these flyovers were left in a deteriorated state with issues such as garbage disposal etc. The lack of open green spaces along the flyover stretch, increasing pollution levels, lack of vending and hawking zones, and no pedestrian walkways for the people demanded solutions that would contribute to all these issues in the city.

The vertical garden project along the busiest stretch from Dogra chowk to KC chowk is a small-scale solution contributing to the city’s aesthetic aspect. On the other hand, commercialization along the Jewel chowk and vending activities along the stretch of Dogra – KC chowk [Ref Image 3] have also contributed to the increase in footfall in the area, leading to an increase in illegal activities, noise and air pollution due to the increase in traffic.

The vertical garden project in Jammu city evolved with the concept of the undeveloped spaces below elevated highways or flyovers that have the potential to be transformed into major corridors, gathering areas or recreation spaces that

1.2.B Significance of the project Wayfinding and signages

The proposed Way Finding Signages are to be placed in accordance with the laid down norms as per IRC 67-2012 at all major identified public and tourist places. Way Finding Signages are one of the essential social infrastructure components under the Smart City project.

Importance of Road Signages in Jammu City:

The road signage in Jammu City is intended to provide

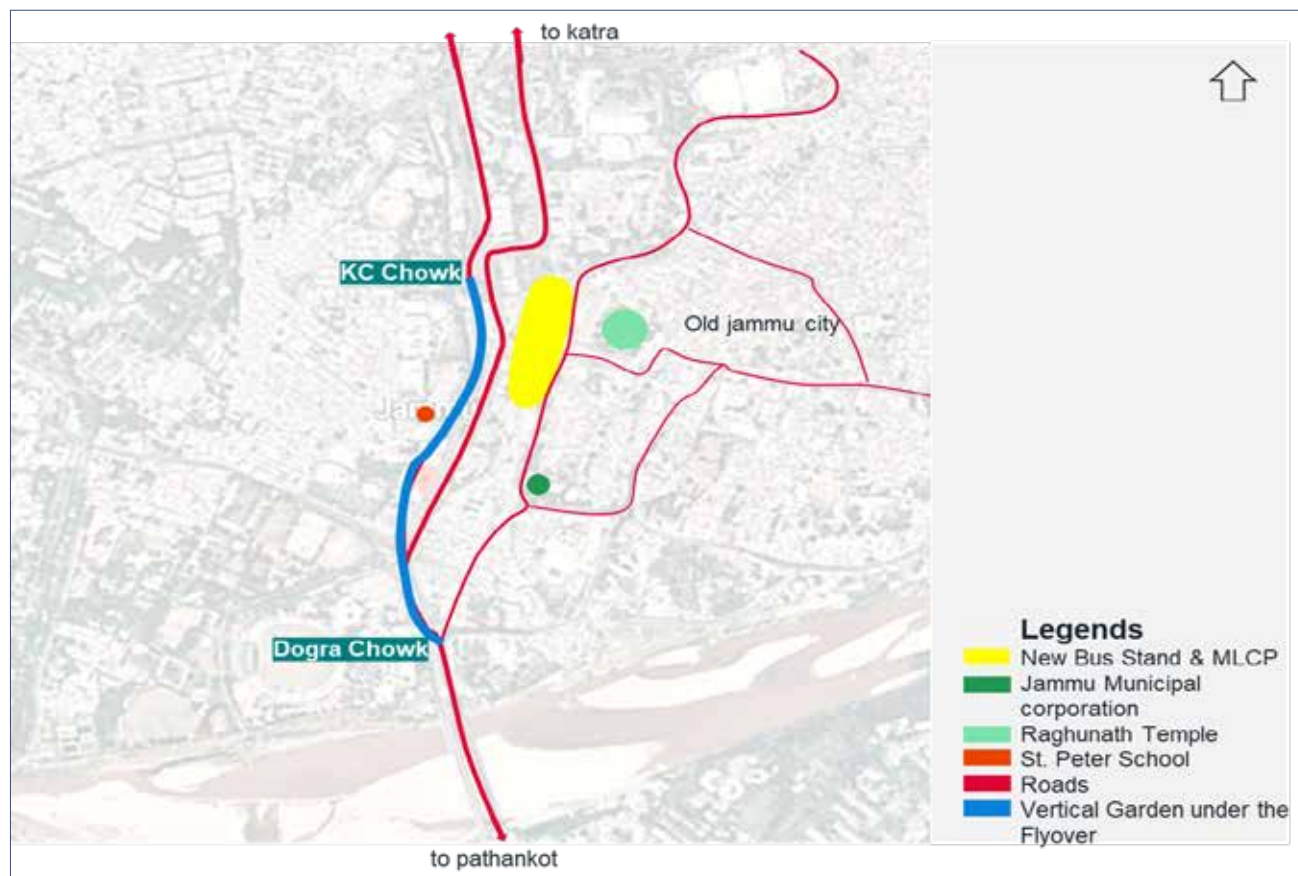


Fig. 3 Location Map showing Dogra chowk – KC chowk

Source: Google Map Accessed Dated on 27 March 2022 IST19.00hrs Compiled by (Author,2022)

the needed information distinctively with adequate clarity and prominence so that citizens and tourists will never feel inconvenienced in searching desired destinations and/or finding facilities in the same. The works should also add aesthetic value to the public information system in the city.

The main objectives of the road signage works are:

- Ensure that the establishment and existence of road signage in the city roads
- Highlight attractions and services, locations.

1.3 Aim and Objectives Vertical Garden

Problem statement

The prime objective of the Smart City Mission is to make the city sustainable from every aspect. Environmental sustainability is a primary consideration. Increasing solar energy usage, green cover, proper solid and liquid waste management, and promoting rainwater harvesting will make Jammu more environmentally sustainable.

The primary purpose of this project is to make the city clean and green. This way, it also controls air pollution. Earlier, the area under flyover was neglected and was filled with garbage. There was a shortage of space in cities so the government came up with the idea of a vertical garden.

1.3a The city's vision and how the project has been ideated/aligned w.r.t the vision.

The vision of the city under the Smart Cities Mission, is to make a sustainable and livable environment, addressing all issues big or small and providing appropriate solutions for the same. The primary goal that aligned directly to the vertical gardens project was to reduce air pollution along the flyover stretch and use neglected spaces with issues related to urban blight under the flyover.

Due to the shortage of space, spaces under flyovers were identified for the implementation of the vertical garden project.

1.4 Aim and Objectives: Wayfinding and signages

The road signage works in Jammu city are intended to provide the locational information distinctively with adequate clarity and prominence so that citizens and tourists will never feel inconvenienced in searching for desired destinations and/or finding facilities in the city. The work should also add aesthetic value to the public information system in the city.

The main objectives of the road signage works are. [Ref Fig 4]

- To provide road signage on different localities of the city.
- Ensure that the establishment and existence of road signage in the city roads.

2. Contextual Background Vertical Garden

2.1 Brief project description - outline. Vertical Garden

Brief project description - outline

Vertical gardens are particularly suitable for cities as they allow good reuse or regenerate the spaces of available vertical surface area. The project was initiated under the Smart Cities Mission initiative, which involves covering flyover columns with vertical gardens and a bio wall system to beautify the entire stretch. [The Hindu, 2021]

Vertical gardens are particularly suitable for cities as they allow reasonable use of the available vertical surface area.

Twenty-five pairs of piers of the flyover between Dogra Chowk and KC Chowk have been covered, and around 42,000 plants of 12 different species are strung on bio-panels with a plantation-dedicated drip irrigation system. [The Hindu,2021] The vertical garden, also known as the green wall or the living wall, is self-sufficient and is attached to the exterior or interior walls of a building.

According to the UT administration, the two cities have been chosen under the smart city projects, and different works have already started. The vertical garden project on the pillars of the flyovers has completely changed the area's look. Smart vertical garden projects are being

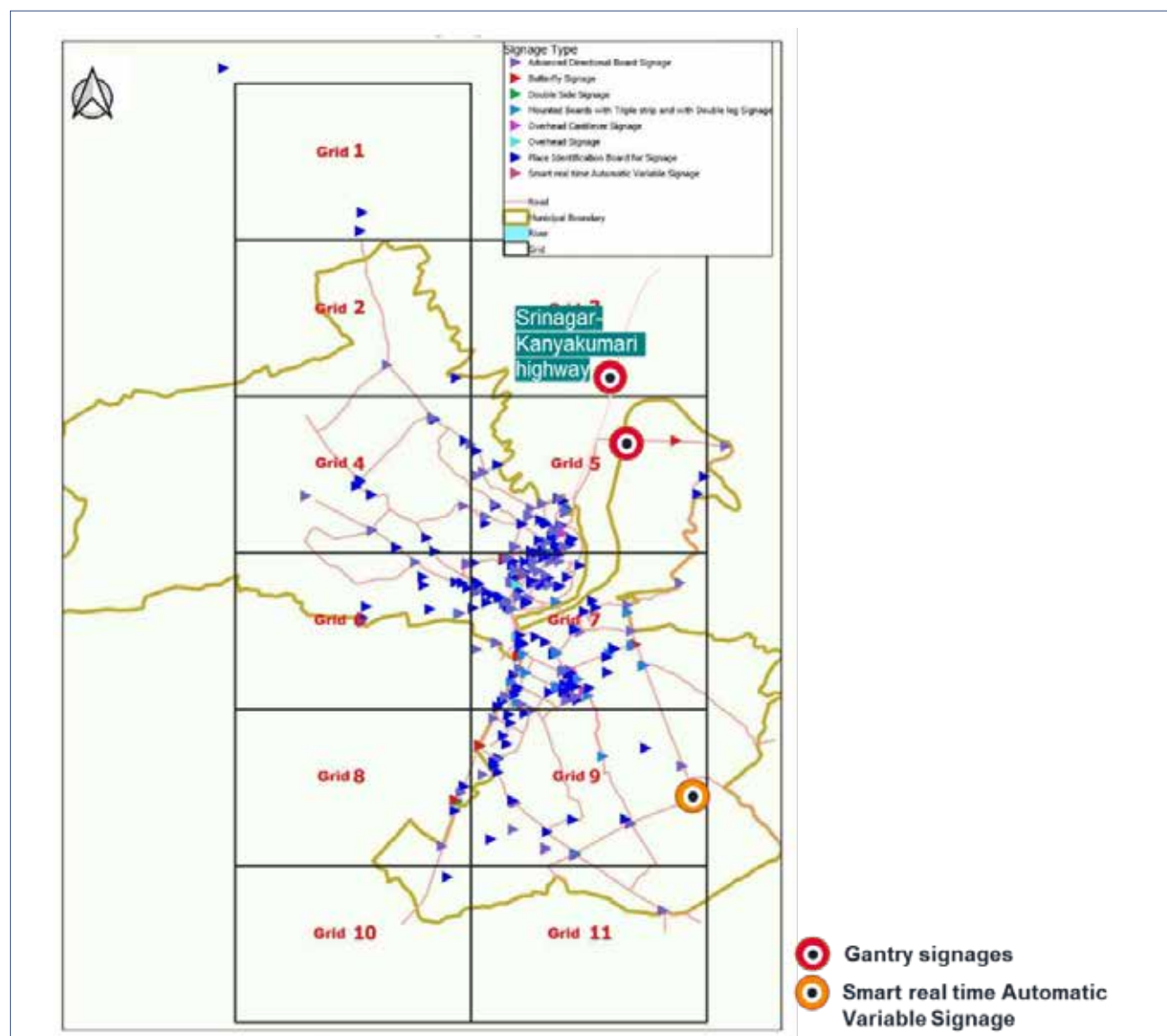


Fig: 4 Location of Signages

Source: Retrieved from DPR, Jammu Smart City, 2022

supplied water by digging bore wells in between the flyover pillars. Also fountains are to be implemented. Specific issues faced by people due to the delay of construction are roadside accidents, no space for pedestrians to walk, crossings being compromised at the old flyover site etc.

Projects for the installation of vertical gardens have started, but the sites have been dug out and left untouched without further notice of work completion.

2.2 Key features of the project

2.2.3 Challenges in the project

- Relocation of social infrastructure present at the site
- Relocation of Shops
- Implementation of the project phases on the scheduled time
- Inter-departmental coordination among key stakeholders

2.2.4 Risks involved in the project

- Lack of safety due to levels
- Non-maintenance of the infrastructure
- Vandalism of the infrastructure

2.2.5 Features and Benefits (social, technical, city administration level, impact on environment and economy) to the city (expected and observed)

- Linked and comprehensive development of social and physical infrastructure to accommodate the requirements of the business class as well as ordinary citizens.
- Combination of pit puzzle, overground puzzle, and conventional parking. (JDA)

2.6 Key features of the project Wayfinding and signages

2.3.1 Challenges in the project

- Reviewing the positioning of the signage of underground sewer line and other supply pipes
- The recent road development brings about the lines of electric poles to lie in continuation along the footpath.
- The series of poles resulted in shifting the signage to unfeasible distances, making them unable to maintain complete visibility.

2.3.2 Features and Benefits (social, technical, city administration level, impact on environment and economy) to the city (expected and observed)

- It will save the time for the road users to reach

their destination

- The signage will be the directional link in communication between the municipal corporation of Jammu and the visitors to the city.
- The signage will reassure visitors that they are travelling in the right direction, give advance notice of locations and services, and direct visitors to tourist locations

2.3.A Key findings from the interviews, surveys, and primary/secondary data collection [Vertical Garden]

Land Monetizationscaping: The railings need to be removed for visual continuity and to utilize the space for the plantation. A walking plaza under the flyover is proposed. If provided, active areas like kids' play, reading, and senior citizen areas will further increase the traffic and add to the chaos. The proposal is limited to vertical gardens on piers with the area below developed as a green space with a walking plaza, seats at regular intervals with aesthetic lighting. Free standing water curtains shall be added between the piers along the length at suitable locations. By transforming urban environments with green facades and living walls, cities will become more livable, cooler, and quieter.

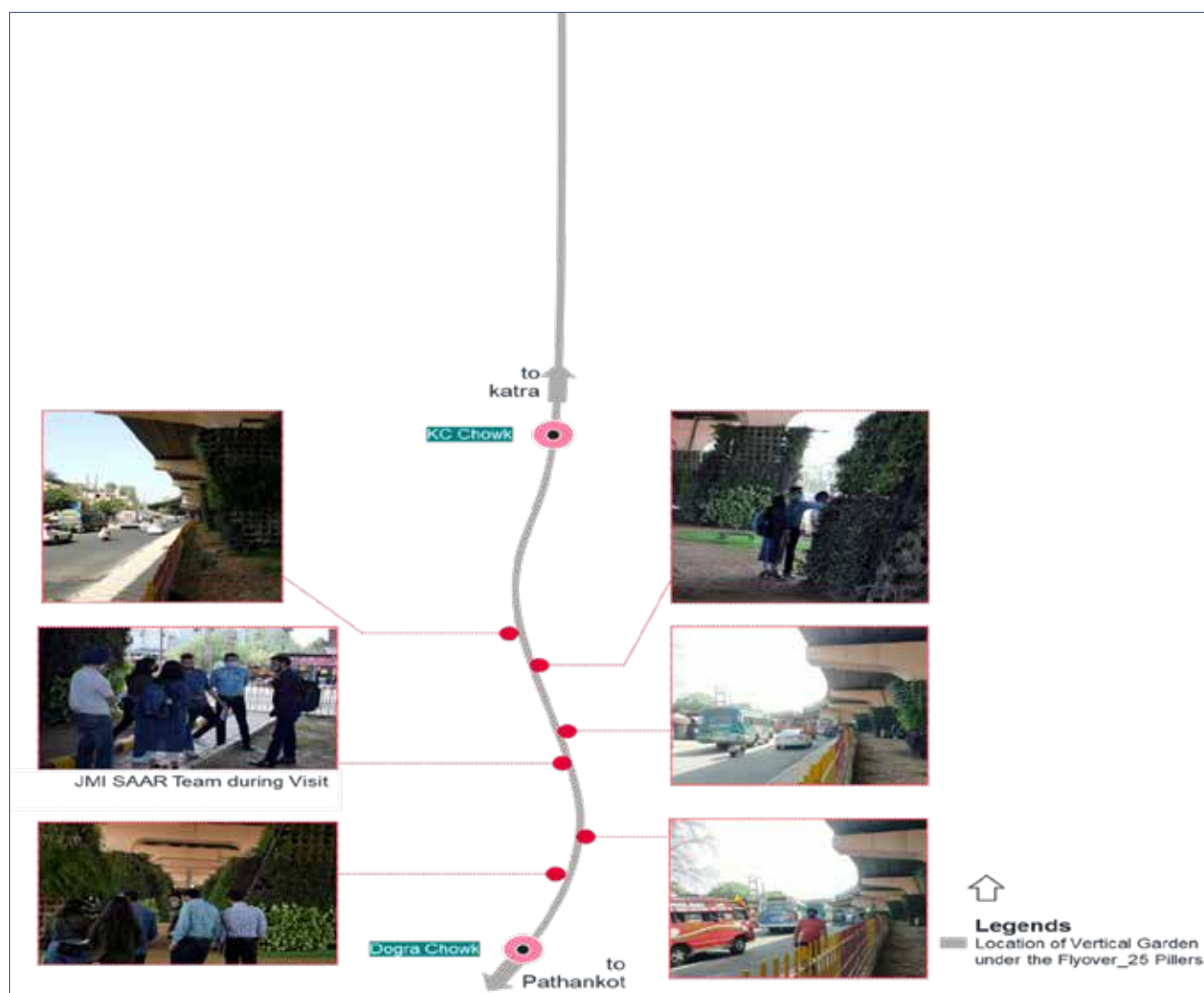


Fig. 5 Location and photographic essay on the vertical garden project

Source: Photos and Graphics by (Author,2022) based on Primary Survey dated on 21st March 2022 IST 13.00hrs to 3.30hrs



Fig 6: Jewel Chowk before the intervention



Fig 7: Area under Flyover DC Chowk and Jewel Chowk [before intervention]

2.3.B Key findings from the interviews, surveys, and primary/secondary data collection [Wayfinding and signages]

The basic information to guide in the form of signage inadequate and ad-hoc.

A city survey revealed that many sign boards do conform to IRC67-2012 in respect of their shapes and sizes and are not properly anchored to ground.

Many private parties also have put-up sign boards hanging from poles and trees. Being very diverse in nature, there is a need for proper way findings and signages across the city. But due to specific reasons, signages are not properly installed.

Signages are installed 100 metres before a certain point. And some of the signages have been installed in such places where they are not visible to the road users while some others have been fixed over the footpath but with a height of 4 feet, resulting in obstruction of the pedestrian movement.

There are signages clubbed together which create a very poor communication for the road users. Signages and directions are missing at every coming intersection.



Fig. 8 Visual Analysis of Signages



Fig. 10 Visual Analysis of Signages

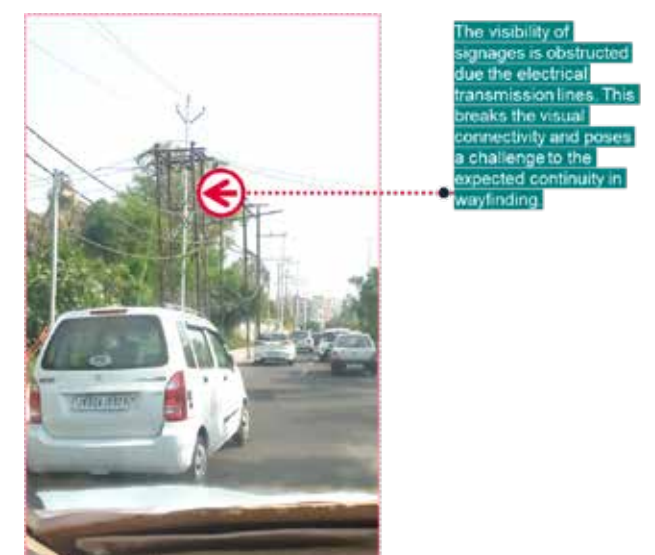


Fig. 11 Visual Analysis of Signages

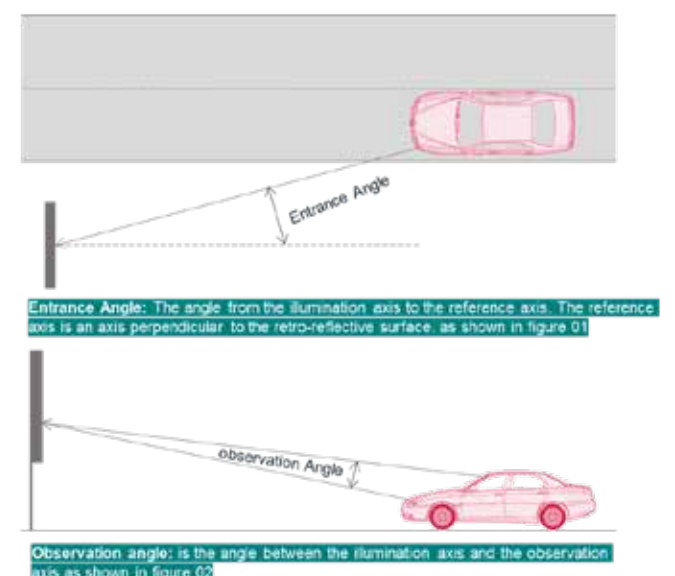
While Some are bent or broken, while others do not



Fig. 9 Visual Analysis of Vertical Garden [Smart feature]



source: https://morth.nic.in/sites/default/files/ASI/104201851404_PM4_Final_DF_AIS-090_Rev1.pdf Page no. 24



source: code of practice for road signs. IRC 067, Page no. 21 irc.gov.in.067.2012

Fig. 12 Visual Analysis of Signages

have proper color as per IRC code 67.[Ref Image 7,8]

3. Discussion and Conclusion

Vertical gardens as a project have not made a significant impact on people's lives. However, it is a positive approach toward a sustainable development of degenerated spaces. Jammu's increasing population has resulted in a shortage of water supply and depletion of groundwater levels. Keeping that in mind, the water system installed for irrigating the vertical gardens has been designed in such a way that only 5 mins of watering throughout the day is enough for the maintenance of the bio walls. During the implementation phase of vertical gardens, the engineers faced a few challenges. They had height restrictions which involved the risk of collapse of the bio wall, while laying down the pipeline for the drip irrigation system, old pipelines had to be shifted. However, the major challenge still faced is the problem of littering of these bio walls and area around. The operation and maintenance of these bio walls at the moment is under the PMC (tpf JV Rodic) which is for 3 years, after that the PMC will hand over the project and its maintenance to the Jammu Municipal corporation.

3.1 Implications

1. One of the issues they faced while reviewing the signage positioning is the underground sewer line and other supply pipes. The undesired presence of the same results in shifting the signs to a tentative distance of about 1 to 2meter away from the desired location.
2. The recent road development brings about the lines of electric poles to lie in continuation along the footpath. At the turnings, direction is lost since the view gets disturbed by the poles. The series of poles resulted in shifting the signage to unfeasible distances, making them unable to maintain full visibility. [Ref image 11]
3. The overhanging tree/hedge of the native vegetation keeps blocking the sign at various locations. The need is to ensure that the sightline should be kept clear from any sort of obstructions, like the foliage. [Ref Image 12, 13]

3.2 Limitations of the research

This research conducted on a broad scale tries to identify the reasons for the selection of the projects mentioned above, and assess their impact. It is an outcome of an evaluation made by architects and planners, with experience in highway signage projects and landscape, to see the project's success from the perspective of urban aesthetics, the location selected, impact on city functions, change made to Jammu through the Smart city project. The DPR, documents, discussions with the public and interviews of the key stakeholders were conducted on-site. Economic analysis, rates and contractors selected for the work were not a part of the project assessment. Facts and figures have been shared with us through the interviewees. A post-installation design analysis for better functioning was conducted through experience in professional practice. The research works toward the Smart city functioning and selection of projects. All interviews and meetings were conducted through the Smart city teams and with their participation. However, interviews with the public were held through a random selection and while in transit at different city locations to assess the project recall. The survey on site was conducted after pre-intimation in March, immediately after Holi, and on-site observations are limited to observations in one season.

3.3 Key lessons learned

While executing Smart city signage solutions in India, the scarce land area on footpaths is compromised. Efforts must be made to integrate signages with other city functions like overhead bridges, traffic posts, and light poles so that they can be managed in less vertical structures. City aesthetics projects are essential for a sense of well-being in the city.

3.4 Recommendations

A smart city that intends to change city functions and urban mobility is not just a building solution. The Urban mobility projects respect the projected aesthetic responsibility of the Smart City in conjunction with authorities towards the Jammu city reshaped in the modernizing process, providing road infrastructure and highways that have rattled the geography of the precincts on its periphery. Signages must follow not just the IRC and NHAI but also the 3M international colour codes. As per the Six Sigma guidelines on signages, there has to be a more diverse distribution of signages inside the city eg. the use of brown ECF for heritage and tourist areas. Signage in the Indian city is almost always on a free-standing pole under the city ownership and on the public land. In contrast, building facades of new, old and historic buildings should be used for the in-city directional signs. The non-integration of resources in the public domain is creating not just a wasteful expenditure of taxpayers' money, but also makes it impossible for all to survive within the urban. In-city signage programs for Jammu should be undertaken with more vision, and independent signage posts may not be needed everywhere. Special design posts than the bare pipe structure could also be designed, especially for Jammu. The vertical greening of columns sent out a good message to the city and the city as an extension to the Smart green solution must develop small landscape areas in old derelict squares of the old city mohallas, making the people feel more wanted and respected in the age of the new city. Regional language - Dogri in Jammu could be used in the signage.

This aptitude may be inherent in an individual, but it can be aided by a facility's wayfinding information

system, which includes maps, signage, architectural cues, and verbal guidance. (Arthur & Passini, 1992) Users believe this information system drives their wayfinding behavior, therefore, it should contain all of the information necessary to make and execute decisions along a route, as well as to construct a mental image of the environment (i.e., the cognitive map). This information system is part of a built environment's (e.g., facility) environmental communication and should be developed as a whole.

In addition to the typographical corrections, attention must be paid to the inclusion of the regional languages in the signage. From local commoners to highly intellectual visitors, they all rely on signage to explore the place. English is the global language, being understood and spoken by a number of people. In consideration of the same, the local languages must be given enough importance to mark their significance and to lead a mark in the mind of the visitors.

The fact that India has 22 major languages written in 13 distinct scripts and over 720 dialects illustrate the nation's cultural and linguistic diversity. And the dogri, the native language of Jammu is one of the 22 Major languages of India mentioned under schedule 8 of the constitution of India (legislative Department, Gol & Ministry of Education, 1950 & 2022). So, the incorporation of Dogri typography in the sign will state its recognition and, this initiative would be a sensitive submission towards the aim of a smart city's mission on city imageability. It will inculcate a sense of inclusion, pride, and sensitivity in native people towards their regional language and cultural heritage.



Fig. 13 Visual Analysis of Signages

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Interview & Survey

1. Location Vertical Garden Project, Jammu City 21st March (2022), Jammu City, Jammu & Kashmir, India – 12.30hrs to 13.30hrs, [note the Interviews are not digitally recorded]
2. All the photos by author during primary survey dated 21st - 24th March 2022 IST 11.00Hrs to 19.00Hrs

C14

St. Luke's Church-Heritage Restoration project

Name of the project: Conservation of Existing Shrines- St. Luke's Church

Location: Srinagar, Jammu and Kashmir (U.T)

Year of Project Implementation: 2021

Sector: Heritage Restoration & Conservation

SDG: No Poverty (SDG 1), Gender Equality (SDG 5), Decent work and Economic growth (SDG 8)

Project Cost: (Rs. .9 Crore)

SDGs: SDG Goal 11 (SDG 11.4)

Institute: Faculty of Architecture and Ekistics, Jamia Millia Islamia

Advisors: Dr. Hina Zia, Dr. Nisar Khan

Students: Nomaan Khan, Sheikh Intekhab Alam, Qazi Mohammad Tavqeer

Keywords: Conservation, Restoration, Cultural heritage, Built heritage, Community

Abstract:

St. Luke's Church (hereinafter referred to as 'Church') holds an important place in the history of Kashmir as it was the first church established by the Christians belonging to the Protestant Faith. The construction work of the Church was completed in 1888 and was functioning in normal course till 1986, during which period normal prayers and Sunday masses were being conducted but unfortunately, with the militancy and other political issues hitting the valley, the church was shut down. The shutdown of the shrine had a huge adverse impact on the structure and the interiors of the Church.

The Government of India in the year 2015 launched the 100 smart cities mission. The objective was to integrate city functions, utilize scarce resources more efficiently, improve the quality of life of citizens, improve safety and security, and improve the efficiencies of municipal services. The Srinagar administration under the said mission initiated the restoration of historic buildings and conservation of existing shrines. Under the said attempt to conserve existing shrines, shrines of all faiths in the old city of Srinagar (Shehr-e-Khas) were identified and as a pilot project, conservation of St. Luke's Church and conservation of Rangunath Mandir were taken up.

Under the said program, the conservation work of the church was done and on 24.12.2021 the church was thrown open for general public and prayers after passage of more than 35 years. The event of reopening was celebrated in Kashmir valley in general and Srinagar in particular with regenerated spirits by not only the local Christian population but also by the people of other communities. This project has given a boost for the conservation of other religious structures which have remained dilapidated for around three decades and the work on those structures has already started.

The evaluation of the Church was done by first looking at the primary and secondary data and then by conducting the site study and by interacting with the stakeholders that were involved with the project and the members of the Christian community. Overall, the impact of this project has been enormous on social relations between communities and people's response has been very positive towards the project.

Case Study: C14

1. Background

1.1 Topic and Context

On Christmas 2021, a 125 Year old church was reopened to prayers for the first time in over three decades in Srinagar, Jammu and Kashmir (U.T). The event was one of the most celebrated news in the Kashmir valley as it was one of the most positive stories coming out of the valley about social justice and religious harmony after years' long history of turmoil. The city where this church is located is Srinagar, Kashmir, located in one of the largest valleys of the Himalayan Range. The valley is drained by river Jhelum and surrounded by peaks up to 6000m high. Kashmir valley which was located close to the historic silk route which passed through Central Asia became a center for sharing culture and traditions among civilizations. The route which made possible for art and culture from other traditions to come to the valley also invited many saints to come and settle in Kashmir to make the religious pallet of valley more colorful. From the perspective of culture and built heritage, the valley stands apart from other regions within the Himalayan canvas (M I Khan,1978). Hence, when the Srinagar city was listed amongst the cites to undergo change under the Smart City Mission of Government of India and the Srinagar Smart City Ltd (SSCL) was established; two major heads which were selected to bring change to the city were linked to built-

heritage. The two major umbrellas under which the SSCL started identifying projects were Conservation of Existing shrines and Upgradation of Historical Markets. The local life in Kashmir is revolving around these two major elements of the cultural heritage, where people are flocking to these shrines and religious places, and because huge gatherings in the valley were around these structures, major markets also sprung up in the close vicinity to these religious centers. The selection of St. Luke's church is a unique and curious case when one tries to study it. The church is neither located in close knit with Shehr-e-khaas [heritage core of Srinagar] and neither has it had a heritage market in close vicinity. Yet the cultural and heritage viability of this site is enormous.

The patron saint of physicians and artists St. Luke, who was also known for his miraculous healing, is the saint who inspired the earliest Christians visiting the valley to establish the first modern hospital (today under government run as Government Chest Disease Hospital) in Kashmir. The mission hospital at Durgjan was established in year 1888. In year 1896 St. Luke's church was dedicated to people of Kashmir by The Bishop of Lahore which is evidently visible in stone readings (right above the entry) written in English inside the church. In 1941, the total Christian population in Kashmir was 3000, but later it declined with the passage of time and Kashmir being inflicted by the turmoil. The hospital was

transferred to Government of Jammu and Kashmir in 1960s which resulted in a bulk of Christian staff to move out from Kashmir. Last prayers in the church were held in 1980s. Since St. Luke's Church was devoid of regular prayers, it fell into neglect.

Geographical Location: The St. Luke's Church is a protestant church which stands near Government Chest Disease Hospital at the south west slope of Koh-e-Sulaiman or Shankaracharya Hill in the Dalgate area. The church is located near Datgate taxi stand and at walking distance from Boulevard Road which is an epicentre for tourists who are staying in the houseboats of Dal Lake. It is approached through the road either from Dalgate or from UN office.

The church is also around 800m away from another protestant church at Sonwar, All Saint's Church.

Project Timeline: No prayers were held in St. Luke's Church since 1980s. The neglected Church fell into despair and the Christian community went to the SSCL CEO with a request to restore their church in 2016. The restoration works in St. Luke's started in 2020. The work halted for a while due to the pandemic but restarted with a deadline in mind. Christmas 2021 was decided as a deadline and the project as per SSCL was completed two days before Christmas 2021.



Figure 1: Left to right: a. Old Photograph of patients relaxing in mission hospital and St. Luke's Church visible in background b. St. Luke's Church and Govt CD hospital picture Source: Kashmir network and SSCL

Target population: The last census conducted by the government officials reveals that the population of Christians was 0.2% in Kashmir Valley. The local unofficial sources reveal that currently there are around 650 Christians only. The project selection was an endeavour to safeguard important milestone in the cultural and religious landscape of the valley. It also brought social justice when a miniscule religious population's demand was upheld by SSCL. The Christian community is very happy with this project being taken up by the SSCL.

The research on this project focuses to examine the restoration works taken up for the project and impact of this project in the valley. Investigations will also probe into the architectural and historical significance of St. Luke's Church, conservation project, future viability and replicability of the project.

1.2 Significance of the project

The St. Luke's Church is an evidence of presence of Christians in Kashmir valley. Hence, the selection of project was unique when it targeted a small but significant religious population in the valley. Constructed in 1896, the church was an integral part of the entire Hospital precinct even though the Hospital was taken over by the Government of J&K in the seventies with the church continuing to remain under the management of Diocese Amritsar and the pastor in charge of All Saint Church Srinagar looking after this Church as well. The hospital was previously known as Kashmir Mission Hospital which was renovated and expanded by the Neves brothers in 1888. The Neves brother, Dr Ernest and Dr Arthur Neve had laid the foundation of the church and the Bishop of Lahore dedicated it to people

on September 12, 1896. The Prayers in the church were abandoned with the onset of law and order situation in the valley in 1989.

The Church is a single-storey building constructed on a cruciform plan. The church follows the Gothic Style of Architecture which is distinct from the other important monuments dotted in the landscape of Srinagar. The functional parts of the Church are similar to the style which are found across the globe in Gothic style churches. In the front, there is a porch which leads to the Narthex which opens into the grand Nave. The Nave has functioned as a library in the erstwhile times. The front of the nave lies the transept, which is main prayer hall. The Chancel is positioned in the center of transept, it is the elevated platform from where the father delivers sermon. The Church is constructed in brick, stone with lime mortar. The external façade of building is in stone with decorative brick surrounding the windows and the corbelled eaves below roof line. The structure has typical Gothic arches which is also called the pointed arch or a two-cantered arch. This arch is significantly different from the Mughal arch seen across the structures. Both the north and south transept consist of circular rose windows.

After the structural assessment of the building, there were findings that the structure was intact but alterations and neglect made some important architectural repairs necessary. Much heed was paid to the character of the church and hence key features of this project were to restore the CGI roof, removing unwanted additions, restoration of walls and bell tower and restoration of Khatamband ceiling. If the project was not taken up by

SSCL, there was a risk of more structural deterioration and complete loss of this church structure. The upgradation of the surrounding landscape has also been attended to including access to the Church, lighting and the allied components. The inside of the Church has also been redone with construction of altar, wooden flooring, seating, window panes, access gate and porch.

The restoration project focused on reclaiming the lost glory of this gothic style church in Srinagar. Being a standalone building in a tightly packed neighbourhood there was not much that could be done with the surrounding. The agreed vision was to restore the church in its original shape, keeping the character intact.

The project was completed days ago Christmas 2021 and was thrown open for public and prayers. The community and public visiting the site on Christmas were pleased with the restoration work and were amazed with this building re-immersing as an important heritage site in the city. The reopening also marked the religious harmony being practiced by residents of the valley.

1.3 Aims and objectives

The aim of the study is to examine the restoration works taken up by SSCL at St. Luke's Church and probe into future viability, operation and management and key learnings from the process involved in the project.

The objectives of the study are:

- i. To study the relevance of project in Kashmir valley.
- ii. To understand the conservation process in which the building is not altered in any way and how the

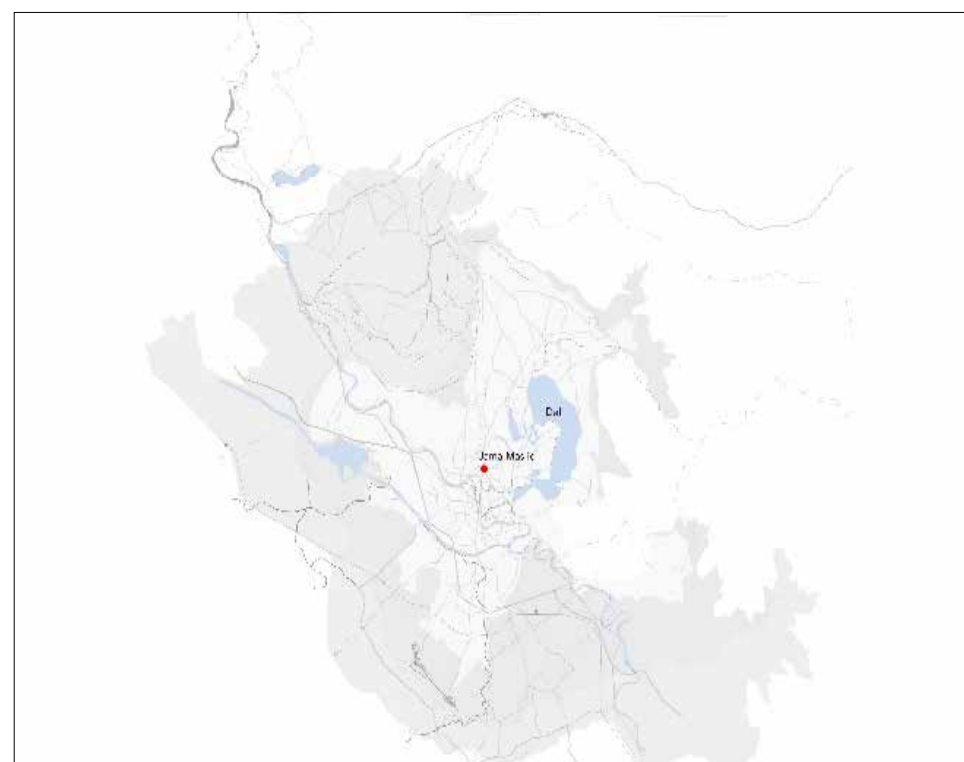


Figure 2 a. Location of St. Lukes in Srinagar b. Location of St. Luke's Church wrt Dalgate taxi stand, Boulevard road and Shankaracharya Temple

authenticity of building materials and design were taken care of.

- iii. To evaluate the effect of conservation of St. Luke's Church on social, cultural and economic aspect of the city.
- iv. To understand methodology of conservation of heritage structures.
- v. To appraise the work of Srinagar Smart City in improving people's well-being and to build more inclusive, sustainable and resilient societies.

2. Contextual Background

The contextual background as studied for this project falls under three major categories: the significance of church as an important cultural heritage, the authenticity in the conservation process and impact and implications of the project.

St. Luke's church was established because of the mission hospital and staff employed there. It was difficult to find information on who designed the church but looking at the structure today, architectural style used can be recorded. Apart from being a Gothic style church as discussed in detail earlier; the St. Luke's Church also stands as an example of amalgamation of cultures and architectural style. The church by its outlook was like any gothic church around the world but the presence of Kashmiri Khatamband made it unique and possibly the only gothic church in the world with a khatamband ceiling. Kashmiri Khatamband is an art practice of making a ceiling by putting together small pieces of walnut or deodar wood in geometric patterns. The art was brought to the valley during 14th century by Mir Ali Hamdani, a revered saint who visited the valley with many disciples including khatamband artisans from Iran. Khatamband in the early times was limited to important palaces,

shrines and mosques because of the cost it required. Lately, machine crafted khatamband is highly used in residential buildings across the valley. For restoration of the church, artisans who still craft khatamband with hand were brought in. It was a challenge for the artisans to accurately redesign a new khatamband ceiling in the same design as was present in the church.

In the restoration process of the church, the impacts of reopening it were also considered. The local Christian community and priests petitioned the state administration in 2016 to request that it be renovated so that it may reopen. The church refurbishment was included in the Smart City initiative, and under a larger umbrella of Conservation of existing shrines of all faiths the project was taken up by the administration. It is

a sacred initiative that fosters religious concord and bears witness to intercommunal solidarity, as well as providing local economic prospects through tourism and hospitality. The church provides for community needs for Communication Bridge between families of same faith and other community works like education, health initiatives. It will also contribute to keeping the market alive when foreign and domestic tourists visit the church.

2.1 Conceptual Framework/Research Design

Starting with secondary data collection and compilation in the standard format provided, the data comprises of news articles and a presentation. Study is also helped by some information on Srinagar city as a whole in published researches worldwide. Also, site study was

Component	Task	Details
Structure	Cleaning and painting of trusses, piers.	Structure was analyzed by the preliminary surveys on the site and the gothic arches holding to the rafters and roof were not failing in strength.
Roof	Replaced/Reconstruction	Truss rafters were intact. The CGI roof was damaged and needed a complete replacement
Ceiling	Replaced	The khatamband ceiling was completely replaced and was re-installed in the same design as it was earlier.
Walls	Cleaning	Old paint and plaster from some places was scrapped.
Floor	Repaired	Old wooden floor needed a repair. Wooden floor was later covered by a floor laminate which looked like the wooden panels.
Doors and Windows	Replaced	Shattered window panes were removed, old panels were repaired and cleaned as per requirement. The main entry door was reconstructed.
Furniture	New	Furniture at altar and gathering hall was brought a new on negotiations between stakeholders.
Surrounding	Repaired	Walkway around the church was restored. The front porch was finished with Devri stone laying.



Figure 3: Clockwise from top a. Pattern of Khatamband ceiling in Khankah-e-Maula, Srinagar, b. pattern of restored Khatamband ceiling St. Luke's Church c. restored Khatamband ceiling and roof truss St. Luke's Church. d. Pattern of Khatamband walls in Ziyarat Naqashband Sahab
Source: author

Figure 5 Clcokwise from top: a. Restored Khatamband Ceiling b. restored walls and laminated floor, restored windows c. New entry door installed d. restored windows and cleaned stone masonry picture
Source: SSCL

done to see the conservation work done and the effects of it on the neighbourhood.

2.2 Key features of the project

In view of the church's importance in the city from the perspective of both community and heritage, the restoration was the sole important feature of this project. Being a standalone building in a tightly packed neighbourhood, there was not much that could be done with the surrounding. The agreed vision was to restore the church in its original shape and keep its character intact. After the structural assessment of the building, much heed was paid to the character of the church and hence key goals of this project were a) Restore the CGI roof b) Removing unwanted additions c) Restoration of walls and bell tower d) Restoration of Khatamband ceiling. The structural members of the church were intact hence were restored by cleaning and painting of roof trusses. The CGI roof was completely replaced and so was the khatamband ceiling which was recrafted with the help of khatamband artisans. The wooden floor was not completely repaired but was covered with floor laminates. The furniture inside the church is new, brought in by user consultation. Walls interior and exterior both were cleaned, plaster and paint was scrapped. A new door was installed at the entry and the surrounding walkways were paved with local devri stone.

2.2.1 Challenges in the project

Before the restoration works, the church was lying in a dilapidated condition with the structural members suffering major damage. The CGI roofing was completely damaged, the rain water intrusion from roof aggravated the decay of important components. The plinth of the church was also suffering from major damages due to unwanted vegetation. Superstructure walls were suffering from dampness from plinth and due to ingress of rain water.

- One of the challenges was to restore the church structure to its original character.
- Study of original state of the church was difficult through historical study because the church was not functioning for over three decades. Hence major study on material and character was studied through what remained of the building.
- Finding right team of craftsmen/artisans and through them recreating the same pattern in khatamband was difficult.

2.2.3 Risks involved in the project

- In the process of conservation, there is a risk of damage to the original fabric/structure.
- Discontinuation of grants/funding while the process of conservation is undertaken could have detrimental effects on the buildings.
- Meeting the tight and clear deadline of Christmas '21.

2.2.4 Features and Benefits (social, technical, city administration level, impact on environment and economy) to the city (expected and observed)

The major benefits of the project are yet to be seen. Although the restoration of St. Luke's church is complete, it is yet to be dedicated by Bishop of Amritsar to the people and only after that rededication of church community services can fully resumed. On special requests from SSCL, the pastor of All Saint's Church allowed for a gathering on Christmas '21 to mark grand reopening of this church. The reopening was very well received by local media, civil societies, city residents

and tourists. The Christmas celebrations also marked a milestone in cultural and religious harmony in the valley.

- This project bears testimony for the social harmony between the different communities which have lived here and after the project, it bridged the gaps if any between the communities.
- The local economy got a boost with the starting of operations at this church as tourists from all over the country wanted to visit this place which was hyped in the media as well.
- It gave a boost for other conservation works that were in the pipeline and now the administration is

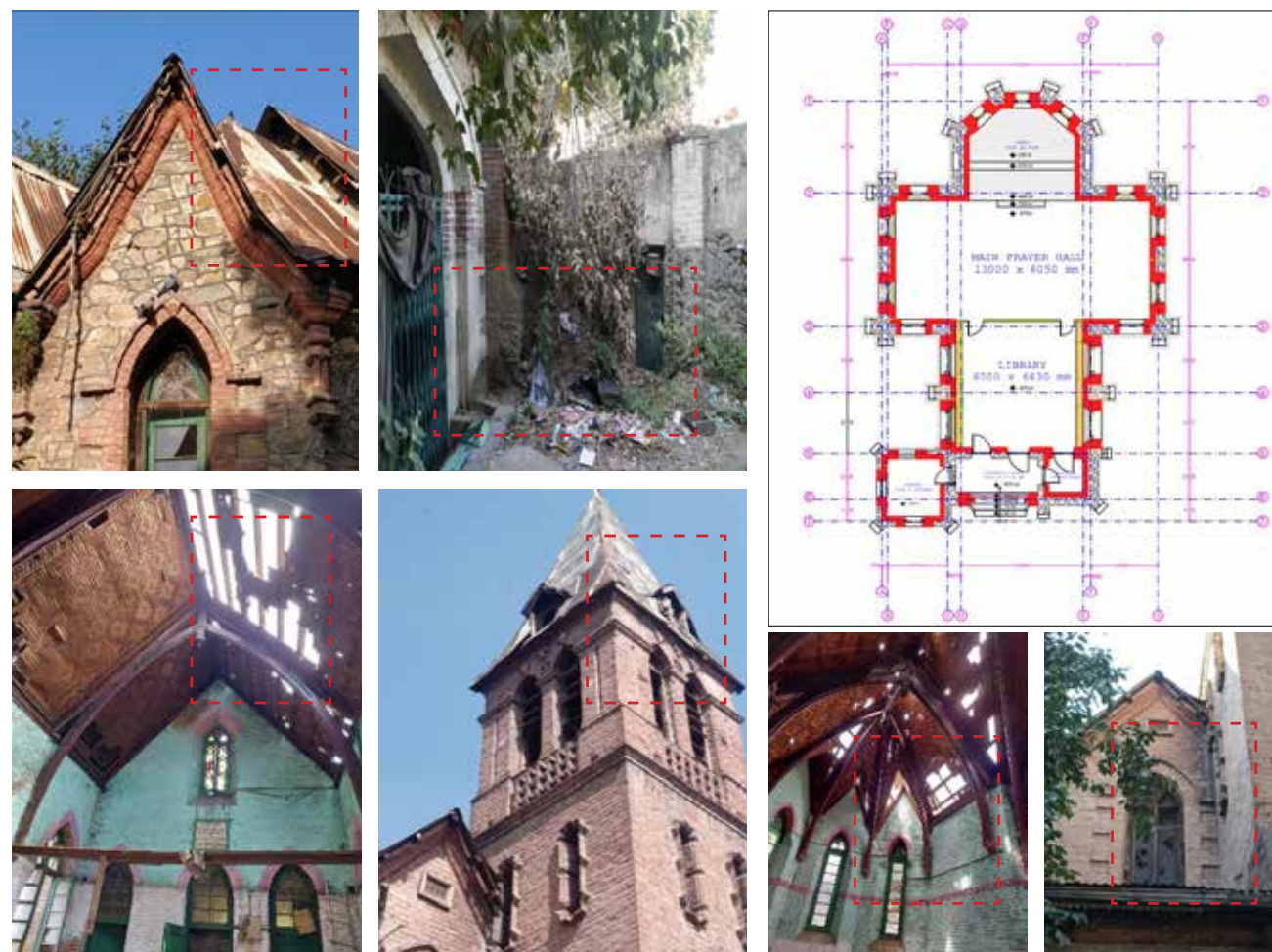
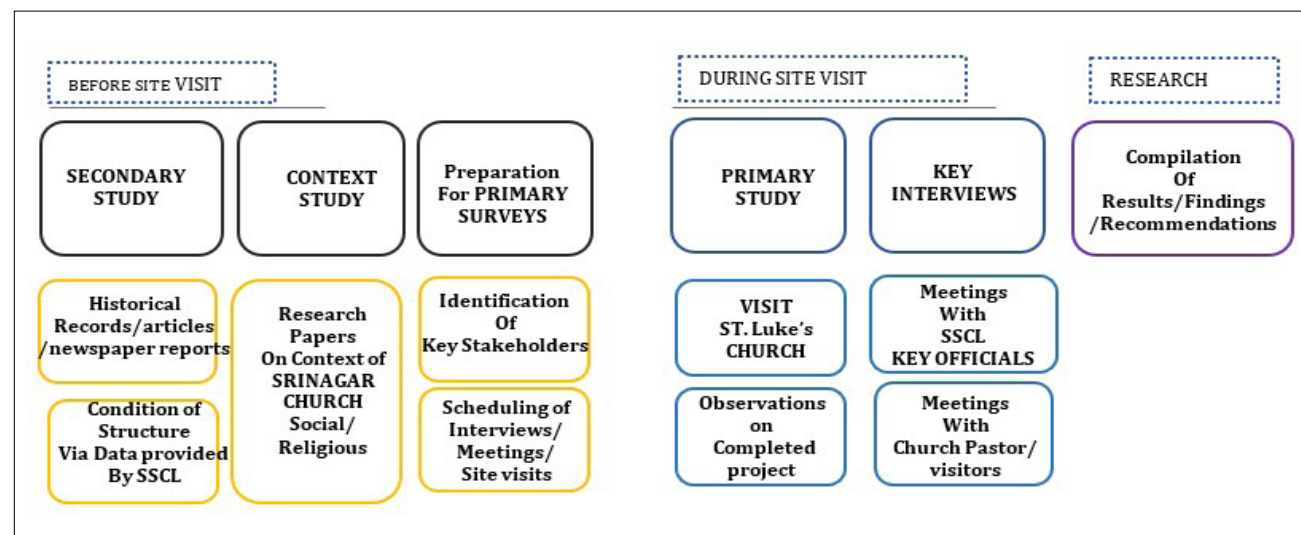


Figure 4: Clockwise from top: a. damaged roof structure b. entry gate overgrowth on walls and floor c. Church Plan d. damaged windows and overgrowth on walls e. damaged roof and flaking on bricks f. damaged bell tower e. damaged 'khatamband' ceiling. Picture Source: SSCL

expediting the works on other similar projects by seeing the success of this project.

2.3 Key findings from the interviews, surveys, and primary/secondary data collection

Discussions with the stakeholders were conducted mainly in two ways. SSCL team was interviewed for insights on the project and key findings were highlighted. The SSCL [Srinagar Smart City Ltd.] GM planning and urban development highlighted an interesting story of peace and justice brought by the project during interview for this research. The story of justice is hiding under how the site was selected. The SSCL had selected in its approach few larger umbrellas under which individual projects were to be selected. Two of these larger umbrellas were upgradation of heritage markets and conservation of existing shrines. Consideration of both these umbrellas and the fact that St. Lukes was way far from the Shehr-e-khaas area, the selection of the church for SSCL project was unlikely. The Protestant Christian community of the valley performing services at All Saint's Church a fifteen minute walk away from St. Lukes visited the CEO SSCL and requested him to do something about their church which was not in use. This call from the people excited the whole team of SSCL and it has since become an example for sheer will of bringing each community to the forefront with help of built environment interventions of Smart City Projects.

- Interdepartmental collaboration and smooth functioning proved to be important for the project.
- Pre-bid meetings proved to be fruitful for the project.
- Negotiations with the community were spearheaded by CEO and finalized deadline on discretion.
- The project implementation and timeline to finish was based on already announced big event for the community. In normal conditions this could have not met desired deadlines. But the zeal to deliver to the



Figure 6: A Satisfaction on restoration of St. Luke's church B. Satisfaction level on restoration of Interiors of St. Luke's Church

community on an auspicious occasion boosted the morale of SSCL members way high.

Community Feedback:

Discussions with the community were held in All Saint's Church at Sonwar. Questions were asked largely on two major issues for satisfaction with the restoration project and interiors of the church. Better satisfaction levels were recorded among respondents over interiors of the church where there is a factor of restored religious place with new furniture and clean environment inside the church. Satisfaction levels for the complete restoration project were a little lower compared to the

Component	Process	Technique	Material	Design
Structure	Cleaning and painting of trusses, piers.		No Change	No Change
Roof	Replaced/ Reconstruction	New roof	Same as before	No Change
Ceiling	Replaced	The khatamband ceiling was hand crafted.	New wood pieces were used.	No Change
Walls	Cleaning	Old paint was scrapped.	No Change	No change
Floor	Repair	Old wooden floor needed repair	Laminate was covered on old wood flooring	Changed
Doors and Windows	Replaced	Shattered window	New door at entry, old window frames were cleaned	No change
Furniture	New	Furniture was selected by church pastor	Wood	
Surrounding	Repaved	Old surface was removed	Local Devri stone was used to pave the walkways	Changed

interiors because of two reasons. One that the church is not yet rededicated to the people and community because of some ongoing negotiations between the users and SSCL. Secondly, because the bell tower still does not have the bell installed. When asked about the functioning and future plans for Sunday service in the church, Pastor stated and was resonated in the words of nearly every respondent that they are very happy now that the church is restored and they plan to keep an afternoon service in St. Luke's Church every Sunday.

3. Discussion and Conclusion

Table 3 observations on restoration components The research on the project also focused on the criterion on which the project was selected and some very interesting facts were learnt through literature study on the context of this site. The geographical location of St. Luke's Church is prominent in itself but once looked at the entire heritage scape of Srinagar the selection of the church was a special deal and is standing tall for social justice through smart city intervention. The story of justice is hiding under how the site was selected. The SSCL had selected in its approach few larger umbrellas

under which individual projects were to be selected. Two of these larger umbrellas were upgradation of heritage markets and conservation of existing shrines which are all located in the heritage core of Srinagar (Ali Iqbal K, 2018). Consideration of both these umbrellas and the fact that St. Lukes was way far from the Shehr-e-khaas area the selection of the church for SSCL project was unlikely.

Based on the location of the church in accordance with the major mobility nodes in the city, the project has a very

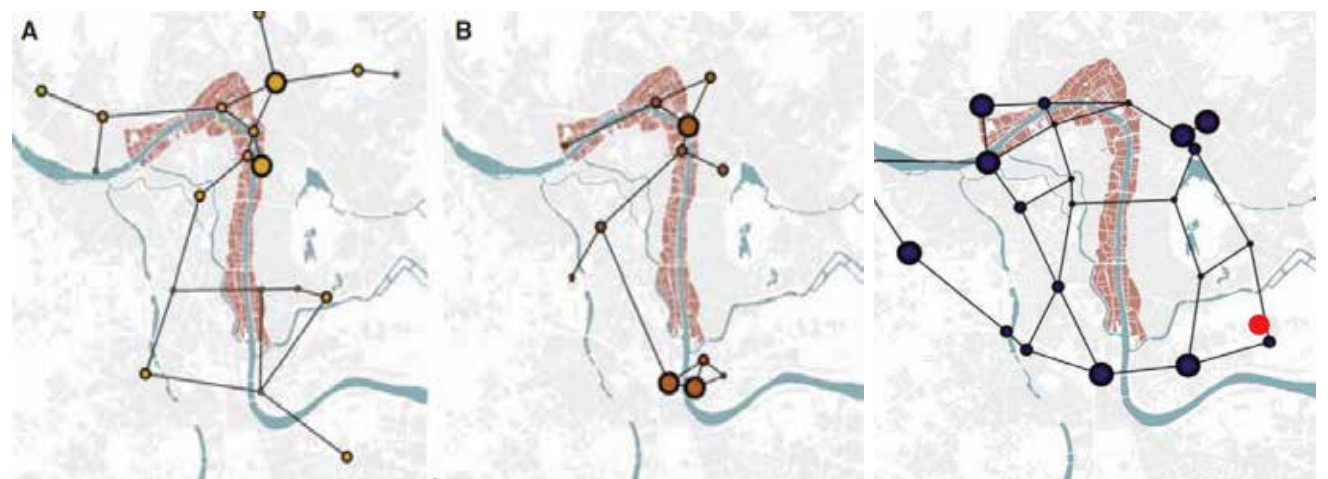


Figure 7 All maps show the heritage core of the city aligned with dalgate area A: Location of religious Places B: Location of Heritage Markets C: Location of important mobility nodes in the city. St. Luke's Church highlighted in all maps by red dot Source: Aertgeerts k 2011

Physical	Social	Economical	Environmental
Physical implications of the project are evident and can be observed on site.	The conservation of the shrine St. Lukes Church can be regarded as a successful project based on the response it received from locals.	Capacity building for artisans who worked on this project would serve for their better livelihood	Conservation of existing building rather than making a new structure have enormous environmental impact.
Residents of neighbourhood have got a new landmark for orientation	Social harmony between the different communities		

good future in becoming a tourist attraction and also one of the easiest sites to reach in the city. Discussing the project timeline the tight deadline proved out to be a positive motivation for the entire SSCL team. The Conservation of existing shrines all over the valley is a very known and successful project vision in the valley because these projects are directly connected with community. The focused project of St. Luke's has also become an example of social justice for a very small community in a city. The conservation of the shrine St. Lukes Church can be regarded as a successful project based on the response it received from locals. From being a forgotten heritage, it emerged as a known block of city's history. This can be replicated in other cities as well to build trust and unity within diverse communities.

The restoration works done in the church were observed through site visits and were studied if the conservation work maintains the authenticity of material and technique. It was noticed that although major work was in line with the conservation ethics of the heritage

building; at some places the authenticity of materials and techniques was compromised hence engagement of qualified professionals is highly recommended for similar projects

Figure 7 above illustrates the dimensions of heritage conservation that accrue not only for heritage assets, but also to larger development aspects (across the x-axis). Distinctions across the y-axis on the other hand show the benefits at the community level, and at the city levels.

3.1 Limitations of the research

This research has its own limitations. Data/reports for this research were provided by SSCL although a formal DPR was missing. Other data sources which were looked into came from media reports with multiple versions of facts and timings; and other published articles. The current state of the site was observed during site visit but state of project prior to restoration was studied through documentation provide by SSCL. Interviews

were conducted during site visits but sample size was small. Major interviews with users were held during Sunday prayers.

3.2 Key lessons learnt

The response of the locals on reopening of St Luke's Church proved that a standalone project such as church can also have wide impact on the city due to its cultural and heritage significance. The project has brought awareness towards the Christian community and their built heritage in the city and region.

3.3 Recommendations

- The workforce which worked on khatamband ceiling and other craft related improvements in the project must be empanelled for skill development of other SSCL contractors. Creating such detailed and matching the designs is a skill which is valuable. Other SSCL projects can improve their quality of such designs if they are keen to invest in skill development of other teams of artisans by people who worked on St. Luke's.
- It is highly recommended to SSCL to work closely with the Church authorities and follow up with requests from the church for installation of bell and other amenities for proper functional use of the structure.
- Regular efforts should be taken by the stakeholders for making the church fully functional.
- Based on proximity of the site with other tourist attractions SSCL can also work with local tour operators to bring the church on the must visit map of the city.

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C15

Public Bicycle Sharing and Promoting NMT in Chandigarh

Name of the project: Public Bicycle Sharing and promoting NMT in Chandigarh

Location: Chandigarh

Year of Project Implementation: 2020-2022

Sector: Urban Infrastructure

SDG: 3, 7, 9, 11, 12, 13, 17

Project Cost: 11.05 Crores INR

Institute: Faculty of Architecture and Ekistics, Jamia Millia Islamia

Advisors: Dr. Hina Zia, Dr. Nisar Khan

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Keywords: Public Bike Sharing, PBS project, Smart City Mission, Bicycles, NMT, Chandigarh

Abstract

With the rise in the number of vehicles on roads, cities across the globe are facing major challenges leading to climate change and congestion. In India, where development is on an exponential rise, Chandigarh is no exception. Having the highest per capita ownership of private vehicles, and the highest density (878 Vehicles/ 1000 People), the city has the second-highest per travel emissions in the country. Known for its outstanding architecture, planning, and landscaping, Chandigarh has an opportunity to set an example for other urban centres by revolutionising the mobility & NMT sector.

The city already has V7-roads hierarchy and basic cycling tracks. So, under the Smart Cities Mission, the Public Bike Sharing (PBS) system aims to expand the use of sustainable transport choices and modal shifts. The city is implementing a Pan City PBS project (only in the country so far) that will account for 5000 bikes and 617 dock stations. After completion, the dock stations would cover the catchment area of major public activity areas such as tourism circuits, institutional areas, commercial spaces, garden/ open spaces, and transportation networks. The project will lead to better life for the residents, safer short trips, and better air quality.

This research aimed to examine the PBS project in Chandigarh. The research employed both qualitative and quantitative methods to evaluate the project's impact on the users and the city. Various professionals and officials directly associated with implementing and executing the project were interviewed. Questionnaires and site visits facilitated the findings of the project. Analysis of the key features, innovations, benefits, and risks involved in the project will help in further improving the system and making it a city-wide success. The research also suggests some ideas that can be adopted in Chandigarh to remove some discrepancies from the system.

Case Study: C15

1. Introduction

1.1 Topic and Context

Planned by the renowned French Architect Le Corbusier, Chandigarh was dreamt of as a model urban centre by the first Prime Minister of India, Pandit Jawahar Lal Nehru. The city ushers an impactful modern idiom of architecture and city planning in India. Chandigarh has always been at the forefront of visionary planning and development. As a Smart City, Chandigarh has a big vision of promoting Non-motorised Transport (NMT) as a foundational sustainability mobility concept.

Chandigarh is among India's top cities with the highest motor vehicle ownership. The project aims to make the city more liveable and less dependent on motorised vehicles. This paradigm shift is crucial for urban centres like Chandigarh, where putting people first over motorised vehicles will provide better mobility choices. As per the Smart City Proposal Report of Chandigarh, the goal is to introduce low carbon mobility options and promote last-mile connectivity through Public Bike Sharing program, elderly & handicap friendly streets, more walkable and cycle-friendly streets.

The Public Bike Sharing Scheme in Chandigarh is being implemented for the entire city boundary of Chandigarh, having a total area of 114 sq. km. A total of 617 bicycle docking stations have been identified based on primary

	Population	No. of Trips	Targeted % of Trips	Targeted No. of Trips by PBS	No. of Cycles (Assuming 3.5 trips/cycle)
TOTAL POPULATION	1055450				
Total Population for Age Group (15-44)	572250	572250 x 2= 1144500	1	11445	3270
Total No. of Domestic Tourists (daily)	5134	5134 x 4= 20536	25	5134	1467
Total No. of Foreign Tourists (daily)	110	110 x 4= 440	50	220	63
TOTAL				16799	4800

Figure 1. Demand assessment for the number of bicycles. Source: EGIS

PROJECT TIMELINE	
Phase I (June 21)	Duration: 6 months, Docks - 155, Cycles - 1250
Phase II (Oct 2021)	Duration: 4 months, Docks - 310, Cycles - 2500
Phase III (Feb 2022)	Duration: 4 months, Docks - 465, Cycles - 3750
Phase IV (June 2022)	Duration: 4 months, Docks - 617, Cycles - 5000

Figure 2. Project Timeline for PBS project. Source: Chandigarh Smart City Limited

surveys that cover the entire city. Thus, making it the densest and largest PBS Pan City Coverage in the country with 186 km of dedicated cycle track, 5000 bikes, and 617 Docks.

The number of bicycles was calculated as per the public bicycling toolkit developed by the Ministry of Urban Development (MoUD). For the population of 10.55 Lakhs (as per the 2011 Census), the demand assessment for the bicycles was done by identifying the first pick up/drop points based on primary surveys. The bicycle demand for the city was carried out based on four parameters: the city's overall population & targeted age group, influence area, tourist Inflow, and users survey.

The PBS project is divided into four phases. 1st July 2020 marked the beginning of the project. Phase-I was inaugurated on 12th August 2021 where 155 dock stations were installed, electricity metres at 138 stations, and 1250 cycles were provided. Phase-II was completed on 5th February 2022. The next two phases will add another set of 155 dock stations and 1250 bicycles each. The pan-city coverage was supposed to

be completed by June 2022. However, the project was delayed due to various reasons. Till March 2022, 50% of the project has been implemented with a total of 310 dock stations and 2500 bicycles.

M/s Egis International SA is the Project Management Consultant (PMC) for implementing projects in Chandigarh Smart City including the PBS project under the Smart Cities Mission of MoUD, GOI. The PMC's scope is to assist Chandigarh Smart City Limited (CSCL) in designing, managing, and finally implementing the projects within the Chandigarh administrative boundary.

As an implementation agency, CSCL supports system planning, contracts for operation, monitors the operator and system performance, and helps coordinate with various government agencies and departments for smooth project operation.

The project is being implemented and operated on Design, Build, Finance, Operate, and Transfer (DBFOT) basis in a public-private partnership (PPP) mode for ten years. The Concessionaire, Smart Bike Tech Pvt Ltd,



Figure 3. Location of 617 Public bike Sharing sites in Chandigarh. Source: Office of the Chief Architect, UT Chandigarh

Hyderabad, is the private operator of this project and is paying CSCL an amount of 12 lakhs per annum. It is responsible for the day-to-day operations of the project. It manages the maintenance & general cleanliness of the fleet of bicycles and stations, as well as the redistribution of the bicycles. In addition, it is responsible for customer service, payment processing, marketing, and general brand management.

1.2 Significance of the project

In response to climate change and issues due to urbanisation, countries all over the globe are trying to integrate cycling as a mode of transport. With the rise in motorised traffic and extensive urbanisation, Chandigarh is also facing challenges such as pollution, road congestion, and safety concerns for pedestrians and cyclists.

Chandigarh already has the 7Vs that establish a hierarchy of traffic circulation. All the major roads V1, V2, and V3 have cycle tracks. So, implementing the PBS project is relevant as it complements the existing public transit to promote first and last-mile connectivity. The project can help stimulate bicycle use and increase bicycle modal share, which is at present negligible. It has great potential to replace cars for short-distance travel. Therefore, encouraging cycling through the PBS system can be a powerful tool in enforcing cycling as a habit among the city residents.

1.3 Aim and Objectives

The study aims to analyse the impact and feasibility of the Public Bike Sharing System on the mobility of Chandigarh, which provides an environmentally friendly, low-cost mobility option for the residents of the city.

The objectives of the study are:

1. To study the key features of the project
2. To review the bicycles and related infrastructure provided under the project
3. To examine the role of the PBS system as an alternative means of transport
4. To analyse the impact of the project on the city and its users
5. To review the best practices of the public bike sharing program
6. To understand the views of various stakeholders regarding the PBS project
7. To evaluate the further applicability of the project
8. To suggest the possible modifications to facilitate better functioning of the project

2. Contextual Background

2.1 Conceptual framework / Research design

To address the key research objectives mentioned above, this research uses both qualitative and quantitative methods and a combination of primary and secondary sources. In a nutshell, the collected qualitative information is described as challenges, innovation, impact/benefits (direct and indirect), replicability, and

expandability of the project. The SAAR team tested the PBS project for issues and problems faced while using the service and identified suitable suggestions. Quantitative data was obtained from secondary data sources, and the qualitative analysis has been incorporated with the quantitative results in the discussion part of the report.

Data sources

i. Primary data sources

The primary data collection was carried out in Chandigarh from 14th to 16th March 2022. The SAAR team visited the multiple bike dock stations at several key locations to get an overview of the PBS project. The team observed the site condition, took photographs of the infrastructure, and used the service firsthand (by downloading the app, adding money to the app, unlocking and riding the bike).

Discussions and semi-structured interviews were done with multiple stakeholders such as CSCL officials, PMC officials, Chief Architect UT, Chief Engineer, Concessionaire, members of Heritage Committee, Project advisors, Academia (from Chandigarh College of Architecture), Architects in the city, citizens, and the users of different age groups and gender.

To understand the perspectives about the PBS project in the city, the team interacted with the following official stakeholders:

- M/s Egis International SA from Chandigarh Smart City Limited: Mr. Arun & his team
- Concessionaire, Smart Bike Tech Pvt Ltd, Hyderabad: Mr. Vikas Dixit
- Chief Engineer, UT Administration: Mr. C. B. Ojha
- Chief Architect, UT Administration: Ar. Kapil Setia
- Principal, Chandigarh College of Architecture: Ms. Sangeeta Bagga
- Teaching Faculty, Chandigarh College of Architecture: Ar. Deepika Gandhi

Questionnaires were also prepared to understand the general perception of the public in Chandigarh about the PBS project. The insights followed after collecting the primary data helped develop discussion, analysis, and conclusion.

ii. Secondary data sources

The preliminary studies were carried out in January, February, and March 2022. The secondary data sources include reports provided by Chandigarh Smart City Limited in the form of Request For Proposal, Detailed Project Report, official presentations, and other project documents. In addition, various government websites, reports, and management

documents were also referred for the literature review. The data obtained from the census, surveys, Chandigarh master plan, statistical data, policies, regulations, standards, and case studies (national and international) were also taken into account for the research.

This research attempts to learn about the ins and outs of implementing and operating the PBS system in Chandigarh. The purpose of the study is to learn and showcase the city's initiative where one can facilitate the exchange of the best practices. The report highlights key innovations, risks, challenges, threats, and suggestions for the PBS project. This will help in promoting cross-learning among the cities across India and beyond.

Literature Review

When we think of public bike sharing leaders across the globe, it is no surprise that Europe and America are the

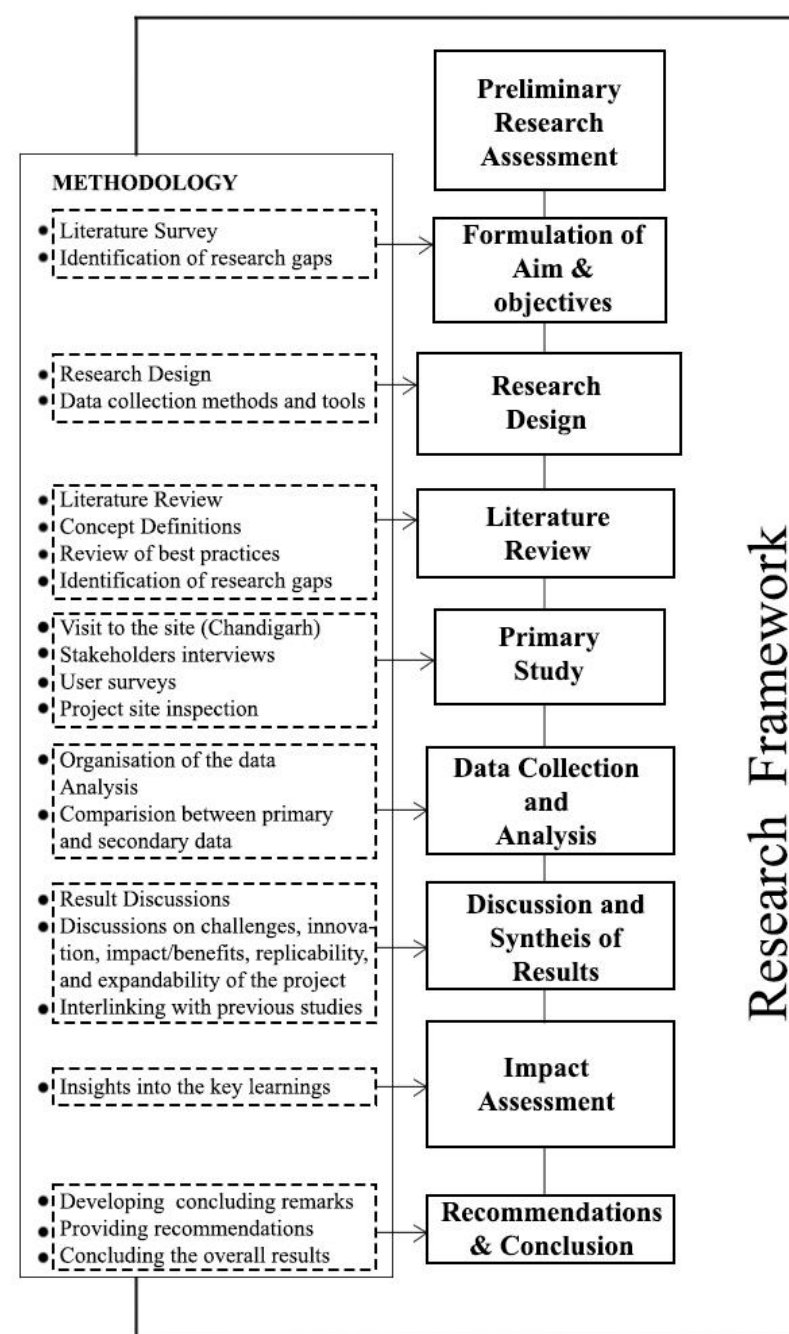


Figure 4. Graphic for research design. Source: Author

first places that flash in mind. Since the development of the bike sharing schemes in the 1960s when this concept was initially introduced, there has been a dramatic evolution in the way services and infrastructures are designed.

The beginning of the concept can be credited to Amsterdam (1965), La Rochelle (1976) and Cambridge in the form of free bicycles. However, the first large-scale second-generation system, a coin-operated system, called 'Bycyklen' or City Bikes' was launched in 1995 in Copenhagen. Then, came the smartcard technology in the late 1990s that has majorly enabled bicycle-sharing to become what it is today. But what made public bike sharing a worldwide phenomenon? The credit can be attributed to the launch of 'Vélib' in Paris in 2007. Since then, the trend has seen exponential growth in terms of public bike sharing systems. (Lebetkin, 2013)

Different cities are trying to make this system work and share several common characteristics, some of which are electronic docking stations, tiered payment scales, and bikes with low theft value. Before evaluating the PBS project in Chandigarh, it is important to understand the best practices that are revolutionising the public bike-sharing systems.

Best practices/Case Studies

1. Paris, France

Table 1. Vélib' Bike sharing system

Place	Paris
Launch Year	2007
Bike Sharing Program	Vélib'
No. of Bikes	23,900
No. of Stations	1,751
Fee/Charges	free (first 30 min) and additional 1 € per ½ hr (regular bikes) / 1 € (first 30 min) and additional 2 € per ½ hr (e-bikes)

Source: Author

Vélib', the bike sharing program in Paris, is the largest in the world outside China. It had an average of 108,090 daily ridership in 2014. The network covers the entire city with an average of 50 stations per square mile making it an integral part of the city life.

Besides its sheer scale, it is also the most ambitious and creative program. Considering a significant population of children, the city launched an initiative in 2014 called P'tit Vélib'. It provides four different models of bikes for

different age groups of children ranging from two to eight years old. This makes cycling in the city more open, accessible, and inclusive, thus fostering a bike culture on a major level. The program is very successful and sets an example for the rest of the world.

2. Montreal, Canada

Table 2. BIXI Bike sharing system

Place	Montreal
Launch Year	2009
Bike Sharing Program	BIXI
No. of Bikes	5200
No. of Stations	460
Fee/Charges	\$0.10 per min (regular bikes) / \$0.25 per min (e-bikes)

Source: Author

Christened by combining the words 'bicycle' and 'taxi', BIXI is a 24/7 bike sharing service with remains closed in winters. More than 90 percent of trips are made by BIXI members. The system is very innovative in terms of responding to Montreal's four seasons. Aimed at young adults aged 25 to 34, the entire bike sharing system is solar-powered, and Radio Frequency Identification (RFID) enabled. (Nicolas, 2013)



Figure 5. Vélib' Bike sharing system. Source: Icebike.org. (2015). The World's Surprising Top 8 Bike Share Programs. Retrieved from <https://www.icebike.org/bike-share-programs/>.



Figure 6. BIXI Station. Source: CNW Group/BIXI Montréal

A wide range of memberships is offered, including seasonal, monthly, and group membership. It offers short-term passes (one-way, one-day, and three-day) and long-term passes (yearly and monthly). It runs on a self-sustaining model through fees, memberships, and some support from corporate sponsorship. The program is very different from advertising revenues-based models that are majorly adopted by existing PBS systems across the globe. The BIXI model shows how a public bike-sharing system can be more attractive and practical. (Verma et. al., 2020)

2.2 Key features of the project

2.2.3 Challenges in the project

- Operation and maintenance of the docking stations and bicycles
- Implementation of the project phases on the scheduled time
- Behavioural change among motorised transit users
- Management of the roads and cycle tracks on a city-wide level
- Inter-departmental coordination among key stakeholders

2.2.4 Risks involved in the project

- The chances of vandalism to bicycles including deserting the cycles
- Glitches in software/ app while booking rides
- Non-maintenance of cycle tracks
- Organising tracks at roundabouts that are merging with motor traffic

2.2.5 Features and Benefits (social, technical, city administration level, impact on environment and economy) to the city

- The PBS system is a flexible, personalised public transport that involves laying out a dense

network of cycle rental stations.

- The system consists mainly of four components: bicycle, a network of stations at key locations, GPS based tracking of bicycles, and allows short-term shared use of bicycles.
- The users have the flexibility of renting and sharing bicycles at nominal rates of Rs.10 per half an hour. With an annual subscription fee of Rs.500, members can use the service at Rs.5 per half an hour.
- As a user, you can simply download the mobile application 'Smart Bike' from Play Store, sign in, select the bicycle, check out the bike at one station and later return it in any other docking station.
- Facilities provided under the PBS system are:
 - Bicycles
 - Parking Stations with Docks/ Locking posts
 - Redistribution Vehicles
 - Depots/ Workshops
 - User Registration Infrastructure
 - Fare Collection System
 - User Information System
 - Advertisement Space
 - Backlit panels for advertisements & public information
 - Mobile App
 - Central Control System
- The Public Bike Sharing project was launched as a pilot under the 'India Cycle4Change Challenge.' 25 dock stations and 225 cycles were initially set up as the corridor pilot (Jan, Himalaya, and Uttar Marg) and neighbourhood pilot (Sector 24 V4 Road).
- As of the date of writing this report, the project's first and second phases are finished with a total of 310 docks and 2500 bicycles (regular bikes and e-bikes).
- The advertisement space at the docking station is

the critical component of revenue generation in determining the feasibility of the project for the Concessionaire.

- The project provides the city residents with a low-cost, environmentally-friendly mobility option. As the project is being expanded citywide, it will help in encouraging a shift to a sustainable mode of transport.
- Subsequently, the system will help in reducing the dependency on motorised personal vehicles and curb traffic congestion, vehicle emissions, and motorised parking demands. This will help provide an alternative form of mobility for short trips as the quickest mode of transport.
- The infrastructure and planning in Chandigarh support cycling and cyclists. Therefore, Regular cycling can improve the health of the citizens.
- The project also helped in the transformation of streets to become safer where bicyclists and pedestrians feel comfortable and safe.
- The PBS project is successful in removing the hesitancy around using bicycles as a utilitarian mode of transportation rather than only a recreation activity. The project's acceptance till now underscores its role in bringing a positive change among the residents of the city.
- The public bike sharing system is expected to improve first and last-mile connectivity.

2.2.6 Key findings from the interviews, surveys, and primary/secondary data collection

In the meeting with the PMC M/s Egis International, officials were briefed about the projects taken under the Smart City Mission for Chandigarh. The Public Bike Sharing Project was taken up under the Smart City Proposal as a Pan-city project. As stated by the Chief Architect of UT administration, the project gained great advantage from the city infrastructure. The UT administration retrofitted the existing 60 km of bike

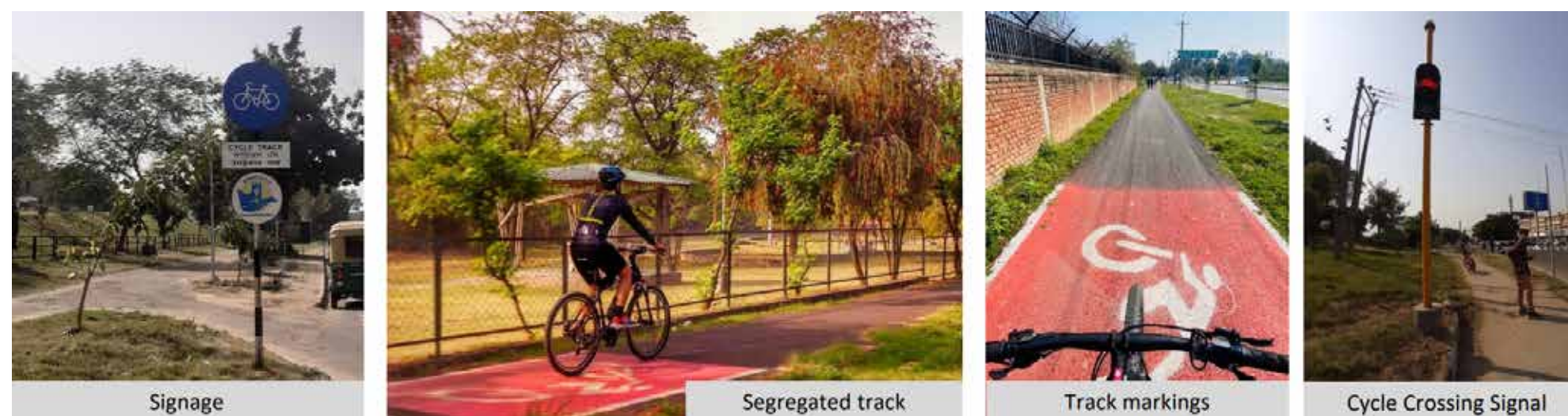


Figure 7. PBS infrastructure in Chandigarh. Source: Public Bike Sharing (2020), Smartnet.niu.org. Retrieved from <https://smartnet.niu.org/indiacyclechallenge/wp-content/uploads/2020/11/Chandigarhs-Cycles-for-Change-W1.pdf>

lanes in the city. In addition, another 220 km of bike lanes were recently added by the UT department as per the Chandigarh Master plan 2031. Bicycle lanes are properly marked with red colour with proper signages and signals. As of now, the crossings are not as per the international standards.

The project is successful in removing the hesitancy among users concerning cycling. The users of different age groups were observed in the city using the services. The children under the age of 12 were also interested in learning to ride the bike. Teenagers use the service in groups to visit the market with friends. The city officials also use the PBS system. In addition, many delivery boys from food services also use the system due to its convenient location and nominal charges.

In an interview with a 24-year-old girl, she stated: “I have started learning how to ride a bike since last week. Right now, I practise after office hours here [in Sector 17 plaza] where my office is located. I am planning to use the bicycle for my commute to work also.”

The users and the Concessionaire mentioned some discrepancies in the project as well. The system is facing issues in the mobile application. Many people we interviewed have faced difficulty in unlocking the bikes

and ending the bike rides. Mobile network issues were prominent in some areas where one cannot use the system easily. For example, Sukhna Lake has an excellent footfall, but towers can't be installed here. Due to poor networks, it is difficult to open the app and use the PBS system.

Another issue in the system is that the bike dock stations are not numbered. So if someone is facing any problem at the dock stations, they have to use the GPS of the app to report the problem. Instead, if the dock stations are numbered, it will be easy to report and even inform the same at the call centres.

After visiting various dock stations, it was found that the bike repairing process is not very prompt. So, if there is a defective bike located at the booth, it is not repaired immediately. There are many cases of vandalism and theft also. Although the cases of theft are not very high, vandalism is affecting the functioning of the bikes. An official from the Concessionaire stated: “The cases of vandalism are quite frequent, sometimes as high as 20-25 bikes/day. The major affected parts of the bicycles are baskets, lock, throttle, saddle, and wheels.”

After further discussions, it was concluded that the individuals responsible for such damages are not

strictly penalised. As the project is prone to extensive vandalism, a proper management system needs to be in place to reduce such cases in the future. The compulsion of membership for using the service can be one such practice.

Table 3. List of major damaged parts of bicycles

Basket	877
Saddle	426
Pedal	219
Lock	471
Tyre	293
Rim	89
Battery	45
Throttle	450

Source: Chandigarh Smart City Limited

3. Discussion and Conclusion

3.1 Implications

The Concessionaire provides two types of bikes: push bikes and e-bikes. The e-bikes are very popular among the users and are getting a good response. These are particularly attractive to children and youth. In response to our queries regarding the PBS service, a group of four teenage boys informed us that “they are using the bikes only because they are e-bikes.” So, the enthusiasm regarding e-bikes is very visible in the city.

The improvisation of the bike models till now is commendable. According to the inputs and grievances received by the users, the Concessionaire has innovated and upgraded bike models to fit the needs.

While discussing the project with the Concessionaire, it was noted that the current revenue model is majorly hit by Covid-19. As the project follows the advertisement revenue model, the earnings were supposed to come from advertisement and ride charges. It was also noted that the rates for the push bikes and e-bikes are the same at Rs.10 per half an hour. This makes the system less remunerative for the Concessionaire. As it is very clear from the literature study of the best practices, different rates can be set for both types of bikes. This will also help in maintaining the usage ratio of both push and electric bikes. The study also suggests that different revenue models can be explored, such as in the case of BIXI (in Montreal), which runs on a self-sustaining model through fees, memberships, and some support from corporate sponsorship.

The Concessionaire is providing e-bikes at his own cost as these were not part of the initial contract. Now, the problem related to batteries is arising. Many bikes stationed at the docks do not have sufficient charge levels. Some do not unlock and others can't complete the ride. One reason is that the batteries are charged only at night. So, if the bikes are drained during the day, these do not get charged. Therefore, if a system can be developed

S. no	Project Name	Cost (Rs. Cr)	Length (in KM)	Source
Completed Project				
1	Dedicated Cycle Tracks shared with Footpath, PART-1	22	200	Smart City Mission (Convergence)
Scaling up- Bicycle Network				
2	Dedicated Cycle Track along industrial corridor & city periphery	0.84	7.2	City Admin
Scale Up of Infrastructure for Cycling Track				
3	Street Lighting along dedicated Cycle Track	8.42	135	City Admin
Public Bicycling Infrastructure				
4	Engagement of Agency for Design, Build, Operate, Finance Transfer Public Bike Sharing System in Chandigarh on PPP Mode	20	-	Smart City Mission (PPP)
Procurement & installation of Solar Road Marking Studs on roundabouts				
5	Fixing solar studs on roundabout	1.4	11.6	CSR & Smart City Mission

Figure 8. Projects associated with the promotion of PBS and NMT in Chandigarh. Source: NIUA

where the bikes will be charged when they are docked, the problem of delay in charging can be resolved.

The cases of theft and vandalism in the PBS system are not new for Chandigarh. The best practices today have faced the same challenges when they started out new. Take the case of Vélib' (in Paris) and BIXI (in Montreal) that were earlier discussed. The cases of vandalism and theft were so high in the initial few years of operation that the program ended up losing a lot of money. Despite that, these programs have balanced it out through the memberships, strict penalties, etc., and are now a huge success story.

The outreach of the PBS project in Chandigarh is immense. The residents of the city perceive it as a positive aspect for the city and they appreciate this initiative.

3.2 Limitations of the research

The study was limited to the bicycle dock stations of Sector 1, Sector 6 and Sector 17 due to time and resource constraints. Feedback from the users could be taken from Sukhna Lake and Sector 17 plaza. Around 100 bicycles were physically examined and the SmartBike

app was used on 40 bicycles. The rides were taken on around 15 bicycles (across all models, push bikes as well as electric). Another limitation of the research was that the study was conducted over a period of 3 days and a continuous evaluation could be done.

3.3 Key lessons learned

The infrastructure of the city is a very crucial parameter that should be considered before implementing the public bike sharing project in a city. Chandigarh had the advantage of existing cycle tracks that were supported by further expansion of the tracks. This is evident in the related projects completed by the City Administration. Therefore, the aim of the modal shift can only be achieved through the long-term planning of the PBS project.

If successfully implemented across Chandigarh, the PBS project can be a prime demonstration case in the country for Pan-city coverage. The project can be replicable in the nearby cities of Mohali and Panchkula. If you look at international best practices, the study reveals that all are aimed for large-scale and city-wide expansion. On the contrary, projects do not go beyond the pilot projects in Indian cities. For example, Ranchi, Bhopal

and Mysuru have 500 bicycles and their numbers have not increased. Pune did try to implement the city-wide expansion but that was never achieved on grounds. (GIZ GmbH, 2021)

Overall, the PBS project in Chandigarh is a good project at generating awareness about cycling. It promotes the habit of cycling and removes bicycle hesitancy. Various range of users are now riding bikes for recreation and work purposes such as city officials, delivery persons, women, and children. So, this project indirectly promotes the health benefits of cycling. The kids and youngsters are now learning to ride the bike. However, the effectiveness of bicycling in creating a modal shift from private vehicles to bicycles is not very visible, which was the project's main intent. Lessons can be learnt from the best practices across cities outside India where the PBS system is effectively implemented and has created significant modal shifts in transit.

3.4 Recommendations

With regards to the bad networks in certain areas, mobile network boosters can be installed close to the bike dock stations. So, wherever the bike dock stations are installed, the boosters can be provided in collaboration

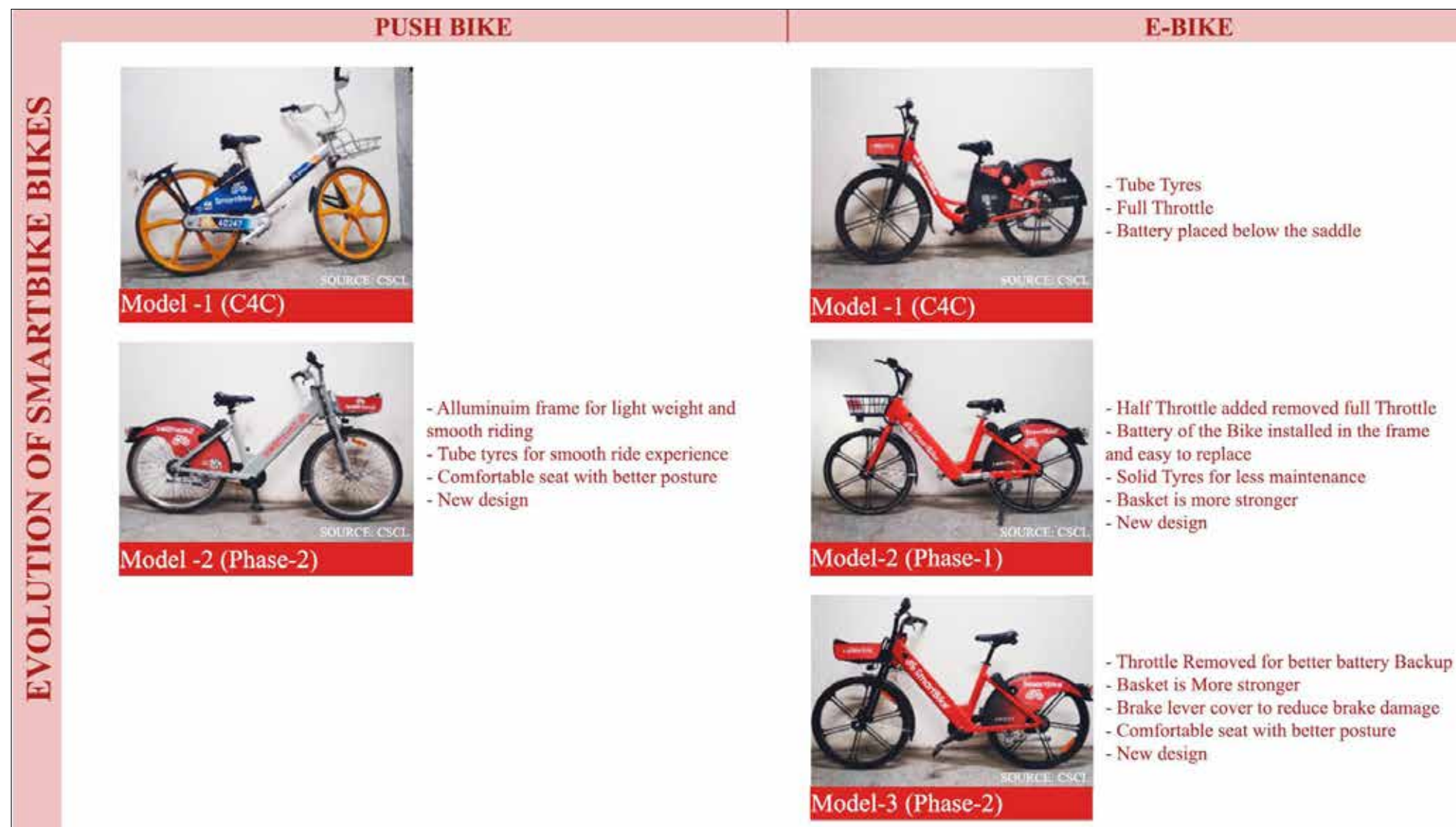


Figure 9. Evolution of bike models. Source: Author

with a mobile company which in turn will not hamper the functioning of the PBS system. Another option that can be explored along with the mobile-based application is a card-based system. For ease of operation, a One Mobility Card (smart RFID card) can be introduced to improve the services. In the case of a public bike sharing project, the card can be used to unlock the bikes and navigate through the system efficiently. The system will become more inclusive as the non-smart mobile users will also have the flexibility to use the service.

The issue of discharged bicycles docked at the station during the daytime can be solved by providing the e-charging infrastructure at the respective dock stations. The facilitation of this service can be effectively clubbed with Corporate Social Responsibility (CSR). This would eventually facilitate the promotion of NMT. So, the areas having large footfalls nearby dock stations can benefit a lot from this proposal. The Sukhna Lake location can be a test case or a pilot project for this service where footfall is generally very high. Later, the facility can be expanded to other areas.

To promote the PBS system as a prominent transit mode at an integral level in the city, long-term rentals can be proposed. For instance, the Concessionaire can collaborate with the food services such as Zomato and Swiggy for food delivery. Right now, e-bikes are sometimes used by Zomato delivery boys due to nominal rates and the presence of dock stations at convenient locations. Thus, the expansion of the project at a larger scale can be beneficial for the city.

Vandalism and theft are the major issues that can be addressed wisely. Most of the successful practices across the globe make membership a mandatory thing for using the system. Besides that, registration for the service will make sure that the users' records are fed into the system. Therefore, the chances of vandalism and theft can subsequently be reduced. The strict penalty provisions will ensure the system is not affected by such cases.

Although the impact of the PBS project in Chandigarh is visible, it is yet to bridge the first and last-mile connectivity. There is a need to make the service more

attractive for the users. The research suggests that varied bike models for different age groups can prove to be very beneficial in promoting cycling as a habit rather than just once-in-a-while activity. Various kinds of memberships such as monthly or yearly options should be made available for the users. The group memberships can also be promoted at discounts to facilitate youths who like to travel in groups with friends.

The literature review presented in the report provided insights into the existing gaps that can be bridged using various means. Further research helped in identifying the key aspects of the project. The assessment led to pinpointing the major issues that require necessary changes to improve the PBS system. The role of various stakeholders and their perspectives was thoroughly analysed in the research. The research provides a basic framework that is believed to contribute to the key learnings and shortcomings in the future implementation of the project in the city and elsewhere.

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C16

Heritage development at Jamia Masjid- Srinagar

Name of the project: *Heritage development at Jamia Masjid*

Location: *Srinagar, Jammu and Kashmir*

Year of Project Implementation: *2021*

Sector: *Heritage*

SDG: *SDG 11 - Sustainable cities and Communities*

Project Cost: *Rs. 8.48 Cr*

Institute: *Faculty of Architecture and Ekistics, Jamia Millia Islamia, Delhi*

Advisors: *Dr. Hina Zia, Dr. Nisar Khan*

Students: *Nomaan Khan, Sheikh Intekhab Alam, Hakim Danish*

Keywords: *Historical, Organized, Recreational*

Abstract:

Jamia Masjid Market in Sheher-e-khaas is one the most prominent retail markets in the city of Srinagar . Its history dates back to 1970s when the development of the market was taken up by Masjid Auqaf with an aim to provide economic opportunities to local residents. At present there are 278 shops that sell daily essential products. The market is famous for textile, food products and crockery items. Apart from the residents of Sheher-e-Khaas, buyers from other districts of Kashmir frequent the market. On an average 4,000 people visit the market daily and the footfall increases significantly during Friday prayer and the number goes upto 50,000 during Eid. The location of the mosque is also one of the reasons for its high footfall. Market is well connected with the neighborhood through streets and roads in all directions. The market falls under the domain of Anjuman-e-Auqaf, a private enterprise. It is the caretaker board of the mosque and market. The physical condition of the market, however, had been deteriorating over a period of time.

Heritage development at Jamia Masjid precinct was initially taken up by the Department of Tourism, J&K, later under Smart City Mission, the project was taken up by Srinagar Smart City Ltd. which carried forward placemaking and upgradation at Jamia Masjid precinct. The site is a prominent historical and urban landmark of Srinagar, representing the physical and urban development of the city. Jamia Masjid and Market represents the most prominent architectural achievements of Kashmir, it also marks a unique synthesis of different usages namely public, private and religious.

The market complex surrounds the mosque in all four directions, in a manner that all the shops face the mosque. The heritage development work at Jamia Masjid is still going on. With market façade improvement on south- east side and construction of ablution block phase-I is completed. Facade improvement through newly added arched arcade with exposed brickwork, modern lighting, Khatamband Ceiling and devri stone flooring of the market has beautified the precinct and visitors' experiences. Further, the intervention will act as a catalyst for future development of other similar projects in the city. The evaluation of the project is done by primary and secondary data analysis followed by a team visit to the sit and interaction with stakeholders associated with the project.

1. Introduction

Srinagar Smart City

Srinagar region has long been a melting pot of cultural practices that includes Hinduism, Buddhism and Islam. The 14th century, in particular, is considered a watershed in Kashmir's history, when different traditions of art and architecture came together. Srinagar has several mosques, each with its own unique history. Spread all over Srinagar, these mosques are extremely peaceful

and a pillar of Kashmir's cultural structure. For culture enthusiasts, they are a treasure trove of knowledge. Jamia Masjid was built by Sultan Sikandar in 1400 AD under the order of Mir Mohmmad Hamadani, son of Shah Hamdan. Later, the son of Sultan Sikandar, Zain-ul-Abidin got the mosque extended.

The attractions of the Jamia Masjid of Srinagar, Kashmir includes beautiful Indo-Saracenic architecture. Another feature of the mosque is the peace and tranquility inside

it, standing out against the hustle of the old bazaars around it. Thousands of Muslims assemble at the mosque every Friday to offer their prayers. It was damaged by fire on three occasions in the years 1479, 1620 and 1674 AD, respectively and were later restored. Apart from regular prayers, thousands of people gather here on the last Friday of the holy month of Ramadan to offer congregational prayers. It is the biggest Mosque in the city. It is connected with the city through alleys and a big old market is also established on three sides of the

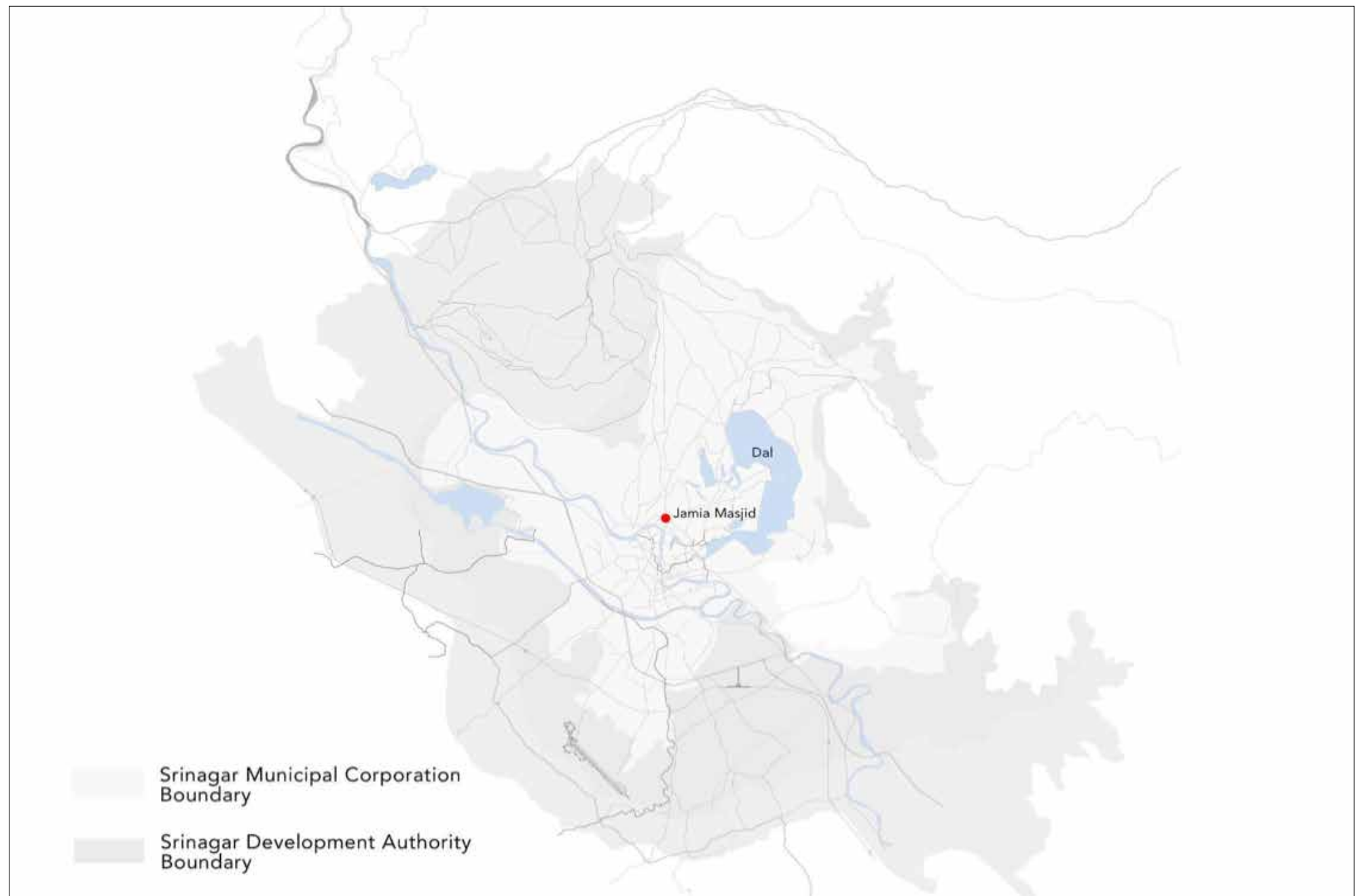


Figure 1: Map of Srinagar city showcasing location of Jamia Masjid, the mosque precinct is in the Srinagar Municipal Corporation, the mosque is located in Sheher-e-khaas and is also a popular tourist destination. Source: Author

mosque compound. The markets that were established have been a source of income for many families, apart from domestic customers they get benefited because of the tourists that visit the Mosque.

To understand the precinct multiple surveys were conducted by the smart city Srinagar, the issues were further categorized into Infrastructure, Mobility and Morphology, lack of interconnecting networks to distribute the vehicular intensity in NH, non-designated inlets to the network, lack of footpaths/breakage in footpaths, no designated bicycle track, Parking area, lack of signages were some of the problems. Further unplanned junctions, unplanned zebra crossing without refuge area, no designated bus stops, segregation of solid waste and grey water, unavailability of building codes and regulations for new constructions, encroachment on roads, no specific vendor zones causing footpath spillovers, improper management of open spaces were other major challenges

Based on analysis of the issues following projects were identified in the Jamia Masjid Precinct:

1. Junction Improvement
Nowhatta Chowk, Jamia Masjid Entry 2 Junction, Nalamar – NH Junction, Gojwara Junction

2. Jamia Masjid Precinct upgradation
Pedestrianizing, access improvement and pavement improvement, upgradation of Shaheed-e-Millat Market, upgradation of drainage and drinking water facilities

3. Skyline management
Deconstruction plan, building codes and regulations

Jamia Masjid is known as one of the most sacred mosques in Kashmir. Composed of 370 pillars of wood, Jamia Masjid symbolizes one of the best architectural specimens which survived the ravages of time ever since it was constructed in the valley of Jammu and Kashmir. The area of Jamia Masjid extends up to an area of 384 feet by 381 feet. This mosque holds a capacity to accommodate more than 33,333 people offering prayer at a time. There is a perfectly square garden in the middle and the mosque is surrounded by wide lanes on all the four sides. At the peak, about 1,00,000 people offer prayers together.

The forum of the Jamia Masjid has played an important role in the growth of social, religious and political consciousness among the people of Kashmir; it was used by people to socialize with each other. It became the hub of transferring ideas of people from different ideologies as they used to connect in the mosque compound for various religious gatherings.

The masjid falls under the domain of Anjuman-e-Auqaf, a private enterprise. It is the caretaker board of the mosque which was constituted in 1975. The major source of revenue is generated from the rent of 278 shops that are owned by the Auqaf around the Mosque.

1.1 Topic and Context

Heritage Development at Jamia Masjid

Jamia Masjid precinct development is a prominent historical and urban landmark in the old city known as Sheher-e-khaas, it represents the physical and urban development of the city. Jamia Masjid is one of the most prominent architectural achievements of Kashmir. Jamia Masjid Precinct has a unique synthesis of different usages namely public, private and religious. It represents the traditional historic face of Srinagar city.

1.2 Significance of the project

The heritage development initiative in this regard has played a pivotal role in the landscape of Srinagar city for various reasons and the interventions have once again highlighted the work being undertaken by Srinagar Smart City Ltd. across the city. As discussed with the CEO, all the major intervention in the city are part of a larger Urban Regeneration Strategy that is further broken into smaller initiatives, the Jamia Masjid precinct is one example.



