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Indian Standard

IS 18006 (Part 1) : 2021

नगरपालिका शासन

भाग 1 रेफेरेंस आर्किटेक्चर

Municipal Governance

Part 1 Reference Architecture

ICS 33.020, 35.020

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FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Smart Infrastructure Sectional Committee, had been approved by the Electronics and Information Technology Division Council.

The Composition of the panel, LITD 28/P8 and the sectional committee, LITD 28 responsible for the formulation of this standard is given at Annex C.

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0 INTRODUCTION

A smart city is the one that can effectively leverage technology, infrastructure, public policy, government and citizen engagement to create an environment that fosters economic growth and productivity, innovation, social mobility, inclusiveness, and sustainability.

Cities are complex entities having:

a) Diverse Stakeholders: Citizens, visitors, city administration, state government, central government, vendors, system integrators, business, academia, other organizations.

b) Diverse Geographical Entities: Parking lots, streets, buildings, waste bins, etc.

c) Diverse Services and Business Processes: With diverse functionality and consumers need to be developed.

d) Diverse ICT Technologies: Data systems, sensor technologies, software systems, networking systems etc.

While it is almost impossible to engineer a smart city from scratch, it is possible to adopt the right architectural framework along with appropriate practices and policies to nudge the evolution towards smart city.

The three key principles for facilitating such an emergence or evolution towards a smart city ecosystem are:

a) Interoperability — Refers to the ability of diverse systems and components to work together, even as parts from diverse set of suppliers are substituted and integrated;

b) Composability — Refers to the ability to combine discrete components into a complete system to achieve a set of goals and objectives; and

c) Harmonization — Refers to achieving compatibility between technologies and systems, even when they at first appear incompatible.

This standard provides a reference architecture (RA) for achieving such a unified digital infrastructure for municipal governance and can serve as a template for both the City Administrators, who are the consumers of such ICT based solutions, as well as the ICT solution providers who develop and deploy such solutions.

The reference architecture heavily relies on some of the other standards developed as well as aligns itself to the parent standard, **IS 18000 : 2020**. The Municipal Governance RA is supported by IS **18004 (Part 1)** and **IS 18008 (Part 1)** to achieve a lot of its functionality. For example, one of the core service infrastructure, “Location”, in the reference architecture is enabled by GIS reference architecture and this service supports functionalities such as GIS tracking of Project progress, GIS mapping of Asset and real estates and many others.

Further, this reference architecture also implements components from **IS 18002 (Part 1)** to ensure availability of quality data for effective decision making by city administrators. The interdependence of the aforementioned Standards are illustrated in Fig. 1.

This reference architecture described in this standard addresses stakeholders expectations for efficient municipal operations as well as to enable equitable service delivery to citizens. The cities or municipal corporations can also use this standard as a guide to compare their current initiatives and functionalities. Cities or Municipal corporation shall aim to, at the minimum, create a common Core Data Infrastructure and Core Service infrastructure layer. Cities can go with a phased approach to adopt the functionalities described in business layer , over a period of time.

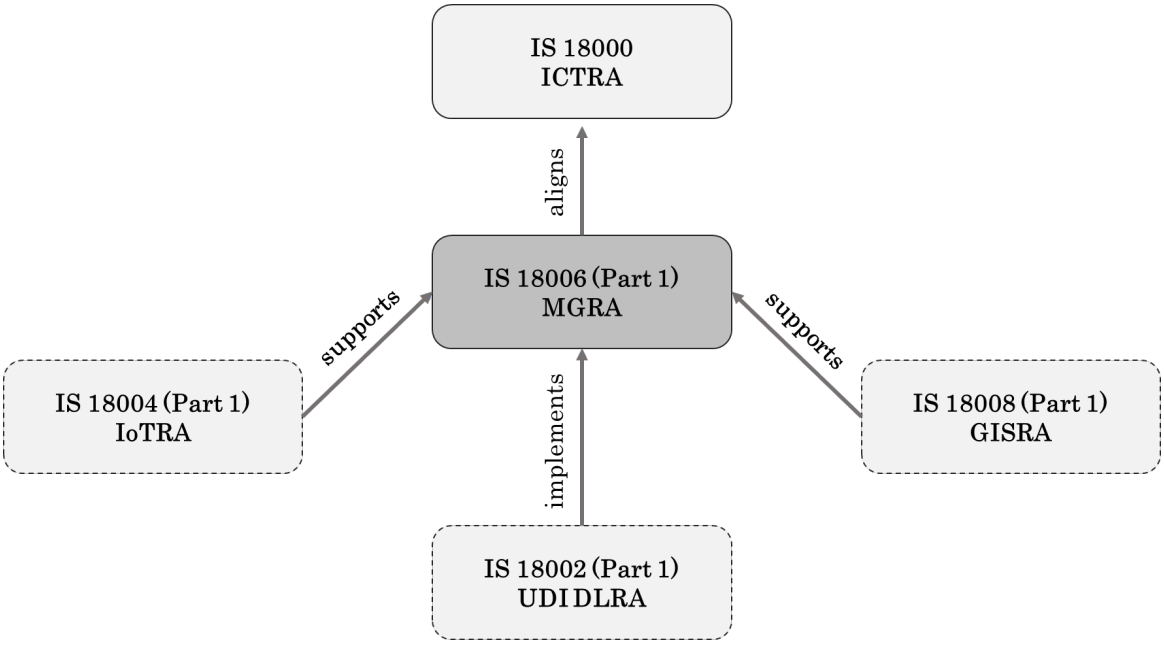

FIG. 1 INTERDEPENDENCY OF IS 18006 (PART 1) WITH OTHER STANDARDS

Indian Standard

MUNICIPAL GOVERNANCE

PART 1 REFERENCE ARCHITECTURE

1 SCOPE

This Indian standard defines the reference architecture and models for Municipal Governance in Urban Local Bodies (ULBs). The reference architecture includes functional reference models, technology reference models and information reference models.

The implementation details are excluded from the scope of this standard.

2 REFERENCE

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IS No.	*Title*
IS 18000	Unified Digital Infrastructure — ICT Reference Architecture
IS 18002 (Part 1)	Unified Digital Infrastructure — Data Layer Part 1 Reference Architecture

3 TERMINOLOGY AND DEFINITIONS

For the purpose of this standard, the definitions given in IS 18000 shall apply, in addition to the following:

3.1 Terms and Definitions

3.1.1 *Desludging Operator*

Desludging Operator, also known as Sludge Emptier is an individual, who is responsible for emptying, transport and disposal of faecal sludge from the septic tank/pits to desludging site / FSTP / Co-treatment plant

3.1.2 *Aadhaar*

Aadhaar is a verifiable 12-digit identification number issued by Unique Identification Authority of India (UIDAI) to the resident of India.

3.1.3 *Goods and Service Tax Network (GSTN)*

The Goods and Service Tax Network (or GSTN) is a non-profit, non-government organization. It will manage the entire IT system of the GST portal, which is the mother database for everything GST. This portal will be used by the government to track every financial transaction, and will provide taxpayers with all services — from registration to filing taxes and maintaining all tax details.

3.1.4 *Goods and Service Tax (GST)*

Goods and Services Tax (GST) is an indirect tax (or consumption tax) used in India on the supply of goods and service

3.1.5 *Unified Payments Interface (UPI)*

Unified Payments Interface is an instant real-time payment system developed by National Payments Corporation of India (NPCI) facilitating inter-bank transactions. The interface is regulated by the Reserve Bank of India and works by instantly transferring funds between two bank accounts on a mobile platform.

3.1.6 *Bharat Bill Payment System (BBPS)*

Bharat Bill Payment System is an integrated bill payment system in India offering interoperable and accessible bill payment service to customers through a network of agents of registered member as Agent Institutions, enabling multiple payment modes, and providing instant confirmation of payment.

3.1.7 *BharatQR*

BharatQR, developed by NPCI, Mastercard, and Visa, is an integrated payment system in India. The system, which was launched in September 2016, founded in 2018 facilitates users to transfer their money from one source to another.

3.1.8 *Core Services*

The Key Building Blocks in the Urban domain that can be used in Multiple urban application context.

3.1.9 *Core Data Infrastructure*

Key building blocks which help define, create, store, access, modify and exchange data and metadata

3.2 Abbreviations

AP	Accounts Payable
API	Application Programming Interface
AR	Accounts Receivable

BBPS	Bharat Bill Payment System
BPM	Business Process Management
CAD	Computer Aided Design
DSO	Desludging Operator
EIM	Enterprise Information management
ERP	Enterprise Resource Planning
FIFO	First In First Out
FSTP	Faecal Sludge Treatment Plant
GL	General Ledger
GST	Goods and Service Tax
GSTN	Goods and Service Tax Network
HR	Human Resource
ICT	Information and Communications Technology
KPI	Key Performance Index
LIFO	Last In First Out
NOC	No Objection Certificate
NPCI	National Payment Corporation of India
NPV	Net Present Value
NUDM	National Urban Digital Mission
OTP	One Time Password
PC	Personal Computers
PPP	Public Private Partnerships
SMS	Short Messaging Service
SSF	Secure Store and Forward
UDI	Unified Digital Infrastructure
ULB	Urban Local Body
UPI	Unified Payments Interface

4 ARCHITECTURE PRINCIPLES FOR MUNICIPAL GOVERNANCE SYSTEM

The Municipal Governance system should be built on the principles listed in Table 1. The principles are derived from with the properties of the Unified Digital Infrastructure (UDI) defined in **Table 2** of **IS 18000**. Municipal Governance system should also comply to Data Principles as defined in **IS 18002 (Part 1).**

5 HIGH LEVEL ARCHITECTURE FOR MUNICIPAL GOVERNANCE SYSTEM

Municipal Governance system comprises of two broad building blocks; 'Citizen service platform' and 'Municipal ERP' (*see* Fig. 2). Each of these building blocks serve a unique purpose and play an important role in the transformation of city's governance. These building blocks are supported by horizontal layers performing distinct functions that are essential for the successful implementation of the functionality provided by each block. The role of each layer is described in **5.1** to **5.3**.

