Doc No: LITD 28 (21729)
Draft IS 18008 (Part 2):2023
May 2023

BUREAU OF INDIAN STANDARDS
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मसौदा भारतीय मानक
स्मार्ट सिटीज — जीआईएस
भाग 2 जीआईएस संदर्भ वास्तुकला का स्वत:निर्धारण

Draft Indian Standard
Smart Cities - GIS
Part 2 Self-Assessment of GIS Reference Architecture

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ICS: 35.240.70

Smart Infrastructure Sectional Committee LITD 28	**Last Date for Comments: 30 July 2023**

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FOREWORD

[formal clauses will be added later]

This Draft Indian Standard may be 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/P10 and the sectional committee, LITD 28 responsible for the formulation of this standard is given at Annex A.

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0 INTRODUCTION

GIS standards are essential for harmonising the technical specifications to aid in the usability of this Spatial data, Applications, Workflows Decision Support Dashboards for Stakeholders of Smart City.

Indian standard IS 18008 (Part 1): 2021 Smart Cities - GIS Part 1 Reference Architecture broadly cover Key Design Principals; Enterprise GIS Capabilities and Functional Architecture; Functional Reference Model, Enterprise GIS- Functional Capabilities, Conceptual Model, Technical reference model; GIS Information Reference Model; and Uses Cases of GIS for Smart Cities.

The aim of this standard is to support the cities in undertaking a self-assessment of where they stand in terms of standard adoption with following objectives:

a) Assessment of the principles adopted while designing the GIS framework for the smart city
b) To assess the functional compliance of the adopted Enterprise GIS platform by the city
c) To assess the technical architectural compliance of the GIS Platform by smart cities
d) To assess the levels of adoption of the information model.
e) To assess the application of GIS for Operational Efficiency and Decision Support System by the cities.

The Smart Cities are at different Stages of development in the country.

a) Some Cities are yet in Planning phase
b) Some Cities have created their ICCC
c) Some Cities are at matured stages of implementation, where operational intelligence is addressed.

Matching these stages of smart city, the adoption of GIS also varies from city to city. With the ultimate objective of Smart Integration with different Data Sources, Survey technologies, ERPs, IOT Sensors and Devices, the Robust Enterprise GIS system need to be adopted at the planning stage itself with capabilities of ingestion of data from varies sources. The Enterprise GIS shall be capable of developing Data Models, Workflow based Applications, Live Streaming, development of hotspots, patterns and trends, spatial analytics and decision supporting operational dashboards etc.

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1 SCOPE

This Indian standard (Part 2) provides guidelines for organizations for the self-assessment of their GIS implementations as per IS 18008 (Part 1).

This Indian standard shall be used in conjunction with the IS 18008 (Part 1).

2 REFERENCES

The standards given below contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of these standards.

a) IS 18008 (Part 1):2021 Smart Cities — GIS Part 1 Reference Architecture

3 TERMINOLOGY

3.1 Terminology

For the purpose of this standard, the definitions given in IS 18008 (Part 1) Shall apply.

3.2 Abbreviations

MSI	Master system integrator
GIS	Geographical information system
SI	System integrator
API	Application programming interface
SDK	Software development kit
GCPs	Ground Control Points

4 OVERVIEW OF THE SELF-ASSESSMENT PROCESS

The Part 1 of this standard provides Key design principles, Capabilities, along with the following models:

a) Functional reference model
b) Conceptual model
c) Technical reference model
d) Information reference model

4.1 Compliance with IS 18008 (Part 1).

The compliance with the each of the Key design principles, and capabilities can be achieved through the implementation of a set of parameters. The extend of compliance with the key design principles, and capabilities can be established by verifying the availability and/or implementation status of these parameters.

Similarly, compliance with the architecture models listed above can be achieved by ensuring the availability and/or implementation of a set of parameters or by establishing a set of processes and/or procedures for each of the entities in the respective models. The extent of

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compliance with the models can be calculated and verified by checking the availability and/or implementation status of these parameters and processes.