Figure 2. Satellite image of Jamia Masjid precinct, the mosque is located in a dense urban fabric surrounded by residential settlements all around. Source: Google Earth

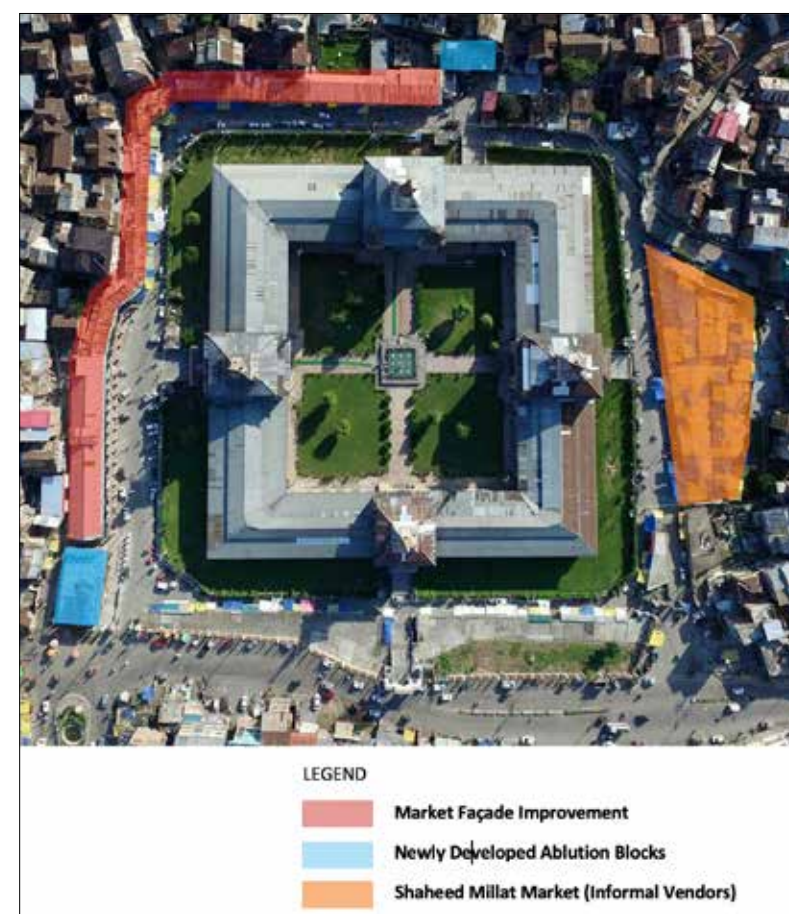


Figure 3. Aerial view of Jamia Masjid Precinct, the mosque also serves as big open public space in otherwise dense settlement of sheher-e-khaas. Source: Author

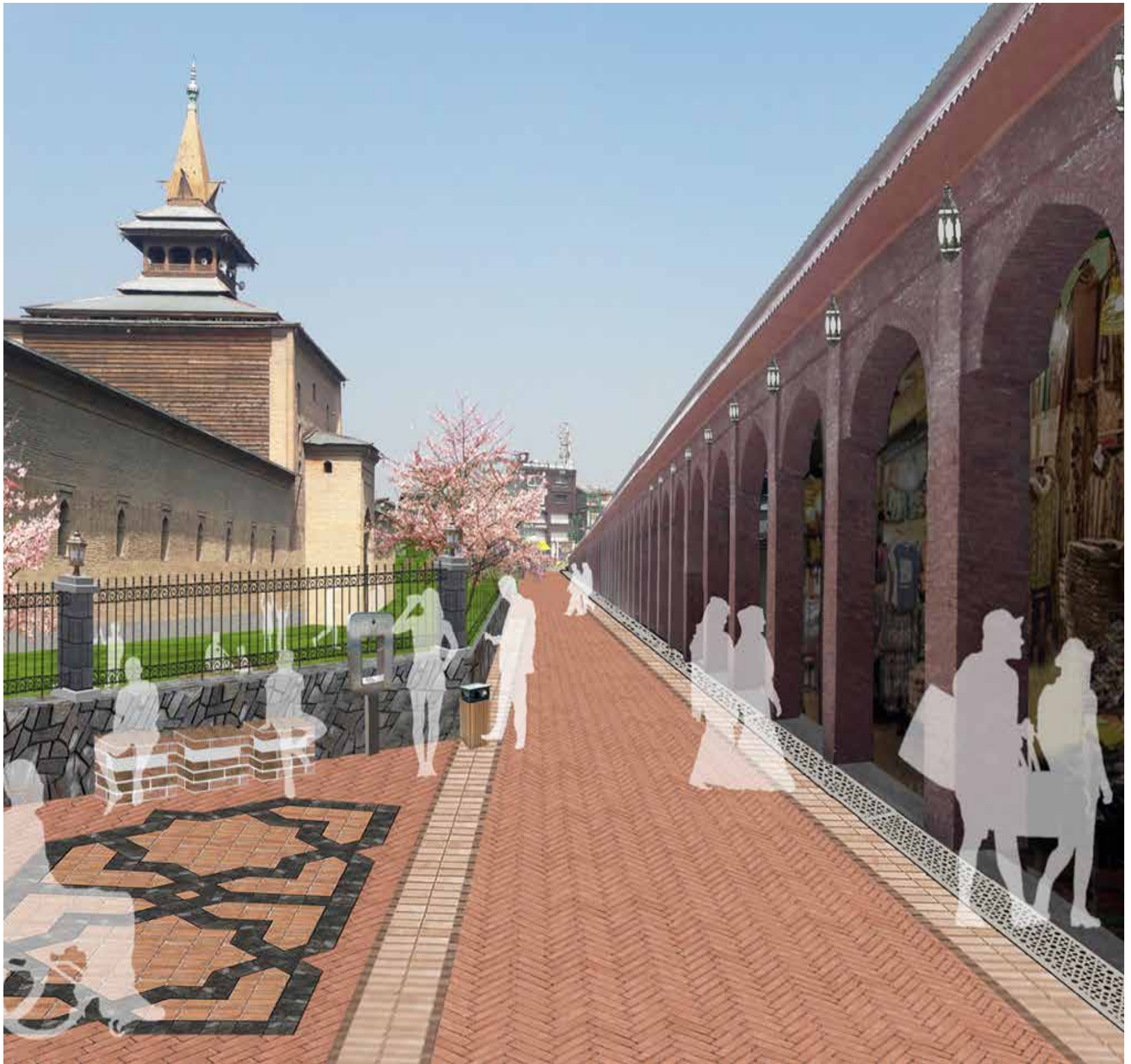


Figure 4. 3D view of facade redevelopment, multiple meetings were held to discuss the same with shop owners and Auqaf members before the finalization of the final design.
Source: Srinagar Smart City

1.3 Aim and Objectives

The aim of the study is to understand the impact on visitors, users and people associated with the market and mosque. The main aim of the project was to improve the market façade and increase the capacity of ablution.

The objectives of the study are:

- To study the impact of intervention on all users and how their experience changed.
- To understand concern/satisfaction of shopkeepers, visitors of market and mosque with the interventions done under Heritage development of Jamia Masjid.
- To understand what demands were met and how the area could be developed further considering the needs and requirements of daily users.

2. Contextual Background

2.1 Conceptual framework / Research design

Starting with secondary data collection and compilation in the standard format, the data comprises of news articles and a presentation. Also, a site study was done to see the developmental work done and the effects of it on the market and mosque.

2.2 Key features of the project

2.2.1 Challenges in the project

- To reach a mutual understanding with all stakeholders of the project.
- To maintain the traditional architectural style and meet the requirements of all users at same time.
- Reducing gap of understanding between the authorities, shopkeepers and Masjid Auqaf.
- Replicating traditional material (Maharaji Bricks) in an arched arcade.

2.2.2 Risks involved in the project

- In the process of façade improvement and construction of new ablution block, there is a risk of

moving away from historic character of the place, there is a risk that the original material and elements used might not be available nowadays.

- Meeting the completion deadline, as the area has witnessed lockdowns on many occasions.

2.2.3 Features and Benefits (social, technical, city administration level, impact on environment and economy) to the city (expected and observed)

- The project bridged the gaps between government agencies and shopkeepers by delivering the commitment made by the authority for Heritage Redevelopment of Jamia Masjid.
- The aspirations of shopkeepers on the East side of the complex for the improvement of same façade with an arched arcade with exposed brick work was realized.
- With construction of new ablution block for both male and female, it eased the operation of the Mosque. A meeting hall above the male ablution block was also constructed which was requested by Masjid Auqaf.
- Arched arcade improved the Façade of the market and improved the experience of visitors to the market.

2.3 Key findings from the interviews, surveys, and primary/secondary data collection

- The project is part of larger vision of Srinagar Smart City Ltd. to preserve the unique heritage essence of historic Jamia Masjid and connect the area with neighboring historical structures, historical markets and waterfront of river Jhelum.
- Heritage Development of Jamia Masjid had been divided into two phases under the phase-I façade improvement on south-west side and construction of two new ablution blocks had been done. Under phase-II of Heritage Development of Jamia Masjid, remaining market façade and brick paving are to be taken up.

- Overall community is happy with the interventions and aware of technical and design details.
- Jamia Masjid Auqaf is a key stakeholder for implementing any future plan for the complex.

3. Discussion and Conclusion

The assessment work is still going on but from the work done till date, the following conclusion can be made:

- The citizens are happy and satisfied with the interventions done with the facade improvement of Jamia Masjid market and construction of utility blocks which includes a meeting hall for the Masjid Auqaf.
- With the success of facade improvement on the south and west side of the market complex, shopkeepers on the north and east side want the same facade improvement to be done in order to improve the aesthetic of the precinct and improve user experience in the market.
- There are some concerns with locals and the general public regarding the use of material in arched arcades where red exposed bricks have been used while Jamia Masjid had traditional Maharaji bricks.
- Facade improvement has added value to the market complex and footfall in the market has increased.
- Srinagar Smart City Ltd. has been working tirelessly with stakeholders in order to continue Heritage Development work at Jamia Masjid. There are some gaps between locals and the authority for which various consultations and meetings are done on regular basis by Srinagar Smart City officials.
- f) Shopkeepers are concerned with the parking facility for the market and want the issue to be addressed by the authority and are willing to play an active role and responsibility in resolving the issue.

3.1 Implications

The Jamia Masjid precinct is not only a Friday mosque but it is one of the prominent markets and open spaces in Srinagar. The interventions by Smart City are first



Before



After

of its kind in the region, the market was in dire need of upgradation, the implication of the project has already been visible. Since the facade upgradation is done, the shop owners are now able to see the impact of the intervention in the trade and commerce. During the field survey, many of the shop owners would suggest additional initiatives that could be done in the precinct.

3.2 Limitations of the research

The data availability from the smart city was not up-to-date, and also some key data like the DPR, RFP, etc. was missing and we had to rely mainly on the media reports and some interviews.

3.3 Key lessons learnt

Consultation of all stakeholders and addressing their requirements is very crucial for the success of such a project. Secondly, smooth functioning of developmental work is possible only when the community participates in planning and developmental work. In most cases, the

users are aware and alert regarding proposals being presented by the authorities of what and what not is being implemented. To keep intact the confidence of users, authorities must make sure they don't divert from actual proposals and plans presented to the stakeholders. And finally, the process of development work can be simplified when multiple government stakeholders are working together by initiatives like Smart City Mission where it acts as a mediator between departments and stakeholders thus, simplifies the approval and implementation process.

3.4 Recommendations

The shop owners and citizens of Srinagar are deeply associated with the mosque. In our field survey, it was evident that especially the shop owners were connected to the mosque. Creating focus on integrated development should not divert a historical site like Jamia Masjid Market from its original character and fabric, great care should be taken in selection of material

and design. In the case of Jamia Masjid, the shop owners expressed their concern over the material used, they further suggested if the same material used in the mosque could have been used in the facade as well.

Creation of a stable policy framework for private investment in such projects is a key factor for the success of public realm projects of this scale. Reducing gaps between stakeholders by sharing information and holding regular consultation meetings would not only ensure smooth work but also generate a sense of belonging. Though the project had taken into account the shop owners but failed to address the informal market areas which consist of Millat Bazaar and adjacent areas, these might be taken up in the next phase. Addressing critical issues can solve multiple problems at once. In case of Jamia Masjid market, parking has been a long standing issue, multiple problems can be solved if a designated parking space is provided for visitors and shopkeepers.



Figure 6. Survey being conducted at site, Source: author

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C17

Citizen outreach in explaining/ engagement of SCM with Children Chacha Chaudhary Books

Name of the project: Citizen outreach in explaining/engagement of SCM with Children Chacha Chaudhary Books

Location: Faridabad & Haryana

Year of Project Implementation: 2021

Sector: Digital Awareness

SDG: SDG 4, 11, 13, 15 & 17

Project Cost: Rs. 10 Lakhs INR

Institute: Faculty of Architecture and Ekistics, Jamia Millia Islamia

Advisors: Dr. Hina Zia, Dr. Nisar Khan

Students: Amitesh Vijay Maurya, Harsimran Kaur

Keywords: Legendary comic hero Chacha Chaudhary; Importance of Smart City; Talking Comic.

Abstract:

As part of the Indian government's flagship initiative aimed at creating 100 smart cities in their five years tenure, Faridabad also became one of the selected smart cities. The legendary comic hero Chacha Chaudhary promoted Faridabad as an emerging Smart City in his latest set of talking comics - Chacha Chaudhary and Rocket ka Apaharan & Chacha Chaudhary and Nurturing Neighbourhood. This talking comic is an initiative by Diamond Toons and Faridabad Smart City Limited (FSCL) that illustrates how Faridabad is distinctively entering into a new age of the smart city.

Case Study: C17

1. Introduction

Faridabad is the oldest city in Haryana. With the establishment of several prominent garment manufacturers, tractors, refrigerators, switch gears, etc., it gradually became an industrial centre for Haryana. In May 2016, Faridabad was selected for the Smart City Mission. In September, Faridabad Smart City Limited was incorporated as a special purpose vehicle. In the Smart City Mission launched by MoUD Gol, 100 cities were to be chosen for Urban renewal and retrofitting with the goal of promoting cities that provide core infrastructure, give a decent quality of life to their residents, and apply smart solutions to improve services and infrastructure.

1.1 Topic and Context

With his latest set of talking comics - Chacha Chaudhary and Rocket ka Apaharan & Chacha Chaudhary and Nurturing Neighbourhood - legend Chacha Chaudhary underscores the importance of smart cities. Diamond Toons and Faridabad Smart City Limited (FSCL) have undertaken this initiative to show how Faridabad is entering a new era of smart cities.

The concept of 'Talking Comics' created by Diamond Toons is a unique way to communicate and interact with kids and adults as it communicates messages effectively through pictures. Talking comics are an engaging format that appeals to active minds, and quick learners, and provides an intelligent quick connection to consumers.

The process of learning is made easy, interesting, and fun with a specially designed program for adults and children in two languages.

1.2 Significance of the Project

The significance of the Chacha Chaudhary Project is to spread key messages for behavioural change through IEC (Information - Education - Communication)

- To bring about a change in society through a behavioural change in Children, Youth, Students & Adults
- To target the Kids, Youth, Students & Adults who are the biggest change agents for any Social Transformation
- To engage with the Kids/children in an innovative manner and spread the key message of IEC

1.3 Aim and Objectives

The aim of the research is to identify the impact of Chacha Chaudhary talking comics on the outreach and awareness strategy for the city of Faridabad.

The objectives of the research are as follows:

- Understanding the idea and strategy behind the project.
- Assessing the role of stakeholders in the project.
- Assessing the outreach of talking comics on the local residents in question.
- Identifying the shortfalls and achievements of the project.
- Recommendations

2. Contextual Background

Chacha Chaudhary, India's most loved cartoon character, is a middle-class urban-clad witty old man who solves everyone's problems swiftly using his brain smarter than a computer. With this and many other entertaining cartoons, Pran made history in the Indian comics and children's book industry. Chacha Chaudhary, the comic book hero, is a new collaborator to help promote Faridabad Smart City Limited's social media initiatives.

The Diamond Group of publications is home to Diamond Toons, one of the most creative teams in the industry. A clear vision is to provide children, who have endless entertainment options, with not just entertainment, but also education on a unique platform. Diamond Toons has a history of partnering with leading children's brands. The most loved and read comic characters in India are Chacha Chaudhary, Billu, and Pinki, who are all part of Diamond Toons. For over 40 years, Chacha Chaudhary has captivated the imagination of young Indians and continues to do so today.

An inside comic - The initiative features excerpts from Talking Comics, where Chacha Chaudhary and Sabu, his loyal sidekick, teach and guide children and adults on how to use the available infrastructure.

There is no doubt that Chacha Chaudhary is a favourite character for all generations in India. It would be possible to spread the message to everyone in an



Figure 2.1: Chacha Chaudhary promoting SMART city project
Source: FSCL facebook page

innovative way with the help of this comic book hero. Using pictures to convey messages, comic strips offered a unique way to communicate with adults and children. This format would connect Faridabad's people quickly and intelligently.

2.1 Conceptual Framework/Research Design

- Secondary data collection- Collected relevant data and information from secondary sources like the FSCL website, newspaper articles, social media etc.
- Interview with Concerned FSCL Officials & Heads- A series of interviews were conducted with FSCL CEO.
- Stakeholders' feedback- The Diamond Toons directors and managers were consulted during a meeting. Their feedback was taken into account for this programme.
- Survey of Users- Surveys were conducted in various parts of the city. Interviews were conducted with people of different ages.
- Case Studies- Case studies of different cities were examined.

2.1.2 Visakhapatnam Smart City Framework Plan

AECOM prepared the Visakhapatnam Smart City Framework Plan on behalf of the Government of Andhra Pradesh with funding from the United States Trade and Development Agency. With the proliferation of smartphones and the Internet, the term smart-city has become more prevalent, and citizen engagement and control are integral parts of modern democracy. The AECOM team engaged with Quicksand to ensure Vizag's citizens were aware of the upcoming changes and empowered to have a voice in them as they crafted a vision for Vizag's Smart City initiative.

They set up a public participation portal for Vizag by using comics and other visual collateral to represent

citizen engagement, in addition to an SMS engagement campaign. The stories are being developed into five comics that have the potential to be made into radio shows in the future. The goal of the campaign is to inform the public about AECOM's vision and to engage them in developing it further (e.g. Vizag in 2030).

Quicksand used the city's people as inspiration for storytelling, creating a series of visual narratives that reflect the voices, concerns, and aspirations of Vizag's citizens. The stories depict a Vizag of the future as well as showing what life might be like in a smart city in 2025. They discovered that visual narratives create engagement as well as incentives, and they became an effective means to express and convey AECOM's Smart City plans.

Through day-in-the-life scenarios and easy-to-swallow scenes, they portrayed five verticals of smart cities - land use, water, governance, mobility, and energy - so that citizens could begin to grasp what these aspects of life are all about.

2.1.3 Namami Gange Programme

In order to encourage children and youth to take up the cause of rejuvenating the Ganga and other rivers, the Executive Committee of NMCG decided to engage Chacha Chaudhary. Namami Gange's 'Ganga ki Baat, Chacha Chaudhary Ke Sath' is an activity for public engagement as part of its overall outreach program. NMCG has conducted a number of public outreach programs, such as Ganga Quest and Rag Rag Mein Ganga, and Ganga ki Baat, Chacha Choudhary Ke Sath is one of them. In this comic series, Chacha Chaudhary discusses how to preserve rivers by telling different stories.

Chacha Chaudhary publisher Diamond Toons submitted a proposal to work with the Namami Gange organisation to raise awareness about this programme. The NMCG has also discussed the proposal with the World Bank, which supports the Namami Gange initiative. Since youth are the impetus of change, the NMCG has focused its outreach and public communications efforts on youth. In order to achieve this goal, NMCG has partnered with Diamond Toons to develop and distribute comics, e-comics, and animated videos. The content of the program has been designed to influence children's attitudes towards Ganga and other rivers. The estimated budget for the program is Rs 2.26 crores.

2.2 Key features of the project

Chacha Chaudhary mission is an awareness program to cater for the age group from 8 to 80 years as mentioned by the CEO of Faridabad Smart City Mission and Director of Diamond Toons. The target audience is - kids, youth, students and adults.

A talking comic is used for this mission which is a cheaper solution compared to animated video. In this, 5-minute content costs only Rs 3 lakhs while a 1-minute animation costs Rs 5 lakhs.

IEC (Information - Education - Communication) are the key messages for behavioural change discussed in this comic book.

2.2.1 Challenges in the project

- It would be a challenge to reach out to non-readers or illiterate citizens.
- Chacha Chaudhary is less popular among millennials and not promoted much.
- The children are more screen-oriented and into the e-space.



Figure 2.2: Chacha Chaudhary promoting cleanliness
Source: FSCL facebook page



Figure 2.3: Citizen centered platform designs for smart cities
Source: Quicksand



Figure 2.4: Chacha Chaudhary promoting Namami Gange
Source: Chacha Chaudhary facebook page

- iv. Distribution of the comics to users in the lowest strata.
- v. Ignorance and the Lack of knowledge regarding the key messages of IEC (Information - Education - Communication)
- vi. Media criticism.

2.2.2 Risks involved in the project

- i. An insignificant amount of money, compared to the overall budget and labour of Smart City projects in Faridabad, was involved. So there is minimal risk.

2.2.3 Features and Benefits to the city

- i. It effectively talks to inquisitive minds & spreads awareness in an intelligent and quick-witted manner.
- ii. It instantly connects and communicates the ideas across.
- iii. Adaptable in multiple Indian regional languages.
- iv. It has the potential to reach out to a larger base of children and adults.
- v. In addition, FSCL has the potential to save money on advertising smart initiatives.
- vi. It is an effective way to induce behavioural change in children.

2.3 Key findings from the interviews, surveys, and primary/secondary data collection

It is expected that smart city will be able to spread the message efficiently and in an interesting way through the superhero of the Chacha Chaudhary comic and other favourite characters. It is an effective way to induce behavioural change amongst children as it is adaptable and instantly connects and communicates ideas. Graphics is the simplest medium to connect with anyone. Getting inspired by the comics and in order to spread the word our team as well had a chance to interact with end-users (children).

Speaking on the collaboration, Ms Garima Mittal, CEO of, of Faridabad Smart City Limited said, the effective usage of infrastructure created under smart city requires public participation for its effective usage and protection. As per CEO, this project was supposed to make people aware of the smart initiatives in the city.

As per the Diamond toon Director and the Manager, the comic is intended to instigate behavioural change in people.

The user survey was conducted and found that people are not at all aware of the talking comics initiative. The strategy adopted to reach the public was not effective, as the comic did not reach the intended users.

It was also found that it takes less investment compared to advertising and reaches out to the whole city at once.

3. Discussion and Conclusion

3.1 Implications

Financial express considers the Chacha Chaudhary talking comic mission as a smart move by the Faridabad authorities. In each post, Chacha Chaudhary will be accompanied by his loyal sidekick Sabu who will instruct and guide people on how to integrate the infrastructure that was put in place. The age group under the scope of this mission is wide and challenging to achieve.

Also, the use of existing relatable comic characters to spread the message across the country in many languages. The project aligned with similar messages can address a wide variety of important issues in the comic for spreading awareness.

Talking comics is a simple concept that can be easily applied to any department, city, etc. The concept allows us to take up a wide variety of important issues for spreading awareness. Comics can be produced in any language, including regional languages. Any popular character can be used (pinkie, billu, etc) or a new character can be customised and used for such programmes. It has the potential to club with other activities (competitions, quizzes, etc) to have a greater impact.

3.2 Limitations of the research

Due to the lack of any official documents or DPR providing information on this programme, the resources were limited. Many of the officials working in the FSCL department were also not aware of the details of this programme.

It was difficult to reach the schools to get information from the children. In light of the current situation, people were hesitant to participate in the survey.

As the comics could not reach the intended audience, the information was solely based on interviews with the CEO of FSCL and Diamond Toons' Director.

3.3 Key lessons learnt

The intended user group of 8 to 16 years, does not have a strong connection to the character. Probably, the new generation is not aware of the character or is more into e-space and does not relate to the talking comic concept. Millennials are the only ones who can relate to the character deeply.

In order to reach more people, the distribution channel must be restructured in a more effective and efficient manner. Innovative ways of delivering the message should be used to continue engaging more people in such initiatives. Unreached to the most common users/ the residents of the city, as the new generation still needs to be connected with old characters.



Figure 3.1: Awareness & distribution of copies



Figure 3.2: Interaction and Feedback from the local residents in the ABD area followed by Chacha Chowdhary Comic distribution

3.4 Recommendations

In order to achieve the goal of outreach and awareness, intended through talking comics few of the recommendations through observations have been listed below:

1. The comics could be distributed to the school's library in Faridabad.
2. Additionally, e-copies of the entire issue can be posted on FSCL's social media and website pages.
3. For greater impact at the school level, the idea can be incorporated with other activities (competitions, quizzes, etc.).
4. Introducing old or new characters - Pinki and Billu - can establish a relationship between people and the city.
5. For stimulating awareness in the lowest strata of the city, the comics could be distributed free to the people and their responses could be studied to know the success rate of the mission.

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C18

Restoration of Capitol Complex, Pierre Jeanneret House and the Le Corbusier Centre

Name of the project: *Restoration of Capitol Complex, Pierre Jeanneret House and the Le Corbusier Centre*

Location: *Chandigarh*

Year of Project Implementation: *2018-2020*

Sector: *Heritage*

SDG: *SDG 11, 11.4*

Project Cost: *65Cr; 5-6 lacs; 3-4 lacs INR*

Institute: *Faculty of Architecture and Ekistics, Jamia Millia Islamia*

Advisors: *Dr. Hina Zia, Dr. Nisar Khan*

Students: *Ripu Daman Singh, Madiha Khanam, Tanya Ahmed, Yogesh Bharadwaj*

Keywords: *Restoration, Outstanding Universal Value, World Heritage Precinct, Innovation, Authenticity*

Abstract:

Chandigarh is considered India's primary endeavour toward modern urban design and an all-inclusive attempt in city planning based on the modular approach and garden city concept. The universally renowned architect Le Corbusier and Pierre Jeanneret along with their team of architects together led to the creation of one of the most well-planned cities in India. The outstanding universal value the city of Chandigarh holds, and the efforts that need to be taken in order to preserve, restore and conserve the contributions of Le Corbusier and Pierre Jeanneret are imperative to the essence of the city.

The project revolves around the restoration of the Capitol Complex in Sector-1, which is one of the monumental works of Le Corbusier. The Le Corbusier Centre in Sector 19B served as the architects' office during the design and planning of the city along with Pierre Jeanneret House no.57 in sector-5.

The significance and need for the project are embedded in the instrumental role played by Le Corbusier and Pierre Jeanneret in bringing the idea and vision of the city as envisaged by Pandit Jawaharlal Nehru into reality. Furthermore, the conservation and regular upkeep of this modern heritage will induce both national and international tourism owing to the Heritage status conferred on the Capitol Complex by UNESCO. The project will also facilitate an increased awareness among the citizens of the city and help sensitise them towards its rich modern heritage value.

The methodology adopted for the purpose of this research involves a qualitative approach that takes into account data from secondary sources of information and collation and compilation of the data. This was followed by a primary data collection in the form of interviews and surveys of various stakeholders, and observations as well as field studies to further understand the issues, challenges and solutions adopted by the administration.

The findings after site visits and interactions with engineers of MC Chandigarh, Chief architect UT, and faculty members of Chandigarh College of Architecture revealed that the project was executed while retaining the essence of authenticity in terms of restoration works. It helped enhance the citizen's awareness of the Modern Heritage in the city and also led to rising in domestic tourism. Ample capacity-building initiatives were undertaken for the successful execution of the project, coupled with innovative approaches that can serve as precedents for other cities to follow.

Case Study: C18

1. Introduction

1.1 Topic and Context

Smart City Mission was launched in India in the year 2015 with the objective to promote sustainable and inclusive cities that provide core infrastructure to give a decent quality of life and a clean and sustainable environment through the application of some smart solutions such as data-driven traffic management, intelligent lighting systems, etc. Though a centrally sponsored scheme, it entails local governments and urban local bodies (ULBs) to commit an equal share to Smart city project implementation. In addition, Smart cities are encouraged to include convergence projects undertaken by AMRUT, Swachh Bharat Mission (SBM), HRIDAY, Digital India, Skill Development, Housing for All, and other programs related to social infrastructures such as Health, Education and Culture.

The present study is focused on the Heritage projects of Chandigarh which fall under the realm of Restoration/retrofitting/conservation/protection/maintenance of Heritage buildings, taken up as convergence projects namely Capitol Complex, Le Corbusier Centre and Pierre Jeanneret House. These were undertaken by Chandigarh UT Engineering Wing, Chief Architect Chandigarh UT with inputs from the Heritage Conservation Committee which acts as an advisory body for all architectural conservation projects of Chandigarh.

The stakeholders involved in this project are as follows:(Ref Figure 1.1)

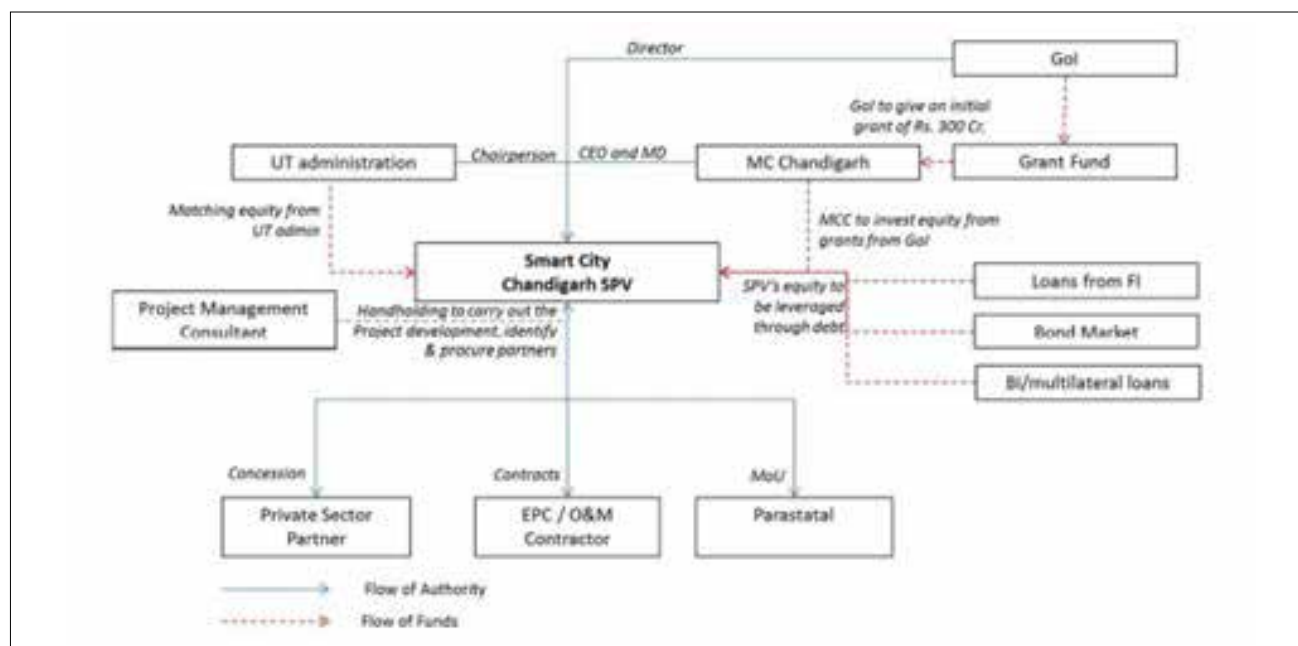


Figure 1.1: Stakeholders and their roles

Source: https://smartnet.niua.org/sites/default/files/resources/Annexures_Chandigarh.pdf

This research will encapsulate the interventions carried out for the successful restoration of the project, and will also document the subsequent challenges and roadblocks that were dealt with during its execution.

1.2 Significance of the Project

1.2.1. Capitol Complex

The Chandigarh Heritage Conservation Committee had approved the plan of restoring the glory of the Capitol Complex in 2017 after the declaration of the Capitol Complex as a World Heritage Site, with the appointment of Mumbai-based heritage architect Abha Narain Lambh and associates. The firm was engaged in the project and prepared the conservation and management plan for Capitol Complex. However, due to certain reasons, the firm quit the project and the work was then carried out in its entirety by the Engineering Department of UT administration, with consultation and advice of the Heritage Conservation Committee.

The Capitol Complex comprises three buildings namely the Legislative Assembly, High court and Secretariat; and four monuments namely Open Hand, Martyr's Memorial, Geometric Hill and Tower of Shadows. The buildings of Capitol Complex were constructed during the 1960s, and have completed almost 60 years of their lifespan. All these buildings are in exposed concrete, that has deteriorated and weathered over the years. Visible signs of distress in the concrete in the form of blackening, chipping, cracks etc. were observed.

1.2.2. Pierre Jeanneret House

After the departure of Pierre Jeanneret from India, the house was allotted to various bureaucrats from time to time, who carried out renovations and alterations as per their needs, which compromised the authenticity of its original design. The major deterioration issues were algae deposition and cracks on the exterior plastered surfaces. Major alterations to the house included enclosing verandas by filling in the brick jaalis and plastering them for a continuous wall to serve as an extension of rooms. The rubble masonry exterior feature wall was also plastered and painted. Other alterations were made to the fireplace in the living area which was filled in with bricks and debris and sealed with a wall. Even the various niches designed by Jeanneret had also been filled in and plastered.

1.2.3. Le Corbusier Center

The Le Corbusier Centre served as a temporary site office for Le Corbusier and his team of architects. The building stayed in a state of neglect and manifested major cracks in the structural columns and junctions. As the roof of the building was constructed with wooden rafters lined with asbestos sheets, over the years it was infested with termites and got damaged in some places. The jute-lined cardboard false ceiling laid under this roofing system also stood damaged. The concrete louvres provided on the south façade of one block had completely sagged and the reinforcement also got corroded.

1.3 Aim and Objectives

The aim of the study is to document the restoration works carried out to protect, preserve and conserve the City's monumental edifices designed by Le Corbusier and his team of Architects namely Pierre Jeanneret, E. Maxwell Fry, and Jane B. Drew. The restoration of the edifices of Le Corbusier's and Pierre Jeanneret's legacy to their original form and the regular upkeep is an integral part of the continuous process of Conservation.

The objectives of the study are:

- To assess the implementation strategy followed by Chandigarh Administration for the Heritage projects.
- To document parameters that relate to challenges, lessons learnt, innovative solutions implemented, and identification of gaps and deficiencies in local urban governance relating to the involvement of multiple agencies.
- To analyse the authenticity of the interventions executed as part of the restoration works.
- To assess the impact of restoration works both direct/indirect.
- To assess measures taken to prevent any further additions and alterations in the design of the edifices of these heritage buildings.

2. Contextual Background

2.1 Conceptual framework / Research design

The objective was to study the restoration, maintenance and preservation of heritage projects as carried out by the Chandigarh Administration which is now a part of the convergence projects of Chandigarh Smart City Mission. Therefore, it was extremely important to interact with experts who were/are associated with these projects. The persons who were interviewed were selected on the basis of purposive sampling, i.e., those who were directly or indirectly involved in proposals, conception, design, administration, execution, and upkeep of the projects as well as the users who were eventually using them. The research is designed in the following manner: The preliminary Secondary studies were carried out in January and February 2022 to collect literature from publications, government reports, websites etc. and thereafter, Primary data collection surveys were carried out in Chandigarh from 14-16th March 2022 where interviews were conducted with Smart City Officials, other key government officials such as Chief Engineers/ Chief Architect, senior faculty members of Chandigarh College of Architecture, PMC personnel, industry professionals/consultants, service providers and their staff, users and citizens of Chandigarh.

In the study, qualitative methods involving structured and unstructured interviews, informal discussions, observation, user feedback, Site/ Field visits, first-hand experience by SAAR team members, and citizen feedback through Google forms, were used to understand the

background, execution, challenges, risks, lessons learnt during the project implementation as well as to evaluate the success, utility, value, replicability, expandability and direction for future projects. In addition, a document analysis of reports, proposals, presentations, and data was performed which included existing issues, the proposed objectives of the Smart City mission and Heritage Committee, and the types of projects proposed.

2.2 Key features of the project

2.2.1 Challenges in the project

Numerous challenges were faced during the design as well as execution of restoration work of the project as given below:

Design Stage:

- i. Survey and documentation of the various alterations and additions done by various departments of State Governments of Punjab and Haryana over the years.
- ii. Mapping of all alterations and additions with the original plans from archives, drawings from UT Architecture Departments, Old photographs procured from Government records, veteran architects, Le Corbusier Foundation, Paris etc.
- iii. Preparing a work plan for execution considering the fact that the most important key government offices of both states- Haryana and Punjab are located at the Capitol Complex in the Secretariat and High court buildings.
- iv. Appointing a suitable conservation architect as a

consultant for this very important modern heritage project

Restoration execution stage:

- i. Executing the work without the supervision of the conservation architect who had discontinued the project mid-way.
- ii. Looking for a suitable technique for the restoration of 70 years old worn-out concrete structures, without damaging the structure.
- iii. Matching of concrete colour and texture as per the original surface due to the fact that various buildings and monuments had varying colours, thereby necessitating multiple batches of the concrete.
- iv. Difficulty in coordinating with both state governments and judges for the execution of restoration works owing to the fact that work could only be carried out after working hours or on holidays since the buildings were in use.
- v. Removal of encroachments and modifications done by different departments without the information/ permission of the UT administration, was a difficult task since the occupants were high-profile government officials.
- vi. The management plan for the buffer zone that segregates the Capitol Complex remains a significant challenge since the surrounding areas of Punjab are developing as per their own plan.
- vii. The unavailability of original drawings for reference made the process of restoration challenging in the case of the Le Corbusier Centre and Pierre Jeanneret house.



Figure 2.1: The condition of the Secretariat before restoration was undertaken
Source: Chandigarh Smart City Limited



Figure 2.3: The encroached exterior edifice of the High Court
Source: Chandigarh Heritage Report by Heritage Conservation Committee of Chandigarh



Figure 2.5: Encroachments covering the original veranda
Source: Chandigarh Heritage Report by Heritage Conservation Committee of Chandigarh



Figure 2.2: The weathering of concrete in the High Court Building;
Source: Chandigarh Smart City Limited



Figure 2.4: Plaza used for parking in front of High Court
Source: Chandigarh Heritage Report by Heritage Conservation Committee of Chandigarh



Figure 2.6: Extension in the original veranda
Source: Chandigarh Heritage Report by Heritage Conservation Committee of Chandigarh

- viii. Since the Pierre Jeanneret house was inhabited by multiple officials over time, alterations and renovations were rampant, which violated the authenticity of the original house design. Removal of multiple layers of alterations and interventions proved to be a challenge.
- ix. Reclaiming the buildings taken over by other departments who made their ad-hoc changes at the Le Corbusier Centre.
- x. Restoration and repair of the jute panel false ceiling, restoring the tapestries, identification of original paint, flooring etc. was a huge challenge.

2.2.2 Risks involved in the project

The various risks associated with the project are as follows:

- i. No involvement of a conservation architect meant that in case some restoration work failed or the structure got damaged, the move would have backfired and the UT Engineering Department would have been held accountable for carrying out the work without the services of a conservation architect.
- ii. Concrete restoration techniques previously in use were invasive and could pose a risk of damage to the concrete surface/structure.
- iii. Discontinuation of grants/funding, while the process of conservation is undertaken, could have detrimental effects on the buildings.
- iv. Further delay in the initiation of restoration could lead to irreversible damage to the built heritage.
- v. Issue of regular upkeep and maintenance schedule once the buildings are restored, failure of which can turn out to be a costly affair.

2.2.3 Features and Benefits (social, technical, city administration level, impact on environment and economy) to the city (expected and observed)

The execution of the restoration work has benefitted the city, and its citizens in the following ways:

- i. Protection of cultural and architectural identity of the city, which was being compromised due to haphazard and insensitive modifications, as well as neglect.
- ii. The restoration work has not only improved the aesthetics of the World Heritage Site but has also



Figure 2.7: The Pierre Jeanneret house lay vacant for 3-4 years before its restoration was taken up;
Source: Ar. Deepika Gandhi

increased the life of buildings and monuments in the complex, as well as Pierre Jeanneret house and the Le Corbusier Centre.

- iii. The restoration of modern heritage also led to the improvement in the disaster management aspects of the site.
- iv. A tourist information centre has also been set up from where a guide is assigned to the visitors who are organised in groups for a guided tour of the Capitol complex.
- v. Landscaping works were also taken up for the high court building in order to prevent the expansion of services as per convenience and to have a microclimatic effect in the plaza.
- vi. The second block of the old architects' office in the Le Corbusier Centre has been put to use as Research and Development Centre to act as a house of information where all archival material of the city's architecture, planning, landscape, art and other similar aspects can be stored and displayed in order to disseminate information on a national and international level.
- vii. Extending the affiliation to the Le Corbusier Foundation in Paris can augment the existing database and facilitate higher research.
- viii. Concerted efforts in the conservation of Chandigarh's Modern Heritage act as catalysts of tourism and have helped boost the economy.

2.2.4 Key findings from the interviews, surveys, and primary/secondary data collection

The meeting with the officials from the PMC Egis International commenced with a brief overview of how Chandigarh was enlisted as a Smart city in the Fast Track round in 2016, following which an SPV in the name of "Chandigarh Smart City Limited" was established the same year and the PMC was brought onboard in 2017. Chandigarh Smart City devised the above-mentioned categories for projects to be taken up and allocated the respective budget for the same.

For the Capitol Complex, the Heritage Conservation Committee and sub-committee played the role of an advisory body to ensure the basic principles of conservation are implemented. All interventions were first taken up for discussion with the committees and only then the engineering department would initiate the



Figure 2.8: The derelict state of the Pierre Jeanneret house front before its restoration;
Source: Ar. Deepika Gandhi

execution of the work. No heritage consultant was part of the project.

For the Pierre Jeanneret house and the Le Corbusier Centre, Ar. Deepika Gandhi was the custodian of the site and the interventions were executed by the UT Engineering department. The project was taken up under the ABD (Area Based Development) which comprised sector-17, 22, 34 and part of Leisure Valley. The heritage restoration works carried out at the Capitol Complex was also the recipient of the ISAC 2020- Project Innovation Award (Culture).

The exposed concrete in all the buildings of the complex was in a dilapidated condition and chipped and the High Court was also subjected to interior and exterior changes over a period of time by the different departments that had taken office. The weathering of exposed concrete is also linked with the Le Corbusier Center. Internal changes in the layout and planning were also prevalent in the Pierre Jeanneret house, where multiple bureaucrats who had been allotted the house had made changes/alterations as per their needs.

To commence the restoration works, a detailed Heritage Management Plan was prepared by professional experts to tackle India's first large-scale restoration of Modern Heritage spread over 100 acres.

Water jetting was the technique adopted by Chandigarh



Figure 2.9: The exterior surfaces of the house taken over by algae deposits;
Source: Ar. Deepika Gandhi



Figure 2.10: The niches being chiselled out of the wall
Source: Ar. Deepika Gandhi

UT Engineering Department for cleaning exposed concrete surfaces owing to its non-invasive nature and a machine for the purpose was imported from a German company Kärcher. The same technique was executed at the Le Corbusier Centre too.

The concrete colour and texture were matched by conducting multiple trials, and the same methodology was implemented for wall paints in the Pierre Jeanneret house, where old archive photos proved to be a tool to identify the original colour scheme.

The nine Courtrooms in the High Court building have heritage tapestries, out of which two tapestries in the courtroom nos. 6 and 9 have been successfully restored by doing specialised repair of the damaged part. For carrying out the same, a detailed analysis of the thread counts was validated by expert institutions from New Delhi such as IGNCA, JNU and Lady Irwin College, following which skilled artisans were called to repair the damaged parts of the tapestries. Carpets were re-laid in the courtrooms and the vitrified tile flooring in corridors and other common areas was removed, which led to the revelation of authentic terrazzo flooring underneath. The terrazzo flooring was re-laid and utmost care was taken to match the grain, colour and texture as per the original. The flooring for the Pierre Jeanneret house was also recast as IPS flooring as per the original.

As part of her list of duties when brought as the director of Le Corbusier Centre, Ar. Deepika Gandhi stated that she was given the responsibility of the restoration of both the Pierre Jeanneret house and the Le Corbusier Centre and also set up a museum at the Pierre Jeanneret house. At her behest owing to the specialised nature of carrying out heritage restoration works, a contractor was not brought on board because there were no such experts available in Chandigarh who had the experience of executing heritage projects since such work was being carried out for the first time. The engineering

department agreed to this and the project commenced in 2016, alongside the restoration of the Capitol Complex.

“The verandas’ were enclosed by inhabitants, doors and windows replaced, fittings and fixtures changed and the brick fireplace and niches were demolished or filled and plastered. We spent nearly four years on its restoration”, recollects Deepika Gandhi, ex-director, Le Corbusier Centre.

Owing to the temporary nature of the Le Corbusier Centre which served as the architects’ office for Le Corbusier and his team, there were major cracks in the structural columns and junctions. The roof was in a very dilapidated condition. “The louvres on the south facade had completely sagged and the reinforcement was badly rotted. After multiple failed efforts to restore the same, it was decided to cast them new in-situ” states Ar. Deepika Gandhi.

Many innovative solutions were worked out during

the execution of the projects by following a thoroughly professional approach while remaining sensitive towards the heritage buildings as well as their interior furniture and furnishings. The work of cleaning exposed concrete surfaces while protecting its structural strength and matching its colour pigment, restoring old terrazzo/ mosaic flooring, reviving original wall paint using original specifications, repairing original furniture, restoration of badly damaged tapestries in Assembly building and High court, the revival of original jute based false ceiling in Le Corbusier Centre etc. has been carried out and documented with the utmost care and following all basic principles of conservation.

The work done is replicable and the same techniques are already being used in the plaza of Sector 17 as well as the exposed concrete facades.

In the interviews, it was found that collaborative efforts and strong coordination between departments can bring about the desired change directed at the successful



Figure 2.13; Graphical representation of the research process
Source: author



Figure 2.11: Broken and damaged door made up of cardboard and jute for passive cooling at Le Corbusier Centre; source- Ar. Deepika Gandhi



Figure 2.12: Structural cracks at the Le Corbusier Centre; source- Ar. Deepika Gandhi

	Smart City Officials	Chief Engineer UT, Asst. Engineer UT, Chief Architect UT, Ex-Councilor MC, Principal and Faculty CCA	PMC, Consultants, Service Providers/ Vendors, Employees	Users/Citizens
Total Interviewees	2	Mr. Ojha- Chief Engineer UT Mr. Armaan & Mr. Bajaj- Asst. Engineer, UT Ar. Kapil Setia- Chief Architect UT Dr Sangeeta Bagga- Principal CCA Ar. Deepika Gandhi- Faculty CCA/Ex-director Le Corbusier Center Ar. Sohan Lal- Faculty CCA	Mr. Arun- Team head, EGIS International PMC	38
Mode	Structured interview	Unstructured interviews, informal discussions	Unstructured interviews, informal discussions	Observation, feedback through the google form

Table 1; Primary data collection interviewees,
Source: Author

implementation of any project. Mr N.P Sharma, CEO of Chandigarh Smart City, stated that “Chandigarh citizens being more aware and educated, support such initiatives, thus leading to successful initiatives.” This is evident in the success and the positive perception of CSCL projects and the convergence projects such as restoration works.

Er. Armaan and Er. Bajaj from Chandigarh Engineering Department shared their experiences and narrated the lessons learnt during the execution of projects and how they had to personally monitor every aspect so that the original work could be restored in its pristine glory. The inputs from Chief Architect, Ar. Kapil Setia indicates that though the Engineers have put in their best efforts, still the continued services of a conservation architect would have led to more fruitful results.

A citizen survey was conducted by the SAAR - Jamia Millia Islamia team through google form which was circulated on various social media platforms among Citizens of Chandigarh. The questionnaire was intended to garner the performance of the Chandigarh Smart City projects which shall help to understand the achievements/limitations/challenges and shortcomings of the Smart City projects.

The questions related to awareness about the Smart City projects, the public perception in the form of rating, and the value of Modern heritage for the public. The analysis of 38 valid responses revealed that more than 52% of Chandigarh citizens were aware of the restoration projects being undertaken by the Chandigarh Administration. This shows that the Chandigarh citizens are quite aware of the rich modern heritage. While answering the question related to rating the performance of the projects, about 30% of the citizens are satisfied with the performance of the projects

while more than 40% feel that though the initiative is commendable, a lot more needs to be done so as to have a considerable impact on the city level. This is due to the fact that in another question related to the value of heritage for the citizens, more than 75% of the citizens value the Heritage of Chandigarh as very important or extremely important. That is precisely the reason that the Chandigarh citizens, who are extremely attached to their Heritage, value the restoration projects very highly and hope for a much larger initiative at the city level with regard to restoration works.

3. Discussion and Conclusion

3.1 Implications

The restoration project of the Capitol complex, Le Corbusier Centre and Pierre Jeanneret house have led to tangible, as well as intangible benefits including visual improvement of the world heritage site which is also an

Area Development			
Sr.	Project Name	Estimated/Proposed Cost	Implementation Agency
1	Heritage Project - Capitol Complex	8.38	UP
2	Heritage Project - Le Corbusier's Centre	0.32	UP
3	Multiple Project - Panch Sthal	0.22	UP
4	Construction of proposed new Secretariat Building, Plot No. 7, Sector 9-B Chandigarh, Chandigarh	49.75	UP
5	Restoring and lighting of City Ring to front of Habitat 67	1.20	UP
6	Restoration and preservation of Govt. Netaji building, 20 lanes, 17 lanes, Term Hall Building, AHA, Term Hall Building, Central Library	2.73	UP
7	Restoration of proposed Urban park Subal Nandan Chakra, Sector 17 Chandigarh	10.20	UP
8	Urban design - public places design for RWH phases	0.20	UP
9	Restoration of Secretariat, Grand Plaza, New Water and Sewer Plant of Habitat Corporation Building, Sector 17, Chandigarh	24.00	UP
Total		106.63	

Figure 2.14: The cost of projects in Area Based Development under Convergence Projects
Source: Chandigarh Smart City Limited

1. Potable water & wastewater	• 1746.12 Cr
2. Solid Waste management	• 182.29 Cr
3. Urban retrofit and redevelopment	• 190.09 Cr
4. Mobility & social sector	• 337.93 Cr
5. Energy reforms	• 452.94 Cr
6. Pan city ICT projects	• 275.19 Cr

Figure 2.15: Categories of projects and allocated funds under Smart City for Chandigarh;
Source: Author, reference: CSCL



Figure 2.16: The process of restoring exposed concrete edifices;
Source: Author



Figure 2.17: Water jetting cleaning of the exposed concrete surface being used at Le Corbusier Centre (above);
Source: Ar. Deepika Gandhi Final cleaned concrete (below); Source: Author



Figure 2.18: Image of High Court before restoration
Source: CSCL



Figure 2.19: Image of High court after restoration
Source: CSCL



Figure 2.20: Image of the Secretariat before restoration
Source: CSCL



Figure 2.21: Image of the Secretariat after restoration
Source: CSCL



Figure 2.22: Image of the Open Hand monument before restoration
Source: CSCL



Figure 2.23: Image of the Open Hand monument after restoration
Source: CSCL



Figure 2.24: Image of the damaged tapestries before restoration
Source: CSCL



Figure 2.25: Image of the tapestries after restoration was done manually by skilled workers
Source: CSCL

important centre for Legislative, Legal and Bureaucratic setup of two states as well the Union territory of Chandigarh. The improved tourist infrastructure and facilitation led to better facilities and information dissemination to tourists by assigning three-time slots for guided tours. A 19.8% jump in tourists from 2018 was seen, where total tourists increased from 12836 to 15460, though the number of visitors is restricted due to the fact that Sector 1 of Chandigarh is a high-security zone. The project also created awareness about the Modern Heritage in the local population also as the number of local tourists increased from 8385 in 2018 to 10799 in 2019, an increase of 28.8%.

The restoration of the Capitol Complex has also positively impacted the architecture fraternity and students in terms of increased awareness. A Commendation letter given by international foundations like Foundation Le Corbusier, France and Getty Foundation, USA for the restoration works carried out at the Capitol Complex has led to the recognition of the initiatives at the international level. It has also improved relations between Chandigarh Administration and French Government & European Union (EU), which had been advocating such proposals for many years.

Increased Life Span of all the structures/buildings/monuments present at the Capitol Complex, Pierre Jeanneret house and the Le Corbusier Centre also augurs well for the city in its process towards getting recognised as a successful Smart City. The success and awareness of the project have also set a precedent and benchmark of good practice for the restoration of

Modern Heritage. A concerted effort was also made to identify and grade the entire heritage stock in Chandigarh. Specific bylaws have also been put in place for the different grades of heritage buildings clearly earmarking the extent of changes/alterations that are permissible in these buildings.

3.2 Limitations of the research

The field study part of the research was limited to visual examination of exteriors of the buildings from a specified distance in the case of the Capitol Complex since the Legislative Session of Haryana was ongoing, and access to the internal areas of the high court and Secretariat building was not provided. The team relied on the inputs given by various interviewees available during the field study but the interaction with key personnel who executed the work, i.e., the masons, carpenters, weavers, painters etc. could not be done.

3.3 Key lessons learnt

The interviews with government officials and relevant documents indicated that the officials focused their efforts on the timely completion of heritage projects even if there were major hurdles like the fact that the conservation architect hired for the work had left the project mid-way. The Engineering Department themselves took up the task with valuable inputs from the Chief Architect as well as the Former Director of Le Corbusier Centre, who had supervised the work of Pierre Jeanneret House and Le Corbusier Centre.

The Heritage Conservation Committee and its sub-committee played a central advisory role in overlooking

all projects that directly/indirectly affect the city and its heritage that are undertaken by various departments or even by private developers. The Chief-Architect of the UT is the custodian of the site, and the Chief Engineer is the executioner of the site. Presence of renowned architects like Ar. S.D. Sharma, who has had the experience of working with Le Corbusier, as well as Dr S.S. Bhatti and Ar. Rajnish Wattas, both former principals of CCA, bring immense expertise and authenticity to the committee. The neutral status of the UT administration ensures that projects that affect the city and its inherent Modern Heritage are executed without any hindrances in the form of clearances/permissions and funds at the State Government level, though the execution is impacted due to the presence of high ranked officials of both state governments. The project successfully reiterates the Outstanding Universal Value that the Capitol Complex holds which makes it imperative to be preserved and reinforced and in order to achieve that there is a pressing need to have a strong voice in the city administration.

3.4 Recommendations

Upon examination, the heritage buildings have donned a new cleaner and fresher outlook depicting the new vigour of life that has been induced into the building interiors as well as exteriors. All key persons, be it the architects from UT Department of Urban Planning, Ar. Deepika Gandhi from CCA, Engineers of UT MC, contractors, workers etc. have tirelessly put in their best efforts to make sure that the restoration work resembles the original work as far as possible. Smart cities working on a similar concept can use the process followed by



Figure 2.26: The process of restoring the light niche that had been covered up with brickwork and plaster;
Source: Ar. Deepika Gandhi



Figure 2.27: The final restored light niche;
Source: Author



Figure 2.28: Plaster chiselled out to reveal original rubble masonry wall
Source: Ar. Deepika Gandhi



Figure 2.29: The final restored wall
Source: Author



Figure 2.29: Plaster removed to reveal original brick jaali on the encroached veranda on the first-floor level
Source: Author



Figure 2.30: The final restored jaali,
Source: Author



Figure 2.31: Process of fixing the jute sack ceiling,
Source: Ar. Deepika Gandhi

Chandigarh as a frame of reference. This study can also guide other Smart city officials by breaking down the complex process of heritage conservation into simpler components, which are achievable and enable in setting long term goals.

The technique adopted for restoration can be used in other parts of the country where exposed concrete structures are deteriorating with time. The projects all over the country can follow the same approach as

a model framework that can be replicated to benefit all other heritage projects of similar nature. It is quite evident that there are tangible and well as intangible benefits of the heritage endeavours as the work carried out is not a destination but a journey in itself that paves way for a more inclusive and sensitive world.

The learnings from the exposed concrete restoration works executed in Chandigarh can serve as the model for Smart Cities of Punjab due to the fact that most

of the Government buildings in Punjab have followed the Chandigarh model for Architecture and planning. Therefore, the numerous exposed concrete buildings of Punjab, which have been built after independence, as per the Corbusian philosophy of Brutalism can use the same methodology for the Smart cities such as Ludhiana, Jalandhar and Amritsar, thereby benefiting them too.



Figure 2.32: Final restored ceiling
Source: Ar. Deepika Gandhi



Figure 2.33: Damaged louvres being re-casted
Source: Author



Figure 2.34 : Final restored louvres
Source: Ar. Deepika Gandhi



Figure 2.35: The replicability of the restoration method to the concrete structures in other parts of the city
Source: Author



Figure 2.36 : The replicability of the restoration method to the concrete structures in other parts of the city;
Source: Chandigarh Smart City Limited



Innovation	Capacity Building of ULBs/individuals
<ol style="list-style-type: none"> 1) Non-invasive technique of water jetting (High pressured steam). 2) Lack of original drawings led to innovative design-driven innovations every day. 3) Hands-on site restoration work that by local labourers and nominal funds, despite which the authenticity was accentuated. 4) Adaptive reuse of the Pierre Jeanneret house into a museum and guest house is a good revenue generation measure and will also ensure the upkeep and maintenance of the Heritage building. 5) Heritage Impact Assessment (HIA) will also be conducted of all projects in order to safeguard the OUV of the Capitol Complex. Conservation consultants will be brought on board for the same. 	<ol style="list-style-type: none"> 1) Capacity of building of UT engineering department in terms of executing restoration works since no conservation architect was part of the project. Good practices to retain authenticity were learned and implemented. 2) Weeklong training to personnel for operating the machine for cleaning the exposed concrete surfaces at the Capitol Complex. 3) Training provided to individuals to work as guides for giving guided tours of the Capitol Complex.
Replicability/Scalability	Issues/Problems
<ol style="list-style-type: none"> 1) The non-invasive technique of water jetting (High pressured steam) was adopted for the restoration of the exposed concrete facade of the Le Corbusier Centre. 2) The project is also being replicated in the ABD zone of the city: Sector 17- 30 bays building, Sector 17- 17 bays Building, Sector 17- Structures throughout the plaza (both Govt & Private Owned) 3) Original terrazzo flooring was recast as per original pattern and finish in the high court. 4) Original sandstone flooring in all corridors of Sector-17 being restored. 5) The restoration of the Pierre Jeanneret house holds potential to be replicated to the other typologies of government housing that exists in the city. Doing so can help prevent unnecessary modifications and renovations. 6) Successful Heritage Impact Assessment of projects proposed at Capitol Complex will serve as a case for best practice that can be replicated to the numerous heritage structures across the city. 	<ol style="list-style-type: none"> 1) Capacity of building of UT engineering department in terms of executing restoration works since no conservation architect was part of the project. Good practices to retain authenticity were learned and implemented. 2) Weeklong training to personnel for operating the machine for cleaning the exposed concrete surfaces at the Capitol Complex. 3) Training provided to individuals to work as guides for giving guided tours of the Capitol Complex.

Figure 2.37 : The comprehensive learnings derived from the discussions with the various stakeholders;
Source: Author

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C19

Public Space at Bemina Park: Srinagar

Name of the project: Public space at Bemina Park

Location: Srinagar, Jammu and Kashmir

Year of Project Implementation: 2021

Sector: Physical and Social Urban Infrastructure

SDG: SDG 11 - Sustainable cities and Communities

Project Cost: Rs. 3.6 Crores

Institute: Faculty of Architecture and Ekistics, Jamia Millia Islamia

Advisors: Dr. Hina Zia, Dr. Nisar Khan

Students: Nomaan Khan, Intekhab Alam, Muzhid

Keywords: Green Spaces, Interconnected, Historical, Organized, Recreational

Abstract:

Srinagar city has been known for its lush green gardens, it is a city which is known for being the home to famous historical Mughal gardens of Nishat and Shalimar. The Mughals fondly called Kashmir “Paradise on Earth” which became their favorite place to visit in summers to escape the unbearable heat in mainland India. Ironically, the city is lacking in sufficient organized green spaces. Many gardens in the city like Dewan Bagh, Bagh Ali Mardan, Baghi Dilawar Khan have already been lost to the developmental works that have come up in the city. (Dharma,2019)

The Master Plan 2035 mentioned that in the city of Srinagar, there is around 287 hectares (5673 Kanals) of organized green spaces which is spread over 169 parks and if we go by urban development norms circulated by Union Urban Development Ministry, the city should have a minimum of 570 hectares (11268 Kanals) of such land. (Ashraf, 2019) To reduce this gap, the Srinagar Smart City Mission under Srinagar Municipal Corporation started the process to identify spaces around the city where a series of interconnected open spaces and public parks can be developed in the vision of ‘Clean Srinagar Green Srinagar’. It proposed to develop open spaces along the national highway into green belt with a provision for multiple recreational activities. These projects can help in reducing the gap in organized green space that the city is facing, besides working actively in enhancing the quality of life for its citizens by developing open spaces, parks, playgrounds and recreational spaces which will again help in promoting the eco-balance within the city.

The evaluation of this project is done by first looking into the primary and secondary data and followed by conducting site visits and having interactions with all the stakeholders involved in this project. Overall, the response from the people regarding the project has been positive and have welcomed the change done to improve their quality of life.

Case Study: C19

1. Introduction

1.1 Srinagar Smart City

Srinagar City traces back its history to the 3rd century BC when Emperor Ashoka founded it and the city grew on both the banks of the river Jhelum which sits in the Heart of the Kashmir Valley. The Mughals fondly called Kashmir “Paradise on Earth” where they often used to come to escape the tortuous hot temperatures of India. They spent their summers in the cool environs of Srinagar where Dal Lake with its waterfront and mountain ranges in the back provided them with a great site to set up the most famous Mughal gardens, where they rested. The Mughal emperors were so fascinated with the beauty of the valley that they made it a place for

retreat. (Kumar,2018)

Ironically, the city which is known as heaven on earth and houses the famous historical Mughal Gardens is lacking sufficient open and green spaces. The situation is worse in core city areas because of the dense population. Year after year the public spaces have been shrinking due to the development works happening in the city. Srinagar has been an ecologically sensitive city. Rapid population growth and unplanned urbanization have been resulting in depletion, deterioration and over-extraction of ecological resources. Protecting the rich biodiversity is directly tied to the city’s sustainability and attractiveness as a place to live, work and visit. It was also clear that addressing environmental issues

at the city level would not have been possible without appropriate urban planning interventions. (Draft Action Plan,2018)

The “Clean Srinagar Green Srinagar” initiative under the Smart City Mission proposes the development of a series of interconnected open green spaces and public parks to increase the area of green spaces in Srinagar. Greenways or green corridor will be developed along arterial roads and open spaces along the National Highway Bypass, it will be developed into a green belt with a provision for multiple recreational activities. The work on this project had started in 2018. On the macro level, it will be beneficial for the city as it has been lacking green spaces in urban areas while on the micro level the park can be used by the immediate neighborhoods as well as people who use the national highway to commute. The majority neighborhood around the park has been developed by the government so the private green spaces are limited. Also, there are many colonies of lower income groups in the area which lack green spaces, the park will be accessible to these groups where they can relax and their children can play.

1.1.1. Geographic Location

The site chosen for the project is located on the strategic National Highway which connects the Baramulla town in north Kashmir to South Kashmir through Srinagar city. Smart City Mission has proposed to develop parks along arterial roads and open spaces along the National Highway Bypass, with a provision for multiple recreational activities to be provided in these parks. The main idea behind these interventions was to efficiently use the open spaces along the National Highways and convert them into a green belt. It can also act as a buffer between the residential colonies and the heavy vehicular traffic on the adjacent highway. The land, however, is available only in patches; thus, continuous development was difficult. The area where the Park is constructed is at the starting of the longest patch of open space along National Highway which continues to around 8 kms from the site.

The Park is located in the Bemina area of Srinagar, this part once laid in the outskirts of Srinagar but gradually it has become part of the core city. It is now in the heart of Srinagar city. It lies in the Batamaloo Assembly Constituency. This area was settled on the local floodplains of adjoining rivers. It was one of the largest water absorbers that the city had, unfortunately unplanned and haphazard construction led to encroachment in the floodplains which is the reason it is one of the most flood prone areas in the Srinagar City. In the late 90’s, in order to decongest the Shehr-e-Khaas area, the authorities came up with a plan to sell the government land at cheap prices in the Bemina area

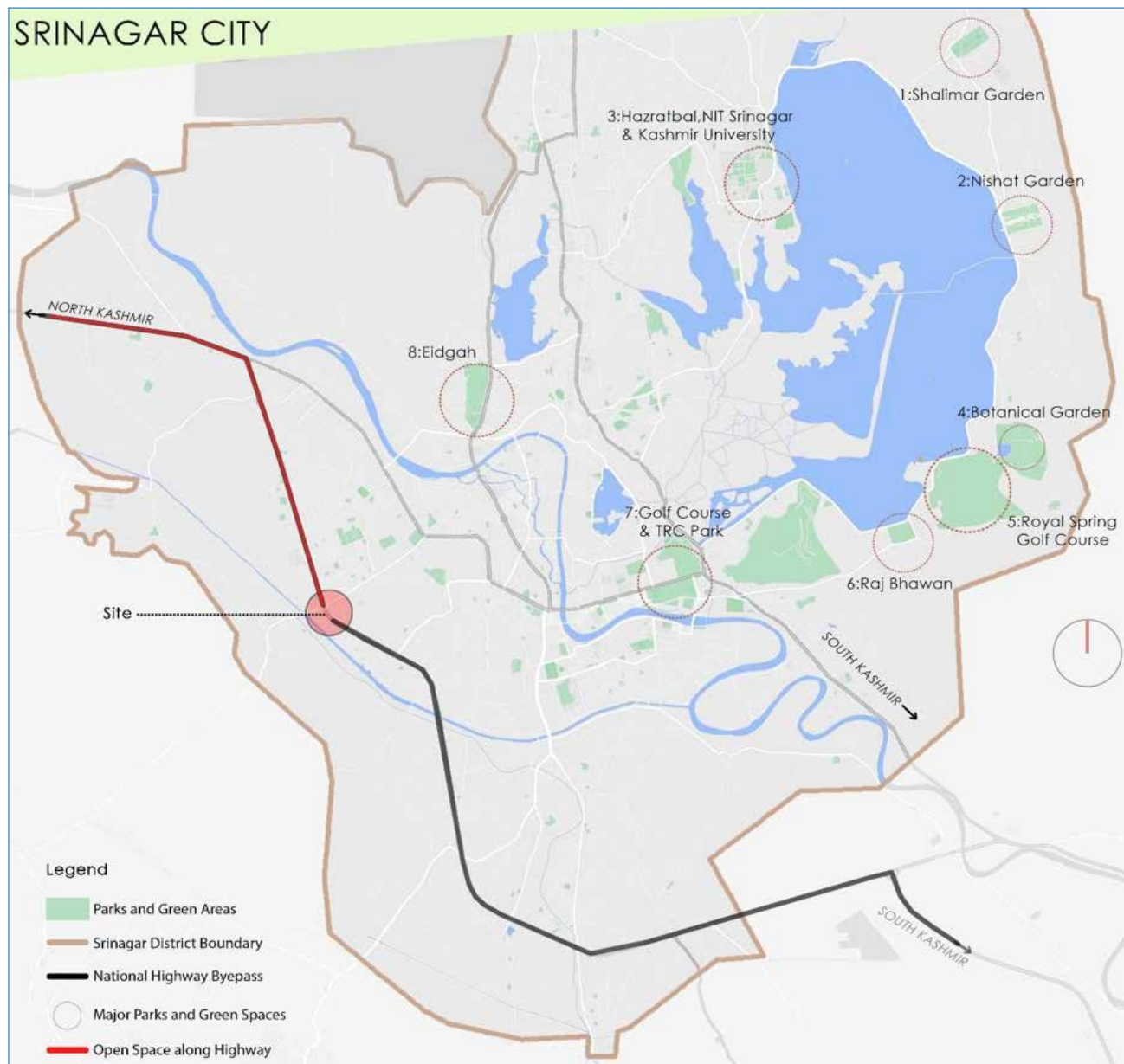


Figure 1: Srinagar City map showing major green spaces and parks in the city
(Source: Google Map, Author)

to encourage people to settle there. (Gazi,2017) Many people from the old part of the city moved to this part and after the construction of the National Highway in the area this migration happened at a faster pace. After the 2014 floods, however, many parts of the open spaces along the National highway became marshy land and it was encroached by people who often parked their cars or used to dump waste.

1.1.2 Project Timeline

In the year 2018, the state authorities took up the site and under the Smart City Project-Development of Green Spaces at various places in District Srinagar started work on the project which was completed and inaugurated by the Lt. Governor on 26th October, 2021. On our visit to the park, we observed that the park is efficiently used by all age groups and genders.

The entire area consisted of marshy land, slowly and gradually new development started taking place, especially post 2014 floods.

The character of the site has changed from unorganized open space to a planned community park.

1.2 Significance of the project

With less than 1.5% of its developed area under open green spaces, Srinagar is unusually far behind other metro cities in India in terms of its organized green cover. Studies reveal that most of the green cities in the world have more than 15% of their surface area under green spaces. The Srinagar Master Plan 2035 rightly highlighted the need for a long-term Action Plan for holistic development of organized public open spaces in each ward and village. The master plan proposed a minimum of 3.5% of organized green space under

parcs and gardens.(Srinagar Master Plan-2035) The Srinagar Smart City Mission aligned their vision of transforming Srinagar into an eco-friendly, resilient and socio-economically vibrant city with the larger issue of less green spaces in the city and identified the land parcels available which are most suitable for greenfield developments under which it will develop open spaces, parks, playgrounds and recreational spaces in order to enhance the quality of life of citizens and to promote eco-balance within the city.

1.3 Aim and Objectives

The aim of the study is to understand the impact of the newly developed park under the public space initiative and how it fits into the larger need of green spaces in the city and the need for public green spaces for the local communities.



Figure 2: Map showing site plan of the proposed park
Source: Google Earth, Author

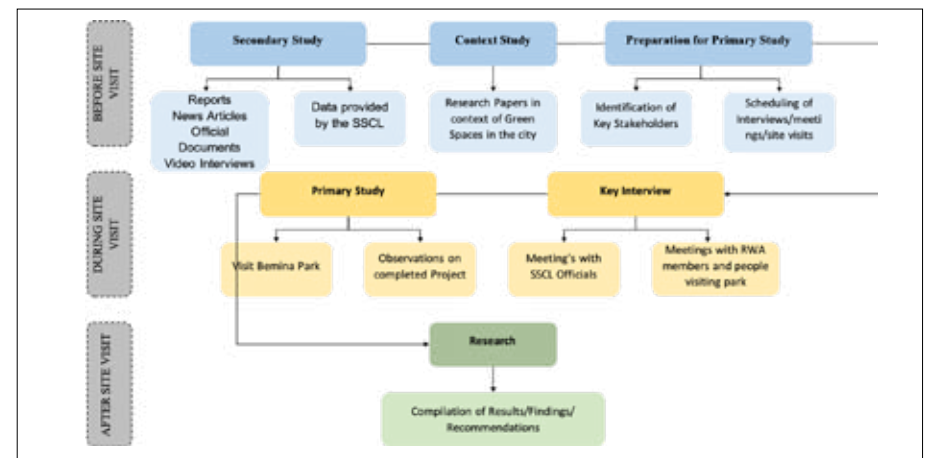


Figure 3: Research Design
Source: Google Earth, 2015



Figure 4: Satellite image of site before intervention
Source: Google Earth, 2015
Source: Google Earth, 2021



Figure 5: Satellite image of site after intervention
Source: Google Earth, 2021



Figure 6: Image of open gymnasium equipment's taken from west to east onlooking fountain



Figure 7: View of park from east to west onlooking Gazebos and various seating arrangements inside the park



Figure 8: Various landscape elements like Gazebos, children play area with toilet facility and a coffee hut for revenue generation



Figure 9: View of park from the corner in east side onlooking different play equipments for children

The objectives of the study are:

- i. To understand the process behind the selection of the area
- ii. To understand the issues while implementing similar projects
- iii. The replicability aspect of this project
- iv. How will the project address the larger issue of the city lacking green spaces
- v. To identify the main problems of the stakeholders with the project

2. Contextual Background

2.1 Conceptual framework / Research design

The research was conducted in a way that first the compilation and data collection was done through secondary data available, which consisted of the official documents like DPR, news articles, videos on different platforms. Then, through site visits all the primary data was collected and key interviews with CEO, Srinagar Municipal Commissioner, Chief Engineer Smart City Limited, Nodal Officer SCL who gave insights into how the projects were executed and the process followed behind each and every project was learnt. Local stakeholders shared some important insights about their aspirations regarding the project and this research will surely help in reducing the gap between the aspirations of people concerned and proposals for Smart City going forward.

2.2 Key features of the project

In view of the park's importance for the city from both ecological and social perspective: the interventions adopted are an important feature of this project where a kids play area, open gymnasium, gazebos have been provided to attract the local people. From an environmental perspective, the trees and plants used

will play an integral role in mitigating the issues such as decreasing green cover in the city, absorption of dust, etc. thereby, improving the overall quality of life of the residents.

The Park has been developed over an area of 18.38 Kanals (4240 Sqm). Three Gazebos/Shelter sheds have been provided with ornamental hand carved deodar wooden posts with ornamental hand railing. The ceiling has been done in traditional Khatambandhi with wooden Jafri work in upper panels.

Major Components of park:

- i. A small prefab café has been made at the edge of the park
- ii. Adequate landscape lighting has been provided
- iii. Adequate seating at important junctions is provided
- iv. A room outside the park for the security guards has been provided
- v. A public convenience/lavatory block has been provided inside the park
- vi. A fountain outside the park has been provided
- vii. Open gymnasium for adults and small children with additional swings and equipments for kids have been provided, such as:
 - a. Chain Swing
 - b. Triple Slide
 - c. Multi-play Station
 - d. Spiral Outdoor Slide Play Station
 - e. Double Seat Swing
 - f. Merry Go Round
 - g. Revolving Plate form with Fiber Base
 - h. See Saw
 - i. Wave Slide

For the open gymnasium following equipments have been installed:

- Cross Trainer Double
- Shoulder wheel
- Surf Board
- Arm wheel
- Stepper

These are frequently used by women from the neighborhood.

2.2.2 Challenges in the project

The main challenges of the project can be categorized into two sections:

1. Conceptualization:

- i. The selection of area for the park
- ii. Interventions suitable for a wider audience
- iii. How to fit the park into solving the larger problem of green space in the city

2. Post Construction:

- i. Maintenance of the park going forward as it has a very large area and there are no responses from the private players to the tenders floated
- ii. Vandalization of the park
- iii. Opening the park for long hours

2.2.3 Risks involved in the project

Major Risks involved with the project have been:

- i. If the park is not maintained properly, the money spent on trees, shrubs and plants will be wasted
- ii. The park vicinity needs proper security arrangements as there are apprehensions of loot or vandalism of public property
- iii. Being along the important National Highway, some miscreants can cause harm to the general traffic plying on it



Figure 10: Image showing Ropeway for children to play
Source: Author



Figure 11: Image of bench swing inside the park
(Source: Author)



Figure 12: Image of See-Saw used by children
(Source: Author)

2.2.4 Features and Benefits (social, technical, city administration level, impact on environment and economy) to the city (expected and observed)

- i. It will surely help the city in mitigating the issue of lack of green spaces and help fight the environment problems more effectively.
- ii. As per a survey, people are happy with the project and are appreciating the work done by different departments in providing this space.
- iii. People are frequently using the park and the park is designed as such that it is used by all genders and age groups.
- iv. It is one of the largest designed community parks in the city.
- v. The open gymnasium is used mostly by women, regardless of age which is an encouraging sign.
- vi. It provides a resting place for people who visit the city from far off places as there are many government offices in the vicinity and sometimes people have to wait there.
- vii. People are aware that this property is a public property and if anyone vandalizes it will be their loss so people have voluntarily decided to guard the place until the administration finds a solution to the maintenance problem.
- viii. sense of ownership among the people has been observed, they appreciate the good work done and aspire to have similar green/open spaces in the city.
- ix. These kinds of spaces along the highway can also act as a barrier between the residential colonies and different types of pollution caused by vehicular movement.
- x. Similar models can be replicated in other parts of the city.

2.5 Key findings from the interviews, surveys, primary/secondary data collection

- i. People agreed that the park was needed and is used extensively by the locals and people traveling from far off places.
- ii. The authorities and the people were facing a common issue regarding the maintenance of the park as there was no response from the contractors when the tenders were floated. The local people living in the vicinity have taken it to themselves for now.
- iii. The people living in the immediate neighborhood are reluctant to use the park to avoid being dragged if anything untoward happens, they are willing to visit the park only after the issue of how to maintain the park is resolved.
- iv. The park has been developed in a way that it will merge into a larger green space area that will be developed along the national highway for a stretch of roughly 8 kms.
- v. The park fits into the larger vision of Smart City Mission in which instead of isolated developments in the city there will be integrated developments. In

case there is change of administration, it will easier for them to take forward the vision and the project will not be left isolated.

- vi. Currently the major issue is maintenance of the park but if it's not resolved immediately, it can escalate into law-and-order problem, keeping in view that the park is along the main highway of the city and major strategic movements happen along it.
- vii. People have this realization that public money has been used to provide them with this space and they are willing to be part of any constructive dialogue in solving the issue.

3. Discussion and Conclusion

3.1 Implications

Physical implications of the project were evident when we visited the site and it was a good space for social interactions. Economic and environmental impact can be studied in detail after the park will be made fully functional.

3.2 Limitations of the research

- i. This research has its own limitations. Data/reports for this research were provided by SSCL although, a formal DPR was missing. Other data sources which were looked into included media reports with multiple versions of facts and timings; and other published articles. The current state of the site was observed during site visit and state of project site prior to restoration was studied through documentation provided by SSCL. Interviews were conducted during site visits but sample size was small. Major interviews with users were held during Sunday prayers.

- ii. All the survey conducted for this research was in the month of March-April, an all-weather survey was not conducted which would have given insights into how people use the park in different weather conditions especially winters.
- iii. On our second visit the park was closed, so survey could not be done properly.

3.3 Key lessons learnt

One of the main lessons learnt while conducting the interviews of all the stakeholders was the issue of maintenance. It becomes very difficult to maintain such a big land area and it surely plays an important role in how the park is being utilized as there are miscreants everywhere and vandalism and other offences can become frequent if the park is not maintained properly. This aspect of a park or green space is critical because the main factor of people using it will be determined by looking at how the place is being maintained. As our lifestyle is changing, people are progressively using public spaces for socializing. One thing that can be seen in all these places is the local street vendors and the local street food being used extensively. Spaces inside the parks can be dedicated to local street vendors who will have to pay a nominal charge and will be under a single umbrella where the money they pay will be utilized in the maintenance of the park.

In future these spaces can be used in collaboration with horticulture and floriculture department so that its maintenance is taken care of and these can be used as a source of research for students where the areas can be promoted by having rich flora and fauna. Once these projects are completed, it can have multiple usage and can serve as a source of leisure activities for locals while being used for academic purposes besides the production of wood which has been an important component in the life of common people.



Figure 13: Open Gymnasium Equipments
(Source: Author)

3.4 Recommendations

- i. Dedicated space allotment inside parks to horticulture and floriculture departments for nursery etc.
- ii. Removing of illegal encroachments along the highway.
- iii. Proposed spaces for vendors and local food carts.
- iv. A small open-air theatre can be proposed so that the

- v. Social forestry projects along the highway where species of Himalayan Silver Fir (Budul), Kashmiri Cypress (Sarva Kull), Himalayan Blue Pine (Kaayur), Willow (Veer) etc can be grown.
- vi. More plantations can be done from highway side to reduce the dust and noise coming towards residential areas and also to reduce any law-and-

- order issue as the highway sees a lot of important movements of security establishments.
- vii. Continuing to develop the areas into greens spaces along the national highway where open spaces are available.
- viii. Assessment study of existing parks and green spaces in the area and its usability.

Physical	Social	Economical	Environmental
Physical implications of the project are evident and can be observed during visits.	The Park is being actively used by the people and it has become a place of active social interaction between people from all age groups and genders.	Various economic activities are directly or indirectly related to the park, the people associated with maintenance of the park have constant source of income. Besides this, café and other informal activities both inside and outside of the park can provide livelihoods opportunities.	It has a huge implication in environmental aspect as the green spaces in the city are shrinking and such projects will help in increasing the green cover marginally.
Extensive usage of equipments by varied users installed by the Srinagar Smart City Limited (SSCL) in the park.	The Park will be used by people from different social classes who reside in the immediate as well as far neighborhoods.		

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C20

Multi-Level Car Parking, Jammu

Location: Jammu & Jammu and Kashmir

Year of Project Implementation: October 2016 to February 2021

Sector: Mobility & Commerce

SDG: SDG 11.2

Project Cost: 201.66 Crore (JSCL Equity 70.58 Crore)

Institute: Faculty of Architecture and Ekistics, Jamia Millia Islamia

Advisors: Dr. Hina Zia, Dr. Nisar Khan

Students: Nitesh Dogne, Anand Khatri, Alisha Khan

Keywords: Mobility, Urban Transport, Livability, Transportation, Car parking, Historic City Intervention

Abstract:

Abstract— Within the ambit of the SMART city projects, the Multilevel car parking project at BC road project is a solution to the problem of severe congestion experienced at the existing road network near old Jammu city. An increase in transport services due to commerce and tourism in Jammu led to mobility issues. The heterogeneous nature of traffic, commercial area development along all the major roads and the diverse needs of the rising population made road safety difficult. The project intends not only to benefit the city in smooth transportation and parking services but also to provide ready to commerce solutions to the displaced shopkeepers. The MLCP [Multi-Level Car Parking] Smart City project includes a bus stand with more buses parked in the bays, multi-tiered parking assisting the city in automobile congestion and two tiers of commercial shop floors. It is envisioned as a one-stop solution to the city and is built at a junction where the city has many levels not just in contours, but also in the gradation of time. With more buses accommodated in the bus parking, its presence next to the core city and historic precinct, a smart decision for the people is made. 40% of the original shops were adapted in rehabilitation plans, showing the project's smart move toward inclusivity. Sitting on a low contour, adjoining living religious and historically significant institutions, it has developed well, respecting all height regulations and would serve as a breather for the core city. It is implemented in a phase-wise manner and the old bus stand that preceded the new still exists to house economies and functions still not active in the new construction. Exits and entries are maintained. With its project conception limitations, MLCP is a SMART facelift to the evolving image of Jammu in 21st-century India.

Case Study: C20

1. Introduction

1.1 Topic and Context

Jammu being a city with a very complex road network serves as a major centre for transportation. The city faces the problem of narrow road networks along with unorganized parking facilities. (JDA)

Heavy congestion is observed in the popular commercial areas of the city like Chowk, Panjtirthi and Karan Market. (JDA) Also, 88% of the city lacks pedestrian footpaths, which further adds to the congestion on the roads. Even the present network of roads also faces the serious problem of encroachment leading to reduced road capacity.

Meanwhile, there is an exponential growth in the number of private transportations in the city. Car registration has been found to be increased from 2306 in the period from 2000-01 to 12344 in 2010-11. Also, the Two-wheeler registration has been found from 11091 in the year 2000-01 to 24757 in the period 2010-11. (Consultants, Detailed project Report)

The above graph indicates the increase in the number of cars however a decrease in the number of two-wheelers is also observed. This trend for the increase in the car number highlights the need for parking facility, especially for cars. (Consultants, Detailed project Report) Hence MLCP project is taken up in order to solve the issue of increased congestion and growth in number of cars.

1.2 Significance of the Project

Jammu's General Bus Stand is located on BC Road in the city's centre (Ref. Image 2). The terminal building is in a deplorable state, according to the current status of the General Bus Stand. Buses are parked and workshops are located in the bus stop area, rendering circulation

difficult and increasing pollution levels in the public area. Parking is also a huge issue in Jammu. Along the main roadways in Jammu, there is indeed a trend of commercialization. Initially, the plots along these roads were used for residential uses, but as the property value and traffic on the highways increased, they became commercialized.

Lack of parking facility has led to increased use of unauthorized surface parking thereby, creating a bottleneck within the smooth traffic flow. (Consultants, Detailed project Report)

Thus, the project of redevelopment of a general bus stand with multi-level car parking at BC road shows the need for a parking facility due to increased congestion at the roads especially buses which has made circulation very difficult. (JDA) Commercialization along the main roads with the conversion of land use from residential

to commercial and mixed-use has added to the woes. (JDA) Poor traffic management along with mismanaged bazaars like AC Market, Hari Market and Karan Market has triggered the problem of the area. (JDA)

1.3 The vision of the city and how the project has been ideated/aligned w.r.t the vision.

The vision for the city is "Transforming Jammu into a sustainable and economically vibrant city focusing on tourism, quality of life and trade by leveraging its heritage and location" (NIUA)

The city has a tremendous amount of potential to transform into an economic centre. However, due to several constrain, there have emerged some hindrances in achieving the aim. Thereby, to address the problem of congestion, to maintain a free flow of transport well planned multi-level car parking projects are proposed.



Figure 2.1: Image of the MLCP and bus stand (Source, JSCL office dated 22.03.2022 and author, 22.03.2022)

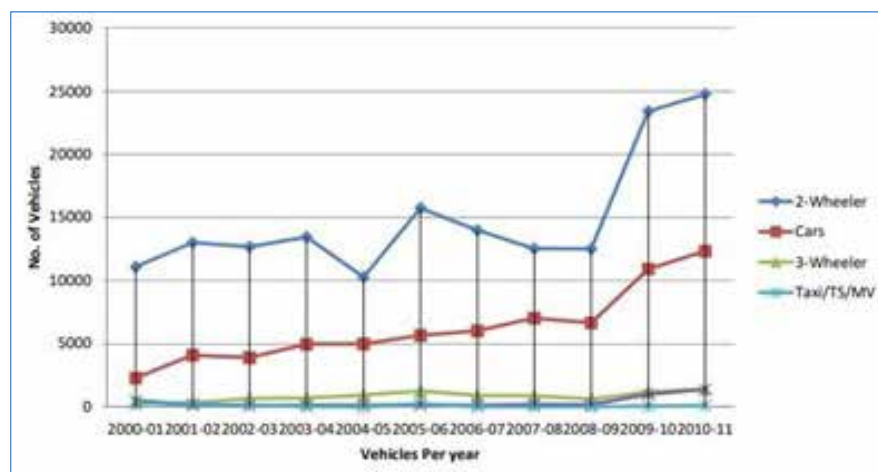


Figure 1.1: Numbers of vehicles registered in Jammu District, (Consultants)

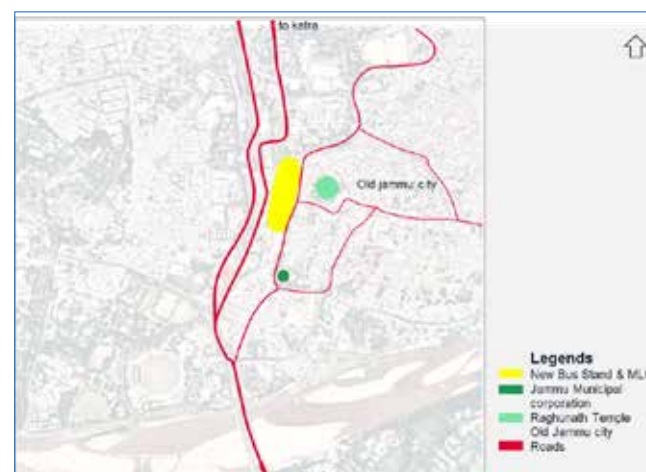


Figure 1.2: Location of MLCP Project, Jammu Google Map Accessed Dated on 27 March 2022 IST 19.00hrs Compiled by (Author, 2022)



Figure 2.2: Methodology, (Consultants), Retrieved from DPR

The Overall objective of the Construction of a Car Parking Facility, is to bring about decongestion of traffic in the adjoining area of Jammu city by reducing on-street parking. This will not only help in providing safe, secure and efficient vehicular circulation/passage but will also enhance public safety & security. (Consultants, Detailed project Report)

1.4 Aim and Objectives

The aim of the study is to evaluate the performance of newly constructed Multi-level car parking projects in Jammu and to analyze the impact of the same in the current scenario.

- The objectives of the study are:
- To reduce the gap between the demand and supply of parking
- To reduce traffic congestion
- To promote commercialization
- To maintain a free flow of the traffic
- To promote road safety and security
- Reduce encroachments

2. Contextual Background

2.1 Brief project description-outline

The project of redevelopment of general bus stands with multi-level car parking at BC road is located at the heart of the city. The total area of the project is 27781 sqm out of which 18819 sqm is for the first phase of development. (JDA)

The site is surrounded by several encroachments and workshops. The project is to create parking spaces for 1130 cars according to the demand of 2027. Also, the permissible commercial development at the general bus stand is limited to two floors on the top with built-up area of 11150 sqm. (JDA)

2.2 Conceptual Framework/ Research Design

The methodology adopted by the consultants of the project is briefly about analyzing the existing infrastructure with the needed infrastructure and doing the gap analysis by doing the comparison to arrive at the solution for the same.



Figure 2.3: Typical Conservancy Lanes in Shivamogga
Source: Feasibility Report on Development of Conservancy Lanes – Shivamogga Smart City Limited



Figure 2.4: Bus Driver and Citizen Interview



Figure 2.4: MLCP Project with Smart features



Figure 2.5: Stakeholder Discussion

Following is the methodology in detail followed in order to arrive at the conclusion: (Ref Figure 2.2)

2.3 Key features of the project (the project of redevelopment of general bus stands with multi-level car parking at BC road)

2.2.4 Challenges in the project

- Relocation of social infrastructure present at the site
- Relocation of Shops
- Implementation of the project phases on the scheduled time
- Inter-departmental coordination among key stakeholders

2.3.2 Risks involved in the project

- Lack of safety due to levels
- Non-maintenance of the infrastructure
- Vandalism of the infrastructure

2.2.5 Features and Benefits (social, technical, city administration level, impact on environment and economy) to the city (expected and observed)

- Linked and comprehensive development of social and physical infrastructure to accommodate the requirements of the business class as well as ordinary citizens.
- Combination of pit puzzle, overground puzzle and conventional parking. (JDA)
- The lowest level has 46 modules of pit puzzle parking and can accommodate 368 cars. (JDA)
- The cumulative parking of the project is 1458 ECS. (JDA)
- The Ground floor, lower Ground and G+1 level accommodate the bus stand services, while the parking is provided at the G+2 and G+3 levels. (JDA)
- Commercial development is provided at the top two floors covering an area of 1150sq meters. (JDA)
- The project also has components like waiting lounges, kiosks, a cafeteria, parcel rooms, cloakrooms, ticket counters and open plazas.

2.6 Key findings from the interviews, surveys, and primary/secondary data collection

The Jammu MLC project was not entirely a smart city project. It was a smart city investment on land that belong to the JDA. The project is in two phases. The

first phase has been executed with a bus parking on the ground floor and your parking on the floors above. Above the car parking Provision for a commercial area has been made. (Ref Figure 2.3)

The old bus stand was made in 1971 and was unable to accommodate the facilities needed. The old bus stand area was taken up. There are 60 bays and buses can be parked overnight. There are 20 different routes on which buses ply and three buses per route can be parked. The rest of them wait in the old bus stand area.

There is a traffic police office in the new bus stand but the traffic police do not comply. The cost per entry is Rs 50 for the bus, but there are buses that do not comply with the bus stand ownership and thus they load and unload customers in different areas. The traffic police can control such malpractices. The economic viability of this project is still not established and hence there is a lack of confidence in overall decision-making for putting up an MLCP.

2.4.1 Smart Innovations

Smart CAMERA

Presently, the car parking area is equipped with smart systems where the slip is presented to visitors at the rate of Rs.30 per min.

What they are visioning now is to incorporate the FASTag system where the Vehicle Number Plate, the face of the driver would get detected and the parking charge would get displayed based on the entry-exit evaluation. The system would make payments directly from the prepaid or savings account linked to it. This smart innovation would help in stating the idea of digital India and would, directly and indirectly, favours the visitors in terms of the justified rent on an hourly basis and also by ensuring the security of their private vehicles. (Ref Figure2.4)

Anpr Camera

These advanced innovations would help in scanning the vehicles from underneath, to detect the presence of any hazardous elements, or bombs. Etc., and to ensure the safety of the visitors at all costs. Also, the ANPR camera is scanned the Car number and Driver's Image. (Ref Figure2.4)

The parking is equipped with smart advancements and digital innovations. 200 CCTV (Ref Image 13) cameras are being installed in the same and the common control centre puts in check all the digital needs, managed by a single personal manager. The record data status manages the information of all the visitors, their vehicles, and other necessary information for three months which later on gets transferred to the main servers.

There is a large volume of gases due to the combustion of fuel and poor ventilation. Shops displaced have not yet taken up the spaces allocated. Security systems installed for passengers and goods in transit screening are not yet functional. The bus entry and exit routes have not changed. The height of the commercial area above parking after the false ceiling is only 8 feet. The sprinkler systems have been installed at 11 feet, but the AHU, which seems to be an afterthought is installed at a level much below the sprinkler, so if a shopkeeper wants to get a false ceiling done, the overall height of the shop would not be more than 7 feet 6 inches.

Following the charts displaying the analysis made from the interviews of the users of the MLCP project.

In figure no 10 On the basis of the interviews conducted it has been observed that about 75% of the people agree that the project director is leading to local area development, however, 25% don't agree with the same.

According to the majority of the users i.e., 81%, projects like MLCP should be promoted as these are leading to immense development. However, 18.8% of the users do not think the same. (Ref Figure 2.7)

About 25% of the interviewees believe that the project has not added to the improved life quality of the citizens, at the same time 75% of the interviewees agree that the project has made significant impact in improving life quality of the citizens.

3. Discussion and Conclusion

Discussions with diverse groups yielded important perspectives on Smart city Jammu and the projects

selected. (Ref Figure 2.5) The city administration and the civic authorities felt that the project was a success. All stakeholders owned up to the project decision and its impacts. They exhibited strong teamwork and admitted to having offered tangible administrative support for the project for the benefit of the city and its inhabitants. (Ref Image 2.6 & 2.7)

Urban mobility is important for urban sustainability and is the biggest challenge for all urbanization. Solutions for urban mobility could be a success for the city. However, they felt that it is important for the citizens to walk. An increase in population cannot mean an equal increase in the number of cars. It is imperative to provide for mass transport and better public transport solutions. The administration also mentioned that a change in thinking is necessary for the people. Citizens need to walk the city also. The problem of urban life is we need auto-mobility to the last mile. The city thus expands indefinitely to support citizens' excess in cars and their demands. MLCP is also seen as an urban use integration project. The site selection is most appropriately done for city functioning and is instrumental in bringing a positive change to decongest the city. The MLCP project could have been connected to the highway and the municipal corporation office and the hospital across for shared use of city functions, but this missed the city's planner's attention. The bus stand also follows the same entry and exits to the city, as the old bus route did. Thus, it does not establish new access and entry routes despite a smart highway entry and exit to decongest the civic areas as a possibility. The difficulty in handling brownfield projects because of multiple stakeholders was shared and the bleak possibility of integration of the disparate interests of governance towards a single point city agenda. The Smart measure meant that it is important to achieve less than to lose the project to conflicting ownerships. The administration felt that there were no fiscal problems felt in the execution of the project. Funds kept moving. The project reallocated commercial areas to 40% of shopkeepers in lieu of them giving up their commercial establishments. Only those with legal ownership and possession of shops get a place in exchange. Those who could not prove their ownership, they did not get anything in return. (Ref Figure 2.7)

The only thing felt was that these projects were not smart economics as the traffic police and the management bodies did not coalesce, nor contribute adequately to concurrent success. Functions under the MLCP were Smart living solutions and the Wellness of the city. The future smart projects identified by the city were for the people. The MLCP was to facilitate the disjointed old city and fuse it with the new developments. The new projects for the upgradation of Anganwadi etc are the ones that are proposed to be undertaken as the future for addressing the old city. It was felt by the governance that the MLCP is a replicable solution for the city's needs, but better projects must be sought for solving the mobility issue of the urban dwellers.

An understanding from the engineering wing responsible for implementing the project on-site and their consultants revealed that the Jammu MLCP project was not entirely a smart city project. It was a smart city investment on land that belonged to the JDA. The project is in two phases. In the first phase, the capacity of the old bus stand has been taken up in the new MLCP building and in the second phase, the old bus stand would be demolished. The first phase has been executed with a bus parking on the ground floor and your parking on the floors above. Above the car parking Provision for a commercial area has been made. The plans for the second phase are not known. It was reported that the old bus stand was made in 1971 and was unable to accommodate the facilities needed. For the new MLCP, the old bus stand area was taken up.

There are 60 bays and buses can be parked overnight. There are 20 different routes on which buses ply and three buses per route can be parked. The rest of them wait in the old bus stand area. There is a traffic police office in the new bus stand but the traffic police have not yet started participating in the management of bus traffic neither at the road nor the bus terminus management level. The cost per entry is Rs 50 for the bus, but there are buses that do not comply with the bus stand ownership of the trade and thus they load and unload customers in different areas on open roads. A bus stand thus tries to bring this city trade practice into the ambit of governance, but it does not happen. This is neither

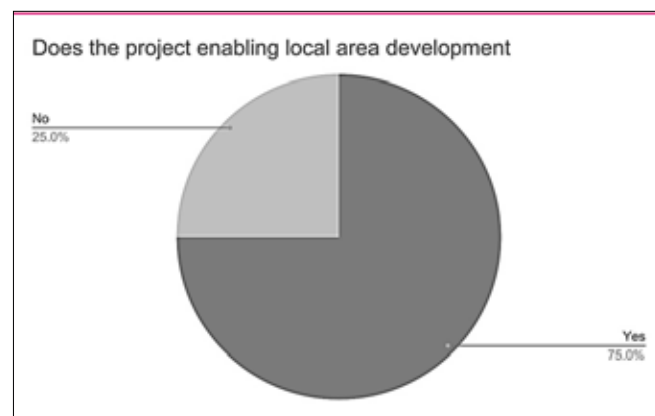


Figure 2.6: Chart showing the citizen's review on the statement if the project enables the local area's development

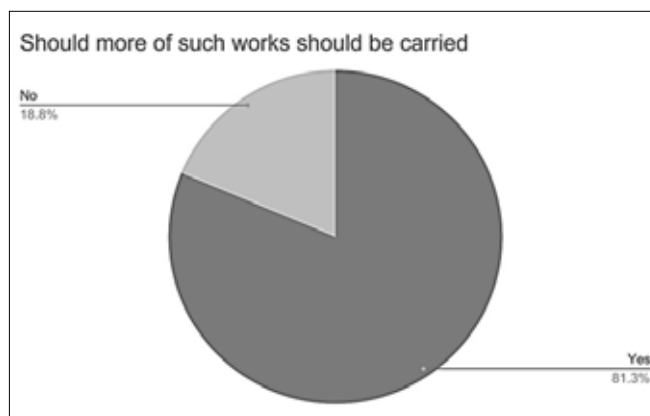


Figure 2.7: Chart showing the citizen's suggestions if more of these projects should be carried

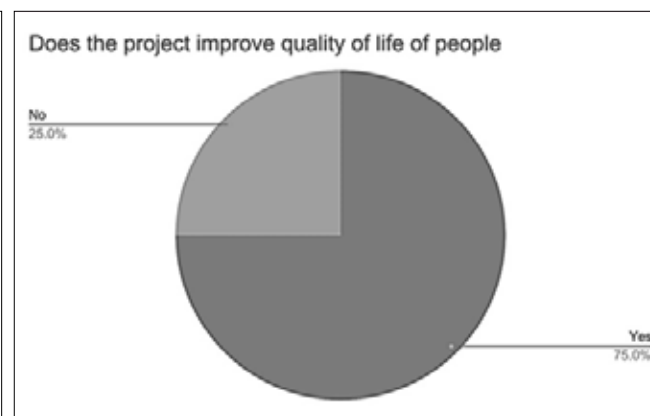


Figure 2.8: Chart showing the citizen's perspective towards the project's role in improving the life quality

safe for the commuter nor good for city development. The traffic police can control such malpractices and also discipline the bus speeds and entry and exit protocols.

With the MLCP not on run, the economic viability of this project is still not established within the managing division and hence there is a lack of confidence in overall decision-making for putting up an MLCP, within the executive wing. 59 shopkeepers, and traders out of the 159 shops dislocated from the land which was used for the MLCP have been allocated new shops. The organized shop format, disconnected from the bus stand traffic transit and with a monthly maintenance charge of Rs 12 per sq. ft has delayed the occupation of shops by the shopkeepers. The market in the old bus stand area is thriving and pulsating with good economics. It falls on the movement passage of the customers, while those designed have been pushed along a complex alley beyond a simple linear geometry which is difficult for visitors to interpret, recall and thus venture into. They have tried to option the restaurant twice, but no bidders participated. Traffic police have not taken up the control room. Bus bays remain unclean as all bus staff clean the bus while they deboard and when they are parked in bays. Shulabh (Public toilet) which is made in charge of the maintenance of toilets remains closed after 8

pm. The number of toilets (eight numbers for men and women and three, for drivers and one for handicaps) on the bus stand is too few. Open defecation and urination along the retaining walls have made the place unclean. A good garbage disposal plan for the MLCP bus bay area is imperative.

With 50 percent of the bus stand in function, there are large volumes of gases due to combustion of fuel and poor ventilation. Shops displaced have not yet taken up the spaces allocated. Security systems installed for passengers and goods in transit screening are not yet functional. The bus entry and exit routes into and from the city have not changed, thus there is of an impact of the MLCP on bus traffic in the city. The luggage scanners, the waiting and ticketing areas, and the ANPR cameras at the entrance of the car parking are not yet functional. There are 22-meter-high retaining wall fortifications all around and just one entry and exit for buses. Fumes from buses do not escape the bay areas and would definitely be present at the time of peak traffic hours. Exits and passages along the retaining walls could have been made for pedestrians.

The car parking areas are sufficient for the current needs. Assisted by mobile-savvy apps and parking

assists it offers smart identification of parking bays. MLCP car parking areas do not have toilets. There is no facility planning for the commuter transit nor for the drivers. The result is a misuse of staircases and other empty areas for defecation.

MLCP is also divided into three different functions; of these, the commercial area construction seems to be a decision in haste. The height of the commercial area shops after the false ceiling would be barely 8 feet. The sprinkler systems have been installed at approx. 11feet, but the AHU, which seems to be an afterthought is installed at a level much below the sprinkler, so if a shopkeeper wants to get a false ceiling done, the overall height of the shop would not be more than 7 feet 6 inches – 8 feet which is very low in-shop ceiling height, even if for just the AHU area. For its viability, the commercial area could have been planned better with more heights for the shops.

The construction quality and the overall finish of the structure during the pre-monsoon summer season seems good and the engineering details of ramp slopes and bay heights have been taken care of in the implementation of the project.



Figure 3.1: citizen interview



Figure 3.2: old Bus Stand Shopkeeper Interviews

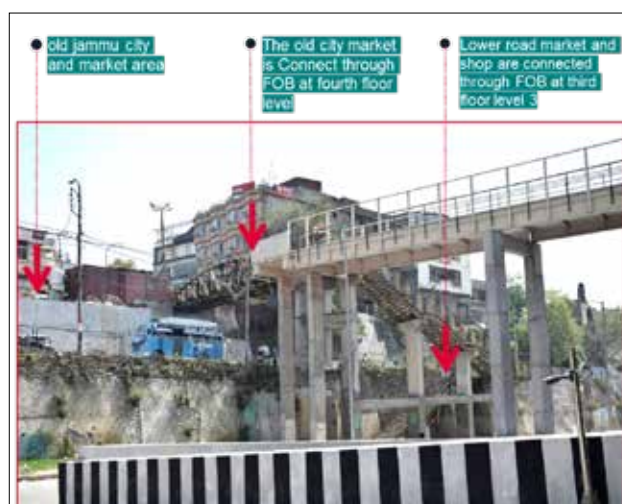


Figure 3.3: connectivity through the old city with a commercial area on 4th-floor MLCP.



Figure 3.4: CCTV Server Room & second floor Car Parking, Author,2022



3.5 Implications (the impact assessment framework to be included here)

The multi-level car parking project in the context of the old Jammu area eradicates the issues of traffic congestion in the locality. The three-floored car parking, with the old bus station at the lowest level, has a justified flow of traffic with entry and exits being on each side of the road. (Ref Figure 2.8)

The major commercial area on the upper floor is directly connected to the foot-over bridge to provide direct access to visitors. (Ref Figure 2.8) The overall vertical zoning account for the smooth channelization of the traffic on all levels. And the major significance of the project lies in its strategic location. The multilevel car parking in context to the major roads on the contoured topography connects Srinagar to Pathankot. The site stands in a close setting to the major roads on the left and, the old Jammu city on the right. (Ref Figure 3.5)

The old Jammu is a highly populated area with major residential density. There exists congestion, traffic issues and thereby, an increase in pollution because of the same. The settlements there are very old and of local importance. The area houses many culturally significant temples of high status. The Raghunath temple is believed to be the main centre of attraction for tourists in the whole area. The footfall there has been continuously increasing for the past years. Apart from the temples, the area incorporates some major nodes where traffic congestion is prominent. the municipal

corporation block located to the south of our site is in close connection to the major commercial areas. Banks, offices, and other important spots are in context the same. Thus, the presence of such a project, housing the multilevel car along with the major commercial area on the upper floor will benefit the visitors directly and indirectly. The solution it provides will help in eradicating the major traffic problems. The absence of significant car parking areas along the neighbourhood will not be a bigger problem anymore.

Though for the past two years the footfall hasn't been that much because of the prevailing covid issues. But the idea of having the complex at a significant location will prove to be beneficiary to its people and, to the visitors in the nearby future. Along with solving the traffic issues, the complex also encourages pedestrian movement as its major commercial area is located on the upper floor. The area stands in direct connection to the foot-over bridge. This will encourage the people in the old Jammu city to visit the same. The old Jammu area will get revived by the successful inclusion of the multi-level car parking and the commercial complex. Thus, the project at such a strategic location will help eradicate multiple issues and provide a source of attraction to the people passing by. If we would be able to somehow link the major highway on the left to our complex, the same would further get more meaning.

This is a Smart city project research, conducted on a broad scale. It tries to identify the reason for the

selection of the project within the Smart city and its impact. It is an outcome of an evaluation made by architects and planners, to see the success of the project from the perspective of location, city functions, old city interventions, change made to Jammu through the Smart city project. The DPR documents and discussions with the public and interviews of the key stakeholders were conducted on site. Economic analysis, rates and contractors selected for the work was not a part of the project assessment. Facts and figures have been shared with us through the interviewees. A post construction, architectural design analysis for utilization of space and recommendations for better functioning was conducted through experience of architectural practice. The research works towards the Smart city functioning and selection of projects. All interviews and meetings were conducted through the Smart city teams and with their participation, however interviews with the public were held through a random selection. The survey on site was conducted after pre-intimation in the month of March immediately after Holi and on-site observations are limited to observations in one season.

3.6 Key lessons learnt

Smart city solutions for India at a junction when the municipal corporations and the development authorities have been working with conventional land tenures, orthodox civic practices and buildings as a city solution; should be city smart. Urban level projects with a fresight for the people and the city should be undertaken with adequate interconnections.