Table 1 Principles for municipal governance system

Architecture Principle	Description
Modularity	Ability to attach, re-associate or remove functional application modules based on business process requirements truly enhances portability, eliminates rigorous and reiterative testing and configuration and increases the flexibility in the light of a dynamic business environment.
Extensibility	The design of system will be modular, with clear separation of data storage, software services and APIs. Components will be minimalistic, independently replaceable and extensible. This will allow different components to be loosely coupled when building applications, thereby enabling application diversity. Different instances of the stack will be able to customize and create contextual solutions to serve their specific purpose.
Interoperable	The Reference Architecture shall enable interoperability of systems by adopting open, standards-based interfaces, protocols, common data models and communication methods at key interaction points between constituent systems.
Standardized	Process/Application/Technology should be standardized across a common integrated platform. Fine-grained auditing across processes, modules and technologies enhances the software governance, risk management and controls. Application functionality should remain congruent over time to provide a consistent views of vital business data.
Inclusive	The design is aimed at ensuring that all segments of citizens can benefit from the Reference Architecture (RA). Different instances of the RA should be able to configure, extend or customize applications to cater to their specific needs. In addition, it can be leveraged across multiple channels – both digital and physical to engage and serve citizens effectively. The system should provide multilingual functionality or at least bilingual for ease of operation to end users and city administrator.

Table 1 (*Concluded*)

Architecture Principle	Description
Minimalistic	The goal of the stack is to enable relevant solutions; hence it is important that the stack remains minimal and allows innovative solutions to emerge rather than forcing a particular type of solution. It may provide reference implementations to seed the imagination of the ecosystem, but should remain minimalistic to allow actors to respond to context and complexity.
Scalablity	Municipal Governance Reference architecture shall be scalable. Scalability is the characteristic of a system to continue to work effectivelyas the size of the system, its complexity or the volume of work performed by the system is increased.
Data Protection	Managing security and privacy of data is crucial to building and maintaining trust between ecosystem participants and thus will be a critical design principle. All data access must be through API calls to ensure appropriate security controls.
Multi-Channel Access	With the rapid growth of net connectivity and the variety of electronic devices available in the market, it is important that the end user's access points and access interfaces are kept in mind while enabling access channels — Citizen Service Centres, PCs, Tablets, Smartphones, local kiosks and doorstep delivery — and ensuring an engaging user experience on all of these channels to enable rapid adoption and ease of operation by the end users. This will enable cities to effectively respond to the needs of all citizens including digitally excluded sections of the society.
Non-Repudiable	The system should enable a means of ensuring accountability. For collaboration and interaction within the ecosystem to thrive on the platform, building trust by ensuring accountability is very important. This accountability will take the form of non-repudiability of any access or changes to data, ensured through the platform's own design and audit mechanisms.
Federated	The system should be able to provide highest possible autonomy in order to reduce the complexity, which at the same time increase the agility. The expected result is a high degree of flexibility.
Infrastructure Agnostic	The system should be able to work on cloud as well as on premise environment with similar output capability.

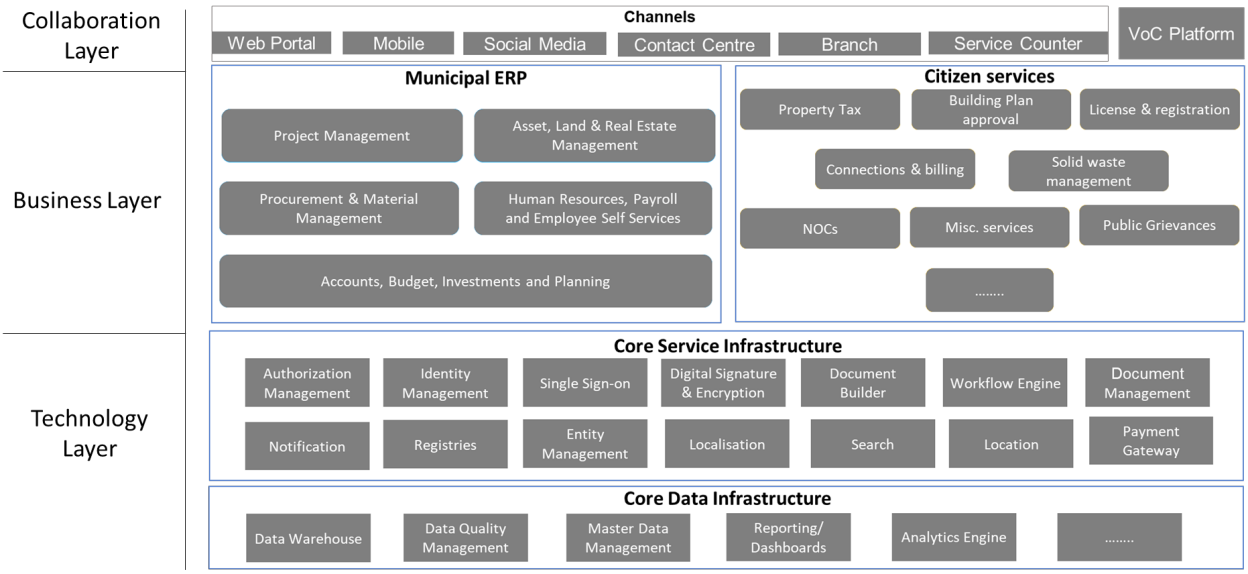

FIG. 2 HIGH LEVEL ARCHITECTURE OF MUNICIPAL GOVERNANCE SYSTEM

5.1 Collaboration Layer

5.1.1 *Channels*

These are points of interaction for the citizens with the various government agencies operating in a city. Citizens can use any method listed here to submit their requests, complaints or applications. The solution should be designed in a manner so that citizens have a similar user experience across these channels, and they can easily move from one to other without causing any disruption in their engagement with the government. The User interface and user experience for these channels shall be designed in such a way that each of the constituent systems should be user friendly, efficient, effective, and easy to navigate for everyone including persons with disabilities. Navigation through the component should flow smoothly and it should be intuitive and adaptive to use. Further, these channels shall be seamlessly integrated into the backend applications to provide a consolidated view to the government bodies.

5.1.2 *Voice of Citizen (VoC) Platform*

A voice of citizen platform enables cities to implement a closed loop feedback process between its citizens and administration. This platform ensures citizen feedback is collected at each touchpoint in the citizen's interaction with ULB or city administration. The platform can help city track various indices such as ease of living, quality of life, happiness index, mental and physical well being, etc. It can also enable feedback on service delivery by the ULB, on the quality of grievance redressel and programs and policies run by the city administration.

5.2 Business Layer

5.2.1 *Municipal ERP*

This is a vertical block in the architecture comprising of five functionalities that are key to the financial sustainability of city governments. These functionalities are Human resource & Payroll Management, Asset, Land and real estate Management, Project or Works Management, Procurement and Materials Management, and Financial Management. The key feature of this block is that all five functions are truly integrated and form the backbone of the expense management for a city.

5.2.2 *Citizen Services*

This vertical block is a set of services that the city offers to its citizens. These services can be offered to individuals, business or other groups operating out of the city. Each of these services can either be delivered through a single application or a combination of different applications. However, the guiding principles for individual applications will remain the same and they all need to be integrated with the overall Municipal Governance Framework.

5.3 Technology Layer

5.3.1 *Core Service Infrastructure*

These are set of common services made available through technology solutions for building or enabling municipal applications described above. Each service identified in this layer is essential to smooth operations of the functional layer. An example of core service in a Municipal Governance system is the 'file management'. This is a service that enables the recording of all the essential documentation into a digital format that can be easily tracked and recovered when required. It also enables the movement of e-files and e-notings up and down the hierarchy of decision making.

5.3.2 *Core Data Infrastructure*

Data and its management is the basic building of a robust Municipal Governance system. The development of any system to run the city shall start with defining registries and data specifications. This layer contains tools that perform Enterprise Information management (EIM) function to keep control on the sharing and usage of data. EIM defines how data will be optimized, processed and stored and manages data through its entire lifecycle, making it available.

6 MUNICIPAL GOVERNANCE: COLLABORATION LAYER BUSINESS ARCHITECTURE

6.1 Channels

The reference architecture suggests a multi-channel interface for the delivery of all municipal services. Each channel serves a unique purpose by addressing the needs of a unique segment.

a) Portal – A website with an overview of the overall functioning of the municipal body with essential information regarding the municipal body and its members and municipal bodies can provide regular updates of the day to day activities through this platform

b) Mobile – A native app that lets citizen access municipal services from their mobile phones as well as access any information related to the city or alerts issued by city administration directly on their mobiles.

c) Social Media – Citizens shall be able to interact directly with city administrators as well as share grievances through social media platforms such as Twitter, Facebook, etc.

d) Contact Center – Cities should setup dedicated helpline numbers that are manned by personnels to respond to any query or an emergency of a citizen.

e) Branches and service counters – City administration shall create facilities where citizens can walk in to avail various municipal services

6.2 Voice of Citizen (VoC) platform

A Voice of citizen (VoC) platform (shown in Fig. 3) shall enable ULBs to capture citizen perception and take appropriate actions to improve their overall satisfaction with city's performance. This platform can help cities to build a brand for themselves, improve their rankings in various indices (cleanliness, Ease of living, ease of doing business, etc) and formulate policies and plans with inputs from citizens to enable a truly participative governance.

The platform shall provide the following functionalities:

a) **Real-time feedback on any channel:** Engage citizens in a branch, online, through email, SMS, social media and many more channels to get real-time feedback on the things that matter to the corporation. The platform shall enable a customizable survey design with multi-lingual support and a strong survey distribution capability to support mutlti-channel distribution along with participant management to control over-surveying as well as followups with non-responders.

b) **Detailed analytics through minimal effort:** Spot patterns in data automatically with detailed statistical and text analysis that always runs in the background to surface the key insights that cities need, These analysis shall be available in real time and should be able to use data streams integrated from different sources. The platform shall be capable of doing various statistical and predictive analysis on data including key driver analysis, sentiment analysis, regression & correlations, etc.

c) **Prompt action to resolve issues:** Improve satisfaction rates for citizens by taking prompt action on the basis of the feedback received from the citizens. The platform shall have the ability to close the loop on customer comments and complaints through a dynamic cases management functionality where tickets are triggered on both quantitative and qualitative (verbatim) data collected in the survey, with additional follow up automatically triggered if necessary

7 MUNICIPAL GOVERNANCE: MUNICIPAL ERP BUSINESS ARCHITECTURE

A municipal governance system provides the functionalities described in **7.1** to **7.5** to re-engineer, integrate and transform the business functions of the city departments along with the field offices and functionaries spread across the state/ nation.