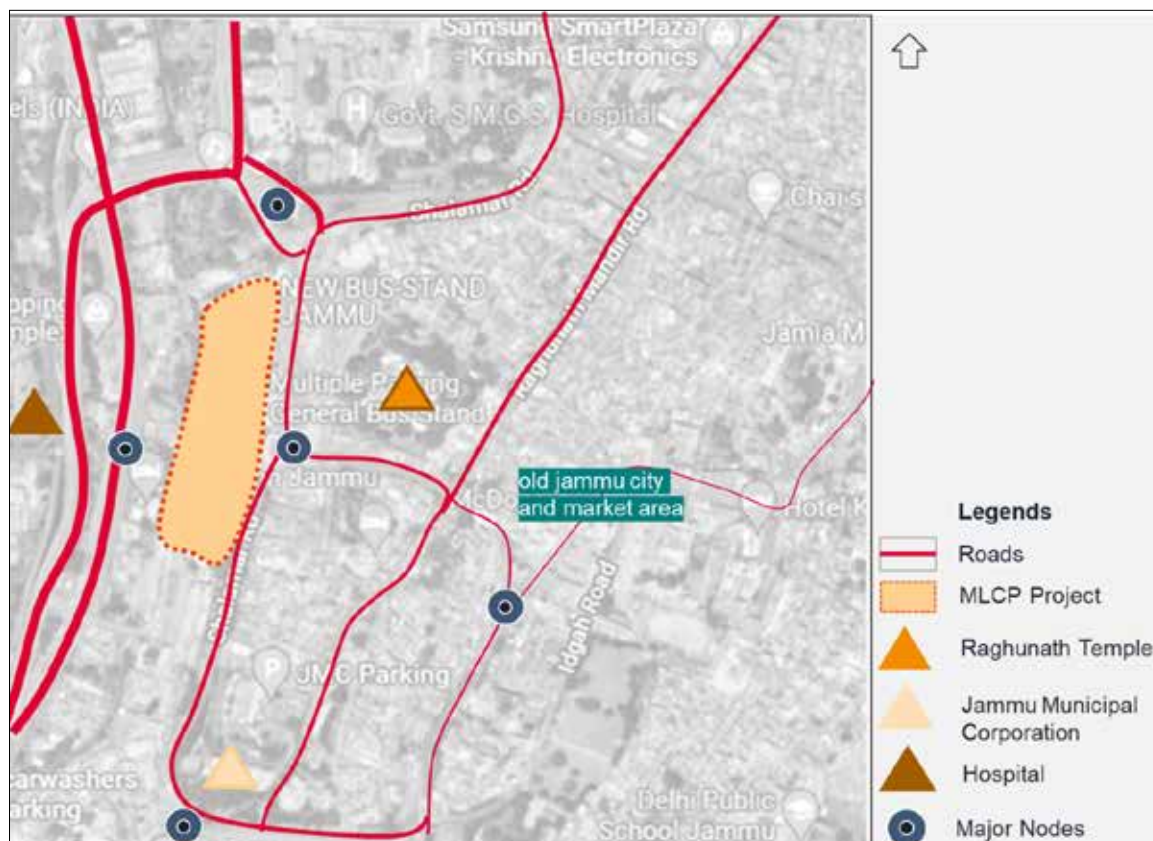


Figure 3.5: MLCP project correlation with the old city
Source: Google Map Accessed Dated on 27 March 2022 IST19.00hrs Compiled by (Author,2022)



Figure 3.6: Bus stand facility

3.7 Recommendations

The MLCP project respects overall height and has an understated and uninterfering visibility from the road. It respects old precincts but could have been a city integrator project. Piecemeal city plans should in the Smart city be replaced by a 25-year city infrastructure and growth plans. MLCP, an integration project that puts the city bus stand, a car parking and a commercial area in one building, at an important junction of the city,

is successful as a building but lacks urban visualization. A smart city that intends to change city functions and urban mobility should not be just a building solution. The project could have established a connection with the surrounding urban area and become a solution for the parking at JMC and the precinct of Raghunath mandir Road. The MLC and such projects should bring a change in the city functions e.g., entry and exit of buses in the city through the flyover. These should also interconnect

to institutions for serving as a facility and extensions to their parking and shopping needs, especially with the city administration, and the municipal corporation involved in the process. Post-project building safety and facility audits should be done for this project. A smart city cannot just be a standalone building investment. MLCP could also serve as an important MRTS junction for future city planning.

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2. All the photos by the author during the primary survey dated 22nd March 2022 IST 11.00Hrs to 13.00Hrs

Interview & Survey

1. Location MLCP, Jammu City 22nd March (2022), Jammu City, Jammu & Kashmir, India – 11.30hrs to 13.30hrs, [note the Interviews are not digitally recorded]
2. Google Map location - <https://www.google.com/maps/place/I+Bus+Stand/@32.7300311,74.8586959,570m/wdata=!3m1!1e3!4m13!1m7!3m6!1s0x391e84bf169d3525:0xf233488eeb8fd8d!2sJammu!3b1!8m2!3d32.7266016!4d74.8570259!3m4!1s0x0:0x586d796a0c9eb29f!8m2!3d32.7301825!4d74.8600848>

C21

Rajasthan High-Performance Sports Training and Rehabilitation Centre

Name of the project: Rajasthan High-Performance Sports Training and Rehabilitation Centre

Location: Jaipur, Rajasthan

Year of Project Implementation: 2021

Sector: Sports, athletics and fitness

SDG: SDG-3

Project Cost: Rs 14.0 crore

Institute: Malaviya National Institute of Technology Jaipur

Advisors: Dr. Nand Kumar, Dr. Pooja Nigam, Dr. Niruti Gupta, Dr. Bhavna Shrivastava, Sangeeth S Pillai

Students: Sehajnoor Singh Sandhu, Prerna Jasuja, Tanvi Gupta, K L V SatyaValli, Yogesh Kumar, Jayant Sharma, Vijender Haritwal

Keywords: Sports training, High tech equipment

Abstract:

Athletes have always been the epitome of fitness and physical training. Rajasthan High-Performance Sports Training and Rehabilitation Centre is a technology-enabled smart fitness centre that has revolutionised sports training and is equipped with state-of-the-art facilities for assessing and rehabilitating injured athletes and enhancing their performance. The high-tech equipment enables trainers to track the movement of athletes and accordingly eliminate injuries and impotence. Sports' training within the facility is primarily focused on optimal performance in a particular sport. The main aim of this facility is to improve the capacity of athletes to achieve the highest possible performance levels. The smart and fitness strategies predominantly focus on National/International standards of infrastructure, types of equipment, coaching and sports science for athletes thereby, leading to healthy and fit civic personalities for the state. Eventually through awareness, a walking, jogging, cycling city will soon be witnessed. What else is required for a state to become smarter in terms of strength and fitness?

Case Study: C21

1. Introduction

The High-Performance Sports Training and Rehabilitation Centre, Jaipur, is a facility for rehabilitating injured athletes and enhancing their performance. It is one of India's most advanced rehabilitation and physiotherapy centres. It is equipped with revolutionary equipment which combines assessment with training to give athletes real-time feedback. Rajasthan state government in collaboration with Abhinav Bindra Targeting Performance (ABTP) was responsible for the process of funding the project. Experts hired for this centre include Centre Head, Sports Physiotherapists (8), Strength and Conditioning Coaches (2), Sports Scientists (1), Sports Psychologists (1) and Sports Nutritionists (1). This project also promotes research and capacity building on performance and fitness-related study domains such as sports medicines, sports physiotherapy, sports psychology and sports nutrition. The project can further be enhanced to reach the general public through various awareness programs such as urban marathons, cycling paths and yoga workshops.

1.1 Topic and Context

Sports rehabilitation and performance brings together clinical expertise, training, modern equipment and focused result-driven methods. Rajasthan States Sports Council (RSSC) is the nodal agency for providing necessary infrastructural facilities and security services to effectively run the centre. There are more than 15 fitness assessment and correction equipments. All

available machinery and equipment in the centre is as per National/International norms.

Table-1: List and description of predominant equipment

S No.	Equipment	Description
1.	Prokin252	Used to assess and train the balance of athletes in orthopedic and neurological areas
2.	Trunk MF	Helps in analysing the movement and control of the pelvis and hips
3.	Walker View	A treadmill with a sensorised platform that provides feedback based on load distribution which identifies incorrect movement patterns
4.	Smart Gravity	An electronic harness integrated with the athlete lifting system to lighten 40% of the load of the athlete during walking
5.	D-Wall	Acts as a customisable personal trainer assessing the patient's strength, flexibility, power, agility, balance and endurance
6.	Iso Shift	Measures major functional movement patterns and jump analysis through the sensorised platform
7.	X-Body EMS	Activates all major muscle groups in the body

S No.	Equipment	Description
8.	Cryo Chamber	Provides pain relief, increases blood circulation, boosts metabolism, regenerates tissues, anti-inflammatory, promotes faster healing of athletic injuries
9.	Cryo Penguin	Delivers the safest and most effective localised cryotherapy treatment in the industry
10.	Care Therapy	For muscles, tendons and bone injury repair
11.	Iso Move	Improves lower body performance and muscle strength, checks hamstring and quadriceps ratio
12.	MJS	Allows superior limb training without load, no gravity and improves precision of movement
13.	Dolor Clast Master (Shock Wave Therapy)	Quickly and effectively treats musculoskeletal pathologies (like tennis elbow)

1.2 Significance of the project

Rajasthan High-Performance Sports Training and Rehabilitation Centre project is highly significant as:

- The technology paired with the Athlete Management System will enable the coaches to keep track of the training, health, rehabilitation, recovery and mindfulness of their athletes



Figure-1: High-Performance Sports Training and Rehabilitation Centre



Figure-2: (a) Walker View; (b) Cryo-therapy unit

- Parameters specific to the sport and customised for athletes can be measured and utilised for training
- Scientific assessments can create a conducive grass-root talent identification process and a development plan of the athlete can be designed
- Being a sports-centric state with an outstanding sporting culture and readying for hosting future events, the sporting objectives of the state can be achieved and the Olympic movement can be enhanced
- Major social impact can be created on the sports platform for all sections of athletes and sporting communities across the state

Through Rajasthan Sports High-Performance Training and Rehabilitation Centre, an athlete can understand his/her body better leading to better physical self-awareness. An athlete can:

- Be more receptive to training
- Avoid injuries with a healthier movement
- Control their body and achieve excellence

The centre offers performance enhancement, injury prevention and management, physiology testing and training, recovery, strength and conditioning training and ultimately enhancing athlete performance (Abhinav Bindra Targeting Performance 2022).

1.3 Aim and Objectives

To develop a world-class rehabilitation sports facility and training centre for better sports performance.

The objectives of the study are:

- Establishment and testing of world-class fitness and facilitating Rajasthan state
- Rehabilitation of injured athletes
- Strengthening and conditioning after rehabilitation to prevent injuries with the help of evidence-based practices
- Providing technology-enabled fitness and performance enhancement strategies

2. Contextual Background

2.1 Conceptual Framework/Research Design

A sports specific assessment will be given based on the parameter requirements of the sport. The reports will be discussed with the athletes and their coaching staff, providing a three-month customised training plan. All athletes will be given a recommended number of sessions based on their age group. Experts and staff have created injury rehabilitation protocols for a range of sports injuries using the devices to facilitate quicker and more accountable treatment. Every three months, the athlete assesses the devices to track development and results. This data is once again discussed with the coaches and training plans are revised to make training more effective (Abhinav Bindra Targeting Performance 2022).

2.2 Key features of the project

2.2.3 Challenges in the project

To effectively run the training centre requires active participation and coordination among multiple civic bodies and funding institutes which is the most difficult challenge of the project.

2.2.4 Risks involved in the project

No risks were identified during both pre and post-implementation of the project.

2.2.5 Features and Benefits

By setting up the high-performance centre with sports science technology, the state's athletes will be able to benefit significantly from global best practices and receive world-class assessment and training. This project's features and benefits were mainly technical by rehabilitating injured athletes and providing strengthening and conditioning coaching to prevent injuries.

2.6 Key findings from interviews, surveys and primary/secondary data collection

During the survey of 20 athletes as a sample, it was revealed that 90% athletes were users of this centre. Facilities like Sports Psychologists, Sports Physiotherapists, Sports Scientists and strengthening and conditioning were used the most. Care Therapy was the most used machine by 15 athletes, followed by D-wall (Elite) used by 11 athletes, and then postural bench used by nine athletes. Athletes were mainly

referred to the facility by coaches (89.5%). All athletes who were not users of this facility (10%) were not aware of it. It also came to light that none of the surveyed athletes were involved in the suggestion/decision-making of the project.

Surveys conducted for organisations showed that ABTP and the state government were involved in the planning and implementation of this project. Benefits of the project include world-class and science-based services and availability of numerical data accessibility. The survey also showed that both injured and healthy athletes are using the facility and about 100 athletes use the facility every day. Time allotted by various coaches and therapists within the facility varies according to the injury incurred by the athletes. The methods used by nutritionists include diet charts, diet recall, BMI (Body Mass Index) and BMR (Basal Metabolic Rate). The methods used by psychologists for rehabilitation are assessment forms, counseling sessions and cognitive behavioral therapy. The facility is mostly used by physiotherapists, followed by strength and conditioning coaches, nutritionists, psychologists and sports scientists.

3. Discussion and Conclusion

The inauguration of this high-performance centre will encourage athletes (competing at the state level and above) to use 'Sports Science' to enhance their performance which will be available free of cost. Moreover to introduce coaches to the newly available

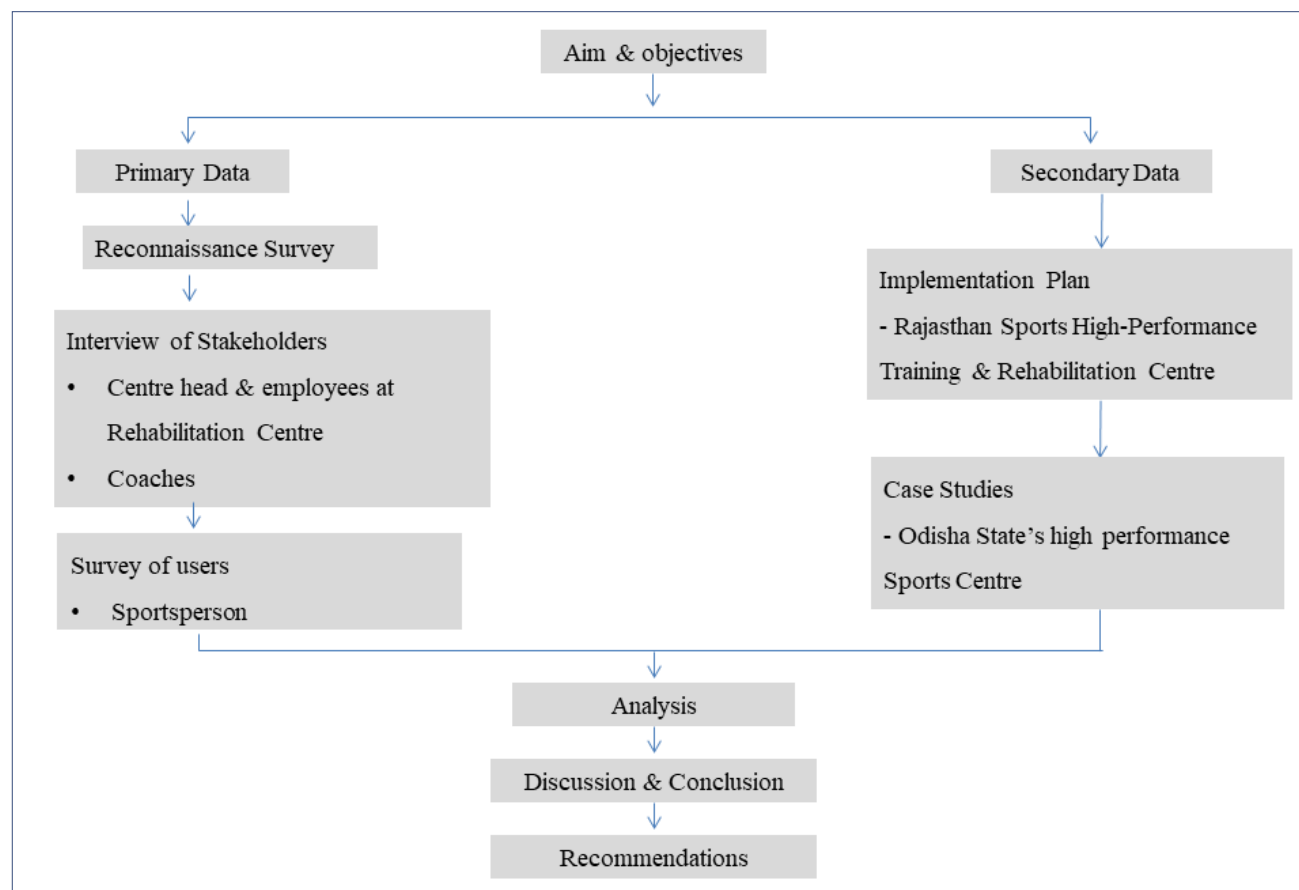


Figure-3: Assessment Framework

technology (Tecnobody Machines) an orientation program was conducted. Athletes will have access to a state-of-the-art, world-class sports medicine and rehab set-up. The better they perform, the more laurels they attain for themselves, the state and the country. With advanced technology in sports science and rehabilitation, this centre has infrastructure and expertise to aid athletes to recuperate from injuries and psychological issues with the help of trained specialists and experts.

The project through this facility in Rajasthan will provide athlete training and lead to injury rehabilitation and improvement in the performance of sports. The facility is well equipped with infrastructure and workforce.

3.1 Implications

The assessment of the project has been done after analysis of primary and secondary data to draw conclusions and make recommendations for further proposals (Figure-3: Assessment Framework)

The significant implications of the project include less healing time, post-recovery training for injury prevention and performance improvement. The project is also financially beneficial for athletes as rehabilitation and training are given free of cost, thus incentivising more people to indulge in sports and represent their states.

3.2 Limitations of the research

Currently, the facility of training and rehabilitation is available to the athletes and sports persons of Rajasthan state only. However, the project is being improved and implemented in a phase-wise manner and eventually, through different awareness methods the facility is expected to reach the general public.

3.3 Recommendations

In our primary data collection, it was noted that all the athletes who were non-users were not aware of the facility. To improve this situation, active campaigning, awareness programs, advertisements and workshops are required to be conducted to introduce and familiarise the athletes with the facilities and equipment available in the centre.

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C22

Conservancy Lanes Quality Evaluation: Prerequisites for space management An Empirical Case of Shivamogga

Location: Shivamogga, Karnataka

Year of Project Implementation: 2017

Sector: Retrofitting and Redevelopment under ABD

SDG: SDG 11.2

Project Cost: 46,409,070 INR

Institute: Manipal School of Architecture and Planning

Advisors: Yogendra Singh Yadav

Students: Madhukiran MN, Shruti Mohan

Keywords: Urbanization, Conservancy Lanes, neighborhood, framework, social fabric

Abstract:

Urbanization in India is known to be Pseudo Urbanization, meaning imbalanced – most of the focus is on the city centers whereas the veins of the city are not paid attention to, although the city lives in these spaces. Urbanization is a process through which a city grows the population shifts from rural to urban areas, the course in which the society adapts to the change and thus results in physical growth with the need to equip infrastructure to facilitate the growth.

Formerly the conservancy lanes operated as service corridors, with individual homes connected to their respective septic tanks or common septic tanks. “A Conservancy Lane typically refers to a natural passage/service lane reserved customarily in the rear side of properties meant to provide different services to the buildings”. As the urbanization rate of Shivamogga city has witnessed growth over the decades, these lanes turned into neglected dumping garbage ground over time.

As per the feasibility report provided by the Shivamogga Smart City Limited, 61 conservancy lanes were surveyed and located in the prime residential and commercial areas with a total length of 7kms. The average length of these lanes is 100 meters and the average width is 3.8 meters. As per the report, only 23 are earmarked for revenue-yielding activities. These lanes were developed into space for car parking, 2-wheeler cum cycle parking, Auto stand, Food Court, Vending Zones, Children’s Play Area, and Landscaped areas with an Open gym.

The project has a major positive influence on the livability of the city, improving employment opportunities in the informal sector of the society, and addition improving the imageability and quality of both the neighborhood and the public space. The objective of this report is to understand the feasibility of these lanes and evaluate the active means of utilization through a framework to facilitate the growth of the city and provide appropriate space management strategies that can be developed for further improvement through a smart approach.

Given the above, all the conservancy lanes were accessed through a framework in conjunction with understanding the neighborhood in which these lanes were located. The method employed was by formulating certain parameters and indicators and identifying the qualities through criteria-based surveys, users’ opinions, questionnaires, and observational studies. Using the above methodology, the lanes in the city with varying performance levels and factors responsible for the same can be identified, as a basis for formulating appropriate management strategies to facilitate further improvements and the growth of the city.

1. Introduction

Located in Shivamogga district Shivamogga city is in the central part of Karnataka. It lies on the banks of the Tunga River and is the administrative headquarters of the district. The Government of India intends to transform 100 Indian Cities into Smart cities and Shivamogga was selected under Tier 2 cities. In this context, SPV – Special Purpose Vehicle and SSCL – Shivamogga Smart City Limited to plan, design, implement, coordinate and monitor the smart city projects were incorporated in Shivamogga.

1.1 Topic and Context

The city's vision states, "Transforming Shivamogga, a City of Lakes, Tradition, and Heritage into a leading destination for Smart, Connected and Eco-Friendly communities focused on Education, Research, Entrepreneurship, and Tourism".

Shivamogga's Area Based Development (ABD) proposal included Retrofitting and Redevelopment of 1500 acres of land within the city, impacting about 23% of the city population. The ABD area has 2 distinct divisions concerning its character and land use, CBD Area of 1225 acres and 275 acres of land stretched along either side of River Tunga which is scarcely developed. Under ABD proposals, the Development of Conservancy lanes falls under the sector of Retrofitting and Redevelopment project in Shivamogga city.

As of Annual report 2021, The project of development of conservancy lanes was completed in packages of lanes within a particular neighborhood. Around 176 conservancy lanes are in Shivamogga with a total length of 70 km of varying widths as per the feasibility report. The width of these lanes varies from as low as 2 meters to 5.5 meters. The majority of these lanes are located in the older part of the city. A total of 61 potential conservancy lanes has been developed.

This paper intends to access and evaluate the lanes which are concerning the activities and facilities provided and in turn provide development design options and appropriate space management measures to facilitate the requirement of growth and improvement.

1.2 Significance of the Project

The conservancy lanes which were in a dilapidated condition were hence therefore identified as one of the key projects to be developed under Smart city intervention in Shivamogga. These spaces were utilized as solid waste dumping zones, dump yards for construction debris leading to waterlogging, open defecation, urination, and thus generating abandoned unusable spaces. These lanes needed to be developed

for active means of utilization, to avoid misuse of urban land. The location of the conservancy lanes in the ABD area is shown in Fig 2.4

1.3 Aim and Objectives

The study aims to examine the feasibility of conservancy lanes and develop a framework to evaluate the utilization of these lanes and to further decode appropriate management strategies to facilitate the transforming city of Shivamogga through a smart, connected, and eco-friendly approach.

The objectives of the study are:

- To identify all conservancy lanes and the extent, scale, and dynamics of these lanes.
- To understand the social and urban fabric of the neighborhoods in which these lanes are located.
- To identify the indicators for the feasibility of the conservancy lanes in the neighborhood.
- To provide design solutions and appropriate space management strategies for active utilization of these lanes.

2. Contextual Background

According to the feasibility report, 176 conservancy lanes were located around the city of which 61 of them were



Figure 2.1: Typical Conservancy Lanes in Shivamogga
Source: Feasibility Report on Development of Conservancy Lanes – Shivamogga Smart City Limited

expendable to facilitate the need of the neighbourhood. Of which only 23 were revenue yielding while the rest were urban spaces of gathering and unyielding revenue. The cost of the entire project was estimated at around 4.64CR but cost around a total of 7.9CR.

Past Scenario

Previously most of these conservancy lanes were in dilapidated condition and were underutilized. In most of the lanes, Construction of drains, sewage lines, and Manholes has been completed. The construction debris was left on these sites and the soil after excavation was not leveled. Thus, leading to waterlogging and filthy conditions of mosquito breeding. Open defecation and urination were observed on some of the lanes regardless of the construction of public toilets mostly in the lanes abutting the commercial neighborhoods. Disposal of waste and solid waste dumping zones were also observed in these lanes, leading to the growth of rodents and stray animals, advancing onto wards unfavorable living conditions.

Current Scenario

To avoid misuse, the conservancy lanes were restored into urban public spaces with varying activities. Activities for each of these conservancy lanes were rationalized



Figure 2.2: Conservancy Lanes developed as Food courts near Tilak Nagar
Source: jnfvo envjn bjonrbjonrb

through a reconnaissance survey, traffic, and land use pattern study according to the existing condition in the area. Resulting in the redevelopment and retrofitting of these lanes to facilitate the need of the surrounding. The description of the lanes and the activities and land use associated has been mentioned in Table 1.

Past strategies for improvement of Conservancies

Past efforts on the development of conservancies. Traffic congestion was excessive due to on-street parking and street vending – food mostly. In around 2011, conservancies were developed into food courts near Tilak Nagar, where food vendors were shifted from the Main Road leading to a reduction in traffic congestion. Similarly, to relieve congestion due to on-street parking on Nehru Road, lanes near Ambedkar Road were developed into covered parking with nominal charges.

2.1 Conceptual Framework/Research Design

The methods employed to further understand and explore feasibility can be broadly divided into four sections:

1. Surveying and locating all the conservancy lanes and segregating based on infrastructure, mode of transport, land use, purpose, quality, and revenue – Data Collection



Figure 2.3: Conservancy Lanes developed for parking
Source: jnfvo envjn bjonrbjorrb

2. Understanding the neighborhood and the social fabric in which the lanes are located through performance analysis, road inventory, transit line mapping, building use, and activity and movement mapping
3. Address various cases through stakeholder analysis, questionnaires, personal interviews, determining indicators, and defining parameters.
4. Evaluating all the conservancy lanes, characters, and activities under parameters and identifying performance levels, issues, and factors responsible for the same.
5. Developing Design options and appropriate space management measures for further improvement and overall success of the spaces in these lanes.

2.2 Key features of the project

1. Drains, Gates, and Equipment
2. Seating Spaces, Public Toilets, Electrical Poles.
3. Drinking water supply

Activities in the lanes were developed specifically for residential and commercial land use, while some could be developed for both lands uses. Each activity would require a minimum width to function with ease and thus

served as a guiding factor in defining activity for each of these lanes.

2.2.1 Challenges in the project

During the execution of the project, certain drawbacks persisted.

1. **The relocation of electrical and water supply lines:** New pipelines were re-laid under the pavements for the supply of water without disrupting the current course, limiting to a time-bound deadline to ease the tribulation amongst the residents.
2. **Interdepartmental coordination:** Execution of the project was dependent on the coordination between different departments that were in cahoots for the successful implementation of the same. Informing and acquiring permission to ascertain the project stalled the commission further.
3. **Hazardous Working Conditions:** Before the development of these lanes, conservancies were prone to being dump yards. Illegal activities accompanied by foul stench were grounds for an unhealthy environment for the residents and the society. Cleaning of the lanes by the workers is incumbent for the project to get launched successfully.

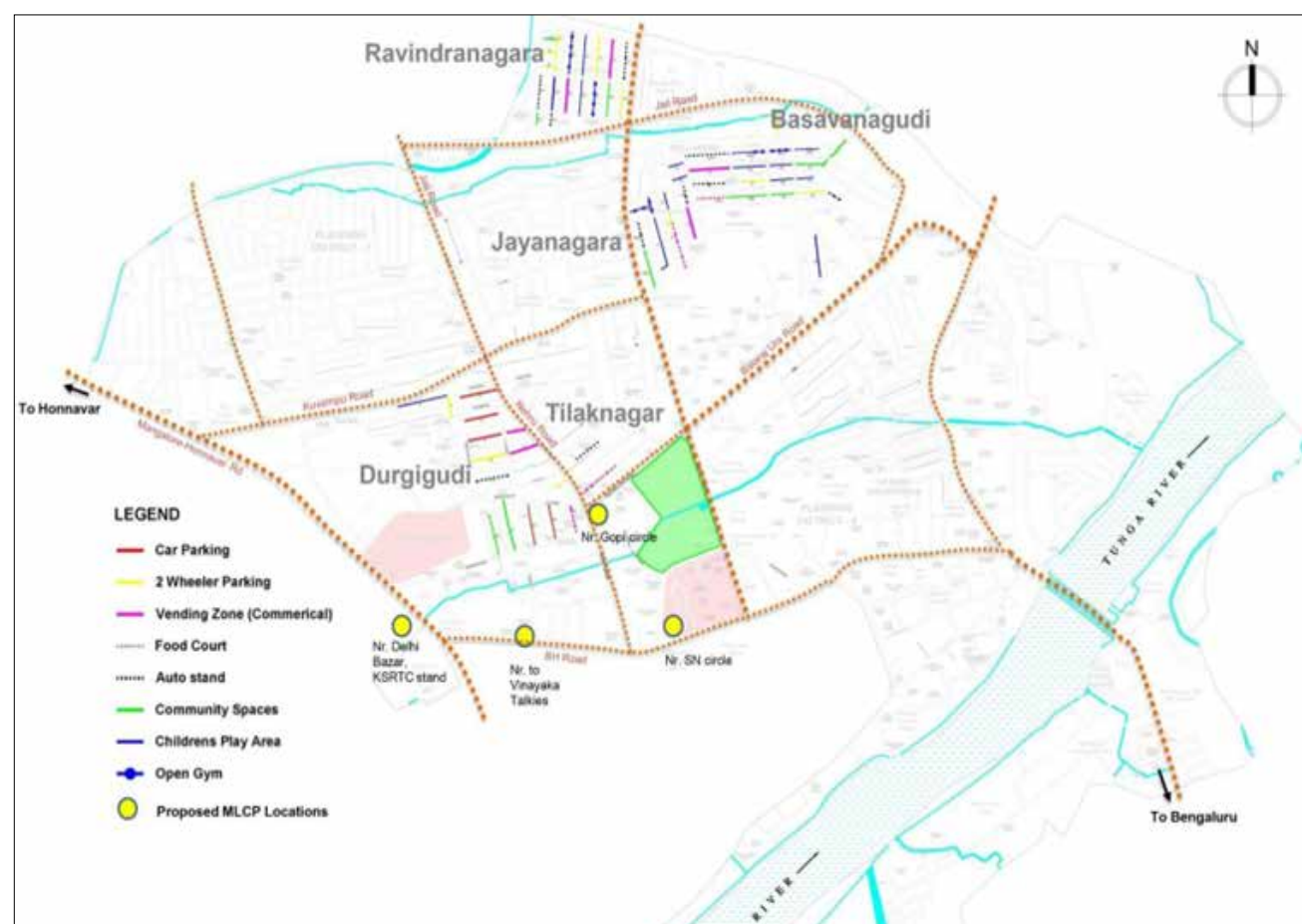


Figure 2.4: Conservancy Lanes in the ABD area of Shivamogga
Source: : Feasibility Report on Development of Conservancy Lanes – Shivamogga Smart City Limited

4. **Relocation of Vendors:** Convincing vendors to rent spaces within the lanes to prevent overcrowding in major roadways. Despite intimation of allotment of stalls within the lanes, the sudden upheaval necessitated utmost convincing.

2.2.1 Risks involved in the project

1. **Maintenance and Management:** With the new lanes developed and restored comes the task of maintaining the lanes. With most lanes being undertaken by the cooperation fewer lanes are being taken care of by the neighborhood welfare association.

2. **Possibilities of theft and other illegal activities:** With relatively fewer lanes being monitored using cameras, the prospect of the lanes turning over to illicit activities is higher. In the present scenario grills that have been used for rainwater to seep in have been stolen.
3. **Vandalism of public property:** Regardless of the efforts taken by the municipalities, vandalism is still a subject of the grave issue faced in the development of such lanes.
4. **The shift in the requirements of the people:** The proposal to design lanes according to the neighborhood and surveys undertaken reflects the requirement akin to a specific location. However, over the years the chance of the neighborhood being modified in terms of its occupiers is salient to keep in mind an open option.

Table 1: Existing condition on all the conservancy lanes

Source: Feasibility Report on Development of Conservancy Lanes – Shivamogga Smart City Limited

Conservancy no	Locality	Landuse	Abutting Main Road	Min Width (in Mt)	Length (in Mt)	Proposed Activity	Cars	2 wheelers	Cycles	Auto	Vending Zone	Toilets (no. of WC)	Revenue Generation	
1	Mission Compound	R + C	Nehru Road	2.3	60	2 Wheeler Park (Prop)							Y	
2	Tilak Nagar	Commercial	Nehru Road	4.8	94	Auto stand				21		6	N	
3	Mission Compound	Commercial	Nehru Road	4.7	102	Vending Zone (Commercial)					23	6	Y	
4	Mission Compound	Commercial	Nehru Road	4.9	68	Vending Zone (Commercial)					15	6	Y	
5	Mission Compound	R + C	Nehru Road	5.3	135	Car Park (Prop)	22						Y	
6	Mission Compound	R + C	Kuvempu Road	3.8	180	Childrens Play Area							N	
7	Mission Compound	R + C	Kuvempu Road	3.4	75	2 Wheeler Park (Prop)		35	25				Y	
8	Mission Compound	R + C	LLR Road	5.2	115	Car Park (Prop)	18						Y	
9	Mission Compound	R + C	LLR Road	5.1	115	Car Park (Prop)	18						Y	
10	Mission Compound	R + C	LLR Road	4.2	115	2 Wheeler Park (Prop)		54	38				Y	
11	Mission Compound	R + C	LLR Road	4.3	115	Auto stand				26		6	N	
12	Ravindranagar	Residential	Savilanga Road	3.3	120	Auto stand				28			N	
13	Ravindranagar	Residential	Savilanga Road	3.7	123	Vending Zone (Vegetables & Fruits)					41	4	Y	
14	Ravindranagar	Residential	Savilanga Road	3.3	130	2 Wheeler Park (Prop)	61	43					N	
15	Ravindranagar	Residential	Savilanga Road	3.6	134	Childrens Play Area							N	
16	Ravindranagar	Residential	Savilanga Road	3.3	139	Open Gym							N	
17	Ravindranagar	Residential	Savilanga Road	3.5	40	2 Wheeler Park (Prop)		27					N	
18	Ravindranagar	Residential	Savilanga Road	2.7	47	Community Space							N	
19	Ravindranagar	Residential	Savilanga Road	3.4	47	2 Wheeler Park (Prop)		31					N	
20	Ravindranagar	Residential	Savilanga Road	3.2	47	2 Wheeler Park (Prop)		31					N	
21	Ravindranagar	Residential	Savilanga Road	3.2	105	Auto stand				24		6	N	
22	Ravindranagar	Residential	Savilanga Road	2.2	41	Community Space							N	
23	Ravindranagar	Residential	Savilanga Road	3.0	109	Childrens Play Area							N	
24	Ravindranagar	Residential	Savilanga Road	3.0	41	Auto stand			9				N	
25	Ravindranagar	Residential	Savilanga Road	3.8	113	Vending Zone (Vegetables & Fruits)					28		Y	
26	Ravindranagar	Residential	Savilanga Road	3.0	114	Childrens Play Area							N	
27	Ravindranagar	Residential	Savilanga Road	3.2	117	Open Gym							N	
28	Ravindranagar	Residential	Savilanga Road	1.8	117	Community Space							N	
29	Ravindranagar	Residential	Savilanga Road	2.7	117	2 Wheeler Park (Prop)	78						N	
30	Basavanagudi	Residential		3.4	114	Childrens Play Area							N	
31	Basavanagudi	Residential		3.7	139	Vending Zone (Vegetables & Fruits)				45		4	Y	
32A	Basavanagudi	Residential		3.4	150	Auto stand				35		6	N	
32B	Basavanagudi	Residential		3.4	116	Open Gym							N	
33A	Basavanagudi	Residential		3.8	79	Open Gym							N	
33B	Basavanagudi	Residential		3.8	84	Childrens Play Area							N	
34	Basavanagudi	Residential		3.8	66	2 Wheeler Park (Prop)	44						N	
35	Basavanagudi	Residential		3.9	78	Childrens Play Area							N	
36	Basavanagudi	Residential		3.8	80	Childrens Play Area							N	
37	Basavanagudi	Residential		3.8	93	2 Wheeler Park (Prop)	62						Y	
38	Basavanagudi	Residential		3.9	82	2 Wheeler Park (Prop)	55						N	
39A	Basavanagudi	Residential		3.8	107	Food Court (veg)					24	6	Y	
39B	Basavanagudi	Residential		3.8	137	Community Space							N	
40	Basavanagudi	Residential		3.8	96	2 Wheeler Park (Prop)	64						N	
41	Basavanagudi	Residential		4.1	56	Childrens Play Area							N	
42	Basavanagudi	Residential		2.9	101	Community Space							N	
43	Basavanagudi	Residential		3.0	139	Childrens Play Area							N	
44	Jayanagara	Residential		4.6	186	Food Court (Non-veg)				44		6	Y	
45	Jayanagara	Residential		4.5	55	Childrens Play Area							N	
46	Jayanagara	Residential		4.5	55	Open Gym							N	
47	Jayanagara	Residential		4.5	165	Childrens Play Area							N	
48A	Jayanagara	Residential		4.1	125	Community Space							N	
48B	Jayanagara	Residential		4.1	80	Auto stand				18		6	N	
49	Jayanagara	Residential		4.7	105	Vending Zone (Vegetables & Fruits)					35	4	Y	
50	Jayanagara	Residential		3.9	55	Auto stand				11		6	N	
51	Basavanagudi	Residential		3.8	109	Auto stand				25		6	N	
52	Jayanagara	Residential		3.8	51	Childrens Play Area							N	
53	Jayanagara	Residential		4.8	51	Childrens Play Area							N	
54	Durgigudi	Commercial	Savarline Road	5.3	87	Food Court (Existing)							Y	
55	Durgigudi	Commercial	Savarline Road	5.4	109	Car Park (Prop)	17					6	Y	
56	Durgigudi	Commercial	Savarline Road	5.3	136	Car Park (Prop)	21					6	Y	
57	Durgigudi	Commercial	Savarline Road	4.7	172	Community Space							N	
58	Durgigudi	Commercial	Savarline Road	3.5	132	Community Space							N	
Total				Avg Width -	3.8	6265		96	541	107	196	256	86	

Table 2: Performance Analysis

Parameters	Indicators	Survey
Imageability	Accessibility	Infrastructure assessment and Questionnaires' Infrastructure assessment
	Visibility of the space	
	Building Edge	
Inclusiveness	Used by all, irrespective of age, race, class, gender, and physical abilities	Infrastructure assessment and Questionnaires Rating Scale Questionnaires
	Control of entrance by fee/usage chargers	
	Control of entrance to the space according to specified timings	
Safety and Security	User Perception	Infrastructure assessment Data Collection
	Presence of adequate lighting, illumination	
	Surveillance Measures	
	Presence of Openings on the building facades	
Maintenance	Criminal/Accident Data	Rating Scale Questionnaires and infrastructure assessment
	Management of Litter and Filth	
	Presence and Condition of waste bins	
	Awareness	

Purposefulness	Suitability of layout and design User Perception	Infrastructure assessment Rating Scale Questionaries
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Table 3: How the survey is to be conducted

Kind Of Survey	Indicators	Methodology
Infrastructure assessment	Visibility of the space Building Edge Used by all Presence of adequate lighting, illumination Surveillance Measures Presence of Openings on the building facades Management of Litter and Filth Presence and Condition of waste bins Accessibility Suitability of layout and design	1. Through literature study – Data from the project 2. Through documentation and observation 3. To be done by the accessor/ interviewer 4. A Table is created for documentation of the same (Ref. Annexure I)
Rating Scale Questionaries	Visibility of the space Accessibility Used by all Control of Entrance User Perception – Safety Management of Litter and Filth Presence and Condition of waste bins User Perception - Purpose Awareness	1. Personal Interview with the Authorities 2. A series of rating scale questionaries shall be asked to the users of the space. 3. Questionaries format (Ref. Annexure II and Annexure III)

Data Collection	Criminal/Accident Data	Revive data from Authorities / Secondary data
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2.2.3 Features and Benefits (social, technical, city administration level, impact on environment and economy) to the city

- Reduction in Traffic Congestion and Improvement of Level of Service (LOS)
- Giving thrust to the informal sector of employment
- Improving Sanitation
- Providing community amenities at the neighborhood level
- Economic generators of the city
- Better blocks
- Strives to impart a sense of belonging at the neighborhood level

2.3 Key findings from the interviews, surveys, and primary/secondary data collection

Data collected through interviews and surveys are segregated into three categories for better perception of the zones and the allotted activity.

- Open Gym, play area, and community spaces

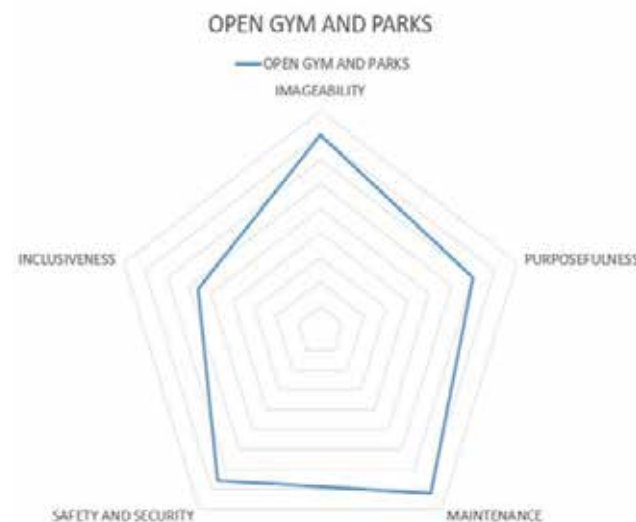


Figure 2.5: Performance Analysis of Open Gym and Parks as per the survey

- Vending Zone: Food Street
- Parking and auto stand

These categories were observed based on existing activity implemented on the conservancy lanes. Each of these categorized conservancy lanes is evaluated under parameters (Ref. Table 2) and established performance levels, issues, and factors responsible through graphs and charts.

2.3.1 Data: Concluded through Interview with the Authorities

- Under the ABD Smart City project of Development of Conservancy lanes, the entire project was divided into five packages. Currently, the last package is in progress.
- The majority of the Conservancy Lanes around Residential areas were developed into Open gyms and play areas. Commercial Area Conservancy Lanes were developed to facilitate parking zones
- While Food streets were developed in Conservancies Lanes located near intersections that were dominated by street food vendors. These vendors were relocated in these lanes.
- Resulting in decluttered junctions, subsequently calming the traffic flow. And promoting better blocks and neighborhoods alike.
- As of March 2022, revenue is not being generated against parking. As user-friendly and convenient E-ticketing measures are being developed and trailed.
- Presently Revenue is generated from those Food Street conservancy lanes. This is collected as rentals by the Municipality corporation for maintenance.

2.3.2 Open Gym and Play area: Concluded through Survey and Questionaries

Open gym for adults and play area for kids. As mentioned in 2.3.1, an Open gym and play area are observed in conservancy lanes located alongside residential areas, which thus are maintained and regulated by the respective communities. These spaces are dominantly used by the neighborhood. Consequently, these spaces were designed to cater to the current needs/ ethos of the neighborhood.

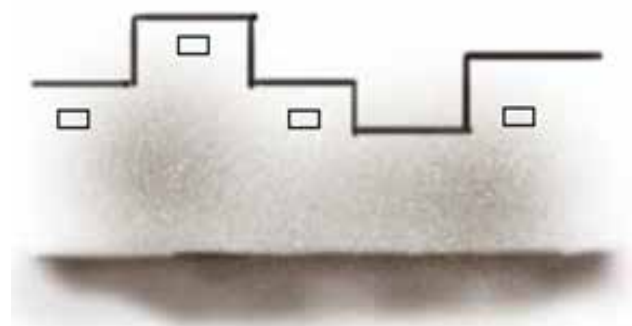


Figure 2.6: Conservancy Lanes along Residential zones

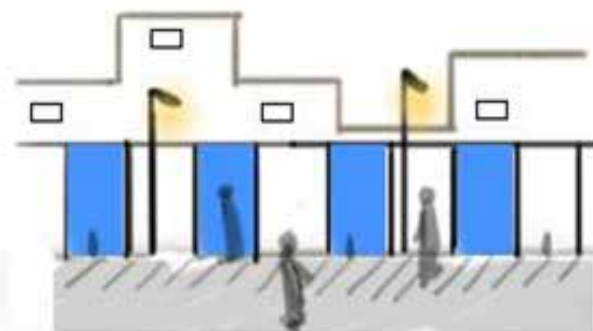


Figure 2.7: Observed: Lanes appropriated for personal use

2.3.2.1 Observation

- Most of the conservancy lanes which were developed into open gyms and play areas are observed to cater to the needs of all age groups, from kids to senior citizens. Which is subjective in terms of design and facilities provided.
- In terms of safety and security, the feedback of the locals was positive, owing to the fact that the space was enhanced, quoting Local 1 “These lanes initially were very dark, logged with water, smelly accommodatable spaces, but now it is much better than what it used to be”
- The conservancy lanes are located at the posterior entrances of the residences, inducing the residents to use these spaces for drying clothes.
- The approach was observed to be eminently disoriented as an outcome of poor design and poor implementation of wayfinding principles.
- As Kevin Lynch states, in his book “The image of the city”, “There seems to be a series of public images, each held by a significant number of citizens. Such a group of images is necessary if an individual is to operate successfully within his environment of a given city, neighborhood, or street.
- Imageability is that quality in a physical object which gives it a high probability of evoking a strong image in any given observer. It is that shape, color, or arrangement that facilitates that powerfully structured, highly useful mental images of the environment

2.3.3 Parking and Auto Stand: Concluded through Survey and Questionnaires

2.3.3.1 Observation

- Conservancy Lanes located in the commercial area were developed into Parking Zones for 2- Wheeler, 4- Wheeler, and Auto Stand facilitating the shop owners and customers alike.
- The density of Parking on the Main Road has significantly reduced, these parking spaces are considerably used by shop owners, unlike customers who are inclined to park their vehicles on the main roads.
- At present, no revenue is been generated from



Figure 2.8: Conservancy lanes developed into Park & Gym

these zones, and an E-ticketing system is been considered for the same.

- The space allotted for parking needs better design assessment to avoid the generation of dead spaces, that act as garbage dumping grounds. These zones are maintained by the municipal corporation.
- Lacks security is a major concern at the moment. The provision of signboards, landscapes, and potted plants adds visual character to the space and boosts its usability of the space.

2.3.4 Food Street: Concluded through Survey and Questionnaires

2.3.4.1 Observation

- It was observed that Food vendors had appropriated spaces along the intersection to attract customers, leading to congestion in traffic.
- To overcome this concern, conservancy lanes near these junctions were used to relocate the Food vendors, providing them with permanent space for occupancy. However, the incomes have been averaged out due to the stationary position of the vendors.
- The flow of population is at its peak during lunch hours between 1:00 PM – 03:30 PM and the space observes a second peak between 7:00 PM – 08:00 PM. Food is mostly prepared on site.
- The Vendors have adapted to the street and altered the space based on their requirements, with tiles, lights, and CCTV Cameras.
- The space was provided with a water supply and Handwash at every interval of 10M, along with seating spaces, and a ventilator aiding both vendors and customers.
- Approach to these streets is cramped with vehicles of the vendors, the space is not barrier-free, as barricades have been placed to avoid vehicles barging in.

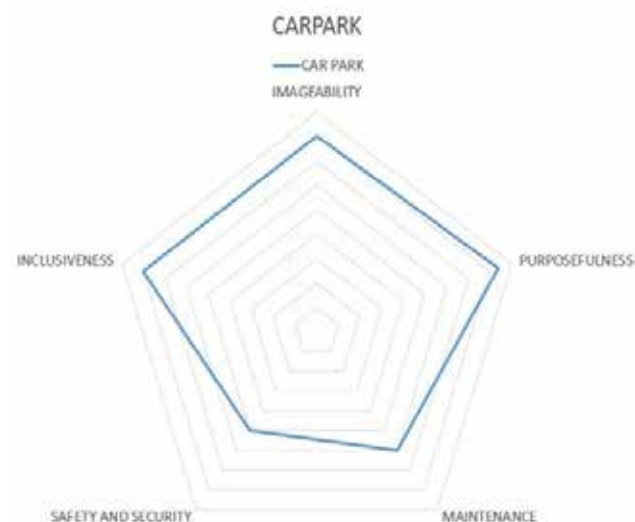


Figure 2.9: Performance Analysis of Car Parking Zone as per a survey

3. Discussion and conclusion:

Through survey conducted and on-site data collection, the following observations were made.

- It is evident that to facilitate a healthy and clean environment for the people, the government initiative to work on the conservancy lanes has an impact on the society and as a result has a profound influence on the urban fabric of the neighborhood and the city.
- The scale of the conservancy lanes defined the purpose it was meant to cater to. As stated earlier the lanes along residential locality were adapted to suit the needs of the residents, while, the lanes along the commercial sectors were focused to take the edge on bottlenecks, created by the local food vendors and the common public who were interdependent.

Most of the conservancy lanes are located in the older part of the city. With frequent usage, these lanes could adhere and become distinctive districts of the city. Talking to a resident, she specifies that “Ever since the conservancy lanes have been worked on, they’ve felt very safe on the lanes and find the lanes to be social spaces for the residents to meet up occasionally”.

- In the Commercial sector of the conservancy lanes, the personalization of these stalls has made the

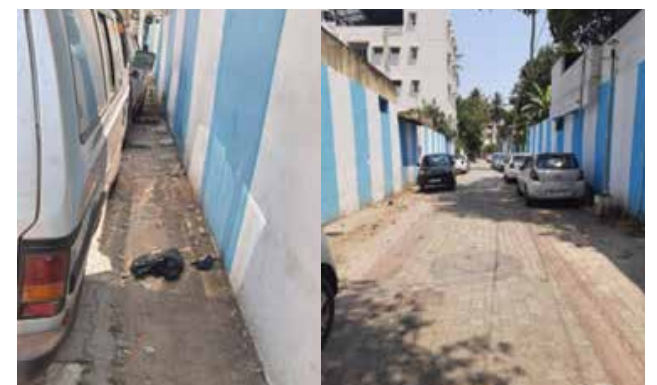


Figure 2.10: Conservancy lanes developed into Parking Zones



Figure 2.11: entrance to the food street modified by the vendors

lane more approachable. Despite the movement of people through the lane, the demarcation of the lane from the rest of the neighborhood is a grind to follow through.

- In the conservancy lanes located along the commercial lanes, car parks have also been provided. The Boom barriers that are yet to function have been installed on-site to monetize from the car park.
- Regardless of the attempt taken forward by the mission, safety and maintenance are two main factors to look into in the preservation of these lanes. Constant monitoring is required for the usage of these lanes.

3.1. Implications

3.1.1 sustainable development goals assessment

The sustainable development assessment goal is a toolkit that was followed to observe the sustainable development goals adopted by the conservancy lanes. Of the 17 goals that exist in totality, it was observed that four of the goals have no impact on the development of conservancy lanes. The rest 13 goals had either a direct impact or an indirect impact on the development of these conservancy lanes.

The revamp of conservancy lanes has helped in the achievement of the following goals:

Goal 3

good health and wellbeing:

The conservancy lanes have been transformed immensely from their earlier state. Lanes that were



Figure 3.1: Conservancy lanes developed into car parking zones in requirement of constant supervision

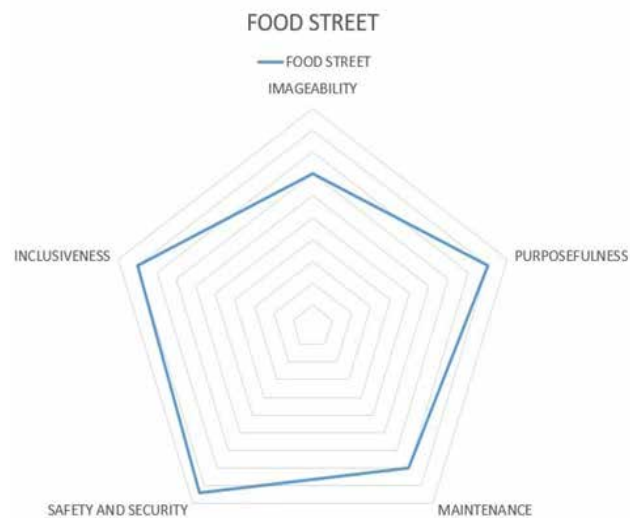


Figure 2.12: Performance Analysis of Vending Zone – Food Street as per the survey

no longer used and considered major flaws of the city have been redeemed for use now and has been cultivated with good intentions to inculcate the sense of neighborhood within. In doing so, the once ungodly lanes have been put into good usage and are now spaces that propagate good health and well-being.

Goal 6

Clean water and sanitation:

Clean water and sanitation a goal has played a significant role in improving these lanes. The pen drains have been closed and proper rainwater can penetrate within without harboring insects to breed. The lanes that are closer to commercial shops have been provided with water for their usage. Washbasins are also installed every few meters within the food stalls for the consumers to wash their hands. Sanitation issues have been well addressed in these lanes by providing washrooms for the vendors.

Goal 8

Decent Work and economic growth:

The vendors from the food lanes have a decent economic

wage from the shift that has been brought by developing these conservancy lanes. By installing Boom barriers in parking lanes, a source of income is generated for the city.

Goal 11

Sustainable cities and communities:

Making cities sustainable means creating career and business opportunities, safe and affordable housing, and building resilient societies and economies. It involves investment in public transport, creating green public spaces, and improving urban planning and management in participatory and inclusive ways.

3.2. Limitations of research:

- Some official statistics such as crime data could not be considered valid as most cases go unreported.
- Hesitancy in answering certain questions of the survey to avoid any implication.
- Limited availability of time to venture into all conservancy lanes as a few were under construction and a few were closed.



Figure 2.13: Conservancy lanes developed into Vending Zones – Food Street

- Certain survey answers could have been biased and could change depending on the age group and gender.

3.3. Key lessons learned:

The key lessons learnt during the survey and the observation are as follows:

- Conservancy lanes have made distinctive boundaries within the city at the neighborhood level. These lanes have increased the social interactions within the neighborhood and are seen as safe places to hang around.
- Safety and well-being are key aspects that have had an impact on the neighborhood. Although the lanes have been seen through a specific lens for the city the people within have adapted the lanes to their personal use. Accessibility and linear line of sight are two important factors that contribute to the success of these lanes to date.
- The conservancy lanes along the commercial sectors have another storyline to them. The shift

in the placement of the stalls to a conservancy lane was not welcomed initially with warmth. Much to the surprise of the public after the development of these lanes, the vendors have been finding it easier to sell their goods. The vendors further went into the role of placemaking by demarcating their spaces in the form of tiles and countertop slabs. This initiative of the shopkeepers has helped the public in also differentiating between spaces.

- The car parking spaces along the conservancy lanes near the commercial lanes have been initiated with a proper understanding of the site based on the land usage and the occupiers. Though this can be seen through its implementation, the main problem that is faced currently by the users of the lane is the lack of safety. Though boom barriers have been installed on either side of the lanes, it hasn't been facilitated still. The maintenance of these lanes is still in an awry state. Theft of common property is still ongoing and hence security needs to be heightened in such places. The rainwater pipes are directly let

onto these lanes and are not covered. This causes discoloration on the walls of the lanes and would have an impact on the imageability of the lane.

3.4. Recommendations:

- In the residential sector, the lanes are linear and are lacking in softscape elements. These elements would

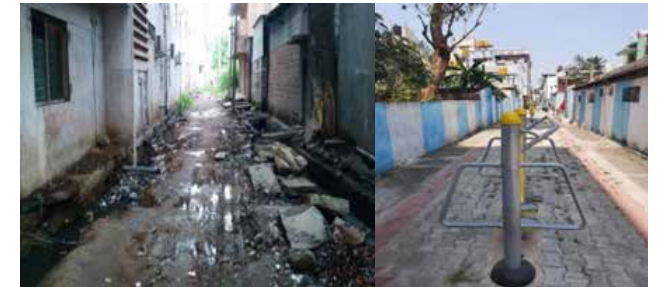


Figure 3.4: Conservancy lanes before and after

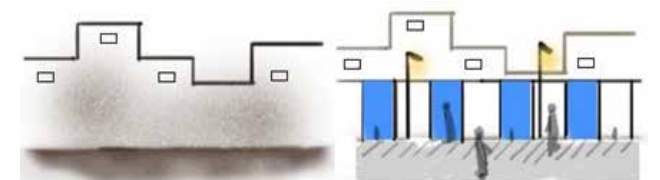


Figure 3.5: Transition Observed in Conservancy Lanes in the Residential Areas

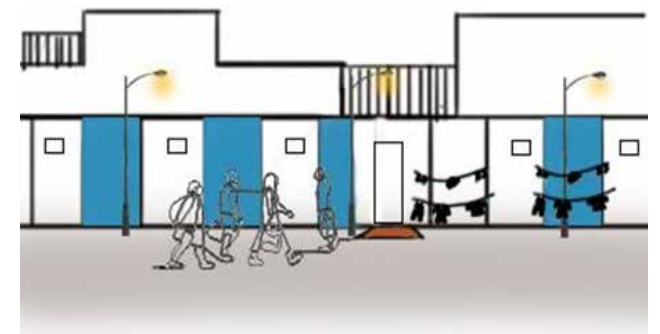


Figure 3.5: Observed Building Adaptation subsequently to the up-gradation of the lanes: Balconies, Larger fenestrations towards the lanes

sdg impact assessment conservancy lanes

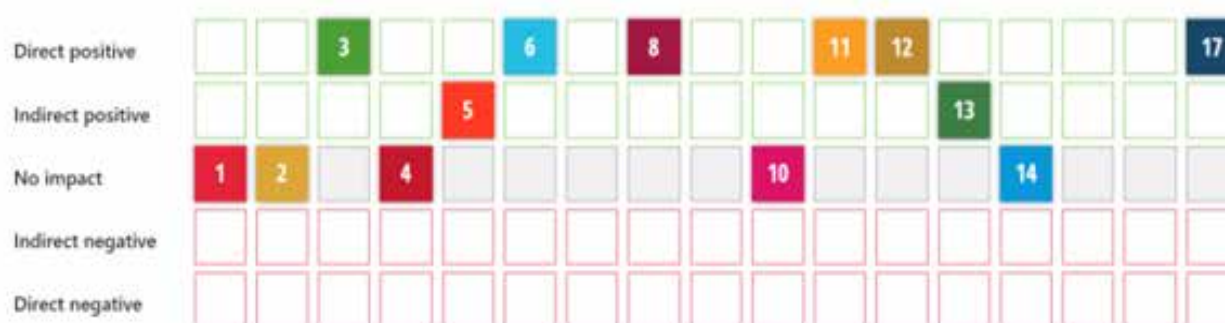


Figure 3.2: SDG Impact assessment of conservancy lanes



Figure 3.3: sustainable development goals



Figure 3.6: Observed: Placemaking, the process through which we work together to shape our public spaces.

help in improving the vitality of the space. The blue and white stripes on the walls of the lanes break the monotony of the stretch of the conservancy lanes. Seating spaces could be provided along the lanes for the members of the locality to sit, as the lanes run up to 100 m or more at times. Though they form districts and act as landmarks for the locality the imageability of the space could be worked on more by creating wall art and instilling the culture of the space through art forms.

- Certain conservancy lanes started on one end and took another direction towards the end. Anyone visiting the lanes for the first time could have difficulty knowing where one lane begins and ends. For such blind spots in conservancy lanes, markers could be provided to not be blindsided.
- The conservancy lanes that have been turned into food courts require proper demarcation from other public spaces. The entrance to the food court is congested and could be maintained well.
- Maintenance is the main issue faced in conservancy lanes operated in commercial sectors. Security has to be improved through the allocation of CCTV cameras as these areas are also prone to burglary and the rainwater pipes coming from the building could be connected well-using pipes so that the flowing water doesn't discolor the painted walls.

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Annexure I – Road Inventory to be conducted

ASPECTS / CASES	Parking and auto stand	Open gym, park, and community garden	Vending zone – food street
Visual Obstacles between the vantage points			
Visibility from the immediate surroundings			
Building Edge			
Control of entrance			
Barrier-Free			
Presence of adequate lighting			
Are there any dark spots in the space			
Presence of Security/ CCTV			
Presence of Openings on the building facade			
Storm Water Drain			
Smell			
Presence of Dust Bin			
Pavement Material			
Traffic Volume			
Presence of Urban Elements			

Annexure-II – Questionaries to be asked to the Authorities

Open-ended questions addressed directly to the Authorities involved in the project
Understanding of the urban space, Range of issue, Environmental Factors, Understanding the community, Barriers, Resources, Assets: Urban and Social Fabric of the Neighborhood

Name:

Occupation:

Telephone Number:

Name of Organisation:

1. What were the risks involved in this project?
2. What kind of connections does your organisation have with local businesses, banks, and local government authorities?
3. What are the issues that you have faced till date? Explain briefly with reason for the issue
4. How often do the issues arise in the neighborhood?
5. Major issues in the last years.
6. What are the current initiatives? How are you going about them?
7. Major objections/hindrances faced while problem-solving, anyone specific
8. Any criminal/ accident data of the areas around these lanes.
9. Any controlled timings for spaces, if yes, why?
- v 10. If yes, what kind of spaces are provided with controlled timings for entrance?

Annexure III – Questionaries to be asked to the Users/Locals

Name:

Personal Address (Specify Street):

From how long have you been living in this locality?

- 0 - 2 yrs.
 2 - 5 yrs.
 5 -10 yrs.
 More than 10 years

Why did you choose to live in this neighborhood?

.....

How often do you visit the space?

Questions	Strongly agree	Agree	Disagree	Strongly disagree	Don't know	Refuse
VISIBILITY OF THE SPACE						
There are a lot of visual hindrances in this space						
I cannot see the immediate surrounding from this space						
The space is in a good condition						
ACCESSIBILITY						
I cannot navigate this urban space						
I have to use a public/private transport system to reach this space						
I can easily walk to this space						
USE BY ALL						
The space is accessible by all irrespective of age, race, class, gender, and physical abilities						
PERCEPTION – IN TERMS OF SAFETY						
There are too many people hanging around on the streets						
Violence is not a problem in my neighborhood						

The area has an adequate presence of lights and illumination						
The space lacks security arrangements						
PERCEPTION – IN TERMS OF PURPOSE						
I find this urban space well organized and benefits my activity						
I don't like how the space is designed						
WASTE MANAGEMENT						
I am against the waste segregation initiative						
There is a lack of dust bins and waste management facilities in the lane						
AWARENESS						
These facilities don't have information/ complaint centers that I am aware						

Questions	Regular	Occasionally	Never
Do you travel by public transport to reach the place?			
Do you find it hard to move around the place?			
DO you find the place easily accessible to you?			
Questions	Yes	No	Sometimes
Do you feel safe in this lane			
Is there sufficient lighting in this lane?			
Are you satisfied with the changes implemented to the lanes?			
DO these changes satisfy your need? Is there any drawback if so?			
How efficient is the waste managed in the lane?			
Are you aware of the complaint centres for the lanes?			

C23

Slum To Home: Assessment of housing and basic services for urban poor at Mariyamma Nagar, Tumakuru

Name of the project: Housing and basic services for urban poor at Mariyamma nagar, Tumakuru

Location: Tumakuru, Karnataka

Year of project implementation: 2019

Sector: Housing

Project Cost (Rs. Crore) : 13.53 Cr

SDGs: SDG 1 No poverty, SDG 3 Good health and well being, SDG 5 Gender equality, SDG 6 Clean water and sanitation, SDG 7 Affordable and clean energy SDG 10 Reduced inequalities SDG 11 Sustainable cities and communities

Institute: Manipal School of Architecture and Planning

Advisors: Purushottam Kesar

Students: Sachin T

Keywords: Smart city mission, Urban poor, slum redevelopment, housing, Tumakuru

Abstract:

The Smart City Mission was launched by the Government of India to provide core infrastructure, and clean and sustainable environment in Indian cities through smart solutions. As part of the mission, to address the growth of informal settlements in the city caused by rapid urbanisation and industrialisation of the city,- Tumakuru Smart City Limited had proposed the “Housing and basic services for urban poor at Mariyamma Nagar”. The project aimed to provide slum dwellers with better housing conditions, access to physical infrastructure and improve the social conditions of the community. In this report, we have tried to understand the aim, objective, and significance of the project and its impact on the community. We also present the key findings of the project through observation, semi-structured interviews, and study of various reports and existing data. The relevance of SDGs to the project have also been discussed.

Case Study: C23

1. Introduction

1.1 Topic and Context

Tumakuru city, the district headquarters of the Tumakuru district located in the southeast of Karnataka is an industrial city that is spread over about 48 square kilometres and is near the Karnataka state capital Bengaluru which is located 70 kilometres southwest of Tumakuru. Tumakuru has been selected as one of the 100 Smart Cities to be developed in India under the Smart City Mission of the Government of India.¹

Tumakuru's Area-Based development (ABD) proposal revolves around retro-fitting of about 1400 Acres in the Central Business District (CBD) area along with several other interventions such as decongesting the city centre and upgrading the available infrastructure & services. One of the projects identified under the Smart City mission is the "Housing and basic services for urban poor at Mariamma Nagar" in an Engineering, Procurement and Construction (EPC) mode. This the slum

rehabilitation project tries to investigate and address, various issues like lack of basic services, land tenure and ownership, substandard housing conditions, unhealthy living conditions, poverty, and social exclusions

Mariamma Nagar slum, situated in the centre of the city (13°22'39" N 77°06'03" E) belongs to ward number 14 and survey number 120 with an approach road of 9 meters. The location of the slum and its context can be referred from image 1.

The inhabitants of the slum, originally from the State of Tamil Nadu, are migrants that have been residing in the slum since the past 80 years for three generations. With an average household size of 4/5, 87 families consisting a total of 368 people inhabit the slum. Most of the houses are semi-pucca, followed by kutchra houses. Kutchra and semi-pucca houses together constitute more than 75%, which as per guidelines and norms are considered as bad housing conditions. These houses are mostly self-built by the residents of the slum. Many of them are engaged in daily wages job where a significant number

of women are engaged as domestic workers. Almost all the families lived in their self-built houses. Most of the families practices hinduism and fall under the scheduled caste category.¹

Table 1 Mariamma Nagar slum details

Location	Ward no. 14
Total Population	368
Total no. of families	87
Total no. of households	81
Average household size	4.5
Total no. of Aadhar cardholders	353
Total no. of BPL cardholders	87
Total no. of voter ID holders	188

Source: Detailed Project Report on Housing and basic services for urban poor at Mariamma Nagar, Tumakuru

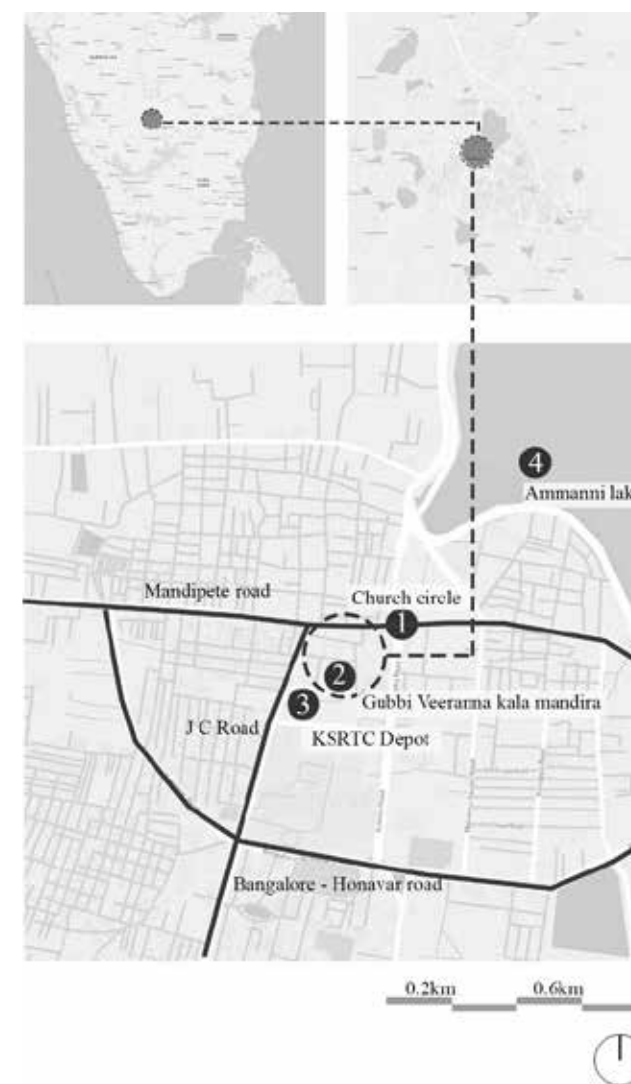
1.2 Significance of the project

- The redevelopment of the informal settlement of Tumakuru i.e Mariamma Nagar slum can improve



Image 2 Slum dwellers of Mariamma Nagar in 2018 (left) newly built residential complex (2020)

Source: Detailed Project Report on Housing and basic services for urban poor at Mariamma Nagar, Tumakuru



¹ Detailed Project Report on Housing and basic services for urban poor at Mariamma Nagar, Tumakuru

the social and living conditions of the slum dwellers.

- b. With permanent land ownership/tenure and added social security, the economic condition of the dwellers can progressively improve with time
- c. Better and improved living condition of the settlement can also improve the health conditions of the dwellers who otherwise are vulnerable to many diseases related to unhealthy living conditions.
- d. The lack of basic infrastructural facilities such as water supply, sanitation, and electricity in the slum areas can also be addressed
- e. The slum rehabilitation project can help to formalise the people living in the informal settlements (i.e. Mariyammanagar slum).

1.3 Aim and Objectives

The study aims to understand the slum rehabilitation project and identify the shortcomings in its planning and implementation.

The objectives of the study are :

- a. To understand the impact of the newly developed housing complex on the social and economic conditions of the slum dwellers.
- b. To understand the risks and challenges faced by the ULBs, and various authorities in the implementation of the slum rehabilitation project.
- c. To evaluate the relevance of the slum rehabilitation project to the Sustainable Development Goals and its indicators

2. Contextual Background

Since the past 80 years the slum dwellers have been living in the land that belongs to the government . But recently, with a private party claiming ownership of the land, the land has been under litigation leaving the slum dwellers insecure with a possibility of being evicted. The settlement also lacks access to basic services like water supply, sanitation, and electricity. Waterlogging issues are commonly reported because of no proper stormwater drains in the area.

Absence of physical and social infrastructure

The status of physical infrastructure and environment is very poor in the Mariyammanagar slum of Tumakuru. The housing community lacks most of the basic essential services. The houses do not have water supply connection instead, a common water tank is the only source of water for the entire slum. Few houses have underground sewage connections which are also poorly maintained and most of the houses had a soak pit. The closed stormwater drains are also used as sewers in a few cases causing a threat to public health, especially during monsoons and floods. Within the vicinity of the slum is a temple with a small foreground that is used as a gathering space for religious activities and an Anganawadi. (image 3)

Slum rehabilitation project

After the Mariyammanagar slum was proposed to

be redeveloped under the smart city mission, A G+4 structure with 3 such blocks has been built on the site which is 150 meters away from the existing slum with all the necessary basic infrastructure. The project, commencing in the year 2019, has been handed over to the beneficiaries on 6th January 2022. (image 4)

2.1 Conceptual framework / Research design

To understand and assess the slum redevelopment project, a qualitative design strategy has been adopted along with the review of documents (such as DPR) provided by the Tumakuru Smart City Limited. To draw the framework in a structured, objective and systematic way the 'Slum Upgrading Legal Assessment Tool by UN-Habitat, 2019' has been referred. The tool provides a perspective on indicators such as land, planning, basic services, housing, and financing that would help in qualitatively analyzing the slum redevelopment.

Data collection and analysis

Data collection has been done by conducting semi-structured interviews with the beneficiaries, engineers, and smart city officials of the housing project at Tumakuru and observation of the redeveloped housing site. To understand and analyse the outcomes of the slum redevelopment project, the *Evaluation of Slum Upgrading Programs* by Laura Jaitman and José Brakarz, 2013 has been referred to.

The SDGs and their indicators are studied with their relevance and impact on the slum redevelopment project.

2.2 Key features of the project

2.2.3 Challenges in the project

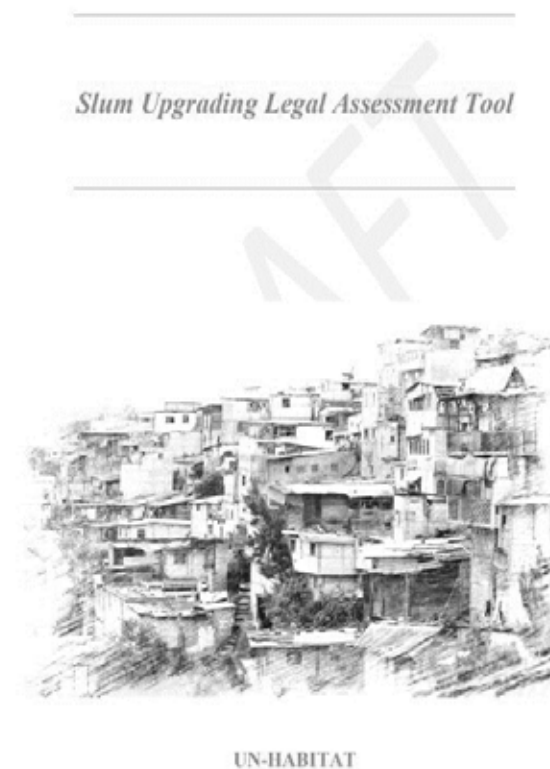
- a. Since the land required for the slum rehabilitation was occupied by other squatter settlements, relocating the squatters and acquiring the necessary land for the development has been one of the challenges for the implementation of the project.



Image SEQ Image * ARABIC 5 The Slum Upgrading Legal Assessment Tool by UN-Habitat, 2019
Source : The Slum Upgrading Legal Assessment Tool by UN-Habitat, 2019



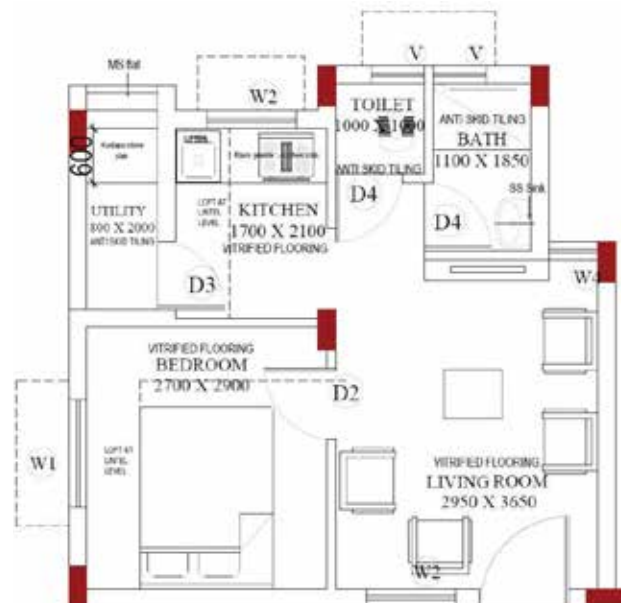
Image SEQ Image * ARABIC 3 Condition of the Mariyammanagar slum before rehabilitation
Source: DPR on Housing and basic services for urban poor at Mariyamma Nagar, Tumkuru



- b. Gaining the trust of the community to support the ULBs and authorities in the implementation of the project.
- c. Identification of the original inhabitants of the Mariyammangar slum i.e identification of the beneficiaries.
- d. The project had to be completed within a stipulated timeline

2.2.4 Risks involved in the project

- a. Failure in acquisition of the proposed land for redevelopment would have resulted in



the relocation of project site. This would have affected the timeline of the project.

- b. Opposition from the dwellers or any organisation/political group/institution against the redevelopment of the slum.
- c. Identification of the wrong beneficiary would result in the wrong usage of public funds.
- d. Since the project had to be completed within the said time frame to gain the trust of people, any delay would reflect bad review on other future slum redevelopment project in the city.

2.2.5 Features and Benefits

Housing features

A residential structure of G+4 was proposed with a dwelling unit area of 33.68 square meters with 8 such units (blocks A, B, and C) on each floor. As such, a total of 88 dwelling units has been built across 3 residential tours to house 87 families. The plan of the dwelling units can be referred from image 4. Each dwelling unit has a living, kitchen(with utility), bedroom, and a shared toilet and bath.

Basic services

The housing project gives access to water supply (individual overhead tanks) and sanitation to all the dwelling units. Since, a storm water drain for the complex was within the scope of the project, the necessary provisions has been made. As per TUDA zonal regulations, a rainwater harvesting system has also been installed in every block.

Public amenities

Each house is also provided with a 2-wheeler parking in the ground floor along with three-wheel rickshaw parking for drivers in the community. Provisions has also been made for a children's playground

Social infrastructure

The housing complex also houses a livelihood center, a community hall, and an Anganwadi on the first floor of the 'A' block. The livelihood center would help the daily wagers of the community (especially women) learn new skills to expand their livelihood skills. The community hall would be shared by the community for any special occasions or gatherings based on the request approved by the community association. The anganwadi would be beneficial for the growth and development of toddlers in the housing complex and helpful for working women in the community.

2.6 Key findings from the interviews, surveys, and primary/secondary data collection

The understanding and assessment of the redevelopment project are based on reading of technical documents, observation of the project site, and semi-structured interviews with various stakeholders of the project.

Key findings from semi-structured interviews and observation of various stakeholders are as below:

Residents

The questions for the residents of the housing complex are based on the access to basic infrastructure facilities(housing, water supply, sanitation, electricity), accessibility and availability of various amenities (drinking water supply, parking, open spaces, etc.), social infrastructure (anganwadi, primary health care centre, etc.), and condition of their land tenure post the development of the housing project. Below are the findings from the interactions with the residents:

- a. a. Most of the residents are happy with the facilities provided to them in terms of basic services like water supply, sanitation, and electricity.
- b. b. Residents responded positively to questions regarding their access to social infrastructure. They shared that the skill development center and Anganwadi within the residential complex would help the working mothers.
- c. c. The residents are provided with a land tenure for 30 years and the necessary documents have been handed over to the residents.
- d. d. Although there is a provision for an elevator for all the blocks, the residents are quite hesitant about using them for various reasons like children using the elevator and damaging the facility. Concerns has also been also about the electricity bill that would be shared by the residents.

Smart city officials

The questioners for smart city officials are based on the risks involved in the projects, the aims, and the difficulties they faced in achieving them. The key findings from the



interaction with the smart city officials are as below:

- The project initially faced difficulty in the procurement of the required land area which was overcome eventually.
- Gaining the trust of the residents is the most important criterion in the implementation of slum redevelopment projects.
- To make sure the residents cannot rent out the house provided to them to outsiders, the ownership was only restricted to 30-year tenure with cross-checking of residents by the officials.
- The residential complex has been handed over to the people by forming a resident's association as caretakers of the residential complex.

3. Discussion and Conclusion

3.1 Implications

Housing

Compared to the previous conditions of the people in the slum, most of the residents are satisfied with basic infrastructures like water supply, sanitation, and electricity in the newly developed residential complex.

Since the provision of secured tenure was one of the main aims of the project, residents have been given full ownership along with the necessary documents handed over to them. However, with the previous experience in the slum redevelopment projects, the authorities have concerns over the re-renting of flats to others by the beneficiaries. The smart city officials of Tumakuru, as an alternative to the problem, shared:

"To avoid the re-renting of flats by the beneficiaries, instead of providing them with permanent ownership of the flat/land we have provided them a secure tenure for the period of 30 years beyond which re-evaluation would be carried out and the tenure will be extended."

To prevent the re-renting of flats there would be periodic inspection from the concerned officials as well.

The size of the dwelling units has been fixed at 33.68 square meters as per the requirement of the EWS unit seems to be insufficient for a redevelopment project with an average household size of 4/51 members. Although households with 3 to 4 members do not face any problems with the availability of space, there is a space constraint for households with more than 4 members..

Basic infrastructure

Compared to the basic services that were available for the slum dwellers most of the residents are happy with the facilities they have been provided in the new residential complex. In the semi-structured interviews, most of the residents gave positive replies about the availability and accessibility to basic services like water supply, sanitation, and electricity. One of the residents Mr. Chakrapani said:

"We do not have any problems with respect to water supply, sanitation, or waste management in the new complex. However, we would like to have a drinking water supply unit nearby"

Drinking water supply is seen to be a common request by many of the residents.

Economic impact

Most of the residents of the Mariyammanagar slum work as daily labourers in the nearby market, and the women as domestic workers..

One of the major support from the slum dwellers for the project is that the location of the site is in proximity to their working place and none of the Mariyammanagar slum dwellers is asked to relocate. This ensures that neither their daily jobs nor their income is affected before and after the project.

The creation of healthy residential conditions as in the

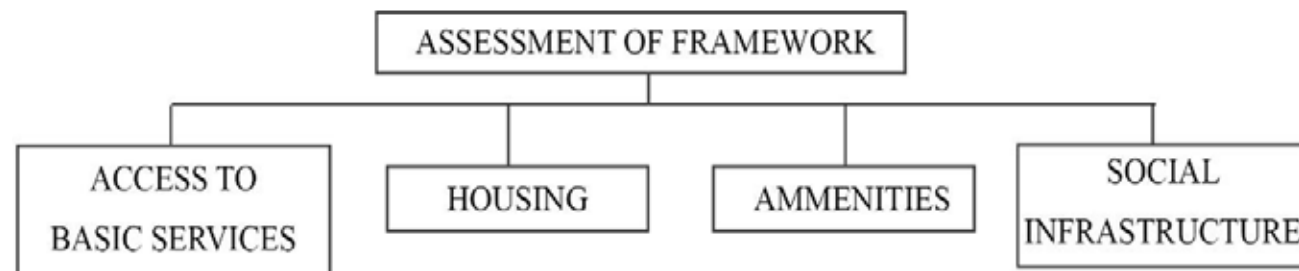
case of the redevelopment project also ensures a healthy lifestyle thus decreasing their yearly medical expenses..

However, since the provision of a residential complex is a change in lifestyle for the dwellers, they have expressed their concerns over the maintenance charges that would be levied on the usage of public amenities (lift, etc.) The member of the residential association Mr. Chakrapani was quoted saying the following regarding the lift maintenance:

"We have spoken to the MLA (member of legislative assembly) and he has assured us to provide the RO water supply unit nearby along with the lift maintenance charges to be covered by BESCOM"

Social impact

The residents before the development of the residential complex had a temple as their social gathering place and an Anganwadi in proximity to the slum. Most of the residents are unskilled labourers who depend on daily



wages. Most of the residents were happy about the provision of Anganwadi in the same residential complex in Block A.

For the skill development of the slum dwellers (especially women), a livelihood centre has also been provided in the same residential complex. Although the centre has not been in operation yet, the women in the community are hopeful of learning new skills.

In the Block A of the first floor, a community centre space has also been provided for usage by any of the dwellers. One of the residents Mr. Annadorai is quoted saying:

“There is a small playground in front of the building. However, kids still play in the parking lot but since it’s within the boundary of the building, we feel it’s safer. There is a primary school nearby and parking space is provided to everyone in the ground floor and we are quite happy with the services provided.”

SDG	Goal	Indicator
1	No poverty	Providing land tenure for slum dwellers can lift their economic condition
3	Good health and well being	Providing healthy living conditions with access to all basic services
5	Gender equality	Providing dwelling units for individuals irrespective of their gender
10	Reduced inequalities	Providing housing units for the slum dwellers would help formalise the informal settlement
11	Sustainable cities and communities	Bringing the informal settlements into the formal settlements

Impact on SDG’s

The slum redevelopment project has the following direct positive impacts on SDG:

3.2 Limitations of the research

- a. Most of the data collection and analysis have been done on a qualitative basis. The semi-structured interviews conducted (6 residents) cannot be projected as surveys to represent the condition of the whole community.
- b. The opinions and data collected from the interviews may be biased.
- c. The quality of the residential complex building construction and other quantitative data have not been considered for the assessment.

3.3 Key lessons learned

- a. For any slum redevelopment project, the trust of the people on the government body/service providers plays an important role.
- b. In the current slum redevelopment project, since the dwellers were not asked to relocate during

the time of construction not much resistance was shown towards the project by the residents as seen in other slum redevelopment projects.

- c. Although provision of the amenities like elevators have been provided, concerns were expressed on who would maintain the facilities

3.3 Recommendations

- a. The Mariyammanagar slum redevelopment project has set ideal an example among the slum dwellers of the city of Tumakuru to trust the ULBs. t Such pilot projects in every city could act as a catalyst in creating trust among people in the ULBs and other service providers.
- b. The provision of basic services like drinking water supply should also be considered in every slum redevelopment project.
- c. Undertaking stakeholder consultation will help to provide a better perspective on their requirements and maintenance.
- d. Along with the creation of a livelihood centre (as in the case of the current slum redevelopment project), a network of such centres within the city would help to provide better opportunities for the informal sector workers.

References

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2. Slum Upgrading Legal Assessment Tool, Un-Habitat
3. Evaluation of slum upgrading programs: Literature Review and methodological approaches- Laura Jaitman and Jose Brakarz: Inter-American Development Bank Nov-2013.

C24

Ring Road: Addressing Congestion in the City

Name of the project: Use of municipal waste for redevelopment of Ring Road

Location: Tumakuru, Karnataka.

Year of Project Implementation: 2019

Sector: Multimodal Transit under ABD area

SDG: SDGs: SDG03, SDG 07, SDG 11, SDG 12 and SDG 13

Project Cost: Rs 68.40 crore (Rupees Sixty-eight crore forty lakh only)

Institute: Manipal School of Architecture and Planning

Advisors: Purushottam Kesar

Students: Mansi Sanjay Shendre, Ketki Vipul Vankudre

Keywords: Ring Road, Redevelopment, Right of Way, Area Based development (ABD), Urban Mobility.

Abstract:

The redevelopment of Ring Road was undertaken by Tumakuru Smart City Limited (TSCCL) to provide improved mobility and connectivity. The redevelopment of the Inner Ring Road was initiated due to the growing urbanisation that led to heavy traffic congestion in the ABD area.

The redevelopment of the Ring Road will also drive socio-economic growth and improve quality of life by enabling economic development. The project was intended to benefit Urban Mobility and Public Transport. The project will ensure smooth flow of vehicles by decongesting the traffic movement in the core areas of the city.

The objective of the report is to understand the feasibility of the redeveloped Ring Road. Few criteria and frameworks were adopted to evaluate the active means of utilisation through qualitative analysis in terms of interviews, questionnaires and documentation.

The report talks about the impact of redevelopment on end-users with regard to travel time, accessibility of public transport and availability of pedestrian infrastructure. The focus of the report is to understand and analyse the impact of the redevelopment on different user groups

Case Study: C24

1. Introduction

Tumakuru, in South-east Karnataka, is an industrial city spread over 48 sq km with an ABD area of around 5.58 sq km. It is known as the knowledge hub of South Karnataka. The food and Agro-processing industry forms the major economic base. The city is close to the Karnataka state capital, Bengaluru which is located just 70 km South-west of Tumakuru.

The government of India intends to transform 100 cities under the PAN city and ABD proposals to give better public infrastructure and a decent quality of life to its citizen. Thus, Tumakuru was selected as one of the cities under the Smart City Mission. Smart City Limited has proposed the “Development of Smart Roads in Tumakuru Smart City” to allow integration and convergence with organisations and local governments to give solutions for the development of the city.¹

1.1 Topic and Context

Tumakuru, also known as the City of Education or the City of Coconuts, is an industrial city spread over

approximately 48 sq km. It lies in close vicinity to the Kempegowda International Airport, Bengaluru (86 km), Tumakuru Railway Station and Yeshwanthpur Railway Station, Bangalore (63 km). Tumakuru has a ready industrial infrastructure that is distributed throughout the seven Industrial Parks and seven Industrial Estates, serving 37 major and medium enterprises²

Demographic and Geographical context:

1. Area: 48.21 sq km
2. Population density: 6300/sq km
3. Population of the ABD Area: 43,941
4. ABD Area: 5.48 sq km
5. City Population: 3,05,821 (2011 Census)

The city has been selected for the smart city mission. The projects therein will be carried out at two levels – ABD and PAN city with ABD (Area-Based Development) focusing on city improvement, city renewal and city extension and PAN city level that envisages the deployment of chosen smart solutions for the city’s current infrastructure.

Tumakuru’s ABD project is centred on retrofitting of around 1400 acres in the CBD (Central Business District) area, as well as other interventions to decongest the city centre and update the current infrastructure and services. One of the projects identified under the Tumakuru smart city plan was “Redevelopment of the Ring Road”. The project is evaluated under ABD projects which was initiated in 2019 and completed in 2020.

1.2 Scope of the Project

The redevelopment was initiated earlier as the Ring Road was frequently damaged due to stagnation of storm water and waterlogging at certain areas of the stretch that lead to traffic congestion and an increase in the number of road accidents. The redevelopment was undertaken to upgrade the existing condition of the Ring Road in the interest of the general public.

The redevelopment is intended to reduce traffic congestion and road accidents, improve air quality and increase durability of the current road infrastructure.



Figure 1: Location of Tumakuru and Inner Ring Road
Source: Author



Figure 02: Pre-existing condition of the Ring Road, Source: Detailed Project Report



Figure 2: Pre-existing condition of the Ring Road
Source: Detailed Project Report

¹Tumakuru smart city limited. (2018). Detailed project report on rejuvenation and redevelopment of ring road . Tumakuru

²Tumakuru smart city limited. (2018). Detailed project report on rejuvenation and redevelopment of ring road . Tumakuru.

The project consists of land acquisition for 45-meters right-of-way for a distance of 10.50 km.

The report will investigate and address problems such as traffic congestion and pedestrian infrastructure through contextual background, qualitative assessment through interviews and risks and challenges involved in the completion of the project.

The report attempts to analyse the project using the above-mentioned issues as a framework to identify shortcomings in the planning and execution processes.

1.3 Significance of the project

The development of the Ring Road will help to decentralise the traffic issues because most of the traffic heading to Honavar uses the inner city core areas. This causes traffic accumulation in the city centres increasing the city's traffic intensity and congestion.

The said development will increase accessibility to public infrastructure, availability of dedicated right-of-way and provision for service lanes that will enable local area development.

The suggested restoration and upgradation of the Ring Road will give an advantage to the ABD area such as decentralising traffic, fewer accidents, improved air quality and increase in the long-term visibility of the city's existing transport infrastructure by redirecting undesirable traffic to the ABD area.

The project intends to improve mobility by creating means of utilisation by decentralising commercial activity to outlying locations. In addition, the project also allows quick access to important nodes through a comparatively faster commute. The project will substantially reduce travel time. The improved road will also provide other benefits such as provision for service lanes, footpaths, street lights as well as improve the economic status of the people living in the fringe areas.

Furthermore, the project will also utilise recycled municipal waste as base material for the construction to make development sustainable.

1.4 Aim and Objectives

The study's goal is to examine the current state of the Ring Road in consideration of the problems and challenges outlined in the smart city plan. The evaluation will be carried out within the scope of detecting concerns along the chosen length and assessing them in relation to various factors.

Objectives of the research

1. To analyse the impact of the newly developed Ring Road on end-users.

2. To understand the advantages and disadvantages of redevelopment.
3. To assess the redevelopment in consideration of the sustainable development goals and their relevance to the project.
4. To identify issues and gaps in implementation, if any, and to provide recommendations for the same.

2. Contextual Background

The existing Ring Road, also known as the Inner Ring Road, was one of the projects undertaken by the Tumakuru Urban Development Authority (TUDA) with financial assistance from Karnataka Urban Infrastructure Development Finance & Corporation (KUIDFC) under ADB loan during 1997-98. The maintenance of the road was poor due to a shortage of funds. The rejuvenation and redevelopment of the 10.5 km-of the Ring Road was not in the original proposal of the Smart city project. TUDA approached the Smart City Mission^{3,4} to redevelop the road under the said project.

The 10.5-km Ring Road runs from Kyatasandra to Gubbi. Due to heavy overloaded vehicular traffic the

road surface has deteriorated and potholes and ruts have been formed over the said stretch. The poor condition of the Ring Road has also been caused by waterlogging and lack of cross drainage. Due to lack of proper signage, street furniture, signalling, footpaths and cycle tracks most of the traffic heading to Honavar from Bangalore did not use the Ring Road and instead took the route through the core area of the city. Traffic in Tumakuru increased as a result of the vast industrial sector in Vasanthanasapura and the HAL Helicopter manufacturing unit in Gubbi. Several major educational institutions and hospitals (including District Hospitals) are currently located along the NH-206. This generates heavy traffic resulting in congestion and frequent accidents making it accident-prone zones.

Another reason for the Ring Road's redevelopment was the current NH-206, which not only serves as a transport link for the traffic heading to Arasikere, Tiptur, Shivamoga and Honnavar, but it also runs through the heart of the city and has a carriageway width of only 15 metres, which is insufficient to meet the current and future traffic demands.⁵



Figure 05: Recycling of municipal waste, Source: Smart city limited

³Tumakuru smart city limited. (2018). Detailed project report on rejuvenation and redevelopment of Ring Road, Tumakuru.

⁴Tumakuru smart city limited. (2018). Detailed project report on rejuvenation and redevelopment of Ring Road, Tumakuru.

⁵Tumakuru smart city limited. (2018). Detailed project report on rejuvenation and redevelopment of Ring Road, Tumakuru.

By diverting the unwanted traffic from NH-206 (Bangalore – Honnavar) and SH-48, the proposed rejuvenation and upgradation of the Ring Road will benefit the ABD area by reducing traffic congestion and accidents, improving air quality and increasing durability of the existing road infrastructure.

2.1 Conceptual Framework/Research Design

The goal of the study was to determine the impact of the Ring Road on end users. Surveys, questionnaires, response analysis and conversations with Tumakuru smart city authorities, site engineers and project management consultants were used to gather primary data. Discussions were also held with key stakeholders including industrialists and local communities to better understand the primary and secondary demands.

A non-experimental, empirical research design was adopted for the study. The Tumakuru Smart City Authority contributed the core data in the form of documents and drawings. The primary data was collected through site visits, observations and photographic documentation. A convenience sample of adult men and women was used to obtain secondary data. The specified age criteria of 18 years and above was considered to reflect a higher level of awareness of the project's socio-political and economic context. The questionnaire was created based on project satisfaction and future ambitions and expectations.

The Questionnaire for semi-structured interviews is covered in Annexure 1.

2.2 Key features of the project

2.2.3 Challenges in the project

i. Land acquisition

To meet the expected future traffic demand, land had to be acquired for road widening. The Tumakuru Urban Development Authority (TUDA) faced significant challenges in acquiring land.

ii. Relocation of vendors

It was a tough challenge for the authority to relocate the vendors who had encroached on footpaths and carriageways of the land required for acquisition. This also led to conflicts between smart city authorities and specific groups of people.

iii. Working with a specific group of people

Due to a conflict of interest, working with a specific set of people was challenging. The residents were concerned about the land that was being taken away from them.

iv. Realignment of electric poles

The previous laid electric poles had to be adjusted in accordance with the new road layout. Relocating the poles without causing any damage was a big challenge, particularly considering the project's time constraint.

2.2.4 Risks involved in the project

i. To gain people's trust, the project had to be completed within the stated timeframe, any delays would reflect poorly on the initiative.

ii. Theft of construction material was noted on a section of the route. As a result, the construction process slowed down.

2.2.5 Features and Benefits

i. Local employment was created during the construction phase, providing financial assistance to the underprivileged in the area.

ii. The rejuvenation and upgradation of the Ring Road provided benefits to the ABD area such as relief in traffic congestion, decrease in accidents, better air quality, increase in durability of the existing road infrastructure by diverting unwanted traffic of NH-206 and SH-48.

iii. In order to meet intra-city transportation needs, the redevelopment assisted in enhancing mobility and accessibility within neighborhoods, wards, zones and suburbs.

2.6 Key findings from interviews, surveys and primary/secondary data collection

The project's evaluation was based on qualitative techniques which included document reading, observations, questionnaires and interviews. All these methodologies were used to determine the project's basic infrastructure, socio-economic impact, accessibility and feasibility.

Documents (Primary Data)

▪ Detailed knowledge about the project was gained after reading various documents which were shared by the smart city authority.

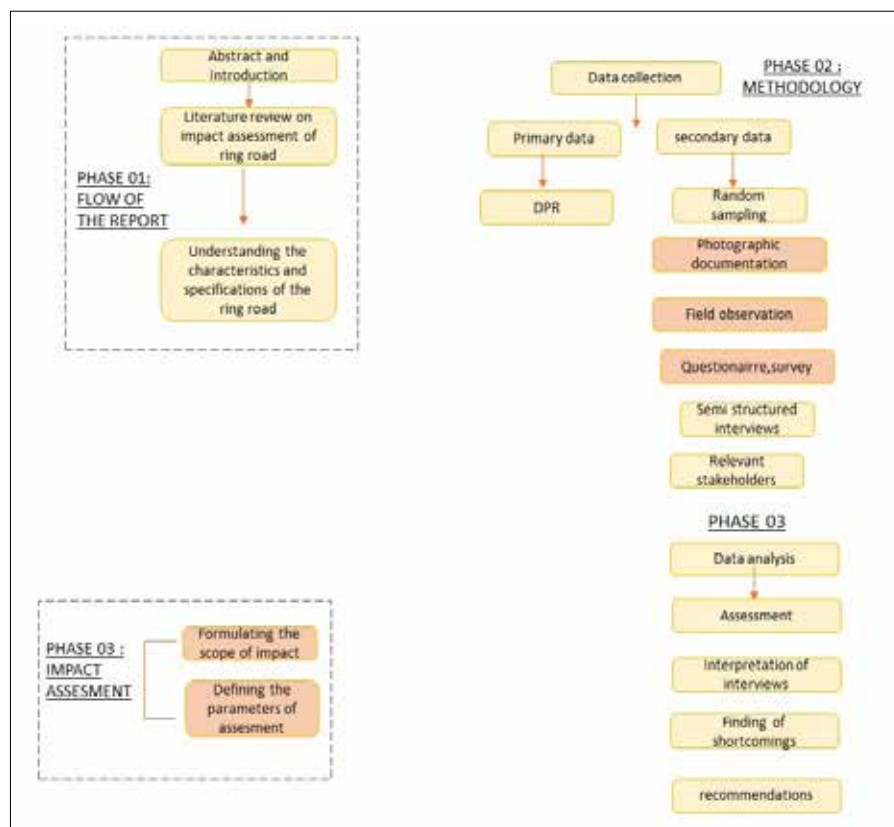


Figure 2: Pre-existing condition of the Ring Road
Source: Detailed Project Report

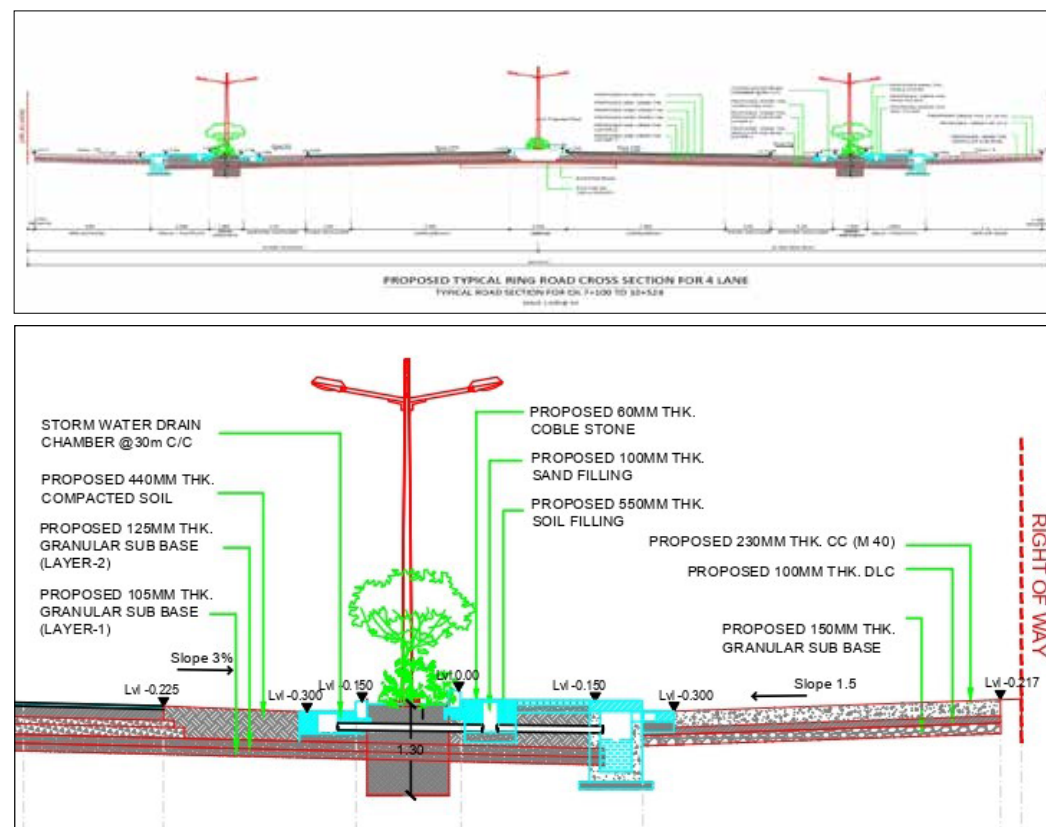


Figure 07: Detailed blow up of service road, drains, footpath and curb
Source: Detailed project report

Key findings from the semi-structured interviews and observations of various stakeholders:

Industrialists and end-users

The questionnaires for stakeholders and end-users (pedestrians and vehicle drivers) were asked regarding access to the road, feasibility and provision of basic infrastructure (footpaths, foot-over bridges, cycle tracks, parking facilities).

- Most of the industries located along the Ring Road were satisfied with the redevelopment as it aided in easy transport of their goods with a decrease in travel time. However, a common request from them was for provision of dedicated parking spaces for their private vehicles.
- People responded positively to the questions relating to traffic decongestion, travel time and road condition. But the common point of discussion was the lack of pedestrian infrastructure.

Smart city officials

The questionnaire for the smart city officials was based on the risks involved in the project, aims, objectives and difficulties faced during the execution of different phases of the project. The key findings are:

Discussion with the project engineers and project management consultants helped to get information about the use of municipal waste as a base material for construction, maintenance and operational authorities and co-ordination with TUDA (Tumakuru Urban Development Authority) for land acquisition.

The main challenge was land acquisition as certain groups of people opposed the project which led to conflicts and some illegal activities like theft.

After talking with the site engineer, detailed knowledge about the reuse of municipal waste was gained. Recycled aggregates were then used as a filling material below the asphalt layer.

The main focus of the project was on redevelopment of the Ring Road to decongest the core city area and pedestrianisation was the secondary aim of the project.

3. Discussion and Conclusion

3.1 Implications

The impact assessment of the project is based on the socio-economic impact, basic infrastructure, accessibility and feasibility.

Socio-economic impact

- i. Before the redevelopment of the Ring Road, some sections of the road were facing illegal encroachment by certain groups of people that catered to their livelihood. The encroachment at the edges of the road included engagement in activities like extending the display area of the shops, garages etc.

- ii. Even though the land had already been acquired by TUDA, few people were not willing to give up their respective shops and garages.
- iii. The redevelopment of the Ring Road led to commercialisation and an increase in the land cost of the surrounding area.

Table 1: Impact Assessment method

PARAMETERS	INDICATOR	ASSESSMENT METHOD
Road user- Pedestrian	Accessibility of pavement Access to public transport Availability of zebra crossing Provision of footover bridges Shading of the pathways Health and safety	Questionnaires and observation
Road user - Vehicular	Saving in travel time Reduced chances of accidents Traffic decongestion Problems of heavy traffic jam Saving of fossil fuel Alternative travel roads	Questionnaires and observations
Local stakeholders/ community	Employment opportunities Community engagement Provision of on street parking Overall economic growth Impact on private assets Formal and informal industries Pressure on supply of local services	Questionnaire/ Data collection
Road infrastructure	Reduced crime and ill activities Addition of service lanes Feasibility of carriage way Major/ minor junctions Road markings Addition of curbs Right of way Civil works	Observations

Basic infrastructure

- i. Comparing the services and utilities mentioned in the DPR like provision for footpaths, street furniture, road crossings, cycle tracks, traffic signals and green belts, some of them were missing.
- ii. After discussing with the site engineer about the above-mentioned shortcomings it was suggested:

The main aim of the project was to decongest traffic, footpath and pedestrian infrastructure will be added in the up-coming days

Accessibility

- i. The project has helped substantially in connecting the nearby towns – Gubbi, Honavar, Kunigal by enhancing the intra-city transportation link.
- ii. The redevelopment has:
 - a. Reduced traffic congestion
 - b. Reduced travel time

The vehicular traffic had easy and fast access to infrastructure however, the stakeholders along the stretch were not provided with dedicated access to their respective shops in terms of parking. As a result of which, the service lanes are partially filled with the private cars of the stakeholders.

Impact on SDGs

An impact assessment was done considering the sustainable development goals which was based on data collected through primary and secondary sources. Here direct positive impact is the immediate consequence of putting the case into action. The indirect positive impact was the effects that may happen as a result of the implementation.

The Ring Road Redevelopment project has direct positive impact on the following SDGs:

SDG Number	Goal	Indicator
7	Affordable and clean energy	Recycled material was used for pavement surfacing and underlying layers, which adds to a clean environment.
11	Sustainable cities and communities	The reuse of waste led to creating awareness among the local communities and set an example for the neighbouring cities
12	Responsible consumption and production	Reuse of municipal waste for construction created awareness about production and consumption of products and services

The Ring Road Redevelopment project has indirect positive impact on the following SDGs:

SDG Number	Goal	Indicator
3	Good health and well being	Providing healthy living conditions with access to basic amenities in and around the stretch that will contribute to overall healthy communities
13	Climate action	The use of municipal waste during construction might reduce the extent of the health island effect

3.2 Limitations of the research

- Access to the samples was restricted due to opposition from specific groups of people.
- Additional information like traffic surveys could not be undertaken owing to time constraints.

3.3 Key lessons learnt

- Priority should be given to public participation during the planning stage to avoid conflicts while executing the project.
- The current project only focused on improving road infrastructure and not all requirements of the local stakeholders and community.
- By providing additional routes for traffic, and decentralising traffic movement from the existing, heavily jammed routes in the city center. As a result, Ring Road relieved congestion by reducing strain on the city's core routes.
- The Ring Road was initially planned for decongestion of traffic from the core areas of the city but at the same time, it has also increased the traffic count/flow in the outlying areas which led to increase in demand for new roads away from the city centres. Thus, it can be said that building more ring roads won't actually reduce traffic congestion issues in the

long run, but will actually induce and increase a new car user that will lead to a degraded environment and generate traffic.

3.4 Recommendations

Conceptual phase

- i. Involvement of all stakeholders should be prioritised.
- ii. Planning for plantation beds should be done considering the climate of the city.
- iii. Monitoring the environment to control pollution levels.
- iv. Dedicated parking space should be provided for the existing stakeholders along the Ring Road as at present people are parking their vehicles in the service lanes.

Design phase

Multimodal transport options can be planned.

- i. Though the primary objective of the project was to connect the two main junctions to decongest the traffic in the inner-city area, the pedestrian infrastructure could have been equally prioritised considering future development along the Ring Road.
- ii. Proper infrastructure for pedestrians like foot-over-bridges and footpaths could have been provided.
- iii. Provision for dividers after certain intervals should be

done.

- iv. Bus stops and rickshaw stops should be provided at regular intervals.