7.1 Account, Budget, Investments & Planning

Finance management (shown in Fig. 4) is a key reform area in the public sector, especially in local bodies. A comprehensive, end to end financial management system would go a long way in transforming local bodies and making them sustainable. The functional architecture for the Financial management system

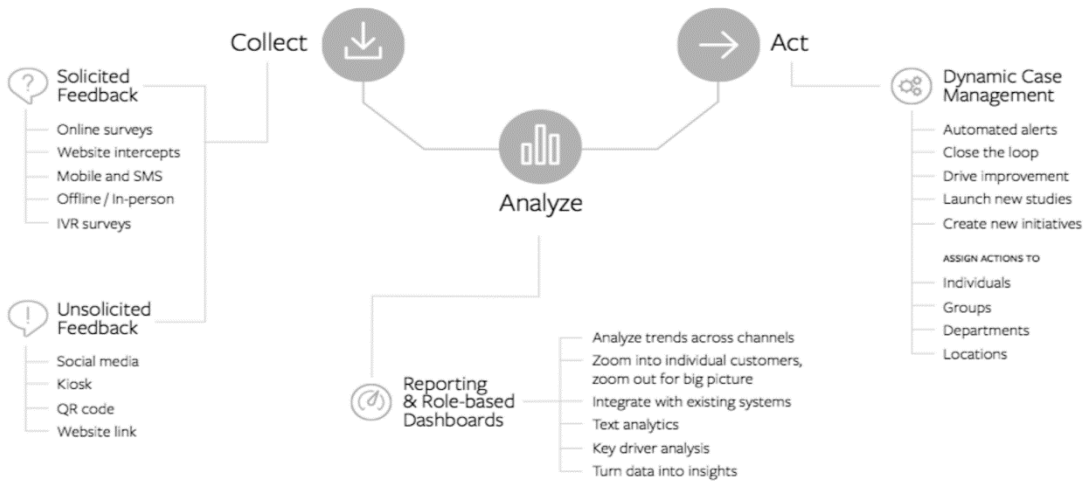

FIG. 3 VOICE OF CITIZEN PLATFORM

is built on the following four pillars that are tightly integrated to the other:

a) Budgeting,
b) Financial accounting,
c) Investments and Treasury, and
d) Management accounting or Planning. .

7.1.1 *Budgeting Creation and Maintenance*

This module helps with the creation, maintenance, management, and monitoring of public funds. User may transfer approved budgets to other projects and departments and monitor and track changes throughout the budget cycle. Key features of this module include the creation of budget structure, update and approve budgets, allow budget increases from revenue, Budget release and reporting.

7.1.2 *Budget Execution*

This module integrates operational and accounting processes with a maintained budget. It enables real-time and parallel budget controls that can operate on multiple levels, helping to monitor and control funds while reducing procurement and operating costs. User can monitor and compare budget values with commitment and actual budget values, set a threshold for the available budget and define what will happen should budget consumption reach or surpass this threshold.

7.1.3 *Budget Closing and Financial Reporting*

This module covers the planning, standardizing, scheduling, and monitoring of financial and budget close activities. It helps manage open remaining commitments and budget committed as well as any residual budget at the end of the fiscal year. User can further reconcile budgetary accounting data with financial and managerial accounting.

7.1.4 *Grants Management*

Help users manage grant information and provide status indicators of the grant process according to the administrative requirements of their sponsors. Coordinate funding throughout the grant lifecycle, restrict specific grant posting objects, and control transactions based on grant status. Users can maintain master data components for managing, controlling, and reporting based on the sponsor's administration requirements.

7.1.5 *Financial Accounting*

An accrual based double entry accounting system covering functionalities like General ledger, Accounts Receivable and Accounts Payable. This module is used to record all financial transactions that occur on a day to day basis. Accounts Receivable allows user to record and manage accounts receivable data of all customers. All postings to accounts receivable are triggered in response to operative transactions

7.1.6 *Asset Accounting*

Asset Accounting module is used to manage and monitor transactions related to tangible fixed assets. User can run an integrated acquire-to-retire cycle for all assets including functions like depreciation, capitalization and post capitalization.

7.1.7 *Inventory accounting*

Inventory Accounting is used to value and monitor material and work-in-process inventories according

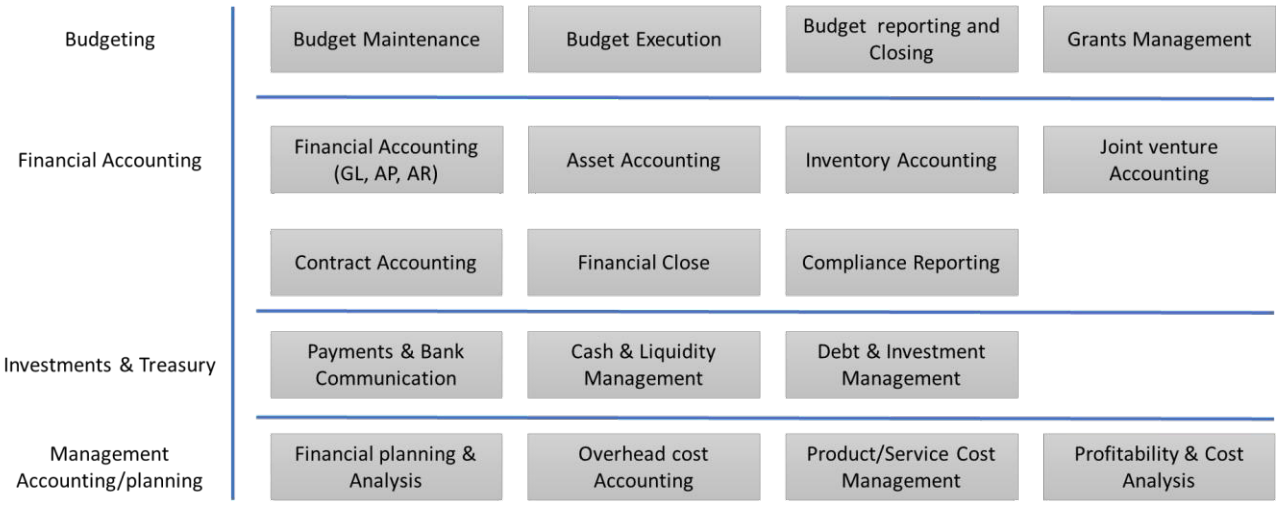

FIG. 4 FINANCE MANAGEMENT

to legal regulations and management accounting requirements. All goods movements are valued in the Material Ledger which supports parallel, real-time valuation of inventories. material inventories are valued at standard cost or moving average automatically. Periodic valuation of material inventories can be carried out according to statutory requirements (such as Lowest Value, LIFO, or FIFO).

7.1.8 *Joint Venture Accounting*

This could be applicable in the scenarios where smart cities are entering into PPP agreements with service providers on a revenue share basis. The primary processes of Joint Venture accounting are Material and asset transfers between ventures, Allocations and settlement with ventures, cash calls, partner netting, partner billing and joint venture reporting and audit.

7.1.9 *Compliance Reporting*

This module gives an optimized overview of user's compliance reporting tasks, and to generate and send the compliance reports on time. User can monitor the compliance status, due dates and generate the supported compliance reports. User can also generate and submit ad hoc or non-periodic reports.

7.1.10 *Payments and Bank Communications*

Payments and Bank Communications streamlines, controls, and gives better transparency into communications with user's banks. Automated payment workflows streamline routing and approval processes and ensure compliance by using rules-based approval workflows that guarantee proper payment approvals and documentation.

7.1.11 *Cash and Liquidity Management*

Cash and Liquidity management helps user monitor cash positions, make bank transfers, approve payments, create cash pools, liquidity planning and perform cash flow analysis and forecasting. The key feature of this module is to forecast the future liquidity trend and track the status and trace the liquidity planning cycle to get an early warning indicator of liquidity shortages or to be used as a steering tool for medium- and long-term investment or borrowing.

7.1.12 *Debt and Investment Management*

Using this module, user can portray the process for managing user's liabilities and capital investments. The following functional areas are covered in this module:

a) Manage Financial transactions (such as securities, money market, derivatives, securities lending, etc.),
b) Manage financial position,
c) Calculate NPVs,
d) Determine market risks of financial transactions, and so on.

In addition, integrated posting and payment processes and integrated position reporting allow a user to achieve compliance with legal requirements and regulatory standards.

7.1.13 *Financial Planning and Analysis*

A central, integrated place for all financial planning data. It also provides real-time access to master data and actual data to compare with the plan data to determine the success of the financial units.

7.1.14 *Overhead Cost Accounting*

This application area covers the journal entries for Overhead Cost Accounting. It captures costs by cost center and defines the output of the cost center in terms of activity types. It allows user to enter statistical key figures as a basis for user's allocations at period close. User can allocate costs between cost centers, enter activity prices for any combination of cost center and activity type and control the budgets in user's cost centers.

7.1.15 *Service Cost Management*

This module allows user to determine the costs incurred by user's products and/or services in order to successfully manage user's portfolio. These costs can be broken down into each step of the value chain mapping the quantity flow with the values of Finance.

7.1.16 *Profitability and Cost Analysis*

This application area enables user to analyze the profitability of various cost objects. It shows contribution margins in real time and offers detailed views for further analysis.

7.2 Asset, Land and Real Estate management

Asset, Land and Real estate management (shown in Fig. 5) is an often-neglected area in cities. Cities hold assets such as Lands, roads, bridges, plants & equipment, worth several crores. Poor visibility & management of these assets lead to losses as well as inefficient spending. An efficient Asset Management System for a city will help it achieve sustainable development without putting pressure on revenue budgets. Further, it will help minimize cost, facilitate long term planning and help respond better to disaster or pandemic situations.

FIG. 5 ASSET, LAND AND REAL ESTATE MANAGEMENT

7.2.1 *Maintenance Master Data*

Asset management process starts with mapping the operational structures to technical objects. This can efficiently manage and evaluate the technical assets and maintenance objects, monitor the costs involved and allow for a faster evaluation of the maintenance data. Creating maintenance master data requires the following set of activities;

a) Create the hierarchical and horizontal structure for the technical objects,
b) Create master records for functional locations and pieces of equipment,
c) Create Maintenance Bills of Material (BOM),
d) Reading measuring points & counters and
e) creating measurement documents.

7.2.2 *Maintenance Planning and Scheduling*

Maintenance Planning and Scheduling helps user optimize the scope of work and effort required for inspection, maintenance, and planned repairs. Based on legal requirements, manufacturer recommendations, and cost analyses, user determine which preventive maintenance tasks are required, which work centers are needed, and how frequently preventive maintenance tasks have to be processed to avoid breakdown time. The system shall be preferably integrated to the ICCC, where possible, to ensure real time alerts.

7.2.3 *Maintenance Execution*

Maintenance Execution allows user to perform planned and unplanned maintenance tasks. Maintenance planners can carry out preliminary costing, work scheduling, material provisioning, and resource planning. They provide maintenance workers with job lists so that they have easy access to all maintenance-related information

7.2.4 *Work Clearance Management*

Work Clearance Management allows user to make sure safety measures are implemented for carrying out certain maintenance tasks. The module allows issuance of work permits for a maintenance order, define the validity of the work permit, define risk parameters, define safety aspects and issue safety certificates.

7.2.5 *Linear Asset Management*

Linear Asset Management enables the management of the entire lifecycle of linear assets like roads, rails, pipelines, or electricity transmission lines. The process helps to optimize the reliability, availability, maintainability, and safety of the networks and infrastructure. It is a comprehensive, integrated process that facilitates and connects linear asset management activities with enterprise processes and data. In addition, the process helps to improve asset management effectiveness, efficiency, and strategy, thereby boosting asset reliability and return on investment.

7.2.6 *Geographical Enablement Framework*

Geographical enablement framework allows the user to see assets or technical objects (pieces of equipment, functional locations, maintenance orders, and maintenance notifications) on a map that allows the user to analyze user's data in a geographical context. It lets the user select a single technical object or a maintenance document on the map and the system processes it further. In addition, user can initiate the asset management processes from the map by selecting multiple maintenance orders or maintenance notifications.

7.2.7 *Resource Management*

Resource management provides insights into user's maintenance workload and available capacities for current and upcoming maintenance activities. This module allows user to check current and forecasted work center utilization, build one or more schedules for a specific target week, and level work center utilization before dispatching the scheduled work. User can get an overview of KPIs related to maintenance planning, track utilization of work centers, create one or more schedule simulations for a target week and check the forecasted utilization at weekly and daily level.

7.2.8 *Real Estate Management*

Real Estate Management is a comprehensive software solution with the ability to boost revenues by managing user's real estate portfolio. The module allows user to create a property portfolio and integrate with CAD drawings to create a 3D visualization of the property. The module allows management of vendor contracts and leases, service charge settlement, property revaluation and any other third-party integration. Another important aspect of Real estate management is Land Management. This feature integrates the internal view with the public and legal view of the land. User can depict land registers, parcels and other public registers, link them to other master data objects, set up contracts, and run reports.

7.3 Project or Works Management (Engineering)

City infrastructure development is one of the key deliverables for any city government and there's an increased focus on monitoring capital expenditures of the city. Cities are not only expected to increase their capital spend but also ensure efficiency in that spends to get maximum value out of the money spent. Capital project Management plays (shown in Fig. 6) an important role in the day to day life of city engineers as it helps them keep track of the progress of each project, assess and manage the associated risk, and keep a tab on the actual vs planned expenditures.

7.3.1 *Portfolio Management*

Portfolio Management provides a comprehensive and up-to-date view of the entire portfolio of ULB projects to present the full extent of project risks and opportunities. It allows user to overcome delays that can occur, as information is collected from disparate sources. Portfolio Management gathers diverse data into dashboards which act as a starting point for portfolio analysis. Portfolio Management integrates information from existing project management, human resources, and financial systems to provide an overview of the project portfolio and resource availability, and it provides an easy drill down to details.

Portfolio management lets user carry out financial and capacity planning for user's capital projects. User can further evaluate projects based on a set of questionnaire and scoring models to assess the impact of each project as well the risk assessment associated with it. User can perform What-if analysis by running simulations for budget assignment or capacity assignment.

7.3.2 *Project Financial Control*

This capability enables the user to define work breakdown structures as a basis for hierarchical project accounting. User can plan costs and budgets and track actual costs that are tightly integrated with core business processes. This provides the user with better insight into the project progress and user's project financial performance and enables the user to avoid cost overruns in time. User can monitor purchase requisitions, purchase orders, and account assigned to work breakdown structures as well as monitor planned and actual project progress values

7.3.3 *Project Logistics Control*

This capability enables the user to define project structures consisting of work breakdown structures and network structure, plan and schedule project activities, control all procurement processes integrated with the core business process, and provide an insight into all logistic related execution aspects of a project. User can create and maintain operative networks assigned to WBS and determine the chronological sequence of activities in a network or a standard network. User can schedule activities within a network by determining the earliest and latest start and finish dates for each activity. In a complex project, the dependencies in a project can make the activities in one network dependent on the completion of activities in another network. User can use the function for the overall network scheduling

Fig. 6 Project or Works Management (Engineering)

where the networks are linked through certain relationships.

7.3.4 *Project Management*

This module helps user standardize and improve project execution and reduce associated administrative and system costs, by providing reliable project management functions that can be deployed independently or integrated into user's, for example, Human Resources or Financials back-end system. It supports structuring, scheduling, visualization, operative planning, and execution of a project. The system can be integrated with the GIS system to identify the project location and tracking of progress

7.3.5 *Resource Management*

Resource Management provides planning tools to support user in planning and optimizing user's human resource deployment within a project as well as across different projects. User can use a planning tool to optimize user's human resource deployment in a project. It focuses on using user's employees efficiently and assigning them to projects based on demand, qualifications, and availability. It offers a role based resource management, and a project or line manager can staff resources on the project

7.4 Procurement and Inventory Management

Transparent and efficient procurement system (shown in Fig. 7) goes a long way in improving the financial health of the city. With the right checks & balances, correct supplier information and up to date procurement records, cities can utilize this platform to save cost by procuring the right quantity and quality. Similarly, real time visibility of inventory and its movement can help reduce leakages. A strong inventory management system can have an indirect impact on user's balance sheet and financial standing that can go a long way in improving a city's credit worthiness.

7.4.1 *Goods Movement*

An inventory management system works on the accepted accounting principle of no posting without a document. According to the document principle, a document must be generated and stored in the system for every transaction/event that causes a change in stock. This module provides two broad functionalities; Goods issue features enable user to post goods movements that lead to a reduction in warehouse stock and Goods receipt features enable user to post goods movements that lead to an increase in warehouse stock.

7.4.2 *Physical Inventory*

Physical Inventory covers the following inventory management tasks to support the recording of actual stock levels (quantities) of materials:

a) Performance of physical inventory (stocktaking) and
b) stock adjustments both for own stock and for special stocks on periodical basis.

This module allows user to perform the periodic process of making necessary adjustments to stock on hand after a physical count thereby providing a transparent view on the stocks currently available and efficient processing of inventory adjustments

7.4.3 *Stock Room management*

Stock Room Management provides capabilities such as material management on levels like storage bin, unit, batch, stock status, etc., inbound processing, outbound processing and internal warehouse movement.

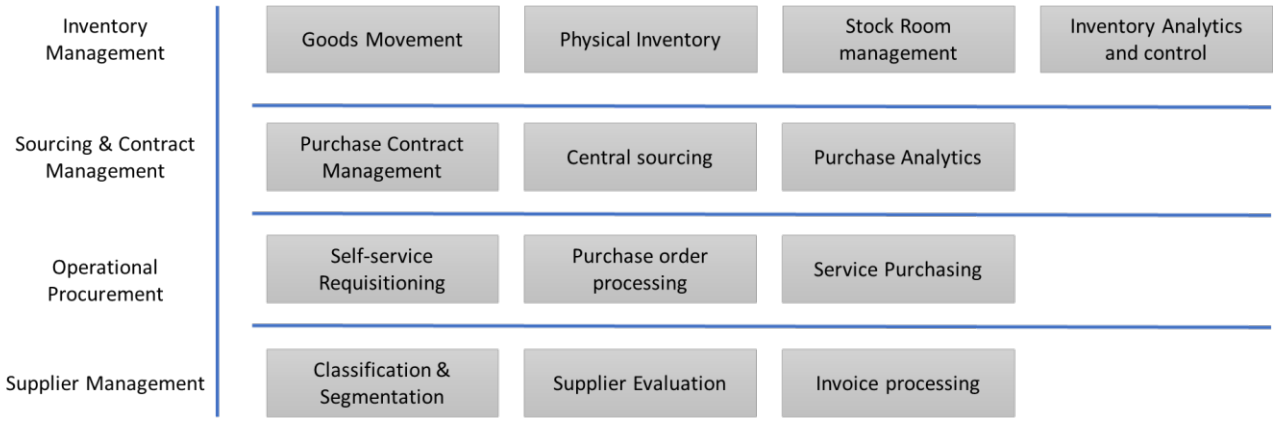

FIG. 7 PROCUREMENT & INVENTORY MANAGEMENT

7.4.4 *Inventory Analytics and control*

Inventory analytics function helps to evaluate and display reports on stock position and inventory documents. In addition, user can monitor KPIs effectively to ensure forecast and inventory accuracy in a timely manner and visualize this in a meaningful way. User can identify critical KPIs to monitor the inventory flow or investigate potential problems.

7.4.5 *Purchase contract management*

Purchase contracts are long-term agreements between organizations and suppliers regarding the supply of materials or the performance of services within a certain period as per predefined terms and conditions. This module lets user create, change and display purchase contracts by type value contracts, quantity contracts and so on. The user can further use workflow based approval for automatic, one-step or multi-step approval.

7.4.6 *Central Sourcing*

The Central Sourcing scenario enables central purchasers to get an overview of all purchasing needs across various departments and locations that optimizes the procurement process and increases user's savings.

7.4.7 *Self-service Requisitioning*

Self-service requisitioning allows user to create, manage, and track user's orders efficiently. User can create items from external catalogues and free-text items. After ordering the products user require, an item or header-based approval process is triggered. Once the user's purchase requisition has been approved, a purchase order is created.

7.4.8 *Purchase order processing*

A purchase order is a request or instruction to an external supplier to deliver a specific quantity of material at a certain point in time or to perform services within a specific period. In this module, user can create purchase orders from existing requisitions, previous purchase orders or from scratch.

7.4.9 *Service Purchasing*

User can use service purchasing for a wide range of services, such as planned and unplanned maintenance and construction or consulting services. When user request services from the user's suppliers, the user can specify all the services that may be procured in detail or the user can just set a limit in the purchase order. User can track service performance through service entry sheets that can keep track of precise values and record the actual performance of the service.

7.4.10 *Invoice processing*

The invoice processing follows the processes of the purchase order and goods receipt. User can create the supplier invoice with reference to a purchase order or without any reference. User can select the reference purchase order using the corresponding delivery note or service entry sheet, for example. The invoice verification checks the supplier invoice for correctness. Before posting the document, the user can simulate the supplier invoice to display the account movements.