Implementation phase

- i. Provision for street furniture and facilities like rickshaw stops and bus stops should be done.
 - ii. Increasing the ease of navigation by making the road more legible through improvising the existing and introducing new street signages and markings.
 - iii. Tree plantation should be proposed along the stretch to provide shade to the footpaths.
 - iv. Markings of basic amenities like petrol pumps, gas stations, maintenance services etc. should be done.
 - v. Specifying the speed limit as per typology of the vehicles.
- i. Tumakuru smart city limited. (2018). Detailed project report on rejuvenation and redevelopment of ring road. Tumakuru.
 - i. India smart city mission. (n.d.). The smart city challenge: Stage 2, Ministry of urban development, Government of India.
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GENERAL INFORMATION	
1	NAME
2	Age Group
	a. 18-24
	b. 25-34
	c. 35-50
	d. 50 and above
3	Occupation
	a. Student
	b. Job
	c. Self employed
	d. Retired
	e. Other
4	Purpose of travel
	a. Educational
	b. Workplace
	c. To nearby residential area and amenities
	d. Other
5	Mode of Transport
	a. Public Transport
	b. 2-wheeler
	c. 4-wheeler
	d. Pedestrian

QUESTIONNAIRE	
A.	PEDESTRIANS
1	<i>Are foot-over-bridges present? If yes, do you use them?</i>
	a. Yes
	b. No
2	<i>Is there proper access to Bus stops and Rickshaw stops?</i>
	a. Yes
	b. No
3	<i>Are subways present? If yes, do you use them?</i>
	a. Yes
	b. No
4	<i>Are you satisfied with the infrastructure provided for pedestrians? (footpath, zebra crossings, subways, foot-over-bridges)</i>
	a. Yes
	b. No
5	<i>Rate the infrastructure on the basis of quality and accessibility.</i>
	a. 0-2
	b. 3-5
	c. 6-8
	d. 9-10

B.	VEHICLE USER
1	<i>Has the road condition improved than before?</i>
	a. Yes
	b. No
	If yes, rate as per the given scale
	a. 0- 2
	b. 3-5
	c. 6-8
	d. 9-10
2	<i>How has the development of the Ring Road impacted you in terms of reduction in travel time?</i>
	a. High
	b. Medium
	c. Low
	d. No impact
3	<i>How clear and visible are the road signs and road markings?</i>
	a. Clearly visible and maintained
	b. Somewhat visible, need to maintain
	c. Not visible
4	<i>How often do you take this Ring Road to your destination?</i>
	a. Daily
	b. Most of the time
	c. Only for work
	d. To access the amenities around the Ring Road
	e. Not so often
C.	FOR BOTH PEDESTRIANS AND VEHICLE USERS
10	<i>How will you rate the redevelopment in terms of road safety aspects like dividers, markings, signals?</i>
	a. 0- 2
	b. 3-5
	c. 6-8
	d. 9-10
11	<i>What are the impacts of the project on the traffic on the adjacent road network?</i>
	a) Less traffic congestion
	b) More traffic during peak hours
	c) No change
15	<i>Has the redevelopment increased easy access to the markets and services?</i>
	a. Yes
	b. No
	c. Maybe
16	<i>Which areas does the Ring Road connect? Does it connect to major cities or large administrative centres?</i>
	a. Yes
	b. No
17	<i>What do you feel about the condition of the road surface?</i>
	a. Unmaintained road surface
	b. Potholes
	c. Slippery road surface
	d. No pavement markings

19	<i>Rate the access and accessibility to public facilities like petrol pumps, public toilets, ATMs and public transport?</i>
	a. 0-2
	b. 3-5
	c. 5-8
	d. 9-10
20	<i>How long is your average commute to work through this Ring Road as compared to the travel route from the core area of the city?</i>
SURVEY	
3	<i>What do you feel about traffic safety?</i>
6	<i>At what time is the major traffic congestion?</i>
	a. Office time
	b. Closure time of schools
	c. Location of toll plaza
	d. Bad road condition
8	<i>How accessible are public amenities like petrol pumps ?</i>
	a. Quite accessible
	b. Not so accessible
9	<i>What do you feel about the condition of the pavement?</i>
	a. Accessible and maintained
	b. Accessible but not maintained
	c. Not accessible
12	<i>Do you prefer the Ring Road or alternate travel routes?</i>
	a. Never
	b. Sometimes
	c. Often
	d. Very often
	e. Always
14	<i>Has the development of Ring Road helped in traffic decongestion?</i>
	a. Yes
	b. No
OBSERVATION	
1	<i>How has the development of the Ring Road affected the smart growth policy?</i>
2	<i>How effective are the bicycle and pedestrian connections?</i>

C25

Mahakaal-Rudrasagar Integrated Development Approach-II

Name of the project: Mahakaal-Rudrasagar Integrated Development Approach-II

Location: Ujjain

Sector: Urban Infrastructure

SDG: SDG 3, SDG 8, SDG 9, SDG 11.

Institute: Maulana Azad National Institute of Technology (MANIT), Bhopal

Advisors: Dr. Krishna Kumar Dhote, Dr. Preeti Onkar, Mr. Amit Kumar Biswal

Students: Mr. Vedankur Sandip Kedar, Ms. Minhaj Qureshi

Keywords: Impact Assessment, Mahakal, Ujjain

Abstract:

Temple Mahakaleswar is one of the major cultural attractions of our country, situated in the town of Ujjain in the state of Madhya Pradesh, popularly known as Central India. A high influx of tourists and pilgrims is a common sight at Mahakal, especially during cultural events and religious festivals. With growing urban land close to the site, the Mahakal temple precinct had some new challenges to face: Congestion; Paucity of parking space; Lack of greenery and shaded spaces and inadequacy of functional spaces available to the lay public. Moreover, the gradual degradation of the Rudra Sagar Lake, which has had a pivotal and integral role to play in the cultural events, has only accentuated the problems. All these challenges required immediate attention.

This project aims to incorporate the Rudra Sagar Lake and its surroundings as a part of the Mahakal temple's precinct. Ujjain Mahakal Temple Corridor is being developed to include a 900-meter-long corridor filled with many installation techniques, a theme park, a heritage mall, E-transport facilities, and most importantly, to establish a facility to divert water from the holy Shipra River to Rudra Sagar Lake.

The present study is an attempt to document and evaluate the impact of the aforementioned development project on the local residents, the floating population, i.e., the tourists and the environment. . The goal of this assessment is to understand whether this project is able to address all the current issues and challenges. This assessment would also serve as the baseline for any future comparison. It may be mentioned here that the study itself faced a challenge: it had to assess the impact of an ongoing / uncompleted project which turned out to be a difficult task.

Case Study: C25

1. Introduction

Ujjain, an ancient city situated in the central part of India, in the Malwa plateau of Vindhya ranges of Madhya Pradesh serves as a site of religious and cultural importance across India. Ujjain is placed in a superior geographical location from where the tropic of cancer passes. It is the 'Greenwich Mean Time' for the Indian Panchang of India. The tilting of the earth at an angle of $23\frac{1}{2}^\circ$ on its axis and geographical line of tropic of cancer has special cosmic influence making it fit for absolute

time location, for the whole nation.

Mahakaleshwar temple in Ujjain is one of the major pilgrimage centers of for the Hindu community. In the ancient Hindu texts, Mahakala is the name of Parama-Shiva or the ultimate form of Godhead, for example, at the temple in Ujjain, which is mentioned more than once by Kalidasa. The primary temple or place of worship for Mahakala is Ujjain. Mahakala is also the name of one of Shiva's principal attendants (Sanskrit: Gaṛḍa), along with

Nandi, Shiva's mount, and is often represented outside the main doorway of early Hindu temples. It is host to the world's largest religious gathering and conglomeration of a diverse population. Apart from the rich tapestry of myths and legends, the city has witnessed a long and distinguished history with rich traditions. This is also the preferred site of a mass Hindu pilgrimage or bathing festival called Kumbh or Simhashta which is celebrated every twelve years at a certain celestial composition with the Hindu calendar. The immortality of the city can be gauged from the fact that even the celebrated Sanskrit poet Kalidasa, in his immortal Sanskrit poem "Meghadutam: The Messenger of Clouds" says this about the city: "Few cities, perhaps, can boast of a more continuous reputation, as it has been a place of great note, from the earliest periods of Hindu tradition down to the present day" (Sharma, 2014).

Culturally, Ujjain has a rich history of traditions, as highlighted by Dipak Kumar Samanta, 1997 about the linkages between this cultural center, and the cultural area, and how this sacred complex compares with its counterparts elsewhere in India.

Also, the city is home to one of the twelve Jyotirlinga shrines of lord "Shiva". Mahakaleshwar. Ujjain (historically known as Ujjaini) is one of the seven sacred cities in Hinduism (Sapta-Puri: Seven holy pilgrimage centers in India). On an average day 3000 and on a special occasion, Ujjain boasts of a floating population of 3,00,000- 5,00,000 (Bansal, 2013). Ujjain possesses a religious legacy of 5000 years. Historians have noted (Saha et al., 2020) how universal accessibility of Ujjain city can invite people across various strata that can lead to improvement in the overall tourism generating high revenue, in turn. Strategizing this executive process, it has been seen in Singh & Tiwari, 2020, that the cultural sacred landscape of Ujjain has been severely degraded

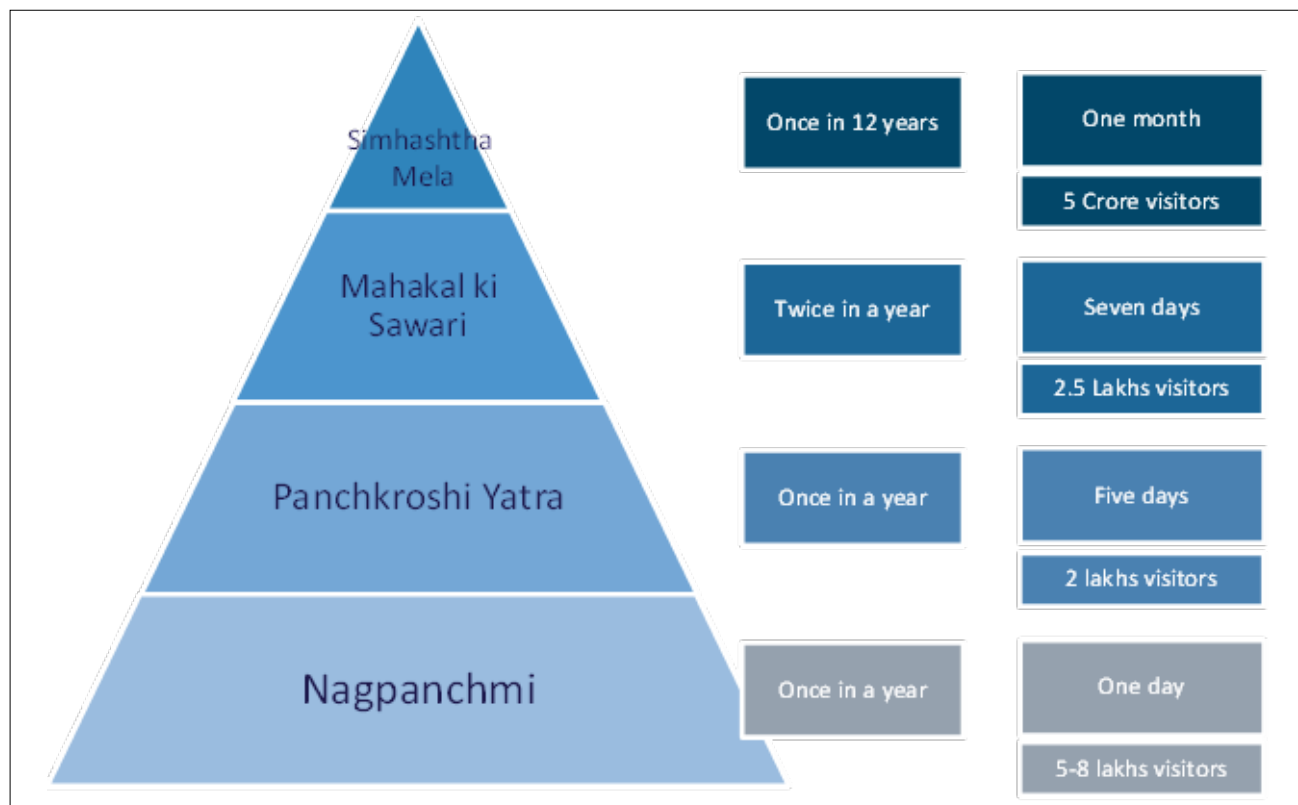
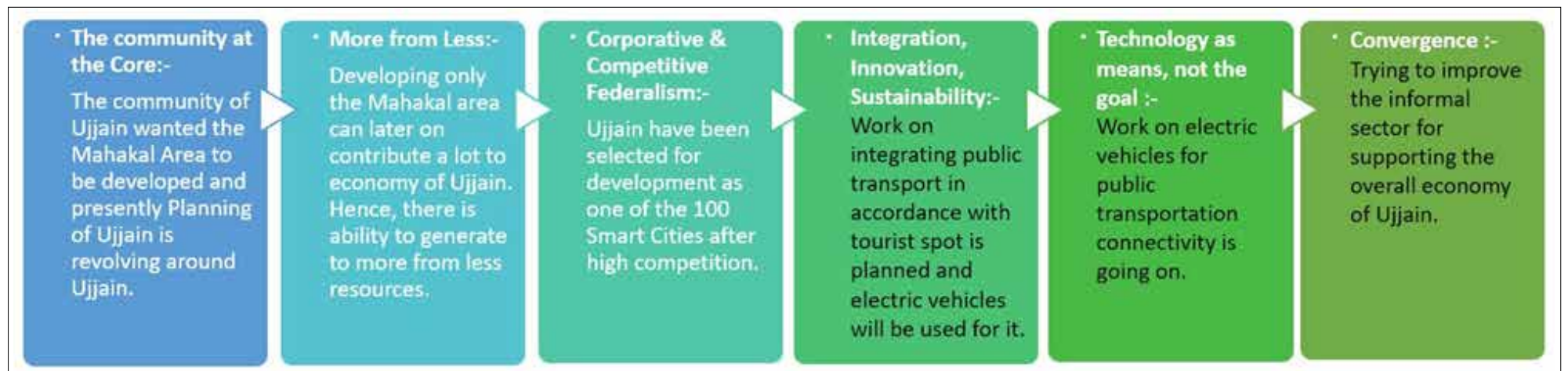


Figure 1: A Hierarchy of event as per time duration of event
Source: Author



Six fundamental principles on the concept of Smart City in the context of Ujjain

leading to the drying of river Kshipra and pollution of the Sapt-Sagar with waste being dumped into their respective precincts. The conservation of these precincts marks an important aspect in preserving the historic, cultural and religious treasure of Ujjain and the Sapt Sagar Lake (Annex One).

1.1 Significance of the Project

Impact Evaluations (IEs) are empirical studies that quantify the causal effects of interventions on the outcomes of interest. IEs are based on an analysis of what happened with an intervention, compared with an empirically estimated counterfactual scenario of what would have happened in the absence of the intervention. Right from history-buffs, or solitude seekers, there are many places to visit in Ujjain for every kind of traveler. With river-ghats and popular temples that belong to different eras, this ancient city attracts tourists from around the globe. With several well-known tourist places, whether it is visiting the temples that shed light on the glorious past of the city.

Ujjain attracts many pilgrims annually, with the influx of tourists varying from around 1.5 lakhs on peak days in a year to a crore of devotees during the Kumbh Mela period. The majority of these tourists arrive in Ujjain for religious purposes and to visit various temples. A whopping, 99.6% of the total tourists arriving in Ujjain are the domestic tourists with varying requirements which are as large as rail connectivity and as small as the general cleanliness in the city and the temple precincts. Development of footpaths along the roads is required where 23% of the total population in the city is dependent on non-motorized means of travel while 45% of the residents use private transport and this majorly involves the pedestrian movement (Bansal, 2013).

Ujjain receives a large influx of floating population which ranges from an average of 3,000 tourists on a regular day, to around 3,00,000 to 5,00,000 pilgrims on special occasions like Nagpanchmi and Mahashivaratri. The population of Ujjain is 5,15,215 (2011 census) while the expected number of devotees for the Kumbh Mela in 2016 is around 5,00,00,000 (5 crore), of which around 1.5 crores are expected to arrive on a single day of Shahi-Snan. The significance of the project underlines the fact that the development and the viability of the new system should be in resonance with the religious and cultural ethos pedestaled in Ujjain.

1.2 Smart City Ujjain

According to Washburn & Sindhu (2009), the main aim of 'Smart Cities' is to reduce the challenges faced by cities, such as the decline of healthcare, housing, energy resources, housing, water, and deteriorating infrastructure (roads, schools, and transportation). According to Caragliu et al (2011), the label 'smart city' highlights the utility of clever solutions through a data-driven approach in quantitative and qualitative dynamics for improving productivity and allowing modern cities to thrive. In general, terms when a city is focused as "Smart", its main focus seems to be on the role

of ICT infrastructure, whereas much research has also been carried out on the role of human capital/education, social and relational capital, and environmental interest as important drivers of urban growth. Only limiting the definition of the smart or intelligent city to the availability of ICT infrastructure will not do justice to the whole equation where other definitions emphasize the role of human capital and education in urban development. It has been highlighted both by C. R. B. E. L. Glaeser (2005) and E. L. Glaeser & Berry (2006), that a strong correlation between rapid urban growth rates and cities possessing a high share of the educated labor force has been found. There have been various perspectives to define a "Smart City", such as Hollands (2008), defines it as the "utilization of networked infrastructure to improve economic and political efficiency and enable social, cultural and urban development", whereas Southampton City Council defines it as "A strong focus on the aim to achieve the social inclusion of various urban residents in public services". Also in a different perspective, Coe et al., 2001 add that A smart city will be a city whose community has learned to learn, adapt and innovate where profound attention is given to the role of social and relational capital in urban development. Centre of Regional Science at the Vienna University of Technology conducted a Pan-European project incorporating 70 middle size cities, where six major 'axes' were identified namely: a smart economy; smart mobility; a smart environment; smart people; smart living; and, finally, smart governance. These six axes connect with traditional regional and neoclassical theories of urban growth and development. Along with the similar lines Caragliu et al.(2011), have put forth the ideology of the city to be Smart when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and high quality of life, with a wise management of natural resources, through participatory governance.

In accordance with the same, Ujjain Smart city development encompasses the parameters of social, religious, cultural, and technological cohesion. For a city like Ujjain, where there is a large influx of floating population the management of the crowd is the biggest challenge to be smartly handled, at the same time generating quality spaces for religious activities and translating the inherited knowledge. Knowledge dissemination of History and meaningful messaging through cultural environs is the demand of the city. The dissemination of spiritual learnings and messages through the cultural environment is the task of the ICT and visual representation of the learnings through engineering skills with technological innovations becomes the objective of the redevelopment interventions.

1.3 Tourist Influx and Economy

Tourism, but primarily religious tourism marks an important aspect of the population influx and economic aspect of Ujjain. Table 2 (Annex Two) discusses the festivals and melas observed in Ujjain with their

periodicity, duration, the location of the event, and population influx of the same.

Ujjain receives a humongous populace influx during the Kumbh Mela, which is held every 12 years due to the celestial alignment of Jupiter in the constellation. The crowd number reaches almost 1-2 crores during one month of the festival. Although most of the festivals observe a moderate population of 20-25,000, certain festivals like Kartik Snan and Maha Shivratri held in the month of Kartik and Magh Phalguna respectively, observe a population ranging between 50-75,000 in totality. Table 3 (Annex Three) throws some light on the amount of floating population that comes in other fairs. Ujjain as a religious center invites devotees from all over the world which can be evidently seen in the same table.

Also, the monthly tourist footfall observed during Mahakumbh has been shown in Table 4 (Annex Four). Mahakumbh, as the center of attraction, observes the highest tourist populace measured between 1.5-2 crores during the months of April and May. Regular tourists, however, account for fluctuations in influx to the tune of 5000-7000 footfalls which exceeds only in April due to Kumbh Mela significance.

2. Literature Review

2.1 Public places as generators of "a sense of place"

Public spaces are defined by their urban layout and architectural design and serve as the unique identity of old towns as they integrate local communities and contribute to the formation of social bonds. The urban fabric plays a very important role in sustainable development, and public spaces testify to a city's attractiveness and its status on a regional scale. Factors determining the attractiveness of public spaces include architectural factors (on the micro scale), urban factors (on the macro scale), as well as the overall composition of these elements, which determines the esthetic and functional attributes of public spaces.

2.2 Heritage Tourism in India

"Heritage tourism has a positive impact on the local economy". Therefore, if 'Heritage' and 'Tourism' both can be managed properly, the overall benefit of 'heritage tourism' would be maximized that can facilitate both the host as well as the guests at a particular destination. In the paradigm shift in Indian Heritage Tourism, the travelers are expecting their trips to be more experiencing and educative compared to the conventional holiday trips where the scope for learning new things is very limited. The heritage sites often make the visitors nostalgic as they reflect the true culture of the host community and have direct links with their glorious past. Moreover, the promotion of heritage sites for heritage tourism is important from the perspective of the development of national identity. Visiting these historical places, monuments, and sites having great archaeological value brings socio-economic and environmental benefits through generating tourism revenue, exchange of

thoughts and culture between the host and the guests, and safeguarding the natural and man-made heritage at local, regional, and national levels.

2.3 Public spaces driving Heritage Tourism

The concept of the public space and its relation with the surrounding buildings asserts that without the void (surrounding space), the solid (significant buildings) will have no value. Thus shape, size, and quality of the space will have a strong effect on the solid blocks around it. One space serves more than a solid mass and connects them together. A notable example of the practice can be observed in As-Salt city of Jordan. The project also aims to highlight the 'Harmony Trail' of the city which informs tourists about the aesthetic and architectural details that enable them to discover the history of the city. The main activities observed in the public spaces and along the Harmony trail are walking, shopping, sitting for entertainment, and playing traditional games. (Bushra Zalloom, 2020)

2.4 Religious tourism and development

Religious heritage sites drive international tourism and economic growth, and also provide important assembly grounds for visitors and host communities, making vital contributions to religious tolerance, respect, and mutual understanding between different cultures and ethnicities (Timothy, 2014). Pilgrimage tourism has opened several sources of cash earning and as a result, several new occupations have emerged due to pilgrimage tourism. Moreover, it is closely linked with the cultural identity and heritage of destinations where also

pleasure components are being added to the familiar pilgrim routes and itineraries. (Vijayanand, 2012). The development of places of religious tourism brings an incomplete change in form and structure of the local city or region especially creating a thrust for economic viability, improvement in standards of livability, and weekly identified sectors of environment sustainability.

2.5 Environmental Sustainability

Pilgrimage tourism is being recognized as a prime industry in most parts of the world. To earn maximum foreign exchange. To boost pilgrimage culture and other types of tourism, they have to start internally by protecting the environment and beautifying the areas in the immediate vicinity of pilgrimage sites as well as providing these areas with the necessary services, including constructing ways to facilitate them. A religious site faces pressure from pilgrims, international tourists, and local day-visitors, all with different goals and needs. There are two apparently conflicting goals: to increase international pilgrimages and tourism use of the site and to enhance the site for local day-visitors. (Vijayanand, 2012)

2.6 Livability

Religious tourism stresses the preservation, restoration, and expansion of religious and historical monuments to attract sustainable tourism. (Maharani, 2019) Thus, improving upon the civic development in an area. Moreover, urban infrastructure and place-making activities are preferably accounted for developing tourist footfall. (Marek Zagroba, 2020) Thus the urban

structure and livability index of the associated locale improves upon any association of fund flow or initiatives in a targeted religious place. (Rahim Heydari Chianeh, 2018)

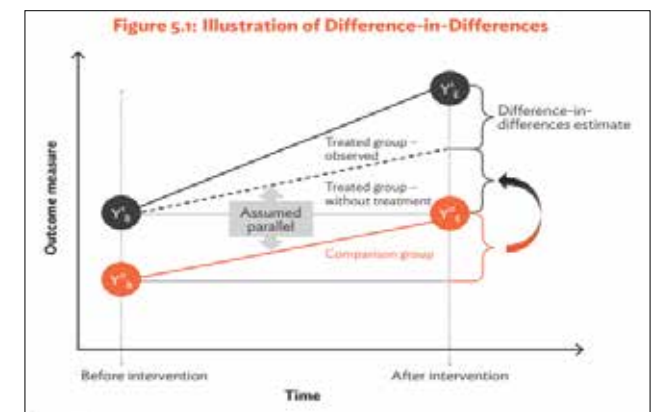


Figure 2: Illustration of Difference in Differences
Source: Author

3. Study Objectives

3.1 The present study was undertaken with the following objectives in mind:

- To ascertain the alignment of the visionary scheme with the project strategy;
- To evaluate the implementation rate of the project with respect to the vision the strategy;
- To identify the magnitude of the impact on various respects and aspects and the nature of the impact; and
- To document the overall impact of the project.



Figure 4: On the street parking close to the temple
Source: Author



Figure 5: Congestion on street approaching Mahakal
Source: Author

4. Methodology Adopted

4.1 Figure 3 (below) depicts the methodology we had tasked with, in order to achieve the study objectives given in 3.0

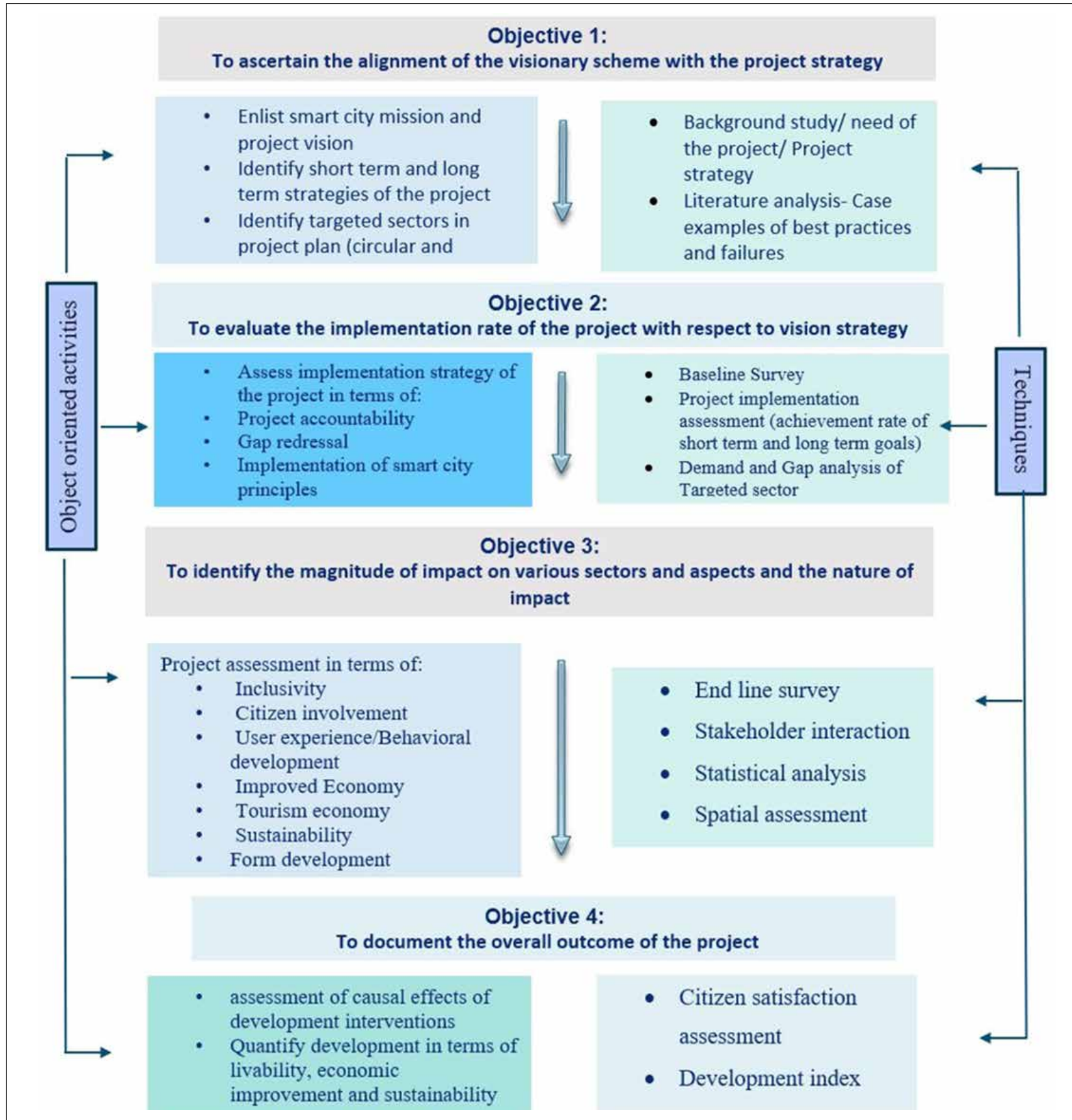


Figure 3: The Assessment Methodology
Source: Author

5. Key Features of the Project

The area close to Mahakal temple had a lot of challenges that had to be addressed to make the experience better for those visiting. The development project for Mahakal and Rudra Sagar was an initiative toward solving these major issues.

5.1 Challenges in the project

The city was facing this stress and the transport network towards them east of the temple as it served as a major connect connecting route to the temple premise. And the infrastructure was not as capable to hold that traffic at the same time there was a lack of parking spaces for the required vehicles.

Now coming to the people visiting the Mahakal that was a major issue that people could not find open spaces to spend some time before or after the visit. There was also a lack in terms of services and facilities available to the tourists or visitors. This hampered the city economy as the lesser time a tourist spends in the city the lesser will be the economic activity in the tourism sector.

The problem of having no public spaces around the Mahakal temple was also to be addressed. And even if there is the provision of building open spaces, without a proper function, beautification and shading of the space may feel more isolating. There was also the problem of unplanned or unorganized bending zones that affected

the area around the Mahakal temple. Along with that some informal settlements that grow around the Rudra Sagar area, enclosed some of the open spaces that are available for the visitors.

Then came the revitalization of the Rudra Sagar. Due to a lack of management, the situation of Rudra Sagar had been gradually declining. And due to the lack of spaces, the Rudra Sagar was used for the temporary allocation of stays for visitors and sadhus during the Simhasth Mela and other occasions. Close to the Mahakal temple boundary, several schools were running with about 200 students, which is below a suitable threshold level. For this, the Smart City authority then suggested building new centralized schools that will serve as an educational hub for a larger mass of students.

5.2 Risks involved in the project

The project also contained a lot of risks. The biggest one turned out to be COVID-19. As COVID delayed the project for over a year, there are certain new gaps and regulations that have come into play. It would be interesting to see whether the current demand is fulfilled with the project.

The process of redeveloping such a core area in a city is already quite challenging. That has been a lot of resistance from the residents and the commercial sector. And due to unauthorized encroachments and lack of cooperation, the development process sometimes gets delayed or stops completely. On the east, there is a section where the reclaiming of the site area was completely stopped after constant resistance from the local community.

Even though this project has previously considered all the gaps before construction it is quite hard to accurately project the human behavior. As this project involves a lot of open public spaces it would be interesting to see how the visitors interact with these sculptures and spaces. As the Rudra Sagar was often dried and being used as a temporary stay and wastewater disposal point, it is challenging to create a lively water body and maintain it.

6. Features and Benefits

For traffic issues, the city plans to divert the traffic from the outside that is vehicular traffic coming from the Indore route, away from the central city. As a result, rather than all the traffic coming from the eastern side of Mahakal now most of the visitors will come from the southern part of the Mahakal and Rudra Sagar project.

To handle the excess traffic the roads were widened. The bridge coming from Indore towards the Triveni Sangrahalaya is planned to widen from 8 to 12 m. The inner roads connecting to the Mahakal Mandir are widened from 16 to 18 meters.

Along with that, there have been parking lots developed on the southern part close to the museum. And there also is an ongoing parking project being developed on the eastern side. So, the current capacity of parking will



Figure 6: Poster against Land pulling activities
Source: Author



Figure 7: Pedestrian and the e-Rikshaw path connecting the temple to the parking space
Source: Author



Legend

-  Congested Road
-  Proposed Parking

Map 1: Road Congestion and Proposed Parking Spaces
Source: Author

grow by over 600 PCU in the parking spaces, from which the existing parking space on the south can house up to 400 PCU.

In terms of open spaces earlier, there were no viable or active open spaces closed to the Mahakal area and the road along the Rudra Sagar was previously bring crowded by the vehicle traffic & the informal vending zones.

With this project, the entire section from the gate of Triveni Sangrahalaya to the Mahakal temple has been converted into a non-vehicular zone. The entire space is now converted into a public space that would allow people to have some quality time to spend near this iconic temple of Mahakal. This non-vehicular zone will also have a designated commercial zone. And this commercial zone will have a variety of stores ranging from pooja materials to souvenir shops.

There was also a merging and relocation of 12 schools that existed near the Mahakal temple. Now there are 2 new school buildings built to support over 2000 students. One of these schools is going to have a hostel facility for boys. This great step now can help in creating more opportunities in a single competitive environment and with good facilities. Spending more time in a single place will ensure a larger time spend in the city, which will result in economic growth for the entire tourism sector

as people will more likely book stays and hotels and will participate and local activities. For the beautification of the site, there were designs constructed to create an aesthetically pleasing facade. This entire pathway from the Sangrahalaya to Mahakal involves a lane for electric autos and esthetically beautiful yet culturally enlightening structures and murtis.

These mesmerizing structures often have a cultural and religious significance connected to them that helps and makes people aware of Indian mythology and health connect the visitors with the Mahakal temple.

The Rudra Sagar revitalization program is focused on creating a beautiful and functioning water body that would serve as the buffer or relaxing landscape for the people visiting Mahakal. The Rudra Sagar revitalization project focuses on de-silting, dredging, and creating an outer wall to the edges, a proposed water treatment plant that would clean the water from the drainage network before the water enters the lake. As before, most of the times the water body was relatively dry now there is a proposal to pump enough water into the lake from the Shipra River.

Previously there were no designated spaces for parking, resulting in on-street parking on nearby streets. On the east, Illegal encroachments and school buildings had a lot of land masses closer to the Mahakal precinct.

The southern part was not at all developed and had a smaller space for Rudra Sagar. There was no public space and sitting spaces and organized vending areas. The designated parking spaces are provided on both east and south. The land was captured from the eastern part after reclaiming encroached areas and merging twelve small schools to create two schools with better services. From Triveni Sangrahalaya on the south to the Mahakal precinct on the north, the entire section was developed to evolve as a public space providing shaded sitting spaces. There was also a revitalization of Rudra Sagar being under the process.

7. Key findings from the interviews, surveys, and primary/secondary data collection

The survey of the current visitors has led to some conclusions that must be addressed and incorporated into our upcoming projects.

Firstly, people visiting the Mahakal temple are mostly people coming from outside the city as per a survey sample of 70 people about 10% of the entire population visiting Mahakal and a normal day or local people. Among these visitors, most if not all have strong cultural and religious beliefs. So, the visitors want to spend more time in the holy Mahakal temple parisar after the temple visit which again supports the proposal for a larger open



Figure 8: Public space created for visitors Source: Author



Figure 9: Sitting space around lotus pond Source: Author



Figure 10: Image of classrooms in one of the new schools Source: Author



Figure 11: Visual depiction of a mythological event Source: Author



2011



2021

Figure 12: Temporal changes in the site since 2011 (Before Project) to 2022 (Project About to complete)

space area. But at the same time, the people don't want to be in the sun, as Ujjain has a hot and dry climate, it is not very suitable for pedestrians. This raises the question what if people don't find the public space as comforting because there is a lack in terms of availability of shaded spaces.

The lack of awareness about all the Heritage templates and the Heritage buildings available in the city is one of the major concerns. While talking to the pandits from various temples there was a clear understanding that people do not have any map or guiding elements that would make them aware of the surrounding heritage monuments. It was also revealed that while Mahakal temple on average gets about five to ten thousand visitors at the same time the Harsiddhi temple that is located just 500 m from Mahakal is visited by only about one thousand people. And, in terms of commercial Hawking zones though Mahakal has a samiti for the street vendors there is no monitored and organized system in place for commercial activities. The street vendors mostly have a negative view towards the new construction as previously these people had a movable tailor that can be adjusted as per the need and can be seasonally placed or removed.

8. Concluding Remarks

This project, like any other, has both positive and negative sides. The project has tried to address issues like traffic congestion, parking, availability of open spaces, services, and amenities, beautification around the Mahakal temple, the designated hawking zone and the management of Rudra Sagar Lake. At the same time, the residents of the city had to go through a lot of adjustments to let this development happen. The site is still under construction and yet to have a functioning system, everyone is oblivious to the outcome or the reaction of visitors when the site starts operating. Here the aim is to uncover a few pros and cons that have been extracted from various surveys, observations, and stakeholder consultations.

9. Implications

The site can now hold up to six lakh population in a single time, which is a great level up from the previous scenario where there were no proper accommodation facilities available for the visitors in terms of specific events. The parking space increased from almost about 200 PCU to now about 800 PCU all over the site. The whitening of roads in theory can handle away larger population size. The availability of e-rickshaws can be a great help for elderly people children and a differently-abled population. The beautification of the site has also created the potential of attracting more people letting them stay longer and making them aware of Indian mythology. The revival of Rudra Sagar can be viewed as a benefit in terms of the aesthetics of the site and the environmental aspects as well.

10. Study Limitations

Projects of these scales are very rare and are only being designed recently. The development of Kashi Vishwanath in Varanasi and Jagannath temple in Puri are two similar cases that are now functioning but since the projects are fairly new, drawing to any conclusion based on their functions is quite challenging and might provide some inaccurate results. And since the project is still undergoing stakeholder consultation and the household survey was quite difficult as there was a lot of resistance towards any sort of information gathering. As the site opens to the public, the data can then be collected and observed to create a more vivid database, using which one can assess the entire scenario.

11. Key lessons learned

The project is not yet operational making it harder to evaluate the success of specific interventions. Yet there are a few key issues during the construction and design phase. To solve this problem there can be a provision of a pilot project to be carried out first instead of the whole project so that we can have a rough assumption of what to expect from the visitors. It is really important to create awareness between stakeholders for the project to

create a system where the stakeholders are supportive rather than defending against the project.

12. Recommendations

The study would like to conclude with a set of recommendations (given below):

- i. While the entire scenario project is a great improvement from what was, there can still be a few changes and additions that can be done to make the space operate better. These recommendations are based on the observations. There can be a better recommendation proposed after the site opens for public use and visitors' opinion are gathered.
- ii. The current proposal that heavily emphasizes on space making for people to spend time is missing a key aspect of having shaded spaces. Currently, though, there is an improvement in terms of shaded sitting spaces it is still quite small in terms of the comparative area of the project.
- iii. There can also be a policy intervention to ensure that shops and other activities can operate temporarily; especially during the time of events like Kumbh Mela and Nag Panchami. As the commercial activity required to full fill the demand and a regular day will be quite less as compared to these mega-events.
- iv. After completing the construction work, the project shall not be directly transferred to the Mahakal authority to operate, rather the smart City authority and the respective consultancies can have a tenure to maintain the site and make further changes required once the site opens.
- v. While it's acceptable to adopt new & innovative materials and tools, It should be strictly prohibited to implement foreign architecture styles, especially in cases of spaces having cultural and religious significance.

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1. Annex One

Table 1: Gathering of the population at different places during Events

Gathering of the population go to Ujjain during different events	1 st point	2 nd point	3 rd point and so on
Simhashtha Mela	Kshipra River	Mahakaleshwar Temple	KaalBhairav Mandir
Mahakal ki Sawari	Mahakaleshwar Mandir	-	End at Ramghat
Panchkroshi Yatra	Naagchandeswar Mandir	Pingleshwer Mahadev	End at shipra ghat
Nagpanchmi	Naagchandreshwar Mandir	Mahakaleshwar Mandir	KaalBhairav Mandir

Source: Author

2. Annex Two

Table 2: Important Religious Events and the Expected Population in Ujjain

Important religious events and the expected population in Ujjain					
S.No.	Festival/Mela	Period (month)	Duration (days)	Place	Estimated no. of Visitors
1	Simhastha/Kumbh	After every 12 years	30	Mela Ground	1-2 Crore
2	Vaishakah Snan	Chaitra Purnima Vaishakah Purnima	30	Near Badnagarbridge, Ramghat and Triveni	25-50,000
3	Panchkroshi Yatra	Vaishakah	5	Mangalnath	25-50,000
4	Ganga Pujan Ganga Snan Ganga Dashehra	Vaishakah Jaisth	9-11	Ramghat Ganga Ghat	20-25,000 20-25,000
5	Durga Shivavratra	Ashadh	10	Gar kalika	20-25,000
6	Kartik Snan	Kartik Purnima to agrahayan Purnima	30	Near Badnagar	50-75,000
7	Makar Sankranti	Paush	1-2	Mahakal temple	25-30,000
8	Magh Snan	Magh Purnima Phalgun Purnima	30	Near Badnagar Bridge and Triveni	20-25,000
9	Maha Shivratri	Magh/Phalgun	1-2	Mahakal Temple	50-75,000

Source: Author

3. Annex Three

Table 3: Floating Population in Other Fairs

S. No.	Other Fairs	Registered Tourists
1	Nag Panchami	100000
2	Amavasya Purnima snan	600000
3	Varoni fest	10000
4	Anant Chaturdashi	500000
5	Mahakal Savan sawari	700000

Source: Author

4. Annex Four

Table 4: Monthly Tourist Influx
MONTHLY NUMBER OF TOURISTS at Ujjain

	Regular Tourists	Other Festival	Kumbh Mela
January	5721	30000	0
February	6187	100000	0
March	3521	0	0
April	11564	0	18750000
May	6690	50000	6250000
June	6730	50000	0
July	6632	25000	0
August	4708	400000	0
September	5467	0	0
October	9274	0w	0
November	6443	37500	0
December	6397	37500	0

Source: Author

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C26

Land Monetization of Area Based Development (ABD): A case of Bhopal, India

Name of the project: Land Monetization of Area Based Development (ABD): A case of Bhopal, India

Location: Bhopal

Year of project implementation: 2017

Sector: Mobility/NMT

Project Cost (Rs. Crore) : 7.6 crore

SDGs: SDG 3 (Target 3.6), SDG 11 (Target 11.2, 11.6)

Institute: Maulana Azad National Institute of Technology (MANIT), Bhopal

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Keywords: Land Monetization, Revenue, Area-based development (ABD), Bhopal Smart City Development Corporation Limited (BSCDCL)

Abstract:

A significant characteristic of Indian cities is the limited revenue sources available to the city management authorities. On the contrary, the city authorities have not used existing revenue potential, such as land-based revenue streams. This is perplexing, as the property values in Indian cities are soaring, resulting in windfall profits for landowners. Furthermore, cities in developed countries have successfully adopted land-based instruments to finance urban development projects during their transition. This research attempts to draw lessons from the theory and practice of land monetization for municipal finance reforms, taking the case of Bhopal Smart City. The study dives into the framework adopted by Bhopal Smart City Development Corporation Limited (BSCDCL), to implement its Area Based Development on Land Monetization Model; it also reviews its land monetization policy for the Area Based Development.

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1. Introduction

Walking, cycling, small-wheeled transport (skates, skateboards,

According to (McKinsey, 2010), India would need to invest Rs. 9.74 billion in its cities by 2030, with Rs. 5.31 billion in capital investment. The High-Powered Expert Committee (HPEC) constituted to evaluate the capital requirement for urban infrastructure services (2011), opined that India would require Rs.3.92 billion for urban infrastructure between 2012- and 2031. When operating and maintenance expenses are included, the total investment translates to Rs. 5.92 million. However, despite the staggering financial demands of India, urban centers in India suffer from a “rich city-poor city administration” problem. Municipal revenue as a percentage of total federal and state revenue fell from 3.71 percent in 1990-91 to 2.43 percent in 2000-01 and less than 2.00 percent in 2020.

Ironically, while the basket of revenue sources with municipalities in India is narrow, inflexible, and non-buoyant, these local bodies have also not exploited

the revenue sources already available to them, such as property tax, vacant land tax, and other land-based sources (McKinsey, 2010) (HPEC, 2014) (Mohanty, 2016). Land values in Indian cities skyrocketed, giving the land and property owners a windfall profit. These undeserved gains are mostly attributable to government investments in urban planning and infrastructure, which are an asset to the society at large and beneficial to the landowners too. Hence, mechanisms shall be developed to monetize the assets created and create an alternate revenue stream for city authorities.

Asset monetization is a transaction that changes a dead/idle asset into a revenue-creating one. Land is one of the most crucial and prime assets available to city authorities. Hence, land monetization is one of the most logical options for city authorities to generate the real essential assets for foundation up-gradation or renovation without having to rely on the state or the central agencies for cash and grants, and so on. The Bandra-Kurla Complex is an excellent example of how the government’s unused or underutilized land assets may be used to encourage planned urban development

while also providing appropriate resources for on-site and off-site infrastructure. Except for Mumbai and a few other cities, land monetization has not been explored to finance capital projects in cities. Many towns and urban development bodies own valuable properties that are either underutilized or are subject to dispute.

1.1 Background and Context

Monetizing land is one of the most viable options for government or local bodies to generate the much-needed funds for the up-gradation or development of required infrastructure without burdening the state or the Central government (Guest, 2020).

The project site, i.e.,the ABD area lies between two prominent business zones, which are namely South TT Nagar & New Market area. These are two major commercial nodes of Bhopal city, having an immense potential to create a commercial arc by connecting these two nodes. This commercial arc will act as a catalyst for inviting more and more investment in the real estate sector. This project puts the land to better use. The commercial development of land accelerates the real estate prospects in the vicinity.

Due to the massive outlay and funding done by the state government in the project, the market will gain assurance and see supply escalation and price appreciation shortly.

The project is based on a self-financing model, and it also contributes to planned urbanization, boosts tourism, and generates employment. It has cascading effects on economic development and citizens’ quality of life.

1.1.1 About the ABD project

ABD Area is planned as Mixed-Use Compact Development with the incorporation of TOD (Transit Oriented Development). It is strategically located between two primary arteries of the city (BRTS & proposed Metro) and tries to provide a compact, walkable and sustainable spatial morphology.

The ABD development in Bhopal is expected to become a contemporary smart city model development in India, advancing the ideas of sustainability and ecology. The project focuses on redeveloping the area as a high-quality, high-density mixed-use district of residential, commercial, and open space facilities that optimize land and real estate values (Bhopal Smart City Development Corporation Limited , 2018).

The project region incorporates North and South TT Nagar (Tatya Tope Nagar), beginning after the New Market in the north and reaching out to Mata Mandir Chowk in the south. It also has portions of Tulsi Nagar on the right of New Market Street (from the Main Road 1 in

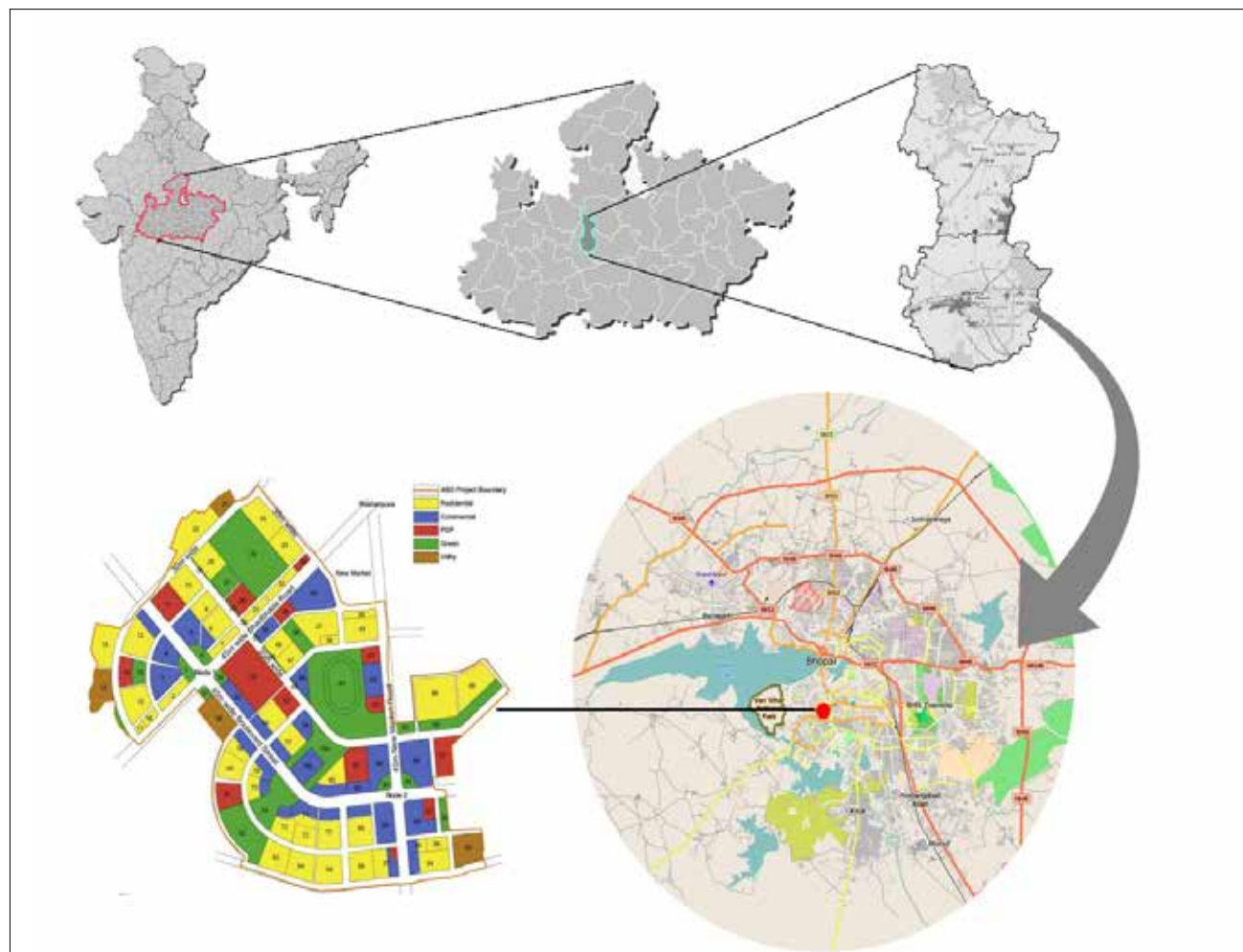


Fig. 1 Location Map of the Site

- Determining whether either of the above (timing and price) could be improved by undertaking any infrastructure augmentation or regulatory pre-approval to the subject property.
- Identifying the most appropriate monetization process (auction, tender, direct allotment, JD, etc.), resulting in the maximum value realization to BSCDCL.
- Transaction structure – identifying the most suitable transaction structure for each land parcel, depending on the usage. Usually, as

general market practice, a sale structure is preferred for residential land use, and a long-term lease or sale is preferred for commercial land use.

- Identifying marketing and advertising avenues.
- Ensuring that the Project Team understands the monetization strategy and maintains the momentum to complete the process.

2.3 Land Monetization process adopted by BSCDCL

1. After getting approvals, BSCDCL floated a Tender for agency selection to draft &

prepare a Land Monetization Policy, Allotment Letter, Deed of Conveyance, and Sample RFP (Request for Proposal) for the Sale of Plot on a Freehold basis.

2. The selected agency prepared the documents mentioned in (1) and uploaded the Land Monetization Policy on the website to get feedback & suggestions. The agency also shared it with the City Forum Committee for their valuable suggestions. After getting observations and incorporating all applicable suggestions in the policy, it was sent to the Govt of M.P. for their approval. BSCDCL also got the approval of the Land Monetization Policy and Draft RFP (for sale of the plot) from the Board of Director (BOD)'s of Bhopal Smart City.

* Land Monetization Policy was prepared by taking references of related acts available in the Govt. of M.P.'s similar departments.

* RFP: same references were taken for preparation of RFP for sale of plots on freehold basis.

3. BSCDCL issued an RFP to select a transaction adviser for plot sales, but due to COVID-19 no bids were received (for plot sales). As a result, BSCDCL opted to sell the plots directly, after receiving authorization (By floating of RFP on MPTENDER's Portal).

4. Before the plot was sold, BSCDCL was registered with RERA. Prior to releasing the RFP for plot sales, BSCDCL had an investment event in Minto Hall, Bhopal. The Chairman of the Board and the ED and CEO of the company presided over this meeting. They shared the information about the initiative and available plots and received comments from the potential investors.

5. After incorporating the acceptable suggestions in the RFP, it was floated on MPTENDER's Portal.

6. BSCDCL aggressively advertised the sale of plots through national newspapers, digital media, bus stops, marketing stalls, advertisement balloons, pre-bid meetings, etc.

7. After the last date of bids, the technical committee opened the bids and scrutinized them. It was then forwarded to the subcommittee of land monetization and put up at the BOD meeting for final approval.

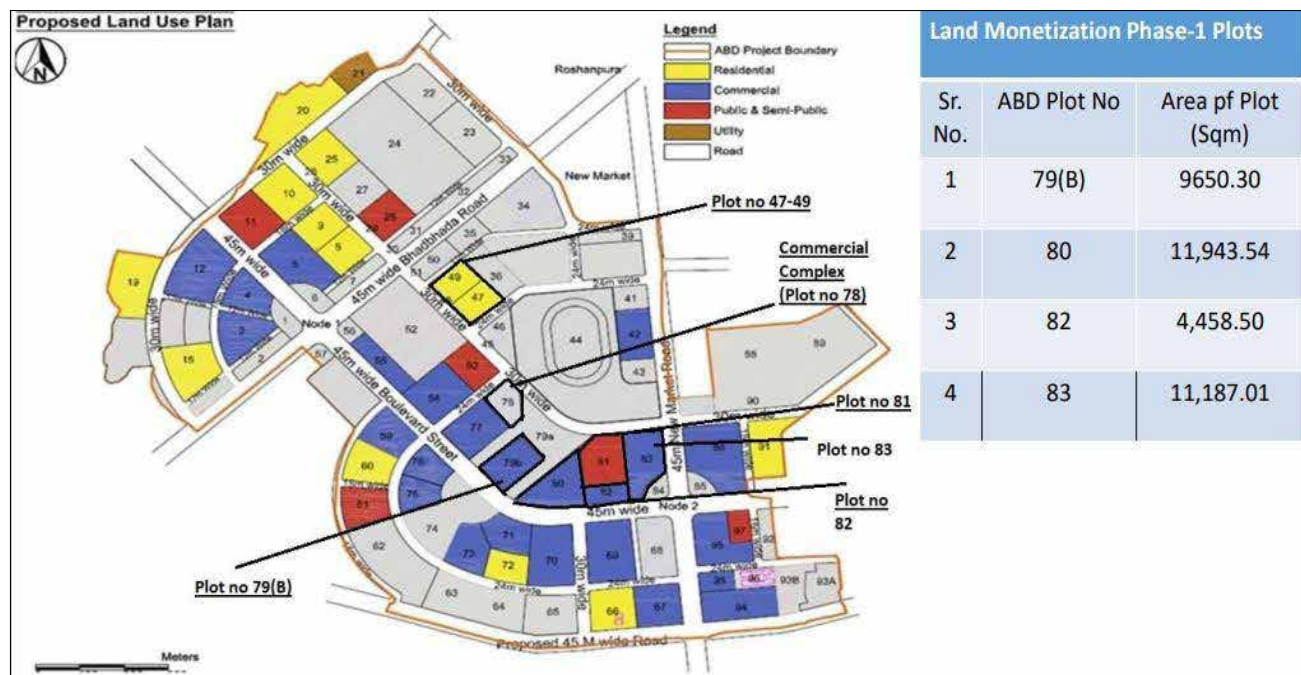


Fig 4 Details of Saleable Plots

Description	No.	Area (Sqm)	Revenue Generation (In Cr)	Remarks
Land Parcels	42	4,55,943.71	2563.40	Rate is taken from the latest collectorate guidelines with development costs.
Total			2563.40	

Source: BSCDCL



Fig. 5 Meeting with the officials and buyers

2.3 Status of Monetization

- Bhopal Smart City has a total of 98 no's of plots under ABD Area of T.T. Nagar
- Out of the total 98 Plots, BSCDCL has 42 plots available for land monetization
- In Phase 01, Bhopal Smart City has successfully monetized 04 plots-79(B), 80, 82 and 83 amounting to Rs 268.47 Crores.

2.4 Revenue Generated through Land Monetization

Bhopal Smart City Development Corporation Limited (BSCDCL) ABD, T. T. Nagar has a total 98 plots available for monetization under the smart city:

2.5 Key features of the Land Monetization Policy

2.5.1 Challenges in the project

- a. Mitigating the adverse impacts of construction and development work on the habitats of the project area, during and after implementation.
- b. Relocation of the activities under the project area.
- c. Time-consuming process of approvals from various civic authorities.
- d. The confidence-building measures for the revival of the economy post-Covid-19 need to be supplemented by fast-tracking the approval processes.
- e. Technical guidelines and a large chunk of land. Buyers wanted to buy small plots, which became a challenge.
- f. Presence of existing infrastructure on-site is a challenge for future land parcel development.

2.5.2 Risks involved in the project

- a. The Risks related to allocation.
- b. Adverse impact of construction on the areas nearby.
- c. Change in informal activities due to relocation.
- d. Risks related to financing on the sold land parcels.

2.5.3 Features and benefits to the city

- a. Value capture through property monetization is key to generating enough funds for sustainable project development.
- b. Growth in the city's real estate market.
- c. Enormous investment of the state government in the project, the market will gain confidence and see supply rise and price escalation shortly.
- d. Revival of the local economy, providing employment opportunities to masses in the coming years.
- e. Huge residential and commercial demand in the market.

2.3 Key findings

The monetization of land is an instrumental means for augmenting the revenue streams of the city authorities, and Bhopal Smart City has done an innovative task by adopting this methodology to fund its ABD project. The scope of learning is there where attempts are made, and hurdles are faced! On similar lines, the study has few findings, which may be of interest to Bhopal and other cities, targeting funding of their development via land monetization. Firstly, the Land Monetization Policy does not give enough flexibility to the Smart City Corporation to decide on specific situations. Rather, it has documented the available methods of liquidating land. A more site and condition-specific policy, giving some degree of freedom to the company in dis-investment decisions could have proved worthy. The policy lacks vision and statements on branding and processes, established for taking the project to an international audience, giving impetus to the foreign and big brand investment in the project. Secondly, the authority has divided the land into small plots, but it is not bundling the plots, which could attract builders and buyers with a large investment in the site.

3. Discussion and Conclusion

Indian cities have not exploited land-based instruments of financing. They assume critical importance in implementing the smart development projects as envisaged in the Smart City Mission of India, launched in 2015. The Mission has referred to four models to undertake smart development projects and demonstrate their replication value in cities throughout the country. These include:

- a. Development of an existing built area greater than 500 acres to make it more efficient and livable.
- b. Renewal of an existing built environment in an area of more than 50 acres and enabling co-creation of a new layout, especially enhanced infrastructure, mixed land use, and increased density.
- c. Development of a previously vacant area of more than 250 acres, using innovative planning, plan financing and plan implementation tools with provision for affordable housing, especially for the poor.

- d. Pan-city program, where at least one smart solution is applied covering larger parts of the city.

According to these models, smart cities will need to embrace area-based and citywide development strategies and the creation of novel land-based finance mechanisms. Land-based taxes and charges, development-related tools like impact fees, and value capture instruments like land value increment taxes and betterment charges are all examples of these instruments. The monetization of idle land assets might be useful for supplementing these funds. Land-based sources can raise a considerable amount of money to fund infrastructure and services in cities.

A frequent remark about Indian urban governance is that the cities contain huge areas of under-utilized government land that are not put to value-creating use. These assets have a lot of potential for monetization. The Bhopal Smart City Development Corporation Limited (BSCDCL)'s experience with the land monetization in the Area Based Development (ABD) project demonstrates the enormous potential for resource mobilization. It could be achieved through productive use of unused or underused land assets with the government while promoting planned urban development and developing on-site and off-site infrastructure facilities.

An important element to remember while building instruments to exploit urban land, as a resource, is that they must be based on a value-enhancing development model for cities and their urbanizing surroundings. This will necessitate a value generation, capture, and recycling strategy for city planning and development. A spiraling process of self-financed or even surplus-generating urban expansion can result from value creation in cities through unlocking economic growth and land. All Indian cities, particularly metropolitan and smart cities, must investigate the potential of urban land as a source of funding for planned urban development.

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School Redevelopment (Assessment Of Nutan And Ganesh School Project, Ujjain)

Name of the project: Nutan School, Ganesh school

Location: Ujjain, Madhya Pradesh

Year of Project Implementation: 2022

Sector: Community School Project

SDG: SDG 11 - Sustainable Cities and Communities; SDG 13 - Climate Action; SDG 15 - Life on Land

Project Cost: Rs. 25.79 crore

Institute: Maulana Azad National Institute of Technology (MANIT), Bhopal

Advisors: Dr. Krishna Kumar Dhote, Dr. Preeti Onkar, Mr. Amit Kumar Biswal

Students: Mr. Vedankur Sandip Kedar, Ms. Minhaj Qureshi

Keywords: Redevelopment of Public Park, Urban Green Space, Ecosystem Services, Green Cover

Abstract:

Ujjain, The Smart City designate, has carried out several new and innovative projects in the last decade. They have been geared towards improving the overall functioning of the city, including much needed conservation and beautification work in and around the Mahakaal temple premises to offer better public spaces to the millions of visitors that come every year. These projects necessitate huge land acquisition that might bring the existing land use or activities in direct conflict with the new projects. In this case, several schools already established in the vicinity, had to be rehabilitated.

One of the key projects that helped in providing spaces for this new development was rehabilitating 12 existing schools with smaller student masses. These schools are designed to hold many students and have a better level of services and infrastructure than earlier.

The objective of this paper is to analyze the project in terms of its economic viability, social well-being and environmental sustainability. This will help us to understand the success of this project, and later provide suggestions to help in replicating the same model elsewhere.

There was a merging and relocation of 12 schools that existed near the Mahakal temple into 2 new schools, with smart buildings to support over 2000 students. One of these schools is going to have a hostel facility for boys. This great step now can help in creating more opportunities in a single competitive environment and with good facilities. This study tries to document and evaluate the impacts of the project on the people, both residents and the student population, and on the environment.

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1. Introduction

India is among the largest economies in the world, with an urban population representing about 35% of the country's total population (approximately 474 million in 2020). Being one of the top countries with the most populated cities in the world, India has taken several initiatives to develop and urbanize the country. As per a United Nations report, India will add around 416 million more people to its urban population by 2050. The country's smart city and urbanization mission are aimed at improving the quality of life of its population.

In the city of Ujjain, there have been several major projects being carried out by the Smart City authorities. One of these projects is the management of schools in Ujjain, under which there has been merging of 12 schools into two new schools that can house over 3000 students at a time. This project aimed to create a better environment for students.

By creating two larger schools now, the focus can be centralized into two specific locations rather than reaching out to 12 dispersed locations. This also helps in terms of providing services and creating better opportunities as more students mean more competition and at the same time better results. Moreover, having all the people in the same place results and better management of space and ultimately helps the city administration in managing the new educational ecosystem.

1.1 The Topic and the Context

The work of Modern and Smart School is completed

by displacing the school from this campus to the new school premises.

The old complex will be included in the Mahakal temple complex, reusing the historic building as Heritage Dharamshala (32 rooms – built-up area 47,000 sq. ft), that will have a food court, recreation area, and plantation (approximately 313 trees - area approx. 1,15,000 sq. ft) are proposed to be done. A structural audit of the building has been done by IIT Indore.

Under the tender process, the cost of Rs. 25.79 crore, estimated date of completion of work June 2023. The agency for the operation and maintenance of Heritage Dharamshala will be appointed by the Mahakal Management Committee.

1.2 The Project Significance

The school project boasts of many different significances in many different aspects. In terms of the development of Mahakal premises, this project helped in clearing a very large section in the east of Mahakal temple that space is now being redeveloped under the MRIDA project.

The project also helped in creating a better environment for students as more heads together will bring more competitiveness and a better learning chain can be created.

In terms of city management, the schools now are easier to consider while developing their surroundings and creating a better environment for the students. Here, the centralization of the schools also helps in creating

a more efficient use of land as more people can be gathered into the same space.

Economically, the schools now require lesser funds in terms of activities and functions as well as lesser space to manage these things. As of now, schools will have to conduct functions for only two schools rather than the previously existing 12 schools.

1.3 Aims and Objectives

The aim of this research is to find out the impacts of this project, both on the students and on the authorities, in terms of:

- It's economic viability;
- It's social impact: the social benefits that are being attended by this project are also being accessed so as to understand how will this project be impacting the social lives of the students and others; and
- (c) Lastly, it's environmental impact that this project has caused is also being considered so as to evaluate how this project has changed the surrounding environment.

2. Project Background

The term "school culture" is often used interchangeably with "school climate" and "school environment," but the general meaning of all terms are students', parents', and school personnel's experience of school life and its associated norms, goals, values, interpersonal relationships, teaching and learning practices, and organizational structures (according to the National School Climate Center).

A growing body of research has examined how these factors influence student learning. According to a school culture survey, almost 90% of teachers at schools with strong instructional cultures feel that their school sets higher standards compared to only about half at low-performing schools and that they can track student progress towards goals compared to only 56% in the bottom quartile schools.

2.1 Conceptual framework

The first step towards assessing the school project was to undertake a complete review of the process:

- First, the desk review where the complete project was reviewed critically based on the existing report. This helps us in understanding the current scenario of the project;
- After an initial understanding of the project, there must be the finalization of criteria or aspects based on which the project is supposed to be evaluated. These criteria have been developed by taking into consideration of existing literature and the understanding of the specific site;

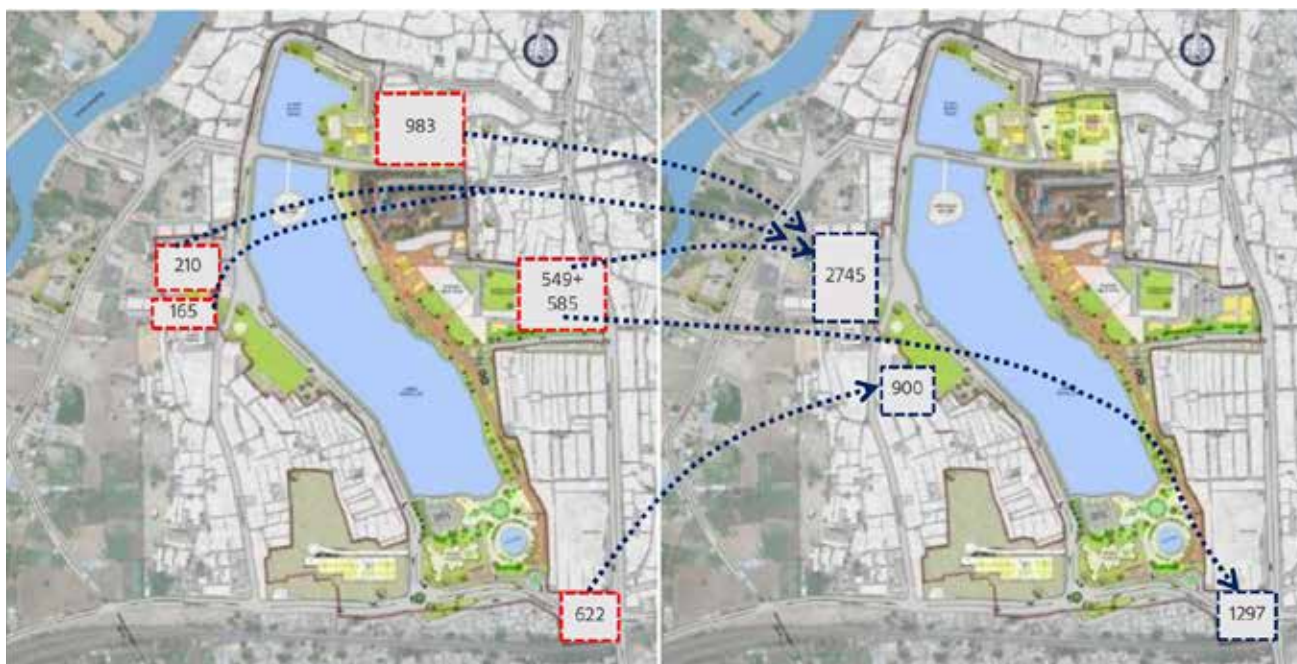


Figure 01: The location of major old schools on the left and new schools on the right

- iii. Following this, a site visit was conducted where observations and a questionnaire-based survey were conducted. (Sánchez, Paulo, and Morrison-saunders 2010); and
- iv. In the end, consultations with stakeholders and the concerned authorities were held to figure out their perspectives. ("Environmental and Social System Assessment A." 2017) (Foundation 2014)

2.2 Research Design

Our research design closely follows a framework developed by OECD (Assessment and Evaluation 2013). A Review on Evaluation and Assessment Frameworks for Improving School Outcomes is designed to respond to the strong interest in evaluation and assessment issues evident at national and international levels.

2.3 Key features of the project

There are three key projects that are being studied under the case:

- The Nutan School Where construction of the school premise and Sanskrit School with hostel facility on the campus have been completed, The existing 9 schools and one college in Mahakaal Adjoining area to be relocated in Nutan school complex, making it the largest school in the city with a capacity of about 2745 students. Which is way more significant than the smaller schools where each had a capacity of about 300 on average. The new building has a Site Area of 16906.00 Sq.mt and has a G + 2 buildings built into the site. Nutan School now has 61 Classrooms and a Sanskrit College with 7 Classrooms and an Urdu School with 23 Classrooms. These schools now can host a larger student count than before and can provide better services.
- An additional facility is being created – Separate Principal offices, Library, Multi-purpose hall, Laboratories, storeroom, first aid room, Hostel, Play Ground, etc.
- The Ganesh Colony School with a total area of the land is 16,522.60 sq ft and the total built-up area is 41,763.97 sq ft. 3 schools located under Hari Gate are being shifted by constructing new school premises. A School campus of 900 students has been built on the school premises for school displacement. The current schools have a student capacity of 622

students and also a provision of the principal room, library, multi-purpose hall, first aid room, laboratory, and grounds in the school.

These schools will be equipped with new furniture and smart class facilities and solar panels will be installed on them for solar energy.

The newly constructed school campus will provide an educational institution with modern facilities for the students of the surrounding area, due to the provision of smart classes in the school, students will get an opportunity to get an education through the new interesting methods of teaching.

97 new classrooms will come into existence. These classrooms are equipped with Smart Board, Projector, Computer and Digital Multimedia content from Class I to XII (MP Board), Language Lab, 2 Additional High-End Computers in each school. And a 4 MBPS Wi-Fi network in every school.

2.4 The Challenges

The major challenge during this project was to create an understanding between all the schools and the students to shift into these two schools. And since this project involved a large number of students it was difficult to discuss with all the stakeholders.

Apart from that, the development of land close to the sensitive site of lake Rudra Sagar has made the construction processes quite challenging.

The effect of COVID 19 has been seen in all sectors and this project was no different as covid-19 has delayed the construction phase by several months.

The challenge of creating a suitable transport network for the schools and at the same time maintaining a good and secure environment in the surroundings was quite evident.

2.5 The Risks

The biggest risk was the creation of a suitable environment for the students. as they were already well set on location, it was quite risky to make the shift to a new location. Since the development of the

MRIDA project is under process, we certainly cannot say what will be the future condition of the surrounding environment.

The schools are yet to function at their highest potential, so it was quite difficult to assess the functionality of the available services.

The same can be said about the Rudra Sagar development project as all three schools are situated close to the site. It will be important to observe the changes in the surroundings as the entire site will be developed and start to function at its full potential. There was also a bit of hesitation among students to share proper information a part of the reason being, that even they are still exploring the services that are being offered.

Also, the development of the MRIDA project since is under process we certainly cannot say what will be the future condition of the surrounding environment.

There was also the risk of gathering different sections of people from different localities into the same space and making them share the same services, which might result in disputes.

2.6 The Benefits

Smart classes are being built into these schools, enabling students to have access to smartboard learning, and a Wi-Fi network for free access. Huge classes have been built with jalis that help in cooling and cross ventilation of the entire room. The multipurpose hall provides spaces for different types of activities and cultural exchange.

A computer lab and a science lab building for a better learning experience.

Solar panels are fitted on the rooftops to provide for the electricity requirements of the facility.

Water coolers and toilet facilities are provided to the students with regular maintenance. Which is an improvement from the previous schools as there were schools where cold water and toilets were not present previously.

Safety was taken into consideration by providing well-lit corridors and classrooms. Fire extinguishers for emergencies.



Figure 02: The Nutan School and its parking space



Figure 03: Classrooms with a good lighting and ventilation system

The quality of spaces and furniture that are provided are way better than the spaces that were available for each school before the building of new schools.

2.7 Key Findings

The study arrives at a set of key findings (listed below) from the interviews with the stakeholders, surveys, and primary/secondary data collection: w

- There is a gap in terms of inclusive design. The building has no ramps or lifts built into higher floors. This results and discomfort among differently-abled and elderly teachers;
- The classroom because of its huge size produces eco that often hinders the learning process;
- The Jalis that are provided and for the ventilation are causing dust issues. Although this is mostly because of the ongoing construction at the nearby sites it is still to be considered that if not properly maintained this can result in health issues;
- There have been several cases of students dropping out of school because of larger travel distance as the schools have been relocated from a nearby distance to a few kilometers away;
- Since these places now have a larger student mass, it requires vast space for sports-related activities yet there is a lack in terms of playground space; and
- There is a lack in terms of student-teacher interaction in the new space as the previous school building with small size and limited occupancy made interaction between different students and teachers easier.

3. Concluding Remarks

Although there have been a lot of improvements in several aspects there are still a few criteria where the project can have improvement.

Here some of these criteria that have been selected earlier are being analyzed based on the survey conducted and primary observations by the visiting team.

3.1 Implications

Again, if you see this table (Annex Two), you can clearly see most of the aspects that have been improvements witnessed by the visitors and by the students that were subjected to the survey. And yet there were few key aspects where the can be an improvement.

3.2 Limitations of the research

The schools are yet to function at their highest potential, so it was quite difficult to assess the functionality of the available services.

The same can be said about the Rudra Sagar development project as all three schools are situated close to the site. It will be important to observe the changes in the surroundings as the entire site will be developed and start to function at its full potential. There was also a bit of hesitation among students to share proper information a part of the reason being, that even they are still exploring the services that are being offered

3.3 Key lessons learnt

Several key lessons surface from the assessment exercise:

- While creating spaces for students, the must be provisions to ensure the space is well coming and not alienating for the students;
- It is quite viable economically, better socially connected, and can I have a very positive impact environmentally if there are centralized schools rather than a lot of small-scale schools;

- In terms of management of spaces these centralized schools now take a quite lays per capita space for each student as these multi-story buildings can make better use of space for each student. This also helps in maintaining better and more efficient land use throughout the city; and

- This model can be applied in different cities with similar issues of a lot of small-scale schools present in a specific area. Although these projects require a lot of effort, especially during stakeholders' hearings, the results are worth the struggle.

3.4 Recommendations

In the end, the assessment exercise would like to make the following recommendations:

- While this project can be said to have been successfully implemented, there are still a few recommendations that can be provided to make the project better;
- The most important is creating a micro environment for student-teacher interaction while at the same time constantly holding discussion sessions with parents; and
- While shifting the schools there must be the consideration of distance that students are supposed to be traveling since not many students will opt to travel for the distance to attend basic education at the same time there is a factor increase in terms of roads safety. As the schools are recently starting, that should be a close observation of the situation to understand how this space interacts with the users that is the students and the Teachers.



Figure 4: Lab rooms for the better learning experience



Figure 5: Solar panels fitted on the roofs



Figure 6: The open spaces and furniture in Nutan school

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Annex One

Table 1: School Project Assessment Criteria

Aspects being considered	
Economic	<ul style="list-style-type: none"> • Project costs • Management cost • Service provision • Transport
Social	<ul style="list-style-type: none"> • Likeability by students • Interaction with teacher • Availability of services • Inclusive design • Perceived comfort • Safety • Parental involvement • Promoting equality
Environmental	<ul style="list-style-type: none"> • Use of space • Waste generation • Surrounding environment • Noise generation • Traffic and Transport

Source:

Annex Two

Table 2: The Assessment of success of the project based on parameters

Aspects being considered		Impact of project
Economic	Project costs	
	Management cost	
	Service provision	
	Transport	
Social	Likeability by students	
	Interaction with teacher	
	Availability of services	
	Inclusive design	
	Perceived comfort	
	Safety	
	Parental involvement	
	Promoting equality	
Environmental	Use of space	
	Waste Management	
	Surrounding environment	
	Noise generation	
	Traffic and Transport	

Legend	
Colour	Condition
	Improved
	Inconclusive
	Degraded

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Chappan Dukan Redevelopment

Name of the project: 56 Dukan Redevelopment

Location: : Indore, Madhya Pradesh

Year of Project Implementation: March 2022

Sector: Infrastructure development

SDGs: SDG 11(Sustainable cities and communities)

Project Cost : (Capex cost Rs. 7.24 Crores, and the operational cost per year is Rs. 0.20 Cr.)

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Keywords: 56 Dukaan, Indore, impact assessment, SDG11, ISDCL, SAAR, economic, socio-cultural, accessibility and environment

Abstract:

The Indore Smart City Development Ltd (ISCDL), under pan-city development, initiated a project of redevelopment of a famous eatery space in the heart of Indore, “Chappan Dukan”. Earlier, one of the major issues of this space was traffic movement, as this food street acted as a connecting road disrupting the pedestrian movement and activities. Other issues were haphazard parking, cleanliness, encroachments, lack of leisure space, and safety measures. Hence, the development was undertaken to convert this famed “Chappan Dukan” to a sophisticated street food destination. The aim was to make this place a ‘living street’ by minimizing traffic congestion, providing parking solutions, aesthetically improving overall ambience along with facade treatment and waste management. The project has also contributed towards SDG 11, by reducing the environmental impact on the cities. Under the Smart cities and Academia towards action and research program (SAAR), MANIT, Bhopal worked with ISDCL to document redevelopment of Chappan Dukan, Indore. Survey based assessment was conducted. Documentation has broadly delineated the impacts of the project based on the criteria such as economic, socio-cultural, accessibility and environment. Focusing on the relation between output and effects through impact assessment, unanticipated consequences and key takeaways were identified. Recommendation for scalability was also suggested

Case Study: C28

1. Introduction

Chappan Dukan is one of Indore's choicest street food hubs that serve delicious food and it is also a famous destination as Chappan Dukan literally means fifty-six shops. This famous food street is located in the Palasia area of the Indore city in the Malwa region of Madhya Pradesh (Figure 1) At the time when it was established, 56 separate shops were started here, all selling food items. The evenings light up the place like nothing else with people consuming the delectable spread with enthusiasm. The place is a destination for thousands of food lovers who visit the place daily, and to facilitate them the place has been redesigned and made pedestrian friendly by restricting the vehicles in the entire stretch of the street.

1.1 Topic and Context

The project for the renovation of '56 Dukaan' was decided to be completed in a span of 56 days (relating it with the '56' typology of the place), but the renovation project was completed within 53 days, making the project even a greater success. The research is envisaged to find out the possible impacts of the project implemented by Smart City Indore related to social behavior, environment as well as economy. The transformation of space can be visualised in Figure 2.

1.2 Significance of the project

Chappan Dukan is Indore's most well-known food street, where people may taste exquisite Indian snacks and other delicacies. It is also one of the most famous food hubs in central India and is the most commonly visited place in Indore. 56 shops give it the iconic name 56 Dukan. The space was facing various major issues. Earlier a food street, it has now grown into a major activity hub adding to the image of the city. One of the major issues was the traffic movement, as this food street earlier acted as a connecting road disrupting the pedestrian movement and activities. Other issues were haphazard parking, cleanliness, encroachments, lack of leisure space, and safety measures. The Indore smart city development ltd (ISCDL), under pan-city development, initiated a project to convert this famed "Chappan Dukan" into a sophisticated street food destination. Glorifying the "Chappan", the project timeline was also set at exactly 56 days. It was the first project of this kind in Madhya Pradesh to include a timer to ensure that the work was completed on time to minimize the economic loss of shop owners. This project was completed in 53 days. The project has also contributed towards SDG 11, by reducing the environmental impact on the cities. The space was made a no-plastic zone and proper waste management was also facilitated. Adhering to the safety issues, the street was made a no vehicular zone, with

ample shaded streetscape. Also, CCTV cameras were installed to ensure surveillance and security. Giving the feel of "living Street" to the space, dynamic lighting, Street furniture (theme-based sitting area), and facade development was also done.

Under the Smart cities and Academia towards action and research program MANIT, Bhopal worked with ISDCL to document and carry out an assessment of 'Redevelopment of Chappan Dukan', Indore. Documentation broadly delineated the impacts of the project based on the criteria such as Physical, Economic, Socio-cultural, Environment. Focusing on the relation between output and effects through impact assessment and unanticipated consequences, key takeaways were identified. The project assessment will enable the possibility to replicate this project and the process.

1.3 Aim and Objectives

The aim of the study is to conduct an impact assessment of the 56 dukan project. The objectives of the study are (refer Flowchart Figure 4)

1. Understanding the Goals and Long-range objectives of the said project during its inception stage.
2. Identification of probable impacts of the project through specific criteria



Figure 1: Location, Map- 56 Dukan, Indore

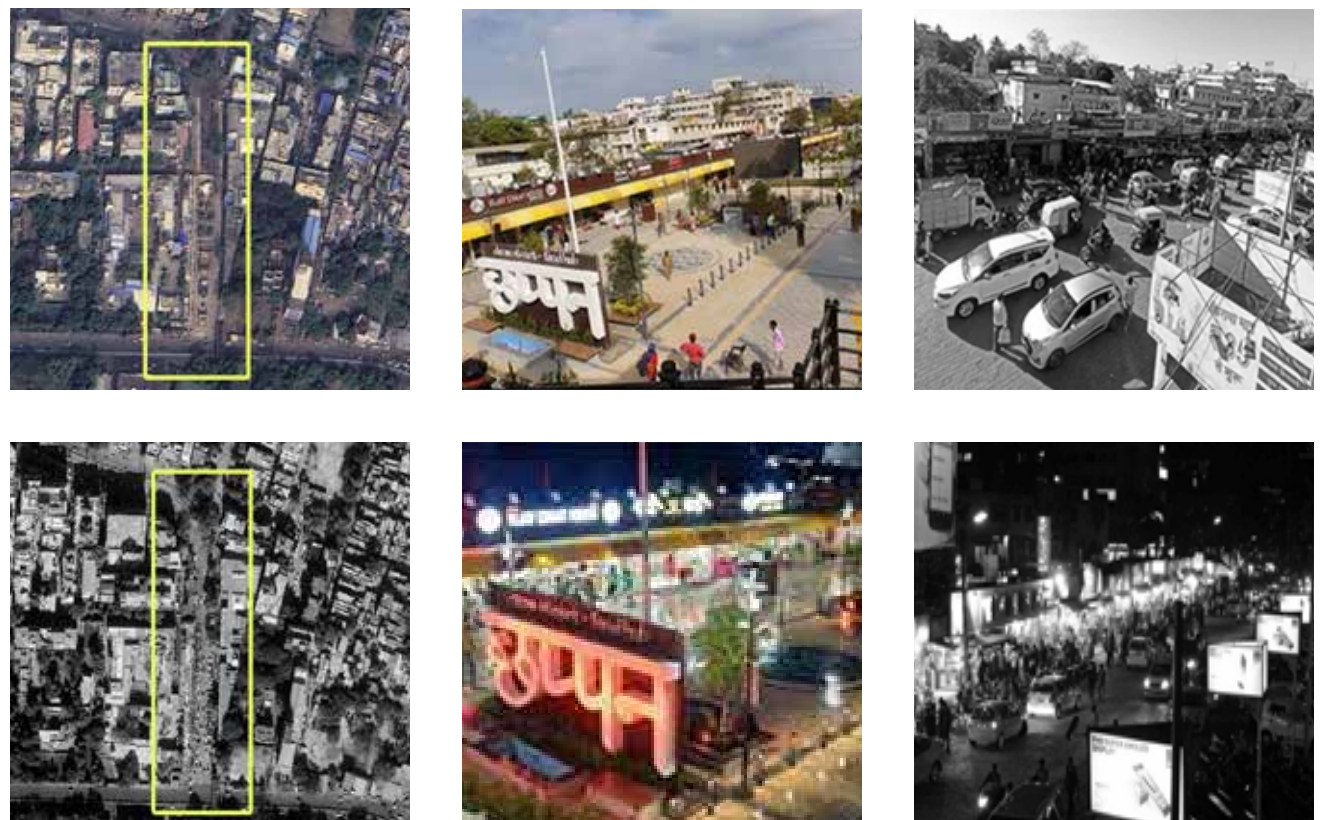


Figure 2: Before and after renovation of 56 Dukan Street

3. To assess the expected and observed outcome of the project.
4. Lessons learned and identification of areas of excellence, where applicable, from the approaches and strategies used for decision making and future project replicability.

2. Contextual Background

2.1 Review of Case study - Chandni Chowk, New Delhi

Chandni Chowk, Shahjanabad, or the Moonlight Square is a similar public place that originally contained 1,560 shops in Delhi and was designed and established by Princess Jahanara Begum, Shah Jahan's favorite daughter in 1650 CE. The spatial characteristics of the market measures approximately 40 meters in width and 1,520 meters in length, where a pool situated in the center of the complex adds elegance to this square shaped bazaar. The reflectance of moonlight in the pool duly gave the bazaar its name, where the shops were originally placed along a crescent, now non-existent. The bazaar was exposed to the influx of silver merchants which eventually contributed to the name Chandi which means Silver in Hindi. Under the Chandni Chowk Redevelopment Plan 2011, revamping of the whole market area was done, where identification of problems and their effective local solutions were taken into cognizance.

2.1.1 Problems

Intense traffic congestion: Although centrally located, the influx of vehicular flow was causing hindrance to the workflow of the area and used to result in temporal bottlenecks in the mobility system. The inevitable presence of hawkers and the local economics supplemented with vehicular intervention caused strain on the situational infrastructure.

Blurring of Historical importance: Due to intense urbanization, the precinct was losing its core historical and cultural importance. The social cohesion of urban form, history and local economics was getting overweight by the exponential urbanization and the associated technological advancements.

Haphazard and Organic Planning: Even being the central place for economic growth since the ancient times, Chandni Chowk suffered unplanned and organic growth, which rendered certain problems in the dense region. The intrinsic urban form of the precinct led to this character growth of the system

2.1.2 Curated Objective

The objective of the entire redevelopment of the area was to create a unique culturally significant destination and public urban space; a pedestrian and user-friendly public transport system; and restating the physical, visual, and historic linkages in the area. Another objective was to develop Chandni Chowk as an overlay of historical periods, including the contemporary activity, using environmental friendly materials and technology. Restriction on cars movement was done from 9:00 AM To 9:00 PM. Parking Capacities were increased and all services were made underground.

2.1.3 Key Parameters of Redevelopment

A. Accessibility: The introduction of the metro system has tremendously helped Chandni Chowk to evolve into a destination where metro stands to be the most hassle-free mode of transportation to the core of Shahjanabad. New Heritage Line will increase connectivity to the monuments within the Walled City, namely Red Fort and Jama Masjid. Motorized vehicle movement is restricted within the core area, and is limited to Chandni Chowk Road, Chawri Bazaar Road and Urdu Bazaar Road. Other major streets which serve as main connector roads within the Walled City, have non-motorized vehicular and pedestrian movement only. (Chandio et al. 2011)

B. Quality of Space: Where residential density is considered, the areas of Kuncha Pati Ram and Sitaram Bazaar are by far the most densely populated areas, with gross densities as high as 852 persons per hectare. These areas typically demonstrate narrower street patterns, smaller property sizes and less maintained built forms. Availability of open spaces is almost negligible. An organized mass void ratio is seen in Daryaganj as it was perhaps the only planned part of the area. The edge of the wall is densely built with a dearth of open space. In the core of the settlement, available open spaces are in the form of courts, courtyards or chowks. It is noted that historical open spaces such as Begum ka Bagh around the Town Hall have now been encroached upon and reduced in size.

C. Urban Character: The built fabric in and around the precinct is very dense with fine grain, texture and latticework of narrow alleys. Important monuments and structures are distinguished by their scale, and thus act as visual landmarks. Buildings abutting roads such as Chandni Chowk, Mission Church Road and Bagh Diwar form a continuous façade. The edges of the precinct are defined by roads: SP Mukherjee Marg on the north, HC Sen Marg on the east and Mission Church Road on the west. On the southern edge, the tall buildings along Bagh Diwar and Kucha Natwa provide a sense of enclosure giving a definite edge to the open space (DUAC, 2017).

2.1.4 Conclusion

Chandni Chowk can be evidently seen as a diorama of Delhi's cultural, historic, and modern blend, focal to the commercial activities. Major aspects which affected the region were: unfriendly environment for pedestrians, high influx of traffic and accident-prone areas in the region, high congestion, and dilapidation of historic buildings due to intense urbanization in proximity. It is pertinent to mention that spatial factors like accessibility, quality of space central to active mobility pedestrians, cyclists and non-motorised transport), and the urban character has a huge impact on the influx of population. Through the case study, it can be evidently highlighted that the region required changes in context to the spatial characteristics to have direct and indirect impacts on the local economy of the area. Dynamic change in the urban character, complemented in interventions focusing on active travel, changed the face of Chandni chowk and its local experience.

2.2 Literature Review- Parameters of Assessment

2.2.1 Place Making

According to standard practices in academic and professional circles, the fundamental aim of place-making appears to be the regeneration of crucial urban areas through redesign of public space with intense community involvement. Recent research suggests that place-making may be a creative and potentially independent field, competing with more established disciplines such as urban planning, urban design, architecture, and others (Palermo & Ponzini 2014).

The problem of place-making presents scholars and practitioners with a much-needed critical evaluation in the domains of urban planning, urban design, and policy-making. Only a thorough reconsideration of long-held (technical, cultural, institutional, and social) premises and viewpoints can truly improve place-making methods.

The pressing need for place-making necessitates crossing unnecessary disciplinary boundaries and experimenting with a place-based strategy capable of innovating and integrating planning rules, strategic spatial visioning, and urban development projects. Furthermore, the place-making challenge forces urban specialists and policymakers to critically consider the physical and social circumstances of their initiatives. In this sense, confronting place-making is a method to revitalise urban planning and design's civic and social function. (Palermo & Ponzini 2014).

2.2.2 Liveability

Definitions of liveability differed depending on the context. Most definitions included terms like safety and stability, quality of life, facilities, public transportation, and infrastructure. Few definitions of Liveability are as follows:

- A livable community is one that is safe and secure and has inexpensive transportation options, and has community features and services that are supportive. (AARP, 2011)

- Livable cities are healthy, safe, harmonious, appealing, and inexpensive in the broadest sense. They offer excellent amenities are easily accessible, and are environmentally friendly. (Australian Cities Report, 2013; Major Cities Unit, 2013, pp. 139)
- A livable and healthy neighborhood is one that is safe, attractive, socially cohesive and inclusive, and environmentally sustainable, with affordable and diverse housing linked to employment, education, public open space, local shops, health and community services, and leisure and cultural opportunities connected through convenient public transportation, walking and cycling infrastructure. (Lowe, Chirombo, and Tompkins, 2013)

2.2.3 Sustainability

The most commonly accepted definition of sustainability is: “meeting the needs of the present, without compromising the ability of future generations to meet their own needs”(Brundtland ,1987). However, few more definitions on sustainability are:

- Use of natural resources at a rate that can be regenerated naturally and waste emissions at a rate that can be absorbed by nature. (Dyllick and Hockerts,2002)
- Securing long-term economic performance by avoiding short-term socially detrimental and environmentally wasteful behavior. (Porter and Kramer,2006)
- Performing well on not only traditional measures of profit but also in social and natural dimensions. (Pagell and Wu,2009)

Referring to the above concepts of Sustainability, the project is being assessed for its sustainability under SDG 11 targets.



Figure 3: Questionnaire Survey conducted by students

2.2.4 Project Economy

The Project Economy is defined as a “fundamental paradigm change” in the business world toward the use of projects to handle work and solve problems. This includes employing initiatives to drive organizational

transformation since “organizations that maintain the status quo risk sinking rather than treading water.” Finally, projects add value to stakeholders through resolving issues, producing products, and aligning projects with an organization’s value streams. The

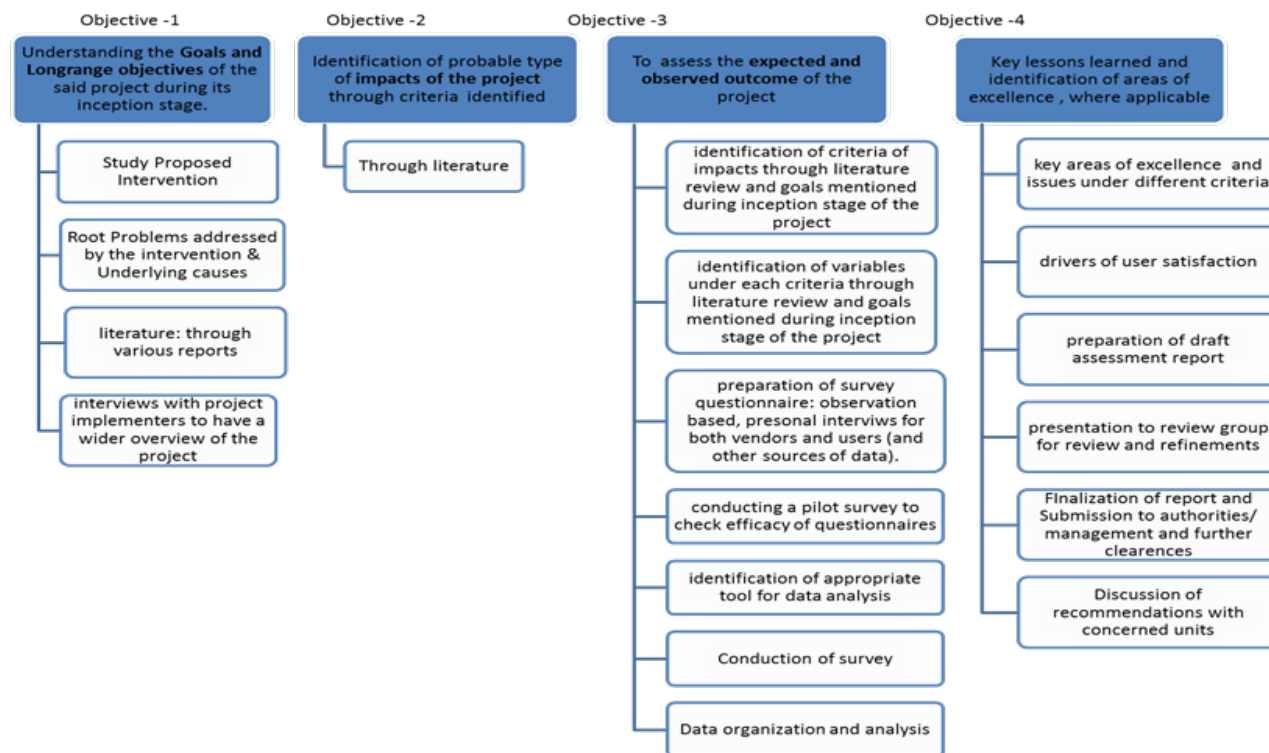


Figure 4: Objectives and Conceptual Framework of the Study

S.No	Parameters	Expected	Observed
1.	Utilities	Underground laying of electric wires as well as water supply and drainage lines.	All the electric wires, water supply lines, and drainage lines were laid underground.
2.	Legibility	Legibility in locating the shops, seating space, etc	The shops were legible with shop numbers on the top. Seating space was easy to find and had a hierarchy for different age groups.
3.	Coherence	Coherence related to shops, streetlights, and the placement of dustbins.	Shop numbers, seating benches, trees, dustbins, and lights created a coherent environment on the site.
4.	Seating Space	Distributed seating space near the shops with proper shade (artificial as well as natural using trees)	Seating space was there on the site, but no proper shading devices were placed. The plants/trees are not dense enough to provide proper shading during the daytime.
5.	Parking	Flexible parking for four-wheelers and two-wheelers near the street with a mechanism for revenue collection through parking.	Haphazard parking of two-wheelers and very little space is available for parking four-wheelers which is often captured by two-wheelers.
6.	Common Facade	Same facade of all the name boards of the shops for uniformity in the space.	Same facade for all the name boards was present but the lettering was different to maintain the unique identity of the shop.

Table 1: Expected and observed outcomes:

project redevelopment efforts are aimed to provide financial and societal value.

2.3 Conceptual Framework/ Research design

The study broadly delineates the impacts of the project based on the criteria such as economic, socio-cultural, physical and environment. Focusing on the relation between output and effects through impact assessment, unanticipated consequences and key takeaways were identified. The project assessment has enabled the possibility to replicate this project and the process. Understanding the Goals and long-range objectives of the said project during its inception stage was done in the beginning, post which, identification of probable types of impacts in similar cases is done through available literature. Literature related with placemaking and renovation of a public space is studied for better results and analysis of the 56 Dukaan. The outcome of the project is done through impact assessment.

After the literature review exercise is complete, establishment and assessment of the expected outcomes were observed. For the same, separate survey questionnaires were prepared (which were observation based); questionnaires for both vendors and users and for personal interviews were created. Pilot survey is an important exercise which was done before survey on the site in order to check efficacy of the survey questionnaires. During site visit, a survey was conducted and the survey results were analyzed thereafter. Analysis of data provided the necessary conclusion of the study like key areas of excellence under different criteria, issues identified under different

criteria, drivers of user satisfaction etc. The research will end after the preparation of a draft assessment report and a presentation to the review group for review and refinements and preparation of a final report after including all the recommendations. The methodology used is shown in figure below.

2.4 Key features of the project

“56 Dukaan”, one of the best street hubs that has been serving variety of cuisines since the formation of Indore. The Redevelopment of the project identified the existing issues of the street and thus provided intervention for the project which made it one of its kind - Smart food streets. These interventions contributed to become major features of the project. Some of the key features are:

- Preservation of the identity of the literal 56 Shops.
- Making the street a No -Vehicular Zone.
- Increased Accessibility for different age groups.
- Public spaces inducing community friendly spaces.
- Smart Waste Management

Also, the built environment - Integration of open spaces and cleanliness of the place creates a well-designed

gathering and eating space experience and adds to the overall landscape of the 56 Dukaan project.

2.4.1 Challenges in the project

- Asking the shop owners to shut down their shops for the renovation work.
- Limited time period for completion of the project (56 days).
- Developing a common facade for all the shops.
- Cleaning the entire area in different intervals of time during the day.

2.4.2 Risks involved in the project

- Convincing shopkeepers to close down during the execution of the project for an anticipated benefit.
- Risk related with decrease in the sale of shop owners after restricting vehicles to enter the area.

2.4.3 Features and benefits

The key project features are social, technical, city administration, impact on the environment and economy of the city. The expected and observed impacts are listed as follows:

- Revenue generation through advertisement
- An urban space for social gathering, meet ups etc.
- Barrier free design and accommodation of all the age groups in the design.
- Availability of seating space in different sizes and forms makes the place unique.
- Increase in land prices in the area nearby the 56 Dukaan site.
- Pedestrian safety and improved accessibility for all age groups.
- Dedicated Parking Space for 200 two wheelers and 50 cars.
- Themes based sitting spaces.

The perceived expected benefits and observed outcomes from the project are listed in the previous page (Table No 1).

2.5 Key findings from the interviews, surveys, and primary/secondary data collection

An onsite survey of around 50 people, including both shop owners and the customers was done. The graphs shown below (refer Fig 5-9), explains the various attributes such as - Accessibility before and after renovation, frequency of visits, likeability etc.

The primary surveys and stakeholder analysis help us understand the changes in 56 Dukaan area.

- Earlier a place for: EAT-WORK-SHOP-HAPHAZARD TRAFFIC to EAT-WORK-SHOP-ART-GREEN-BARRIER FREE -SOCIAL GATHERING and an ORGANIZED PARKING SPACE.
- There is a social upgradation of the place.
- People from all age groups and especially more families are now seen here.
- The space is a 24 hr relaxation area.

Perceived openness and accessibility before Vs after

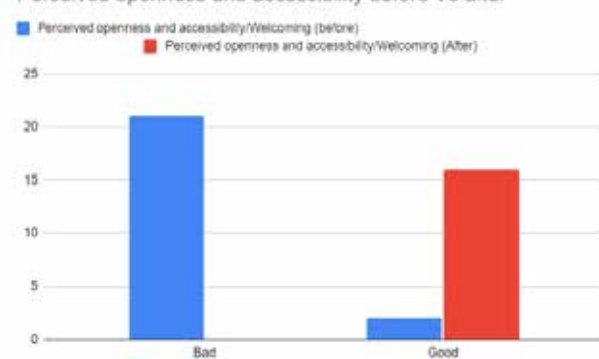


Figure 4: Accessibility before and after

Perceived suitability of space layout and design to activities and behaviour before and after

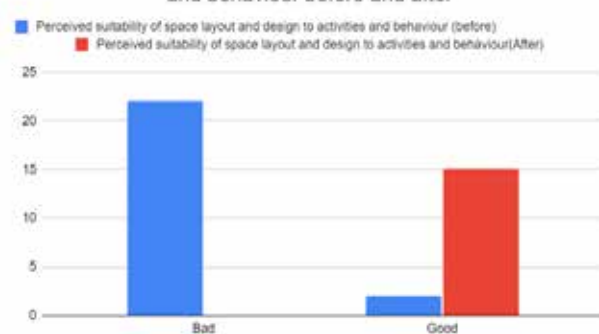


Figure 5: Perceived suitability of space before /after



Figure 6: Distance Travelled by the visitors

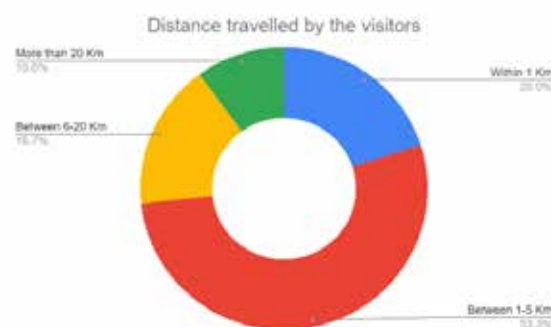


Figure 7: Frequency of visit

People using Public and Private Transport

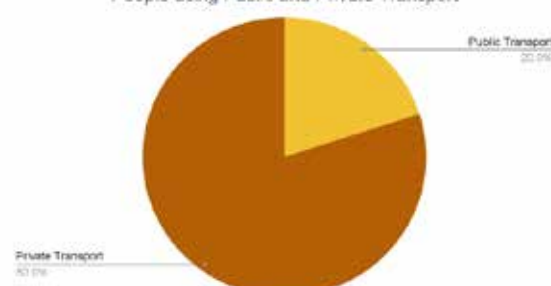


Figure 8: Mode of Transport

- It has added stars to its popularity.
- Worker's likeability of the place increased
- Most of the visitors use private mode of transportation to reach the street.
- Visitors coming from a radius of 1- 5 km were more as compared to visitors coming from relatively longer distances. The frequency of the latter's visit was once a month.
- Users identified the space as more welcoming and open in terms of accessibility after the redevelopment.

3. Discussion and Conclusion

Chappan Dukan has been the favourite street food destination of Indore for a long time and is only growing in its name and popularity. This 175-meter-long street that consists of Chappan consecutive Dukan (hence the name) of different types and varieties of food, feeds thousands of people every day. The small kiosks at Chappan Dukan allegedly contribute to around 40% of the annual 5000 cr. turnover from food markets in the city. People generally flock to the locality in numbers with their friends and family to partake in the variety of delicacies. The whole area seemed to reverberate with an energy that one does not normally experience.

After a meeting with the officials, field survey and analysis of the project, review and feedback were taken from the users, which provided for the impact assessment of the project, as stated below.

ISSUES	INTERVENTIONS
Traffic Congestion	Indore's 1 st no vehicle zone.
Haphazard Parking	Dedicated Parking Space for 200 two- wheelers and 50 cars.
Quality Of space	The Mass and Void Ratio has now improved after interventions of green and shaded public spaces.
Accessibility	Pedestrian safety and improved accessibility for all age groups.
Safety	24 hours surveillance .
Cleanliness	Waste Segregation and Plastic free zone.
Utilities	Underground electrical lines and gas lines.
Lack of Green and Shaded Spaces	Theme based sitting spaces and shaded spaces

3.1 Implications

Chappan Dukaan is a landmark street development project and Indore's first no vehicle zone. The project is successfully implemented within a time period aiming at the objectives. The Project has provided for an interactive and inclusive planning by introducing open sitting and streets accessible to people with different activities. People's participation played an important

role since the inception of the project. Cooperating with all vendors, ISCDL took citizen feedback on implementation and design. There is a huge increase in footfall from 6000 to 15000 per day after the renovation of Chappan Dukan. People like to visit there as the number of facilities have increased. Food Safety and Standards Authority of India (FSSAI), has put a stamp on the hygiene of the market, making Chappan Dukan officially the cleanest street food market in Indore, if not the country. Dynamic lighting and theme based active spaces gives a sense of safety. However, it is also observed that the space for 4-wheeler parking is not sufficient. This might also be because, with the change in quality of space, the demand for 4- wheeler parking has also increased. There is a lack of sufficient drinking water and toilet facilities. Also, these facilities are poorly maintained. Appropriate locations can be identified and this project can be replicated in line with the lessons learned and key findings.

3.2 Limitations of the research

- The assessment study was confined to chappan dukaan project site and surroundings only due to time constraints.
- The footfall, which is generally high on festivals, could not be surveyed.
- This is the first of its kind project in the state, therefore for comparative analysis projects with similar elements were considered.

3.3 Key lessons learnt

Planning interventions can resolve issues in the existing environment. In this project, planning interventions have resolved existing issues of the place and have also contributed towards fulfilling goals of SDG 11- "Making cities inclusive, safe, resilient and sustainable" by creating a No-Plastic Zone, community friendly spaces and also efficient waste management. The planning interventions are shown above.



Meeting with the officials at Smart City Corporation office



Site visit with the officials at 56 Dukan, Indore

Interventions mentioned above provide lessons for further projects of similar kind. Project has resulted in lesser energy consumption. There has been a reduction in air pollution in the area. Place Making as an exercise has increased the footfall of the place, which has further added to overall increase in revenue of all the 56 Shops.

3.4 Recommendations

The successful implementation of this project under Smart City Mission, makes it a unique and an impactful case study. This project planning and redevelopment strategies, displays a systemic design approach which

enables the possibility to scale and replicate the projects and its processes.

As the project is in operational mode now, we can infer that the project has successfully fulfilled the objectives as envisioned during the start of the project. In the case of 56 Dukaan area, the scalability is limited as it is centrally located which does not permit expansion, moreover it has reached its full development potential, but we can create similar eatery joints /areas with more facilities in other parts of the city to achieve similar benefits. Other design recommendations include, increasing the shaded area on the site, considering the

hot peak summer months. Also, more dense trees (for natural shading) could be planted for future comfort benefits.

It is an excellent example of 'Place making' through sustainable practices and state of the art practices like segregation and waste management, thus fulfilling the agenda of SDG 11 targeting - Sustainable cities and communities. It is a successful case of a small project having a high impact on society, economics and culture of the city. Such projects capture the culture of the city as well as provide well-functioning smart infrastructure, and could be replicated in other cities of similar nature.

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Urban Green Spaces as Socia-Ecological systems: A Case of Three Parks Redevelopment in Sagar, Madhya Pradesh

Name of the project: Redevelopment of Three Parks

Location: Sagar, Madhya Pradesh

Year of Project Implementation: February 2020

Sector: Sustainable Environment

SDG: SDG 11 - Sustainable Cities and Communities; SDG 13 - Climate Action; SDG 15 - Life on Land

Project Cost: Rs 4.05 crore

Institute: School of Planning and Architecture, Bhopal

Advisor: Dr. Rama U Pandey

Student: Gurudutt Pandya

Keywords: Redevelopment of Public Park, Urban Green Space, Ecosystem Services, Green Cover

Abstract:

This research aims to evaluate the critical aspects of three parks redeveloped under the Smart City Mission to enhance the well-being of the residents of Sagar city in Madhya Pradesh. The review includes analysis of critical elements such as amenities, community participation, activities and interventions from the perspective of ecosystem services. The study begins with the hypothesis that these three parks provide vital ecosystem services to improve urban lifestyle and other biodiversity and climate regulations. The performance of these parks was evaluated in three different wards of the ABD (Area Based Development) region located in the centre of Sagar city, known as the Civil Lines area.

A survey was conducted on a heterogeneous group of 50 randomly selected respondents and Smart City project executives. The quality of the three parks (Dr Hari Singh Gour Park, Madhukar Shah Park, and Chandra Park) was analysed using field observations and responses of stakeholders collected through interviews. The results indicated that though there were green spaces available, but they lacked maintenance. The parks lacked basic infrastructure such as sidewalks, lights and play equipment etc. However, after Sagar Smart City's redevelopment project, they now function as significant part of the neighbourhood providing possibilities for physical activity and boosting the city's green cover. Furthermore, the notion of the urban ecosystem services highlights the importance of green infrastructure as an essential component of urban space design. This research also highlights the challenges that should be addressed in the planning and designs of the urban parks.