7.4.11 *Supplier Management*

This module gives the user the ability to segment and classify suppliers based on their capability and operational area. User can create master data of all suppliers capturing details like tax registration, name, address, bank details etc.

7.4.12 *Purchase analytics*

Purchasing Analytics provides users with centralized analyses and the necessary capabilities to better understand the procurement areas – both on a holistic level and on a more fine-granular level relating to connected systems. The module enables users to analyse purchase contracts for consumption, analyse overall spend and analyse requisitions all by supplier, item or department.

7.5 Human Resource, Payroll and Employee Self Service

Human capital management (HCM) (shown in Fig. 8) is an upcoming subject in the public sector, but its importance can't be overstated. Something as simple as timely and correct processing of payroll can help improve employee morale and at the same time save hours of effort in accounting. Another area where HCM will play an important role is the area of Skill management. The changing paradigm around us requires public sector employees to have many roles and an integrated skill assessment and management solution would help recognize individual skills and training requirements.

7.5.1 *HR Administration*

This module is where the user maintains the master data for all user's employees. User can capture all personnel details like demographic, benefits, compensation, date of joining, and so on.

7.5.2 *Payroll*

Payroll allows user to process and ensure accurate, on-time payrolls for all employees. User can use this solution to process payrolls, third-party payments, tax reporting, and accounting data. With its integrated

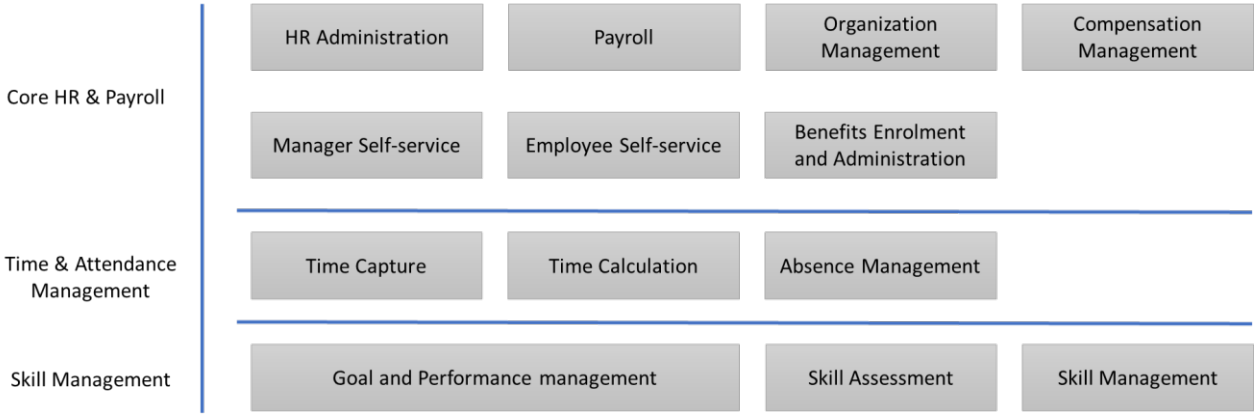

Fig. 8 Human Resource, Payroll and Employee Self Service

functions, the solution manages differentiated value that supports net payroll calculation and legal reporting. As an addition to regular payroll, which carries out payroll at fixed regular intervals, the solution also enables the user to carry out specific off-cycle payroll activities for individual employees on any day.

7.5.3 *Organization Management*

This module lets user create and manage the organization structure, create, display or assign jobs, tasks, or staff assignments, manage funds and budget, and carry out personnel cost planning and analysis

7.5.4 *Manager Self-service*

Manager Self-Service enables the user to increase productivity and reduce operational burdens for HR staff. A role-based user interface that helps managers make decisions on executing human capital, financial, and operational management strategies. This solution supports planning, analysis, budgeting, recruitment, compensation, employee development, and cost management processes on any device. Access to automated processes, data, and workflow requests can reduce cycle times and transactional costs. It integrates self- services with business intelligence capabilities and aggregates data from all sources. Managers can use this integrated data to make informed decisions regarding corporate strategies and resource management

7.5.5 *Employee Self-service*

Employee Self-Service enables the user to improve productivity by automating processes and reducing administrative costs, cycle time, and error rates. By giving employees more control over their own data, organizations can realize a quicker return on investment. Self-services gives employees personalized access to their own HR data, processes, and services. Employees take more responsibility for their jobs and career development. Employees can enter, display, and update personal information such as bank information and emergency contacts. HR staff members freed from routine inquiries and data entry can focus on strategic initiatives that contribute to business goals

7.5.6 *Benefits Enrolment and Administration*

User can perform the following main activities using this component: Enroll employees in benefits plans and terminate enrollments, Monitor continuing eligibility for plans, Monitor provision of evidence of insurability, View information about current benefit enrollments, Print enrollment and confirmation forms, Transfer data electronically to plan providers, Administer retirement plans. Further, user can also manage the pension fund in this module including calculation of employee contribution and calculation of total benefits.

7.5.7 *Time Capture*

Time Capture enables the user to record and manage time data effectively and efficiently. It provides the user with a comprehensive and effective business concept and related processes for manual and automatic recording of personnel times. Time recording allows user to enter employee time data for working time, leave, business trips, and substitutions using different methods. This data can be entered as clock times or in hours and can contain account assignment specifications

7.5.8 *Time Calculation*

Time Calculation enables the user to define and manage time elements for payroll schedules, and shifts. Use a time-evaluation component to generate a variety of payroll-related time codes to determine employee pay.

Decision makers can use time management analytics to get other targeted workforce information. Managers can define work schedules, plan shifts, as well as define incentive wages.

7.5.9 *Absence Management*

Absence Management enables the user to define and manage working calendars and vacation allowances for the user's organization. Employees can enter absences, attendance, and breaks. Managers can approve attendances and absences.

7.5.10 *Goal and Performance management*

Goal and Performance Management enables the user to motivate the user's workforce by aligning them with organization goals. Managers can cascade goals, review employee performance, and identify each employee's development needs with standardized, consistent appraisal and performance processes. Using this solution, managers can develop employees, calibrate their overall performance, and review potential ratings in a visual grid.

7.5.11 *Skill Assessment*

Skill Assessment enables the user to consolidate employee skill profiles for full assessments in a structured and objective approach. With greater ease and speed, HR professionals and organizational leaders can prepare, conduct, and follow up on skill review meetings with a cross-organizational view of up-to-date skill data. This module lets user create a pool of all the skills available within the organization and helps plan skill development activities appropriately.

7.5.12 *Skill Management*

Skill Management enables the user to maximize employees' utility within the user's organization. User can plan and implement specific personnel and training measures to promote the professional development of user's employees. User can also ensure that staff qualification requirements are met and planned. By considering employees' preferences and suitability, user can increase job satisfaction. Personnel development sets out to ensure that all the employees in all the functional areas in the user's company are qualified to the required standards and will remain so in the future.

8 MUNICIPAL GOVERNANCE: CITIZEN SERVICES BUSINESS ARCHITECTURE

8.1 Property Tax management

The Property Tax management module shall provide a digital interface to make property assessments, pay property tax, generate payment receipts and monitor tax collection. It shall be used by the citizens, ULB counter and field employees, and ULB Administrators to accomplish their specific tasks.

8.1.1 *Property Assessment*

This module enables a citizen and employee to perform a self-assessment of a new property for a financial year. This feature helps in registering the property in the system. The details of the property can be entered online and can be assessed for the calculation of the taxes. The module shall be designed in a user-friendly manner to reduce the chances of error. The system shall calculate the tax automatically and create the demand. If a user wants to reassess his property due to any reason (for eg, incorrect data, change in property etc), it can be done by editing details of the last assessment. An employee can edit the details of the last assessment, on behalf of the citizen based on owner's input. The citizen can track down the status of his incomplete assessment. Any incomplete assessment can be searched and completed.

8.1.2 *Property modification*

The system shall have the ability to capture mutation and transfer of ownership. The system shall provide the ability for alteration of assessment after verification and inspection. The system shall have the capability to handle changes like structural changes like addition/extension/reduction of existing built-up area or construction type or utility changes like usage or occupancy, which have an impact on the increase or decrease in a property tax demand. The system shall provide the ability for bifurcation or amalgamation of property. The property bifurcation or amalgamation undergoes an approval process. The parent property needs to be modified accordingly, which should be done in the system.

8.1.3 *Demand Notice Generation*

The system shall have the capability to automatically generate demand notice for a financial year based on set triggers like time-based roll over on completion of a financial year. The system notifies the citizens about the demand through SMS or Email. The generated Bills can also be grouped and printed for physical distribution by the ULB employees. The system shall provide the capability to Employees to merge and download bills based on given parameters to plan their distribution drives.

8.1.4 *Payment collection and Receipts*

The citizen or employee shall be able to view the payment status of previous assessments. The system shall have the provision for making payment for any assessment with a full or partially paid amount. Receipts for assessment should be downloaded in the assessment history section after searching for the property details.

8.1.5 *Reports and Dashboards*

The system shall have the facility to access receipt register, cancelled receipt register, account receipt register, ULB wise property tax collection report, DCB Register. State-level administrator can monitor property tax collections, assessments and other information at a state level through dashboards.

8.2 Building Plan approval

The system shall enable Architects, Engineers, Supervisors, Town Planners etc. to register, submit drawings and plans, applications for approval, and make necessary payments against the same. The module should also allow issuing of approval certificates on a workflow-based approval process.

8.2.1 *Real Time Scrutiny of Drawing/Plan*

The system shall enable the Architect/Engineer to submit the Drawing in Drawing Interchange Format (DXF) format from any Open Source CAD tools of their choice. The Module should enable the Architect/ Engineer to submit the Application for various services along with required supporting documents.

8.2.2 *Submission and processing of Application*

The Online Building plan system handles the plan scrutiny in online real time mode. The entire process from the time of submission of drawing to scrutiny completion should be automatic without any human intervention and instantaneous. From the Plan submitted by the architect the system shall generate all the relevant plan in PDF format automatically. These are the set of Plans which will be issued to the end user with certification on successful completion of the application process. The application shall capture all relevant details for all internal and external agencies; relevant data needs to be forwarded to corresponding agencies for issuing NOCs.

8.3 License and Registration

This module is a digital interface for citizens to apply for various licenses & registration certificates and make subsequent payments using online channels.