1. Introduction

1.1 Topic and Context

Re-development of urban green spaces/parks under the Smart City Mission as a socio-ecological system.

As the world’s population continues to rise at a steady rate, an increasing number of individuals are migrating to cities on a daily basis. According to census 2011, cities now account for around 35% of the present population and provide 65% of the country’s GDP. Urban regions are predicted to contain 40% of the country’s population plus generate 75% of India’s GDP by 2030 (census 2011). In most cases, this entails the integration of immense physical, governmental, sociological as well as economic infrastructure. All these factors help to improve the living conditions and attract more people and businesses, commencing a positive cycle of expansion and development. Smart city development is a move in this direction.

The majority of smart city operations and resources are prioritised to improve public lifestyle. To make a major difference, organisations leverage a variety of techniques, such as technologies and information solutions, urban planning procedures and practices, public-private partnerships as well as policymaking (Smart City India). Major smart city strategies are:

- i. A pan-city plan that includes implementation of at least one smart solution throughout the city
- ii. Improve regions progressively – Three Area-Based Development (ABD) strategies
- iii. Redevelopment
- iv. Retrofitting
- v. Greenfield

The city’s forward-thinking and constructive approach towards expansion has boosted its economic development. Today Sagar is a prominent city of the Bundelkhand region encompassing a substantial part of Madhya Pradesh and Uttar Pradesh’s economic activities. The city serves the region’s commercial, educational and medical interests. Sagar, also known as “Saugor”, meaning hundred castles, is located on a peninsula of the Vindhya ranges in the Bundelkhand region (Figure-1). It is 180-km North-east of Bhopal, the state capital. This historic city, built around the well-known Lakha Banjara Lake, has the ability to become the region’s most important business centre.

Sagar smart city has listed 20 components under the Area-Based Development in the smart city proposal document. These include core area development, lake rejuvenation project, integrated command and control centre, integrated recreational well-being facilities, re-development of multiple areas, advancement of the

water supply system, waste management, and many more. One of the projects - “Redevelopment of three parks,” was completed under the module of “integrated recreational well-being facilities”, with the objective of maximising the town’s recreational value.

Following are the objectives of the project:

- i. To provide attractive, safe and usable green spaces to the public at large
- ii. Special emphasis on provision for children-friendly and elderly-friendly components
- iii. These will also be effective in mitigating the urban heat island effect in the future
- iv. To be a valuable environmental resource as the town continues to grow in both size and population
- v. These parks will also improve the aesthetic value of the town.

1.2 Scope of Research

In this study, the three parks (Dr Hari Singh Gour Park, Madhukar Shah Park and Chandra Park) located in different wards of the ABD region, as shown in Figure (2), were evaluated for the socio-ecological activities and impacts on the neighbourhood. The evaluation was done by analysing field observations and stakeholders’ interviews. A primary survey was conducted to capture the responses of a varied group of 50 randomly selected stakeholders, as well as smart city project administrators.

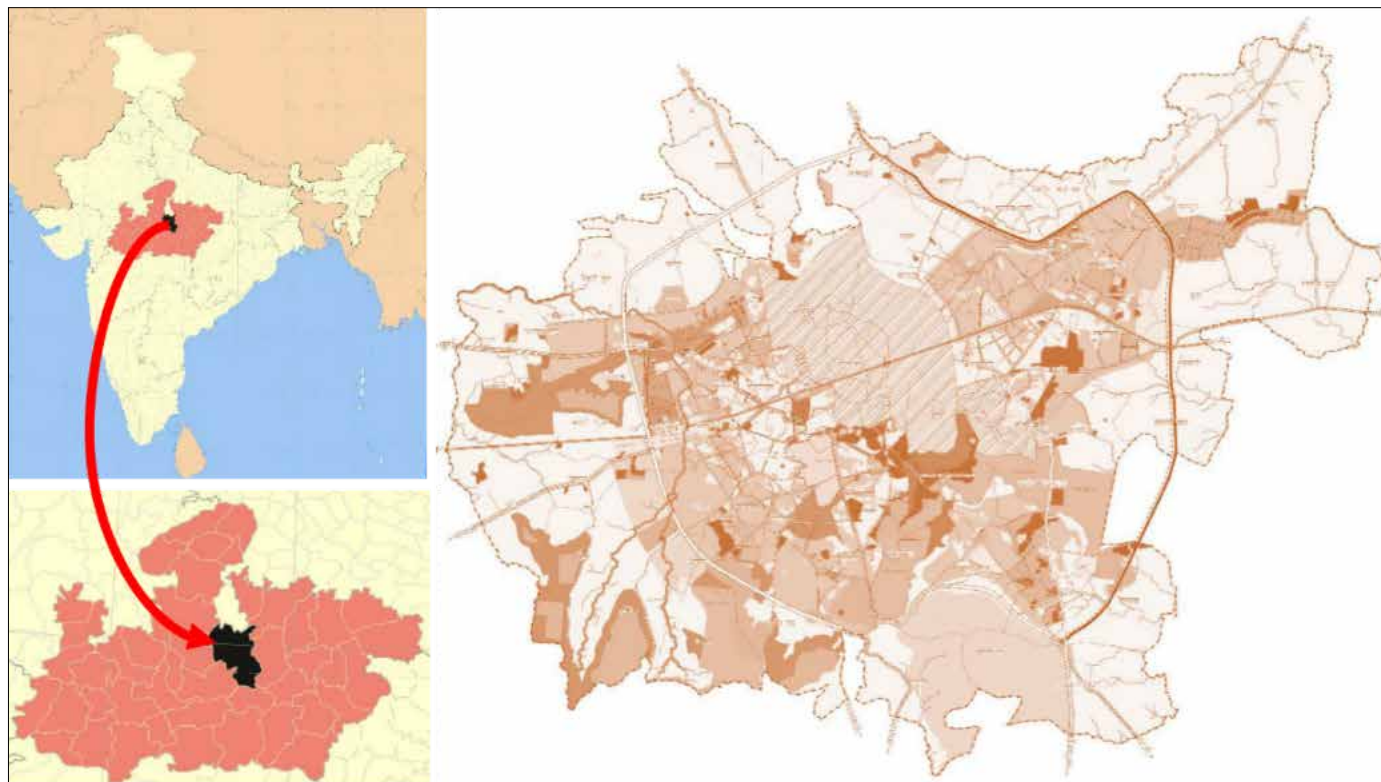


Figure 1: Location Map of Sagar city
Source: Sagar Smart City Limited.

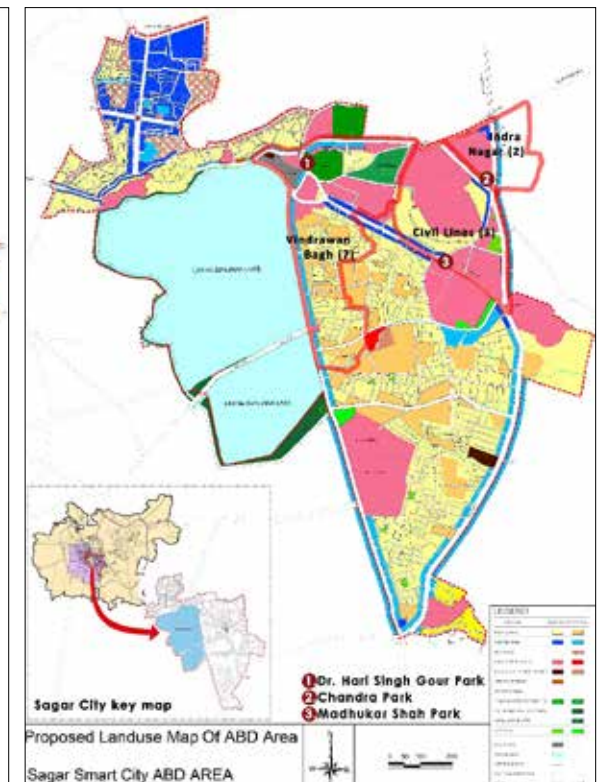


Figure 2: Location Map of 3 Parks in ABD area

1.3 Significance of the project

Many Indian cities have a lower per capita ratio of public open spaces and do not fulfill national or international criteria. Furthermore, problems such as lack of public open space design principles, limited funding as well as absence of adequate interaction have impacted these few public open spaces, making them wasteful and unable to meet the present needs of different broad range of users. To make effective use of available infrastructure and amenities, it is important that they are not just inclusive and inviting, but also user-friendly and engaging. It is also important to not only make them functional and economical but also culturally, socially and environmentally friendly.

Unplanned development over time has resulted in an inequitable allocation of public open areas in the city as shown in the Figure (3) and Table 1. Furthermore, increased public spending on urban energy consumption has risen as a serious issue in the city. To improve the ecological urban environment within the city, a balance between developed and open spaces must be achieved. Green spaces in the cities play a significant role in promoting green technology, resulting in a more sustainable urban ecology and solving global climate issues. Priority should be given to the efficient use of natural resources.

Land Use	Area in Ha	Percentage
Residential	145.31	24.26 %
Commercial	34.49	05.76 %
Mixed Use	14.46	02.41 %
PSP	104.36	17.42 %
Facility and Utility	01.61	0.27 %
Transportation	61.67	10.30 %
Recreational	11.38	01.90 %
Vacant Land	70.77	11.81 %
Water Body	154.10	25.73 %
Heritage	0.86	0.14 %
Total	599	100 %

Table-1: Existing Land Use of ABD area
Source: Smart City Mater Plan-2031

1.4 Aim and Objectives

The aim of this study is to analyse the social and ecological impact of the three newly redeveloped parks, and highlight the linkages between human well-being and urban green spaces. This has been achieved through the following objectives:

- Mapping the urban parks and understanding their recreational and cultural significance
- Evaluating the integrated quality of the three urban parks
- Assessing the ecosystem services provided by these urban parks

2. Contextual Background

2.12.1 Conceptual framework

The research focuses on three urban parks. These public parks are located in the city center and are open to the public. The research findings are based on a review of the literature as well as interviews with park visitors and officers during primary survey. The integrated quality of the three urban parks was evaluated, which comprises of five key elements: Human well-being, inclusivity, interaction, sustainable landscapes and management. For data collection, the study used a hybrid strategy that included a random questionnaire survey of varied stakeholders and site observation. The stakeholders included 50 visitors from all three parks. The study will assist planners, designers and Urban Local Bodies (ULB'S) in developing measures to make such scarce urban parks inclusive, functional and sustainable, while also enhancing the users quality of life. The results suggest that the visitor's or user's experience of visiting and utilising the space is influenced by the available facilities and amenities and the visual appearance of the parks. Interpretation is an essential and subjective feature that designers and planners seem to be unable to regulate. Figure (4) depicts a diagrammatic representation of the study's approach.

Public Open Space

Public open spaces are social venues that are usually open and accessible to everyone (Carr, et al., 1992). Public open spaces are defined as, "An outdoor place that is freely chosen and freely open to freely selected

and spontaneous activities, movement or visual observations" (Woolley, 2003). People use public open spaces to convey their culture, ideas and feelings, which symbolise society (Carr et al., 1992; Woolley, 2003). Public open spaces promote social contact, gatherings, public activities and services that support individuals and develop a "sense of community." Researchers proposed various distinctive features of effective community open space such as linking people to nature (Saldivar et al., 2020), encouraging active and passive activities (Woolley, 2003) and giving freedom to act and accessibility [(Carr, et al.,1992; Bahriny, et al., 2021)].

Ecosystem Services and Urban Parks

The theory of ecosystem services includes environmental and human interactions that integrate biological

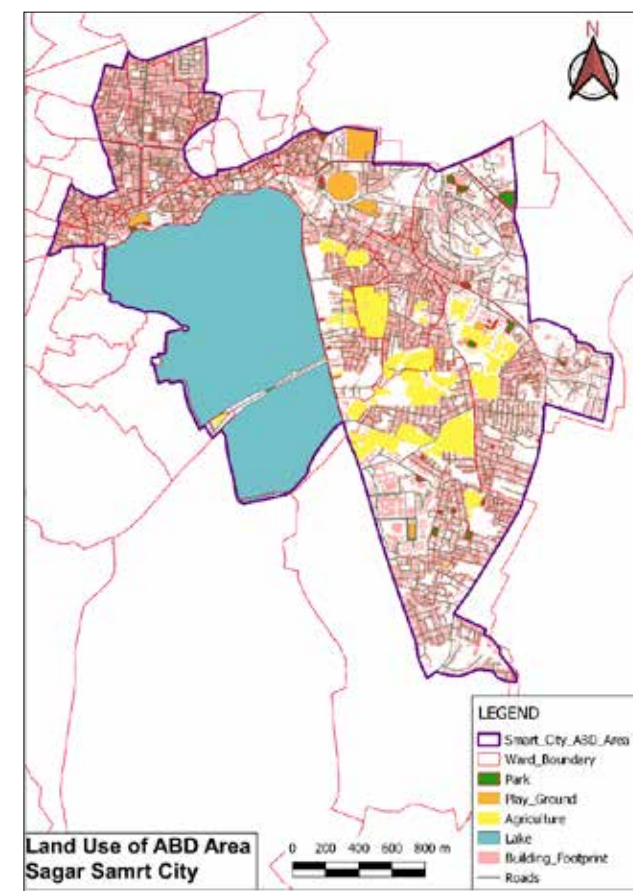


Figure 3: Land Use Map of ABD Area of Sagar

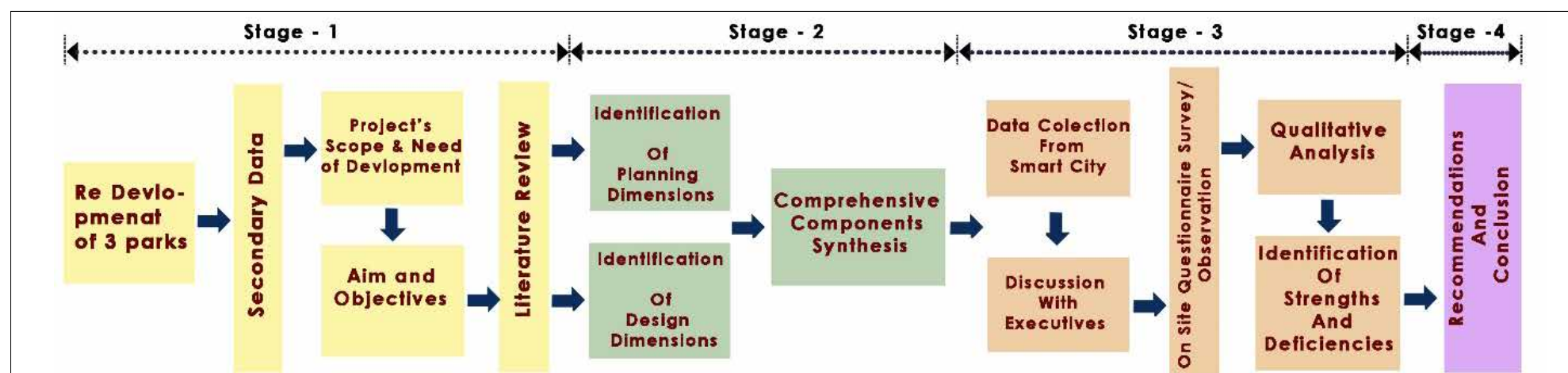


Figure 4: The methodology used for the study is shown schematically.

components as well as ecological processes with goods and services used by humans (MEA, 2005). The term “ecosystem services” is becoming popular as a way to highlight the linkages between urban landscapes as well as urban well-being (Bolund & Hunhammar 1999; MEA 2005). Ecosystems and biodiversity economics (TEEB, 2010) developed an ecosystem services classification system based on the millennium ecosystem assessments

(MEA 2005). Table 2 shows the services provided by parks which are classified as regulating, supporting, provisioning and cultural from field observations and literature references.

Urban parks are physiological spaces where individuals from all cultures as well as ethnic backgrounds come to connect and engage with the environment in their leisure

time. They are established for physical, psychological, ecological and leisure; and, they carry passive and active physical activities such as meetings, recreation, relaxation, and so on, which helps to reduce the stress of urban lifestyle. Aspects like “amount of public green space per person,” “public parks,” as well as “recreation locations” were commonly identified as being crucial in establishing a city liveable, attractive and appealing for

Ecological Processes	Ecosystem Services	Benefits
The effects of nutrient cycling on the ecosystem's energy and resource development (Ozone layer, CO ₂ , etc.)	Regulation of air quality	<ul style="list-style-type: none"> Nitrogen oxides, CO₂, Carbon monoxide, particulate matter and volatile organic compounds are all removed from the atmosphere CO₂ absorption Reduction of Carbon footprint
Evapotranspiration, increase of surface albedo	Climate regulation	<ul style="list-style-type: none"> Reducing the impact of urban heat islands Reducing air temperature Reducing carbon emissions in the city Reducing carbon footprints involved in food Reducing ventilation and air conditioning demands Reducing gas emissions for food production
Solar radiation converts energy into food plants and insects	Food	<ul style="list-style-type: none"> Fruits Food safety Raising citizens' knowledge Agricultural production and processing Resource consumption and production
Flood protection, water filtration, retention and storage	Water treatment, extreme event mitigation and surface runoff control	<ul style="list-style-type: none"> Retention of soil nutrients Organic waste and fertiliser production
Accumulation of organic matter	Erosion control, soil fertility preservation	<ul style="list-style-type: none"> Retention of soil nutrients Organic waste and fertiliser production
A habitable environment for natural flora and fauna to flourish and reproduce	Pollination, biological, preservation of migratory species' life cycles, protection of biological diversity	<ul style="list-style-type: none"> Habitat provision for insects and wildlife Development of vegetation biodiversity Landscape enhancement Plant agro-biodiversity
Attractive landscape features	Aesthetic qualities	<ul style="list-style-type: none"> Recreation and relaxation Establishment of a leisure space with a sense of safety and security Horticultural methods and upkeep Community engagement, funding and volunteer administration Promoting psychological well-being Community building Strengthening social ties Dismantling social obstacles Landscaping vacant plots Taking back the city Cultural identification
Recreational usage of urban space changes	Opportunities for recreation and tourism	
The importance of cultural and changes of aesthetic natural elements	Inspiration for culture, art and design	
The spiritual and historic natural aspects having a wide range of values	Spiritual experience	
Nature's influence in ways that involves scientific and educational effects	Information for intellectual growth	

Table-2: Major environment benefits and ecosystem services provided by Sagar's urban parks
Source: (Urban green space planning: An ecological approach on social benefits, Semeraro at. El, 2021)

Visitors	Variability/Activities	Linkages and Accessibility	Appearance and Convenience	Social Abilities
<ul style="list-style-type: none"> Thoughts and behaviours Views Needs Intimate Sense of calm Convenience Security Health Environment Requirements Expectations 	<ul style="list-style-type: none"> Walking Sitting Resting Eating Watching Lying Celebration Fun Vitality Chatting 	<ul style="list-style-type: none"> Continuity Proximity Convenience Legibility Walkability Accessibility Connection with activities Connection with transportation 	<ul style="list-style-type: none"> Safety Suitability Walkability Greenness Cleanliness Landscape elements (Benches, steps, dustbins, lighting fixtures, greenery/trees, murals, banquetts and toilets) 	<ul style="list-style-type: none"> Interaction Story-telling Friendship Interactive elements Multicultural

Table-3: Quality attributes/criteria of the three urban parks
Source: Design Guidelines for Urban Open Space, Marcus and Wischemann (1990)

its citizens (Chiesora, 2004). According to Marcus and Wischemann (1990), accessory items incorporated in park design, as well as these elements' capacity to achieve the demands of users can be assessed as per criteria listed in Table 3.

2.2 Key features of the project

Surroundings of all the three parks have distinct contexts and users. The locations of these parks are also distinct. Because of the differences shown in Figure (5), it is critical to examine all the three parks separately.

The parks are in the heart of the ABD area. The large and well-known Chandra Park is near the Civil Lines Circle. This is one of the city's elevated areas. The development of these three parks is only the foundation. More parks are being developed with the goal of having

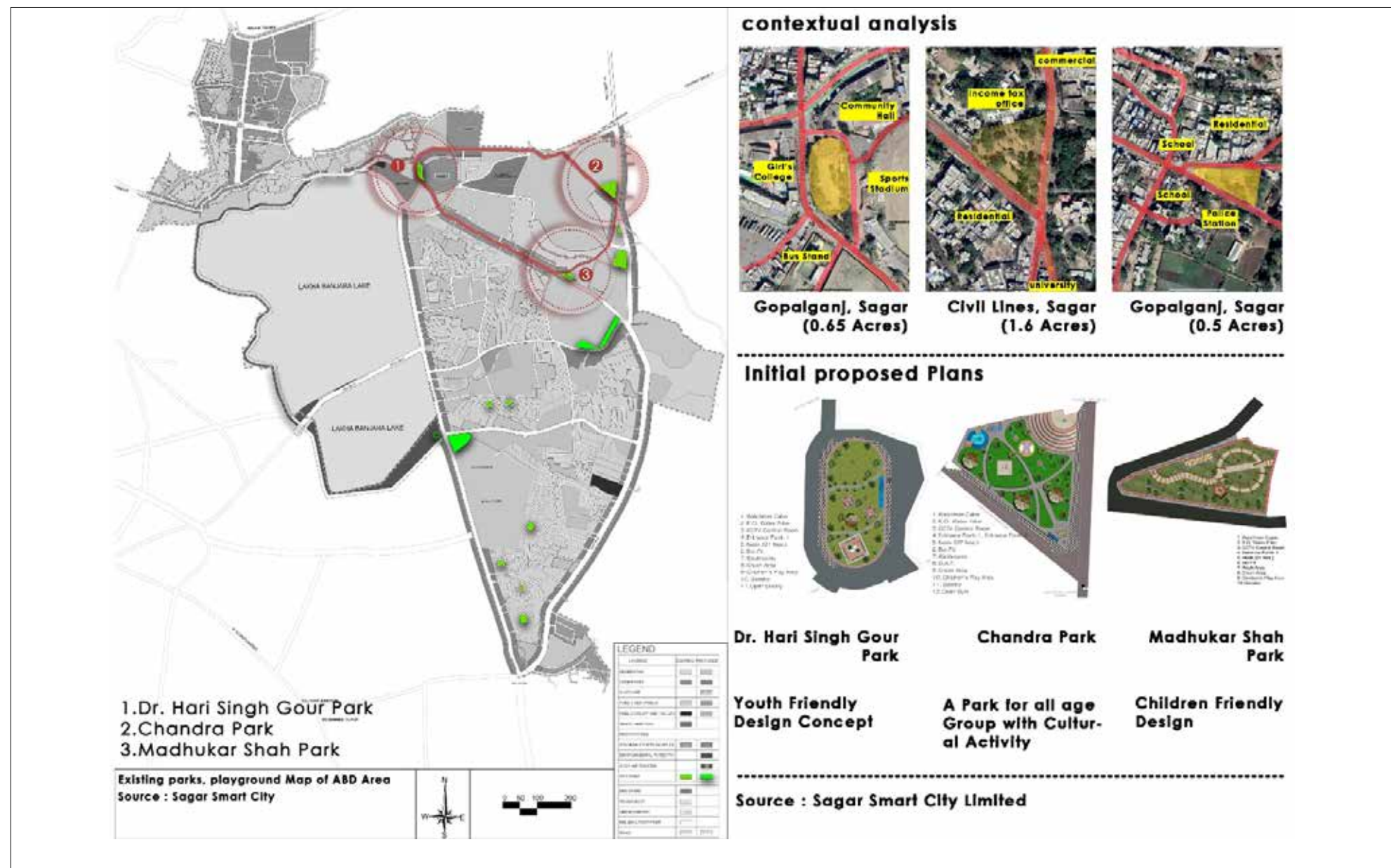


Figure 5: Location of the Parks and Site Context

Work planned by SSCL (Rs 4.05 crore)	Dr Hari Singh Gour Park(Rs 0.90 crore)	Chandra Park (Rs 2.33 crore)	Madhukar Shah Park(Rs 0.81 crore)
<ul style="list-style-type: none"> Horticulture works Paving works Boundary wall and entrance gate Street furniture Gazebo Open air theater Drainage, irrigation works and rainwater harvesting Lighting and electrical works Toilet and septic tank Children's play area Open gym Related civil works 	<ul style="list-style-type: none"> Pathways Green lawn Open gym Toilet block Open library Security cabin RO filter and CCTV control room 	<ul style="list-style-type: none"> Pathways Green lawn Leisure activities Play area for children Kiosks Gazebo Open air theater Toilet block Security cabin, RO filter and CCTV control room 	<ul style="list-style-type: none"> Pathway Green lawn Fountain Toilet block Security cabin, RO filter and CCTV control room Children's play area

Figure 5: Location of the Parks and Site Context
Source: Sagar smart city

a small urban green park in each of the city's 48 wards; "Atal Park" is being built by the municipal corporation; 2-to-3 additional park development projects with sports facilities are currently under construction. Because the area of the parks is small, the facilities are adequate. Walking paths, open gyms for exercise, visitor toilets and most importantly, large open green spaces with designed landscapes have been provided in all the parks. Every park has dedicated children's play area as well as music system and seating for the elderly. There is also an open amphitheatre in Chandra Park. A feedback survey system has been installed in all parks, but it is currently not operational. A list of the work done under the redevelopment is shown in Table 4.

Prior to the redevelopment of the parks there was a large drainage ditch that ran through it, which had a negative impact on the park's environment. This included poor waste management and air and land pollution. All these issues have been resolved in the redevelopment. All green space projects come under the smart city mission.

2.2.3 Challenges in project implementation

After reviewing the land use plan and the city's growth, it is clear that there will be very few land available for development of open spaces in the city's ABD area. These three parks were historically used as parks. The municipal corporation was in charge of operation and maintenance. Due to lack of funds and lack of staff, the condition of these parks deteriorated significantly. The problems in each park are unique, so surveying all three wards was a difficult task. According to officials, the time allotted for development was limited. The budget was divided based on the size of the parks. Chandra Park was the largest and had the maximum features of the parks, as was listed by the Sagar Smart City Limited (SSCL) in Table 4. Prior to redevelopment, the common issues in all the three parks were:

- i. Poor landscape
- ii. Poor condition of furniture

- iii. Entrance to the parks were located on busy streets
- iv. No lighting
- v. No facilities for drinking water and toilets
- vi. Lack of walkways
- vii. Insecurity in female users
- viii. Patchy lawn area
- ix. Underutilisation of the parks

All these difficulties were encountered by users and as part of redevelopment, smart city attempted to cover and resolve these issues.

Due to lack of time and willingness to complete the project as quickly and efficiently as possible, the initial proposal presentations were not held. As a result, the project began straight away with the proposal drawings. To solve problems and make quick decisions on a variety of issues that surfaced during construction, many design decisions were altered because of public consultation with the residents of the park and nearby areas, particularly the Girl's college near Dr Hari Singh Gour Park. Furthermore, residents near the Madhukar Shah Park were also consulted. Therefore, the drawings and 3Ds were not perfectly aligned. Many focused group discussions regarding facilities and requirements took place in the Girl's college and the school near Madhukar Shah Park. In the early stage of design, there had been provision for a small toilet for park visitors, but after consultation with stakeholders, it was removed so the park space could be increased. Another example was the building of Kalicharanji's statue at the intersection corner in Chandra Park, which is entirely due to public demand.

The project was completed three years ago. Municipal corporations now take complete responsibility for these parks including ownership of the land. At the start of the program, they had floated tenders and a number of companies had even bid for it. Contractors who succeed in the tender had to maintain these three parks for three years; this is referred to as "DLP" (Defect Liability

Priority). In case of any damage such as the equipment breaking or wiring problems, cleaning or landscaping damage must be carried out by the contracted firm. Pratap Builder (PB Tech) served as the executive firm for all these three projects. The contracted firm had to also operate and maintain these parks for three years.

The smart city's responsibility was only to develop this project, after which they handed over the project to the municipal corporation, so any liabilities incurred after this would not be accountable by the smart city. Furthermore, the smart city unit was very limited in terms of technical expertise and staff such as waste and water management, as well as cleaning staff. The parks were inaugurated in 2020, but since then due to the Covid pandemic there have been very few social gatherings and events, even though they have facilitated many competitions such as drawings and dance in Chandra Park. Drama was also performed in the open amphitheatre.

2.2.4 Features and Benefits (Social, technical, city administration level, impact on environment and economy) to the city (expected and observed)

Dr Hari Singh Gour Park is situated close to a Girls College, so a library and an open gym for female students were built. A green lawn took up the largest amount of space. The most important thing is not how a park can be built, but that it also has to be maintained. The area of the park is inadequate. To preserve the park's natural beauty, minimal equipment and more open space for public use was needed. There are walkways throughout the park for walking purpose. To make the park youth-friendly and target all age groups facilities were provided for them.

The Madhukar Park is located in a residential neighbourhood facing the city Jail. The development of this park was intended to make it more child-friendly. As a result, it has been fitted with kid-friendly amenities such as swings, slides and gym equipment. To make



Figure 6: Drawings of the final execution of all the three parks
Source: Sagar Smart City Limited. Drawings: Grant Thornton India LLP

it further attractive to visitors, mountains have been built all through the park. Elements such as fountains and seating areas have been included to cater to the parents of the children who will visit the park. Green infrastructure has been used sparingly in this park. As an instance, space has been provided in the paver blocks for water to dissipate into the ground.

In addition, Chandra Park has been provided with rainwater harvesting and a water storage tank at the back of the park. Space has also been created for manoeuvrability of the fertiliser. Due to the absence of engineering skills, gardner and limited technical staff,

drip irrigation system has not been provided. The cost of construction was also an important factor to consider. At the time, the project's funds were very limited and there were other upcoming projects in the pipeling. There are also plans to develop parks in each of the 48 wards, which is a very difficult task. The size of the parks is also important because the smaller parks can be manually operated. In terms of sustainability, solar energy lighting and water heater for toilets have been installed. A large area is covered by green lawns to make space for stable furniture.

Prior to redevelopment, these parks had haphazard green plants, including eucalyptus. This contributed to groundwater depletion and loss of soil fertility. During redevelopment such plantations were removed, so initially it appeared that the green area had reduced, but in the long run it is beneficial for the parks. Many larger trees were preserved in their natural state. To keep the coronavirus from spreading, entry to the park is restricted. The park is open only for an hour in the morning and evening. All three parks were developed without public consultations during the design development stage. The SSCL wanted to finish the work as soon as possible so they could open it for the citizens.

2.5 Key findings from interviews, surveys and primary/secondary data collection

Name of the Park	Dr Hari Singh Gour Park	Chandra Park	Madhukar Shah Park
User area	Shanivarich, Gopal Ganj, Girls college, Bus stand, Krishna Ganj	Civil Lines, Gopal Ganj, All wards, other cities	Civil Lines, Gopal Ganj, Ahmad Nagar, Shree Ram Colony, other cities
Before Development	<ul style="list-style-type: none"> Visitors speak abusive language Unsafe for girls Misbehaving with girls Couples and Delinquent elements No children's play equipment No adequate walkways Consumption of alcohol People hesitant to visit No proper sitting space Unpleasant sewer line passing through 	<ul style="list-style-type: none"> Nothing appealing From outside Animals trespassing No irrigation and no sanitation No walkways No lights No parking Improper use of park at night Inadequate levelling 	<ul style="list-style-type: none"> Not sufficient fencing Dilapidated children's play equipment Less appealing Less used People hesitant to bring their children No illumination Dust pollutants in the air Muddy during rainy season Unhygienic sewer line encircling the park Students exploit equipment Neighbours uninterested Markets around the fences Property was taken from jail authorities but was being used as garbage dump Presence of alcoholics Misbehave with women and play cards
After Development	<ul style="list-style-type: none"> Gate eliminated anti-social elements Better security Nirbhaya rounds Improved play space for kids Suitable for meetings Yoga, walking, sports ground nearby Increased usage Vegetation enhanced Peacefulness enhanced Lawn area extremely beneficial 	<ul style="list-style-type: none"> Attracts people Children's play area Open gym, relaxation Lawn area Cultural activities Walking Meditation Exercise Children's Recreation Meetings 	<ul style="list-style-type: none"> Using it for leisure and calmness Entry gate changed for safety Eucalyptus trees removed Walkways developed Increased greenery and vegetation More appealing More visitors in the evenings Elderly and child-friendly Rise in number of visitors Residents engaged Drop in local temperature Old women come for exercise Users come during spare time
Suggestions from Interviews	<ul style="list-style-type: none"> Plantation and flowering plants are desired A camera is requested A security guard needed Plant irrigation necessary Cultural or social events should be organised Timings could be updated Additional open gym equipment required Additional furniture would be appropriate Maintenance required Drinking water facility desired 	<ul style="list-style-type: none"> Gym equipment must be repaired and maintained Additional furniture needed for the weekend crowd Music systems not working A selfie booth is needed The best out of waste can be used Restrooms can be better Parking needs to be improved A canteen for youngsters 	<ul style="list-style-type: none"> Maintenance improvements required Irrigation to be done on a regular basis No toilet block Space was rented Timings to be revised Open gym furniture could be more A security guard and a camera are desired Drinking water supply not working Old walls to be restored Artistic work could be done on the boundary wall Sewer line around the park to be covered
Frequency of visitors	70% - 7-8 days in a month 10% Daily 20% First time/Once in a week	60% - 3 to 4 days in a month 20% Daily users 20% First time/Once in a month	70% - 10 days in a month 20% Daily 10% First time/once in a week
Age Group	14-30 years	All age groups	All age groups
Park Activities	Exercise, yoga, sitting, chatting, resting, eating, watching, walking, fun	Exercise, gym, yoga, cultural events, drama, sitting, chatting, resting, eating, watching, walking, fun	Exercise, gym, yoga, sitting, chatting, resting, eating, watching, walking, fun

3. Discussion and Conclusion

Urban parks in regions where the human-environment connection is damaged are essential to redevelop. City spaces with high building density and heavy traffic need parks to provide visitors with a wide range of choices or an opportunity to take a break or re-energise an individual's connection with nature. The following sections discuss the findings obtained from the synthesis of field observations and stakeholders' interviews.

Field survey comprised of questionnaires conducted on randomly selected 50 users (visitors) to the parks. Almost 60% of the total respondents were females. The analysis highlighted that people aged 16 to 24 years (68% of the sample) now visited these parks more frequently. Majority of the park users are students (60%), followed by retired personnel (10%) who live in the Civil

Lines area, Government officials (10%), and housewives (10%). Amongst the students, 55% are college-going whereas, 25% are neighbouring school students and 20% are primary school students. In terms of usage, 30% used the parks only during weekends as compared to 20% who claimed they used it on weekdays. While 23% of the respondents visited once a month, 27% visited frequently. The locations of the parks indirectly influence the visits due to their proximity to city-level amenities such as training facilities, governmental institutions and commercial set-ups.

The variety of activities available in urban parks to the proportion of people using them was some of the factors influencing the satisfaction of the occupants. The responsible authority can discuss the concerns with potential stakeholders, such as efficient utilisation of

park spaces for multiple activities throughout the year during the conceptualisation stage of the project itself. Consultation is also essential to encourage visitors' engagement in various park programmes and determine whether the park is appealing at different times. When looking at all three parks in this context, there are spaces for activities accessible to the public like multi-purpose lawns, kid's playgrounds, gardens, relaxing green areas, walkways and tourist features.

As per the results of the survey, 30% respondents preferred to spend time in the green spaces, particularly on weekends, and 25% preferred seating spaces, followed by garden use (20%). Only 10% of the visitors indicated using the multi-purpose lawns and their adjoining areas.

3 Parks Before the Re-Development



Dr. Hari Singh Gour park



Chandra Park



Madhukar Shah park



Patchy Lawn / broken Equipments



Bushes / not working fountain



broken Equipments / not working fountain



Patchy Pathway / poor waste Mangement



Broken Equipments / Patchy Lawn



unused Equipments / Euclyptus



The completion of the project having public amenities and services inside the parks has made the neighbourhood environment much healthier. Citizens of Sagar can now access improved facilities such as a free open gymnasium in their neighbourhood to better their health. Children can now play in the parks, there is more place for efficient entertainment and better performing arts which has re-defined the idea of “park” among the citizens of Sagar.

3.1 Implications

Parks have always been an important part of the communal landscapes. As open green spaces become increasingly rare, public parks have potential avenues and incentives to engage with other agencies and departments to effectively use designated public green spaces. Many of these benefits could be achieved only by planning current or future parks to regulate the

runoff using green infrastructure concepts. Green infrastructure may be utilised to revive the existing parks or to improve the design and performance of new parks.

Parks are local investment for green infrastructure because they are usually highly visible and multi-functional public places with green elements. Adoption of Green infrastructure has risen over the last decade as awareness of its benefits has evolved. Integrating green infrastructure within parks can have a significant impact on the neighborhoods. Focusing on Green infrastructure-based parks, redevelopment and restoration initiatives in neglected neighborhoods, where the need is typically highest, can guarantee that the influence has social equity benefits in addition to environmental and economic value.

3.2 Limitations of the research

The initial field visit was highly challenging. Only 50 questionnaire surveys of visitors and neighboring households were possible because of the Covid pandemic. The samples were selected using a random sampling method. The literature review also helped in comprehending the ecological services and benefits. It is tough to identify each ecosystem service in-depth due to the short duration of the study.

Furthermore, the project’s data access was severely restricted. The urgency to complete the project due to stringent deadlines made the authorities skip a presentation round essential to finalise the specifications and design. Some of the park activities provided in the project were not contextual such as Amphitheatre in Chandra Park. The survey respondents do not want to use them. Moreover, in the collective answers one

3 Parks After the Re-Development



Dr. Hari Singh Gour park



Sitting / Chatting Lawn



Kids Playing equipments



Fountain / laying on lawn



Chandra Park



Walking / kids Gyming



Sitting on the Benches



open amphitheatre / Gyming



Madhukar shah park



Kids Play / walking



Fountain / Gyming



Walking / Busy street

could not discover all the benefits of the park's various activities.

3.3 Key lessons learnt

The findings drawn from the field observations about the significance of urban parks and the lessons from the research are as follows:

- i. Urban parks provide a natural environment that helps to reduce urban pressure and play an essential function in improving the city's standard of living. The physical, emotional, and mental interactions between the public and the environment guarantee the effectiveness of these spots. As a result, user opinions of their environment play a prominent part in this assessment.
- ii. Parks are well-known for their recreational and social benefits. Connecting parks, green spaces, water channels, as well as other undeveloped or reclaimed areas were used to create an interlinked open spaces network. On the other side, it provided more significant benefits to people, nature and the economy.
- iii. A web of parks can also create a pathway for species to move from one isolated natural habitat to another. Moreover, just as it is crucial to plan and build road networks and other physical infrastructure ahead

of urban growth, it is also essential to prepare and preserve urban green infrastructure as the municipality expands.

- iv. Parks connect individuals and neighbourhoods, provides opportunity for activities to help overcome today's obesity and elderly diabetes trend and improve mental well-being by bringing nature "closer to home."
- v. Maintenance and administration are two significant variables influencing quality control and management of the parks. The regular maintenance and repairing of installed equipment will enhance the appearance and add quality to the space. Visitors will also feel safe and comfortable.

3.4 Recommendations

In the context of the three redeveloped parks of Sagar city, based on the understanding developed from studying urban green spaces as social-ecological systems, the following is recommended:

1. A real-time tracking system, standard maintenance methods, operation & maintenance training system and a database detailing the location of infrastructure can become part of the contract.
2. Currently, there is a paucity of skilled workers to maintain and sustain the beauty of these parks. Recruitment of trained workers is needed.

3. Establish long-term maintenance funding to support capital expenditures and green infrastructure implementation initiatives.
4. The involvement of residents as volunteers for inspection and maintenance activities can help ease the burden on limited resources. Garbage, dead leaves, invasive plant removal and regular inspections are easy and efficient methods to involve volunteers.
5. In the existing landscape features, incorporate green infrastructure such as retention ponds or bioswales.

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Review of Smart City Components: An Assessment of Implementation of Area Based Development (ABD) Strategy in Gwalior

Name of the project: *An Assessment of Implementation of Area Based Development (ABD) Strategy in Gwalior*

Location: *Gwalior*

Sector: *Urban Infrastructure*

SDG: *SDG 7, SDG 9, SDG 11*

Institute: *School of Planning and Architecture, Bhopal*

Advisor: *Dr. Kshama Puntambekar*

Student: *Itisha Behera*

Keywords: *Urban Population, JNNURM, Smart city Mission*

Abstract:

One-third of the population in India can be catalogued as an urbanite. Today, significant share of people moving to the cities contribute to urbanization and this fact cannot be disputed.

The Government of India has been trying to resolve the issues of urban India with various schemes like Mega city, JNNURM and Smart city being the latest. In June 2015, the Smart Cities Mission (SCM) was launched to enable improved living conditions and to achieve higher economic growth in 100 cities.

The mission constitutes of two approaches: Area-based development where in city renewal, retrofitting or greenfield development is carried out in delineated area of the city and Pan city promoting digital solutions in larger part of the city.

To ensure that the mistakes of the past are not repeated, and successful implementation of Smart City Proposal is taken care of, it is of vital importance to have a methodical framework for both the area-based and Pan city approach. This study, however, is limited to the examination of ABD in the delineated part of the city of Gwalior, Madhya Pradesh which is of 803 acres. The research explores SC implementation in Gwalior that's undergoing a smart transformation currently with its Projects that involve the targets of Sustainable Development Goal (SDG): seven (affordable and clean energy) and eleven (Sustainable cities and communities). Out of all, the projects like the **Intelligent Transit Management System (ITMS) and mobility sector (38.5 Crore)**, **façade restoration and Heritage sector (123 Crore)**, and **social infrastructure upgradation projects (18.4 Crore)** were given special attention in the study owing to the city's major problem being road condition and green space. While examining the projects in Gwalior, the research also explores the perception of public in the city and considers the Smart city projects as a method of Service delivery.

This research will be useful to

- 1) Cities (in developed and developing nations) that are implementing SC projects now, by providing a framework to systematically examine the strategy for successful project implementation; and
- 2) Communities/institutions (especially in developing nations) proposing SC initiatives by helping them focus on components, goals, and enablers of a SC.

1. Introduction

1.1 Topic and Context

The Smart Cities Mission (SCM) was launched on 25 June 2015, by the Ministry of Housing and Urban Affairs (MoHUA) then Ministry of Urban Development (MoUD). 100 cities and towns in different states and UTs of India were selected under the mission. Highest number of cities were selected in Uttar Pradesh (13), and Tamil Nadu (12) followed by Madhya Pradesh (7). In Madhya Pradesh, Bhopal and Indore were selected in the first phase while Gwalior, Jabalpur, Sagar, Satna, Ujjain were selected in the second phase of the mission. (MoUD, 2015)

Smart City Mission Components:

Two principal approaches were selected for the mission that includes: The area-based development (ABD) strategy and pan-city approach. The ABD strategy includes components like Retrofitting, Redevelopment and Greenfield development. For ABD an area is delineated first for the implementation of Smart City Proposals (SCPs). In retrofitting an existing built-up area of more than 500 acres is taken to improve its infrastructure by employing smart applications. In redevelopment, an area of more than 50 acres is identified for replacement of existing built-up environment using mixed land use and increased density. In Greenfield development previously vacant land of more than 250 acres is identified for innovative planning. ABD employs components like Affordable housing, Open spaces management, Lake, River precinct and Sea Shore protection, heritage protection and promotion activities, Central Business District and markets development, street façade improvement, transit infrastructure improvement, promotion of sustainable means of transport etc.

Pan-city approach however incorporates smart solutions for improvement of infrastructure and services by application of technology and IoT.

Analysis of the mission revealed that Indore and Bhopal have been performing quite well in terms of project tenders issued and projects completed. Therefore, it would be interesting to inspect the performance of heritage capital of Madhya Pradesh, Gwalior. (SPECIAL REPORT NO. 155 ORF, 2021)

Gwalior:

Gwalior had both ABD and PAN city projects while it was selected for the mission. Gwalior was chosen under Round-2 selection with SCP of Rs. 2300.57 crore. During preparation of SCP for Gwalior, people's participation was given enough importance to bring their views to the centre stage. (Nasir et al., 2019). Gwalior is a two-tier

city in central India with 13,67,474 population and 66 wards in it which expand over 423.35 sq.km. area. It is known to be a princely state that centres on the walled fortress with varied monuments like palaces, forts, temples with a unique identity and façade. (Gupta & Education, 2019)

1.2 Scope of Research

The ABD area of Gwalior is of 803 acres which is 0.77% of the entire city. It comprises of 8.9% of the city population i.e., 1,02,883 people. The area spreads over approximately 18 wards in Gwalior. Gwalior's SCP had 8 core modules for ABD & 3 Modules for Pan City. All the modules have further listed out components that have to be implemented. The ABD project modules include 'Heritage and Culture Module, Housing Module, Mobility Module, Infrastructure Module, Recreation and Social Upgradation Module, Technology Module, Economic Development Module, and Sustainability Module' in it. (Smart City, n.d.)

The main aim of ABD projects in Gwalior was to regain the lost glory of its heritage and culture thereby making Gwalior a commercially viable, and environment-friendly city. For this, a project like "Revitalizing Maharaj Bada" was launched with other catalyst projects like "Pedestrian Only Zone at Bada, Development of BRT corridor for Smart city buses, Intelligent traffic management systems, upgradation of parks, Transformed Digital library" which will be extensively examined in this study. (Gupta & Education, 2019). Hence, this study will help in finding the challenges encountered and efforts made for the implementation of ABD to make Gwalior a vibrant smart city.

1.3 Significance of the project

The first and foremost important module of ABD is "Heritage and culture module" that will create the **Brand Gwalior** through Retrofitting and Redevelopment of Maharaj Bada in old sub-city of Lashkar. This would preserve the identity of Bada and consequently give it the spotlight that it deserved.

The next prominent module to look upon is Mobility, since this has been an issue in Gwalior for the long time. The module introduced *pedestrian-only zones at Bada, integration of Intelligent Transmit system ITS and Information and Comuunication Technology components for traffic surveillance analytics, and promotion of IPT through SC buses* which would do the needful to solve the traffic issues. This would also encourage people to go for public transport options.

Then comes the sector that primarily contributes to improving the quality of life: the 'Social development sector'. For this projects like *Upgradation of parks and*

playgrounds that includes installation of open gym and other equipment's were taken up for inspection. (Smart City, n.d.)

1.4 Aim and Objectives

The aim of this study is to evaluate the implementation of ABD strategy in Gwalior, Madhya Pradesh.

Objectives:

- To identify various components of ABD implemented in various modules of the Smart City Proposal.
- To inspect the usability of smart infrastructure interventions undertaken.
- To evaluate the implementation of ABD strategy in the case of the chosen smart city Gwalior.

2. Contextual Background

2.1 Conceptual framework

Smart city is a flexible term as per the guidelines however a city that is physically, economically, and socially smart with its Institution as smart as the other three is known to be a Smart city. The prime factor in all must be the integration of Information and Communication Technology. The aim of introducing 'Smart principles' in all aspects of life was to foster economic growth of the cities thereby improving the quality of life and make the citizens smart. (Series & Science, 2020)

Understanding the two approaches of SCM, the ABD approach is also underappreciated, and the reason for this is that Indian cities have a large population, and if some portions are chosen and upgraded, while others are looked after in the traditional manner by the existing civic agencies for a long time, it may result in an inequitable situation. And this fact can't be disputed. (No, 2015)

ABD strategy is majorly focused on one part of the city which means "more into polarization and benefiting only one class of the society, disowning other factors to an extent." So, the condition of making the cities Smart, as well as Inclusive, is ruled out in this case. (Chugh, 2020)

However, Smart City guideline views ABD as selected portions of the city that are enhanced as a more realistic means of urban development which will induce the development in the rest part of the city just like a ripple effect. (HOELSCHER & ABSTRACT, 2015)

The idea of the Ministry of Housing and Urban Affairs, then Ministry of Urban Development, GoI in the project Smart Cities is not to convert the entire city into smart city, but rather to showcase here and there in bits and pieces how Smart City can be attempted. It will be an

eye opener for every local body on how to improve the quality of life. (Moses & Elango, 2017)

This research will give an insight towards the impact assessment of the ABD strategy in Gwalior, Madhya Pradesh.

Research design

The methodology followed for this study has been prepared stage-wise. The first stage is literature study through which the problem was identified, the research questions were framed, and then aim and objectives were formulated.

Data collection, which is the next phase, is further broken down based on objectives. In this, the first objective was to identify the components from SCP. There were 8 Modules in the SCP, Gwalior. The projects selected were for building quality of life in Gwalior through *Revitalizing Maharaj Bada*, *Pedestrian only zone at Bada*, *Availability of Public Bike sharing*, *Smart city bus*, *Intelligent Traffic Management system (ITMS)*, *Upgradation of Parks and Playgrounds*, *LED Streetlighting*, *façade restoration and Digital library*. For objective 2: the usability of smart

infrastructure interventions was to be inspected, using a suitable instrument i.e., SERVQUAL. SERVQUAL means Service Quality which is a Model used as a Performance Evaluation Instrument and it also rates consumer satisfaction. (Shahin, 2017)

Smart city mission is a mechanism of service delivery that serves the citizen with their needs while solving the issues of the city. SERVQUAL scores can be used after taking the public perception of the various components implemented through the mission. SERVQUAL has five components (1) Tangibles: Physical facilities, and appearance; (2) Reliability. Ability to perform the promised service dependably; (3) Responsiveness. Willingness to provide prompt service; (4) Assurance (including competence, courtesy, credibility and security); (5) Empathy (including access, communication, and understanding the customer). (Kawulich, 2015)

3.54.1 Details of Data Collection:

First, a data checklist was created for data collecting, separating primary and secondary data. Secondary data was collected from concerned departments viz- Smart City Gwalior, Integrated Command, and Control Centre,

Gwalior, Gwalior Municipal Corporation, and various other online sources.

For primary data following methods were adopted:

1. User Preferences: Random Sampling
2. Public Survey: Questionnaire
3. Stakeholder Consultation
4. Focused Group Discussion
5. Visual Survey of the area: Photographs

A sample size calculator was used to find the appropriate sample size. The confidence interval for this study is 10, and the degree of confidence is 95%. Using the aforementioned technique, 96 samples were the required sample size. 110 samples were gathered for this investigation. (Kawulich, 2015)

2.2 Key features of the project

2.2.2 Challenges in the project

- a. Converting Bada into a pedestrian-only zone is difficult for the city due to public resistance and is ongoing.
- b. Currently, road expansion work is taking place,

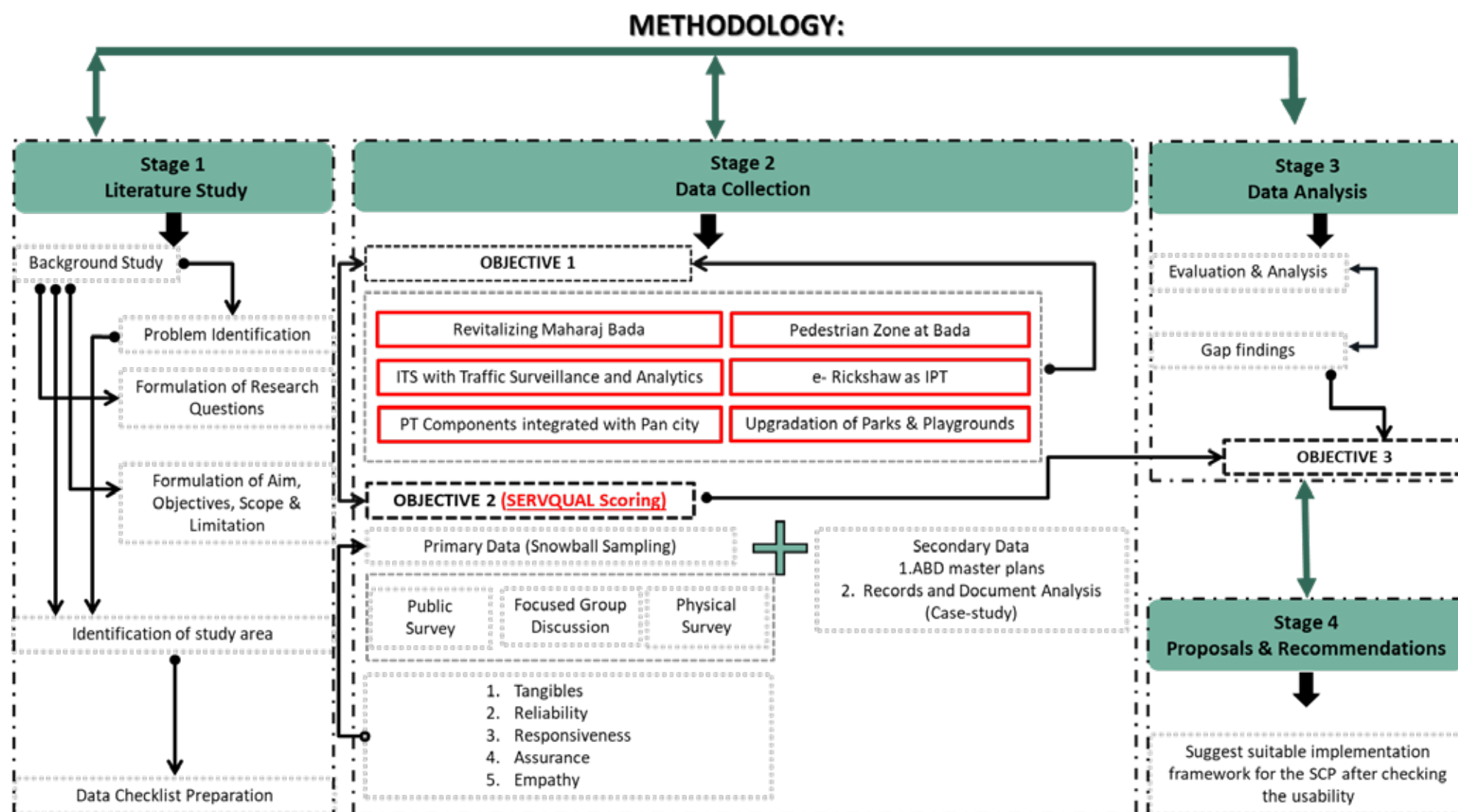


Figure 1: Methodology chart prepared for the research (Source:primary)

occasionally obstructing roads for public usage, in order for smart roads to function.

- c. The Smart city bus services were stopped owing to the pandemic and financial losses and haven't been started even after 2.5 years.

2.2.3 Risks involved in the projects:

- a. PBS services were not suitable for a city like Gwalior considering its extreme weather condition. (Both Summers & winters)
- b. The needs and routes of Smart city buses had to be examined before making them functional.
- c. Delay in project execution and progress is demeaning the actual impact.

2.2.4 Features and Benefits

- a. Façade lighting has truly transformed the view of the city which would contribute towards creating *Brand Gwalior*.
- b. Transforming the central library into a "Digital Library" will help the city and the students with a lot of facilities that earlier only the privileged were getting.
- c. E-rickshaw that is flowing from fixed origin points and routes with specific numbers has made the entire city easily accessible.
- d. People of the city who did not have enough common space are now enjoying the experience of upgraded and newly installed smart parks and playgrounds.

2.3 Key findings from the interviews, surveys, and primary/secondary data collection

This section contains pictures from primary survey, public perception representation from interviews. The analysis below is given module and project-wise.

Project-wise analysis: Brand Gwalior (M1.1); M1.2 Revitalizing Maharaj Bada

Maharaj Bada is the city centre in Gwalior that is surrounded by seven heritage buildings with seven different architectural styles. The SCP was for conservation restoration and adaptive reuse of these buildings with façade lighting. Façade restoration works have been done for the SBI building, SBI ATM building, Post office building, Hanuman mandir. The old central library has been upgraded with new digital infrastructure and adaptive reuse works have been completed for Town Hall, Government Press building, Gorkhi Palace, Victoria market. Also, a Tourist Facilitation Centre is established for the purpose of providing general information to the tourists. Lighting Solutions Responsive and sensitive to the architectural value, material fabric and design of the buildings, have been showcasing external facades of landmark heritage building structures of Maharaj Bada. (Pradesh, 2013)

Public Perception: Revitalization of Maharaj Bada

People from across the ABD area in Gwalior were asked

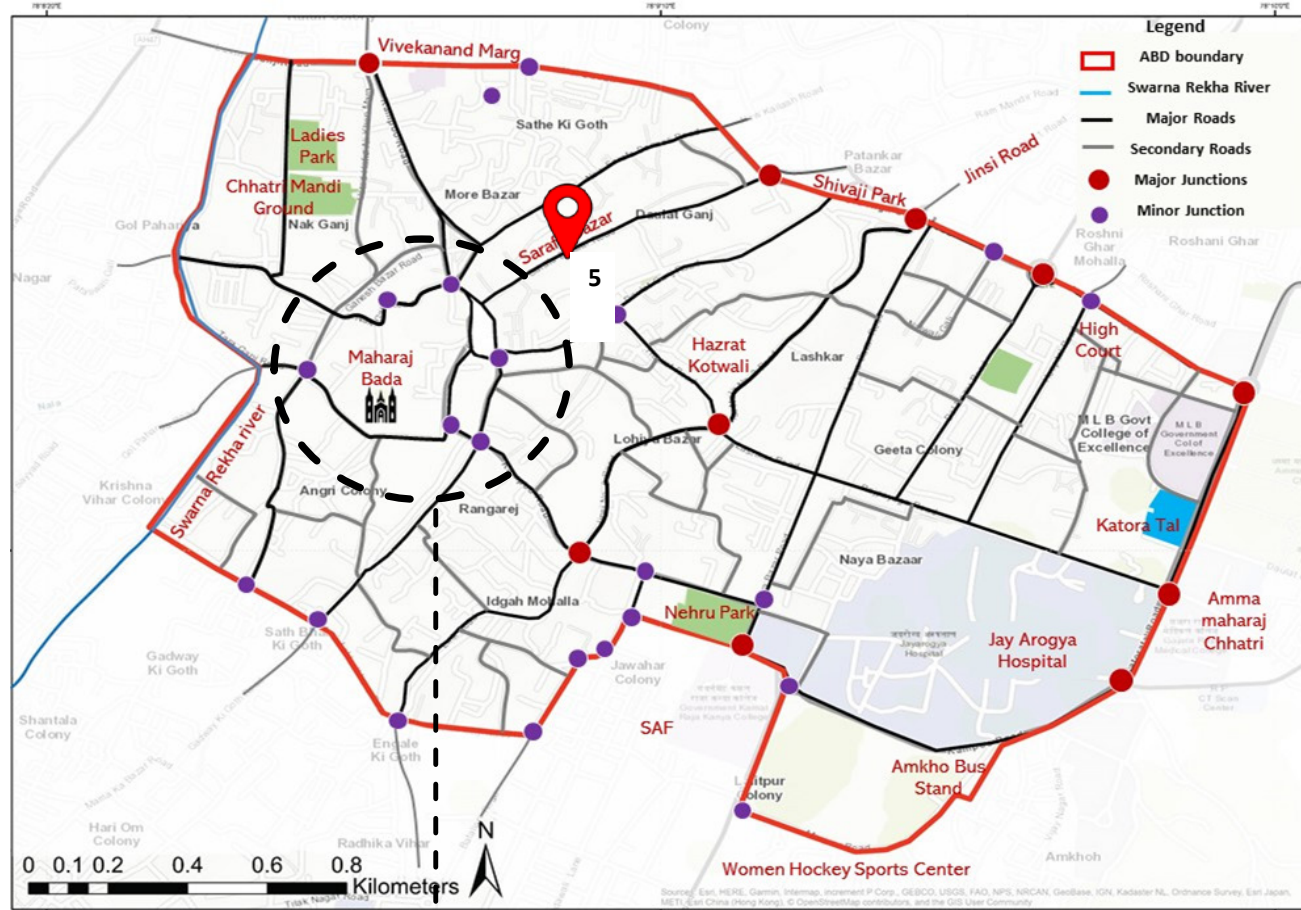
to rate the projects that have been completed in the area. Public survey reveals that people are happy and are welcoming towards the change that has happened. In fact, few say that the marketability of the area has improved due to the facade restoration, and it truly now feels like heritage and cultural capital of central India. (Nasir et al., 2019)

However, the Central Digital library has not been inaugurated yet. And hence the access has not been given to the public. The delay caused was due to the pandemic. Also, people weren't aware of this facility. Few aware of the library do not know about the digital transformation.

Project-wise analysis: Pedestrian-only zones at Bada (M4.3)



Figure 2 shows the Maharaj Bada area in ABD indicating 7 buildings that have been restored or are put into adaptive reuse (Source: Gwalior Annexure II)



Map 1 shows the base ma of ABD area highlighting the Maharaj Bada



Figure 3 shows the façade lights of Victoria Market (Source: primary)

The third module of SCP is the mobility module. This Module has ten projects out of which pedestrian-only zone at Bada is the third project.

However, this area even after transformation and Maharaj Bada revitalization is always filled in with heavy traffic and congestion. Being the city core the area is always crowded. It allows all types of vehicles to enter it. There is a huge rush of four-wheelers and rickshaws here irrespective of timings because it is the main market of the city. Public Perception:

The graph below shows how people reacted to the question of Bada being a pedestrian-only zone or not. The majority of people said it isn't functional.

Project-wise analysis: ITS with Traffic Surveillance and Analytics (M4.2)

The project was planned to design, supply, install, test the following components at 31 junctions in the city: Adaptive Traffic Control System (TCS), Smart Traffic Sensors, Speed / Traffic Violation Detection System, E-challan system, Surveillance Cameras, Video

Management system etc. (Smart City et al., 1984)

Public Perception: Twenty-seven junctions are currently functional with the ITMS services. The work is on-going in three more junctions for the facility. So, the city will have more than 30 junctions with the facility by May.

The services are rated "Very Good" by the citizens of the city. Furthermore, in a recent annual analysis, Gwalior came to be one of the best ITMS functioning city in Madhya Pradesh out of five cities



Figure 4 shows the façade restoration of Town Hall (Source: primary)



Figure 5 shows the Central library with upgraded infrastructure (Source: primary)

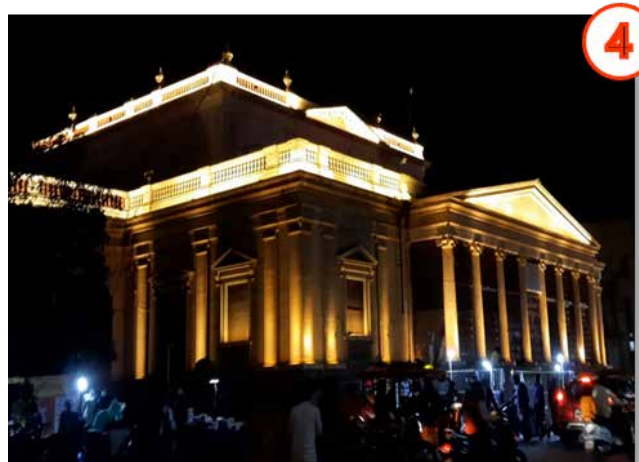
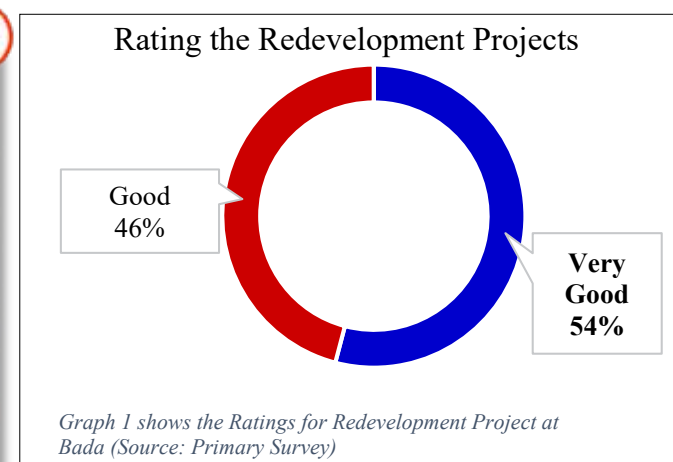


Figure 6 shows the faced lighting of Government Post Office (Source: primary)

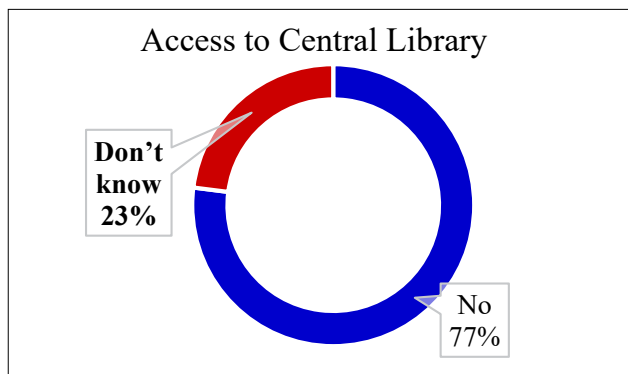


Figure 7 shows the Tourist Information Centre (Source: primary)

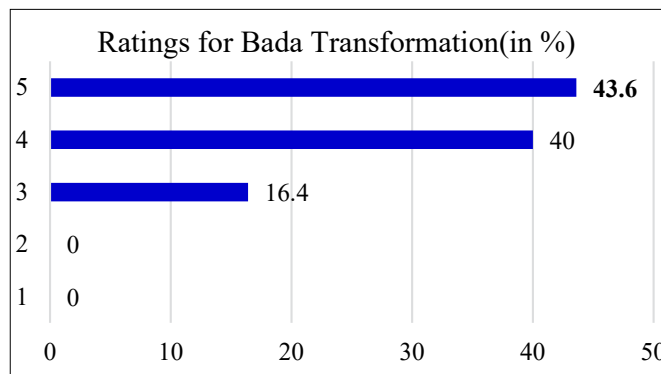


Graph 1 shows the Ratings for Redevelopment Project at Bada (Source: Primary Survey)

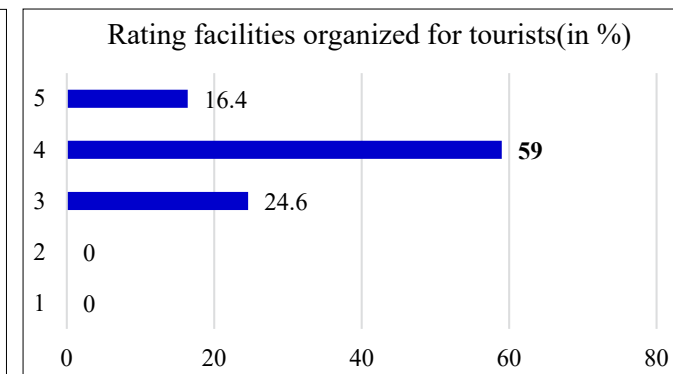
Graph 1 shows the Ratings for Redevelopment Project at Bada (Source: primary)



Graph 2 shows the share of people having access to Central Digital library in Gwalior (Source: primary)



Graph 3 shows public ratings for Transformation of Bada (Source: primary)



Graph 4 shows public ratings for Tourist facilities organised at Bada (Source: primary)

Project-wise analysis: e- Rickshaw as IPT (M4.8)

The plan was to operationalize 100 E-rickshaw, 50 E-loaders along with allied infrastructure. Due to lack of participation, the project is proposed to be taken up on the CAPEX model as an initial thrust factor for the smoother rollout of the program. CNG-powered rickshaws run throughout the city on different routes. Each route is assigned with a number which makes it easier for commuters to travel to their locations. However, there is a lack of Gas Stations in the city.



Figure 8 shows Maharaj Bada with Vehicles in (Source: primary)



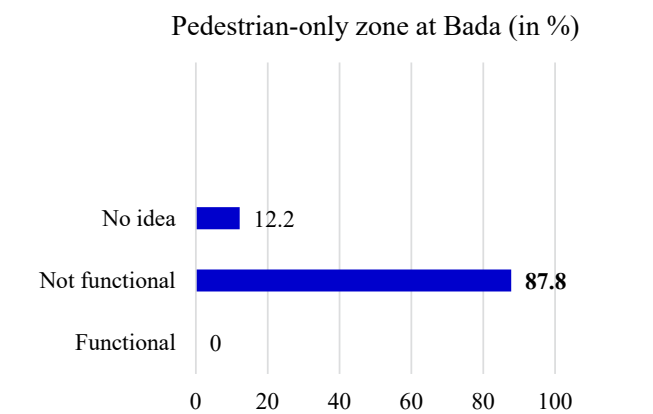
Figure 9 shows how people walk along with vehicles on road (Source: primary)



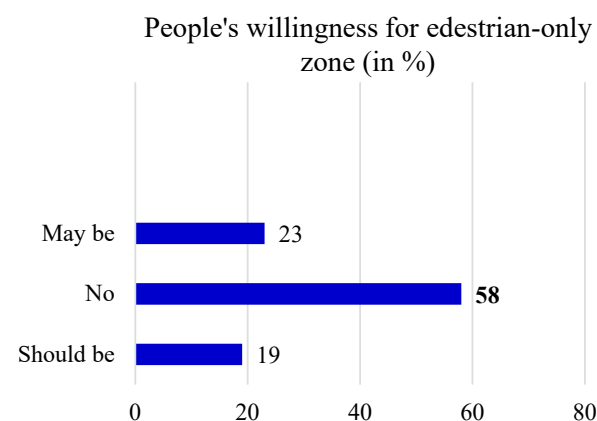
Figure 10 shows the speed governors on the roads (Source: primary)

time, they carry more than what the actual occupancy should be. This makes people uncomfortable during travel. The ratings given by people for IPT here indicates medium satisfaction of consumers. Also, the chart above shows maximum people are using autorickshaws as city buses do not function and e-rickshaws are less in number.

The graph above reveals most people use private vehicles while travelling to work or for other purposes. And the reason behind this is the unavailability of PT all the time. (as discussed)



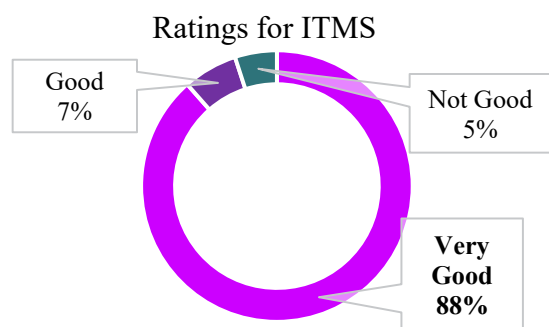
Graph 5 shows People's awareness about Pedestrian-only zone at Bada (Source: primary)



Graph 6 shows people's willingness to have a pedestrian-only zone at Bada (Source: primary)



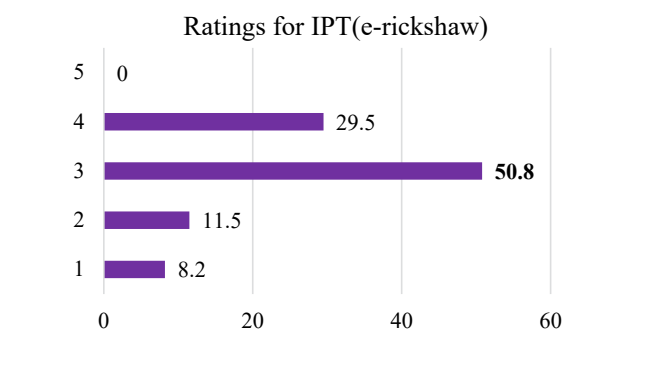
Figure 11 shows marked road junctions as part of ITMS (Source: primary)



Graph 7 shows the Ratings given by public for ITMS facility in Gwalior (Source: primary)



Figure 12 shows stakeholders training program arranged for ITMS (Source: Annual SC report, 2021)



Graph 8 shows the public rating for e-rickshaw (Source: primary)

Project-wise analysis: PT Components integrated with Pan city (M4.10)

Table 1 showing the intracity bus routes, highlighted are traveling to ABD area (Source: Augmentation of city bus services, 2021)

S. No.	Intra city Routes		No of Buses engaged currently
	From	To	
1	Deendayal Nagar	Maharaj Bada	6
2	Purani Chawani	Maharaj Bada	6
3	Purani Chawani	Sirrol	0
4	Airport	Gudagudi Ka Naka	0

Smart city bus:

The table above shows the list of buses that connects the city to ABD area. These buses were operational until pandemic hit India. However, the SC bus services is no longer active owing to the pandemic and financial losses as reported by the PMC. The graph, therefore showed higher percentage of people using private vehicles and autorickshaws (e-rickshaw)

Public Perception: Pedestrianisation: Public Perception

The graph below reveals that people do not prefer to walk in Gwalior because there is not enough pedestrian infrastructure on the streets of Gwalior. Further the width of the roads and congestion adds up to this and people end up using private vehicles for every small purpose.(Smart City et al., 1984)



Figure 13 showing mostly CNG rickshaws in Gwalior (Source: primary)

PBS:

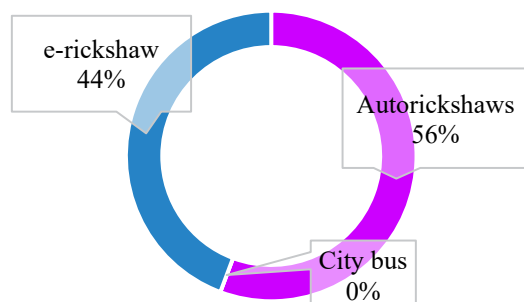
There are around 500 cycles in 50 PBS stands spreading across the city. The location of PBS stops of ABD area is shown in the map below along with the Smart Road stretch.

However, people do not prefer to cycle around the city always owing to congested roads, extreme weather condition of the region. Also, the cycles and



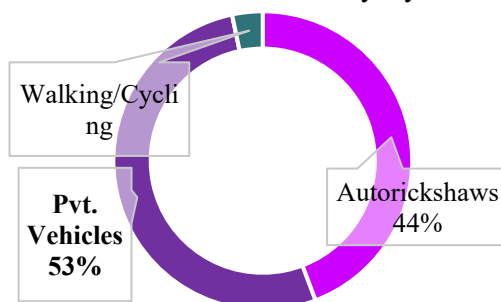
Figure 14 showing gas stations jammed with rickshaws at peak hours (Source: primary)

Modal share of PT



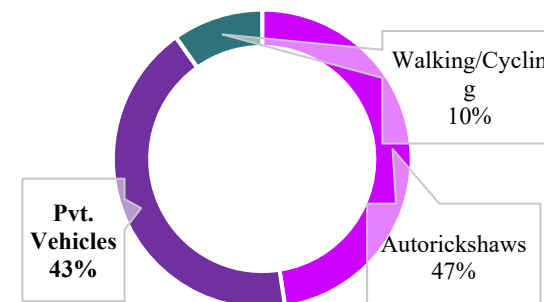
Graph 9 shows the modal share of public transport used by people in Gwalior (Source: Primary survey)

Mode of Travel for Everyday use



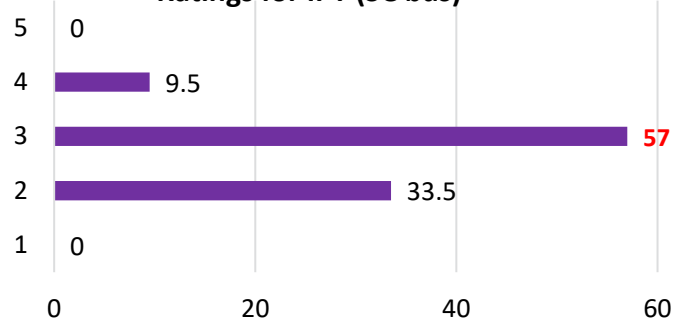
Graph 10 shows the modes preferred by people for everyday use (Source: Primary survey)

Mode of Travel for Work



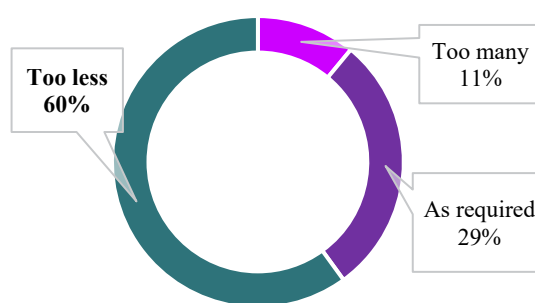
Graph 11 shows the modes preferred by people for traveling to work (Source: Primary survey)

Ratings for IPT (SC bus)



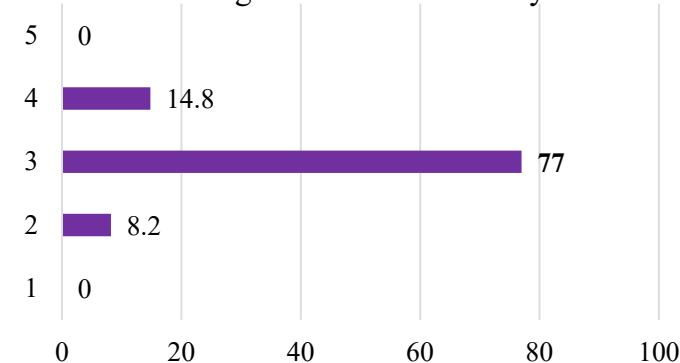
Graph 12 shows public ratings for SC bus which were functional 2 years ago (Source: primary)

Availability of Pedestrian infrastructure



Graph 13 shows availability of pedestrian infrastructure on the streets of Gwalior (Source: Primary survey)

Ratings for Pedestrian safety



Graph 14 shows public ratings for pedestrian safety (Source: primary)

the stands need maintenance because few cycles do not work anymore.

The usability of the cycles can be seen in the morning or evening time even after the pandemic and this can increase with smart roads coming in.

The 15.625km road stretch in ABD will be transformed into a smart road with the pedestrian section and 18.20m ROW along with other facility. This is sample road section prepared is to be replicated for the entire stretch proposed in the ABD.

Project-wise analysis: Upgradation of Parks and Playgrounds (M5.2; M5.3)

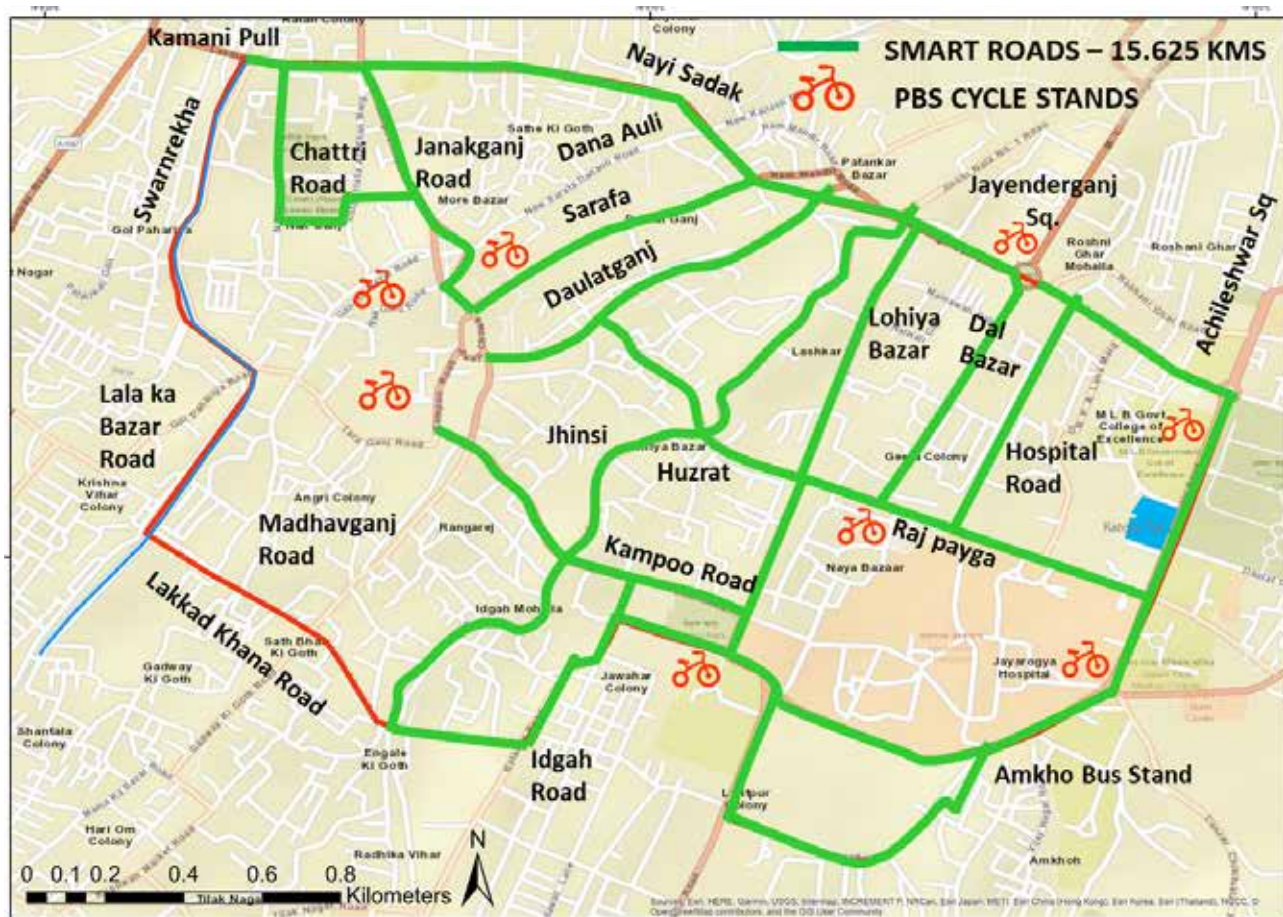
The age-old parks have been now upgraded with new infrastructures i.e., Yoga area, Walking Pathway Pavement; Performance Stage, TOT-LOT (Age 0-3), Kids Play Area (Age 3-7), Seating Area; Play Court (Volleyball/Badminton), Semi-covered Open GYM, Fountain and Music System, Flower Bed/Planting Bed, Wooden Deck; Grassy Mound etc. Redevelopment of 3 public playgrounds including Horticulture, Irrigation Civil, Electrical, and equipped with Open Gym Equipment's was undertaken recently. Development of

Playgrounds with state-of-the-art sports facilities which includes Lawn Tennis, Cricket, Football, Basketball, Volleyball, Long Jump, Synthetic running track etc. is also complete. (Smart City, n.d.)

These areas, which in the past did not draw a lot of people, are now used frequently by the community. There are visitors here both in the morning and at night.

Public Perception:

The chart below shows how people rated highest in the section of rating the smart parks. This reveals majority of people being satisfied with the transformation of parks.



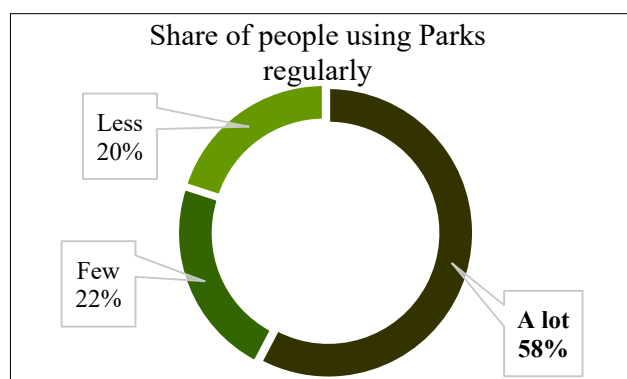
Map 2 shows the length and road network where transformation is on-going to smart roads and the location of PBS stands in the ABD area, Gwalior (Source: GSCDCL, Annual report 2021)



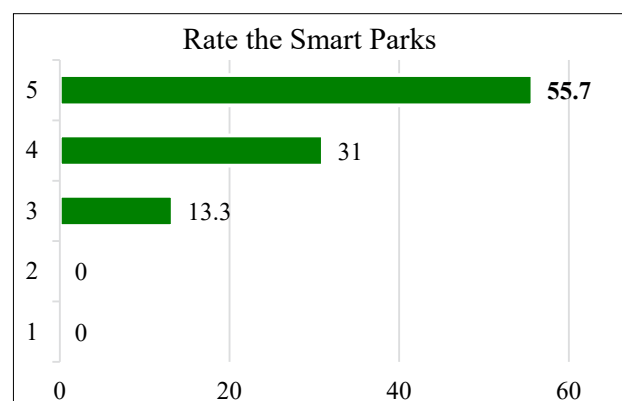
Figure 15 shows upgraded Nehru Park, Gwalior (Source: primary)



Figure 16 shows Shivaji park with new lighting (Source: primary)



Graph 15 showing share of people using smart parks regularly (Source: Primary survey)



Graph 16 showing public ratings for smart parks (Source: Primary survey)



Figure 17 shows Ladies Park with smart equipment's (Source: primary)

3. Discussions and Conclusion:

3.63.1 Implications (the impact assessment framework)

After data collection and analysis (in the previous section) SERVQUAL scores were assigned to these projects based on the five dimensions: Tangibles, Responsiveness, Reliability, Assurance and Empathy. In the SERVQUAL instrument, a list of statements was taken up to measure the performance across these five dimensions, using a seven-point Likert scale measuring both citizen expectations and perceptions. The gap between the Perception and expectation was taken to get the average score for each aspect.

After analysis of each project, each of these components is given a weight (by experts through FGD). These weights were crucial in understanding which aspect needs more attention and a better framework while implementing. Hence these scores will indicate the direction in which the projects need improvement. (Servqual Model as Performance Evaluation Instrument for Small and Medium Sized Enterprises (SME): Evidence From Customers in Nigeria, 2016)

THE SERVQUAL INSTRUMENT

EXPECTATIONS (E)

This survey deals with peoples' **expectations** of the initiative "Smart City Gwalior". People were asked to show the extent to which they think Smart City Strategies should possess the following features. A number that best shows public expectations from 'Completely Satisfied' to 'Completely Dissatisfied' about the services and performance of the projects under SMART CITY PROPOSALS undertaken was recorded to obtain the score.

Completely Satisfied 1 2 3 4 5 6 7 Completely Dissatisfied

CALCULATIONS TO OBTAIN UNWEIGHTED SERVQUAL SCORE FOR ALL THE PROJECTS:

Average **Tangible** SERVQUAL score -2
 Average **Reliability** SERVQUAL score -2
 Average **Responsiveness** SERVQUAL score -2.25
 Average **Assurance** SERVQUAL score -2
 Average **Empathy** SERVQUAL score -2.6

PERCEPTIONS (P)

The statements related to peoples' feeling about the project were taken as **public perception**. The extent to which they believe **Smart City Gwalior** has been able to

exhibit the features described in the statement would be rated as a number as per their level of satisfaction.

Completely Satisfied 1 2 3 4 5 6 7 Completely Dissatisfied

AVERAGE (= Total / 5) UNWEIGHTED SERVQUAL SCORE= -2.17

The image above shows what kind of statements were prepared for "Tangibles" to take out unweighted average score. A similar procedure was followed for the rest of 5 aspects. Then weights were assigned by a group of experts through focused group discussion, to each aspect depending upon the priorities they have for successful implementation totalling it to 100.

SERVQUAL IMPORTANCE WEIGHTS

1. The appearance of the Smart City, Gwalior's physical facilities, equipment, personnel, and communication materials. (Tangibles) **23 points**
2. The Smart City, Gwalior's ability to perform the promised service dependably and accurately without fail. (Reliability) **26 points**
3. The SCG's willingness to help citizens and provide prompt service. (Responsiveness) **22 points**

Tangibles EXPECTATIONS		PERCEPTIONS		GAP	
E1. SCM has transformed the heritage and culture of the city creating its unique identity.	7	P1. The heritage projects are completed, and Maharaj Bada area is transformed.	7	0	
E2. The physical infrastructure facilities are excellent with in Gwalior. (In parks, tourist spots)	6	P2. Gwalior has physical infrastructure facilities.	4	-2	
E3. The traffic system is well taken care of in the city with ITS, Parking and IPT system.	6	P3. The infrastructures needed for Mobility is at place in Gwalior.	3	-3	
E4. Social life is brought to the spotlight by upgrading parks, playgrounds, riverfront projects, smart classroom etc.	6	P4. Alteration and upgradation in the social infrastructure components are made.	5	-1	
E5. The conservation and restoration work of the city is commendable.	6	P5. The buildings that could be restored were restored and adaptive reuse is also carried out.	4	-2	
E6. Road's condition is improved, and movement is smooth within the city.	6	P6. The on-going work will reduce congestion and make movement easier in Gwalior.	2	-4	
Average Tangibles SERVQUAL score= -2					

Figure 18 shows a sample of statements taken to calculate unweighted score for Tangible aspect (Source: primary)

4. The knowledge and courtesy of the SCG's employees and their ability to convey trust and confidence. (Assurance) **15 points**
5. The caring, individual attention the SCG provides to its citizens. (Empathy) 14 points

Total: **100 points**

Lessons Learned:

From the above-mentioned points, it is clear that the major issue lies in the dimension of reliability and responsiveness followed by tangibles. This is a real cause of concern and reveals that citizen expects most from the reliability dimension of the service. The relatively

low importance of empathy could be attributable to the fact that they do not expect much in form of assurance or empathy for individual citizens rather they want the service delivery mechanism to be fast (Reliability & Responsiveness) and in form of tangibles (infrastructure and other development in physical forms).

3.7 Key lessons learnt:

The negative gaps are results of higher public expectations for service delivery. However, this expectation is not met and can be filled in by working on the responsiveness and reliability dimension of service delivery in smart city developmental works (Tangibles).

Furthermore, the tool SERVQUAL was used to understand people's perceptions on how the initiative has performed. Analysis of specific projects here revealed that Mobility Sector needs major change in its implementation framework.

Heritage and Social Development sectors implemented at a faster pace with proper attention Gwalior would fulfil its vision of being the Heritage and culture capital of Central India.

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C31

Assessment of NMT (Non-Motorized Transit) in Jabalpur, Madhya Pradesh

Name of the project: Assessment of NMT (Non-Motorized Transit) in Jabalpur, Madhya Pradesh

Location: Jabalpur

Year of Project Implementation: 2017

Sector: Urban Mobility

SDG: SDG 3 (3.6), SDG 11 (11.2, 11.6)

Project Cost: 7.6 Crores INR

Institute: School of Planning and Architecture, Bhopal

Advisors: Dr. Mohit Dev

Students: Satendra Singh

Keywords: Non-motorized transportation, Walking, Smart City, Sustainability

Abstract:

Non-Motorized Transit, or NMT, is a mode of transportation that allows solely pedestrian and non-vehicular travel. Such a network is proposed to be created in Jabalpur, Madhya Pradesh, and Jabalpur Smart City Limited (JSCL) has constructed first for a stretch of 1.2 km on OmtiNala, from the Bus Stand to Madan Mahal. The project's goal is to change OmtiNala from a neighbourhood with abandoned, unused dumping grounds into one that is more environmentally and culturally sensitive, as well as pedestrian and bicycle-friendly, while taking into account the needs of all street users. This study aims to assess the impact of the newly developed NMT corridor phase-1 on several factors like trip purpose, travel time by walk or cycle, examination of infrastructure, facilities, design, construction, implementation process, environmental aspects and land use, etc. The study also discusses the traffic and transportation issues and the current non-motorized scenario in the city. Primary and secondary surveys were conducted to assess the impact of the corridor on identified parameters (utilization, mobility, land value, ambience, and level of service). The survey findings (land use, corridor inventory, trip profile, user perspective, and stakeholder discussions) highlight that the developed NMT Phase – 1 corridor has enormous potential to attract NMT users. At present, the corridor is being used by pedestrians and mostly use this corridor for recreational purposes. It has been observed that the corridor is not open for bicycle and wheelchair users at present and there is a dead-end at the Bus Stand side of the corridor. It will attract bicycle and wheelchair users as well as more pedestrians if the opening at the Bus Stand side is integrated with the existing road and the subsequent phases of the NMT corridor for their smooth flow. Also, other issues that need attention in terms of design and infrastructural development, operation and management framework, etc. are discussed to enhance the usage of this corridor.

Case Study: C31

1. Introduction

Walking, cycling, small-wheeled transport (skates, skateboards, push scooters, and hand carts), and wheelchair mobility are all examples of non-motorized transportation. However, users may view a given journey to accomplish recreation and transit purposes (they provide access to commodities and activities). Some people, for example, prefer to walk or cycle rather than drive because they like the action, although it takes a longer time (Deeksha Jain, 2021). The benefits of non-motorized transport modes are discussed in Table 1.

In the early 1980s, NMT in Indian cities, which included bicycles and walking, accounted for roughly 40–60 percent of all trips. A trend study in seven Indian cities shows that the modal share of NMT has dropped since the 1980s except for Chennai and Patna (Figure 2).

Non-Motorized Transit, or NMT, is a mode of transportation that allows solely pedestrian and non-



Figure 1: Various modes of NMT
Source: (MoHUA, 2016)

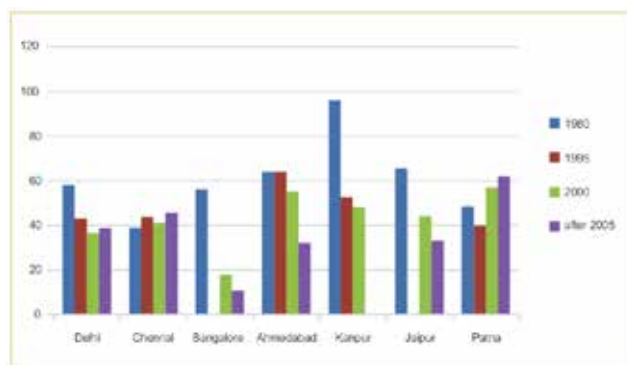


Figure 2: Trends in modal share of NMT (walking and bicycle) since the 1980s
Source: (Tiwari & Jain, 2013)

Table 2: Jabalpur's population growth

Year	Population	Decadal Growth Rate (in %)	Annual Growth Rate (in %)
1971	426224	NA	NA
1981	614162	44.09%	4.41%
1991	741927	20.80%	2.08%
2001	932484	25.68%	2.57%
2011	1055525	13.19%	1.32%

Source: (DPR, 2021)

vehicular travel. An NMT network has been proposed as a green corridor in Jabalpur city, and it has been designed for a 1.2-kilometre overlay on OmtiNala, which runs from Madan Mahal to the bus stop (DPR, 2021).

1.1 Topic and Context

According to 2011 census data, the total population of Jabalpur is 10,55,525 people. From 2001 to 2011, the decadal growth rate was around 13.19 percent for the last decadal year. The most considerable decadal growth rate was 44.09 percent between 1971 and 1981, followed by 25.68 percent between 1991 and 2001 and 20.80 percent between 1981 and 1991. Table 2 depicts Jabalpur's population growth during the previous five decades (DPR, 2021).

Table 3 shows the city's population forecast till the year 2045 (Town and Country Planning, 1973).

Similar to other Indian cities, the predominant motorized mode of transportation is two-wheelers in Jabalpur. According to a past study conducted for the Jabalpur city, 65 percent of respondents use non-motorized modes of transportation to get to work (walking, cycling,

and riding a cycle rickshaw). Only 7% of users rely on public transportation provided by private transport agency using mini-buses and three-wheeler tempos, while over 24% utilize two-wheelers (DPR, 2021) (Town and Country Planning, 1973).

Jabalpur is a tourism city in Madhya Pradesh and central India with many tourist attractions. Some notable sites include waterfall, ghats, parks, gardens, and open fields in Jabalpur, which are unfortunately not well maintained and have lost their attraction value. As a result, this project was imagined using the 'OmtiNala' model to improve the economy, tourism, and public health in such locations (DPR, 2021).

1.2 Scope of Research

It has been discussed in the previous section that the NMT has the highest modal share in the city, and therefore, this study focuses on the newly created non-motorized corridor. The NMT corridor has a length of 4.2 km and is to be constructed in three phases. The first phase of the corridor, a distance of 1.2 km, was completed in January 2021, and this study limits itself to the first phase only. The remaining two phases of the

Table 1: Non-motorized transport benefits

User benefits:	Increased user convenience, comfort, safety, accessibility, and enjoyment as well as savings from reduced vehicle ownership and use
Equity objectives:	Benefits economically, socially, or physically disadvantaged people.
Congestion reduction:	Reduced traffic congestion from private cars on congested roadways.
Roadway and parking:	Reduced roadway and parking construction, maintenance, and operating costs.
Cost savings:	Energy conservation: Economic and environmental benefits from reduced energy consumption.
Pollution reduction:	Economic and environmental benefits from reduced air, noise, and water pollution.
Land-use impacts:	Encourages more accessible, compact, mixed, infill development (smart growth).
Improved productivity:	Increased economic productivity by improving accessibility and reducing costs.

Source: (Adapted from Litman, 2013)

Table 3: Jabalpur's Population Forecast

Population Forecast (not including the population of newly added 55 villages)									
Census records for the last five decades					Population Projection as per City Sanitation Plan (CSP)				
1971	1981	1991	2001	2011	2015	2018	2030	2040	2045
426224	614162	741927	932484	1055525	1112398	1152781	1294846	1389437	1428621
% Growth per Year						1.21	1.023	0.730	0.56
%Av. Growth per Year						0.8829			
Note: Considering average growth pattern and future expansion 1% average growth per year has been considered for projection of population in newly added 55 villages									

Source: (DPR, 2021)

NMT corridor are under construction (DPR, 2021). Figure 4 shows the project's geographical location, i.e., NMT corridor, and Table 4 shows the project's details (phases, timeline, cost, and status).

The research's topic is the "Assessment of NMT (Non-motorized transit) in Jabalpur, Madhya Pradesh". The concerns being researched are infrastructure, user comfort and safety, usage, overall travel experience, and NMT green corridor's operation and management.

1.3 Significance of the project

As per the discussions with JSCL representatives and previous reports, the significance of the project is as follows:

- The box section was not continuous because it was broken at some places however, it is now continuous and covered across the drain due to the addition of an NMT corridor.(DPR, 2021)
- The complex's encroachment on this Nala over a distance of around 200 meters has finally been rectified.(DPR, 2021)
- Due to the Nala passing through the area, the neighbourhood was in a very unsanitary state; however, it has now been converted

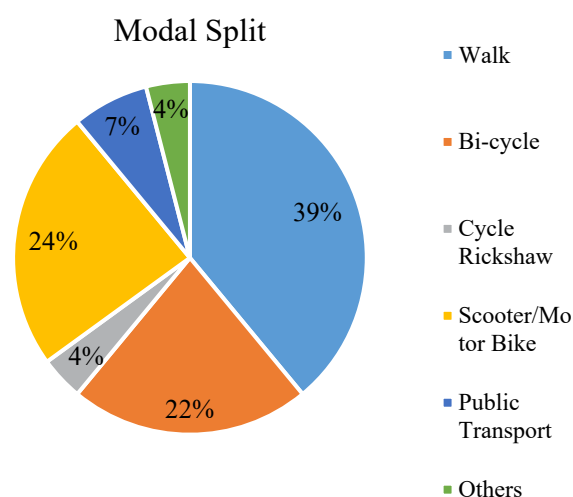


Figure 3: Modal Split of Jabalpur City
Source: (DPR, 2021)

Table 4: Project Formulation and Timeline

Phase	Project Cost	Implementation Year	Status
Madan Mahal Junction to Bus Stand- 1.2 km Phase - 1	INR 7.60 crore	Implemented in 2017	Completed in January 2021
Bus stand to Naudra Bridge 0.4 km Phase - 2	INR 2.85 crore	Implemented in 2020	Work under construction
Naudra Bridge to Ghanta Ghar 1.0 km Phase - 3	INR 5.05 crore	Implemented in 2020	Work under construction

Source: (DPR, 2021)

into a green corridor, and people are taking advantage of the hygienic neighbourhood and recreational spaces provided by the corridor. (DPR, 2021)

- For NMT users, the trip length and trip time from Madan Mahal to Ghanta Ghar have been shortened.(JSCL, 2021)
- In terms of contagious diseases and criminal activities, the specific area is now safe and secure.(DPR, 2021)

1.4 Aim and Objectives

The study aims to assess the impacts of the newly developed NMT corridor phase-1 on the users. The objectives of the research are:

- To understand and analyze the existing NMT scenario
- To assess the impact parameters affecting the NMT Green Corridor
- To suggest intervention strategies for the NMT Green Corridor

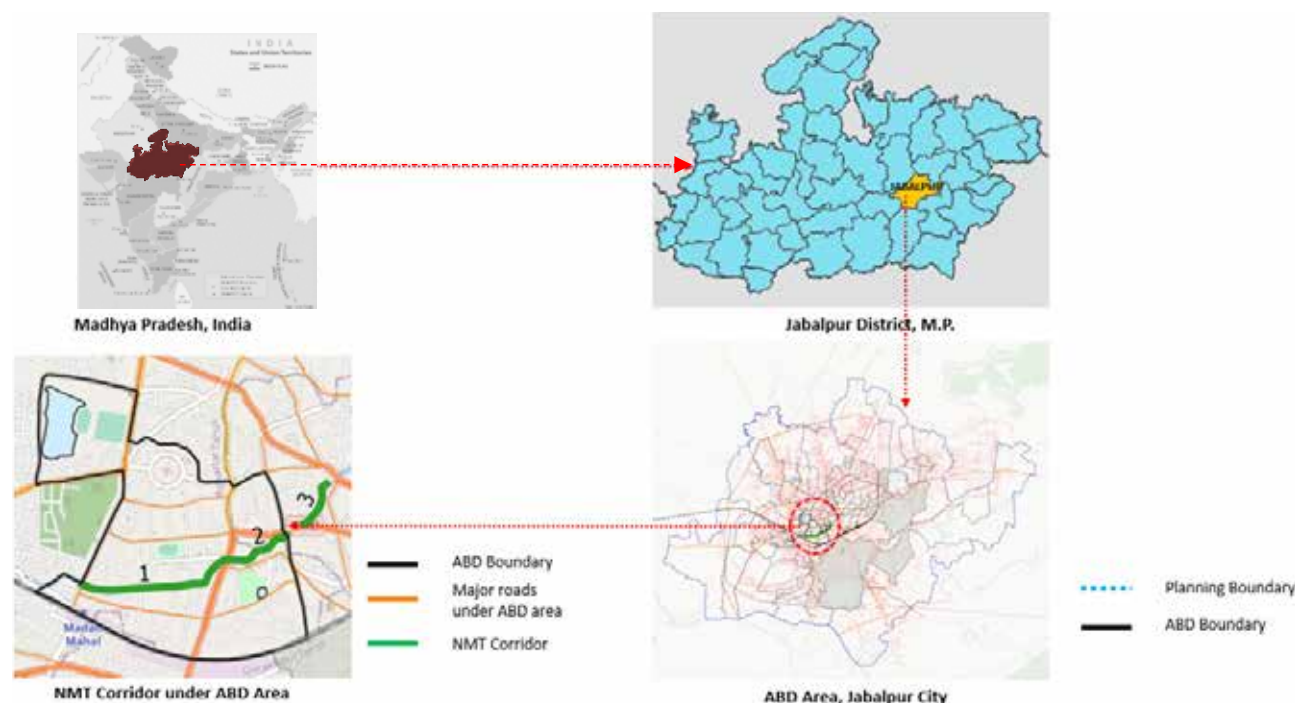


Figure 4: Geographical area of the NMT corridor
Source: mapsfindia.com, Author

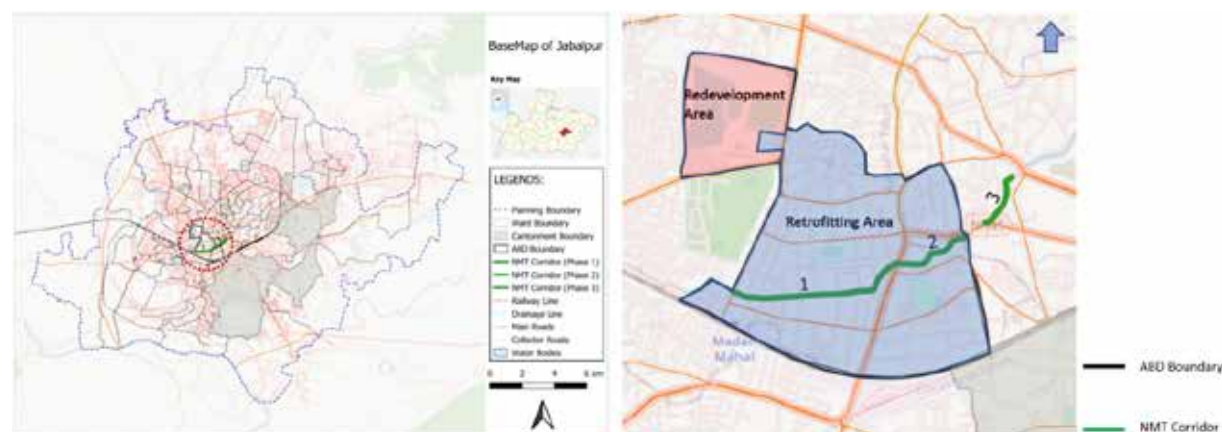


Figure 5: ABD area in the city base map
Source: Author

2. Contextual Background

The Area Based Development (ABD) area under the Smart City development mission is 743 acres and the population residing in this area is approximately 41,000 (JSCL, 2021) The ABD area is divided into two parts i.e., redevelopment area and retrofitting area. 75% of the ABD area comes under retrofitting, and 25% comes under the redevelopment area (figure 6). Jabalpur's ABD is across seven key themes:

- Physical infrastructure
- Public services
- Energy
- ICT solutions
- Transportation
- Water
- Waste & sanitation

This NMT Green Corridor is being developed under the transportation theme of the ABD. The NMT corridor is an overlay on the existing box drain on OmtiNala, which was utilized as a dumping site by the people. Phase-1

of the NMT corridor of 1.2 km from Madan Mahal to bus stand comes under the retrofitting area, i.e., NMT Corridor 1.

The waste dumped (Figure 7) within had severely impacted people's life. It has also affected the physical and mental health of those who live in the nearby area. This overlay now allows city people to enjoy developed leisure and walking spaces (DPR, 2021).

2.1 Conceptual framework / Research design

The conceptual framework for this study was created with the identification of numerous parameters and the technique to achieve the aim of the study. The case study method, along with a qualitative and quantitative mix strategy is used. Data collection (primary and secondary) i.e. qualitative and quantitative, data analysis, conclusion, and suggestions are all included (Tiwari et al., 2016a).

2.1.2 Methodology

Step 1: Literature Study

The research has been developed with the help of a literature review, an awareness of the project's background, the necessity for the study, and the development of the research's goal, objectives, scope, and limitations. The literature talks about the NMT infrastructure scenario in India by studying various cities like Delhi, Vadodara, Jaipur, Patna, Chennai, Bangalore, Chandigarh, and Delhi. General parameters used for analyzing NMT infrastructure in these cities have been discussed in this literature.



Figure 6: Proposed NMT corridor over Omti Nala, Jabalpur
Source: (JSCL, 2021)

Step 2: Data Collection

The data from primary and secondary surveys will be evaluated after examining the available research and publications related to the project and understanding the present scenario. A preliminary survey was conducted to understand the utilization of the NMT project. The essential data was obtained via meetings and discussions involving all stakeholders.

Step 3: Data Analysis and Final Outcome

The project's impact on various indicators was established after data analysis and processing, with a clear understanding of the issues and challenges that may arise during the project's design, development, and implementation. The research's conclusion will be to understand the demand for and availability of infrastructure in current and future scenarios. As a result of the study, strategies, interventions, and recommendations were developed based on the findings and understanding of the project's current and future demands.



Figure 7: Condition of Omti Nala before the construction of NMT corridor.
Source: (DPR, 2021)

2.1.3 Findings of Literature Review

The overall literature is based on the NMT infrastructure to understand what is or was the scenario regarding the NMT infrastructure of different cities in India.