8.3.1 *Registration, Login and creation of user profile*

a) OTP Based Login for Citizen via Web or Mobile App
b) OTP Based Login for Employee via Web or Mobile App
c) Provision for language selection during first time registration for both employee and citizens
d) Provision of creating a personalized Profile for Citizens and employees on Web App
e) Login Credentials for the various hierarchies of employees
f) Role-based access for performing different actions relating to various License modules

8.3.2 *License Application*

User can apply for a new license from the system by selecting the type of license to apply. The user enters trade details, owner details and documents after which the application can be reviewed and submitted. Similarly, a counter employee can also apply for a license on behalf of the citizen. The system has a workflow integration that enables stage-wise approval before issuing the License.

8.3.3 *License Issue*

The system shall have the facility to assign the application to the respective Inspector for survey and verification. After the application is submitted, it goes to the document verifier. The next step after document verification is field inspection. After the field inspector's approval, the license is approved by the approver.

8.3.4 *License Modification*

The system shall have the facility to edit/update the Application based on the Inspection report against the application. The system shall also allow the business owner to apply for Business Name or Business category changes to the department for approval.

8.3.5 *License Renewal*

The system shall have the facility to provide a hassle-free renewal process for citizen and employee ease, leading to increased revenues, by reducing unlicensed trades. The system should allow sending of SMS and Email notifications and reminders based on the renewal cycle.

8.4 Connections & Billing

The Connections & Billing module provides a digital interface to apply for water and sewerage connections and, pay the water and sewerage charges for connection/s. It can be used by the citizens, Urban Local Body (ULB) counter employees and field employees, and ULB Administrators to accomplish their specific tasks. It is available as a mobile and web-based application.

8.4.1 *Application for new connection*

The system allows the Citizen or ULB user (with an appropriate role in the system) to apply for a New Water or Sewerage connection. The application goes through an approval workflow before it is available for various transactions in the system. The workflow

to be followed for new water or sewerage connection is configurable. In the workflow, the ULB official will generate the estimation notice. Once the payment is made, the work order will be generated. Every time there is a change in the status of an application, the citizen will be intimated through in-app notifications, SMS, and email.

8.4.2 *Modifications to a Connection*

The system facilitates the title transfer of water tap connection from one person to the other person. Title transfer of water tap connection directly depends up on Property tax. If title transfer is done in the property tax module then at the time of final approval, the changes will reflect in the module automatically. After the title transfer has been completed successfully, subsequent bills will be generated with the details of the new owner/s.

Water tap change in usage happens when property type is changed from residential to Non-residential or from Non-residential to residential. Change in usage directly depends on the property tax module. If the property type is changed in the Property tax system, then it will automatically reflect in this module. When there is a change in the usage type, the subsequent bills will reflect the rates as per the updated usage category. When there is a change in the usage category in the middle of the billing cycle, pro-rata charges will be applied in the next billing period. The change in connection category from non-metered to metered and vice-versa is also possible in this module with the appropriate workflow configured to intimate all stakeholders of the change and collect any charges (if applicable) from the citizen.

8.4.3 *Meter Reading*

The module enables ULB employees to automatically read the meter values. Based on this information the employee can generate the bills for connections

8.4.4 *Generate Demand*

The system has the capability to configure the demand generation as an automatic or a manual process. In automatic process the demand generation for non-metered connections is automatically done periodically. For metered connection as soon as the employee enters the meter reading and clicks on 'SAVE', the demand is generated

8.4.5 *Payments collection and Receipts*

The citizen can pay for dues by searching his/her connection. In search results, the citizen can click on pay, which redirects to the summary page of the dues. After this, the citizen can pay for dues online. The employee can also collect the payment on the citizen's behalf. After searching for the desired connection, clicking on pay will redirect the employee to the common payment page. The employee can print the receipt after the payment is successfully collected. The citizen is also notified and gets a download receipt link in the notification.

8.4.6 *Closure of Water Connection*

If the water tap owner has got his own water source, then the water tap owner can initiate for Water tap connection closure permanently. So, that tap will be closed permanently, and demand would not be generated for the connection. Application for closing of water tap connection is accepted only with the latest water charges receipt and clearing of old dues.

8.5 No-Objection Certificates

No objection certificates (NOC) are certifications or permissions acquired from various bodies like Airport authority, monument authority, etc before any construction activities actually take place. To acquire a building permit, an applicant needs to acquire NOC from the concerned authorities. The system shall allow the NOC department user to login and upload the required NOC and approve or reject the application.

8.6 Sewerage Management

Sewerage Management is a system that enables a citizen to raise a request for septic tank cleaning with their ULB's directly or by reaching out to the ULB counter. The Citizen can track the application, make a payment for the charges and rate the service. The system shall also enable ULB employee to create and search Vendor i.e Desludging Operator (DSO) and create billing slab with different combination of Property Type , Slum , etc. There must be a facility to generates the demand after calculating the charges for the given application using the billing slab already configured.

It shall provide the following additional capabilities:

a) A Citizen can file, track and rate the application for cleaning septic tank
b) ULB Employee can file an application for cleaning septic tank on behalf of Citizen
c) ULB Employee can assign DSO to the given application with a possible service date
d) DSO can accept or reject the application
e) DSO or ULB Employee can complete the application after cleaning the septic tank
f) Admin in ULB can cancel the application at any stage before completing the application
g) ULB Employee or Admin can view the audit log of the given application

8.7 Public Grievance management

The public Grievance management module shall enable citizens to lodge complaints and track them, whereas employees can track, and address grievance incidents raised by the citizens. The platform shall be available for use in both mediums, as web and mobile app. The functions of this module can be broadly classified as the following:

8.7.1 *Registration, Login and Creation of User Profile*

This module provides enables OTP Based Login for Citizen and employees via Web/Mobile App. Users shall be able to select the language of their choice during registration and even create personalized profiles for themselves. The module allows role-based access to various functionalities provided as part of this solution.

8.7.2 *Lodging a Complaint*

The Citizen or Citizen Service Representative (CSR) on behalf of citizens can lodge, any municipal services related complaints in the PGR system. Users can also upload associated or relevant pictures with the complaint. For identifying the location of the complaint, the user can provide city, mohalla, house no. and other details or even select the location using maps. After filing the complaint a complaint number is generated.

8.7.3 *Assigning a Complaint*

The assigning officer shall have a dashboard with unassigned complaints. Any complaint can be selected to view details and expected closure timelines. The assigning officer can select and assign complaints to appropriate employee from a department-wise list. A complaint can also be re-assigned, if it is assigned incorrectly or for any other reason.

8.7.4 *Resolving a Complaint*

The Employee can view the complaints assigned to him on a dashboard with a functionality to mark them for closure. An employee can view details and closure timelines of the complaints from a list. After resolving the complaint, the Employee can upload pictures as evidence and enter comments. With the help of the share feature, complaints details can be shared via Whatsapp, SMS, email etc. to contractors. If the citizen finds the resolution to be unsatisfactory, the complaint can be reopened. Citizens can also provide feedback and rate the resolution. Citizen also have the option to reopen request if they are not satisfied with the resolution. Request for re-assign can be raised if the complaint cannot be resolved by the employee for reasons that could include employee leave or partial resolution requiring attention by an additional department, among other reasons.

8.8 Solid waste management

Solid Waste Management (SWM) is one of the Significant focus areas for ULBs and is also one of the challenging areas for the cities to demonstrate outcomes to the stakeholder in line with the Sustainable Development Goals. Demonstrating control for the entire SWM process involving management of collection, handling, disposal, and processing the waste in an environment friendly manner is very important. An overview of the SWM system is shown in Fig. 9.

A SWM system shall have functionalities such as door to door waste collection, real time monitoring of vehicles and manpower, monitoring operations of waste processing facilities, route planning, scheduling, and provision of alerts to citizens. Some of the KPI that shall be tracked through the solution are:

a) Vehicles Coverage: Deployment of vehicles (ward-wise), route deviations, start & end timing
b) Manpower: Attendance for deployment of manpower
c) Non collection instances: geo-tagged complaints from generators
d) Quantum Details: load (fill/unfilled status) on secondary transportation vehicles and quantum received at weighbridge system placed at processing facilities and landfill sites

8.8.1 *Biometric Attendance System*

An integrated attendance system with the use of biometric would bring transparency in the operation of collecting waste. Details of the employee with their punch in and punch out time will be captured for monitoring attendance. All such attendance details shall be maintained on a real time basis and appropriate reports can be viewed on the application.

8.8.2 *Door to Door Collection*

Door to Door bins plays a vital role in fulfilling the goals of municipal SWM. Door to door waste provides a base for municipal solid waste and needs to be collected daily by municipal staff. Each household will be equipped with a proper bin and QR code mounted on the bin. Tracking of this data will make it easier for the city to track the waste collection. QR code will be mounted in each household to monitor the collection of wet waste and dry waste. At the time of collection of waste from home, Auto Tipper Drivers/Helpers shall scan the QR codes with the QR Code scanner assigned to the route to keep track of waste collected from home or society. Missed households will get notified in reports along with its area, zone, or ward details.

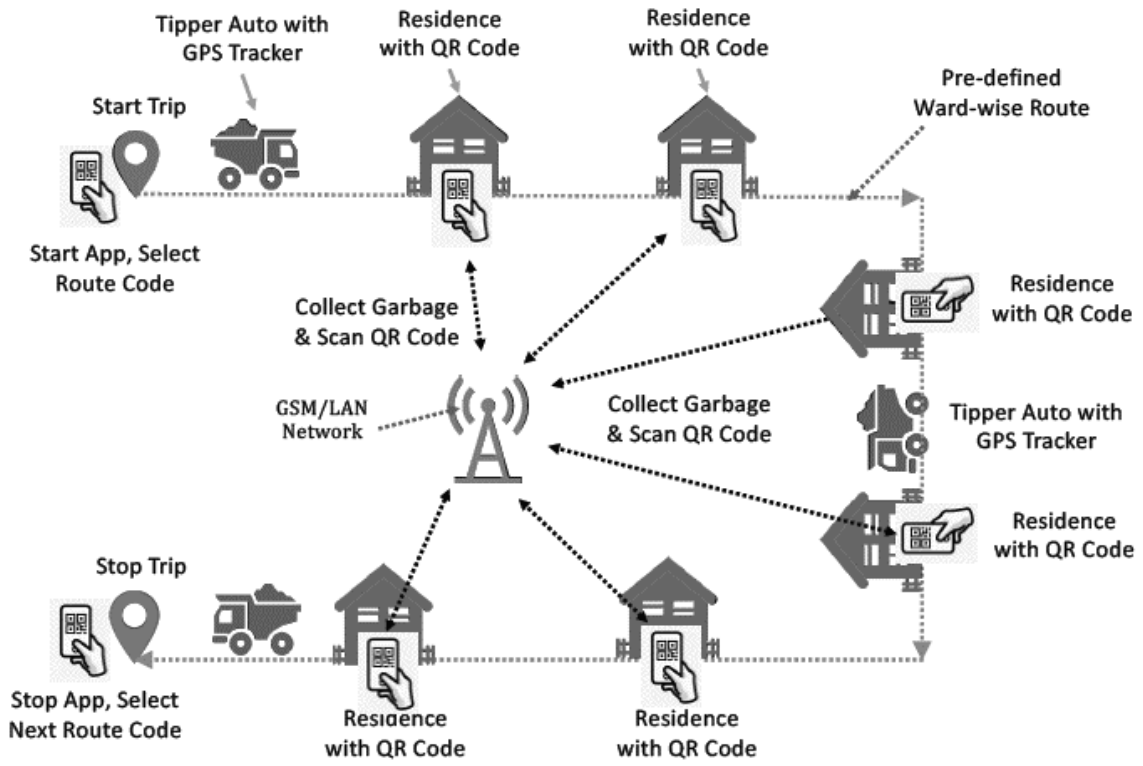

FIG. 9 AN OVERVIEW OF SWM IN A CITY

8.8.3 *Transit Management System*

Both primary and secondary waste collection vehicles shall be equipped with a vehicle tracking unit as well as passive RFID Tag. Vehicle tracking unit will be a GPS device mounted on a vehicle for sending location details of the vehicle at any time. Fleet status along with its routes, schedules and assigned driver details can be traced on real time basis on GIS map through the Transit Management System

a) The primary vehicles transfer the waste to secondary vehicles at specific transfer points. The Compactor should be connected with a RFID reader. Every time an auto tips into the compactor the RFID tag of the auto tipper should be read by the scanner on the Compactor.

b) The load sensors at the compactors will record the load of the Compactors.

c) Entry/exit points of all Dry Waste Collection Centers (DWCC), Wet Waste Processing facilities, Landfill, Transfer Stations and Bio methanation Plants shall be installed with RFID Readers, Barrier Gate and Weight Sensors to be integrated with a local controller and workstation.

d) Waste carrying vehicles shall be fixed with RFID Tags to enable their reading at the entry/exit points of the processing facilities.

8.8.4 *Route Mapping and Optimization*

The Route Mapping and Optimization Module shall enable defining of route and waste collection points on the map. It should define a schedule for each route and waste collection points there in, with respect to its collection in terms of the start time, end time and grace period if any. The module can further assign specific or multiple routes to a particular contractor, vehicle, or driver and monitor the route attendance by designated vehicle in terms of in time, out time and duration.

8.8.5 *Billing and Collection Module*

a) Module shall facilitate the generation of demand note for billing.

b) The application shall facilitate integration with payment gateway for online payment of the fees, fines and other kinds of financial transaction.

c) The module shall also have the facilities to accept offline payment by capturing details of Demand Draft or bank challan.

d) The application shall enable integration with handheld POS devices to enable the update of onsite payment.

e) The billing and collection mechanism as well as the assessment of the penalty should be developed in line with the provision of the existing collection and transportation contracts to avoid any conflict in future.

9 MUNICIPAL GOVERNANCE: TECHNOLOGICAL ARCHITECTURE

Technological Architecture derives the benefits of the latest technologies and standards and enhances efficiency through customer-centric behaviour. Municipal governance functionalities and applications are built on two key layers: Core Service Infrastructure and Core Data Infrastructure that are described in **9.1** and **9.2** and shown in Fig. 10 and Fig. 11 respectively.

9.1 Core Service Infrastructure

9.1.1 *Authorization management*

Authorization Management enables administrators to make sure that users only have access to functions for which they are authorized. This service lets you manage user authorizations by defining standard application roles, aggregate them into role collections and groups, and assign them to users.

9.1.2 *Identity Management*

Identity Management deals with identifying individuals in a system landscape and controlling their access by associating user rights and restrictions. An Identity is a combination of all user accounts of a person in a system landscape. It contains the settings required for system access and the associated user rights and restrictions.

9.1.3 *Single Sign-on*

Single Sign-On (SSO) eases user interaction with the many component systems available to users in a municipal governance system environment. Once users are authenticated on the portal, they can use the portal to access any applications. With SSO in the portal, users can access different systems and applications without having to repeatedly enter their user information for authentication.

9.1.4 *Digital signature and encryption*

Digital signatures help implement the Secure store and forward (SSF) mechanisms that provide the user with the means to secure data and documents. The digital signature uniquely identifies the signer, is not forgeable, and protects the integrity of the data. Any changes in the data after being signed result in an invalid digital signature for the altered data. The digital envelope makes sure that the contents of the data are only visible to the intended recipients.

9.1.5 *Document Builder*

Document Builder component lets you author simple to complex documents quickly and easily, using customer defined formats, templates, and clause content. The service adds value to any scenario that has a need to generate documentation. The content of the document may be simply formatted correspondence with fill-in values, such as recipient name, or it may be a very rigidly formatted contract with hundreds of clauses selected by rule-based logic.

9.1.6 *Workflow engine*

The Workflow or BPM Engine is a lightweight framework that provides capabilities to define business process targeted at internal users, developers, and system admins. It allows to define various steps in the process and their execution flow. For example, a typical origination process involves an eligibility check of a customer, application form submission, and approvals.

9.1.7 *Document management*

Document Management service enables the user to create a new document in the system or store a scanned copy of one, automatically route documents to concerned employees, store metadata for each document, create an index to track documents and retrieve the status

Fig. 10 Core Service Infrastructure

Fig. 11 Core Data Infrastructure

of the documents based on various search parameters and share auto updates to various stakeholders. It shall enable integration with a workflow engine to enable a multitude of departmental services.

9.1.8 *Notification*

Notification service enables notification of the user through SMS and email for taking actions on specific activities or to inform the user when a task gets completed.

9.1.9 *Localisation*

This service enables a solution to adapt to the needs and preferences of the citizens and users in different regions. Every service needs to communicate with the user in a language that is understandable by the user. Localization service will provide the capabilities to serve multilingual content to the users and citizens.

9.1.10 *Enterprise Search*

Enterprise Search is a search solution that provides unified, comprehensive, and secure real-time access to enterprise data which enables users to search for structured data (business objects) and allows direct access to the associated applications and actions.

9.1.11 *Registries*

Registries enable decision makers across organizations to have access to common sets of data that are logically organized and act as a shared source of truth, to improve collaboration and decision-making in the ecosystem. In addition, for citizens, Registries can ensure that their data is secured and encrypted with trusted parties and is shared only with their explicit consent. The registries will be backed with a common data ontology that will enable sharing of data across functions and creation of dashboards and analytics at various levels.

9.1.12 *Location*

This service enables capturing of the location of various assets either being created or owned by ULBs. The location can then be displayed on a map for a GIS based tracking of the assets.

9.1.13 *Payment Gateway*

This is a unified payment service to enable receipt of payment from citizens against service delivery.

9.1.14 *Entity Management*

This service manages the primary data of entities amongst different programs in conjunction with corresponding registries (e.g., user, device and so on). It will help ecosystem actors in resource management. It can also provide various user administration and security functions, including creating new users, managing user passwords, editing the profile, enabling or disabling certain users.

9.2 Core Data Infrastructure

9.2.1 *Data warehouse*

An Enterprise data warehouse shall be governed, scalable, high-performance platform for storing integrated data as well as processing large, complex queries and advanced analytics to provide the insights for data-based decision making. The platform shall act as the single source for self- service BI and analytics and will provide long-term trends, patterns as well as predictive insights for more effective planning and optimization of city operations.

The data warehouse platform shall deliver fast query performance and storage efficiency for structured data through a native columnar architecture providing speed and agility with a low total cost of ownership. Column based storage makes it easy to execute operations in parallel using multiple processor cores thus providing massive parallelization in Query Execution. In addition to the above, it shall provide extremely strong support for complex predictive analytic methods through in-database analytics, handling massive data sets for better modeling accuracy, and ability to work with leading analytics and visualization tools.

9.2.2 *Data Quality Management*

In a smart city, the function of data quality becomes very important as similar information about citizens (Address, phone number, etc.) is collected across multiple applications and most times it is entered manually. Also, when application forms are filled by citizens or operators there's always the possibility of missing data in some fields. A data quality solution will ensure these errors or omissions are either corrected through linkages to other sources of similar data or highlighted for correction.

9.2.3 *Master Data Management*

Master data governance is the process of creating a centralized database of data entities used by multiple application across a city. Examples of master data in a city could be addresses (property, buildings, road names, locality names, etc.), Assets (Fixed asset like real estate, plant & machinery or a movable asset like vehicles), Citizens (or customers), and many more. This practice helps meet the data quality requirement as these central databases act as the single source of truth for all applications.

9.2.4 *Analytics engine*

This is a combination of tools such as AI & ML workbenches that help cities use data collected across various modules of the municipal governance system to drive decision making.

9.2.5 *Reporting/Dashboards*

Reporting and dashboards are enabled through the Business Intelligence (BI) platform that simplifies the process of data manipulation, allowing users to access, navigate, analyze, format, and shares information across different environments. It allows a wide range of processes, from search and navigation to advanced analytics, enterprise query, reporting and analysis, dashboards and visualization, self-service access to relevant information and information infrastructure management.

10 MUNICIPAL GOVERNANCE: DATA ARCHITECTURE

Data Architecture ensures the adoption of which ensures establishing data as a "Single Source of Truth" that is shared by all. India has a unique challenge pertaining to Data Architecture for Municipal Governance due to federated governance and policies as well as the market for municipal governance systems.

Data Description Abstract Models like Taxonomy, Data Models and APIs can hence focus on providing an unambiguous understanding of the data in terms of structure (syntax) and meaning (semantics). Correct and uniform description of data will thus enable the following capabilities in government:

a) **Data Discovery** – It enables a department to quickly and accurately identify the data required to fulfil its governance objectives (through functions and services). The data may be owned by the department itself or by another department in any level of Government. Data discovery is further strengthened by the categorization, search and query capabilities provided by other areas.

b) **Data Sharing and Reuse** – The ability to discover data (who is generating/managing what data) and a clear understanding of its meaning ensure that the data can be easily shared and reused in many activities both within and outside the department.

c) **Data Harmonization** – A uniform way of describing the data through a well-defined model enables different departments to compare the data assets and helps in harmonizing the syntax and semantics of the data assets; a useful outcome of this would be the creation of common entities which can be used across departments.