Speed, travel time, accessibility, and safety are the factors used to evaluate NMT infrastructure in Delhi, Vadodara, Jaipur, and Patna. Pedestrian infrastructure, such as pathways, was either non-existent or poorly maintained. As a result, pedestrians and motorized traffic are in direct conflict. Bicyclists are unable to use specified infrastructure because it is not properly designed and there is no continuous network available at the specific places. The available network is not fully integrated with other public transport. At some required places, it is not available. Government officials are unconcerned about low-income populations who rely heavily on NMT (Tiwari et al., 2016).

The parameters used to evaluate NMT infrastructure in Chennai and Bengaluru are design, speed, travel time,

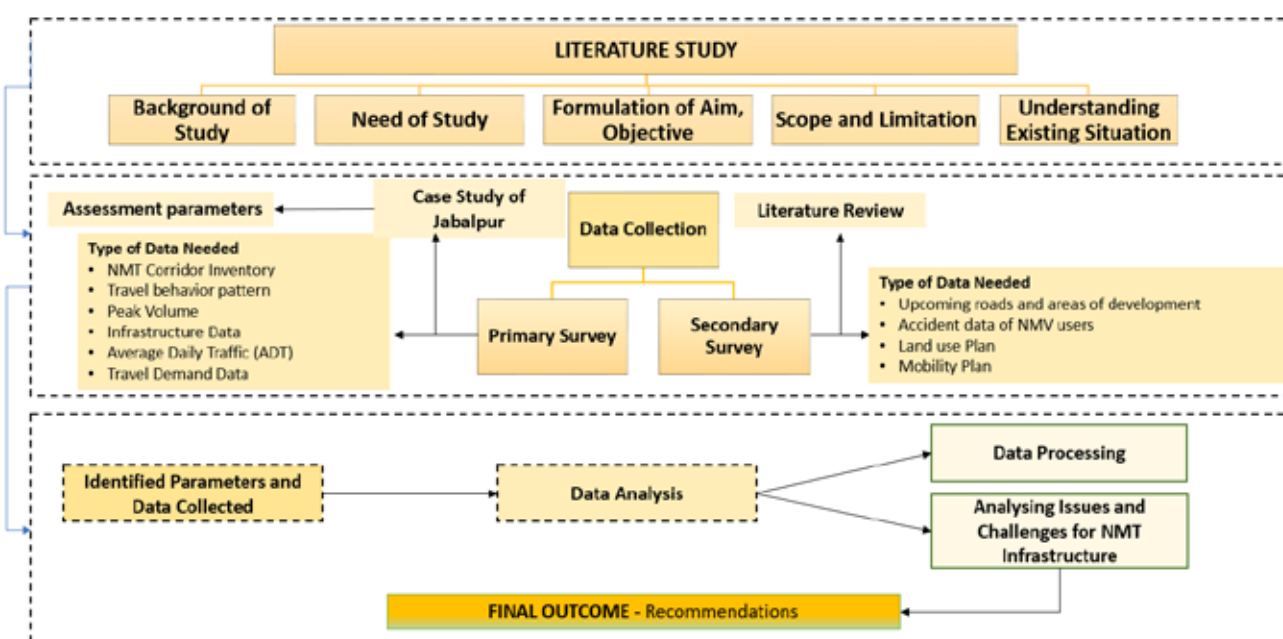


Figure 8: Methodology for the study
Source: Author

accessibility, safety, availability of cycle lanes, riding surface, and street connectivity. The infrastructure for pedestrians is either non-existent, damaged, or hindered. There are significant height disparities between sidewalks and driveways/ alleys—flooding during rainy seasons, danger at roadway crossings, and distance between crosswalk locations. The footpaths lack continuity, with significant portions being in bad shape due to utility repairs and maintenance. Few exclusive-use lanes exist for bicyclists being driven off major highways by motor vehicles on adjacent roadways (Bank, 2005) we have prepared a series of Economic Evaluation Notes that provide guidance on some of issues that have proven more difficult to deal with. The Economic Evaluation Notes are arranged in three groups. The first group (TRN-6 to TRN—10 (Gota et al., 2013).

Obstructions, security from crime, speed, travel time, accessibility, and safety are the factors used to evaluate NMT infrastructure in Chandigarh. Special pedestrian walkways have been built on some major arterials. Between 2001 and 2003, a total of 160 kilometres of broad cycle routes were built (Pucher et al., 2007).

The availability of cycling lanes, riding surface, and street connectivity are the characteristics used to examine the

NMT infrastructure in Delhi. Currently, 40 percent of the city’s roadways lack a pavement refuge, and those that do exist are frequently inaccessible, especially to the disabled. Zebra crossings are frequently disregarded, and light-controlled crossings are spaced far apart. More emphasis is being placed on providing motorized vehicle with barrier-free movement by constructing foot over bridges and subways (Mamun et al., 2009) (Singh, 2018).

Pedestrians and cyclists have few options when it comes to infrastructure. Existing transportation infrastructure development initiatives in India are geared toward faster means of transportation that claim ROW by replacing NMT (Newsletter, 2014).

2.1.4 Identified assessment parameters

Several assessment parameters based on the project’s suitability were identified to appraise the NMT green corridor. These are shown in Table 5 with their relevance and data required for assessment.

2.5 Key features of the project

The key features of the NMT corridor project are as follows:

- Green Corridor where motorized vehicles are strictly prohibited.

- Overlaid on Omti Nala, a drain passing through the ABD area.
- The first green corridor is where recreational facilities are available for users.
- Conservancy lanes are used as a feeder to the corridor.

2.2.1 Challenges in the project

There were numerous challenges in the project, from the starting to the completion stage.

- Expertise was required due to the uniqueness of this NMT green corridor, as the project was new to the working groups.
- To comprehend the project in terms of connectedness, accessibility, and the structure of an interconnected NMT network. The NMT network is developing using the drainage network of the ABD area, given that the drainage network for the selected ABD area was designed in 1940 by the British government with backside conservancy lanes. Those conservancy lanes and the main drain i.e., Omti Nala, were getting choked. It was necessary to clean it before implementing the project. The NMT corridor is being layered on an existing drain (OmtiNala) and conservancy lanes will be used as feeder for the corridor. Conservancy lanes are

Table 5: Assessment Parameters

Parameters	Relevance	Data Required
Utilization	To measure the effectiveness of the corridor	Traffic volume count (TVC) of pedestrians and cyclists and availability of vendors
Mobility (Non-motorized traffic flow on the corridor)	Availability and condition of the pedestrian lane and cycle lane on the corridor	Width of the lanes, material of the lanes, segregation of the lanes, and visibility during day and night time
Land Value	How the corridor has increased the value of land by changing the utilization of space on Omti Nala	Temporal condition of the nearby surroundings, land utilization, and land use
Ambiance	Placemaking, spaces for community gathering, and landscaping	Temporal status of the surroundings and MUZ
Level of Service	To measure the trip experience through the corridor	Comfort and safety infrastructure, signage on the corridor, and user’s perspective

Source: (United Nations Centre for Regional Development, 2018)

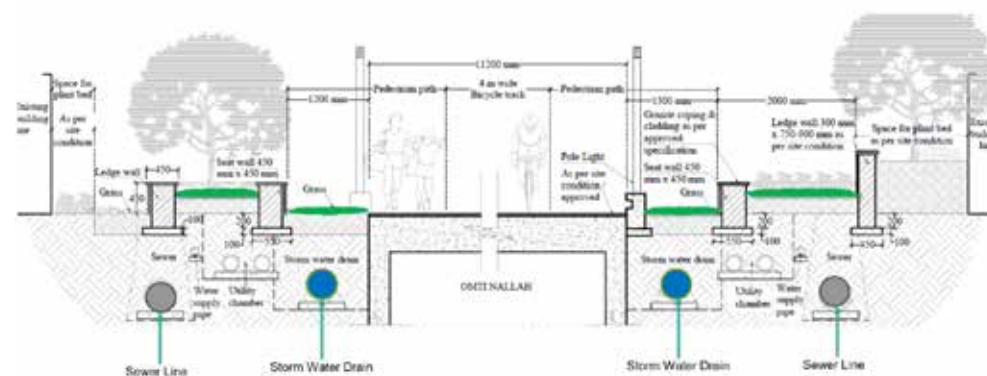


Figure 10: Cross-section of the NMT corridor
Source: (DPR, 2021)



Figure 9: Entrance of the NMT corridor
Source: Primary Survey



Figure 11: Open gym at the NMT corridor
Source: Primary Survey

- under construction and yet to be integrated.
- c. Project implementation due to poor conditions at the chosen location. The location for the corridor was a stretch of OmtiNalla that falls under the ABD area of the city. The drain was not fully covered and encroached at a few places.
- d. Integrating the projected NMT corridor with existing road infrastructure.
- e. To integrate the proposed NMT into existing public transportation (PT) and intermediate public transportation (IPT).

2.2.2 Risks involved in the project

- a. User adaptation is required for the use of the specialized corridor.

- b. The design efficiency of the dedicated NMT corridor is determined by user behaviour.
- c. This project has hazards associated with operations and maintenance (O&M).

2.2.3 Features and Benefits (social, technical, city administration level, impact on environment and economy) to the city (expected and observed)

As per the primary surveys and JSCL report, the features and benefits of the project are as follows:

- a. It is a unique NMT green corridor where motorized vehicles are prohibited, allowing people to travel safely and healthily. (JSCL, 2021)
- b. People have a higher quality of life in terms of a

- healthy living environment along the corridor rather than on the backside of the properties where the drain existed.(JSCL, 2021)
- c. Using the covered drain as a green corridor for the NMT.(JSCL, 2021)
- d. The creation of public spaces and the beautification of the catchment area.(JSCL, 2021)
- e. Increase the use of bicycles and walking as modes of transportation.(JSCL, 2021)
- f. Improvements in pedestrian and cyclist safety. (JSCL, 2021)
- g. Raising public awareness about the importance of using environmentally friendly modes of transportation.(JSCL, 2021)
- h. Improve microclimate through the use of native vegetation and the integration of infrastructural and environmental components.(JSCL, 2021)
- i. Improve citizens' physical health.(JSCL, 2021)
- j. Any increase in NMT results in a direct reduction in emissions.(JSCL, 2021)



Figure 12: Conservancy Lanes along the NMT corridor
Source: (DPR, 2021)

2.4 Key findings from the interviews, surveys, and primary/secondary data collection

Trip profile, vending profile, land use survey, TVC survey, NMT corridor inventory, user survey, and relevant stakeholder survey were all completed to meet the study's aim and objectives. Secondary data from the City Development Plan (CDP) of Jabalpur under JNNURM, National Urban Transport Policy NUTP's NMT guidelines and policies, and Jabalpur Smart City's DPR of Non-Motorised Transit from Ghanta Ghar to Madan Mahal have also been referred for examination.

2.3.1 Land use survey

It can be seen in the present land use condition and its usage along the corridor following the JSCL implementation based on the NMT Corridor land use survey. Figure 13 shows the location of the surveys.

Figure 15 depicts the existing land use plan for NMT corridor 1, including residential, commercial, mixed-use, educational, religious, and building frontage.

2.3.2 NMT Corridor Inventory Survey

According to the NMT Corridor Inventory Survey, we can determine the current state of the corridor and its utilization following the implementation of the JSCL. Figures 15,16 and 17 depict the corridor's plan and cross-section to understand the current state. The ROW is 21 meters, the clear width of the cycle lane and pedestrian lane is 11.2 meters, the cycle lane width is 4 meters throughout the corridor, the pedestrian width is 3.6 meters, and the MUZ is 3.3 meters wide. There is a 2.2-meters wide buffer between the MUZ and the building line that is covered by planters and trees.

Figure 18 below depicts the material plan for a specific section of the corridor, where flooring tiles are used for the pedestrian and cycle lanes, and bitumen is utilized for cycling the lane in some areas of the corridor.

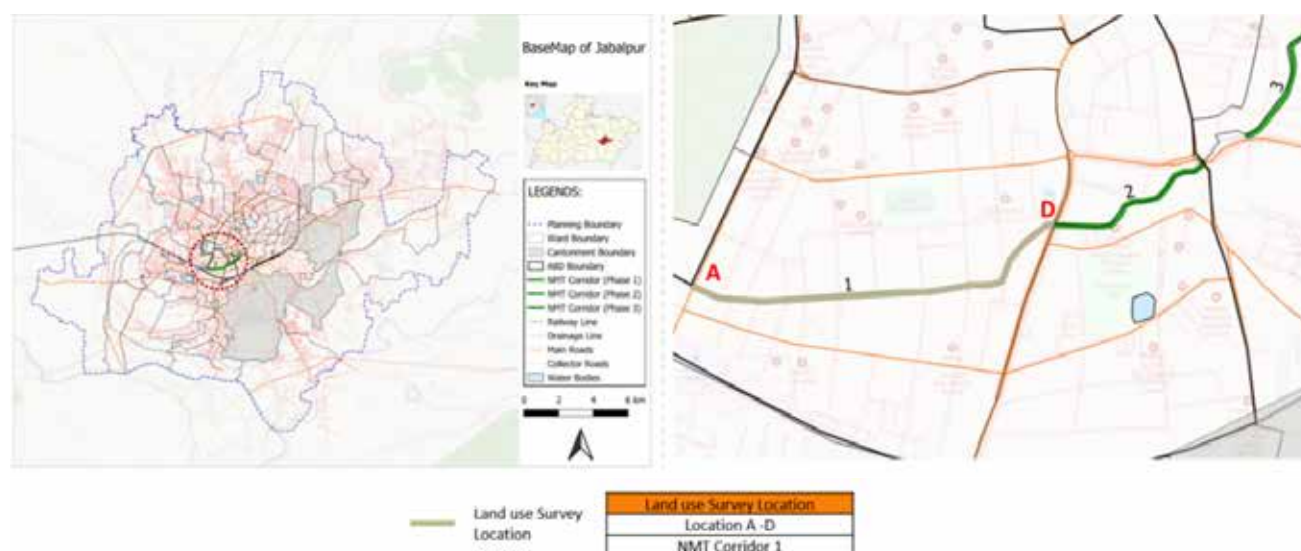


Figure 13: Location of land use survey
Source: Author

The corridor's photographs (Figures 19 and 20) illustrate the pavement material for the pedestrian and cycling lanes.

The lighting plan and specifics of lights on a specific section of the corridor are shown in the figure 21.

On the corridor, other facilities such as trash cans, drinking water facilities, and public restrooms were discovered missing.

2.3.3 User Survey

After JSCL implementation, the current user perspective, need, and trip profile based on the user

survey can be observed. A random sampling technique was used at the time of the survey, and the sample size was 30 people.

Question: Where do you live?
Key finding: The catchment area is 0 to 5 kilometres around the corridor, and the effective catchment area is 0 to 3 kilometres.

Question: What is the purpose of using this corridor?
Key finding: Because 73.33 percent of users use the corridor for recreational purposes, we may conclude that it is best suited for recreational usage.

Question: How frequently do you use this corridor?
Key finding: Because most users use the corridor for leisure purposes, 66.67 percent of users visit daily.

Question: Is this corridor safe in the daytime?
Key finding: According to 80 percent of users, the presence of light makes the corridor safe during the daytime.

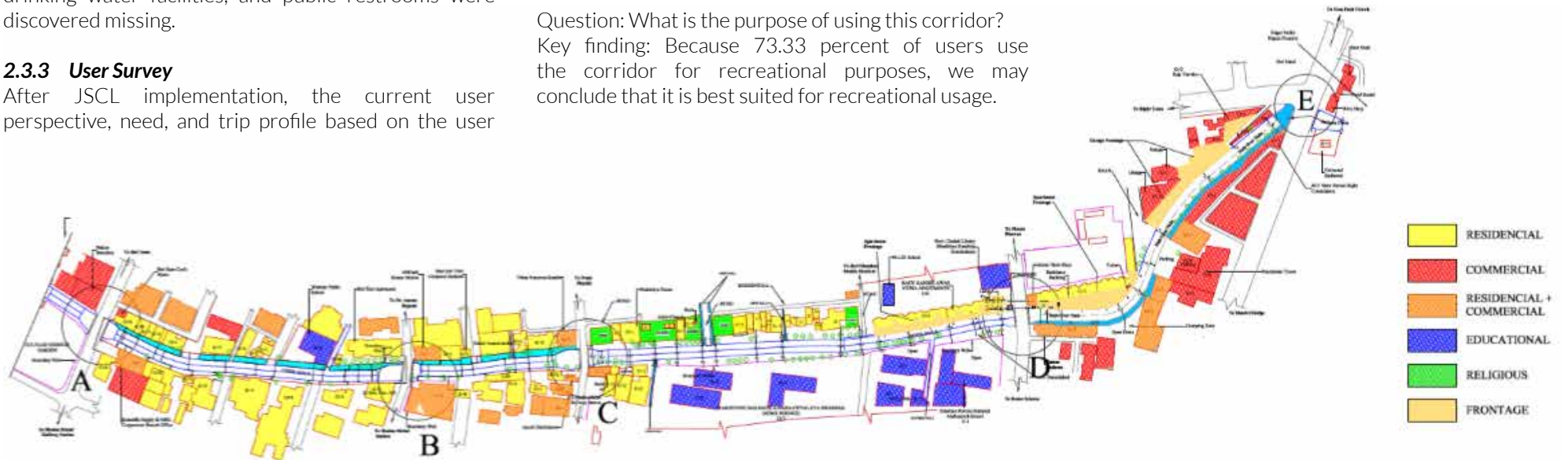


Figure 15: Key plan of NMT corridor's section r
Source: (DPR, 2021)



Figure 14: Land use plan of the NMT corridor
Source: (DPR, 2021)

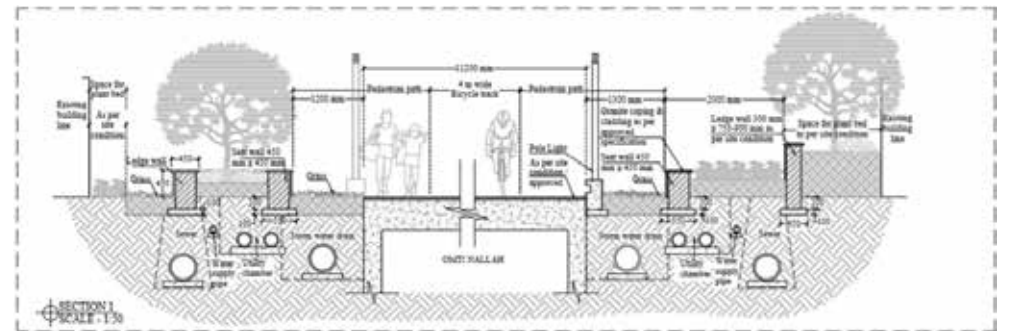


Figure 17: Cross-section of the NMT corridor
Source: (DPR, 2021)

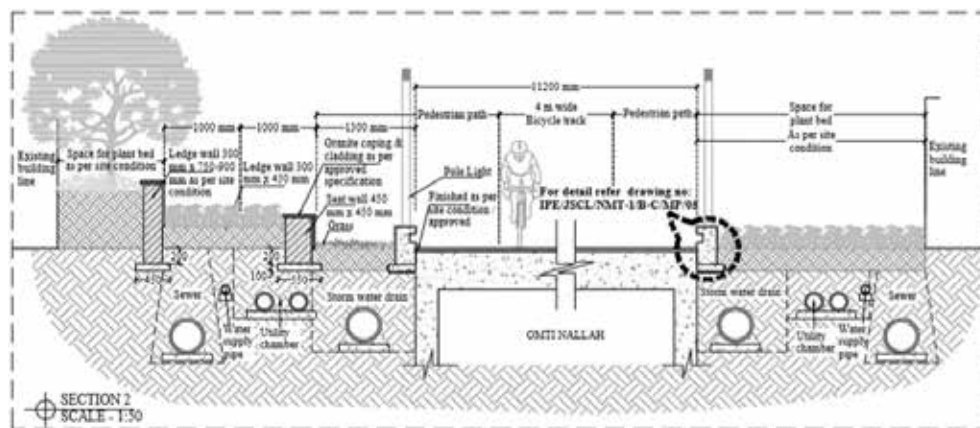


Figure 16: Cross-section of the NMT corridor
Source: (DPR, 2021)



Legend
As per site condition
Tile Flooring
Softscape
Grass

Figure 18: A material plan of the specific section of the NMT corridor
Source: (DPR, 2021)

Question: Is this corridor safe at night time?

Key finding: 70% of users stated that the corridor is unsafe at night since some lights are out and those working correctly are turned off late at night to save electricity.

Question: How would you rate the current NMT corridor?

Key findings: Because of the lack of amenities such as drinking water, public bathrooms, and trash bins, 43.33 percent of users indicated the corridor is averagely used. Animals such as dogs and pigs have easy access to the passageway, making it dangerous for children and other users (Figure 29 A, B, C, D). Some areas lack shading infrastructure, making it difficult to use the corridor in the afternoon.

Question: Would you like to visit this corridor again?

Key findings: Only 6.67 percent of users stated they would not visit again, indicating that the corridor is popular and people are attracted to it.

Question: How strongly do you recommend a new NMT corridor should be like this in the city?



Figure 19: Showing the paving material on the track
Source: Primary Survey



Figure 20: Showing the paving material on the track
Source: Primary Survey



Symbol	Type	Description	Distance(c/c)	NOs.
	L1	Recessed Linear Light (1.0 m long)	4.0 m	120
	L2	4 m High Tubular Pole Light	4.0 m	120
	L3	Tree Uplighter	2.5 m	115
	L4	Spread/Mushroom Light	1.5 m	70

Figure 21: Light plan of the section of the NMT corridor
Source: (DPR, 2021)



NMT Trip Profile Includes : O-D Data, Mode type, Trip frequency, Trip Purpose etc.)
NMT Infrastructure Survey Location
NMT Trip Profile Survey Location
Location A-D
NMT Corridor 1

Figure 22: Location of User Survey conducted
Source: Author

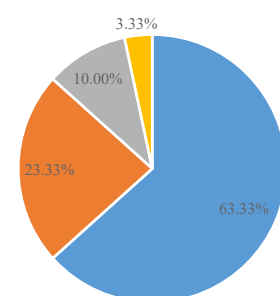


Figure 23: Where do you live?
Source: Author

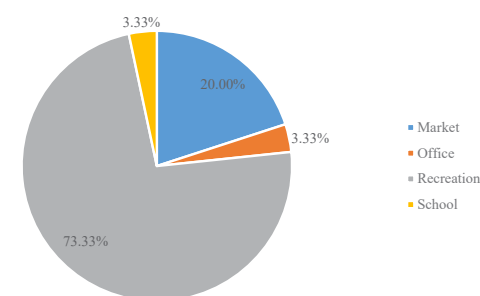


Figure 24: What is the purpose of using this corridor?
Source: Author

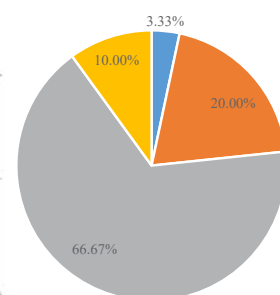


Figure 25: How frequently do you use this corridor?
Source: Author

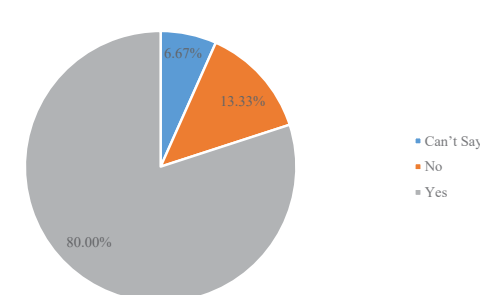


Figure 26: Is this corridor safe in the daytime?
Source: Author

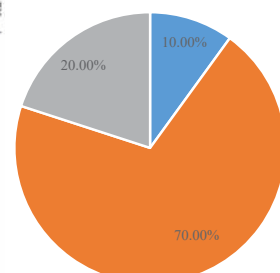


Figure 27: Is this corridor safe at night time?
Source: Author

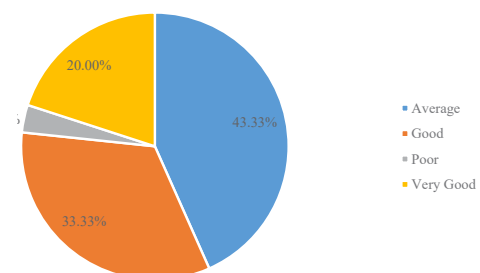


Figure 28: How would you rate the current NMT corridor?
Source: Author

Key findings: 73.33 percent of users strongly approve of a corridor like this in the city because it benefits people and improves their quality of life.

Figure 32 was created using the Google API and depicts a walking path from Non-Motorized Track 1 Entry to Guru Kripa Chole Bhature.

Key findings: The green corridor has the shortest distance of 1.2 km compared to the other alternative routes. The most preferable and safe route by choice because of the shortest time is taken and the availability of pedestrian infrastructure. The least chances of an accident are because motorized vehicles are restricted only on the corridor, not on the alternative routes. For cyclists, the same journey profile applies.

2.3.4 Traffic Volume Count Survey

A Traffic Volume Count survey was conducted at several locations (Figure 33) along the route during peak hours of 7 am to 9 am and 6 pm to 8 pm. The average of multiple locations along a certain route during specific peak hours was considered to obtain reliable data.

Table 6 : Mode wise TVC count at A-B
(Gomata Chowk Road)

Modes	Volume Count (7 am – 9 am)	Volume Count (6 pm – 8 pm)
Pedestrian	496	395
Cycle	216	158
Wheel chair	5	1
Loading Rickshaw	12	14
Battery Rickshaw	24	28
Rickshaw	48	36

Source: Primary Survey



Figure 29: Showing animals on the NMT corridor (A,B,C,D)
Source: Primary Survey

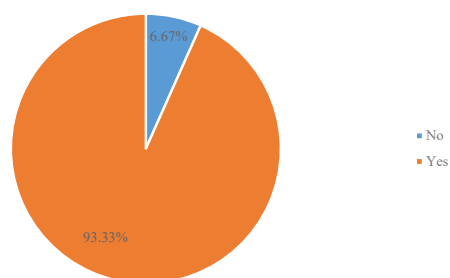


Figure 30: Would you like to visit this corridor again?
Source: Primary Survey

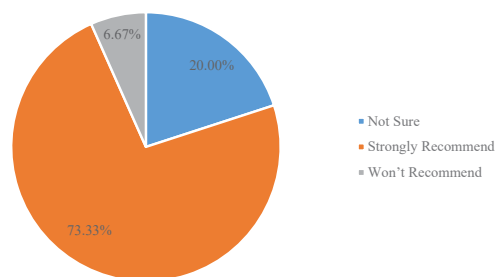


Figure 31: How strongly do you recommend a new NMT corridor should be like this in the city?
Source: Primary Survey

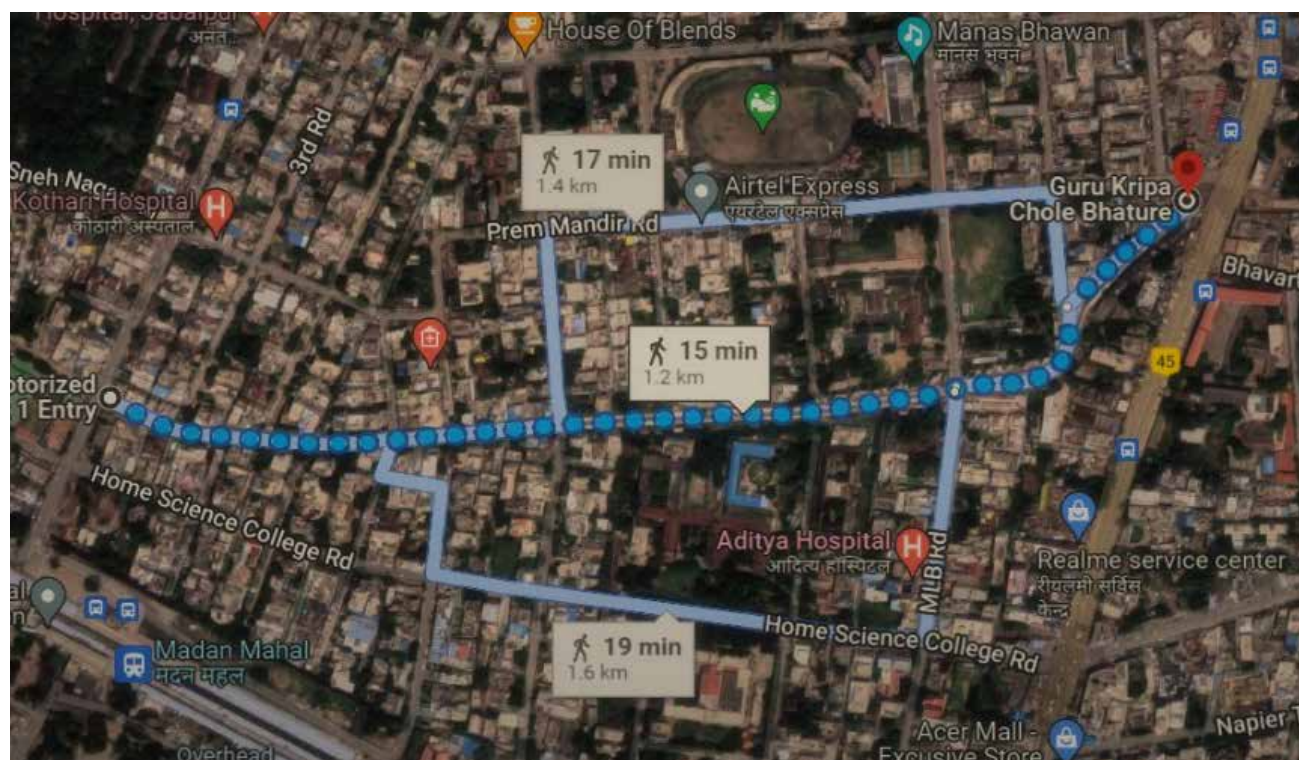


Figure 32: Walking path from Non-Motorized Track 1 Entry to Guru Kripa Chole Bhature.
Source: Google API

Table 7 : Mode wise TVC count at K-L
(Home Science College Road)

Modes	Volume Count (7 am – 9 am)	Volume Count (6 pm – 8 pm)
Pedestrian	408	363
Cycle	96	89
Wheel chair	0	1
Loading Rickshaw	0	0
Battery Rickshaw	0	0
Rickshaw	72	32

Source: Primary Survey

Table 8 : Mode wise TVC count at C-J (NMT Corridor 1)

Modes	Volume Count (7 am – 9 am)	Volume Count (6 pm – 8 pm)
Pedestrian	1056	865
Cycle	0	0
Wheelchair	0	0

Source: Primary Survey

Key findings: High pedestrian usage on the newly constructed C-J corridor is observed compared to other alternative routes. This shows significant demand from point C to J that has been catered through this NMT corridor. Due to accessibility issues, there are no cyclists or wheelchair users in the corridor. The entry/exit point has a barrier to prevent motorized vehicles from entering, but it also serves as a barrier for cyclists and wheelchairs. There is a dead-end beside the wall at the end of the corridor. This dead-end can be removed so that the phase 1 NMT lane can also be used for the cycle users.

Figures 34 (A, B, C, D) show the barrier to entry/exit at one side and the dead-end at another side of the corridor.

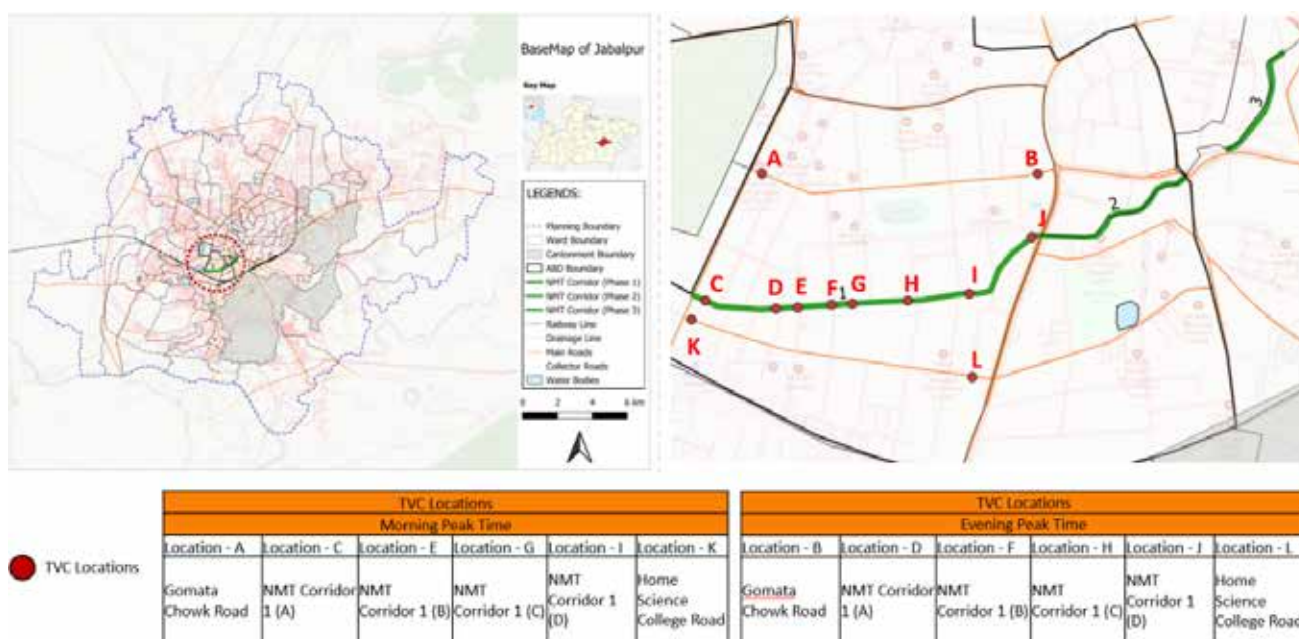


Figure 33: Locations of Traffic Volume Count Survey
Source: Author

3. Discussion and Conclusion

3.53.1 Implications

The assessment of the NMT green corridor has been done based on the various parameters mentioned above (Table 5). The utilization of the corridor, mobility on the corridor, land value impacts on the surrounding land use, the ambiance throughout the corridor, level of service, and user's perspective were observed through this assessment. The assessment of these parameters is as follows:

Utilization: Pedestrians use the route primarily for leisure purposes. Because of missing infrastructure and vendors on the corridor, it creates issues to use it for transportation purposes. Only pedestrians are using the corridor because phases 2 and 3 are under construction and are yet to be integrated with phase 1. For this reason, there are barriers at entry/exits of the corridor for cycles.

Mobility: The barrier-free structure allows individuals from all walks of life to freely visit and enjoy the location. People of all ages are welcome to visit because it was built and developed by keeping all age groups in mind. A few observed issues are:

- The width of the pedestrian lane varies throughout the corridor, causing pedestrian movement to be disrupted by the shifting breadth and pattern of the tiles,
- The pavement material used is not suitable for walking,
- At the majority of the corridor, there is a shared cycle and pedestrian path.

Land value: The NMT Green Corridor has increased the value of nearby land and property by 10% to 15%. The upscale part of the city where the NMT corridor Phase 1 was established was losing land value due to the

unpleasant atmosphere generated by the drain crossing their property prior to its construction. The NMT green corridor has enhanced connectivity in the area, and more conservancy lanes are being built to serve as feeder lanes for the corridor. In addition, economic activity has exploded.

Ambiance: According to the stakeholder study, the 1.2-kilometer corridor has directly touched 1200 people and about 300 homes. 5000 residents and non-residents benefit indirectly from the clean air and open space for recreation. The general ambiance is pleasant, albeit it is not constant along the corridor due to discontinuity in placemaking and inadequate landscaping upkeep, since more parts of the NMT corridor are being implemented and will not be fully integrated until later. In comparison to the previous scenario of the area, the whole ambiance at the NMT corridor phase 1 and the neighbourhood along it has improved. The neighbourhood no longer has a terrible odour or an unsanitary environment.

Level of Service (LoS): The current service level is inadequate due to missing infrastructures and poor corridor operation and maintenance but has attracted pedestrians to use this corridor. However, it can be improved once the entire project is completed. Infrastructure such as public restrooms, drinking water facilities, vendors, and climate-related infrastructure such as shades are all missing, posing a problem for the corridor's users. However, after completing and integrating all sections of the corridor with other public transportation, it could be much better. Conservancy lanes, which will serve as a feeder to the corridor, are now under development and will undoubtedly improve the corridor's level of service.

This NMT Green Corridor also contributes to reaching the sustainability goals as shown in Figure 35.

Overall, the NMT Green Corridor is mostly used for recreational purposes; nevertheless, transportation solutions are currently insufficient due to concerns with cycling accessibility and a lack of public convenience and drinking water infrastructure. With the completion of the whole project, it would be fully utilized for transportation purposes by all modes of NMT.

3.63.2 Limitations of the research

The research is limited to the area surrounding NMT Green Corridor 1. NMT phase 2, phase 3, construction of conservancy lanes and integration of phase 1 with the existing road at the Bus stand end are under construction. Therefore, these phases and other under-construction works are not considered for the study. As described in the preceding section, only the identified parameters were assessed due to data availability to accomplish the study's objectives.

3.73.3 Key lessons learned

The NMT green corridor's location and surroundings are quite crucial in terms of proper utilization. People would be encouraged to use the NMT if there was a

pleasant pedestrian environment and a well-connected corridor to neighboring landmarks and surrounding places. As a result, the right of way can be utilized in a highly effective manner by providing people with more social gathering locations.

According to the primary survey data, more users came from within 1 kilometer area, while the least came from within 5 km area. The NMT green corridor has a 5 km catchment area. Radially, a 1 km region has a strong affected zone, which decreases from 1 km to 5 km. This corridor is mainly used for recreational purposes by residents of the impacted area. NMT Corridor 1 has certain limitations in terms of accessibility, but after the entire project is done, it will be more widely used for transportation by all NMT modes. Supporting infrastructure such as user convenience, safety and security, garbage bins, and drinking water facilities,

among other things, is crucial in ensuring that NMT projects are fully utilized. People are becoming more aware of the use of sustainable transportation modes such as walking and cycling as a result of the project's uniqueness.

3.83.4 Recommendations

As per the analysis of the NMT Green Corridor, there are a few recommendations that can be stated for further improvement.

- The entry/exit at the dead-end can be redesigned to provide access to cycle and wheelchair users. In the current situation, the corridor of phase 1 seems incomplete due to the dead-end on one side.
- Infrastructure such as drinking water, public restrooms, trash bins, and shade devices and CCTV cameras must be erected and made available.

- The corridor needs to build a dedicated place for vendors.
- Stairs and ramps at the entrance and exit must be correctly planned.
- The material choices for the pavement should be modified, such as antiskid for pedestrians and asphalt for cycling tracks.
- In the corridor, all horizontal and vertical signage must be available.
- The provision of solar lights should be there to save electricity.
- For the corridor, an operation and maintenance model must be developed (Tiwari & Jain, 2013).



A



B



C



D

Figure 34: Showing barriers at the entry/exit point of the NMT corridor (A,B,C,D)
Source: Primary Survey



Ensure healthy lives and promote well-being for all of all ages



By 2030, halve the number of global deaths and injuries from road traffic accidents



Make cities and human settlements inclusive, safe, resilient, and sustainable



By 2030, provide access to safe, affordable, accessible, and sustainable transport systems for all, improving road safety, notably expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons



By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management

Figure 35: SDG Goals related to NMT
Source: (UN, 2016)

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C32

Assessment of Multilevel Parking, Raipur

Name of the project: Multilevel Parking

Location: Chhattisgarh

Year of project implementation: 2021

Sector: Urban Mobility - Parking

Project Cost (Rs. Crore): 23

SDGs: SDG 9, SDG 11 & SDG 13

Institute: School of Planning and Architecture, Bhopal

Advisors: Dr. Mohit Dev

Students: Adesh Gupta

Keywords: Multilevel parking; Impact assessment; Parking problem; Off-street Parking; Parking revenue.

Abstract:

In India, private vehicle ownership has expanded by 400% between 2001 and 2015. Increasing on-street parking places increases land demand, especially in cities where land is scarce and expensive. The demand for parking in Indian cities has increased as the population has grown. Similar to other Indian cities, Raipur is also facing parking issues. The 'Collectorate Parisar' is situated in the heart of the city and people are facing congestion, minor accidents, pollution, and inconvenience due to unorganized on-street parking facilities in surrounding areas. Poor on-street parking management disrupts the pedestrian flow.

This study aims to assess the current parking scenario at the Collectorate Parisar, determine the impact of new multilevel parking on the surroundings, and suggest intervention strategies for improving the multilevel parking facility. The study methodology includes a literature review, identification of assessment parameters (mobility, travel speed, level of service, parking capacity & revenue, ambience, and safety & comfort), primary and secondary data collection, and to assess the impacts (before and after implementation) of multilevel car parking on these parameters. Secondary data has provided an understanding of the street parking scenario before implementing the multilevel car parking project. Primary surveys helped in analyzing the existing situation. The random data sampling technique is used for the user interviews as per the prepared questionnaire. The questions include information about how many days people use this parking, how convenient & safe to use the multilevel parking, etc. Stakeholder interviews (smart city office, design firm, nearby government office, etc.) were conducted to understand the need and challenges of the project. The study's assessment of the collected data from various resources finds that the multilevel parking has resolved many stern issues like congestion, encroachment, poor safety, comfort, etc., and improved the surrounding ambience.

Case Study: C32

1. Introduction

Raipur is the state capital of Chhattisgarh with total area of 226 square kilometers, of which 140 square kilometer is governed by the Municipal Corporation. The 2011 census shows this metropolitan agglomeration has over 1 million residents. Between 2001 and 2011, the Raipur area's population grew by roughly 4% annually (Raipur Public Transport Scoping Study, 2015).

Connectivity

Raipur is connected to the surrounding region via four major intercity routes: NH-200 (towards Raipur and bisecting the city in two parts), NH-43 (towards Vishakhapatnam), and NH-6 run east-west through the city (Figure 1). Figure 2 and Table 1 shows the land use

distribution of Raipur. In the year 2009, Raipur developed a comprehensive traffic and transportation plan to improve traffic conditions in the city (Revised City Development Plan for Raipur Interim Report, 2014).

Table 1. Land use as per proposed Master plan 2021

Land Use	Area (Ha)
Residential	8088
Commercial	1370
Industrial	1451
PSP & PUF	1506
Recreational	1610
Transportation	1975

Total	16000
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1.1 Topic and Context

A review of transportation factors in Raipur indicates an alarming increase of private vehicles at a pace of 13% per year over the last decade, and it will surpass nine-lakh vehicles this year. (Figure 3) This increased travel demand has resulted in peak-hour travel speed far lower than 20 km/h, making it significantly slower than cycling (Raipur Public Transport Scoping Study, 2015).

For every 1000 people in the city, there were 268 registered motor vehicles a decade ago. Today, that number is 756, almost two and a half times the national average of 2932 for cities with more than a million people (ACT, 2015). Figure 4 shows the number of



Figure 1: Location Map of Raipur
Source: (Department of Planning, 2020)

Land use distribution as per proposed master plan 2021

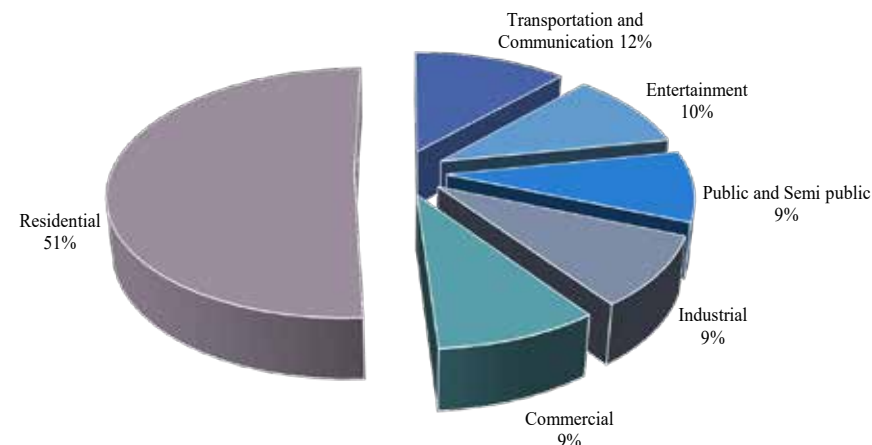


Figure 2: Land use distribution as per proposed Master Plan 2021
Source: ("Detailed Project Report Raipur," 2013)

Impact of Motorisation and City Expansion on Travel Demand

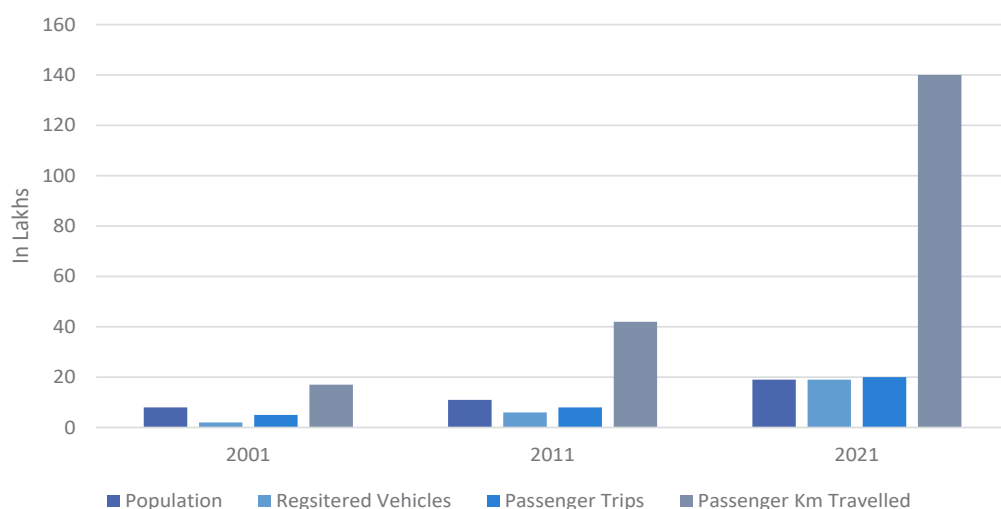


Figure 3: Impact of Motorisation and City Expansion on Travel Demand.
Source:(ACT, 2015)

Registered Vehicles in Raipur

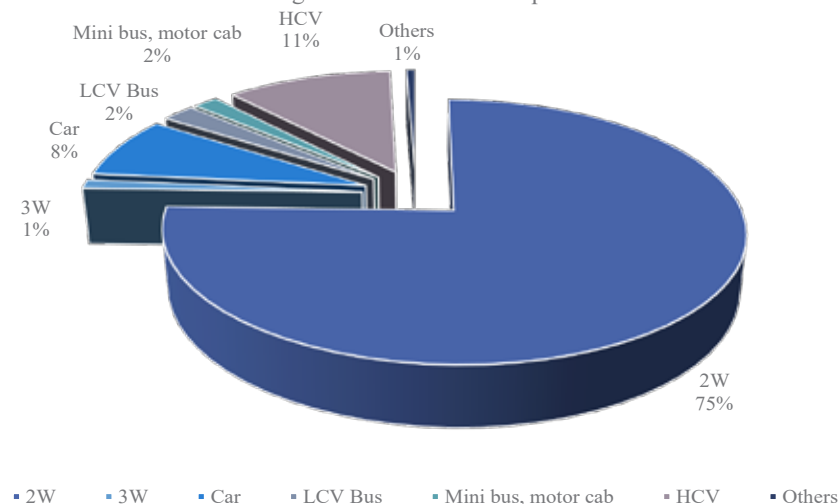


Figure 4: Registered vehicles in 2011-12
Source: (ACT, 2015)

registered vehicles in 2011-12.

1.2 Scope of Research

The multilevel parking is located at Greater Eastern Road, also known as Gaurav Path, near the historic Collectorate Parisar of Raipur. It is also nearby the most famous Ghadichawk, which is one of the ancient and important monuments of Raipur.

The Collectorate multilevel Parking is 17,792 square meters. It is a G+6 Floor conical-shaped structure. The top floor is designed for the rooftop restaurant to increase usability and revenue after & during office hours. Construction of the multilevel parking began in 2018 and was completed in 2021. The project's total cost is INR 23 crore. After completing the project, Smart City Raipur awarded the operation & management of the parking to a private company named 'Moon Services' for a period of five years.

A revenue generation plan was developed, under which the parking operator has to recover INR 83.55 Lacs over five years and hand it over to the smart city. Parking is charged at INR 10 for 2-wheeler and INR 20 for 4-wheeler per hour. Multilevel Car Parking (MLCP) has the capacity of accommodating 450 four-wheelers and 250 two-wheelers ("Chhatisgarh News," 2021; "Nai Duniya_Multi Level Parking," 2021; State Urban Development Agency, 2013).

This parking was built to meet the parking needs of the Collectorate and nearby offices. The Collectorate staff had reserved parking space in the Collectorate Parisar, limited public or visitor parking was available for other people. Due to the lack of parking spaces, people were bound to park their vehicles on the street (As per stakeholder Interview).

The Collectorate MLCP is the second dedicated multilevel parking in the city; the first parking was implemented in 2015 in Jaistambh Chawk, one of the busiest central business district areas. The Collectorate MLCP is approximately 700-800 meters far from the Jaistambh Chawk. This shows that two MLCP's within a km distance reflects high parking demand in this area. Figure 5,6,7 & 8 shows the location of MLCPs.

1.3 Significance of Project

Many organizations are located along this impacted corridor, and parking outside of them leaves little room for pedestrians, causing severe congestion. On-street parking is unorganized and unreliable, reducing road mobility and increasing accidents. On any given day in India, nearly 40% of city streets are used to park cars. Every day, city dwellers waste 20 minutes looking for parking. This causes gridlock and excessive CO2

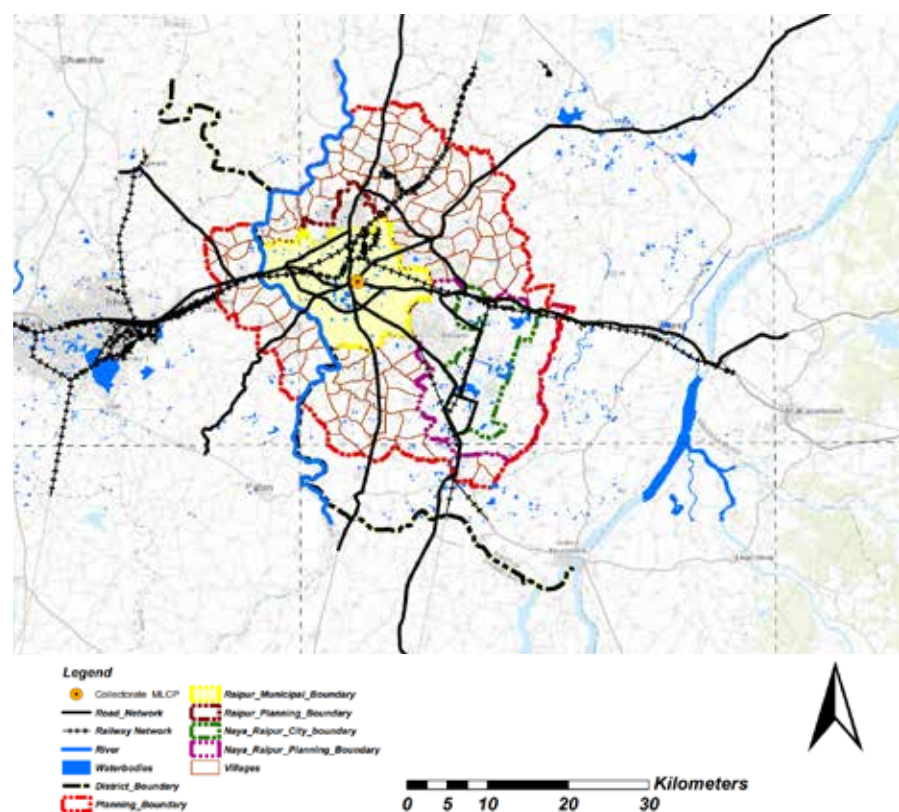


Figure 5: Location of The Multilevel Parking on Raipur's Base map



Figure 7: View of Collectorate Multilevel Parking
Source: By author

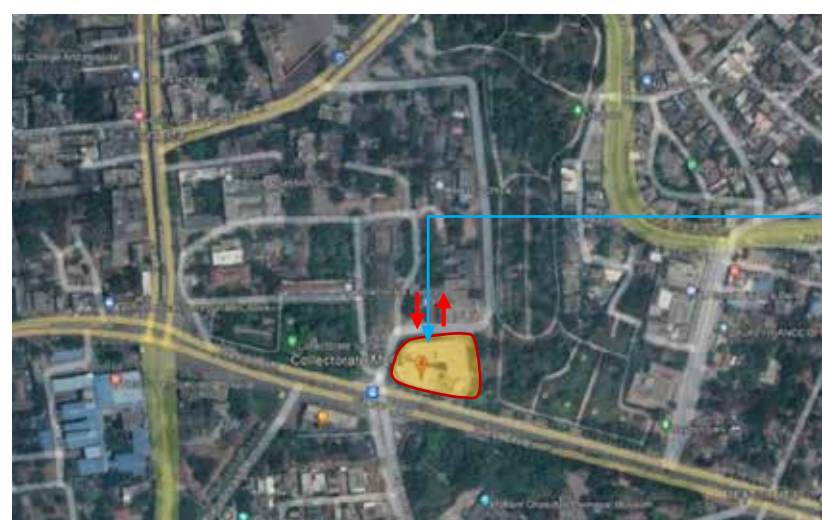


Figure 6: Location of Multilevel Parking
Source: Google earth

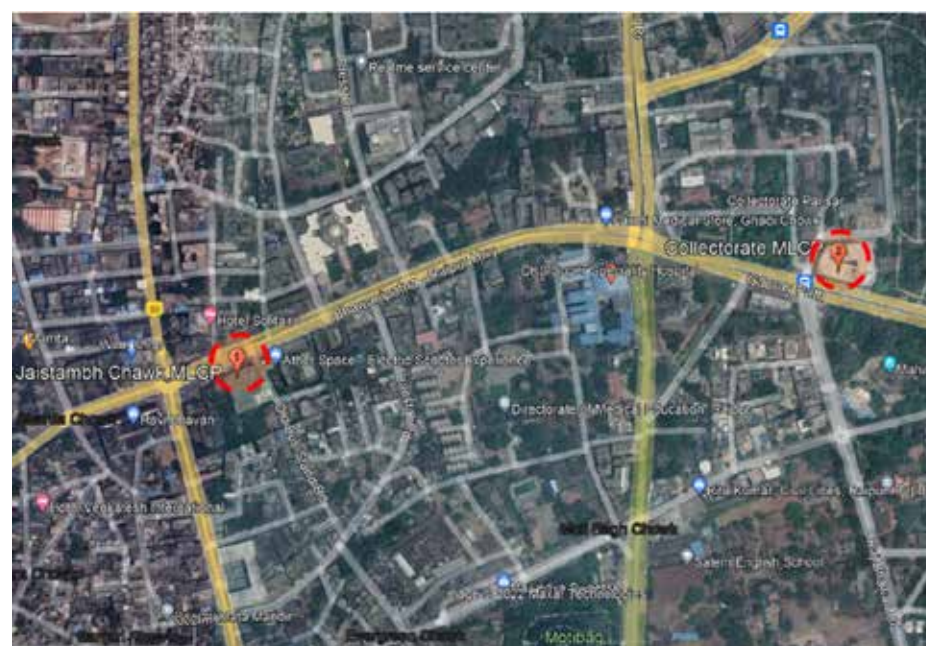


Figure 8: Location of all multilevel parking
Source: Google earth & prepared by the author

emissions. While cities are clogged with cars parked on the street, half of the available private parking space goes unused.

Table 2: Road Hierarchy of Raipur

Right of Way (in m)	Road Length (in Km)	Percentage (%)
<10	141.82	39.37
10-20	140.47	39.00
20-30	36.73	10.20
30-40	16.67	4.65
40-60	24.02	6.67
>60	0.42	0.12

Source: (State Urban Development Agency, 2013)

Around 39% of Raipur's roadways are less than 10 meters wide (Table 2). Parking on the Collectorate Parisar will benefit users in various ways, as this is the heart of administrative offices such as the District Court and Register office (CRISIL, 2014; State Urban Development Agency, 2013). Multilevel parking could help to achieve the SDG goals, such as Good Health and well-being (SDG 3), Industry, Innovation, and Infrastructure (SDG 9) by making parking safe; and Sustainable cities & Communities (SDG 11) by reducing the need of users to search for the parking hence reducing CO2 emission (Table 3).

Table 3: SDG related to parking



Source: Parking as part of your business sustainable development goals - become a city hero with Mobypark,' 2019

Figure 9, highlights the impacted corridor by the multilevel parking near the Collectorate Parisar. As the travel demand increases, cities cannot afford to have too many cars to meet demand if parking spaces are not managed properly. Increasing vehicle population, limited Right of Way (ROW), and parking spaces are causing traffic jams, accidents, pollution, and chaos in the city. To free up the streets from unstructured street parking and meet the MLCP's intended goal, the city needs to increase parking efficiency.

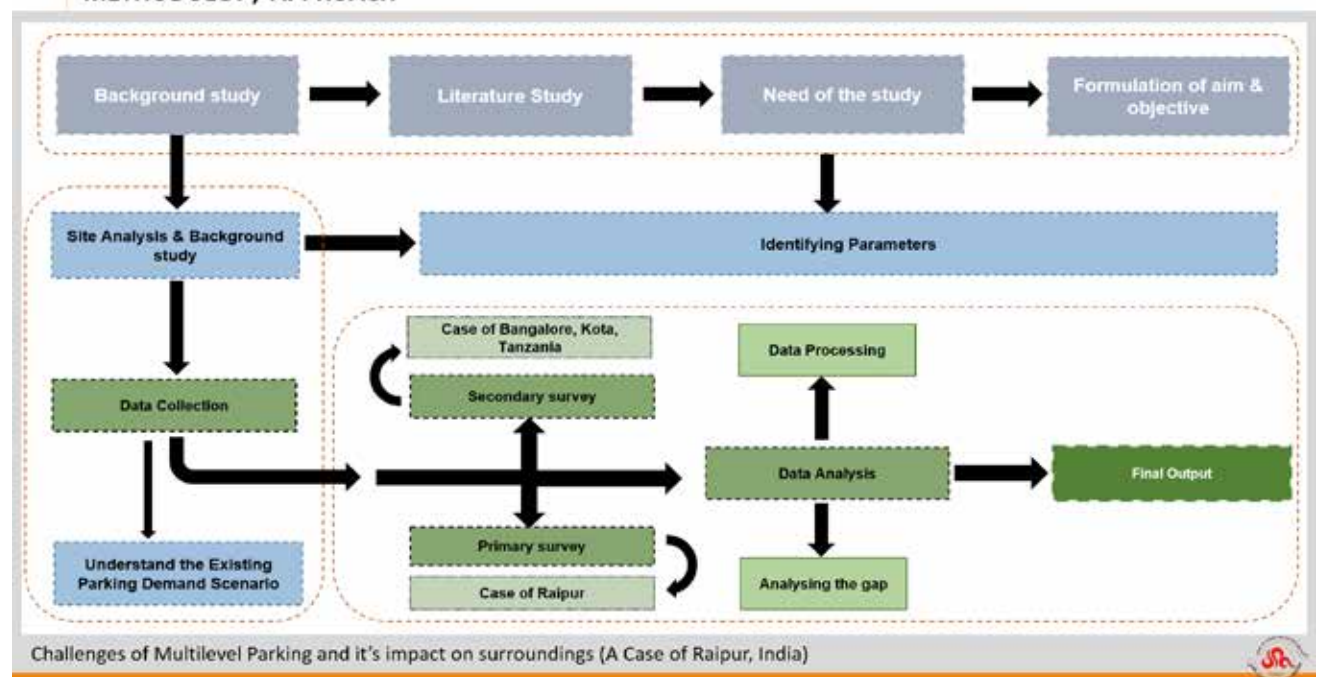
1.4 Aim and Objectives

The study aims to assess multilevel parking and its impact on the surroundings, based on selected assessment parameters.

The objectives of the research are:

- To understand the existing parking scenario
- To analyse the existing parking demand
- To assess the impact of multilevel parking
- To suggest intervention strategies for the multilevel parking

METHODOLOGY / APPROACH



Challenges of Multilevel Parking and it's impact on surroundings (A Case of Raipur, India)

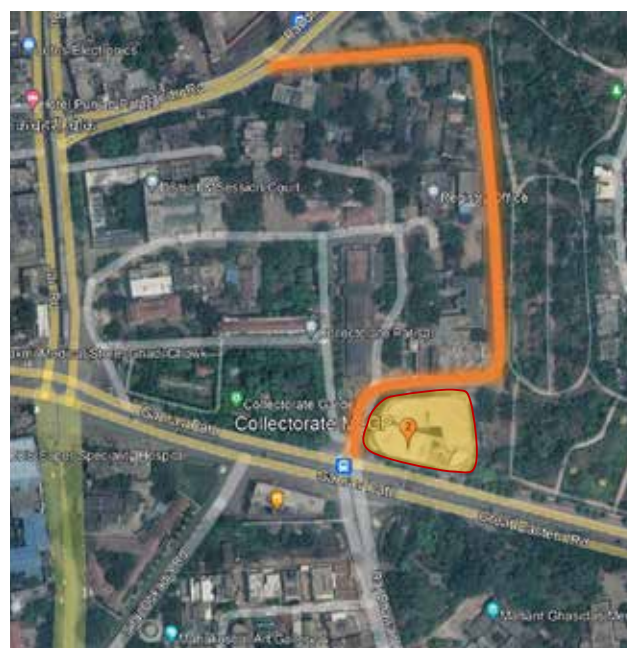


Figure 9: Major Impacted Corridor by Collectorate Multilevel Parking
Source: Prepared by the author

2. Contextual Background

On-street parking is a major issue in the city center, and all other major routes (MG Road, Sadar Bazar, Gol Baazar, Jaistambh chowk, Sharda Chowk, Bus & Railway station). Parking on both sides of the road on several major streets (mostly near bus stops) hampers the traffic flow. Most of the intersections have nearby parking (SUDA, 2013). Before the MLCP, on-street parking on the Collectorate Parisar was free. Parking fees have a significant impact on travel patterns. The National Urban Transportation Policy 2006 also set up for high parking fees commensurate with the occupied site's value.

Table 4: Average Vehicular Travel Speeds for the Year 2021 for various scenarios

Modes	Baseline (Vehicle Speed Km/hr)
Car	19.2
Motor Bike	25
NMT	5
Charter Bus	17.6
Auto Rickshaw	12
Minibus	16
Standard Bus	16

Source: (ACT, 2015)

Data from the parking survey conducted by Rail India Technical and Economic Services (RITES) was used to estimate daily vehicle and two-wheeler demand along major corridors like M.G. Road and Banjari Road in 2009. Raipur's parking demand is expected to be 1.5 times that of the study's active market locations. The survey also reveals that the average parking time is one hour. Table 4 shows the average speeds of different modes in th

Figure 10: Methodology
Source: Prepared by the author

city (Abhinav Agarwal, 2020.; ACT, 2015; CRISIL, 2014; State Urban Development Agency, 2013).

2.1 Conceptual framework / Research design

A triangulation research approach was used to accomplish the aim of the study. As a result, this research utilized qualitative and quantitative methods and a diverse set of data sources.

2.1.2 Methodology

An initial background study of parking demand management and parking typologies is followed by several literature reviews to clarify the study's purpose, objective, and necessity. After a literature review, site analysis, and background study, several assessment metrics for multilevel parking were chosen. To understand the project's status on the ground, a data collection checklist was created for primary and secondary surveys, followed by data analysis via data processing to identify gaps and determine the conclusion. Figure 10 shows the methodology adopted for the study.

Literature Studies -

Three cases have been studied to understand the process of assessment of parking facilities. To cater for the parking issues of incremented population and vehicles, Authority should look after the construction and development of infrastructures and should make the master plan with the inner, middle, and outer roads ("Problems of parking and their possible solutions with special reference to Kota city," 2017).

The study includes zone-specific on-street and off-street parking surveys, opinion polls, and road inventory surveys at and near the kg road MLCP, one of Bangalore's busiest CBD districts. The pertinent information was investigated and assessed. Because this MLCP is entirely controlled by the BBMP, the parking cost must be updated. The charges are extremely minimal, resulting in a poor revenue for BBMP. (Rajashekara, Khalandar Khan, & Kattimani, 2014).

To design a multilevel car park for the alleviation of traffic challenges in public areas. The redesign of Janpath is going to restrict the on-street parking to certain areas. This will create a demand for MLCP. It'll be able to accommodate the demand of Saheednagar particularly. To shortcut the problem of the parking by multilevel car parking. The solution to the parking requirements is the multi-level car parking system to maximize car parking capacity by utilizing vertical space, rather than expanding horizontally (Madhuri, Rathi, Darshan, & Patel, 2013).

On-street parking should be discouraged, and adequate off-street parking facilities should be provided, this paper suggests some solutions that result in more efficient utilization of parking resources (Ebihart Msigwa & Bwana, 2013).

The first-generation restraint measure was

parking policy as a demand management tool—pricing parking, limiting parking supply and enforcing parking management rules. This seemed the most attractive option for developing country cities that already have an administrative framework for some modicum of parking management measures. Evaluation has become important at a time when municipal bodies and development agencies in Delhi and other cities are committed to building numerous multilevel car parks. Before more urban spaces are surrendered to this mindless and expensive construction for cars, it is important to draw lessons from the structures that have already been built and get the terms right (Anumita Roychowdhury and Usman Nasim, 2016).

Identified assessment parameters -

To assess multilevel parking, the study has identified some of the assessment parameters based on the literature reviews.

- Mobility (Decongestion of the road) – Availability of the entire carriageway for the vehicles
- Travel Speed – Increment the average travel speed of the road
- LOS Improvement – To measure the quality of traffic service to a given flow rate.
- Parking capacity & Revenue – More no. of vehicles can be accommodated with a better revenue generation plan
- Safety & Comfort - Safety and security of the parked vehicles and comfortability to find the parking space.
- Ambience – A rise to open frontage of the building, spaces for community gathering and landscaping. (User-generated Urbanism)
- Land Value – How the spaces have increased the value of land by changing its utilization.

(Mathew V. Tom, 2019; Oxford Plaza and the David Brower Center traffic impact analysis and parking study June 2, 2005, Prepared for Equity Community Builders, 2005).

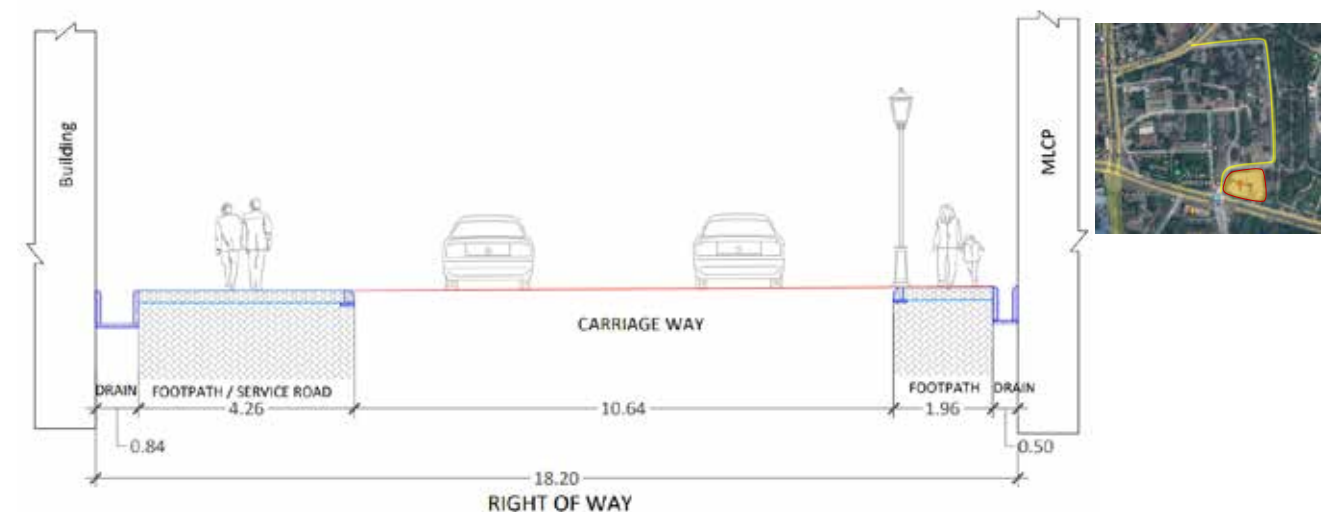


Figure 11: Typical Cross-section of the Impacted Corridor in front of the MLCP

Source: primary survey

2.3 Key features of the project

The key features of the multilevel parking project are following as

2.2.1 Challenges in the project

There were numerous challenges in front of the project, starting from the project to its completion, those were

- The unexpected introduction of the project
- To fetch the land from the existing running office
- The design of the project to accommodate more vehicles
- Difficulty in implementation of the project due to unskilled workmanship
- To finish the project within the timeline during the pandemic

2.2.2 Risks involved in the project

There are a few risks that were concerned during the project implementation, which are as follows:

- Revenue regeneration: a considerable amount has been invested in the project (INR 23 crores), and the target of earning revenue of INR 83 lacs in five years has high risks involved.
- Utilization rate: as we have seen, various multilevel parking projects have failed in India due to their underutilization; this project also involves the same risk.
- Traffic enforcement plays an essential role in the management of parking. The project's success requires the enforcement to make the people park inside the multilevel parking instead of on the street.
- Popularization of the project: To make people aware of the benefits of the parking facility and its location.

2.2.3 Features and Benefits (social, technical, city administration level, impact on environment and economy) to the city (expected and observed)

The benefits of the project are:

- This project has marginally improved the livability

- of the Collectorate Parisar
- b. Optimum space utilization by using vertical space for the parking
- c. Environment-friendly as it leaves more open spaces for landscaping and greenery such as on the road, besides the footpaths
- d. Enhanced security of the vehicles
- e. Full utilization of right of way as there would be vehicles hurdling the road
- f. It has reduced traffic congestion in the old areas where ROW is usually significantly less.
- g. The proposed rooftop restaurant will intensify the usability of Multilevel parking.
- h. Public parking will enhance the revenue collection during non-office hours and on weekends as well.

2.4 Key findings from the interviews, surveys, and primary/secondary data collection

The study's objectives were achieved through road inventories, speed tests, traffic volume counts, road infrastructure, and user and stakeholder surveys on the ground. The Raipur CDP 2021, the RITES Long and Short-Term Traffic and Transportation Study, 2009,

the Raipur Draft Parking Policy, and the Raipur DPR for financial support are secondary data sources. The 2013 JNNURM Bus Funding Scheme has also been referred to. As per the road inventory survey, the current road situation, and its utilization after the MLCP implementation can be analyzed.

Figure 11 and 12 shows the current situation of the road. Here we can see the ROW is 18.20m, carriageway 10.64m, left side footpath is wider 4.26m and right-side footpath is 1.96. There is only one side streetlight available.

The primary survey shows an average spot speed of 25 Kmph. Performed spot speed surveys show that incoming vehicle speed from Collectorate is 24 Kmph and outgoing vehicle speed is 28 Kmph.

According to the Google API speed & delay survey, traffic on the most impacted corridor has decreased. The corridor used to be very slow due to on-street parking where vehicles would stop and go.

As per the conducted Traffic volume count survey at

the peak hours, the incoming PCU/hour towards the collectorate office is 712 and the outgoing PCU/hour is 538.

For the study purpose, 50 users interviews were conducted. The opinion as per the questionnaire has been presented in figure 16. Collected data is from heterogeneous users (as per their used transportation mode e.g., 2W, 4W etc. and recurrence utilization of MLCP). The following questions have been asked to the users:

- a. How many days in a week do people use to park their vehicle inside multilevel parking?

Findings - As per above figure 15, it can be seen that 29% of users are likely to use parking throughout the week (5 days), 18% of users use it twice, 22% use it once a week, 24% use it occasionally, and 7% rarely come to collectorate campus.

- b. How much time does it take to park the vehicle at MLCP?

Findings - 87% of user says less than 5mins and 13% of user says less than 10 mins, they take to park the



Figure 12: View of the Impacted Corridor (In front of the MLCP)

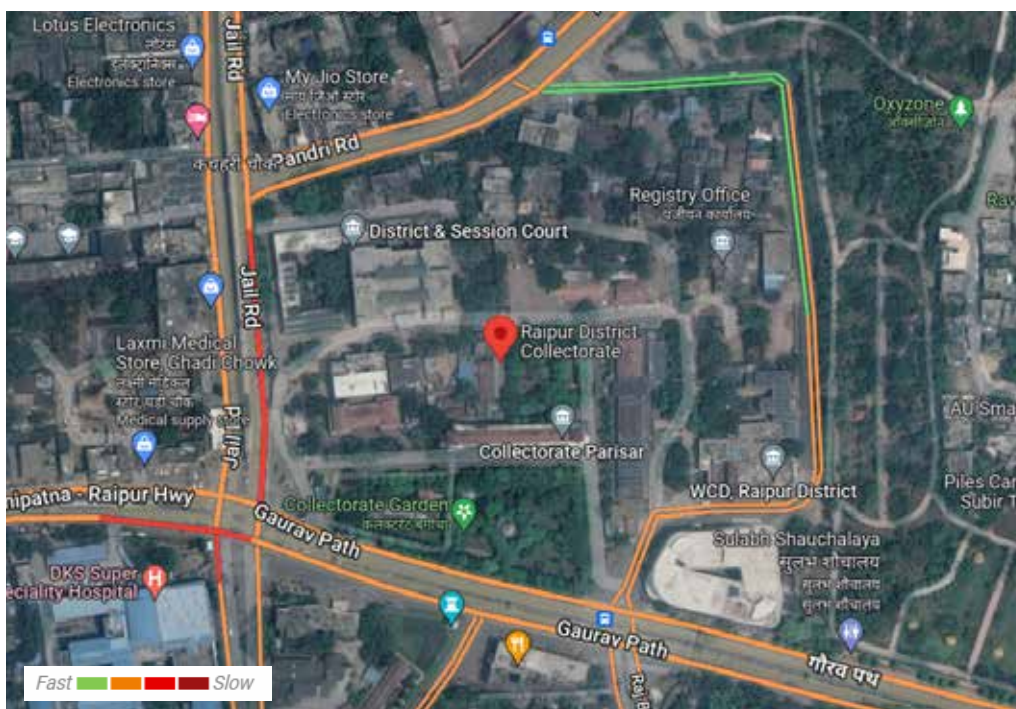
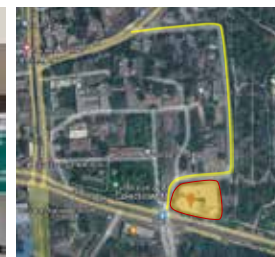
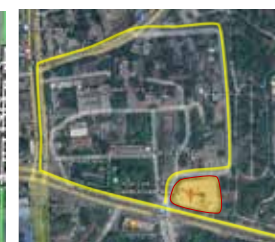


Figure 13: Peak hour traffic.



Modal Split of Inbound Traffic to Collectorate Parisar Internal Road

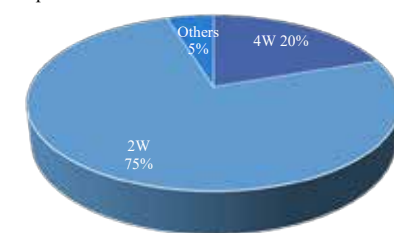


Figure 14: Modal Split of Inbound Traffic Source: Primary Survey

Modal split of Outbound Traffic from Collectorate Parisar Internal Road

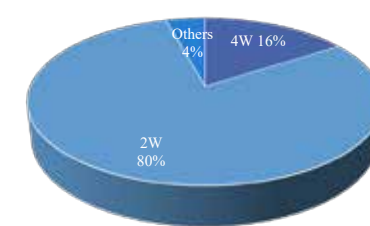


Figure 15: Modal Split of outbound traffic Source: Primary Survey

Recurrence utilization

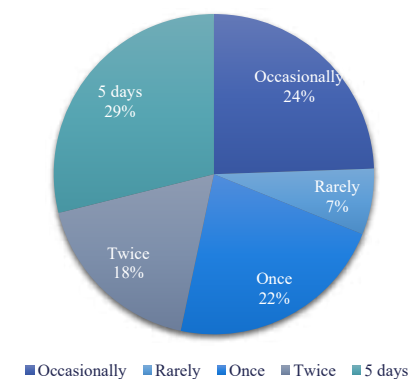


Figure 16: Utilization Rate Source: Primary Survey

vehicle inside the MLCP.

- c. Are they happy with the current parking situation now?

Findings - 80% of the surveyed user said yes, they are happy with the current situation, 11% of users said somewhat they are happy, and 9% people said they are not happy with the MLCP; hence they prefer on-street parking.

- d. Do you ever have to park on neighbouring roads because there is no space on your road?

Findings - 69% of the user said yes, they have to park on other roads as there was no space on the road to the park, 31% of users said no, it might take time, but they can find the space to park.

- e. Do parked vehicles on your road cause your problems as a pedestrian or non-motorist

Findings - 71% of users said yes on-street parking was causing obstacles to other road users such as pedestrians and cyclists, and 29% of users said no it was adjustable.

- f. Do they prefer multilevel parking compared to on-street parking and why?

Findings - 89% of users preferred multilevel parking because it leaves more space on the road, is readily available, and is safer and more convenient, whereas 11% of users chose on-street parking because it takes less time, and no walkability was required.

- g. What is the best way to inform you about the parking availability?

- A. Digital Signboard
- B. Website / app
- C. Other (Please specify)

Findings - 82% of users have chosen option A, the Digital signboard, and 18% of users have preferred option B through the website and app.

- h. What is it that you want to change about this multilevel parking?

Findings - There are a few things suggested by the users, such as the electric Charging station, bigger entry/exit, separated entry/exit, CCTV for more security, better security, Automatic Ticket vending machine, better management, Fare should be less, and Better Facilities (Drinking water, more no of Lifts, Canteen, etc.)

3. Discussion and Conclusion

Congestion is a problem in all Indian cities including Raipur. In the late twentieth century, cities sought to resolve this issue by expanding roadways and constructing flyovers. However, they quickly learned the influence of “generated demand” and the proverb “if you build it, they will come.” The researchers discovered a one-to-one association between road capacity and traffic volume, suggesting that a 20% increase in road capacity leads to a 20% or more significant increase in traffic. The key to “solving” this

congestion is to boost the general efficiency of the transportation system, either by lowering traffic or making other means of transportation more appealing, such as public transit, walking and biking (EbihartMsigwa & Bwana, 2013).

Cities worldwide are becoming aware of the hefty cost of free parking. Even little parking costs have a noticeable effect on travel patterns. According to research, doubling the cost of parking results in a 30% reduction in solo driving; a study conducted in the United Kingdom found that halving the parking availability resulted in a 30% reduction in automobile use. Variable pricing can represent demand at different times of the day. Long-term parking can be priced higher than short-term parking to increase parking lot use and deter employees from driving to work.

3.53.1 Implications

The study identified the assessment parameters based on the project’s appropriateness to assess the multilevel parking.

Mobility – MLCP has made full use of the adjacent road which was previously encroached by automobiles due to unorganized parking facilities and high parking on the pedestrian. Vehicles encroached on the pedestrian’s tracks and leaves no space for the pedestrian to walk over. As the vehicles continuously stop and look for the parking space, hence interrupt the flow of the entire corridor and contribute to the unnecessary vehicular emission.

Travel Speed – Before the implementation of the MLCP, existing congestion in the corridor made the travel speed of the vehicle to a bare minimum of 15 to 20 kmph. As the people continuously, park and take out their vehicles, made the corridor to a very slow speed road. After the Implementation of the MLCP, all the vehicles are being parked inside the parking, therefore no vehicles on the roads. According to spot speed data, the study can confirm that the same corridor’s travel speed has increased from less than 20 Kmph to more than 25Kmph in a continuous flow in the inner road of the Collectorate Parisar. As a result, we may see an increase in the average journey speed as well.

LOS – As per the capacity of the road and interrupted vehicular speed, the LOS majored as ‘E’ and after the implementation of the MLCP the travel speed has increased and as per the survey it can be seen that the LOS has improved to LOS D, showing the sign of improvement.

Parking Capacity & Revenue – On-street parking capacity was limited to around 100, and there was no parking management for the revenue collection. After the implementation of multilevel parking, the capacity increased and it can accommodate approximately 450 – 4W and 250 2W. A revenue collection system also has been prepared in which the private operator (Moon services) who is handling the parking management would give the amount of INR 83 Lacs in the five years of operation.

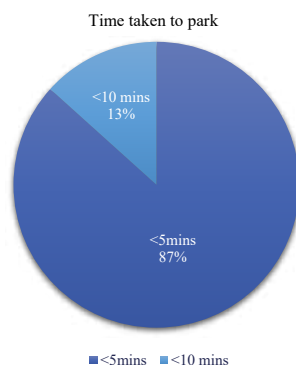


Figure 17: Time taken to park
Source: Primary Survey

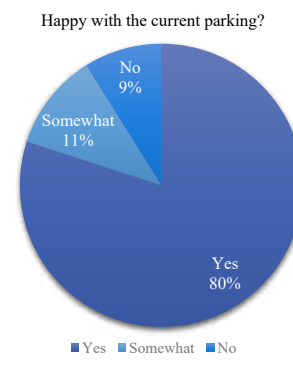


Figure 18: Happy with the current parking?
Source: Primary Survey

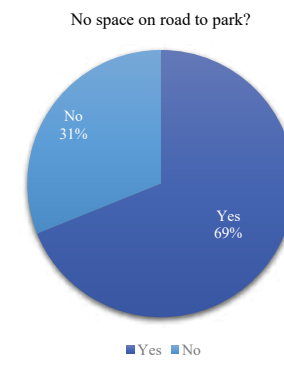


Figure 19: No space on the road to park?

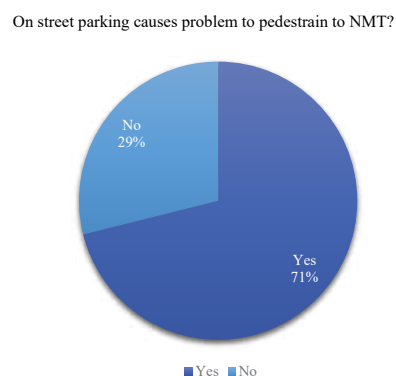


Figure 20: On-street Parking causes a problem for NMT?

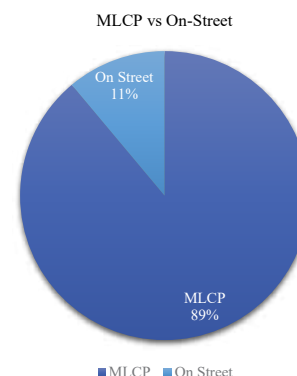


Figure 21: MLC vs On Street

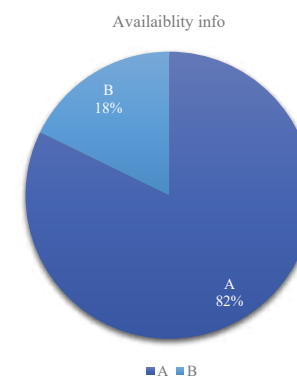


Figure 22: Parking Availability Info

Safety & Comfort – People were required to search for the parking space as there was always a shortage of parking spaces. There was no car safety because no parking management was present. Multilevel parking has increased safety and comfort by allowing individuals to park their vehicles without having to look elsewhere because there are enough parking spaces. The parking lot has CCTV cameras and parking attendants to ensure the safety and security of the vehicles.

Ambience – On-street parking has straddled the frontage of the buildings. It has hindered the green spaces, open plazas etc. After MLCP, the on-street parking is no more straddling the avenue of the corridor and providing the improvement in visual appearance of the corridor.

Land Value – The entire corridor was congested and always full of vehicular activities and unnecessary moments of vehicles looking for parking, making the place stuck under the development. Implementation of the MLCP has opened new doors for the future development of that area. MLCP decongested this corridor and provided more open space for the greenery and landscape. It will surely increase the land value of the neighborhood.

Table 6: Assessment Parameters

SN	Parameters	Previous Situation	Current Situation
a.	Mobility	Congested streets (roadside footpath was full of parked vehicles)	Decongested (entire ROW is available for the road users) (Effective ROW 18.20 M)
b.	Travel Speed	15-20Kmph	More than 25Kmph
c.	LOS	E (Hampered)	D (Improving)
d.	Parking Capacity & Revenue	Limited (less than 100 vehicles), No Revenue	Increased (450 – 4W & 250 – 2W), Increased Revenue
e.	Safety & Comfort	Inconvenient	Improved safety and convenient
f.	Ambience	Hindered	Improved (far better)
g.	Land Value	Existing Value	May be increased

Note: The previous situations are from the secondary survey database and the current situation is analysed from the primary survey and stakeholder interview.

Source: Primary Survey & Secondary survey data

3.63.2 Limitations of the research

The research is limited to the parking site and surrounding areas where multilevel parking is located. The assessment is limited to the identified factors/parameters only, which were mentioned in the above sections, as this would fulfil the study's aim.

3.73.3 Key lessons learnt

The multilevel parking location and surroundings play a significant role in its proper utilization. A pleasant pedestrianizing and a well-connected corridor to the nearby landmark surrounding areas would significantly increase its success rate, as people would be encouraged to use the parking. Hence, the entire right of way can be utilized effectively by providing more social gathering spaces to the people. The successful implementation of multilevel parking will reduce traffic congestion and vehicular emissions since individuals will spend less time looking for parking. Proposing the rooftop restaurant would take the multilevel parking towards a new 'shared parking' concept. It would immensely support utilizing the multilevel parking to the full extent and increasing the revenue even after office hours, weekends, and holidays.

3.83.4 Recommendations

As per the analysis of the multilevel parking, a few recommendations can be stated for further improvement. The existing adjacent road left-hand side footpath is currently getting utilized by the pedestrian traffic and as a service road as the width of the left side footpath is approximately 5M. An open drain beside the road can be covered and utilized as a pedestrian pathway or cycle track as well. As per the smart city stakeholder interview, this road is proposed to develop as a smart road. They are going to propose a cycle track (on the left side of the road) and pedestrian (on the right side of the road or adjacent to MLCP). It is better to provide the cycle track and pedestrian/footpath on both sides of the road for better seamless movement or connectivity. Most of the offices are on the opposite side of the multilevel parking. If people have to visit from one office to another, it might not be feasible for them to walk only on the opposite side of the footpath and cross it again. As a result, NMT facilities should be expanded to improve parking influence. Proposal of PBS (Public bike-sharing system) or E-bike sharing facility might work immensely great in this case, as apart from collectorate office there are many other essential offices like as district court, registry office, etc. are located there. Currently, those offices have their parking together to their office. This multilevel parking

can serve those offices as well, and users can park their vehicles in the multilevel parking only. In the current situation, users need to travel 200-300 meters to use that parking, in this scenario, E-bikes/E-cart can help many elderly people or women who want to travel to their destined offices after parking their vehicle. They can use this service by taking a ride and through this initiative, the entire neighbourhood can be converted into a green neighbourhood/car-free campus/emission-free zone. Like this, it also encourages the concept of walkable parking, which is already been suggested by many researchers as well.

Currently, multilevel parking has only one entry point, which also serves as the exit point as well. It has been observed that the space provided for the entry and exit point is insufficient to accommodate peak-hour parking traffic in future. Also, the entry-exit gates are present at the very beginning of the building leaving no buffer space for the vehicle queue. In case of increasing future demand, one entry and exit point will not be able to serve the traffic and create congestion and the vehicle queue would put more load, which will directly impact the adjacent road. It is recommended that multilevel parking would have a separate entry and exit point so that one gate can be used for the entry point and another just for the exit. Making the two different points for entry and exit would also help reduce the load on the road. People have to access the entry point to enter the parking. They can directly take the exit towards the outside of the campus without entering again to the collectorate campus inner road.

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C33

All Abilities Park Project Under the Smart City Mission in Visakhapatnam : An Appraisal

Name of the project: All Abilities Park at Beach Road

Location: Visakhapatnam, Andhra Pradesh

Year of project implementation: 2020

Sector: Recreation and Parks

Project Cost (Rs. Crore): Rs 3.54 Crores (Approx)

SDG: Goal 11.7 (provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities)

Institute: Dept. of Planning, SPA, Vijayawada

Advisors: Dr. Ayon Kumar Tarafdar, Dr. Adinarayanane R

Students: Mr. Obulesh C., Ms. Atchaya N., Ms. Pranathi G., Mr. Sai Kiran, Ms. Aswathy B., Mr. Joseph

Keywords: Differently Abled, All Abilities Park, Smart City

Abstract:

The development of an All Abilities Park in Visakhapatnam, under the Smart City Mission of Government of India, coordinated by the GVSCCL is one of the hallmarks of the city. A park that caters to all differently abled persons by sensitizing the fundamental sensory elements of smell, sight, touch and sound to stimulate them has been a far-sighted innovation. The park is operational and draws huge visitors which are both abled and disabled. It is a showpiece of integration of different sections of the society with scientific designs and socially inclusive elements. It has been innovative and exemplary for GVMC to invest on smart all abilities park aimed at creation of a better social infrastructure for the city. Subsequently, it has also started organizing and assembling other key elements of smartness in the park which can be automated remotely. This report attempts to study this project and bring out the key achievements, scope of improvement and possibilities of replicability and scalability.

1. Introduction

As a part of the research initiative titled “Smart Cities and Academia towards Action and Research (SAAR)” which is a project under the Ministry of Housing and Urban Affairs, Govt of India, coordinated by NIUA, this research report attempts to appraise the innovative “all abilities park” project in Visakhapatnam city.

Visakhapatnam (also commonly known as Vizag, Visakha, or Waltair) is the largest and most populous city in the Indian state of Andhra Pradesh, as well as the state’s proposed administrative capital¹. It is the capital of the Visakhapatnam district and one of the four smart cities in Andhra Pradesh, as designated under the Smart Cities Mission of Government of India. As a part of the Smart City Mission, the Greater Visakhapatnam Smart City Corporation Limited (GVSCCL) undertook several significant projects, one of which was creating parks for all abilities so that the differently abled and challenged citizens can have access to high quality parks and playgrounds. This approach has been widely applauded and developed a much larger sense of inclusion and participation with the citizens of Visakhapatnam.

The city Vishakhapatnam has taken up and recently completed the project “All Abilities Public Park” under Smart City Mission.

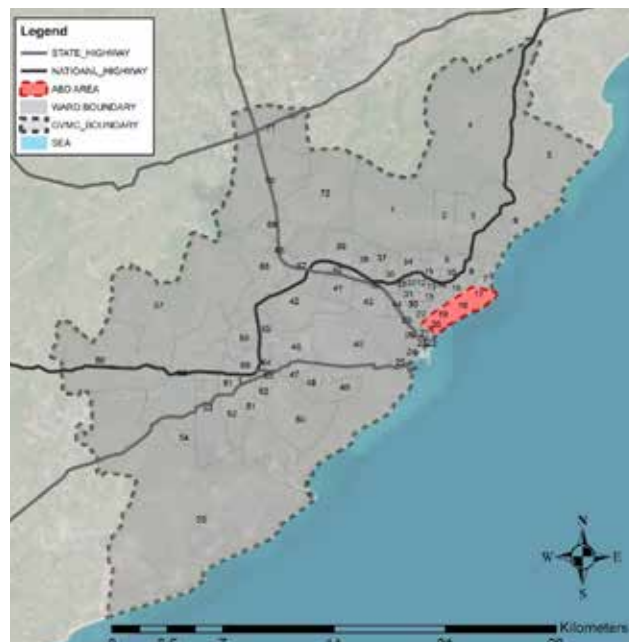


Fig. 01: GVMC Boundary and Area Based Development (ABD) Zone under the Smart City Mission in Visakhapatnam

1.1 Topic and Context

Visakhapatnam is a rapidly developing city with rising migration and population. The exponential rise in population in the city in the last one decade has been due to several factors. After the bifurcation of the State, Visakhapatnam saw several big scale investments in industrial and commercial sector. It is projected by many as the next administrative capital of the State of Andhra Pradesh, the land value, real estate development, industrial and commercial sector and the population, have all grown in multiple dimensions. Between 2001 and 2011, the city’s spatial extents increased by 91.8 percent. In 2005, the municipal territory was expanded to include Gajuwaka and 32 villages and the Greater Visakhapatnam Municipal Corporation (GVMC) was formed, which resulted in an increase in spatial extents and population. The zones of Anakapalli and Bheemli were added to GVMC’s limits in 2013. After the state was bifurcated into Telangana and Andhra Pradesh, Visakhapatnam became the industrial and ITES hub of the state. The city is placed 122 on the list of the world’s fastest-growing cities.

In this backdrop, while majority of Indian cities entrusted with the funding of Smart City Mission looked at the routine upgrading of physical infrastructure, Visakhapatnam developed several innovative and alternative projects that are set on the premise of inclusiveness and participation. The Greater Visakhapatnam Smart City Corporation Limited (GVSCCL)² conceived that there is a need to improve and uplift the parks and playgrounds of the city, with particular focus on making them inclusive in true

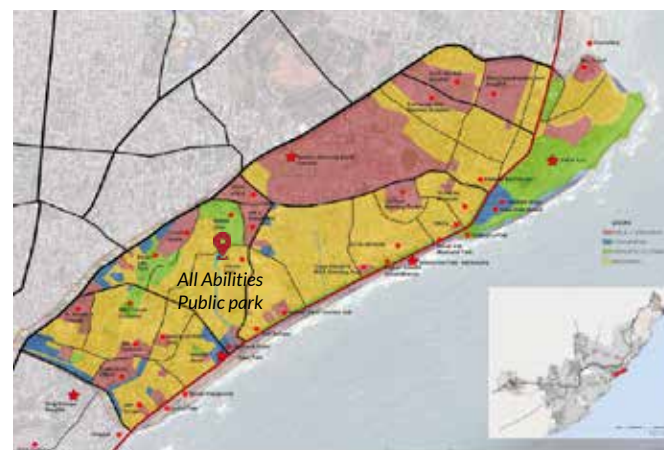


Fig. 02: Location of the All Abilities Park in the Area Based Development (ABD) Zone under the Smart City Mission in Visakhapatnam

sense. In this respect, it envisaged the first-of-its-kind ‘All Abilities Park’ in the city. Located along the beach road and in a prime and highly accessible zone of the city, this theme park addresses the needs of all types of disability and is one of its few kinds in the country.

1.2 Project Background

The All Abilities Park of Visakhapatnam has been developed from one of the existing parks opposite to Young Men Christian Association at Beach Road. With a complete re-design and innovative components installed, it acts as smart park that caters to the recreational needs of various types of disabilities as well the general citizens. The vision of the project is to enable a better, more accessible and more inclusive social infrastructure of the city. The project also aims to to promote flexibility in design in order to enhance equity, dignity, comfort and safety for all types of users. It not only improves the health and wellness of the general citizens but also specifically caters to the differently abled people. The park is specially designed for all types of differently-abled users - Visual Impaired, Hearing Impaired, Mobility Impaired, and citizens with Mental/ Cognitive limitations.

As a part of the SAAR initiative and this report, the All Abilities Park was studied in depth for a clear understanding of the project and its implications on the city of Visakhapatnam. The project management consultancy firm for the projects related to solar power plants within the city, is AECOM Asia Ltd. Figure 1 shows the extent of the GVMC boundary and the ABD area (area based development) of the smart city mission. Figure 2 as presented herewith, shows the location of the park in the city with respect to the ABD area within the GVMC boundary.

1.3 The All Abilities Park Project of Visakhapatnam: Highlights

The primary focus of the project is to achieve approachability, accessibility and usability of public open recreational space. This innovative park seeks to meet the needs of the physically challenged people in particular. Its location along the main Beach Road, with direct access to the beach makes it a very popular destination in the city. Several play zones within the park that stimulates and encourages the differently abled people is a very high societal value. A notable characteristic feature of the park that it helps the users to spend good and quality time in the park while helping them practice and hone their skills of using various sensory organs. Various activities which enhance

¹Visakhapatnam is reported to be elevated to the status of administrative capital of Andhra Pradesh state in the future. However, a formal legislative announcement is yet to be made.

²Greater Visakhapatnam Smart City Corporation Limited (GVSCCL) is a government formed special purpose vehicle incorporated in lines with Companies Act and functions like a Corporation. It is responsible for coordinating, executing and monitoring the Smart City Mission components in the city. It is a corporation with representatives from various departments of the State Government.

people's physical and mental activity and well-being have been designed and installed.

Though the main focus is to provide a barrier free accessibility in the park, other play activities like climbing, crawling, swinging, water play, sound play, etc have been carefully installed with supervision and assistance available during the opening timings of the park.

The GVMC and Greater Visakhapatnam Smart city Corporation Limited (GVSCCL) took part in the Annual Smart City World Congress and Expo held at Barcelona, Spain and included the All Abilities Park as an entry under the 'Social integration through creation of parks' theme category. The project was awarded the one of the best projects under the "living & inclusion" award category.

The importance of this park can also be understood in terms of its contribution to the well-being and social development of the differently abled people. The park is one of its few kinds in India and has substantially increased the attendance and use of such spaces by the physically challenged people of the city.

2. All Abilities Park Project Appraisal

2.1 The Concept

This report shall first explain the components of the park in more details on the basis of the site visits and discussions with its maintenance staff. Then, the report shall try to bring out the perception of the users and beneficiaries of the park. Finally, it will indicate the areas and scope of improvement or replication in other areas of the city.

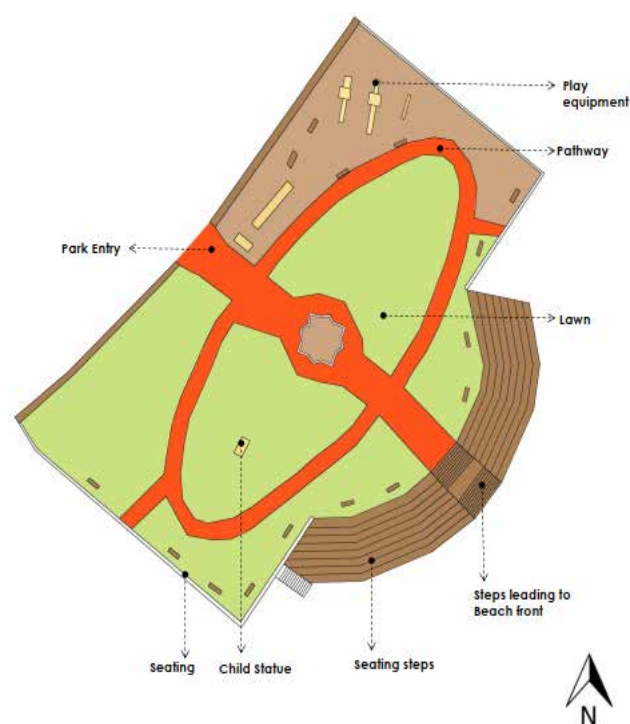


Fig 3: The All Abilities Park at Beach Road, Visakhapatnam: The Basic Layout Plan. Source: GVSCCL

The officials from GVSCCL and AECOM Ltd. were kind enough to provide us with all the requisite data. This was supplemented with site visits in March 2022, when interviews were held with the technical staff of the park and other authorities who are responsible for the operations and maintenance of the facilities available at the park. The maintenance of these projects and assets have been out-sourced through a long term maintenance contract. Further, group discussions with the GVSCCL officers and local residents near these projects were held, to understand the general perception of such projects.

2.2 Project Summary

The park is located in Jalarpet of Visakhapatnam along the main Beach Road and very close to the sandy beach. Through the park one can have an easy access to the beach. The neighborhood has a mix of residential and commercial functions. All sections of the sociality from the nearby residential areas mainly access the park while the disabled population come from all over the city. The total area of the park is 0.55 acres. The total cost of the developing the project has been 3.04 crores.

Residents within a distance of two to four kilometers generally access and use the park more. Also, there are a good number of tourists who visit. The GVMC and GVSCCL people frequently visit and maintain the park. This kind of park is the first of its kind in Visakhapatnam and has been recognized nationally and internationally.

Figure 3 presented herewith indicates a basic layout plan of the site. Figure 4 depicts a detailed layout with distinct play and landscaping zones that have been carefully thought of for easy movement, aggregation and separation of different types of activities.



Fig 4: The All Abilities Park: The Sub Zones of Activities. Source: GVSCCL

The park is designed to satisfy the needs of the specially-abled people. It is, accordingly, equipped with several unique features, such as:

- Universal accessible design;
- A ship play structure;
- A steel bridge;
- Several standalone play equipment for persons with limited abilities;
- A play earth mound with tunnel;
- A climbing net;
- A multi play equipment zone including slides, shoulder builder, leg roller, merry-go-round, drums, musical panels – all having components designed for the differently abled;
- Re-aligned pathway with special surface treatment and colors; and
- Optimized lighting, Signage, braille, and landscaping.

2.3 Active and Passive Zones of the Park

The active zones in this park are the areas with play equipment climbing net, shoulder builder, leg roller, multi play equipment, play mound with tunnel crawling equipment, etc. The passive zones in the park are the areas of casual walking, viewpoints of the sea, and seating. For this walking tracks, specially designed seats, and viewpoints have been created. Picnic tables, hard-scraped, soft-scraped and landscaped area has been developed. Table 01 (Annex One) summarises the different equipment and fixtures used in the park. It also depicts the various play components which have been installed in the park for public use.

The park has elements that activate and stimulate all senses like – smell, sight, touch and sound. These senses are awakened through different elements in the

park making it a unique outdoor setting. Presently, the games are mainly there for the toddlers and children of age 5-10 years and there are tactile paving guides for the blind. There are specific 'mild slopes' to make the movement barrier free and easy for any wheel-chaired person. Ample parking facilities are available for easy access. Figures 5 and 6 (below) indicate some of the innovations behind activating the users' senses of touch and sound.

3. Stakeholders' Perceptions

At present the park is a major crowd puller in the city. The SPAV team conducted interviews and focused group discussions with visitors of the park during their site visit and obtained the responses of the users. A perception survey was done to gain a sense of the user's perspective about the all abilities park. Over 50 respondents gave their opinions. The project team of SPAV spoke to the visitors in the park at length and also

with the officials who maintain this park. The findings are presented in the subsequent sections herewith.

3.1 Levels of Attractiveness of the Park

Majority of the people come to the park by two wheelers followed by four wheelers and walkers. Over 20% of the respondents indicated that they visit the park at least once a month and over 54% visit at least once a week, or daily. This indicates a high level of returning visitors at a frequent count. Majority of the people who come to the park are the residents of the Visakhapatnam. Their association with the elements of the park and their sense of belongingness are high. Majority of the people are willing to travel to the park from long distance also because of its unique features and play equipment. Within the various activities of the park, quiet reflection, and nature play activity have received the highest score.

3.2 Maintenance and Upkeep

The survey revealed that the maximum people were satisfied with the overall usage and maintenance of the park. A large number of respondents (46%) indicated that they are willing to pay a certain amount for further development of the park. Also over 68% of the respondents mentioned that they are willing to travel longer distance to come and visit the park, if required. These are strong indications of the positive impact of the visitors to the park. The five features which were chosen by the people as the elements which can be added to the park for further improvement are - picnic

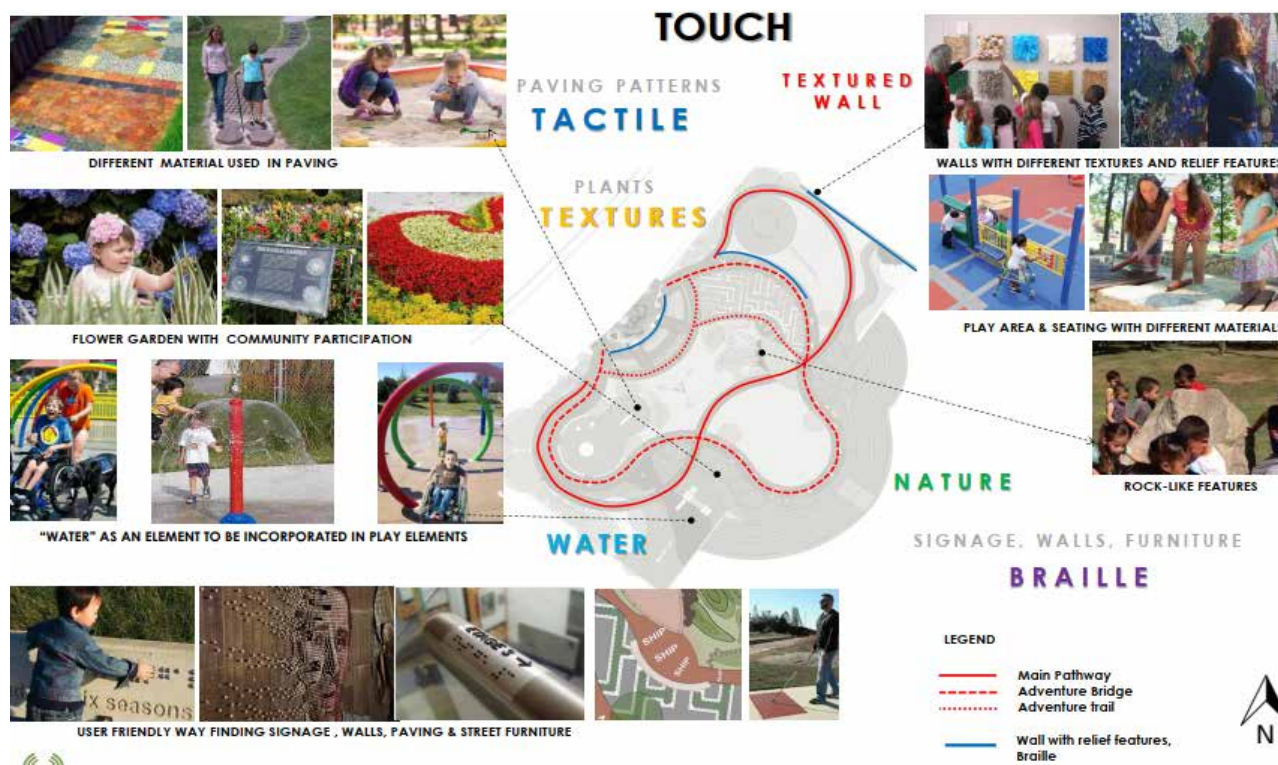


Fig 5: Elements of Touch in the All Abilities Park, Visakhapatnam. Source: GVSCCL

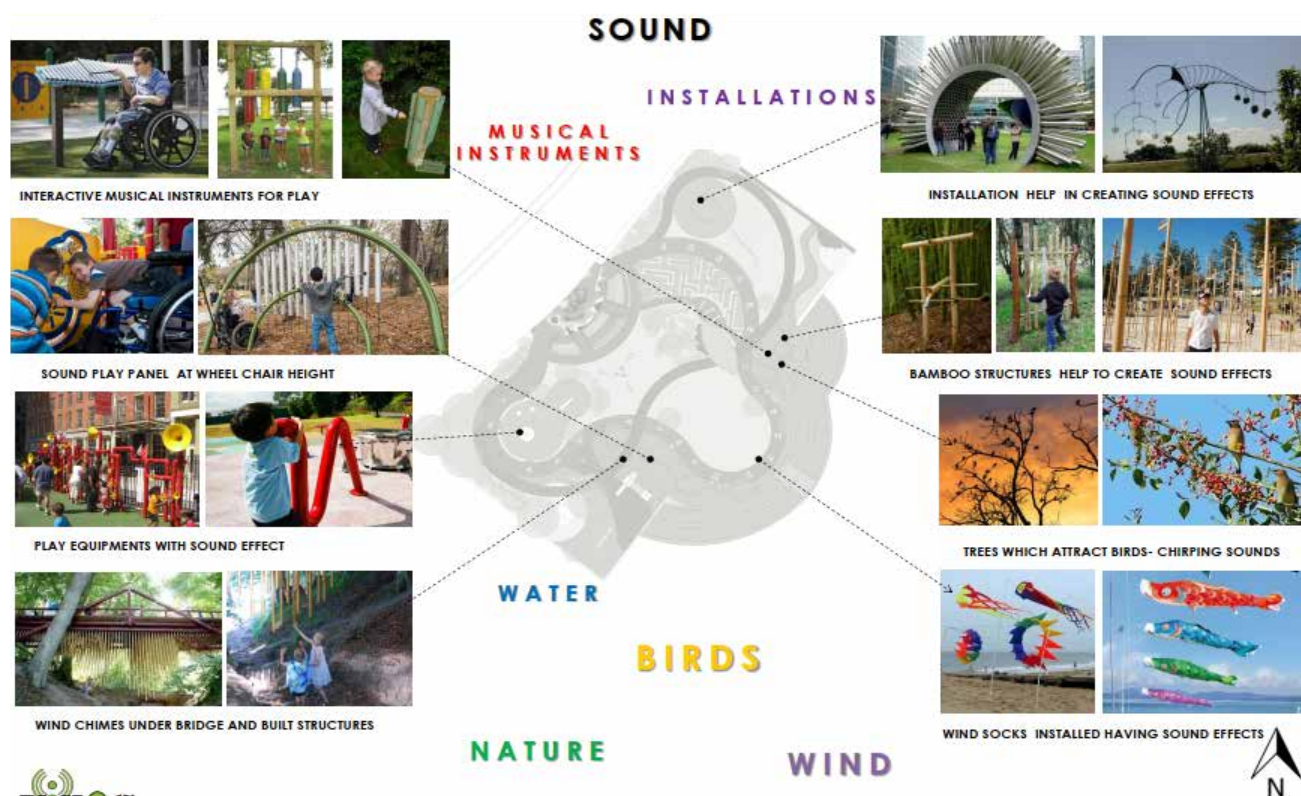
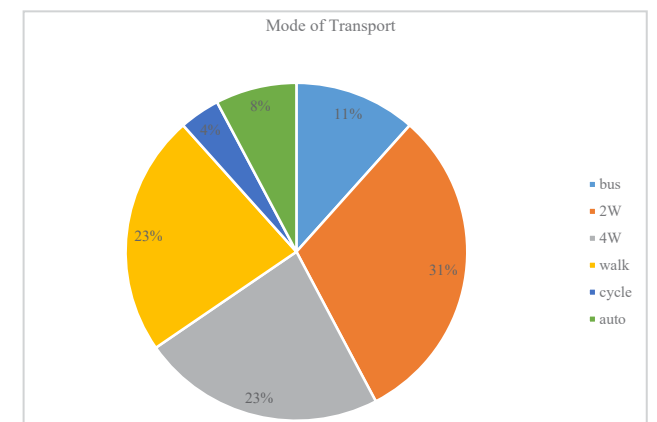
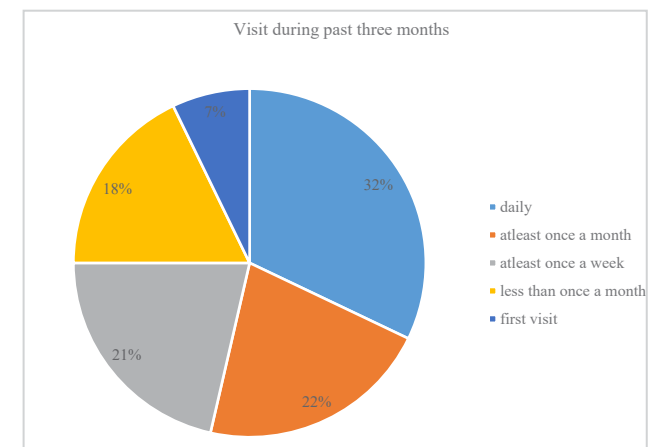


Fig 6: Elements of Sound in the All Abilities Park, Visakhapatnam. Source: GVSCCL



Graph 1: Mode of Arriving at the Park



Graph 2: Frequency of Visit

tables, universally accessible car parking, drinking water, and accessible toilets.

The tactile flooring in the park is designed to help the visually impaired navigate around with ease. The rubber flooring in the play zones that ensures safety for children while playing and the fact that the park is constructed

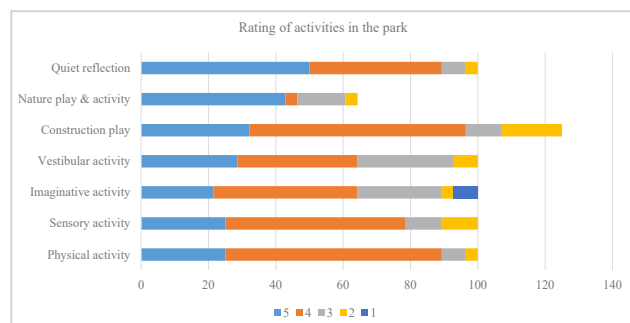
in a manner which would help one in a wheelchair to cover every corner of the place with ease are reasons for its popularity. The bridge present in the park enables children to get across with ease while also giving a picturesque view of the amazing coastline. To provide knowledge about plants, tyre-planting, a technique of growing plants in tyres, has been incorporated at the

park. The play zones are divided keeping in mind the different age groups and their play requirements. A large blackboard located to a side provides an opportunity for children to draw, express themselves and generally have a fun time.

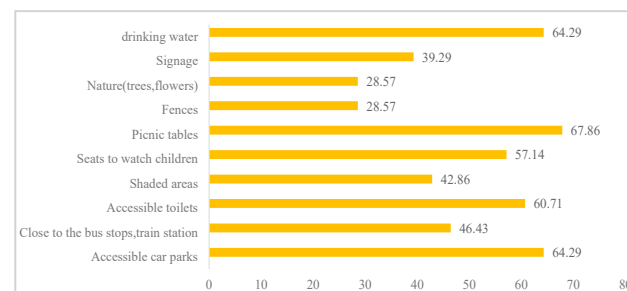
4. Inferences

4.1 Implications and Benefits of the Project

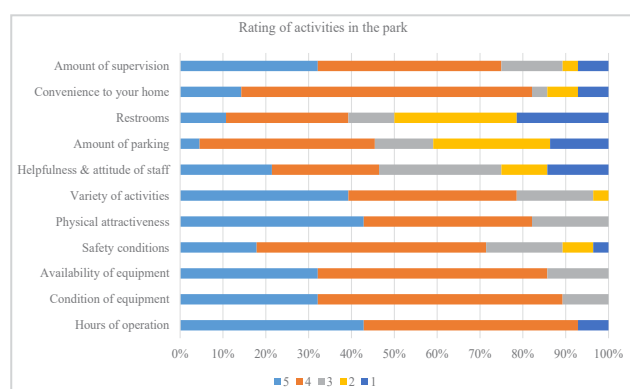
There are several benefits of such a park for a city like Visakhapatnam. Development of public spaces and parks is a sign of well-planned social infrastructure in any city. It gives citizens the option to spend quality social time in the urban open and public spaces of the city. In most Indian cities, the presence and availability of such public spaces is very limited. In such a context, the development of an All Abilities Park



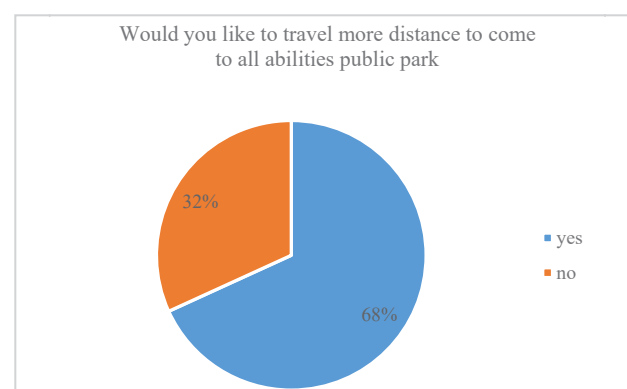
Graph 3: Perception Rating of the Activities of the Park



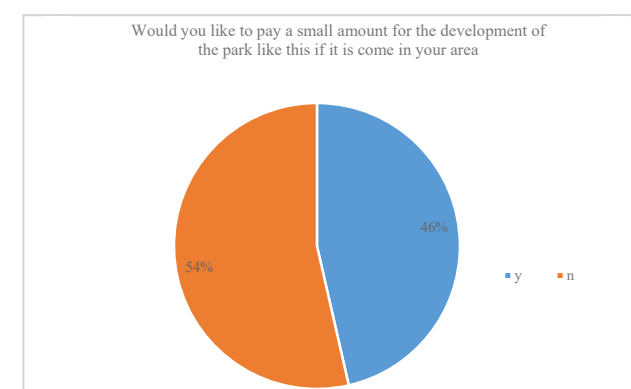
Graph 5: Perception of Further Components that can be improved / added



Graph 4: Perception Rating of the Amenities in the Park



Graph 6: Level of Attractiveness



Graph 7: Willingness to Pay



Plate 1: View from entrance at the park



Plate 2: Children's Play-net for crawling and climbing



Plate 3: Landscaped and hard-scaped zones in the park



Plate 4: Various Play activities area in the park



Plate 5: Access to the beach and play area



Plate 6: Pathway to beach side of park



Plate 7: SPAV team at the site with GVSCCL officials



Plate 8: SPAV Team at site

next to a sea shore with carefully designed elements is innovative spending or public money. Some of the essential benefits of the project are as below:

- Creation of outdoor open space for social integration;
- Creation of inclusive space that welcomes differently abled and doesn't segregate or marginalize them;
- It provides a space for building of physical and mental abilities of the differently abled, by making them confident, positive and joyful;
- The location is devoid of pollution and enjoys fresh air, calm temperature and breathtaking views;
- The park is active during day and night times, making guardians of the differently abled choose an appropriate time; and
- It serves as an element of integration and acceptability of the differently abled with the abled.

4.2 Scope of Improvement

While the initiatives taken up to develop the all abilities park at Beach Road is applaud-able, there can efforts to conceive the project in greater scale for mass replication. For that, cost estimation of such park's development is to be strategically estimated so that the essential and most popular elements are taken up for mass production for installation in various parks of the city. Presently, the park's impact is high, but replicability is unclear, due to possible high costs.



Plate 9: An Aerial View of the All Abilities Park. Source: GVSCCL

Locally made elements can be explored which can scientifically replicate the texture, design and elements in the park so that there can effective cost optimization to the extent it can replicated across the city.

4.3 Scope of Replicability and Scalability

In this section, the report puts forth a basic and conceptual estimation of the possible number of parks that can come up in the city of Visakhapatnam through projections. The ward level count of differently abled was projected for 2041 and then the wards having more than 500 disabled persons were identified as potential wards to implement an all abilities park. Table 02 (Annex Two) and figure 7 indicate the potential wards where All Abilities Park can be developed from the existing available planned green spaces.

4.4 A Summary of Thoughts

With the growth of urban population, there is bound to be pressure on infrastructure. While physical infrastructure like water supply, sanitation and drainage gets revamped and augmented as they serve as essential, it is the social infrastructure that often gets left out. Creation of education and health facilities always assume higher significance with the sector of social infrastructure compared to creation of urban green and open places. Creation of parks and playgrounds are often the last investment many municipalities make. Use of resources available through the smart city mission, to envision, build and operate parks that are inclusive and all abilities is a strong commitment towards human well-being and healthy cities. It speaks volumes about a city's aspirations to be high on that scale of human

development. The All Abilities Park in Visakhapatnam is good example of utilization central and provincial funds to aim at building socially integrating infrastructure. It is smart as it is different from routine parks and innovative as it amalgamates the requirement of per capita green with being inclusive.

There is a clear need to develop urban green spaces in every ward as per planning standards. While parks are already present in many wards and conceptualized to be developed in other wards; there is a need to cater to areas and zones where the volume of disabled population is high and require compassionate and inclusive planning.

While smart city is often interpreted with automation, use of apps, cloud computing and AI to deal with city administration, it is also pertinent to address aspects that are basic, fundamental and grassroots driven. Smart innovative solutions that can bring together people at a place to enjoy, learn and be integrated is an excellent example to be replicated. The scalability of All Abilities Park in the city of Visakhapatnam is therefore, highly recommended.

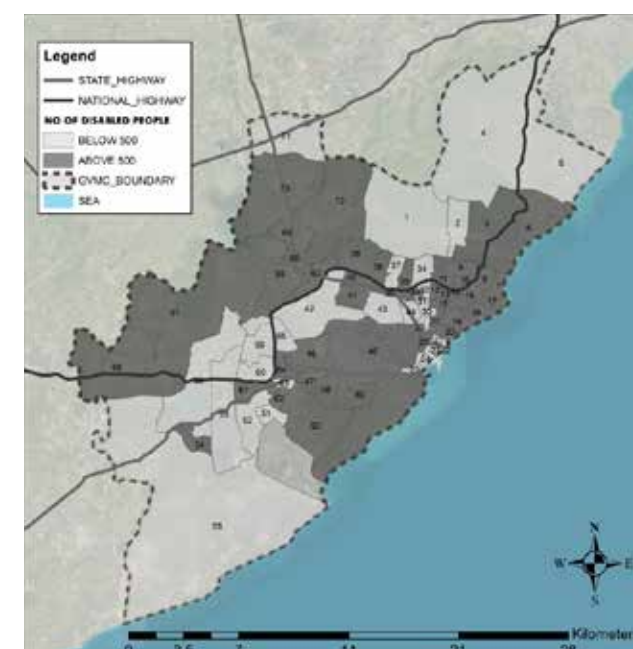










Fig 7: Wards having more than 500 disabled population as projected for 2041, indicating potential locations of the new All Abilities Parks (Estimated Scenario)

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Table 1: Components of the All Abilities Park, Visakhapatnam. Source: Replay play equipment website (given to SS Constructions)
Link: <https://5.imimg.com/data5/SELLER/Doc/2023/1/IN/IU/UF/1614195/slide-multiplay-stations.pdf>

S. No.	Image	Specification
1		Zick Zack Crawling tunnel This is used for crawling. A kid can crawl in and out, tunnels offer a child an interactive and fun way to play. They can move through them.
2		Palm wheel It is designed for handicapped children. They can easily come with wheel chair, sit and exercise. It is an exercise which helps in blood circulation.
3		Leg roller It is designed for handicapped children. It is a leg exercise equipment which helps in flexibility & rotation of legs.
4		See Saw It is a fun activity for kids. Where two kids can play together & it teaches the balance level to them.
5		3 Sitter Merry Go Round It is designed for handicapped children where they can play with their wheelchair kids usually sit and hold to get it spinning.
6		Wheel Chair MGR It is designed for handicapped children where they can get inside through the ramp with their wheel chair & they can spin and play.
7		Play panel It can be used where they can play the X & O game. It is a kind of puzzle game where a kid can learn and enjoy about puzzling and solving it at the same time.
8		Musical Panel It is designed for handicapped children where he can play the drums and enjoy his own created tones and music. It is activity of learning music.



S. No.	Image	Specification
9		Drum Track It is designed for handicapped children where he can play the drums and enjoy his own created tones and music. It is an activity of learning music.
10		Musical Panel It is designed for handicapped kids, where he can produce different sounds. It is all about learning music, the sound echoes all around the playground. It helps the handicapped kid to open his listening skills much better.
11		Sound Play It is a sound play equipment, played meant for all kids in general. It has been installed in the playground, where kids can play the sound and enjoy their own created sounds with the equipment.
12		Multi-Play It is designed for handicapped children, There is a ramp for kids with wheelchair to easily get in play different activities like sliding through different slides & playing the panels.
13		HDPE Kids Play System It is designed for junior kids with a roto tube slide, sitting bench & climber. In this multi-play, HDPE & LLDPE parts are used which is light in weight with a matte finish. A kid can rest there with seating bench after sliding & playing.
14		Wheelchair Swing This is designed for handicapped children. There is a bucket type seat with a small gate for the kids to enter along with the wheel chair. There are XO balls in the both sides of the swing.
15		Shoulder Builder It is designed for handicapped children where they can easily sit in their wheelchairs and do shoulder strengthening exercises.

Table 2: Ward-wise Disabilities population and Park requirement for the year 2041

WARD NO.	Population 2041	2041 disabled population	2041
			Area required for neighbourhood level parks (URDPFI) (in ha)
1	24282	486	1.62
2	23457	469	1.56
3	27420	548	1.83
4	23850	477	1.59
5	24010	480	1.60
6	28542	571	1.90
7	28462	569	1.90
8	28614	572	1.91
9	28169	563	1.88
10	28619	572	1.91
11	27426	549	1.83
12	27786	556	1.85
13	28035	561	1.87
14	25757	515	1.72
15	28551	571	1.90
16	28289	566	1.89
17	27964	559	1.86
18	26097	522	1.74
19	28612	572	1.91
20	27261	545	1.82
21	24835	497	1.66
22	24906	498	1.66
23	23679	474	1.58
24	23460	469	1.56
25	23967	479	1.60
26	26978	540	1.80
27	25360	507	1.69
28	24425	489	1.63
29	24833	497	1.66
30	24072	481	1.60
31	24261	485	1.62
32	24128	483	1.61
33	25812	516	1.72
34	23962	479	1.60
35	25599	512	1.71
36	26939	539	1.80

WARD NO.	Population 2041	2041 disabled population	2041
			Area required for neighbourhood level parks (URDPFI) (in ha)
37	24340	487	1.62
38	27125	543	1.81
39	26465	529	1.76
40	27903	558	1.86
41	28606	572	1.91
42	24074	481	1.60
43	23921	478	1.59
44	23886	478	1.59
45	27839	557	1.86
46	28128	563	1.88
47	28119	562	1.87
48	26627	533	1.78
49	27730	555	1.85
50	27252	545	1.82
51	23776	476	1.59
52	24151	483	1.61
53	24607	492	1.64
54	26046	521	1.74
55	24945	499	1.66
56	27262	545	1.82
57	25826	517	1.72
58	23608	472	1.57
59	24102	482	1.61
60	24790	496	1.65
61	27504	550	1.83
62	26843	537	1.79
63	23689	474	1.58
64	27124	542	1.81
65	23784	476	1.59
66	26095	522	1.74
67	27339	547	1.82
68	26809	536	1.79
69	25176	504	1.68
70	28640	573	1.91
71	24414	488	1.63
72	26715	534	1.78

C34

Micro-Skill Development Centre

Name of the project: Micro Skill Development Centres

Location: Agra, Uttar Pradesh

Year of Project Implementation: 2019

Sector: Economy

SDG: No Poverty (SDG 1), Gender Equality (SDG 5), Decent work and Economic growth (SDG 8)

Project Cost: Rs 2 crore

Institute: Indian Institute of Technology, Roorkee

Advisors: Faculty Coordinator: Dr. Arindam Biswas, Mentor: Ms. Nikita Ranjan

Students: Ms. Kritika Sharma

Keywords: Socio-economic, Handicrafts, Skill, Training

Abstract:

Indian handicrafts are famous worldwide for their design, quality and craftsmanship. The sector employs a large proportion of the informal population in many heritage cities of the country, Agra being one of them. The city has a copious number of artisans working in this unorganised sector. Most of these artisans belong to the marginalised sections of the society. In this context, under the Smart City Mission four Micro Skill Development Centres were developed in the city as one of the flagship programs for the Area Based Development (ABD) in Tajganj area. Tajganj is an important economic base for the city as many small scale and household industries are based here. However, these communities face many challenges from lack of adequate skills to job insecurity. Women in the artisan industry are more vulnerable to exploitation and low wages. Therefore, the centres were developed with the primary purpose of enhancing the socio-economic conditions of the beneficiaries, especially women, by providing them skill training for seven skill-sets. The project also aims at promoting local art, culture and tradition through production of handicrafts.

The purpose of this paper is to provide the outcomes of the study that was undertaken to understand the effects of the skill training on the socio-economic profile of the beneficiaries, evaluate the efficiency of the training programme and determine its impact on handicraft promotion. Analysis of secondary literature, interaction with stakeholders, questionnaire surveys done with beneficiaries as well as physical inspection of the centres was undertaken to measure the performance of the Micro Skill Development Centres. An attempt was made to assess the project's performance and to investigate the problems encountered during the process. The paper concludes with recommendations which could pave the way for further implementation of such programs for the upliftment of the handicraft artisans.

1. Introduction

Agra Smart City

Agra lies in the North Indian state of Uttar Pradesh on the banks of river Yamuna. The Agra Municipal Corporation forms part of the Agra Metropolitan Region.

In the third round of the Smart Cities Challenge, in September 2016, Agra was selected as a Smart City. Agra Smart City Limited (ASCL), a Special Purpose Vehicle (SPV) was established under the Companies Act. The chairman of the SPV is the Divisional Commissioner of Agra district and the Municipal Commissioner of Agra is the CEO. City and district administration personnel from several departments are among the stakeholders in the ASCL Special Purpose Vehicle (SPV). To manage and ensure the smart city design, development and implementation efforts, this team collaborates closely with the CEO of the SPV and the Program Management Consultant (PMC) team. Agra's Smart City project comprises of core redevelopment initiatives for Rs 2,133 crore. The total area is 2,250 acres. The project will include areas around the Taj Mahal, Agra Fort and other portions of the city.

The Smart Cities Mission is an urban renovation, retrofitting and extension program started by the Indian Government in 2015 to enhance city infrastructure

and quality of life. The vision for Agra Smart City was formed on the goals of its citizens and analysis of the city's strengths, weaknesses, opportunities and threats. Tourist-friendly, memorable, liveable, culturally vibrant, economically dynamic, preservation of history, urban mobility and sustainability were among the topics suggested by citizens. The Vision Statement for Agra Smart City is: **"City of Taj – where history is preserved, environment is pristine, infrastructure is world-class and opportunities are plenty – a safe place to live, a great place to tour."**

Figure 2 shows the Area-Based Development (ABD) plan for Agra. It focuses on improving social equity and infrastructure for citizens, heritage and cultural tourism and tourism infrastructure for visitors. Revitalising green spaces and enabling development of sustainable livelihood will impact the residents' quality of life and visitors' experience.

Flagship Projects under the Smart City Project in Agra include:

- Integrated Command & Control Centre
- Micro-Skill Development Centres
- Automated Self-Cleaning Toilets
- Smart Health Centres
- Smart Classes

The main focus of this research paper is on Micro Skill Development Centres.

India has a rich cultural heritage. The handicraft industry is world famous for its quality, designs and craftsmanship as it represents the unique cultural identity of the people who create them. India is home to over 7 million artisans involved in more than 3,000 craft forms spread across the country. After agriculture it is one of the most important sources of employment, providing a vital source of income for the country's rural and urban populations (IBEF, 2021). According to National Statistical Commission Report (2012), the informal sector plays a crucial role in the Indian economy. This sector consists of the underprivileged and marginalised sections of the society, particularly women. It is labour-intensive and cost-effective because of the low investments. The handicraft sector has faced many challenges in the globalised economy. However, the tangible and intangible aspects of the Indian handicrafts present the country with a vast potential for growth in this sector.

1.1 Topic and Context

The state of Uttar Pradesh is world famous for its rich cultural history and the architecture of its heritage cities. Herein lays Agra, the city of the Taj Mahal, one of the Seven Wonders of the World. It is known throughout

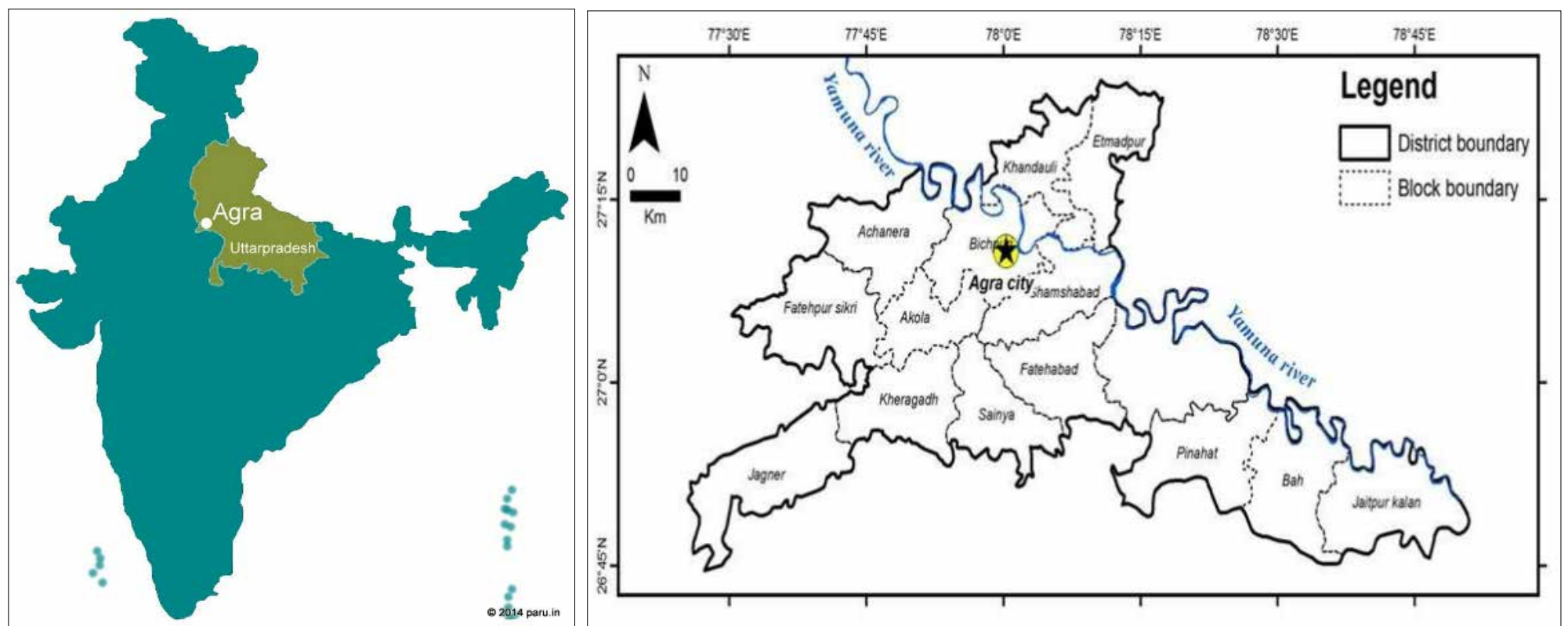


Figure 1: Location of Agra in India, Location of Map of Agra district showing various blocks.
Source: Singh et al., 2020

the world for its unique style of art, architecture, culture and traditions that have developed over the years. The city attracts millions of visitors from all over the world to witness this plethora of culture and craft. Some unique expressions of handicrafts are marble inlay articles, zardozi work, flower art, carpets and other goods. These have not only received international acclaim for their exquisite craftsmanship and functional utility but are also world famous and unparalleled for quality and design. These skills have been passed on through generations and have evolved with cultural exchanges, changes in trends and experiences (Chauhan, 2019).

The economy of Agra thrives on tourism, but because of the seasonal nature of the industry and the global economic scenarios, it provides limited job security. But this flourishing tourism and rich cultural heritage have had little impact on the economically weaker sections of the society, particularly women. Many of the artisans employed in the handicraft industry are migrating to other unskilled jobs. Problems of unemployment and livelihood insecurity mostly prevail amongst the weaker section. The unstructured nature of the handicraft industry has been harmed by lack of competent education, cheap capital and limited exposure to new technologies, as well as lack of market intelligence, poor infrastructure and institutional framework (Effat Yasmin, 2013). In Agra, the working-to-non-working population ratio is 32% workers to 68% non-workers. Among the working and non-working population, 13.2% women come under the working category and the rest of the 86.8% are non-working women (DMEO, February 2021).

Study Area Profile

Tajganj is one of the oldest settlements of Agra city. Workers, artisans and craftsmen involved in the construction of the Taj Mahal settled around the nearby site along with their families and the area came to be known as Tajganj. Because of its vicinity to the Taj Mahal and river Yamuna, the Tajganj area emerged as a centre for trade, hosting communities of artisans, traders and dealers involved in various traditional handicraft skills. Only a few descendants of the artisans who worked in inlay during the Mughal Empire are still working in the same field. Descendants of the workers practicing the same profession still live in Tajganj, specialising in marble inlay work, zardozi work, carpet making, etc. These communities consist of the socially and economically underprivileged sections of the society involved in informal economic activities.

Economic Base

Agra is a commercial city and a tourist hub. The industries here are primarily small-scale. A large proportion of the population in Tajganj is engaged in tertiary activities like small businesses, tourist guides, vendors, sweepers and rickshaw pullers. In addition to these, a certain amount of people are also involved in the handicraft sector. Multiple factors like availability of raw materials such as marble from Makrana, leather and cotton from within the city or nearby regions have contributed in making the city

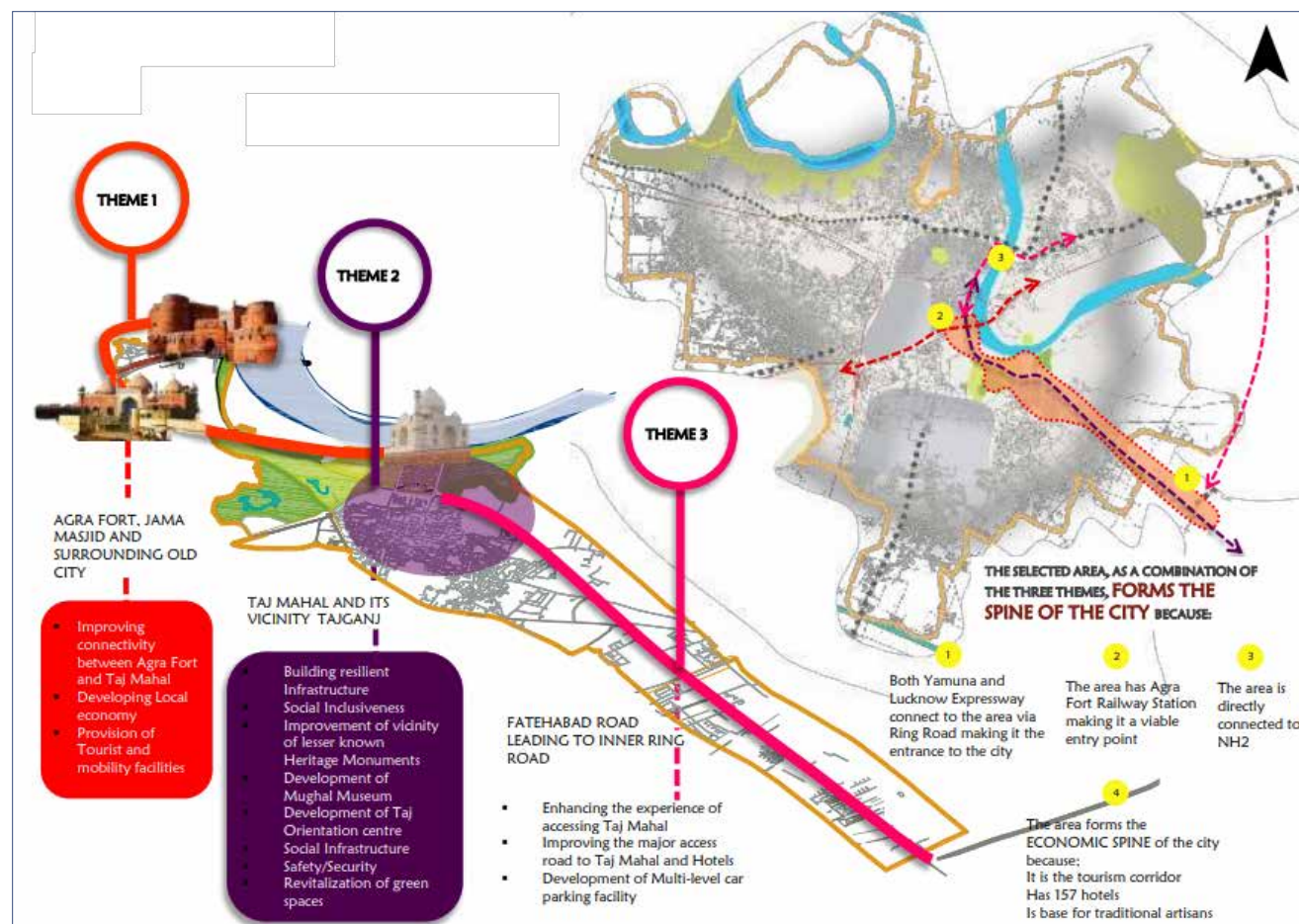


Figure 2: ABD Concept, Theme 2 highlights the developments proposed in the Tajganj Area, Agra, UP
Source: The Smart City Challenge Stage 2: Smart City Proposal Agra (Agra Annexures)

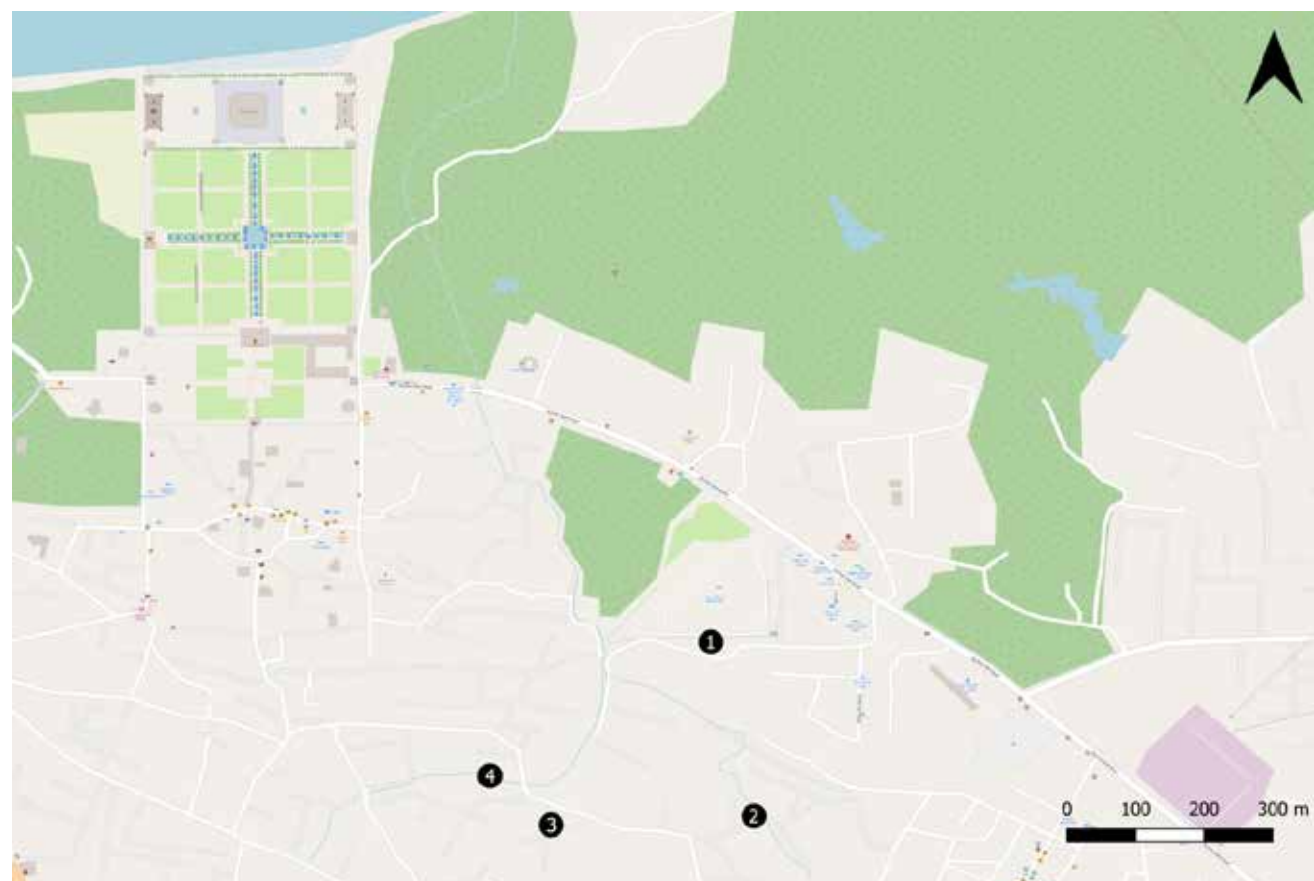


Figure 3: Location of the four Micro Skill Development Centres in Tajganj, Agra. Source: Authors

a hub of traditional handicraft industries. Handicrafts has long been a significant economic activity in Tajganj due to the lack of large-scale enterprises. However, the inability of the artisans to cope with the globalised economy is pushing them into the vicious circle of poverty. The enormous employment potential of this labour needs to be utilised. Niti Aayog recognised that the unorganised sector, which accounts for roughly 93% of the workforce, lacks a formal mechanism to facilitate skill acquisition and upgrading (Chauhan, 2019).

1.2 Scope of the project

Against the backdrop of a rich cultural heritage and the need to ensure a sustainable livelihood for the people, especially women, the idea of developing the centres was conceptualised. Four Micro Skill Development Centres (Figure 3) were developed under the Smart City Mission with the central objective of promoting traditional skills vis-a-vis generating employment opportunities for women through skill-enhancing training. The existing community centres were recognised and converted into Micro Skill Development Centres (MSDC) as part of the ABD. Table 1 displays the location of the centres in Tajganj, Agra.

Table 1: Location of Micro Skill Development Centres in Agra (Figure 3). Source: Authors

S.No.	Name of MSDCs
1	Kolhai Micro Skill Development Centre
2	Teela Shahid Nagar Micro Skill Development Centre
3	Chaunk Intara-Telipada Micro Skill Development Centre
4	Nala Shekh Bulaki Micro Skill Development Centre

These centres aim at developing the 'Economy' of Tajganj. The main focus is on the socio-economic development of the beneficiaries through the formation of various SHGs (Self Help Groups) for training, product development, value chain analysis, linkage and other concerned activities (Figure 2). In 2018, the task of establishing and developing the centres was assigned for five years to Adarsh Sewa Smiti, an NGO. The project began on October 10, 2018 and infrastructure construction was completed on February 10, 2019.

1.3 Significance of the project

Under the Smart City Mission, the skill development centres were proposed to create a resilient economic base for the city. Training provided to the women by enhancing their skills would lead to their socio-economic growth while promoting the local arts, crafts and culture. The central philosophy of the project was to solve the problem of livelihood, particularly for the local and marginalised communities of the Tajganj area and preserve the rich cultural heritage of the city. In spite of the position enjoyed by the traditional skills in Agra, the general awareness among the people about the crafts and the intricacies has been poor. The centres have been established with a broader vision of preserving the traditional assets of the city in terms of skills and crafts. They provide a two-way solution by integrating the socially inclusive livelihood with cultural opportunities. It is against this backdrop that the research attempts to document and study the landmark project was undertaken by Smart City Agra.

1.4 Aim and Objectives

The aim of this study is to analyse the impact of the Micro Skill Development Centres in the Tajganj area on the livelihood and socio-economic growth of the people, along with the promotion of local art, craft and traditions.

The objectives of the study are:

1. To evaluate the impact of the Micro Skill Development Centres on the livelihood and skill development of the beneficiaries.
2. To study the effectiveness of the training program and the challenges to be overcome in the process.
3. To assess the impact of the project on the promotion and development of local handicrafts.

2. Contextual Background

2.1 Conceptual Framework/Research Design

The evaluation framework adopted for the study aims to achieve the broader objectives through a unique set of data analyses. (Table 2).

The methodology devised for conducting the mentioned research is shown in Figure 4. It includes analysis of secondary and primary data to achieve the desired objectives of the study.

Table 2: Evaluation framework for the Objectives. Source: Authors

S. No.	Objectives	Evaluation Framework
1	To evaluate the impact of the skill development centres on the livelihood and skill development of the beneficiaries.	<ul style="list-style-type: none"> e. Income assessment of the beneficiaries f. Performance assessment during the pandemic: Participation of beneficiaries, sale of products g. Participation breakdown: Handicraft production, promotion, distribution and sales
2	To study the effectiveness of the training program and the challenges to be overcome in the process.	<ul style="list-style-type: none"> h. Process of connecting beneficiaries to employment i. Average time taken to impart each skill j. Evaluating the stock of trainers and responsibilities of stakeholders k. Quality and quantity assessment of the infrastructure facilities l. Assessment of the maintenance problems, annual rework/service data on infrastructure
3	To assess the impact of the project on promotion and development of local handicrafts.	<ul style="list-style-type: none"> m. Evaluation of sales data: Number of products sold, revenue generated n. Study the evaluation technique for quality check of the products, number of final products rejected o. Scalability of the project: Identification of any new skills

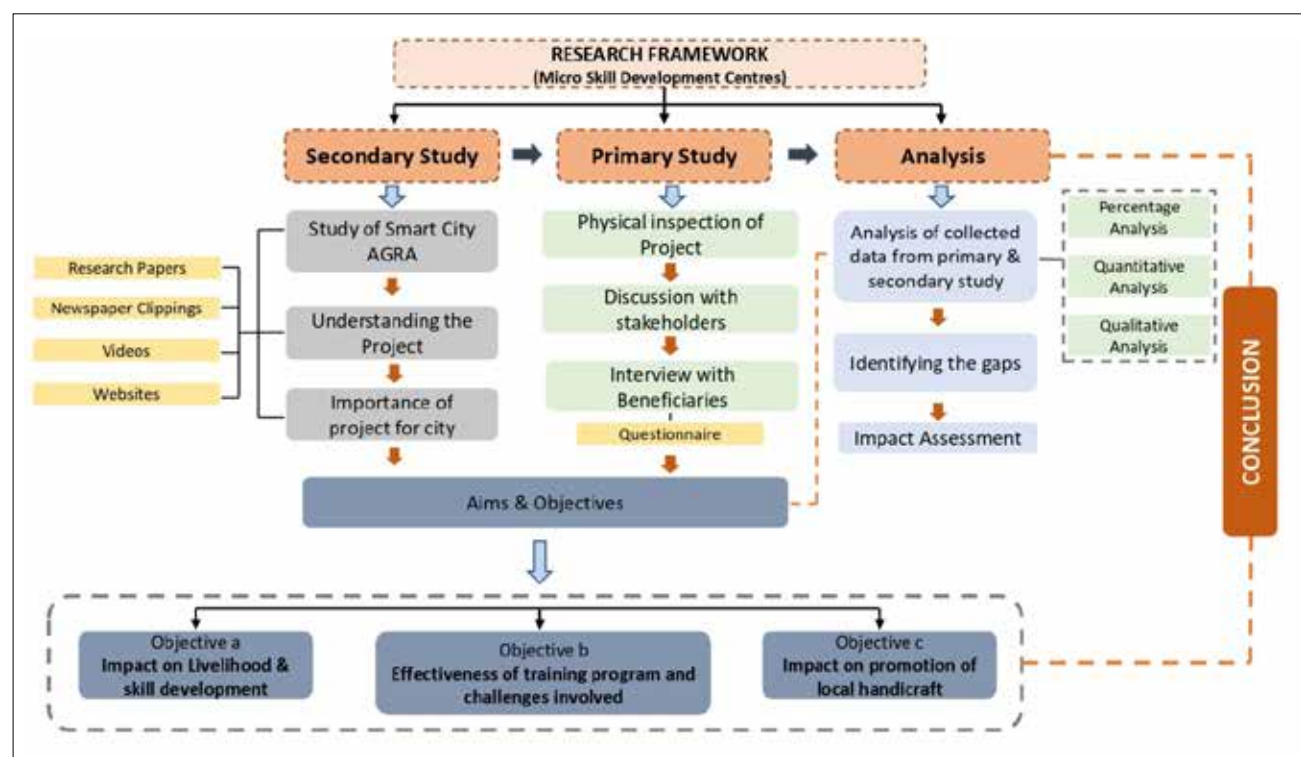


Figure 4: Research Framework. Source: Authors

Data Collection:

Extensive analysis of the available secondary sources has been a significant part of the research to arrive at the primary aims and objectives of the study. The Institute complemented this data by conducting primary survey through field visits and interactions with beneficiaries and stakeholders. Open and close-ended questionnaires and physical inspection of the training centres have been used as a tool for primary survey. The data/information thus obtained was used to analyse the performance of the Micro Skill Development Centres.

Sampling method:

Stratified sampling method was used by dividing the population based on the available beneficiaries and giving due representation to each skill-set. Then, simple random sampling was applied to select samples from within each set of skills.

Data Analysis:

The data obtained from the questionnaires was analysed through percentage analysis. The methodology adopted was a mixed method approach, involving both qualitative as well as quantitative methods. The indicators for evaluating the impact of the centres on stakeholders, beneficiaries and the city are given below:

- Stakeholders: Output, Productivity, Knowledge Transfer, Challenges Faced
- Beneficiaries: Reaction, Learning, Livelihood, Employability
- City: Heritage promotion through handicrafts

2.2 Key features of the project

2.2.1 Challenges in the project

- Mobilisation of women:** Mobilisation of women for such training programs is often hindered by various factors such as time constraints, family restraints, lack of awareness and community pressure.
- Anti-social elements:** The existing community centres were in the hands of anti-social elements who posed a significant challenge in the takeover of the centres and mobilisation of women beneficiaries. Winning the trust of the diverse religious communities in the Tajganj area was also a hurdle and caused unnecessary time delays. Administrative measures (police force) were combined with negotiations and consultations with the NGO to resolve the situation in the Tajganj region.
- Skill gap:** In today's globalised economy, the digital skills gap, illiteracy and skill capacity gaps caused by a lack of access to education or training, or the low quality or relevance of that training, keep the marginalised sectors of the society trapped in a vicious cycle of low skills and low productivity. The inefficiency of the beneficiaries in soft skills also poses a challenge.
- Adaptation to new designs:** New designs were incorporated into the traditional skills to cater to

market trends. However, adapting to these latest trends and design styles poses a challenge. Skills like sketching are also a weak point for the artisans.

- COVID-19:** Since the project involves community mobilisation, gathering, consultation, and discussions among the stakeholders and beneficiaries, the social distancing restrictions delayed the growth of the program.

2.2.2 Risks involved in the project

- Budget Constraints:** The total allocated budget for the project is Rs 2 crore, which could limit the progress and expansion of the training programs in the future.
- Availability of orders:** Availability of necessary work orders is required to provide a sustainable source of livelihood to the beneficiaries.
- Coordination between stakeholders:** The coordination between the stakeholders and policy coherence is crucial to the project to avoid mismatch and reduced productivity.
- Capacity Constraints:** Capacity constraints involve the existing four centres, training equipment, a pool of trainers and assessors for quality training,

buildings with adequate space for storing the raw and finished goods.

2.2.3 Features and Benefits (social, technical, city administration level, impact on environment and economy) to the city (expected and observed)

- Four skill centres provide skill development training programs spread over seven different traditional skill-sets:
 - Zardozi work
 - Marble inlay work
 - Carpet-making
 - Brush-making
 - Flower art
 - Stitching
 - Decorative handicrafts
- Artisans developing higher-value handicraft products are supported, and the community trains them in skills related to handicraft production, market linkages, promotion, distribution, and sales. (Figure 4: Process of Micro Skill Development initiative; Source: Compendium of Best Practices, Smart Cities Mission)



Figure 4: Process of Micro Skill Development initiative
Source: Compendium of Best Practices, Smart Cities Mission



Figure 5: Entrance to Micro Skill Development Centre at Nala Shekh Bulaki. Source: Authors



Figure 6: Micro Skill Development Centre at Kolhai in Tajganj. The ground floor is used for community activities, while the upper floor is being used for the training program.

3. The centres are equipped with e-learning equipment (projector and screen), CCTV cameras, furniture, internet, product and development tools.
4. Increase their interpersonal communication skills through community-based SHGs. They also act as places of knowledge exchange and social bonding of women groups.
5. The project is associated with SDGs such as No Poverty (SDG 1), Gender Equality (SDG 5), Decent Work and Economic Growth (SDG 8). The main objective focuses on women's empowerment and socio-economic development along with promotion of local art. Inclusivity, the main strength of this initiative, is a predictor of the program's sustainability

as it comprises 107 SHGs, of which 100 are women SHGs. Livelihood creation leads to poverty reduction and the economic growth of the people involved.

Benefits to the city

- i. Social Benefits:
 - a. Help to preserve the heritage of the city.
 - b. Help empower the weaker section of the society.
 - c. Training improves creativity and skills of the beneficiaries.
 - d. Development of confidence and self-esteem, especially for women, through skill enhancement and sustainable livelihood opportunities.
 - e. A platform for community engagement.
 - f. A platform for socio-economic growth of women

Economic Benefits

- a. Skill development in the informal sector allows for increased productivity and higher wages for workers. There is a 10% increase in the household income of the beneficiaries.
- b. Selling one-of-a-kind products at trade shows and exhibitions enhance exports and boost economic growth. The sale of around Rs 15 lakh worth of products has been made till December 2021.
- c. By addressing poverty reduction through improved employability and income growth, the project is linked to SDG 1 (No Poverty) and SDG 8 (Decent Work and Economic Growth).

Environment Benefits:

- a. Renovation and repairing of non-operational community centres in Tajganj area to convert into Micro Skill Development Centres instead of opting for new construction.
- b. Since the products are mostly made by hand, they require less material and less energy, thus making them environment-friendly.
- c. Locally available products have less carbon footprints.

ii. Technical Benefits:

- a. Technical skill training (hard skills) aims to train the artisans in all stages of product development. The non-technical skill training (soft skills) trains
- b. the artisans in skills that will enable them to run their businesses efficiently.
- c. Technical training leads to creation of a skilled workforce in the city.



Figure 7: Zardozi artisans working around the 'adda' i.e. the wooden frame, which can accommodate four to six artisans working together. Source: Authors



Figure 8: The stitching unit at MSDC Nala Shekh Bulaki. Source: Authors

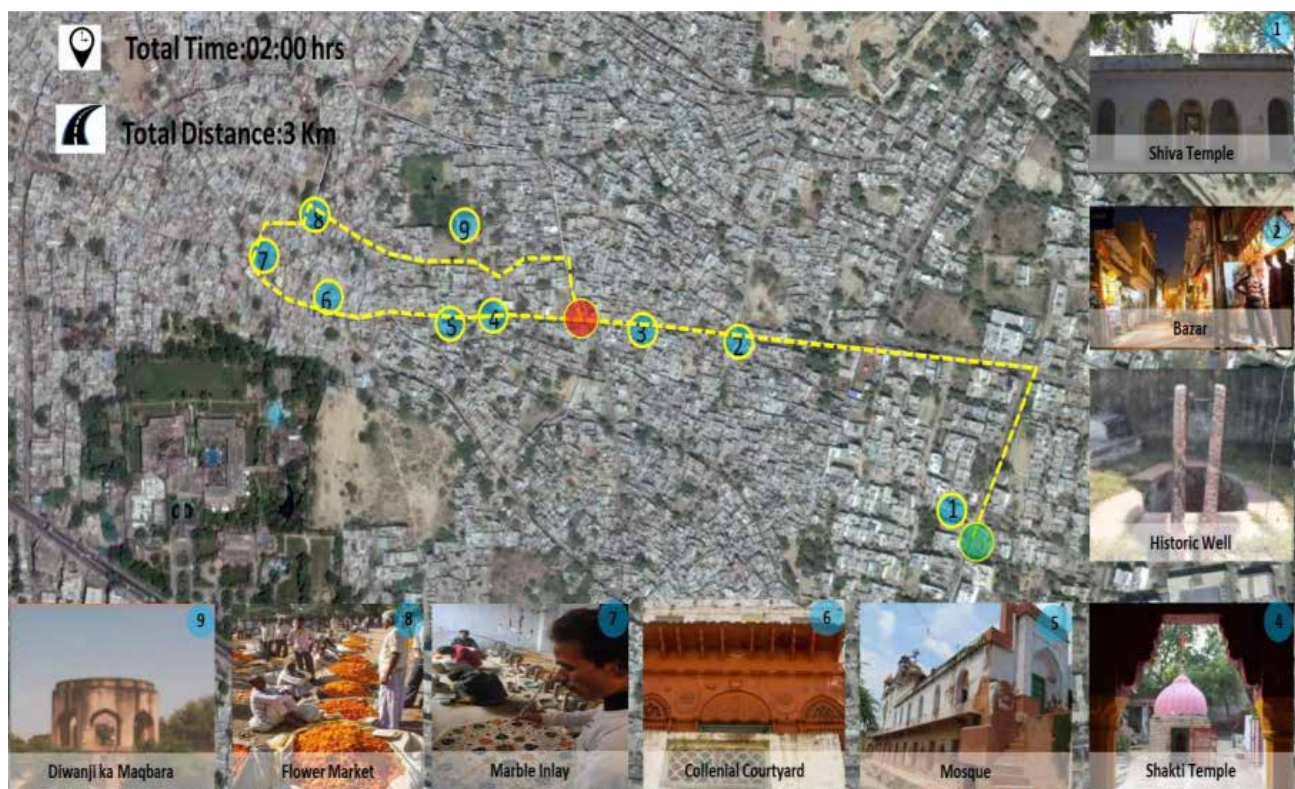


Figure 9: Many varieties of the local art forms are practiced by the skill worker's in this historical walk and neighborhood, and they require some awareness to improve their business so that they may sell distinctive products to tourists
Source: Detailed Project Report, Micro Skill Development Centre, City Officials

2.3 Key findings from interviews, surveys and primary/secondary data collection

With the establishment of the four Micro Skill Development Centres in the available community centres in Tajganj, along with identification of skilled workers of the local art forms, the Smart City Mission created a multivariate effect for the beneficiaries and the handicraft sector of the city.

iii. Key findings from Stakeholders (Officials and Training Providers)

Based on discussions with stakeholders along with onsite visual observation, the following parameters were used to analyse the information:

Output:

Identification of the four existing community centres in Tajganj (Nala Shekh Buaki, Teela Shahid Nagar, Kolhai and Chowk Intara Telipada), necessary interventions to improve the physical infrastructure of the buildings and provision for required utilities at the centres. The creation of the heritage walk exploring the Tajganj area (Figure 9) will also cover the households of the local artisans, which generate awareness required by the crafts and the artisans alike.

Self Help Groups (SHGs): SHGs in Tajganj are groups of men and women voluntarily organised together under

a group corpus. Each SHG consists of 10 members involved in the production of a handicraft good. Some of the SHGs were already identified by DUDA (District Urban Development Agency), and activities for women were being carried out. Apart from development of the handicraft goods, the SHG is also responsible for managing their funds and maintaining their records. E-shram cards and Shilpi cards (artisan cards) have been developed for the beneficiaries. However, there is no provision for a certificate for the skill training.

Productivity

As per the smart city proposal, the total project cost is Rs 2 crore (including GST). The total expenditure for the first year was estimated to be around Rs 86,73,750 and the total budget for the next four years is Rs 60,99,200. Rs 15 lakh (Table 3) worth of products has been sold during the last six months of 2021 (offline and online). It is observed from the table that the revenue generation has increased significantly during the months following the festival seasons. Maximum sales occurred during the months of September, October and November. A portion of the revenue is kept in a fixed deposit to act as base capital in future. Rest of the profit generated is delivered to the SHGs.

Table 3: Revenue generated during the last 6 months of 2021. Source: Authors

S.No.	Month	Total Orders	Amount (Rs.)
1	Jun-21	55	30,744
2	Jul-21	298	75,822
3	Aug-21	43	51,505
4	Sep-21	962	7,44,675
5	Oct-21	435	5,51,875
6	Nov-21	102	1,00,450
7	Dec-21	44	34,050
Total		1939	15,89,121

Knowledge Transfer:

The seven skills are divided into two categories - Traditional (Zardozi, marble inlay, carpet making i.e. Agra duree) and Modern (Decorative handicrafts, brass brush for jewellery cleaning, flower art, stitching). The length of the training program varies for each skill (Table 4): Empanelled trainers under the government's handicraft department have been hired to guide and train the beneficiaries. Two types of training are being given in the centres. First is the entrepreneurship training that includes business model creation, grouping as ALF (Area Level Federation) and further CLF (City Level Federation) named as 'Pragati Shahar Stree Smiti'. These federations are headed by women from the SHGs and act as a marketing channel to create work orders. To date, around Rs 5 lakh worth of orders have been generated through these federations. Second is the livelihood promotion training wherein after conducting a market analysis, fusion and contemporary designs were added to cater to the demand and changing tastes of the buyers. For example, Madhubani art, Braj art and

Modern art were introduced in zardozi and marble inlay depicting yoga poses and birds and carpets depicting Sikkim's flower valley. It was also noted that 8-9 people took around 15 days to complete a traditional zardozi piece. As a result of the training, the time consumption has been reduced to four days, wherein the artisans have been trained in all the channels pertaining to product development and finally the delivery of the product to the market. The training period for all the skills is shown in Table 9.

Table 4: Details of the Skill Training Program. Source: Authors

S.No.	Skill Name	Training Time (Days)	Name of Trainers
1	Zardozi Work	5	Mohammad Bilal
2	Marble Inlay	4 (2+2)	Swati Gupta
3	Carpet Making	7	Mohammad Bilal
4	Brush Making	3	Sachin
5	Flower Art	2	Suraj
6	Stitching	6	Ruchi Bhadouria
7	Decorative Handicraft	5	Mohammad Bilal

Skill Centre	Beneficiary	Gender	Age	Educational Qualification	Skill Program
Kolhai	1	Female	35	9 th Pass	Zardozi, Carpet making
	2	Female	32	12 th Pass	Zardozi, Carpet making
Teela Shahid Nagar	3	Female	21	12 th Pass	Carpet making
	4	Female	34	Illiterate	Carpet making
	5	Male	19	Illiterate	Zardozi
	6	Male	29	5 th Pass	Zardozi
Chauk Intara- Telipada	7	Female	45	Illiterate	Decorative Handicraft
	8	Female	28	8 th Pass	Decorative Handicraft
Nala Shekh Bulaki	9	Female	40	8 th Pass	Stitching
	10	Female	32	8 th Pass	Stitching

Table 5: Details of the Beneficiaries interviewed. Source: Authors

Skill Centre	Beneficiary	Satisfied with the training	Efficient Trainers	Appropriate Sanitation/ Hygiene Measures	Child care facility at centre
Kolhai	1	Yes	Yes	No	No
	2	Yes	Yes	Yes	No
Teela Shahid Nagar	3	Yes	Yes	Yes	No
	4	Yes	Yes	Yes	No
	5	Yes	Yes	Yes	No
	6	Yes	Yes	Yes	No
Chauk Intara- Telipada	7	Yes	Yes	No	No
	8	Yes	Yes	Yes	No
Nala Shekh Bulaki	9	Yes	Yes	Yes	No
	10	Yes	Yes	Yes	No

Table 6: Reaction of the Beneficiaries towards the training program. Source: Authors

Challenges:

The challenges faced in the effective implementation of the training program have been discussed in Section 2.2.1.

iv. Key findings from Beneficiaries

The primary data collected from the four Micro Skill Development Centres is based on questionnaire interviews of 10 beneficiaries (8 females and 2 males) and physical observation of the centres. The minimum and maximum age of the sampled beneficiaries was 19 and 45 (Table 5). The average age of the sample was 32. Almost 70% of the respondents were literate however, only 20% possessed higher secondary knowledge. The observations based on the following parameters are:

Reaction (Table 6: Reaction of the Beneficiaries towards the training program):

Overall the beneficiaries were satisfied with the training programs which included the training centres (infrastructure), course content, stakeholders and the trainers. The program has fully met the expectations of the beneficiaries. The centres are equipped with ramps for the physically disabled and appropriate sanitation facilities for the beneficiaries have been provided. However, as of now, there is no childcare facility/

facility/provision at the centres. The children often join their mothers in the centres after school because of which a need for such a provision is felt among all the respondents. It would also improve the working efficiency of the women.

The primary purpose of the skill program was to equip the beneficiaries with the knowledge of new designs and skills to cater to the global market. All the interviewed beneficiaries were affinitive to the new learning being imparted at the skill centres. Knowledge reinforcements help to brush up and enhance their existing skills. A healthy 90% of the people have confirmed a positive change in their confidence and competence after the training. It is observed that 70% of the respondents did not have any prior training in the skill they were involved with and are still working with the ancestral know-how of the handicraft sector. The marketing and entrepreneurship training is improving confidence and leadership qualities of the women and making them capable of handling the work orders independently.

Employability (Table 8: Views on employability after the training program)

Majority of the respondents were literate (70%), but only 20% had graduated high school. The low education level of the artisans makes them highly vulnerable to exploitation at the hands of middlemen. Before this project, the artisans were paid meagre amounts for their intense labour. The skill enhancement programs and other training programs like entrepreneurship training, marketing linkages and financial training have enhanced the competence and knowledge of the artisans. However, only 50% of the respondents expressed a distinct positive change in the likelihood of finding a job or procuring work orders. After discussions, it was observed that the primary factor for the shortage of work orders for the SHGs is the decline in commercial activities because of COVID-19. Although 90% of the respondents had the required space and equipment at home to comply with any work orders, the shortage of demand resulted in the procurement of limited offers beyond the skill centres.

Skill Centre	Beneficiary	Improvement in likelihood of finding a job	Required equipment at home
Kolhai	1	No	Yes
	2	No	Yes
Teela Shahid Nagar	3	Yes	Yes
	4	Yes	Yes
	5	No	Yes
Chauk Intara-Telipada	6	No	No
	7	No	Yes
Nala Shekh Bulaki	8	Yes	Yes
	9	Yes	Yes

Livelihood (Table 9: Views on livelihood improvement after the training program. Source: Authors):

There is a distinct improvement in the income of 70% of the beneficiaries after the skill training. Overall, a 10% increase in the wages was reported as a positive outcome of the training. As a result, there is improvement in the household income which has brought about a positive change in the living standards of the families. Women are satisfied by their contribution to the household income. It is noted that the time frame within which the training is imparted is not sufficient. Nearly 80% of the respondents expressed their dissatisfaction with the present length of the training program. The duration of the training period for most skills is required to be increased so that the beneficiaries can learn and adapt to the new designs and techniques in a better way.

Skill Centre	Beneficiary	New Learning	Feel Confident and competent	Prior training in the skill	Regular Knowledge Reinforcements
Kolhai	1	Yes	Yes	No	Yes
	2	Yes	Yes	Yes	Yes
Teela Shahid Nagar	3	Yes	Yes	No	Yes
	4	Yes	Yes	Yes	Yes
	5	Yes	Yes	Yes	Yes
Chauk Intara-Telipada	6	Yes	Yes	No	Yes
	7	Yes	No	No	Yes
Nala Shekh Bulaki	8	Yes	Yes	No	Yes
	9	Yes	Yes	No	Yes
Nala Shekh Bulaki	10	Yes	Yes	No	Yes

Table 7: Learning of the Beneficiaries from the training program. Source: Authors

Table 10: Reaction of the Beneficiaries towards the training program. Source: Authors



Figure 11: Zardozi artisans creating Buddha embroidery on black velvet. Artisans have now started creating new designs instead of the traditional motifs, to cater to the market demand.



Figure 10: Zardozi trainer Mohammad Bilal guiding the artisans on this 'chhapayi' step.

Skill Centre	Beneficiary	Improvement in income	Change in standard of living of family	Duration of Training Period
Kolhai	1	No	No	No
	2	Yes	Yes	No
Teela Shahid Nagar	3	Yes	Yes	No
	4	Yes	Yes	No
	5	Yes	No	Yes
Chauk Intara-Telipada	6	Yes	Yes	No
	7	No	No	No
Nala Shekh Bulaki	8	Yes	Yes	No
	9	No	Yes	Yes
Nala Shekh Bulaki	10	Yes	Yes	No

v. Key Impacts on Handicraft Production

Handicraft promotion is done through both online and offline modes. The online platforms include an android application (MSDC) along with an e-commerce website (www.msdcascl.in). These are developed for brand creation and marketing of the products created by the beneficiaries. Memorandums of Understanding (MoUs) have been signed with Amazon, Flipkart and PayTM to ensure the initiative's long-term viability. In addition, a comprehensive IT framework for product delivery has been built through tie-ups with DHL and e-kart in the backend logistics infrastructure. The offline platform includes tie-ups with travel agencies, exposure at Taj Mahotsav and melas. The beneficiaries are also given a platform to showcase and sell their products at the Government offices in Agra. The products are also being used by the Government of Agra as gifts to dignitaries. As per the officials, zardozi work and marble inlay generate maximum revenue. On 20 August 2020, marble inlay works were recognised in the One District One Product (ODOP) scheme of the Uttar Pradesh Government in addition to the existing leather works. Around 1900 products were sold under various handicrafts during the last six months of 2021 (Table 3: Revenue generated during the last 6 months of 2021).

Replicability and Scalability:

With help from the Micro, Small and Medium Enterprises (MSME) Department, Skill India, and the Pradhan Mantri Kaushal Vikas Yojana, the project could be expanded. Talks for a new Artisan Centre with the Tourism department in the Kachpura region of Agra are underway. New skills like artificial jewellery, recycling of plastic waste, waste paper and leftover cloth material to create products are being explored. Skills like sketching to enhance the drawing skills of the artisans have also been identified. The learning from the implementation of the project in Agra is being replicated by the NGO to develop similar artisan centres in Mathura.

3. Discussion and Conclusion

The handicraft sector plays a significant role in the local economy of Tajganj, Agra. This sector is a good fit for the region. It is environment-friendly and labour-intensive rather than capital-intensive. A large number of artisans in Tajganj were employed by middlemen, because of which they remained largely underpaid. Agra Smart City Limited developed four Micro Skill Development Centres in Tajganj with the aim to address the issues plaguing the handicraft sector and to bring about a positive change in the lives of the artisans.

The first objective was to evaluate the impact of the skill development centres on the livelihood and skill development of the beneficiaries. When the survey was executed to ascertain the impacts, a positive response was reported. Satisfaction with the program was observed to be good on most parameters. On account of employability, the response however was moderate. The dissatisfaction could be attributed to factors

like COVID-19, which has slowed down commercial activities and immensely impacted the tourism sector.

Skill Development is a continuous process and regular knowledge reinforcements were given to the SHGs. However, it was found that a similar training pattern was used for all the beneficiaries irrespective of their existing skill potential. Reviewing the skill w.r.t. current standards and addressing the same on different levels is crucial to bring efficiency in a training program. The officials were planning to undertake the advanced level of training for the artisans in the coming months. No provision for a test/examination has been devised to evaluate the skills learned by the artisans.

The formation of SHGs is essential for the effective implementation of the project and for realising the objectives of the program. DUDA recognised SHGs were identified by the skill centres. As a result, the management and functioning of the beneficiaries become efficient. The beneficiaries were paid Rs 200 per day for the training duration. The amount seems small but is fair when compared to the wages earned by the beneficiaries before the program, which were between Rs 150-200 per person per day. The program also engages women's participation through community development programs about Family Welfare, Public Health and sanitation. Such programs are essential for buying in the consent of the community whilst creating awareness amongst the women from the marginalised sections of the society. As a result, the centres have become a hub for community activities for the local area. During the pandemic, vaccination drives were also carried out in the centres.

Initial hiccups were faced in the mobilisation of women, but awareness regarding the intentions of the government w.r.t. the centres and the success of the program paved the way for sustainable growth of the project. It was noted that enthusiasm of the beneficiaries in the program could only be sustained if a suitable market for their products was established. However, the duration of the training remains debatable. As per the officials, it was limited to less number of days, keeping in mind the time availability of the beneficiaries. However, the beneficiaries desire the time frame to be increased. Given the success of the program in the region, the budget of Rs 2 crore allocated to the project needs to be looked into so that it does not hinder the development process in future. Equitable division of the work orders to various SHGs also needs to be analysed.

The skill centres have had a positive impact on the promotion of handicraft within the city. Marble inlay work of Agra has also been recognised in the ODOP (One District One Product) scheme of the Uttar Pradesh Government. The proposed heritage walk around the artisan households is also expected to generate awareness needed by the handicrafts. However, the impact could not be assessed correctly because of the pandemic. The creation of e-commerce mediums increases the reach of the products. There is, however, a need for better promotion of these platforms to generate awareness amongst the public. There is a need for better showcasing of the products created by the artisans to get the necessary attention, which would generate revenue for the beneficiaries and promote local handicrafts. Sensitising the public on the benefits of using locally made products should be done within the city and the country.

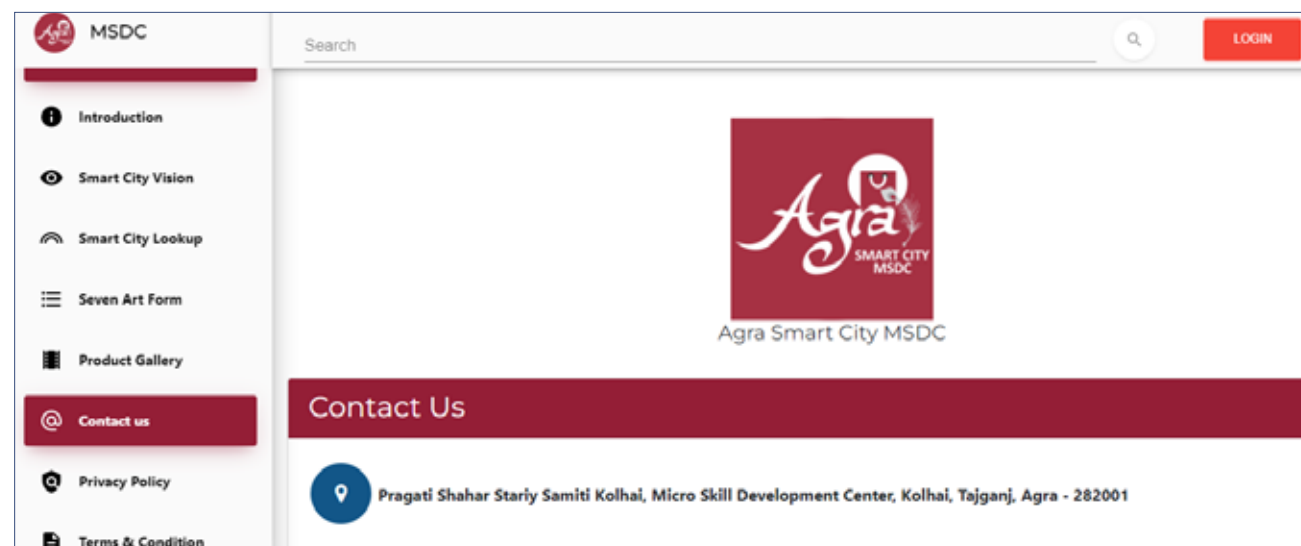


Figure 12: MSDC website

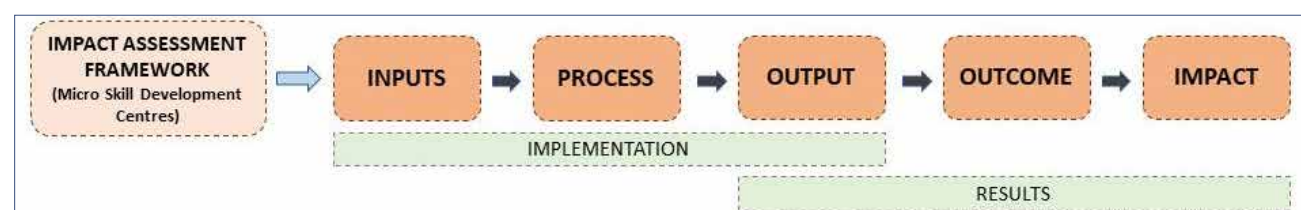


Figure 13: Impact Assessment Framework. Source: Authors

The research paper analysed the performance of the Micro Skill Development Centres. Such initiatives are essential to develop and sustain the local handicrafts because of the immense potential to generate employment and a means of sustainable livelihood for the artisans. The NGO has made a commendable effort in putting a theoretical concept into practice.

3.1 Implications (the impact assessment framework to be included here)

Inputs:

It includes the allocated financial resources for the development of the centres. The total project cost is Rs 2 crore for a period of five years.

Process:

The process includes surveying of community centres and existing communities, local skills and existing SHGs. The desired investments on infrastructure, equipment, capacity building, expenses on team building and administration were made as per the budget. All the processes were carried out by Adarsh Sewa Smiti (NGO).

Output:

The resultant output is the creation of four Micro Skill Development Centres equipped with all the necessary facilities to assist in the training process.

Outcomes:

A total of 107 SHGs (100 women and 7 men) are linked with the centres. A pool of recognised trainers is maintained to assist in the training of these beneficiaries under seven skill-sets. The project secured a position at national level under the Smart Cities Award Contest (ISAC) 2021, under the economy category.

Impact:

An increase in the income of the beneficiaries along with enhanced skill development resulted in increased financial independence for women. This has had a positive ripple effect on other societal sectors of the community as well. There has also been a promotion of

handicraft products with diversification in designs and increased attention by the government.

3.2 Limitations of the research

Due to paucity of time, the primary survey was limited to a certain number of beneficiaries and SHGs present at the centres. Only the skill programs available with the present beneficiaries could be observed. Since only one training provider was present at the time of visit, the trainer's perception of the training is limited to his response.

The paper uses both quantitative and qualitative data reported by the stakeholders without much cross-verification with other sources of data. This introduces subjectivity in the responses.

Because of the pandemic, tourism and trade are yet to recover completely therefore, the impact of the project has not been realised to its full potential.

3.3 Key lessons learnt

Research work primarily involves the study of secondary and primary literature. Secondary data is essential for any research work, particularly in times of COVID-19, when there is uncertainty concerning the field visits and interviews. Also, careful analysis of secondary literature is necessary to get a first-hand observation of the subject and arrive at a preliminary framework for the research. Well-documented literature enhances the overall experience.

The primary survey included discussions with stakeholders and beneficiaries using close and open-ended questionnaires. It was a unique opportunity since we were writing a research paper for the first time as urban planning students. But it had its set of challenges. Cooperation of the authorities is a crucial factor. The officials in Agra provided the best on-field support that boosted our enthusiasm and efficiency. Knowledge of the local language also becomes essential to interact with the beneficiaries, although it was not much of a concern for us in Agra.

3.4 Recommendations

The centres have been fairly successful in the effective implementation of the skill development program in the region. Following are the major points and suggestions that emerged from the study:

Initial screening of the beneficiaries should be necessary. Appropriate processes or formats should be developed for the same to categorise the artisans based on their skill competency. Based on that, the appropriate level of training should be provided.

The key reason for participation in the training program is that it would generate employment and lead to increased income for the beneficiaries. It is thereby suggested that employability assistance should be provided under the program. A follow-up study could also be undertaken to analyse the impact of the program on the livelihood of the people. Innovative approaches to strengthen the local businesses should be developed.

Along with e-shram cards and shilpi cards (artisan identity cards), certificates for the training program should be issued to the artisans, which could be further used to avail employment opportunities.

The time duration of the skill training should be increased so that beneficiaries get more time to acclimatise themselves to the new design trends and enhance their skills. Provisions like examination based skill evaluation could be explored to improve the quality of training. This would help in creating a hierarchy of artisans based on their skills. It would also enhance the efficiency of the training program.

Since during the initial years the development of the project was hindered by the pandemic, more awareness generation programs need to be undertaken. These could help to sensitise the people of the city as well as beyond the city, regarding the handicrafts of Agra. This would also be a boost to generate revenue for the artisans as well as promote the local handicrafts. Brand promotion of the local handicrafts is also crucial.

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C35

A case of Kalyani Honda and Clock tower, Durgambika Temple Precinct, Davanagere Karnataka

Name of the project: *Natural and Cultural heritage. An opportunity to integrate social identity of the place - A case of Kalyani Honda and Clock tower, Durgambika Temple Precinct, Davanagere Karnataka*

Location: *Davanagere*

Sector: *Urban Infrastructure*

SDG: *SDG 11*

Institute: *RV College of Architecture Bangalore*

Advisors: *Prasanna Rao, Ramya Krishna, Dr. O.P Bawane*

Students: *Ms. Harshita G, Ms. Veena*

Keywords: *Socio-Cultural, Area Based Development,*

Abstract:

Natural landscape of the city defines its geographical interface with the nature in which people relates and identify the cultural connection. In the changing time and space, these associated identities re-establish its identity in new diverse socio-cultural context. Nature and culture of the place along with the people believe system connects to the emotional and nostalgic identity* of the place. Smart city project in Davanagere explores the natural and cultural heritage of the historic precinct near Durgambika temple and demonstrate the revival of Honda¹ which brings back the old association cultural value with the natural heritage of the place which is lost due to the development. It also demonstrates the importance of inclusive approach in program that relate to cultural, natural heritage with economic overlay of the place

¹Definition of Honda (kannada word refers to still water body) / open Pond – formed Natural (larger part of biodiversity) or artificial used by the village for cultural/socialising activities.

Case Study: C35

1. Introduction

Davanagere once it was called as place of many lakes, the city is built around the natural systems such as lakes which also found suitable for traders/travelers established Davanagere as one of the cities of trade importance which connected Bangalore in the south and Hubli/Dharwad in the north. In this region, Water body exist in many forms and condition such as various natural condition it possess Such as open pond (also called as Honda in kannada which is basically used for irrigation, house hold activities and animal cleaning/ drinking purpose. Some refer it as Pushkarani which

lotus pond)maidan (open space) generally part of the extension of the lake during dry season.

Historically, these conditions influenced to flourish trade and cultural activities such as animal fair, cultural events, informal market etc.the location and cultural significance of the precinct influenced trade that related to cotton, oil and small-scale industrial products etc. the economic, cultural activities influenced area around the inner core part of the city Durgambika temple precinct, Davanagere. over the period of time precinct has developed in to trade and economic hub which led to the issues relates to traffic, pedestrian, parking etc. which

impacted the image and socio-cultural engage with the open space.

this precinct has been selected to implement the project under the smart city ABD (Area Based Development). This project identifies two heritage nodes to address the issues related to development within the heritage precinct of Durgambika temple node and around the clock tower a heritage structure.

2. Core Enquiry

This documentation of the smart city project highlights the importance of Natural and Cultural heritage of the place in influencing the program and design of social space for the city.

2.1 Understanding of the Natural and Socio-Cultural layer of the region and the city:

As per the name Davanagere itself brings its strong relation with the socio cultural and Natural heritage. Ecology is seen as significant element that integrates with the cultural layer of the place. for example, it is found that there are many man-made water bodies/ Kalyani found nearby vicinities. It has significance of cultural and political history of the region.

The precinct of Durgambika temple located in the old cultural and commercial core of Davanagere which had neglected Kalyani Honda more than 100-year-old (water body or pond with access with steps) which is misused badly. (As per chief engineer of Davanagere City Corporation it was used by children for swimming and animal drinking purpose) Hondada circle is one of the main node where the road connecting village called Kondajji one of the village connecting historical region during Chalukya period and towards south it connects the famous Santhebennur another historically significant place famous because of Large Pushkarani (lotus pond) built during 16th century, the Palegara¹ Kenga Hanumantappa Nayaka from Nayaka dynasty. This informs the importance of access to Hondada circle historically and also connects the Doddapete one of the main commercial spines of the old part of the city.

There are many communities and their economic/ religious structure is located within this precinct. as many as more than ten temples related to different community exist Such as Kalikamba Temple, Venkateshwara Temple, Durgambika Temple, Mata Annapporneshwari Temple, Sri Nimishamba Devi Temple, Mylara Lingeshwara Temple, Sri Veerabhadreshwara Temple, Gorwrasandra Maramma Temple, Durgamma Mariyamma Temple, Durga Devi Temple, Sri Vasavi Kannika Parameshwari



(Santhebennur Pushkarani (Lotus Pond) source of the image: Deccan herald news <https://www.deccanherald.com/content/557286a-masterpiece-stone.html>)

For Mr. Ravindra B Mallapur MD of smart city, the project is to connect the requirement of current meaning such as leisure space, park or open space, entertainment with fountain. For Chief engineer, goes back to the memory of how kids use to play with water, swimming etc. according to Mr. Hanumanth Rao Jadhav, local resident stays very close to the Kalyani Honda and within the precinct of Garadi mane* (A traditional gymnasium in this region which is popular activity among the youth.) which has rich long history and importance in shaping the youth and culture of the place. the Kalyani and surroundings were part of the larger Nullah (storm water drainage network- Nullah means open drain- natural storm water drainage.) once used as large maidan as social gathering space. This place was used predominantly as weekly animal market which include such as ox, cow, buffalo, goat etc. the richness of such places so that it reflects in the how each personalize the place and its identity.



Garadi Mane entrance. (Image: Author)

¹(Palegara-feudal title for a class of territorial administrative and military governors appointed by the Nayaka rulers of South India -https://www.google.com/search?q=palegara+means&rlz=1C1CHBF_enIN977IN977&oq=palegara+means+&aqs=chrome..69l57j0i512.3878j0j15&sourceid=chrome&ie=UTF-8-)

Temple. The major mosques are located in Azad Nagar, Vinoba Nagar, Imam Nagar, P.B Road, KTJ Nagar. There are two churches in the city. These are located at P-J Extension K.R. Road, and Jayanagar. This shows the diverse community and their cultural practice in the region and place.

The changing cultural and natural heritage and its association with the community is significantly changed over the period of time. This predominantly because of the change in the demographic pattern and their engagement with the economic activities such as importance to cotton and related. one of the important time lines was when there were many cotton mills were established in this town. And once Davanagere was called as Manchester of Karnataka

2.2 Natural heritage

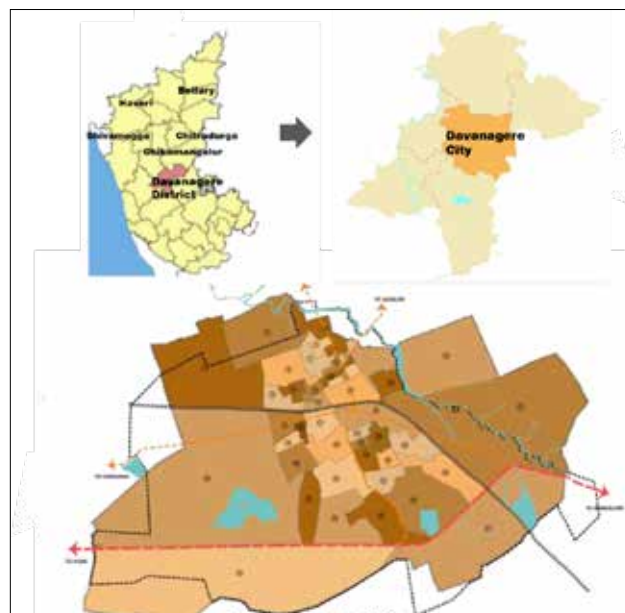
The old city of Davanagere A large storm water drain (Nullah) runs around the old part of the city. Open spaces along this drain indicate the cultural activities such as agriculture, maidan (Kalyani Honda and large open space around is part of cultural activity such as animal fair) and play area/gathering space during festival etc. existing Kalyani Honda and open space around was part of ecological network over the period of time it was used for cattle fair².

3. Introduction to the Context

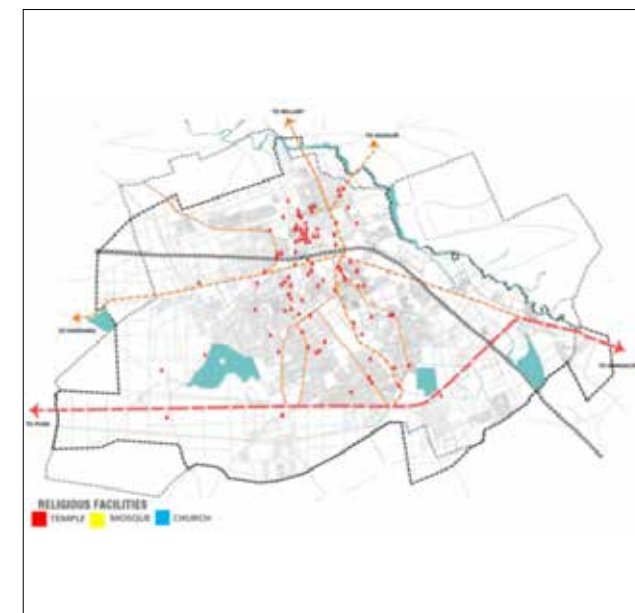
Hondada³circle area which is part of old core of the city also known as Durgambika temple Precinct, consists of 2.5 acre of land partly owned by Durgambika temple trust and Davanagere City Corporation. Hondada circle and the area has social and cultural infrastructure such as public toilet, bus stop, schools, water tank, Garadi



Location of Hondada circle where Doddapete street (main economic spine of the city) and Kalyani Honda.



Davanagere-CONTEXT



Broader socio cultural context of the city and Natural system



Precinct showing Hondada circle and its connection with old cultural and economic core of the city



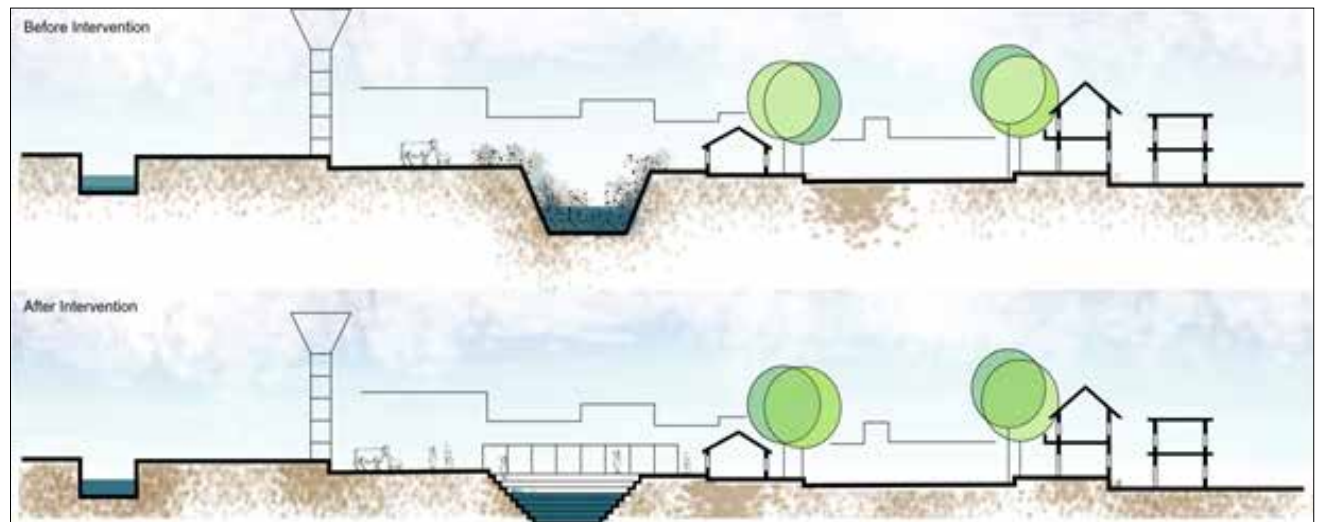
Site image showing newly built Kalyani and its spatial and social reference

²Cattle fare- Place where cattle were sold or exchanged. It is the place where large animal gathering in an open space, generally part of the natural system along with availability of water for the cattle to bath and drink.

³The pond/either Natural or man-made.



Plan Showing the Context



Section showing Before and After the project implementation



Image showing edge condition of the precinct. (Image:Author)



Old Image of Honda (author- Smart City Project report)
Kalyani Honda-after Smart City project



Nala that runs along the west edge of the site (Image:Author)

Mane⁴, temple, formal and informal commercial. A Nala⁵ adjacent to this land runs on the west side of the land which is owned by temple trust and Davanagere city corporation and it connects to the city level water network including lakes and storm water. This created smaller pockets of open space and green network connected with the communities and their cultural practices towards this natural heritage. also, it behaved as transitional space for the traveler/animals to rest and move forward to the next town. Animal fair is the one event that emphasize the cultural significant of the space and built around it. Many religious institutions such as Durgambika temple celebrated once in a year by the entire city where cultural and social activities are celebrated in such open space. Doddapete⁶

The Nallah that nearly runs around the old precinct of Davanagere creates many smaller open spaces around old town which is associated with the cultural memory of the place. they used as Maidan, playground, cattle fair, parks etc.

Smart city project intends to make this project as city level recreational urban space. There are two project area identified to take up under smart city project within the Durgambika heritage and cultural precinct (old core of the city) first project that include



Entrance steps to Kalyani (Image:Author)



Religious typology (Image:Author)



Kalyani Honda, Hondada Circle

⁴Wrestling area generally dedicated to lord Hanuman

⁵Nala- Natural drain system/stream

⁶Doddapete- Main street with market related economic activities

1. Cultural intervention at Hondada circle
2. Heritage intervention at Clocktower near Mandi Pete market

After the project intervention

4. Risk and challenges during implementation

Making of program as part of the intervention was a challenge faced during the implementation of the project. As clearly the precinct offered diverse community as stakeholders made the project challenge to finalize the program for both the project. Following are the challenges that faced during the implementation of the project

4.1 Social inclusivity

The land was belonged to the Davanagere City Corporation and Durgambika temple trust. The cultural identity and associated values of the communities played an important role in deciding the intervention program for the place. this include reviving the Honda as social space, making of garden for the community, conservation clock tower as of the heritage structure and enhance the use of the garden around the clock tower.

4.2 Technical issues relate to project and program

As informed in the beginning the precinct is part of the natural heritage and the goal of intervention in the system can be achieved only by understanding the system well and come up with the right intervention approach. Behavior of natural system during critical period and taking that as an advantage to create entertainment aspects in design of social public space.

4.3 Integration of community aspiration

It is found difficulty in considering the aspiration of the communities around the precinct. Such as people who are involved in informal economy and cultural/ youth organization such as Garadi Mane (Gymnasium in Kannada) who are involved in one such traditional sports of the region.

5. Project Description

Smart city Davanagere identified Two Heritage precinct Durgambika temple precinct and clock tower area under Area Based Development. There are many other ABD projects focused on bringing new experience in use of these heritage structure and its image, that completed under the SCP. Such as Smart Road and ICT based projects relating to the energy, infrastructure and environment.

As per DPR "Specific to the design for the Kalyani Park envisages an inclusive design that caters to the renovation of defunct heritage structure, proposed amenities block as well as park / open space, transforming it into a multi-use space that is flexible

for use throughout the day and year. The design of the park attempts to focus the attention of the viewer and passer-by on the Clock Tower and emphasise the same as a landmark for the city."

6. Intervention adopted/ implementation methodology

6.1 structural intervention

Structural intervention of the project includes making of Kalyani as social space by

6.1.1 Restructuring the Kalyani and its edges with stone work

Two entrances to the project provided from the Kondajji road from eastern side and southern side. Main entrance to the site is from the eastern side with colonnaded structure around the Kalyani is provided. With seating space and landscaped elements. A separate entrance is also provided from the proposed garden/park side along with proposed amenities block of Durgambika temple trust. Pedestrian pathways along the east and south direction of the site is enhancing the accessibility of the communities and informal activities as part of cultural and social inclusion.



Proposed image of the clock tower precinct Source: DPR Davanagere



Proposed plan of the clock tower precinct. Source: DPR Davanagere

6.1.2 Making of garden and entertainment zone

The garden designed along with Kalyani enhances various scale and level of social spaces that planned and integrated with utilisation of the space effectively.

6.1.3 Rain water harvesting the place and making of community hall.

The road adjoining boundaries of the site are provided with rainwater gratings to capture run-off water. The water is proposed to be redirected towards the step well.

6.1.4 Conservation of clock tower

The main scope of the work is conservation of the clock tower with rehabilitation measures and landscape measures. This involve in dismantling the unwanted structures around the park, creating seating and



Creating social infrastructure and facilities enhances the quality of space.

landscape measure to improve the usability of the space, reorganising the parking space and related infrastructure facilities, pedestrian path around the garden etc.

6.2 Nonstructural intervention

Natural and cultural heritage projects need to be integrated with consultative process with the community that it engages. Here the consultation process itself is broad base as communities and profession that engage with space and meaning of the place. Wide range of community need to be considered here such as place specific to Kalyani Honda such as traders, engages with small scale economic activities, other religious institutions etc. all these communities historically engaged with the place as per their cultural/economic need.

Mr. Rohit, is an Engineer working in smart city project Davanagere, accompanied us to the site such as Kalyani Hondada project and clock tower within the Durgambika temple precinct. After visiting the Durgambika temple, he went in to one of the old settlements of Davanagere. After crossing nearly 3/4th km through the smaller streets and alley he showed us one more Kalyani Honda, which is not in good shape and form. It is almost same size that of Kalyani Honda near Hondada Circle and entire edge of the kalyani is built with medium height compound wall for safety purpose. Currently water is not available in the Kalyani and misused by the communities around it. We wanted to engage with the community to know more about this structure. Residential neighbourhood compactly developed around this Kalyani which led to mis use of the Kalyani and many women wanted to develop this Kalyani in the similar manner that done under the smart city project near Hondada circle So, shows the community and their wish to see the success story of Hondada circle project repeated in other similar condition and this could be an opportunity for the local government to identify similar structure/condition to bring back the identity and take ecological and cultural benefit.



Image: Kalyani Honda (source: Author)

7. Key features of the Project

6.1 Socio-cultural impact and Ecological Benefit

The key feature of the project is to create new socio-cultural relation with the space which is lost in time. The making of Kalyani as new urban form to the city would provide an opportunity to the local government to address the spaces that are defunct in similar manner. This means it will sensitize communities to re-engage with the space in new form. The ecological layer as fundamental base on which the socio-cultural practices play an important role of owning the project results in cultural/social/ecological dividend

8. Conclusion and Future direction

Following specific and significant conclusion is made based on the project site observation, interaction with stakeholders and on sight interaction with officials and stake holders by the team of student researchers and faculty in charge to conduct the research to facilitate the process of compendium as per the direction.

8.1 Order to The Place

Larger objective of the project is to get right the idea of natural and cultural layer integrate to enhance the social life and bring order to the place. All three projects such as rejuvenation of Kalyani Honda, heritage conservation of Clock tower and smart road project locates within the busy market area. Informal economic activity that dominated in the old Bazaar area is now functions are organised and distinctly active. Smart city road design brought order to the place by distinctly creating spaces for vehicle parking, storm water drainage, etc. this allowed smooth flow of vehicle, it strengthened the economic relation with formal and informal market.

8.2 Reclaiming the cultural and social space

Bringing back Kalyani Honda in to the social activity network is result of how a left out social space can play an important role in re-establishing the image of the social space and its relevance in the present context. Project revolves around to enhance visual connections and making it in to a people place is a challenge in itself and need to consider it's important significantly.

C36

Surat Smart City Project - Affordable Housing

Name of the project: Surat Smart City Affordable Housing Project

Location: Surat, Gujrat

Year of Project Implementation: 2017

Sector: Area-based development

Project cost: Rs. 235.22 Crores

SDG: SDG 11

Institute: Kamla Raheja Vidyanidhi Institute for Architecture and Environmental Studies

Advisors: Prof. Ainsley Lewis, Dr Binti Singh

Students: Simran Mahtre, Rajeshwari Sawant, Disha Chinoy, Priya Mishra

Keywords: Affordable Housing, EWS, PMAY

Abstract:

The irresistible desire for affordable shelter compels the poor to encroach on vacant land, constituting the problem of slums. Unhealthy living, poor housing and sanitary conditions within slums results in illness. Thus, provision of housing which is inclusive in nature becomes the need of the hour in cities. Affordable housing is more than just a habitable space. In recent times, a paradigmatic shift has been witnessed in the nature of such dwellings by consideration of sustainability and a better quality of life. The incorporation of these principles is beneficial to the health and well-being of the occupants, the community. Innovative technologies have been beneficial in building sustainable affordable housing. However, the people should be educated to understand the benefits of innovative technologies so that it is maintained in the future as well. The study area is Surat City of Gujarat, India with a population of 44.62 Lacs (census 2011). Surat has observed rapid urbanization in the last few decades resulting in population growth in search of better working opportunities in the city. Affordable housing is aiding in the reduction of slums and providing the citizens with a better life at an affordable price. The findings of the study consist of four affordable housing projects developed under PMAY which aims to give better housing design, and housing production as per the demand of lower-income groups. The framework used in the study is useful in the documentation and analysis of the Surat Smart City - Affordable Housing features of better living.

Case Study: C36

1. Introduction

1.1 Topic and Context

Government of India (GoI), Ministry of Housing and Urban Poverty Alleviation (MoHUPA) have stated that the urban housing shortage across India was at 18.78 million houses for the period of 2012 to 2017, where 85 percent of the gap was for low-income households. As per the 2011 census, approximately 108,000 slums consist of 13 million households, where 3.6 million are renters. India's urban housing shortage is caused more by congestion, a lack of tenure security, and insufficient basic services in existing informal housing. Various schemes have been implemented over the years by a succession of

governments to address this shortage. Affordable housing means a family should spend only about 30% of their annual income on shelter.



Figure 1



Figure 2: Showing DMIC going through Surat

The Pradhan Mantri Awas Yojana – Urban (PMAY-U), launched in 2015, was introduced to provide subsidies to private developers, or households to make affordable housing. The PMAY has four main components, namely:

Affordable Housing-in-Partnership (AHP): AHP adheres to the resettlement approach, which entails beneficiaries being relocated away from their initial settlements.

In-situ Slum Redevelopment (ISSR): Private developers demolish existing slums and erect apartment buildings on slum property.

Beneficiary-Led Construction (BLC): Partially follows the 'upgrading' model as it supports self-construction where beneficiaries receive subsidies to either build or improve housing themselves.

Credit-Linked Subsidy Scheme (CLSS): Households are eligible for a rebate on the interest on housing loans, which may be used to buy new homes or repair existing ones.

The city of Surat, located in the western part of India in the State of Gujarat, is the second-most populous city in the state and eighth in the country. (Census 2011). It is one of the most dynamic cities in the country known for its textile trade and diamond cutting and polishing industries which makes it the economic capital of the state of Gujarat. This is also the reason for population growth in the city due to immigration from various parts of the country. Surat is one of the cleanest cities in India and is known by several names like The Silk City, The Diamond City, the Green City, etc. It is one of the fastest-growing cities between the Mumbai and Ahmedabad corridor. There is a 225 km long industrial belt, starting from Valsad in south Gujarat to Mehsana in north Gujarat and Surat is at the center of it. The city is situated on the bank of river Tapi with a 6km long coastline of the Arabian Sea

on its west. Surat is the main center of business and commerce in the South, Surat Municipal Corporation (SMC) has an area of about 334 sq. km.

The city is divided into seven zones and in 114 wards of the Municipal Corporation. west zone, Central Zone, North Zone, East Zone, South Zone, South-East Zone, and South-West Zone.

Slums are an important feature of urban economies, contributing heavily to them through labour market contributions and informal production activities. The density of slum shelters is quite high, making slum regions extremely crowded and devoid of drinking water, roads, street lights, and drainage.

The unsanitary and desolate wretched atmosphere that prevails in the slums is not only a cause of illness transmission throughout the city, but it is also a humiliation for people who live there. It is also an embarrassment to the authorities and road users,

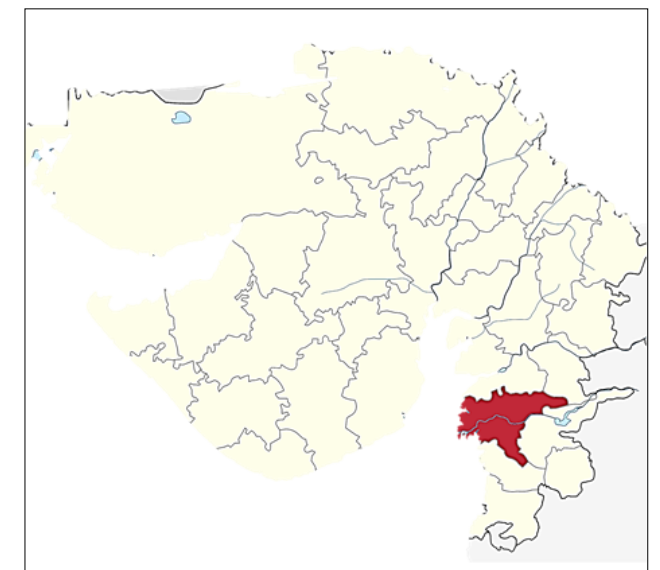


Figure 3: Location of Surat

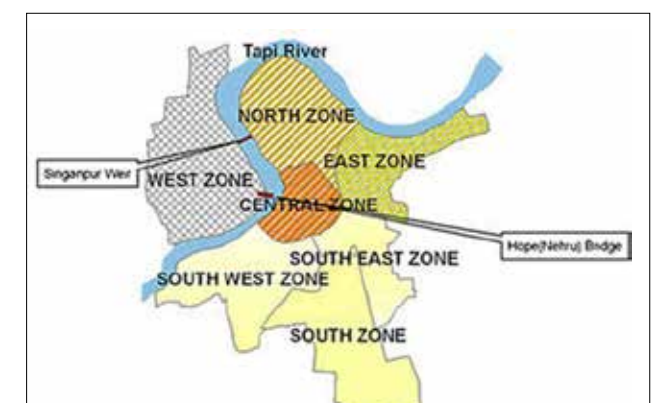


Figure 4: Map indicating different zones in Surat

despite the fact that slum people contribute to the city's growth and success.

The poor make up a sizable proportion of the urban labour force and contribute significantly to total productivity and labour market competitiveness. Surat Municipal Corporation has acknowledged the urban poor's contribution to city success and has chosen to provide enough provisions for them to have access to inexpensive land, housing sites, and services. In order to improve the physical condition and quality of life of slum inhabitants, it is critical to renovate the slums by offering site and service projects as well as ready-built housing schemes. (Slum Upgradation Cell, SMC) These are implemented on open plots belonging to the SMC, state government, or charitable trust as stated in figure 4.

On June 25, 2015, Prime Minister Shri Narendra Modi launched the Smart City Mission. Surat was chosen as one of 100 cities in India to be developed as a smart city as a result of several successes, efforts, and an all-inclusive strategy. The Smart City Mission represents a paradigm change in the country's approach to urban development since it is based on a 'bottom up' strategy that involves residents in the formation of city vision and smart city plans.

Out of the 20 cities selected in the smart city challenge in round one, Surat ranked 4th which was a matter of pride for its citizens. Surat Smart City Vision states: "Smart Utilization of

Surat City's potential for enhancing quality of life for the citizens by providing equal access to best quality physical infrastructure, social infrastructure and mobility through leveraging state of the art technology; thus, making Surat a futuristic global city with focus on enhancing economy, protecting the ecology and preserving the identity and culture of the city". (Surat Smart City)

Citizens Engagement is the foundation of four pillars of institutional, physical, social, and economic infrastructure for comprehensive development under Surat Smart City, according to Smart City Mission guidelines, and thus Citizens Engagement tool is widely used to know the suggestions / feedback from citizens through various online & offline methods such as -

- Stakeholders' consultation meetings with Elected representatives,
- Press media,
- Different industrial, trade & commerce associations,
- Doctors, engineers, architects and ngos,
- Ward level meetings with citizens,

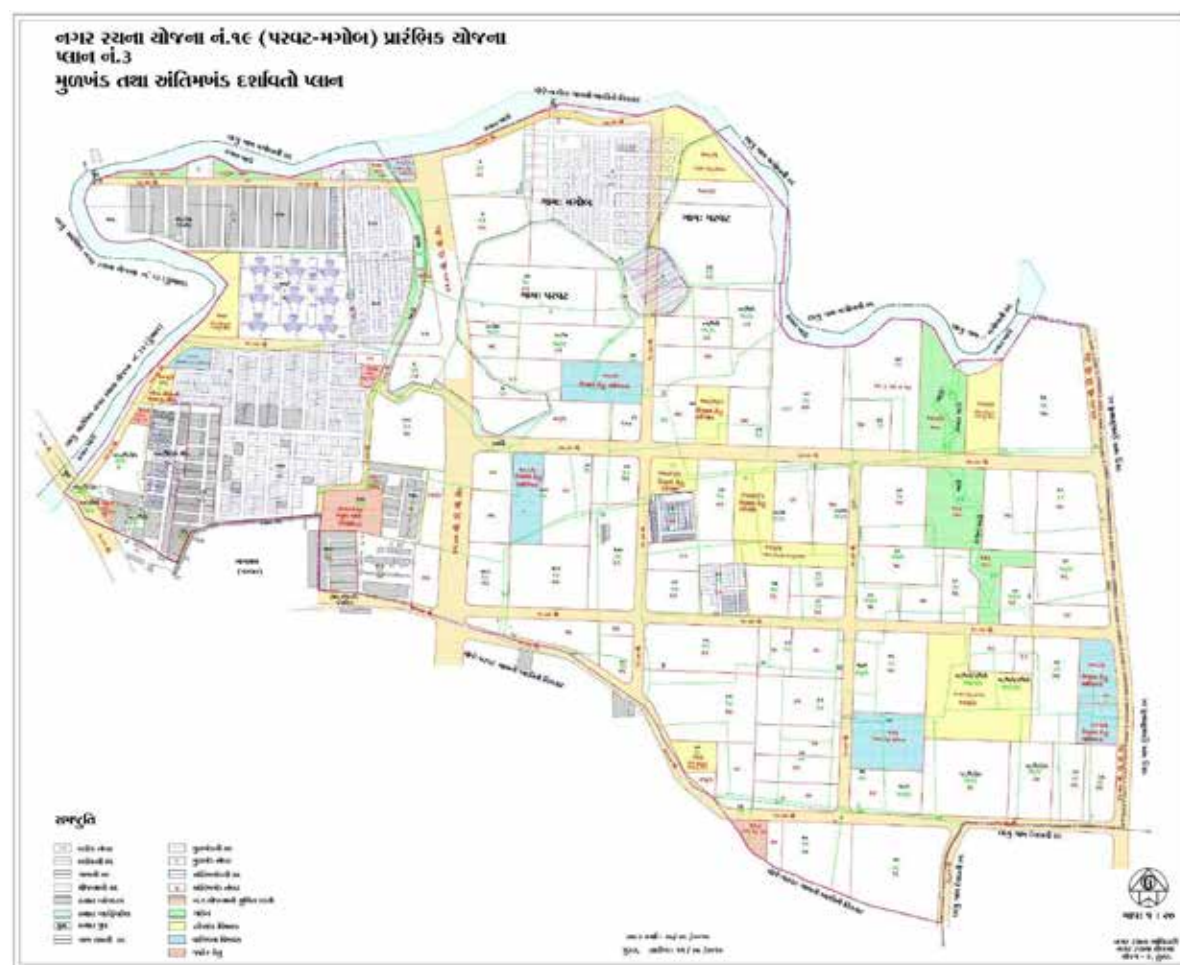
- Essay & Drawing competition for students and citizens,
- Techno fair for informing citizens about possible smart solutions,
- Citizens Poll on myGov and SMC's website and seminars/webinars on different subjects etc.

Surat Smart City Undertakes two initiatives, Pan City Projects and Area Based Development Projects.

The pan city proposal for Surat city is envisaged to maximize the benefits out of the service base. The proposal aims to improve public services and citizen interface. It is centered around the theme of Citizen Friendly Surat through Intelligent Transport and Connectivity.

"Retrofitting" has been chosen for area-based development based on suggestions/feedback obtained during Citizens Engagement. After screening all potential choices, an area of 2167 acres (8.77 square kilometers) comprising 7 T.P. projects in Anjana, Umarwada, Magob, Dumbhal, and Parvat in the city's East and South-East zones were chosen for retrofitting in the Smart City Proposal.

Surat's selected region accounts for 3% of the city's entire geographical area. By population, it accounts for around 10% of the city's population, while the GDP share of this area accounts for approximately 16% of the city's GDP. Region-Based Development in this area with smart characteristics would boost the business environment and improve people's quality of life.



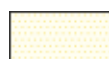
 Housing for Socially and Economically Weaker Section.

Figure 5: Town Planning Scheme Map of Parvat Maghob in Surat.