Two aspects of data description that are needed to be captured are:

a) The metadata (data about data) and

b) The mechanism for storing the metadata.

The metadata should accordingly be captured along these two dimensions:

a) As logical data models for describing structured data and

b) As Digital Data Resource metadata for describing semi-structured and un-structured data (using standards such as Dublin Core Meta Data Standard)

The structured data would invariably be implemented in the Data Architecture as Entity – Relationship diagram. The Digital Data Resource would be captured as metadata records. Data Context Abstract Model Data context is any information that provides additional meaning to the data in terms of nature of data (category), the organization which is responsible for creating and managing the data, which business process created the data etc.

The data context along with the data description makes it possible for a potential consumer of data to discover the data (if such a data discovery service is available) and understand the context in which the data was created so that a decision can be taken on whether the data is relevant for his/her purposes.

Table 2 provides the list of various publications related to Policies and Standards on Data and the location from where the related published documentation can be accessed.

Some of the standards which have been notified in http://egovstandards.gov.in are listed below:

a) Metadata and Data Standards – Demographic

b) Digital Preservation Metadata and Schema

c) Localization and Language Technology Standards

d) Technical Standards for IFEG

e) Standards and Specifications for e-Authentication

f) Data Security Standards

Annex A provides an example of data model (Fig. 13) and Annex B provides an illustrative process and information flow between different components of the Municipal Governance architecture (Fig. 14).

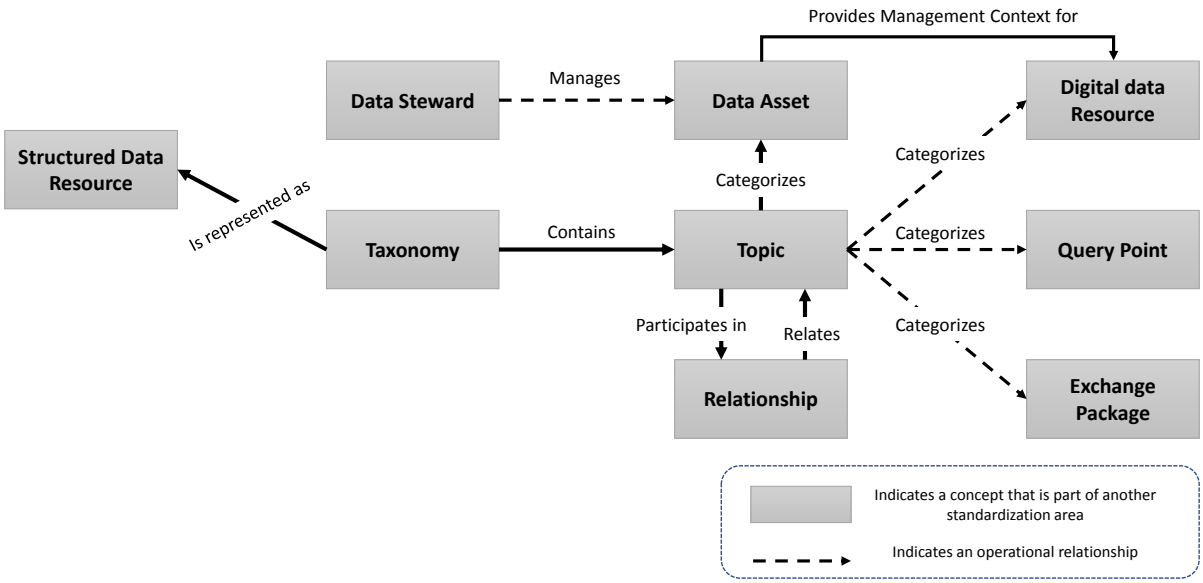

FIG. 12 DATA ABSTRACT MODEL

Table 2 eGovernance Data Standards

Publication	Purpose of the Publication	Published By
eGov Standards	Provide a platform for sharing of ideas, knowledge and draft document among the members of various committees involved in Standards formulation Process	Ministry of Electronics and Information Technology, Government of India http://egovstandards.gov.in
Local Government Directory	To make available Standard location codes with a mechanism for dynamic update of create /split /merger of villages/ blocks / districts/ states and local governments (Panchayats and municipalities)	Ministry of Panchayati Raj, Government of India under e-Panchayat Mission Mode Project (e-Panchayat MMP) http://igdirectory.gov.in
National Data Sharing and Accessibility Policy (NDSAP) – 2012	To make data available to public for access, for enabling rational debate, better decision-making and use in meeting civil society needs	Ministry of Science & Technology (Department of Science & Technology), Government of India https://data/gov.in http://dst.gov.in
Open Data Element Framework (O-DEF), Version 1.0	To define Object-oriented classification of data elements	The Open Group www.opengroup.org/bookstore

ANNEX A

(*Clause* 10)

EXAMPLE OF DATA MODELING FOR ASSET MANAGEMENT SYSTEM

Data modelling based on Geographical, Functional, and Technical Criteria

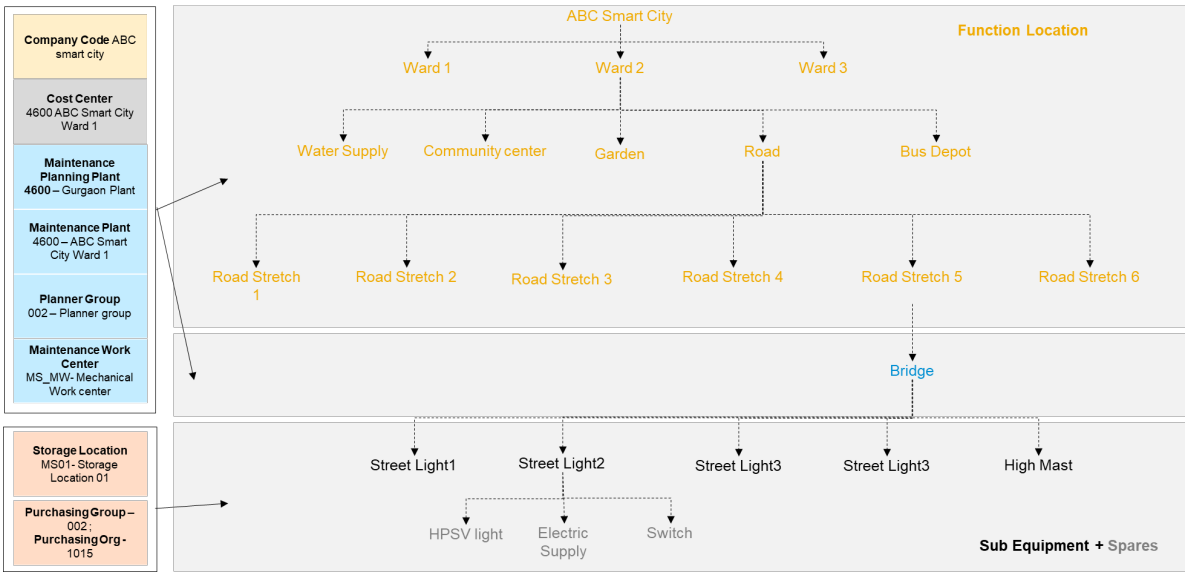

FIG. 13 EXAMPLE OF DATA MODELING FOR ASSET MANAGEMENT SYSTEM

ANNEX B

(*Clause* 10)

EXAMPLE OF A PROCESS FLOW FOR ASSET MANAGEMENT SYSTEM

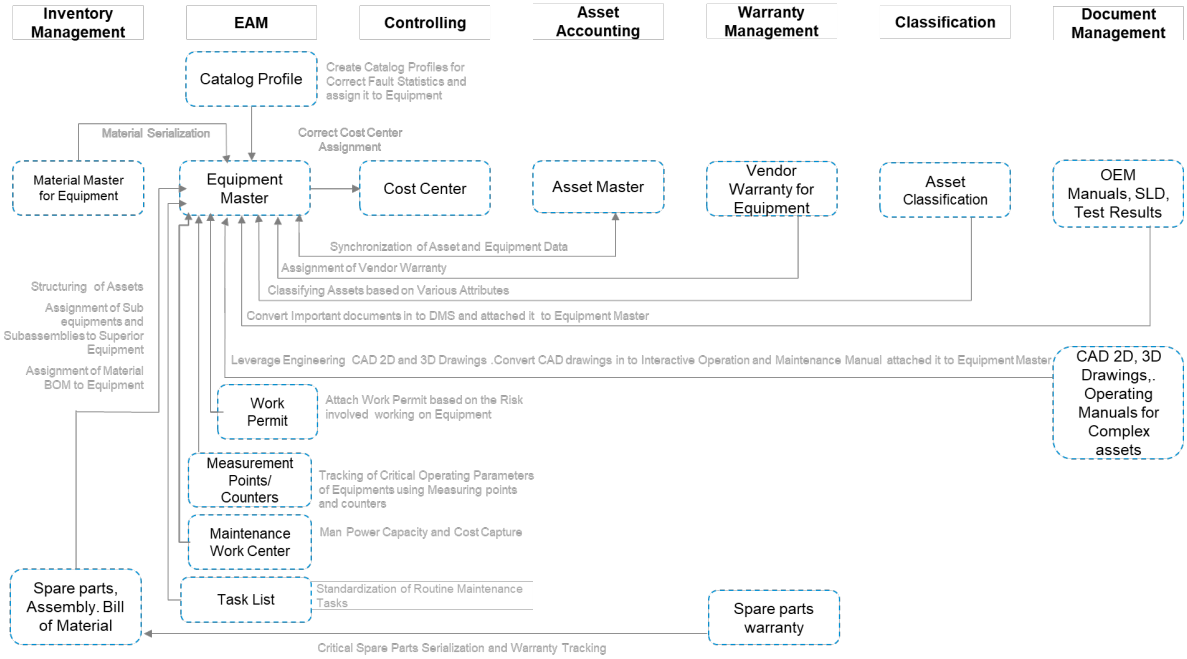

FIG. 14 EXAMPLE OF PROCESS FLOW FOR ASSET MANAGEMENT SYSTEM

ANNEX C

(*Foreword*)

COMMITTEE COMPOSITION

Organization	*Representative(s)*
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In personal capacity	Prof Suptendranath Sarbadhikari
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Hexagon India	Mr VinayBabu Adimulam

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d) MeitY India Enterpise Architecture (IndEA) – 2019

e) E-Gov standards – http://egovstandards.gov.in

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