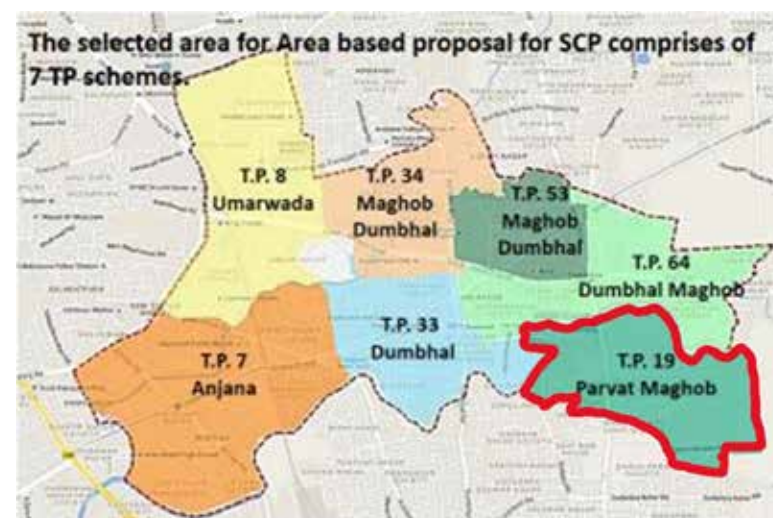


Figure 6: Figure showing 7 Proposed Town Planning Schemes



Figure 7: Smart Solutions- affordable housing, water supply, renewable energy, waste management, etc

Many smart solutions in the domains of water supply, sewerage, solid waste management, water recharge, renewable energy, street lighting, town planning & development, economic development, and vital Smart City Solutions were implemented for retrofitting of area-based development.

The Affordable Housing initiative by Surat Smart City under PMAY was proposed in the above-mentioned areas to improve the liveability condition of citizens in the slum pocket. The project aims for:

- Planning of 1050 EWS and 1950 LIG Houses under Pradhan Mantri Jan AawasYojana.
- Planning of Zero Slum Area by developing 5750 houses based on PPP model.
- Total Projected cost of Rs. 700 crores. It includes Rs 460 crores of PPP.

1.2 Significance of the project

Surat has transformed itself into one of the cleanest cities in India in less than two years following the December 1994 plague. This shift was primarily the result of better municipal management. Its early success sparked widespread support among the local populace and gave impetus for municipal staff and elected officials to make more changes to the city. Surat's experience has shown that urban municipal governments in developing

nations have the potential to meet the problems of rapid urbanization while also improving the quality of life for all citizens. (Swamy et al., 2009) These reforms have continued to open several opportunities for the Diamond city. Affordable housing projects are proposed to improve the liveability condition of citizens in the slum pocket and give them a better quality of life. Approximately 3000 affordable houses are provided under PMAY of which 1050 is for the Economic Weaker Section (EWS) and 1950 is for the lower income group (LIG). The Surat smart city is planning a zero slum by also developing 5750 houses based on the PPP model.

1.3 Aim and Objectives

The aim of the study is to study and analyze the effectiveness of affordable Housing by Surat Smart City under PMAY

The objectives of the study are:

Hon'ble Prime Minister envisioned Housing for All by 2022 when the Nation completes 75 years of its Independence. In order to achieve this objective, the Central Government has launched a comprehensive mission "Pradhan Mantri Awas Yojana – Housing for All (Urban)".

- To study the percentage of land cover used by

slums in the past few years.

- To understand the basic facilities and amenities provided by SMC to the people under Affordable Housing Project
- To understand the perception of people residing in these houses.
- To analyze the impacts of the project at the city level.

Mr. Chaitanya Bhatt, CEO, Of Surat Smart City Department has been helpful in making the authors understand the many various projects that have taken place under Surat Smart City. Mrs Trupti Kalathia, executive Engineer of SMC and head of the Surat Slum Upgradation cell, and Mr. Nirav Puniwala, have been helpful in making the visit a success by showing us the various projects implemented the Surat Smart city where it has tackled the issue of slums by have 21% slums in the 1900s to only having 6% slum in the entire City.

2. Contextual Background

The Surat smart city intends to maximize the benefits for the people of the city, beyond the provision of basic services, in terms of inclusivity, affordable housing, safe environment, and renewable energy through recycling. Where the Pan City proposal aims to improve public services and citizen interfaces to create a citizen friendly city through intelligent transport and connectivity. The idea being to integrate various services and offer citizens a variety of options to avail these services conveniently and cost effectively. The Area Based Development proposal is based in Anjana, Umarwada, Magob, Dumbhal, and Parvat Maghob, in the city's East and South-East zones.

2.1 Conceptual framework / Research design

The right to adequate housing has been described as an absolute and fundamental human right by the United Nations. It features a common thread through the sustainable development goals (SDGs) which is the globally accepted development outline to achieve sustainability, especially in SDG 11. Efforts are being made by the municipal corporation to ensure that dwellings are delivered to satisfy various income brackets in the city of Surat at the same time supporting improved levels of social inclusivity and cohesion, economic access, and productivity with the least enfeebling impact on the environment. The opportunities for development in this housing market is improving due to growing demand and the efforts of the public sector housing schemes, non-governmental organizations, and low-profit entities.

A paradigmatic shift in the nature of affordable housing toward the increased consideration of sustainability principles during the planning, design, delivery and operations phases has been noted in recent times. This quintessential shift is beneficial to the health and well-being of the occupants and community, culminating in the rise of the sustainable affordable housing construct. The research will be conducted by studying and

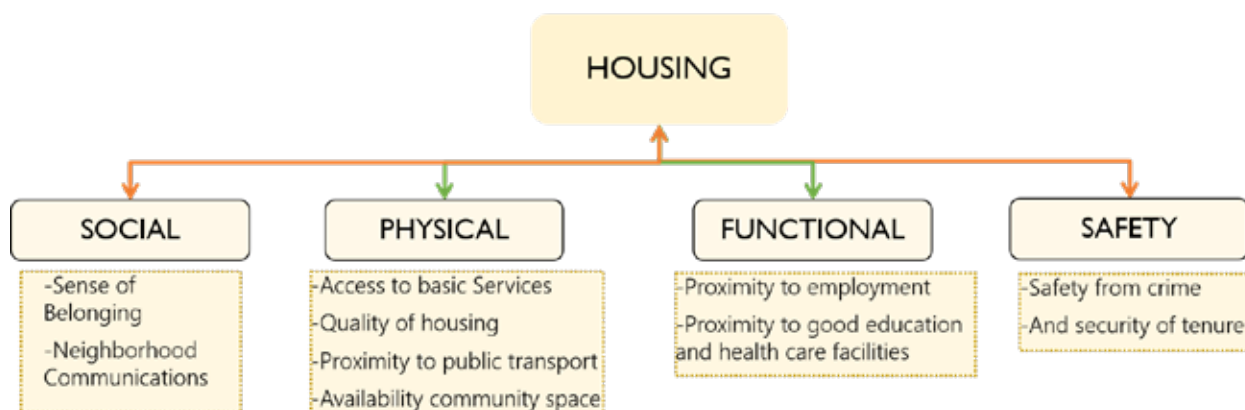


Figure 8: Research framework

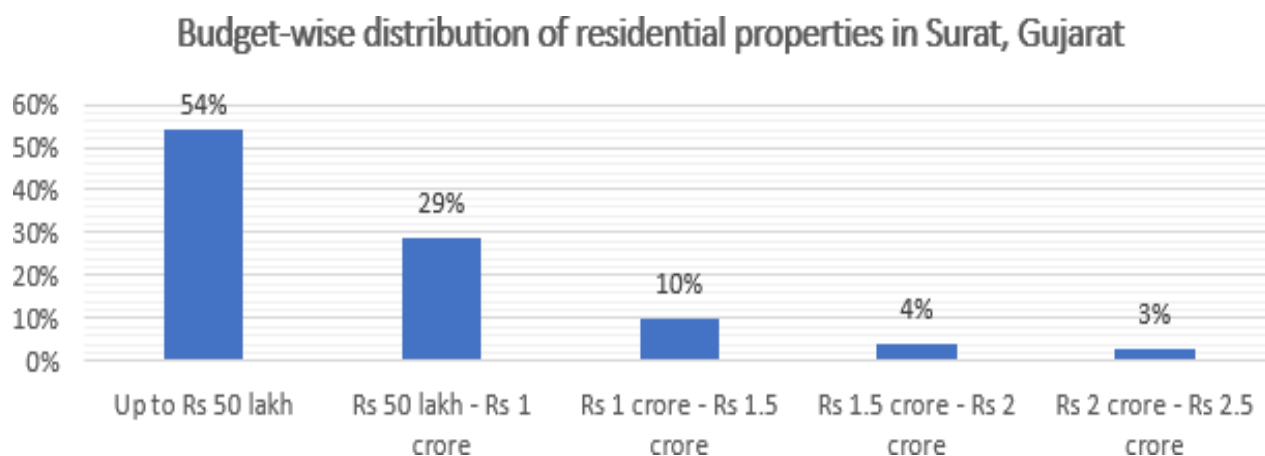


Figure 9: Budget wise distribution of residential properties in Surat, Gujrat
Source: 99acres listings as of October 2021

analyzing the effectiveness of affordable Housing by Surat Smart City under PMAY by the above mentioned factors - Social, Physical, Functional and Safety.

2.2 Key features and details of the project

Affordable Housing by Surat Smart City

Surat Smart City under PMAY has constructed 3958 EWS-I and EWS-II Residential Unit having areas of 26.46sqmt. and 36.56sqmt. These premises include all Internal Infrastructure Services & Site Development Work Under Pradhan Mantri Awas Yojna.

The projects are mostly located in Parvat Maghob and Dhindoli, some are also located in Varachha, Sigapore-Tunki, Katargam and Dhumbal. The oldest being Parvat Maghib.

Suman Sanghini, Suman Sangit, Suman Prahar and Suman Prabhat have been visited during the visit made by the authors.

Sr. No.	Project Name	EWS I/II	Project Location	No. of DUs
1	Suman Dham	EWS I	T.P.41(Dindoli),F.P.No.29	160
2	Suman Sangeet	EWS I	T.P.19(Parvat-Magob),F.P.No.100	408
3	Suman Prahar	EWS I	T.P.19(Parvat-Magob),F.P.No.111/1	570
4	Suman Prabhat	EWS II	T.P.19(Parvat-Magob),F.P.No.112	208
5	Suman Sangini	EWS II	T.P.53(Magob-Dumbhal),F.P.No.82	1088
6	Suman Niwas	EWS I	T.P. 25 (Mota Varachha) F.P. 147	560
7	Suman Mangal	EWS II	T.P. 25 (Sigapore-Tunki) F.P. 97	192

Methodology:

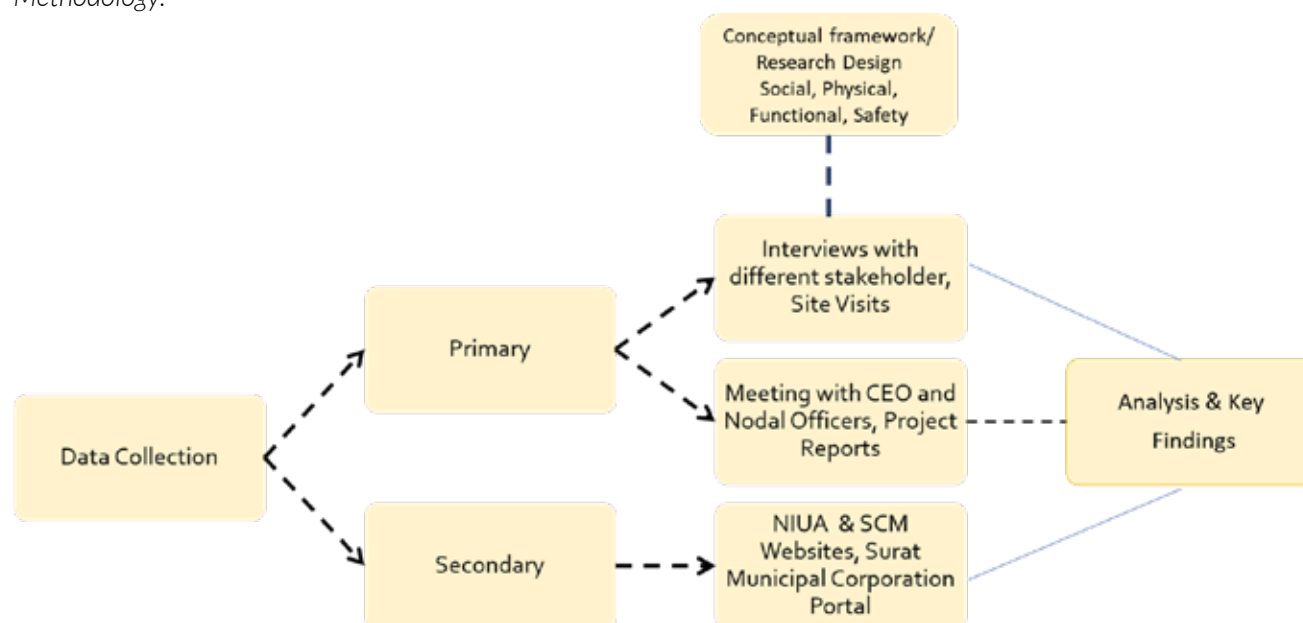


Figure 10: Methodology for Research

8	Suman Niketan	EWS II	T.P. 19 (Katargam) F.P. 180	112
9	Suman Malhar	EWS II	T.P.28(RUNDH-VESU) F.P.32/P-	660
			Total	3958

Table 1: Project Details of 3958 EWS-I and EWS-II Residential Flats

2.2.3 Risks and Challenges in the project

- The first challenge was ensuring that the units are distributed evenly among eligible beneficiaries.
- The criteria for allotment of a dwelling unit are that the allottee should be a resident of Surat and should not be an owner of any other property.
- The SMC encounters one major challenge with respect to maintenance of the sites, as the tenants modify the units according to their needs which leads to waterproofing issues causing leakages and structural problems.
- Further, the premises of each of the sites were maintained only until the SMC was involved. After the handover, the premises and the provided amenities do not see proper upkeep on the residents' part.
- The residents being ignorant to the maintenance of the sewage treatment plants has led to the stagnation within the plant leading to a foul odour within the complex.
- These sites are on Government-owned land in the outskirts of the city, hence these being the new up and coming developments see inaccessibility to some amenities such as schools and hospitals. (Author.)

2.2.4 Features and Benefits (social, technical, city administration level, impact on the environment and economy) to the city (expected and observed)

- Surat Municipal Corporation has constructed 3958 EWS category houses under the AHP vertical of Pradhan Mantri Awas Yojana at 9 locations, in Smart city ABD area.

- The work is carried out through EPC contract consists of various items i.e. development/ construction of EWS-II houses including Conceptualization, planning, structural designing, structural proof checking and all other internal & external amenities like
 - Plumbing & sanitation,
 - Drainage,
 - Electrification,
 - storm water drainage,
 - Horticulture,
 - Fire safety,
 - Infrastructural facilities like CC roads, compound wall, entry gate, COP Development,
 - Street lighting with providing, installation & commissioning of Tertiary Sewage Treatment Plant (TSTP), Organic Waste Converter (OWC) including Operation & Maintenance
- The planning & design of the building is carried out as per the Guide-lines of UD & UHD and prevailing GDCR-SMC norms and got approved from authority. The carpet area of one Dwelling Unit is 36 sq mt. Percolating wells with rain water collection systems are also provided.
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Implementation Objectives

Main Objective:

It is a vision of all of our countrymen that not a single citizen/family of our country should be without a home by 2022. The Hon'ble Prime Minister launched Pradhan Mantri Awas Yojana on 25th June 2015 and Housing

for all Plan of Action was prepared by Surat Municipal Corporation so as to work out actual demand to achieve the above goal .

It was required to develop the housing campus with all the basic amenities for EWS families who are currently residing in rental houses or slums, so that they will get their house at an economical price.

Specific Objectives:

Organic Waste produced within the housing complex is also required to be treated in-house in Organic Waste Converter and the residue can be used/ sold as manure for agriculture work which will help to provide a sustainable living environment and RWA will be economically benefited.

Scope of Implementation:

1. The main issues are requirement of centralized/ single contract for building work as well as other infrastructures i.e. CC roads, water supply network, electrification, Drainage line network, paver block in marginal area, recharge bore well, gardening and maintenance and operation work during completion on urge of actual occupation to the beneficiaries. Thus, tenders were floated and works were awarded on EPC basis for civil work as well as infrastructure including operation and maintenance for two year even with provision of OWC by Surat Municipal Corporation.
2. The entire campus is provided with following facilities to the economically weaker section (EWS) families, so that they will get their house at economical price

and no need to run out/ coordinate with other agencies/departments for basic amenities.

- a. Each dwelling unit consists of a Living Room, Bed room, Kitchen, toilet, bathroom and wash area with vitrified tiles flooring. Also, Kitchen Platform, Wooden Flush Door in for all Rooms and PVC Flush Doors in Toilet & Bath are provided.
 - b. Electrical facilities i.e. Concealed wiring with Switch board-Plug points, MCB in each unit, Lift having capacity of 6-8 passengers, DG sets in each building are provided as per requirement and norms.
 - c. Internal & External Fire fighting and safety services with Fire water tank having 1,00,000 lacs liters capacity.
 - d. Beneficiaries facilitated with Basic infrastructure i.e. Water supply network, Drainage network, C.C. Roads and VDS/Paver block in Marginal area, Landscaping and gardening in C.O.P. space, Compound wall and attractive entry gate, PNG Gas line network, LED street lighting.
 - e. Rain water harvesting and Percolating recharging well
3. Surat Municipal Corporation has adopted a transparent procedure for allotment of these houses through computerized random draw of valid applications and formulated the building wise resident welfare association (RWA) of beneficiaries.
 4. Surat Municipal Corporation is providing organic waste converter (OWC) having capacity of 500 gm/family/day i.e. 100kg/day for solid waste management, thereby beneficiaries of this scheme can treat their organic waste and utilize the treated

residue for their benefits and contribute to the community as a whole. This can reduce disposal of solid waste to the centralized collection center.

Innovative Characteristics of the Project

Waste segregation is the biggest movement nowadays in India and disposal and management of segregated waste is a crucial problem for environmental experts. Surat Municipal Corporation has decided to accept this challenge and remarkable steps towards dry and wet waste segregation have been taken. Even solid waste management on a very small scale i.e. houses, society, apartments, commercial units, public buildings and offices level through installation of organic waste converters is promoted and executed. Taking into the consideration, an organic waste converter having capacity of 500 gm/ family/ day i.e. 100 kgs/Day is installed at this Suman Prabhat Campus having fully automated operation. The daily output from the OWC will be valuable 20kg/day fertilizer for farming and gardening.

Further, The campus is facilitated with four percolating recharge borewells at various locations for rain water harvesting and all the street lights are having LED fittings.

Project Benefits / Expected Impact

- The homeless economically weaker section eligible citizens, who are currently residing in the rented houses or in the Slum area are facilitated with their own house with all amenities at a very economical



Image 1: MCB for every unit



Image 3: Fire Service amenities



Image 5: .Provision of social spaces



Image 2: 6-8 passenger capacity lifts



Image 4: Power Supply Units



Image 6: .Provision of social spaces

price. So, their socio-economic standards are found to be highly improved.

- Due to continuous activities for construction of Affordable houses, the city's pre-planned development will be possible and formation / extension of slum / densely residential areas will slow down and the rising property / land prices will be reduced.
 - Houses provided with individual Toilet and Bath facilities as well as drinking water facilities.
 - The locations are so selected that Mass Transportation facilities of BRTS and City Buses are available and well connected with the place of their livelihood. Safer and affordable commuting.
 - Due to these works slum areas have drastically reduced and the percentage of homeless people has also decreased.

Replicability / Scalability of the Project

At the end, Surat Municipal Corporation, the administrator of Surat Smart City on its part and ongoing experiences arrive at a conclusion that to keep up the developmental pace and progress of city, more and more industries should come may be heavy, service etc. so more and more skilled and unskilled laborers, workers will come for work & employment will increase housing, water supply and drainage demands, solid waste management will be a huge task. Water supply management will require huge managerial skill & recycling will be needed of the hour. Day to Day, water is becoming a scarce commodity so scientifically use is the only solution.

Surat Municipal Corporation has decided to replicate such practices i.e. Organic Waste Converter, rain water

harvesting through recharge bore wells and other basic amenities in all the new sanctioned projects for construction of 10564 EWS-II houses at 13 locations.

In a nutshell, Surat Municipal Corporation came to the conclusion that it's a need of the hour, for every local body to go for such types of projects in Government sector as well as private sector, so as to make our towns, cities a sustainable and environment friendly place to live in with good living standards.

2.3 Key findings from the interviews, surveys and primary/secondary data collection

The key findings from interviews, surveys and data collection for the ABD projects under PMAY are as follows:



Image 7: Provision of gazebos and open spaces



Image 8: Percolating recharge well



Image 9: Boards with campus name, owner name ad flat no and security monitors at the entrance of every building



Image 10: Signages regarding cleanliness throughout the campus



Image 11: Organic waste converter



Image 12: Tertiary Sewage Treatment Plant

- The allocation of the units was carried out by a lottery system.
- The projects were completed within a span of 2-3 years
- All the ABD projects met all the smart city criteria and all listed amenities were provided to the residents.
- The overall process, including distribution, construction, handing over and maintenance of the projects was duly carried out and up to date.
- The beneficiaries were completely satisfied with the process and features of each of the projects.
- The residents are able to modify the functioning of the housing and its amenities according to their needs and requirements.
- SMC ensures that the project is duly completed with

all checks and requirements and they are also up to date with the maintenance checks and warranties.

- SMC has also ensured that any future requirements or services that need to be done can be carried out by opening a savings account worth approximately 50,000 per dwelling.
- Each building consists of a representative who is part of the resident's welfare association, that caters to the resident's problems, overlooks the functioning of the society and manages all activities and maintenance that happen in the society.
- The majority of the structural issues, if any at all, are caused due to negligence of the tenants, who modify the houses according to their needs and wishes. For example, the tenants uproot the flooring and change

all sanitary fixtures which lead to waterproofing issues and cause leakages.

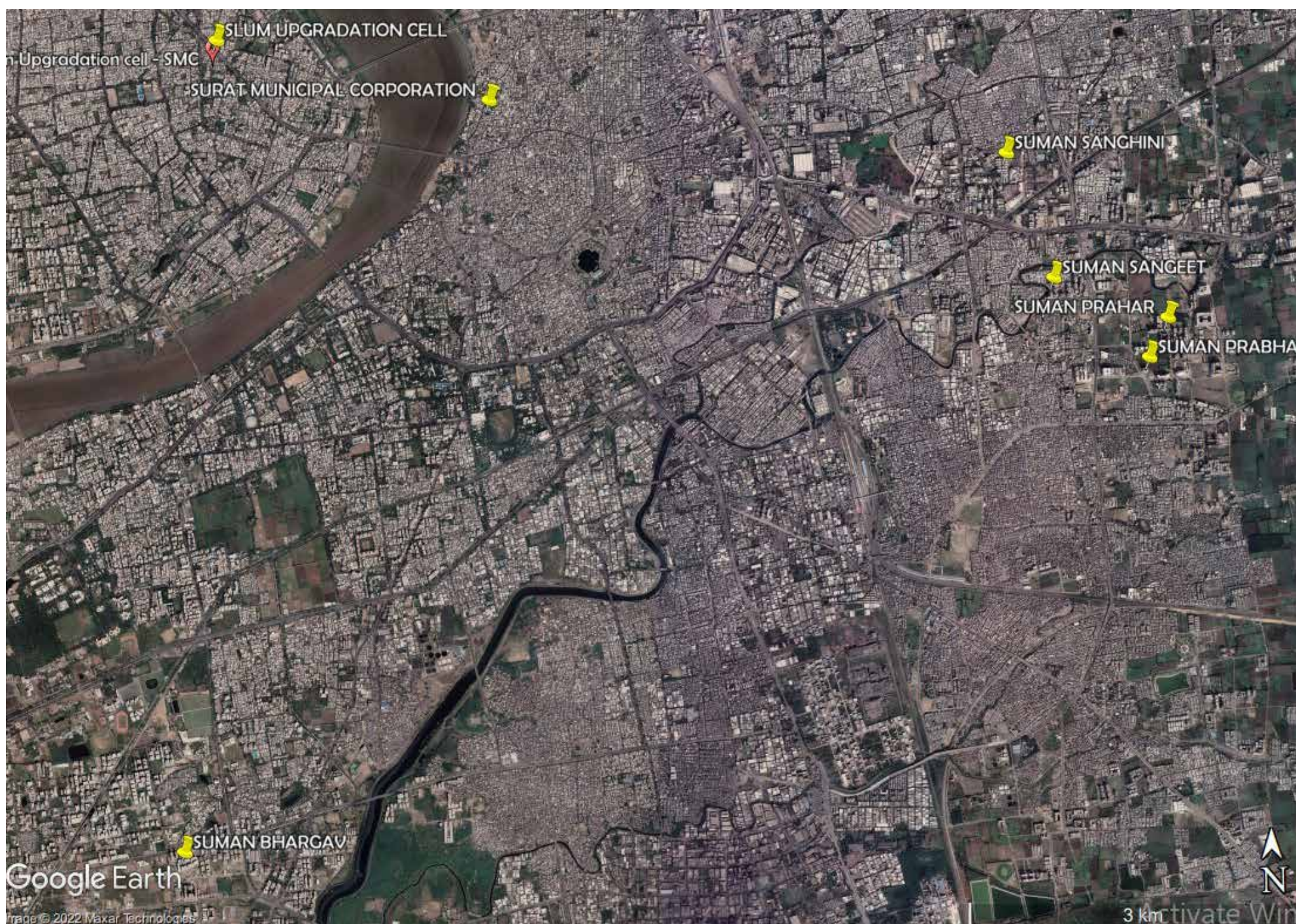


Image 13: Location of all affordable housing projects in Surat

Project Name: Suman Sangit

Location: Suman Sangit, T.P. Scheme No. 19 (Parvat-Magob), F.P. No. 100

Nearby Vrajbhoomi Apartment, Parvat-Magob, Surat.

Estimated Time of Project Work Start: 17/02/2017

Date of Occupation: 31/03/2019

Brief Description:

568 EWS-I Dwelling units, Parking + 15 floors

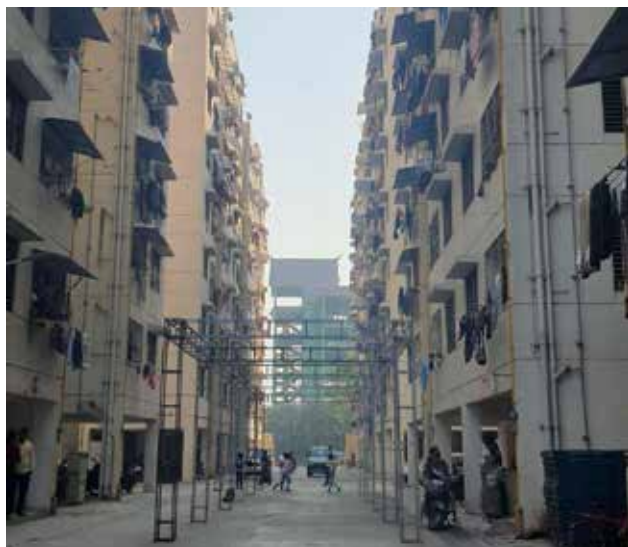
Site Images:



Before:



After:



Each Unit provided with living hall, bed room, kitchen, W/C, Bath and Balcony, total carpet area of 36.56 sq mt.

DPR Cost: Rs. 235.22 Cr

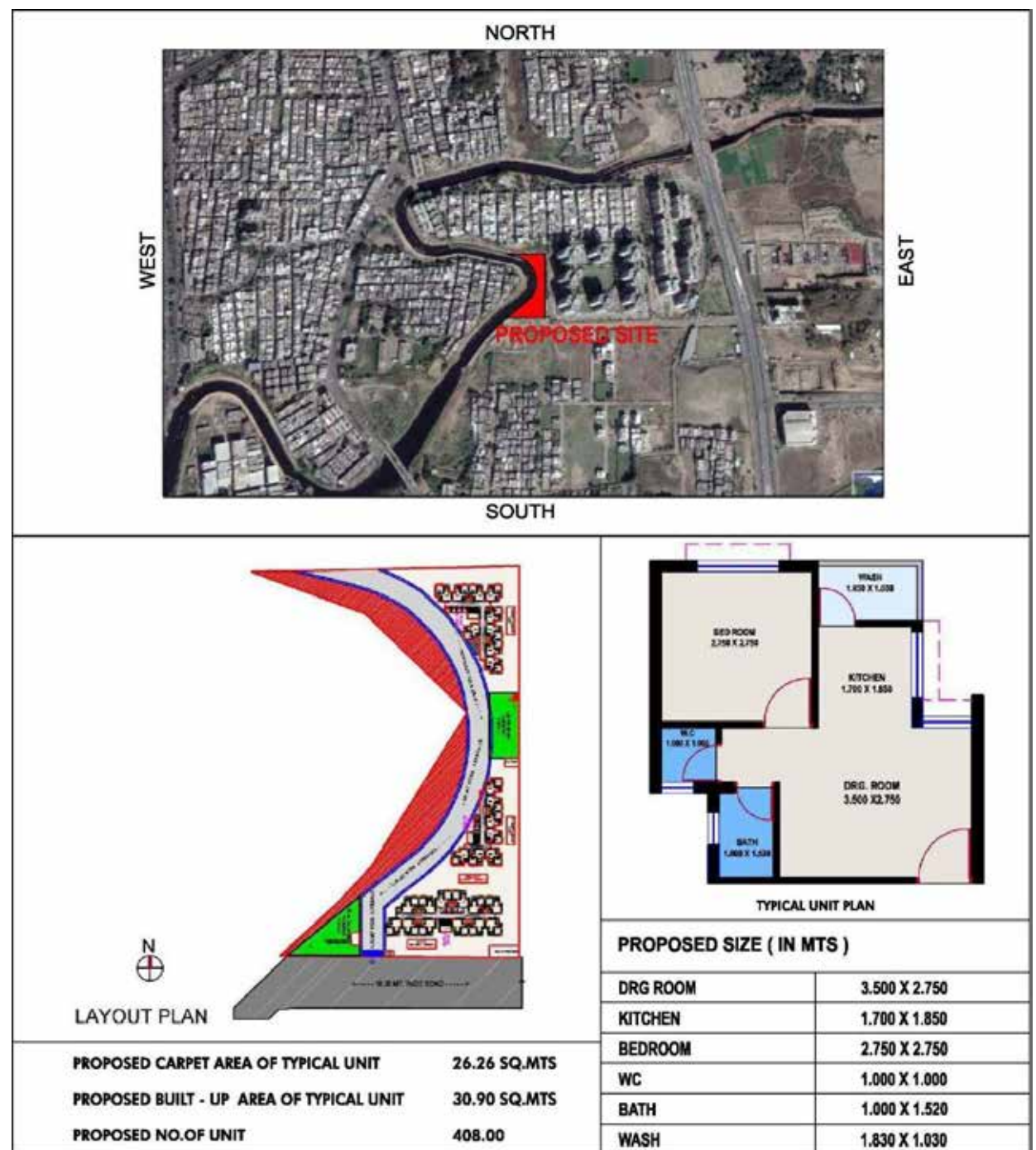
Tender Estimated Cost: Rs. 35.35 Cr.

Tender Sanctioned Cost: Rs. 33.12 Cr. **SCM / Convergence / PPP / SMC Costing:** GOG-1.5 Lacs, GOI-1.5 Lacs, Beneficial-5.50Lacs (Max.)

Geographical Coverage - 6945 sqmt **Population Coverage** - 570 families having a total 2850 persons.

Mrs. Leela: living here for the past 3 years, since the building is near the canal, the smell is inconvenient, since the site is away from the main road, markets and other

amenities are at a distance. More permanent houses with basic amenities to live in, a huge improvement from their previous living conditions. difficulty in looking for employment due to a change in residence.



Project Name: Suman Sangini

Location: Suman Sangini,

T.P. Scheme No. 53 (Magob-Dumbhal),F.P.No. 82

B/H Amazia Water Park, Parvat Patiya, Surat.

Estimated Time of Project Work Start: 04/05/2017

Date of Occupation: 04/05/2019

Brief Description:

1088 EWS-II Dwelling units, Parking + 8floors

Each Unit provided with living hall, bed room, kitchen, W/C, Bath and Balcony, total carpet area of 26.46 sq mt.

DPR Cost: Rs. 235.22 Cr

Tender Estimated Cost: Rs.83.89 Cr.

Tender Sanctioned Cost: Rs.70.71 Cr.

SCM / Convergence / PPP / SMC Costing: GOG-1.5 Lacs, GOI-1.5 Lacs, Beneficial-3.00Lacs (Max.)

Geographical Coverage- 17928 sqmt Population Coverage - 1088 families having a total of 5440 persons



Mr. Suresh: Living here for the past 2 years, have no issues with the house, easy travel to work, can hold functions within the society, very cost-effective, provision of basic amenities, functional security cameras, and working lifts.



Mr. Tak: Has been living here since the past 2 years, they have modified the house as per their convenience, like some bathroom fixtures, kitchen walls etc. satisfied with the provisions, safety for his children.

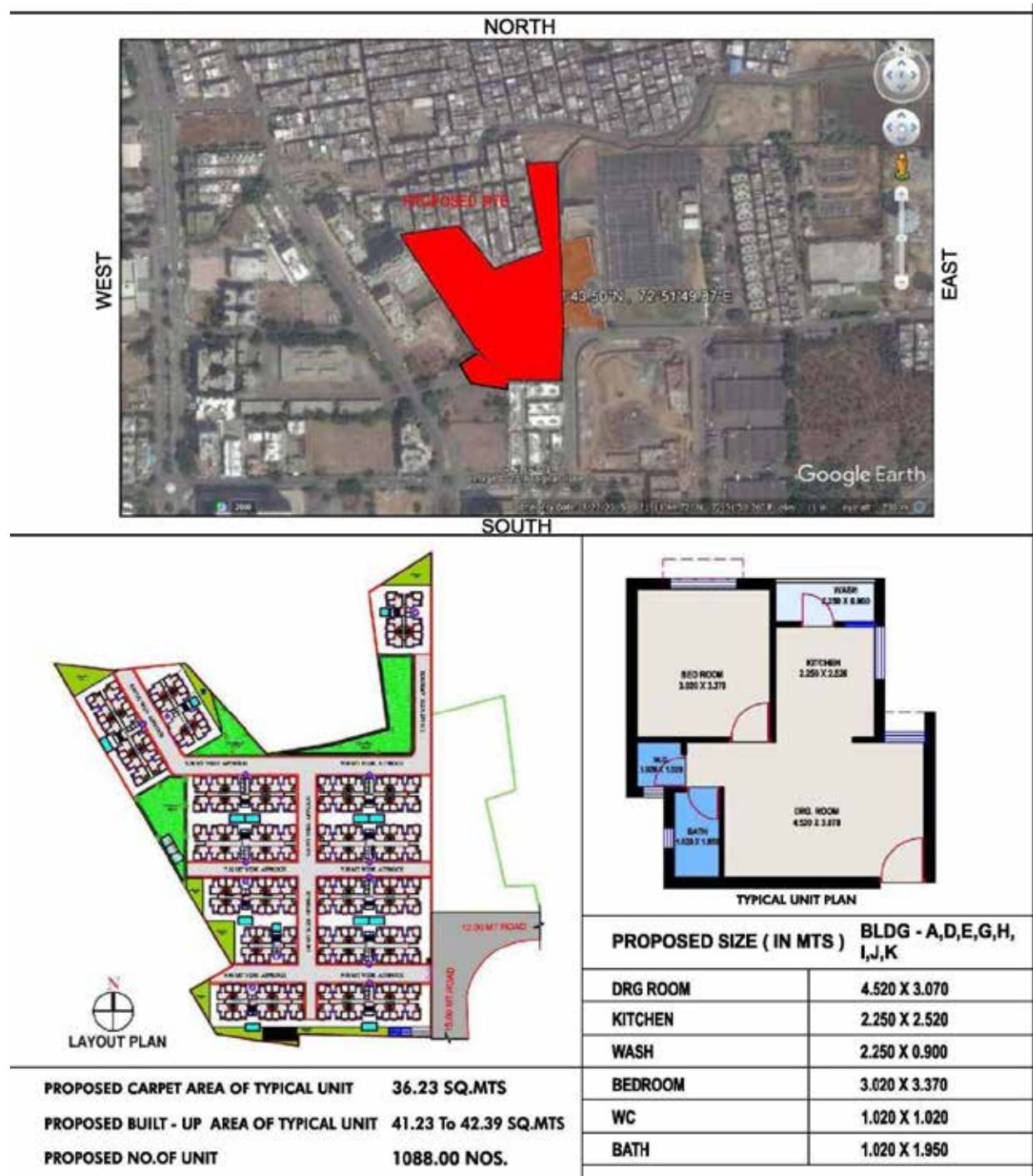
Site Images:



Before:



After:



Project Name: Suman Prahar

Location: Suman Prahar,

T.P. Scheme No. 19 (Parvat-Magob), F.P. No. 111 B/H
Capital Square, Parvat-Godadara road, Surat.

Estimated Time of Project Work Start: 03/05/2017

Date of Occupation: 31/03/2019

Brief Description:

Site Images:



Before:



After:



570 EWS-I Dwelling units, Parking + 15 floors Each Unit provided with living hall, bed room, kitchen, W/C, Bath and Balcony, total carpet area of 26.46 sq mt.

DPR Cost: Rs. 235.22 Cr

Tender Estimated Cost: Rs. 35.36 Cr. Tender Sanctioned Cost: Rs. 32.78 Cr.

SCM / Convergence / PPP / SMC Costing: GOG-1.5 Lacs, GOI-1.5 Lacs, Beneficial-3.00Lacs (Max.)

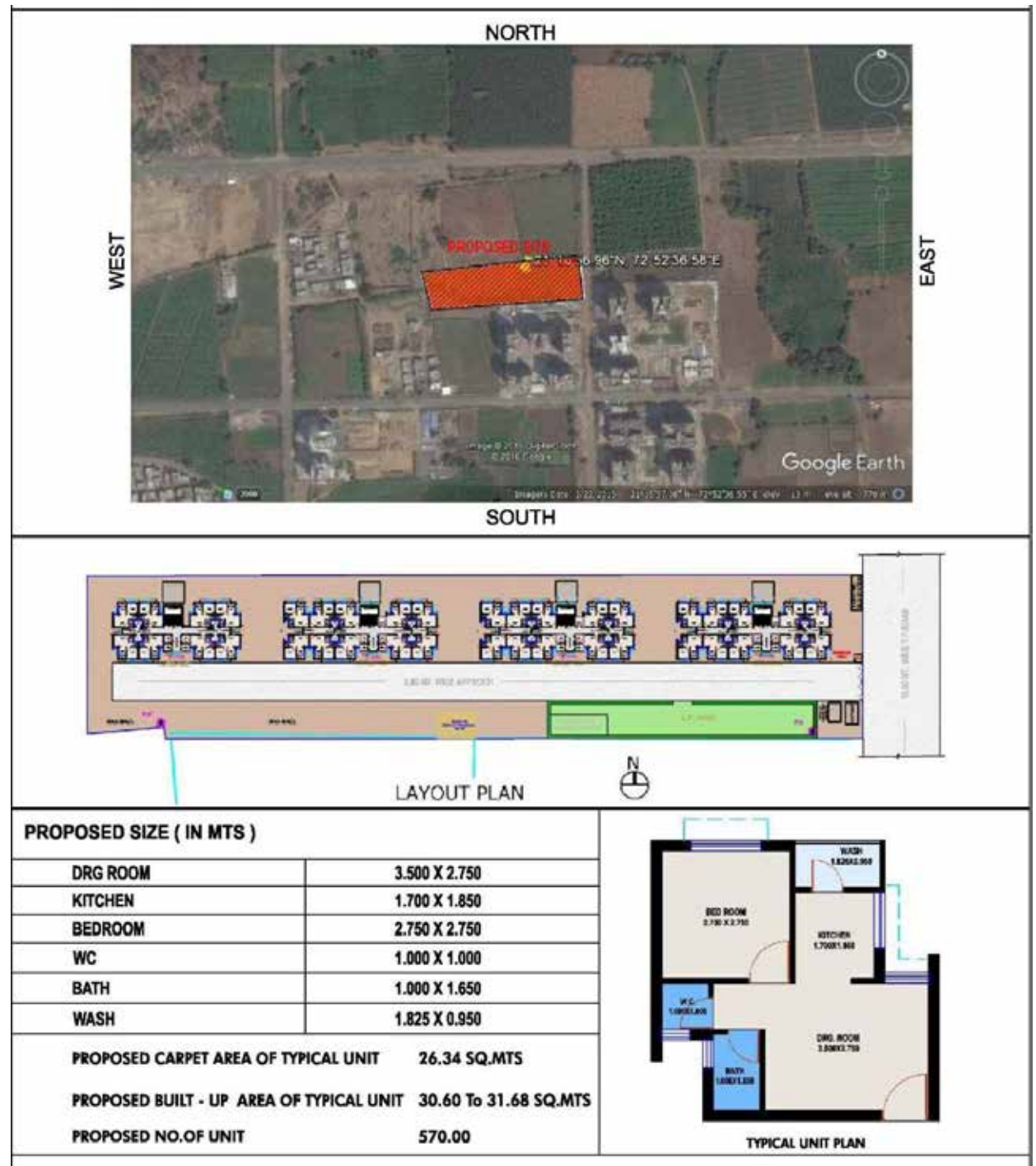
Geographical Coverage – 6945 sqmt

Population Coverage – 570 families having total 2850 persons



Mr. Pandey, a rickshaw driver, has been living here since the past 2 years, he is satisfied with the accommodations provided to him; he claims that everyone celebrates festivals together, and have representatives in each building that take care of the management of the society.

They have individual toilets, clean running water and proper amenities where they have to pay Rs.500 Per month for their maintenance.



Project Name: Suman Prabhat

Location: Suman Prabhat,

T.P. Scheme No. 19 (Parvat-Magob), F.P. No. 112

B/H Midas Square, Parvat-Godadara road, Surat.

Estimated Time of Project Work Start: 15/05/2017

Date of Occupation: 16/12/2018

Brief Description:

Site Images:



Before:



After:



208 EWS-II Dwelling units Parking + 13 floors

Each Unit provided with living hall, bed room, kitchen, W/C, Bath and Balcony, total carpet area of 36.56 sq mt.

DPR Cost: Rs. 235.22 Cr

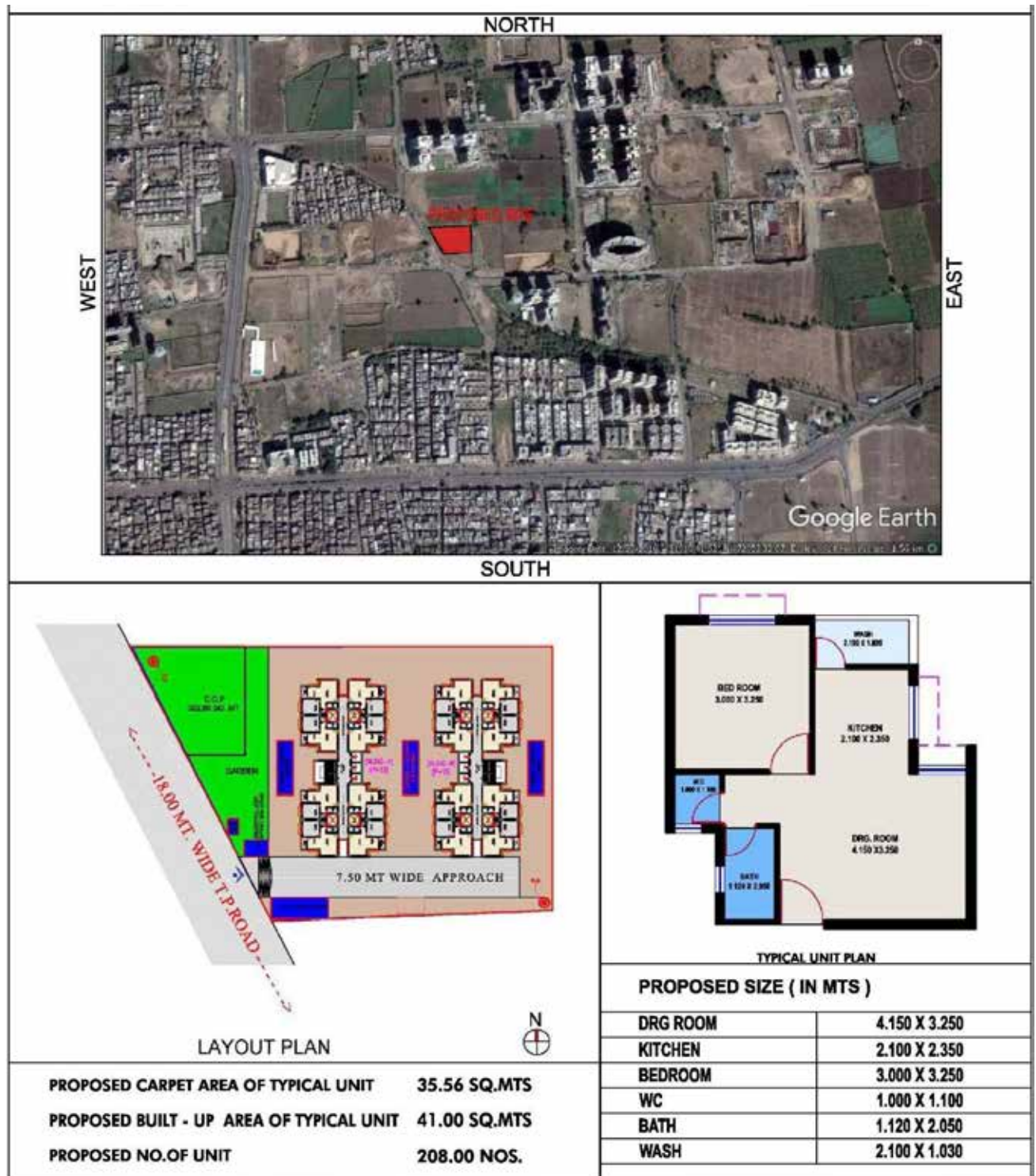
Tender Estimated Cost: Rs. 16.84 Cr. Tender Sanctioned Cost: Rs. 15.60 Cr.

SCM / Convergence / PPP / SMC Costing: GOG-1.5 Lacs, GOI-1.5 Lacs, Beneficial-5.50 Lacs(Max.)

Geographical Coverage - 3225 sqmt Population Coverage - 208 families having a total 1040 persons.



Mrs. Suman Pradas has been living here for the past 3 years, here she takes private tuitions of the children in the building, she claims that the houses are of good quality, but due to some reasons there is leakage from the floors above due to some of the people tampering with the water proofing, she also claims that markets and rickshaw services from this plot are very far and it is also away from the place of employment of her husband.



3. Discussion and Conclusion

3.1 Implications

The implications and the impacts have been studied w.r.t the framework - Housing with Physical, Social, Functional and Safety parameters:

Physical - The study led to an understanding that the newly developed affordable housing in Surat addresses the issues of increase in slums and bad living conditions with a sustainable development approach. The minimum unit size provided is about 26 sq.m which is comfortable for a family of four with proper light and ventilation and basic facilities of toilet, electricity and water supply makes these projects suitable. Thus, the units provide better and hygienic living conditions.

Social - The visit to all 4 projects had common amenities which also included common open spaces. These open spaces bring the people together to celebrate different occasions and festivals, bringing in a sense of belonging and encouraging neighborhood interactions. The large open spaces are used by all age groups residing within these housing societies but the Gazebos provided are mostly at one corner of the plot. Thus, it is rarely used or completely neglected by the residents. It can be designed within the center of the common areas to attract more and more people to use it often.

Functional - According to the occupiers of these buildings, through interviews, the location of the housing projects is in newly developing areas and in moderate proximity to the city where they have to travel a little further for jobs and better schools. The provision of BRTS near these projects will definitely make it easier and affordable to travel long distances as well.

Safety - Since the initially developed housing projects are not isolated, the people residing here feel safe in the day due to the shops at one side of the street - keeping the eyes of people on the street and therefore, acting as surveillance. But the safety issue is a concern for projects which are still at the selling stage like a project in Vesu (a locality in Surat) which is not completely developed and presently lacks health and education facilities as well.

Overall, the residents were satisfied with the facilities being provided but few were concerned about the smell that arose from the TSTP (Tertiary Sewage Treatment Plants) located in each site. These plants were either stopped by the committee of the societies or were not maintained due to lack of knowledge on the benefits of the TSTP. In terms of functionality and socialness of the project it fulfills the expectations of the occupants with a better quality of life. Safety is a bit concern for one or two projects which are newly developed due to lack of public activity and amenities within the area.

3.2 Limitations of the research

Limited only to the smart city projects of Surat and the projects and infrastructure built within the smart city projects, the research focuses on affordable housing.

Since the projects were comparatively new, long-term issues could not be identified wrt proximity, safety, nearby amenities, electricity and water issues or any other infrastructural problems that would occur with prolonged use of space

The research faced restrictions on the number of interviews that could be conducted, although the limited number of interviews provided sufficient insight for the research.

3.3 Key lessons learnt

The affordable housing projects not only reduce the number of slums but also help improve the quality of living of the residents giving them access to more opportunities and a better life.

Integration of social spaces plays an essential role in improving the livability and increases interactions between the residents of different communities which helps in maintaining harmony.

by the implementation of such projects, innovative sustainability projects can be proposed and implemented within the smart cities taking a step toward self-sustainability.

3.4 Recommendations

Although the affordable housing project by Surat smart city has seen immense success in dealing with the issue of slums in the city, by bringing down the slum density from 21% to 6%, there is a need for some aspects to be looked into (Chaitanya Bhatt, SMC)

An anonymous system for the residents to report their issues and problems, that they would like to communicate to the higher authorities so that they can be duly solved without any middlemen hindrances.

Though the city already has an efficient transportation system in place, the sites still seem to be isolated from the various locations of the city. Therefore, the connectivity needs to be enhanced.

educating the residents regarding the systems that exist and their use and benefits, like the TSTP plant, organic waste converter, waste management systems, etc.



Image 14: Provision of gazebos and open spaces in the premises

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C37

Transit Initiatives by Smart City Thiruvananthapuram Ltd.

Name of the project: Transit initiatives under SCTL-Smart Bus shelters

Location: Trivandrum, Kerala

Year of Project Implementation: 2019

Sector: Urban Basic Services

Project cost: Rs. 4.10 crores

SDG: SDG 9 & SDG 11

Institute: College of Engineering, Trivandrum

Advisors: Dr. Priyanjali Prabhakaran, Prof. Lakshmi S R

Students: Yasmin A, Aleena Mariya S, Sneha John, Vipin Sebastian, Sophy Ann Xavier, Sandra Sreekant, Keerthana K P, Devika S Nath, Liya Paul, Divya Ros Davis

Keywords: Smart city, Multi-level car Parking, Smart bus shelter, Sustainable urban development

Abstract:

The Government of India has launched the Smart Cities Mission on 25 June 2015 with the objective to promote sustainable and inclusive cities that provide core infrastructure and give a decent quality of life to its citizens, a clean and sustainable environment and application of 'Smart' Solutions. Smart cities were selected across India for the same in different stages. Kochi was the first SMART city from Kerala selected in 2015 and the city of Thiruvananthapuram was selected in 2017 in the third round of SMART city selection.

Urbanisation in Kerala, which is the second highest in the country, has created a multitude of challenges for the cities across the state. Thiruvananthapuram as the capital city is facing a number of issues like traffic congestion, pollution, poor condition of roads etc. The city of Thiruvananthapuram requires a sustainable and efficient transportation system to ensure better quality of living for its people. Transit initiatives under Smart city Thiruvananthapuram Ltd (SCTL) like Smart roads, Smart bus shelters, Multilevel car parking systems, ITMS with Smart cameras & E mobility tries to address this problem using smart solutions.

This research paper explores the different aspects of Transit initiatives under Smart City Trivandrum with focus on the role of Smart technologies for sustainable urban development. Based on parameters identified from literature reviews, user group survey & stakeholder meetings, we have analysed the impact of the project on the city & its people. The findings from the study show that the projects considered have several issues owing to lack of understanding of the context and user preferences. There should be an effective mechanism for continuous monitoring, evaluation & feedback involving all stakeholders which can help in the success of the projects.

Case Study: C37

1. Introduction

The Smart Cities Mission is an innovative and new project by the Indian government to accelerate economic growth and improve people's quality of life by enabling local development and leveraging technology to produce smart outcomes for inhabitants.

Smart City Thiruvananthapuram Limited (SCTL), is a Special Purpose Vehicle (SPV) established to carry out the Government of India's Smart City Mission, with a project budget of Rs. 1538 crore. Thiruvananthapuram was chosen in the third phase of the Smart City Selection process and placed first in the 2017 Smart City Challenge. The vision of SCTL is to create a vibrant & alluring capital city that is inclusive, safe & accessible and which respects its natural environment & celebrates its heritage & culture. The projects under smart city can be classified into two groups (a) For the entire corporation area, a Pan City Solution (IT-based solution) with a project cost of INR 152.07 crore (b) Projects for area-based development (ABD) that are specifically intended at 9 wards in the City Center as a retrofit model with a project cost of INR 1,386.12 crore.

The Smart City Thiruvananthapuram Limited (SCTL) has appointed a consortium led by IPE Global Limited and Jones Lang LaSalle as the project management consultant for execution of the smart city projects as IPE Global in association with its consortium partner Jones Lang LaSalle (JLL) are responsible for the planning and

design, as well as the supervision of the implementation of Thiruvananthapuram smart city's projects under Smart City Mission.

For the purpose of this study, Transit Initiatives by Trivandrum SMART city coming under the ABD are considered.

1.1 Topic and context

The city of Thiruvananthapuram, geographically situated between latitude 8°25' North and longitude 76°55' East on the south-west coast of India is the administrative capital of the state of Kerala. Thiruvananthapuram municipal corporation area has a population of 9,57,730 (2011 census) spread over 214.86 sq.km in 100 wards with an average density of 4.470 persons/sq km. The city profile indicates rich in heritage & cultural base, ample water availability, good educational & health facilities, participatory planning approach, thriving tourism and flourishing IT sector. However, the city needs improvements with respect to 100% coverage of basic services especially sewerage & solid waste management, conservation of its water bodies, good tourist infrastructure facilities, safety & security measures & integrated mobility.

The transportation scenario in the city is progressively worsening with an average of 35,800 vehicles is being added every year. This has resulted in traffic congestion, transportation related environmental pollution and parking issues in the city. The share of NMT is limited to only 7%.

Transit initiatives under Smart city Thiruvananthapuram Ltd (SCTL) like Smart roads, Smart bus shelters, Multilevel car parking systems, ITMS with Smart cameras & E mobility tries to find solutions for this problem using smart technology.

1.2 Significance of the project

Thiruvananthapuram Smart city's blueprint is built on 5 Strategic Pillars: 1) Urban Basic Services, 2) Land-use Efficiency, 3) Cultural Identity & Heritage, 4) Resilience & Eco-friendliness, and 5) Socio-economic Inclusiveness. These pillars are guided by 10 'Strategic Directions (SD) which are the key focus areas for the smart city plan. Transit initiatives are considered under Urban Basic services. The strategic direction SD 03 focuses on 'Creating a well-connected, safe & accessible city center, Integrated approach towards mobility - Interlinked multi-modal system supported by Intelligent Traffic & Transportation system and NMT infrastructure will facilitate ease of commuting within the city and reduction of congestion & pollution levels. The major projects coming under Transit initiatives of SCTL are listed below.

1) Smart Roads: The major component of the Rs 427 crore smart road project will be the 36.94 kilometers of roads under the Public Works Department and the Kerala Road Fund Board in the core city area. All cables, including electrical utility cables, telecom cables, digital TV cables and optical fiber cables will be shifted to the utility ducts in the entire stretch. The project is expected to be completed in February 2023.

2) Smart Bus shelters: Smart Bus shelters with comfortable seats, charging facility, drinking water, FM Radio, CCTV surveillance, Emergency Call Button, UPS backup, Digital Advertising Boards and PIS display are being installed at 34 locations within the city in 2 phases with a total outlay of Rs 4.10 crores. Phase 1 is already completed with 5 Smart bus shelters at major nodes within the CBD area.

3) Multilevel car parking systems: Multi Level Car Parking Systems (MLCP) are planned in ABD area such as Thampanoor, Palayam, Public office & Putharikandam maidanam. Multilevel car parking cum commercial complex project at Thampanoor and MLCP with electro-mechanical car parking system at Palayam & Public Works office are still under construction.

4) ITMS & ATCS: The proposed adaptive traffic light system under ITMS will scan the number of vehicles at a particular junction and change the lights accordingly. Under integrated traffic management system existing 72 locations of cameras will be revamped and additional cameras are provisioned at the new 26 locations within

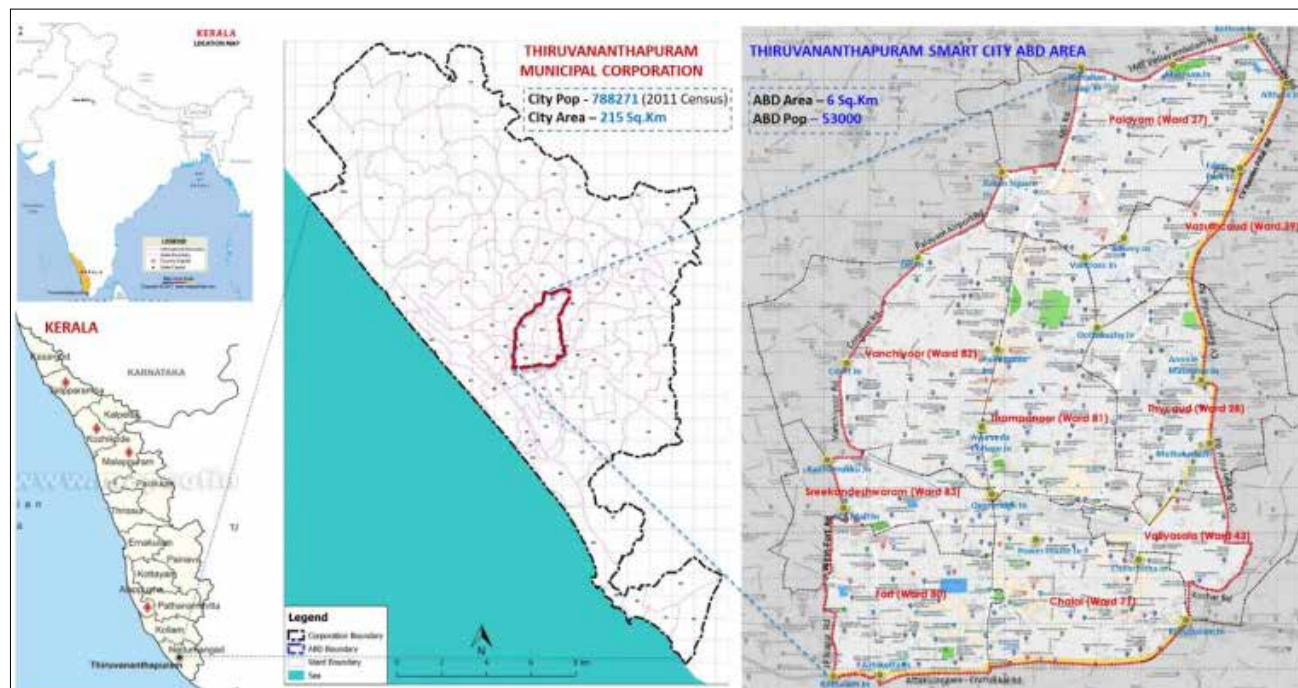


Figure: 1 Thiruvananthapuram Smart City ABD & PAN City areas and details
(Source: Smart city Trivandrum website)

the PAN City area. A total of 885 CCTV cameras are being planned, some of which would be equipped with automatic number recognition capabilities to track over speeding vehicles. Implementation of ITMS and ATCS is an initiative taken by SCTL to provide a secure and pleasant road experience to the citizens of Thiruvananthapuram and aims to enhance the safety and security of the city and its residents.

5) E mobility: Under smart city mission, Thiruvananthapuram two EV charging stations are installed at Gandhi Park, opposite to Sree Padmanabha Swamy Temple. 15 number of e-rickshaw and 15 number of e-auto are procured by Smart City Mission, Thiruvananthapuram and handed over to beneficiaries. Public vehicles are also allowed for charging via QR based solution and charging is free for vehicles distributed through smart city mission for an introductory period.

Among the various projects under transit initiatives by SCTL the smart bus shelter-phase 1 & E mobility programme are completed at present. Detailed study of Smart bus shelter project is discussed in this paper.

1.3 Aim and objectives

The aim of the study is to conduct an evaluation of Smart bus shelter projects under Smart City Mission Thiruvananthapuram and to understand its impact on the city & its people in terms of livability & sustainability. The key objectives of the study are:

1. To develop a methodology to evaluate transit based smart city projects
2. To evaluate existing completed projects using formulated methodology
3. To analyse the projects and identify their impact on surrounding context
4. To arrive at findings, recommendations and suggestions.

2. Contextual background

2.1 Conceptual framework / Research design

The general methodology used to carry out the study can be divided mainly into two parts; secondary data collection and primary studies. Secondary data collection is based on study of Smart city proposal, review of relevant research papers and literature case studies from which a research methodology and parameters for study were identified. Two major literature case studies from Singapore and Budapest were analysed to understand how smart bus shelters can contribute to safety, energy efficiency & better quality of living for the city. The Primary study includes site study of smart bus stops and identifying various user groups, their needs, user satisfaction etc. using research tools such as user survey, stakeholder meetings, feedback forms, real time observations etc. Then the data collected are compared with Harmonised Guidelines and Space Standards for Barrier-Free Built Environment for Persons with Disabilities and Elderly Persons, 2016 (HGSS) to assess accessibility and inclusivity parameters in the

project. It is expected that the results from this study will give an insight into how the new smart bus shelters have contributed to improvement of transportation infrastructure and sustainable urban development for the city of Thiruvananthapuram.

2.2 Key features of Project

Smart Bus shelter: This project aims at creating comfortable and safe waiting area for daily commuters, thus encouraging the use of public transport. Smart Bus shelters with comfortable seats, charging facility, drinking water, FM Radio, CCTV surveillance, Emergency Call Button, UPS backup, Digital Advertising Boards and PIS display is being installed at 5 locations as Phase 1 of this project. The Phase 1 locations are at Ayurveda college, Panavila, Killipalam along the school, Women's College and Thampanoor.

The bus shelter is designed as a standard module having size 6m X 1.8m with 2.1m clear height using M.S frame at the same level as footpath. In some locations like Thampanoor where crowd is more, two such modules are provided together to get a dimension of 12m

X 1.8m (Fig:10). Galvanised aluminum tiled profile sheets are provided over MS frame as roofing material. Ergonomically designed SS seats for 4 persons having a dimension of 2.4m x0.45m X0.45 m with hand rests are part of the design. The second set of seats as shown in the drawing (Fig: 9) were later avoided to provide space for wheelchair users.

The main stakeholders in this project are Road owners like PWD, KRFB, Thiruvananthapuram City Corporation, KSTRC, Police, Traffic police, NATPAC and members of citizen advisory forum. SCTL had awarded design and construction supervision to M/s IPE Global, Delhi based consultant for all projects. The location of these projects was already identified by and part of the Smart City proposal document submitted to Government of India. The feasibility was checked by IPE Global prior to design after stakeholders' consultations.

Meetings & discussions with stakeholders conducted to understand the risks, challenges & perceptions expected impacts and benefits of the project.



Figure 2: Smart Roads



Figure 3: Smart Bus shelter



Figure 4: EV charging station



Figure 5: MLCP, Thampanoor



Figure 6: CCTV cameras for ITMS



Figure 7: E rikshaws

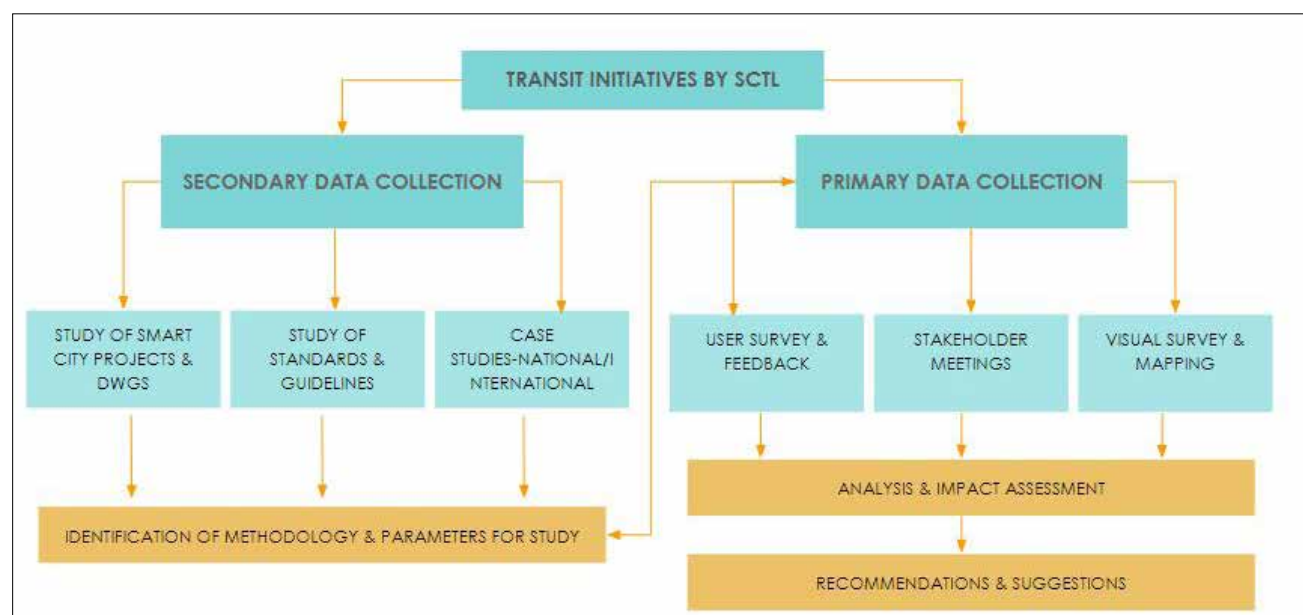


Figure 4: EV charging station

bus stop include 6 Benches, 6 Advertisement Boards, 24 plug points for charging, Drinking water facility, CCTV surveillance and Lighting

The bus shelter in Ayurveda college has 2 sets of benches, 2 Advertisement Boards and 8 plug points

Panavila bus shelter has been provided with 1 Bench, 2 Advertisement Boards and 4 plug points The bus shelter Opposite woman's college has 2 There are 2 bus stops at Killipalam with 2 sets of benches, 1 advertisement board & 4 charging points each.

2.3 Key findings the Interviews, surveys and primary/secondary data collection

The analysis was done with the help of setting parameters from the case studied identified, cross comparing with the standards of Harmonised Guidelines and Space standards for Barrier Free Environment for Persons with Disabilities, 2016 (HGSS) and taking into account the results of the feedback forms collected from the bus shelters.

2.3.1 Survey analysis

Primary data collection for the impact assessment of the project was carried out with the help of questionnaires

based on five parameters selected from literature study. The parameters identified were public awareness, availability of smart facilities, safety & security, user comfort, accessibility and inclusivity. A sample size of 50 citizens were surveyed through random sampling method for the facilities provided at 5 selected bus shelters.

Parameter 1: Public Awareness

84.2% people are not aware about that the bus stop is a SMART bus stop constructed by SCTL.



Figure 12: Location of Smart Bus shelters and MLCP
Source: Generated by author using QGIS as a part of primary study, 2022



Fig 14: Ayurveda College Smart Bus stop
Source: Generated with reference to Primary Study, 2021



Fig 15: Smart Bus stop Opposite to Women's College
Source: Generated with reference to Primary Study, 2021



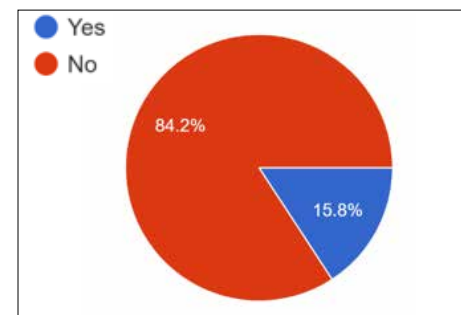
Figure 13: Thampanoor Smart Bus stop
Source: Generated with reference to Primary Study, 2021



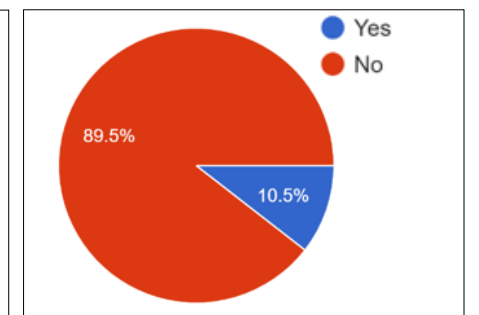
Fig 16: Smart Bus stop at Killipalam
Source: Generated with reference to Primary Study, 2021



Fig 17: Smart Bus stop at Killipalam, Source: Generated with reference to Primary Study, 2021



Awareness about SMART bus stops



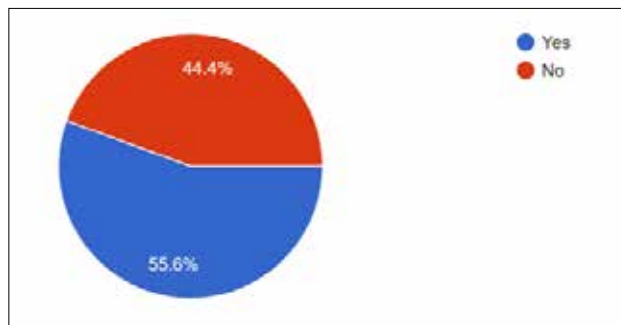
Awareness about FM Radio & WiFi

89.5% of the people are not aware about FM radio & WiFi facility in the bus stop since it is not operational now.

61.5% of the people are aware of drinking water & mobile charging facilities in the bus stop. Digital display boards & PIS integrated with ICCC will be operational only later.

Parameter 3: Safety & security

44.6% of people don't feel safe to use bus stops after dark, especially if they are not crowded with people. Women specifically feel unsafe during night. Negative spaces behind the bus shelters invite anti-social activities. These areas behind are not under camera veillance

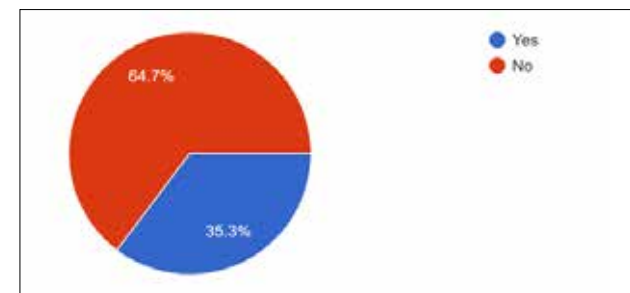


Parameter 4: User comfort

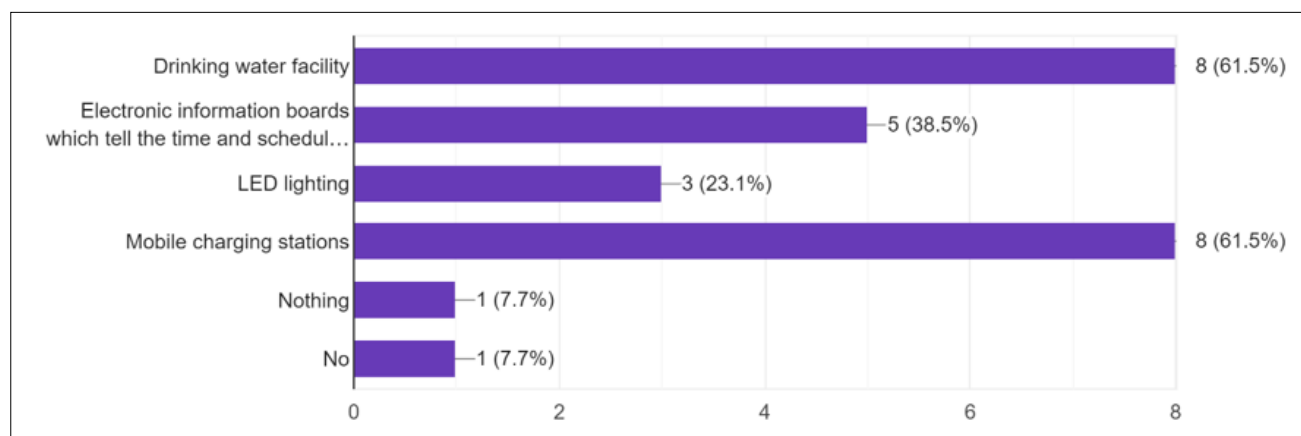
Protection from sun & rain Space to accommodate people during peak hours

64.5% of the users said that the shelters don't 'shelter' them from rain and sun as it should. This is a major

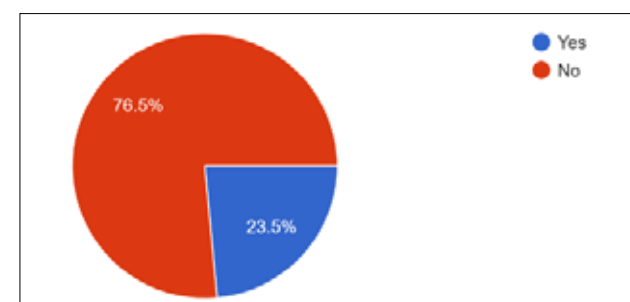
problem during driving rains. When the sun is at low angle esp. in the evening the bus stop is not protected as it faces either East or West direction along the road. 76.5% people said that there is not enough space to accommodate the crowd during peak hours & people spill over to the road.



Protection from sun & rain



Awareness about facilities in SMART bus stops



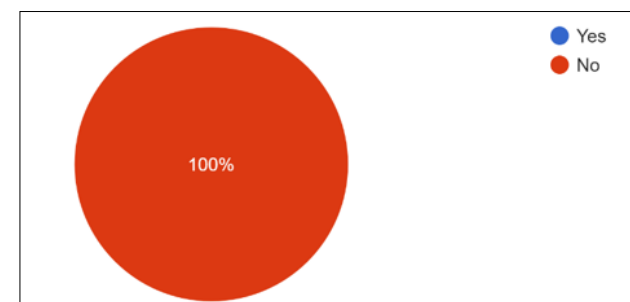
Protection from sun & rain

Parameter 2: Availability of Smart facilities

Table1: Availability of Smart facilities

Smart facilities	Present condition	Reasons	Suggestions
Drinking water fountain	63.6 % of the crowd having seen drinking water facility in the bus stops. None of them have however taken water for drinking from the facility. Facility not functioning properly	Safety concerns of drinking the water (unclean or unsafe) Having to directly sip the water from the tap feels unhygienic. Most of them carry their own water bottles at all times.	Drinking water fountains are not suitable in our context.
LED lights	55.6 % of the people said that the LED lights function properly at all times when required.	Working properly	Sometimes lights are on during day time. Automatic control system with sensors is advisable.
Wi-Fi	Don't use	Wi-Fi is not enabled at present.	—
FM radio	Does not work now	FM radio is not enabled at present.	—
Charging point	71.4 % said that the mobile charging facility is not working properly.	Plug points are getting damaged	Need to provide proper maintenance.
Electronic display boards	Present in all the bus stops but they are currently used to stick posters.	Not yet functional.	The electronic boards could display bus timings and buses that have passed the shelter. They could be solar powered.
Seating	70.6% people said that seating is comfortable.	Comfortable & ergonomic design	All the bus stops should have similar seating like the smart bus shelters.
CCTV camera	76.5% of the respondents are unaware of CCTV camera	Not easily visible	It helps in city surveillance when connected to ICCC & can bring down crime rates.

Parameter 5: Accessibility & Inclusivity



Accessibility standards as per Harmonised guidelines (HGSS,2016) are not considered in the design of bus shelters. Even though the bus stop is at grade with the footpath, there is no kerb ramp for wheelchair users. Tactile tiles & audio-visual signages could have been incorporated to make the bus-stops inclusive & accessible for all.

3. Discussion and conclusion

3.1 Implications

The primary studies mainly focused on the first phase of Smart bus shelters which are completed. On the other hand, the study shows that most of the projects under Transit initiatives have exceeded their timeline for completion due to various reasons. The results from the primary studies of smart bus shelter and comparisons with standards and case studies indicate that there is still scope for improvement to satisfy pre-determined criteria laid down by the mission and also move more towards achieving the 'Smart' status.

3.2 Limitations of the research

Transit initiatives of Smart city Trivandrum was the focus of the study, but since most of the projects are still under construction only one project under the transit initiatives are taken under consideration. The smart bus shelter project which is to be completed in two phases have around 34 bus shelters planned. The study has been limited to five bus stops completed as a part of phase one. Multilevel parking project in Thmpanoor is still under construction and hence it was not possible to get a post occupancy analysis of the same.

3.3 Key lessons learnt

The vision of Smart city Trivandrum was to create a vibrant & alluring capital city that is inclusive, safe & accessible and which respects its natural environment & celebrates its heritage & culture using five Strategic Pillars. These pillars lay the foundation for the Vision Statement and are derived from City Profile, Citizen Engagement & SWOT analysis. But as we went ahead with the study, we realised that the projects considered, have multiple issues owing to the absence of a detailed study and understanding of the context and user preferences. There is a lot of delay in the completion of projects due to involvement of multiple stakeholders & protests from public. Only 5 out of the proposed 34 bus shelters could be completed now.

Smart bus shelters, without being assigned a designated space are placed right in the middle of the footpaths. Most of them don't have the provision of bus bays and hence hinders the flow of traffic as buses stop to take or drop passengers. Even though shelters do have provision the amenities that make them 'smart' digital display, Wi-Fi, FM etc. they are yet to be functional. Accessibility standards as per Harmonised guidelines (HGSS,2016) are not followed in the design of bus

shelters. Even if Bus shelters are accessible unless we have accessible public transport these initiatives don't serve the purpose of inclusivity in city.

The Smart Roads under SCTL with an estimated budget of Rs 530.30 is only partially completed (52%). The delay in the projects has affected the completion of remaining bus shelters in the city. Since the major roads are dug up and work is still ongoing at key areas in the city, it creates congestion and even accidents. The monsoon rains make the situation even worse for the pedestrians.

3.4 Recommendations

The selection of projects for SCTL should have been done only after detailed study and analysis of existing conditions and multiple stakeholder meetings. Involvement of planning professionals and academia should be there at all stages from project planning, design, implementation & operations. This will help in better design and identification of projects in future. There is a lack of understanding and integration with latest Thiruvananthapuram Masterplan (draft) proposals which is reflected in the projects selected.

Even though the Smart city proposal had provision for identifying possible risks & challenges and proposing mitigating measures before the commencement of the projects there is considerable delay in project execution due multiple reasons such as lack of inter departmental coordination, conflicting interests of stakeholders etc. Better stakeholder management strategies are needed for overcoming the risks & challenges in the implementation stage and the completion of the project without delay. There should be a mechanism for continuous monitoring, evaluation & feedback which can help in the success of the projects.

From the user survey it was found that drinking water fountains are not suitable in our context. Coin operated bottle refilling points can be provided instead. Smart bus shelter consume a lot of power. Integrating PV panels on the roof top could have been a smart option for sustainability & energy efficiency. Seating can be reserved for vulnerable people like pregnant women & elderly people. Tactile tiles, audio-visual signages, raised maps & braille signs must be integrated for universal accessibility. A clear passageway with a minimum width of 1500 mm X 6000 mm should be provided for alighting. Kerb ramp with a slope of 1:10 (HGSS,2016) is to be integrated with the bus stop design. Many people from user survey recommended the need for a toilet facility integrated with Smart Bus shelter. Green toilets can be integrated with bus shelters at least at major nodes in the city. There is also a demand for garbage bins at bus shelters. Bike rental stations can be integrated with bus shelters to encourage use on NMT. Vertical landscaping can be introduced instead of vertical louvres in the design of bus stops to bring in green elements.

Before building more smart bus shelters it would be ideal if the existing ones are monitored and maintained annually after taking the feedback from the general public who use it on a regular basis. This feedback can be taken into considerations in the upcoming projects so as to make them more user friendly. Sustainability & livability could have been ensured by integrating solar panels or taking into consideration need of pedestrians and disabled people in the initial stages of design itself.

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C38

Placemaking Projects By Pune Smart City Development Corporation Limited

Name of the project: *Placemaking Projects By Pune Smart City Development Corporation Limited*

Location: *Pune*

Sector: *Infrastructure*

SDG: *SDG 11, SDG 9, SDG 8*

Institute: *College of Engineering, Pune*

Advisors: *Dr. Arati S. Petkar, Ms. Lisha C. Bendre*

Students: *Siddhi Shisode*

Keywords: *Social equitability, Economic viability, Environment sustainability Universal Accessibility*

Abstract:

As one of the fastest growing cities of India, Pune has to deal with its own set of challenges like lack of open spaces, reduced community engagement and increasing demand of upgraded social infrastructure. Pune Smart City Development Corporation Limited (PSCDCL) came up with an innovative solution to make the surroundings in the city more liveable and create inclusive urban spaces. Placemaking projects are a part of the Area Based development projects, an initiative by the PSCDCL to create lively urban spaces and increase citizen engagement. 13 placemaking projects are based on different themes ranging from Augmented Reality Park to Community Farming Park. The unique themes are a result of an extensive process involving stakeholder consultation and experts' involvement. The placemaking sites are located in Baner and Balewadi, two of the most rapidly developing neighbourhoods of Pune city. The current study is undertaken in order to assess the said projects and understand their impact on the citizens. The said projects are major agendas of the PSCDCL and to understand the scope of these projects pan India, they must be reviewed through the lens of city planners. Public perception of the said projects will help improve the spaces and make the future projects more inclusive. The findings of the current study present an interesting reality and generate curiosity to probe further into similar initiatives by the corporation.

1. Introduction

Urbanization has led to demographic shift of people living in urban areas as compared to rural areas globally. PwC (2017) report projected growth in urban population by 66 % till 2050 of the world's population, out of this Africa and Asia are nations which are urbanising faster compared to other regions of the world and the estimated projection percentage is 56% and 54% respectively. This projected population growth and increasing urbanisation is estimated to increase the world's population by addition of 2.5 billion people by 2050 (PwC, 2017).

Urbanization globally is paving way for social and environmental challenges. Cities are drivers of sustainable economic growth on a global scale. They provide entrepreneurial and employment opportunities and this adds more people and promotes inclusion of people in the growth of cities and country. This growth of cities becomes a cause of concern to their ability to address and provide solutions to issues related to urbanization, social, environmental and economic concern in a comprehensive manner. The issue faced by all cities is common when it comes to inadequate infrastructure, use of outdated technology which is incapable of meeting the current needs of citizens. In order to overcome this problem and for successful urbanization following benefits need to be obtained:

1. Social equitability
2. Economic viability
3. Environment sustainability
4. Universal Accessibility

With reference to India, the urban areas are estimated to increase the population growth by addition of 404 million people. The Indian cities have developed as central point for flourishing businesses, livelihood, comfort and better quality of life. This has led to increase in urban population which needs recovery from old and run-down infrastructure. The smart city concept is sort of framework developed for implementation of vision which is a path set to achieve the targeted benefits and conceptualised level of urbanization (PwC, 2017). The smart city model is need of the hour to overcome challenges posed by traditional cities in an organized manner. Today it is important for cities to adopt sustainable strategies for development of cities measures in consideration of all stakeholders, namely citizens, businesses and the government (PwC, 2017).

1.1 Aim

To review the Placemaking projects proposed and completed by Pune Smart City Development Corporation Limited to underline key takeaways and provide critique.

1.2 Objectives

- To understand the need and role of place-making projects in improving urban open spaces in India.
- To get knowledge of the process of transforming open and unused public spaces in consultation with users and key stakeholders.
- To review the impact of Placemaking projects on the lives of the residents.
- To assess component of Stakeholders participation in the process.
- To provide recommendations for improvement of process based on assessment
- To provide a critique on the methodology and implementation strategy adopted by PSCDCL

1.3 Pune Smart City Development Corporation Limited

The Pune Smart City Development Corporation Limited (PSCDCL) was constituted, under the Companies Act 2013, on 23rd March 2016, to implement the smart city proposal within the Pune City. It is responsible for execution of projects in the city. It is formulated through equity contribution from Government of Maharashtra and Pune Municipal Corporation (PMC), which are equal shareholders. As per smart city mission guidelines (MoUD, 2015), PSCDCL needs to enhance core infrastructure and improve the existing quality of life of citizens, make environment more sustainable and make use of 'smart' solutions (PSCDCL, 2016). The smart city mission is an urban renewal and retrofitting program whose focus is to develop citizen friendly, liveable, inclusive and sustainable city . The main services targeted by this mission includes provision of sufficient water supply, access to electricity, Sanitation service, including solid waste management, improved public transport and mobility , provision of housing facilities to all classes, especially for the poor, good IT connectivity and digitalization, Good governance, especially e-Governance and citizen participation, Sustainable environment, Safety and security of citizens, particularly women, children and the elderly, and education , Health (MoUD, 2015). With this mission, PSCDCL is committed to provide efficient and prompt services, to citizens of Pune City. PSCDCL through its systematic and strategic planning implementation process, is said to ensure the availability of all core infrastructure elements in the given time span of 5 years.

1.4 Placemaking

Since open spaces form an important part of our surrounding and improving them would certainly enhance the space itself and the surrounding areas as well. Open spaces also help in keeping up good health of citizens. India lacks percentage of open and green spaces as compared to international standard; World Health

Organization (WHO) recommends cities to provide 9 sq. m. of undeveloped open space for every inhabitant (MoUD, 2014). Unprecedented urbanization has led to reduction in open and green spaces in urban India. Study reveals the existing availability of per capita open space varying from 0.81 sq. m. in Chennai to 278 sq. m. in greater Noida (MoUD, 2014). In India, largely open and un used spaces are found to be in a very poor condition. Pune at present has 7% of open space against the required International standard of 15% (PMC, 2015). By undertaking this topic for research purpose, I have got to learn and understand the necessity and process involved in place-making project and its role in transforming these urban open, un used and neglected spaces.

1.5 Significance of Placemaking Projects Undertaken For Study

As Pune aspires to become one of the most liveable city in India, it has initiated different initiatives to achieve the same. Place-Making is one such initiative to achieve its aspiration. Developing open spaces with innovative solutions not only upgrades the existing condition of space, it also enables community engagement and makes the surrounding more liveable. Rapid urbanization has led to diminishing and deterioration of environment as well as urban spaces. To overcome these issues, Pune Smart City Development Corporation Limited has taken a step to resolve this with an innovative solution and one of its kind in India, which is Place-Making. This project in its pilot stage has received an overwhelming response and hence has been extended further to 20 sites with altogether different themes considering gender, specially abled, age, etc. and thus making the project inclusive.

At present, there are many open and unused and neglected spaces in the Aundh – Baner – Balewadi (ABB) area. The place-making project is an important part of Urban Development, which will transform the liveability of these surrounding areas with upgradation of open, unused areas and parks in the neighbourhood. This will, in turn, make the entire city more liveable, happy and healthy. There are at present 13 place-making projects going on in the Aundh – Baner – Balewadi (ABB area), All these projects are based on different themes. The themes finalized for all these sites was done in consultation with key stakeholders viz. top officials in Pune Municipal corporation and Pune Smart City Development Corporation Limited (PSCDCL). The themes chosen by PSCDCL have taken care of all classes and people of society and are thus inclusive.

1.6 Vision For Area Based Development Projects

Pune aspires to create a model neighbourhood of liveability and sustainability matching global standards in the selected local area (Aundh-Baner-Balewadi –

ABB) by fully deploying all 24 smart city features in a “future ready” manner. Future ready is critical because as the area develops, it will undergo a 4x population growth by 2030 (from 40,000 to 160,000).

2. Contextual Background

2.1 Methodology

- As lack of space being the major constraint to work on green field projects a holistic community engagement process was held for area based local developments selection, with 2.81 lakh inputs for the area selection based on the parameters shared by the PMC (PMC, 2015).
- The area of Aundh – Baner – Balewadi (ABB) was selected on the basis of discussion with urban planners, elected representatives, citizen selection process.
- To gain deeper insights into the process followed for preparation of concept note and component of stakeholders participation, a framework was developed to capture the important parameters of detailed project report/concept for urban places, place-making and an ideal requirement of DPR from extensive literature review. Further the details required for the parameters were captured by referring different policies, guidelines, research papers, DPR's pertaining to urban places and place-making.
- The framework was further refined by adding component of ideal requirements / benchmark for each parameter for getting reliable results. The results were concluded by comparing information obtained from internal documents against the framework developed from primary and secondary data. Along with developing framework, analysis of stakeholders participation was done through several unstructured interviews or discussions with internal senior officials of PSCDCL, engineers involved in the project, PR team members, with team member of GC's and citizens of the selected themes.

Table1: Selection Criteria under the Methodology adopted for choosing sites

Sr. No.	Criteria	Reasons for Selection
1.	Selection of development type	Lack of availability of continuous land for greenfield project with an area of 500 acres, similarly lack of continuous area over 50 acres for redevelopment.
2.	Assessment criteria	10 parameters were set to assess and finalize profile area after discussion with engineers, sector experts and architects.
3.	Short-listing of areas	11 different areas were selected with continuous area of 500 acres based on data at ward level and focused group discussion with urban consultants.
4.	Evaluation by citizen engagement	Aundh-Baner-Balewadi (ABB) was chosen after engaging 23,393 citizens for a period of 6 days to get their inputs.
5.	Evaluation by sector experts	Professionals of diverse sector were set on the panel for assessment of report of the to be selected area for area based Development
6.	Evaluation by Elected representatives	ABB area was consensually selected after engagement of Municipal Commissioner of Pune with 40 elected representatives.

2.2 Selection of Placemaking Projects For Project Report

A total of 13 placemaking sites have been completed. For the purpose of this study, 3 of these sites have been chosen.

Sr no	Location	Survey No	Area (Sq. Meter)	Purpose for use of land
1	Baner	135/1	1309	Placemaking -Renew
2	Baner	140/1	1252	Placemaking-Energize
3	Baner	108/1	1502.04	Community farming
4	Balewadi	23/1c/1, 23/4/1/12, 23/4/13, 23/4/a/18, 23/4a/1/6, 23/1a/12, 23/4a, 23/4a/17, 23/4/1/14, 23/1c, 23/1c/33/3	982.28	Science park
5	Balewadi	23/1/32+ 34/4a/1/5+15	630	Bookzania
6	Baner	117+118	1165.34	Centre of Excellence for Contemporary arts
7	Baner	107	2903.05	Roll ball and Skating
8	Balewadi	36/4	1165.34	Environment Park
9	Balewadi	37/1	863.18	Water Conservation
10	Balewadi	3/5,3/6	1575	Park for Specially abled
11	Baner	34/4	2502.3	Augmented Reality
12	Baner	38/1	953.21	Senior Citizen Park
13	Baner	26/3_	1188.16	Fitness and Rejuvenation

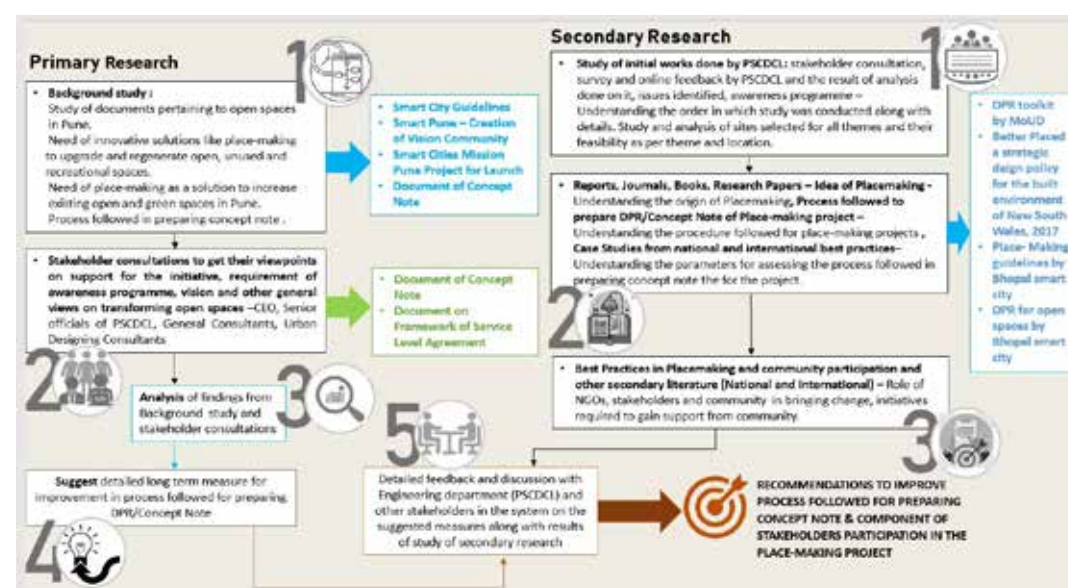


Figure 1: Methodology adopted by PSCDCL

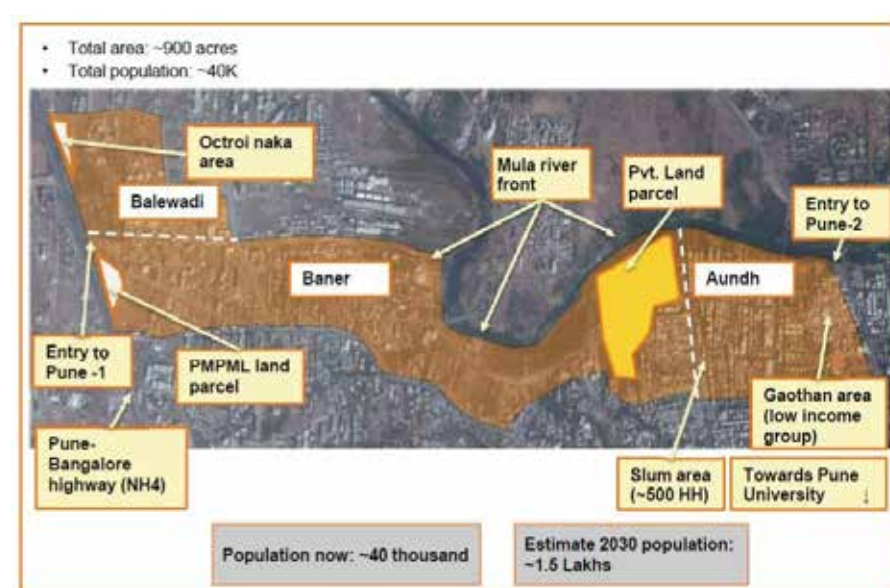


Figure 2: Areas identified for Area Based Development

All the placemaking projects are completed and are available for public use. The pandemic posed challenges to the functioning of the said sites as public spaces remained closed until the subsidence of the third wave of the COVID-19 pandemic in March 2022.

The chosen sites for the study are:

Sr. No.	Theme	Objective
1.	Community Farming	To provide space for experimenting with technological innovations for sustainable surroundings like urban community farming, organic farming, etc.
2.	Bookzania	Encourage reading habits in children in a playful surrounding and provide hobby space for elders
3.	Roll ball and skating	To develop state of the art roll ball and skating facility with neatly designed landscaped spaces.

3. Placemaking Projects

3.1 Community Farming Site Characteristics

- Encouraging Urban Farming.
- Edible Arcade.
- Organic Landscape.
- Workshop Area for Group Activities.
- Community spaces
- Convertible Spaces for Citizen Engagement.

- Users: Senior Citizens, Kids, NGOs, senior citizen clubs, organic food vendor organizations.

The objective behind choosing the theme of community farming was the need for knowledge of farming and creating sustainable ecosystems among the urban population. The idea behind the project clearly reflects on the actual site in the form of flower beds, community farming beds and tree plantations carried. In order to inculcate a sense of belonging towards the surroundings and create an ecosystem by putting one's efforts, the community spaces have been created. To increase dialogue about farming and sustainability and encouraging the locals to grow for themselves, the community farming project has inculcated sustainable practices like permeable pavements on site.

Following are the provisions made on site according to the request for proposal:

- Tree Plantation of 67 Nos. various types of crops plants like, Mango, Chikku, Papaya, Guava etc.
- Solar Panels 4 kw with net metering
- Provision for seating, with top granite/ marble.
- Provisions penetrable paving block for flooring.
- Water storage tank (GSR) of 20,000 Lit. Two pumps 1.5 HP and one 3 Hp.
- Cafe shop
- Different type of 7 flower beds, 7 Community Farming & 6 Fruit plants beds
- Six Mobile charging point.

3.2 Bookzania Site Characteristics:

- Book reading bus
- Book box
- Play gym of book design
- Graffiti walls
- Board games
- Painting boards

The objective behind choosing the theme of Bookzania is the growing distance between people and print media, especially books. The increasing use of social media has lead to children getting addicted

to devices. Reading is an enriching activity and the habit of reading can be inculcated in people of all age groups if the surrounding catapults the same. In Bookzania, the prime focus has been creating an inclusive space for children and elders and creating a conducive environment for reading and learning amidst the chaos of city life.

3.3 Roll Ball And Skating Site Characteristics

- Play fields for roll ball and skating,
- Stands for public viewing
- Changing rooms
- Cafeteria

The objective behind choosing the theme of Roll Ball and Skating sites is to create a facility where youngsters can learn and play roll ball and skating in a monitored and safe environment with world class provisions.



Figure 3: Design Proposal View of Roll ball and Skating



Figure 4: Design Proposal View of Bookzania



Figure 5: Design Proposal View of Bookzania



Figure 6: Design Proposal View of Roll Ball and Skating



4. Key Findings From Interviews, Surveys, and Primary/Secondary Data Collection

4.1 Problems Faced By Pscdcl During Conceptualization Of The Projects:

The process of conceptualising and implementation of the design proposals was posed by challenges. The Roll Ball and Skating Placemaking site design was finalized in 2019 and the tender for the same was floated on the official site. After the start of initial excavation work on site, the Roll Ball Association of Pune approached the PSCDCL authorities and proposed the creation of Roll Ball ground in accordance with the International Standards. The idea behind the proposal was making the sport more accessible and imparting technical know how to the common public. The said proposal was deliberated on by PSCDCL and approved within Phase II of the placemaking project. The project was under a Corporate Social Responsibility activity and had to be paused due to lack of funds during the COVID-19 pandemic.

4.1 Stakeholder Review

“Farming sounds like distant concept to someone who has been living in a mega city for over 20 years, this park provides me with an avenue to reconnect with my roots”, says Mr. Ashok Vyavhare, a resident of Baner neighbourhood of Pune city, who was happy to give his reviews on the newly opened Community Farming Placemaking Site.

A people perception survey was undertaken in order to understand the impact of the placemaking projects. A sample size of 50 was collected over a span of 3 days and people were interviewed based on a questionnaire prepared for the same. 65% people rated the Community Farming Park 3 on a scale of 1-5. Only 20% people were regular visitors.

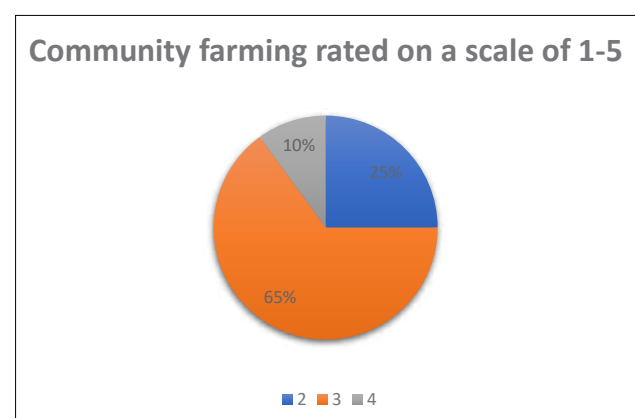


Figure 7: Pie chart showing the rating given by the public to community farming park

It is observed that the facilities stated by the PSCDCL are not provided on site. The designated workshop space has not been created on ground and the park is not maintained. The prime reason why people visit the park is the lack of any other facility nearby. The washrooms are not maintained are in degraded condition. There is

no security guard appointed and the park is left to the care of a gardener who visits the site once in 2-3 days. The café shop has not been constructed on site. The aim of the community farming park is to encourage farming among the urban folks but no provisions to do so have been made. The workshop space, allotment of an expert on farming who can spread information about the existing plants, organisation of events to bring the community together and learn about farming is not done. The overall condition of the Community Farming Park reflects that there is no uniqueness quotient to the project.

The placemaking site, Bookzania was visited thrice over a course of one week. Only once during these times was the site open to public. There is no book collection available at Bookzania and the site is ill maintained. The footfall during two hours of survey on the one occasion that the park was open to public was 11. The park aims to create lively learning spaces for children but the unavailability of books and proper infrastructure on site makes the implementation of its objectives questionable. The public perception survey of Bookzania revealed that the park is closed more often than not and this discourages people from visiting it regularly. The washrooms are not maintained and are not in a condition to be used. There is no security measure in terms of surveillance cameras or a security guard and this makes it unsafe for use by children. Out of a sample size of 11, 80% people rated Bookzania 3 on a scale of 1-5. The site is located in a high-end neighbourhood where societies have their own amenities like parks, libraries and club houses. This could be a reason of the low footfall.

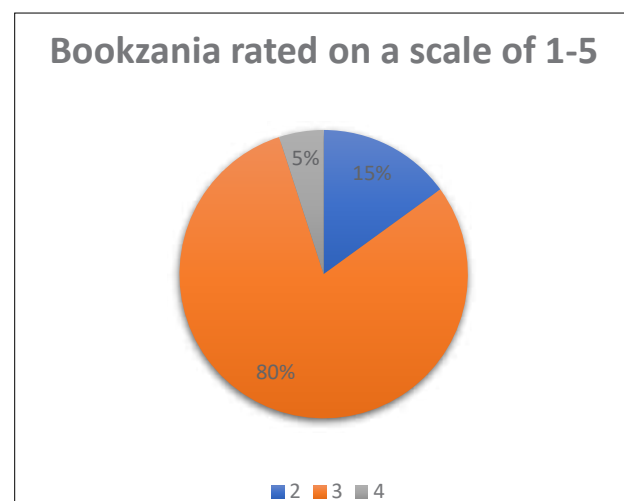


Figure 8: Pie chart showing the rating given by the public to Bookzania

The placemaking site Roll ball and skating has an excellent on paper design and plan but the actual onsite work has not started as of April 2022. The project has been allotted land and tenders have been passed as Request For Proposals have been sanctioned but actual on site construction has not begun.

5. Suggestions and Review

The organization with appreciable top order should focus on creating GIS based data base of all geographical

areas with respect to all services required for smooth working for all projects. It can work in line with Urban Design Research Institute, Mumbai, who have created data base for different services in Mumbai. All projects related to citizen's importance should be done in consultation and engagement with them. A cloud based data management system is required to manage the data easily and for every one's easy access. Information pertaining to interest and importance of citizens should be displayed and available readily on website of PMC & PSCDCL.

This project is appreciable and one of its kind started by government of India under smart city mission to upgrade open and un used spaces. It does have some lacunae which should be resolved by eminent professionals at the top order, if they wish to expand this project further to cover remaining open and un used spaces in ABB area. It lacks basic formulated DPR, which is the base/foundation of any project at small or large scale. Further, public consultation and engagement which is basic and very important for particularly place-making project is absent here, when it comes to understanding the requirements of citizens and their consent or willingness for such development in their near - by surroundings.

The project as is conceptualized to work on principles of sustainability and resolving issues related to environmental concerns should actually be designed to do so on ground. The proposal document doesn't give details in depth about this and all other information as per its vision stated in reports by PSCDCL. The proposal needs dearth of improvement pertaining to information on finances, O & M sustainability, institutional framework, feasibility and land suitability report. The project as projected to be inclusive should also consider and expand its scope to upgrade open/ un used/underutilized areas in slums of ABB area, so as to call it socially inclusive and for betterment of all spaces.

5.1 Operations and Management

One of the major issues observed in the framework was that of the operations and management of the sites after the completion. The framework clearly states that the sites would be handed over to the Urban Local Body, i.e. the Pune Municipal Corporation after the completion of the said projects. But, no guidelines on the Operations and Management have been issued. The Urban Local Body refuses to monetize the project sites and the funding pattern of for the maintenance is unclear. This can pose a grave issue in the future as the maintenance of any public amenity is of prime importance for the project to remain in use and in usable condition over the years. The unclear structure of future funding for the operations can lead to the sites becoming dysfunctional in the future.

5.2 Varying Visions Due To Changing Leadership

Due to the policy of transfers of Government employees, especially Class 1 officers and bureaucrats, the leadership of the said projects changes within short spans. The vision of the leadership must remain constant

throughout the process of project to ensure that the team's efforts are aligned with the vision throughout. This can be done by appointing a set of people in the team who are well aware of the vision and must be given the responsibility of passing on the vision to any new additions in the team. This will ensure that efforts being taken are for a common end goal and will increase the overall efficiency of the team and project.

6. CONCLUSION

6.1 Limitations of The Research

The limitations of the said research are primarily the inefficient impact assessment due to the limited footfall at the said placemaking sites and the non-completion of many sites as mentioned on the site of the PSCDCL. Among the 13 sites, only a few are functional hence the impact assessment cannot be made as accurately as was desired.

6.2 Key Lessons Learnt

By supporting local development and integrating technology as a tool to achieve smart outcome for citizens, smart city intends to improve the quality of life of all residents in the area. Pune Smart City Development Corporation Limited has launched a number of initiatives, some of which are still in the execution stage because of some of the development plan issues and delay in metro work. The placemaking projects have the potential to bring the community together and inculcate a sense of belonging towards fellow citizens. As Urban Planners, we must constantly innovate and inculcate global practices in the cities that we are planning for the future. As placemaking aims to create shared value and connect people and places, it is a great tool to integrate the cityscape and the.

The study was undertaken to perform an impact assessment and understand the issues faced by the Smart City Mission and all stakeholders involved in bringing the said projects to reality. As planners, making

the city livelier, maintaining its character and creating liveable spaces is an onus upon us. Placemaking is a way to achieve these agendas and creating different avenues for the common people. The said placemaking projects are based on unique themes and have the potential to be scaled in various other cities after the reported problems are considered and solved. Various levels of administration and external agencies have to work in synchronization with each other in order to achieve results at the end of such projects. The implementation of concepts is a tedious task. The said projects can act as model placemaking sites after the improvisations and can serve as prototypes which can be adopted by other Smart City Mission Corporations.

7. ACKNOWLEDGEMENT

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Annexure I

Questionnaire for Public Perception Survey of Bookzania

1. Rate your experience at Bookzania

1 2 3 4 5

2. How often do you visit Bookzania?

Once a week

Once in 2 weeks

Once a month

Daily

Regularly

3. Rate the book collection at Bookzania

1 2 3 4 5

4. What do you like best about Bookzania?

5. How do you think Bookzania can improve?

Questionnaire for Public Perception Survey of Community Farming Park

1. Rate your experience at Community Farming Park

1 2 3 4 5

2. How often do you visit Community Farming Park?

Once a week

Once in 2 weeks

Once a month

Daily

Regularly

3. Rate the farming equipment in the park

1 2 3 4 5

4. What do you like best about Community Farming Park?

5. How do you think Community Farming Park can improve?

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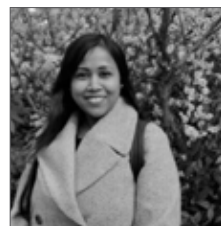
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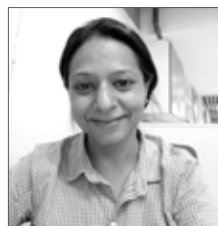
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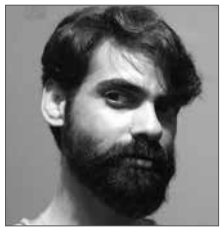


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