Clauses 5.1 to 5.5 provides a detailed set of parameters and/or processes/procedures to be followed to adhere to the Key design principles, achieve the capabilities, and implement the models listed above.

4.2 Maturity level

Although it is desirable to comply with all the parameters, processes, and procedures listed in Clauses 5.1 to 5.5 while implementing an enterprise GIS, the adoption of an enterprise GIS system by an organization (or city) not necessarily demand implementation of all the parameters, processes, and procedures mentioned in 4.1. It depends on the specific needs of the organization and available resources and budget.

In the adoption of an enterprise GIS system, different cities may choose to implement a different set of parameters against each of the design principles, capabilities, and models.

The maturity model described in this standard (Part 2) defines five maturity levels and also provides a rating system to verify the extent of implementation of part 1 of this standard and to calculate the organisation's maturity level in terms of adoption of IS 18008 (Part1).

The rating system can help cities to understand the position of each city in terms of adoption of the enterprise GIS system as defined in part 1 of this standard. It will also motivate the cities to focus on the parameters where it is lagging and improve continuously towards the highest level of maturity.

4.3 Calculation of Maturity level

The maturity level is calculated in two steps. The first step is to calculate the extent of compliance with different components and use cases of GIS Reference Architecture as given in Clause 4.1, 4.2, 4.3, 4.6, and Annex A of IS 18008 (Part 1).

Note: The cities may take the Support of the MSI and GIS SIs in assessing compliance.

4.3.1 Compliance with different clauses of IS 18008 (Part 1)

The first step is to calculate the extent of compliance with different components and use cases of GIS Reference Architecture as given in Clause 4.1, 4.2, 4.3, 4.6, and Annex A of IS 18008 (Part 1). Each of these components has one or more parameters and the mark is evaluated against compliance with each of these parameters. **Error! Reference source not found.** provides the list of components against which the evaluation is done along with the total mark given for compliance with each of the components.

Table 1 Components of IS 18008 (Part 1) and total score given

	Component	**Total Marks**
a)	GIS Design Principles	22
b)	Enterprise GIS – Capabilities and functional architecture	27
c)	Enterprise GIS functional reference model	22
d)	GIS Information Reference Model	172

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e)	Use Cases	200
	TOTAL MARK	**443**

The extent of compliance against each of the clauses of IS 18008 (Part 2) is the percentage of the mark gained against the clause (i.e. $\frac{Marks\ gained}{Total\ mark} \times 100$).

The maturity level of the organization in the implementation of the particular component is assigned as given in Table 2.

Table 2 Maturity level and Percentage of score obtained

Score	**Maturity Level**
$Score < 25\%$	Level 1
$25\% \leq Score < 50\%$	Level 2
$50\% \leq Score < 75\%$	Level 3
$75\% \leq Score < 90\%$	Level 4
$Score \geq 90\%$	Level 5

4.3.2 Overall Compliance

The extent of compliance in the overall implementation of the Enterprise GIS as per IS 18008 (part 1) is the percentage of the total mark gained in the implementation of all the components collectively (i.e. $\frac{Sum\ of\ Mark\ gained\ against\ each\ component}{Sum\ of\ toal\ marks\ for\ each\ of\ the\ clauses} \times 100$).

The overall maturity level of the organization is assigned as given in Table 3.

Table 3 Overall Maturity level and Percentage of score obtained

Score	**Maturity Level**
$Overall\ Score < 25\%$	Level 1
$25\% \leq Overall\ Score < 50\%$	Level 2
$50\% \leq Overall\ Score < 75\%$	Level 3
$75\% \leq Overall\ Score < 90\%$	Level 4
$Overall\ Score \geq 90\%$	Level 5

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5 CALCULATION OF MATURITY LEVEL

5.1 GIS Design Principles (4.1 of IS 18008 (Part 1):2021)

The First component is the Key Design principles which have been adopted by the MSI while Designing the GIS system for ICCC. Principally the designed Enterprise GIS Should have adopted the Parameters looking into current and future requirements of the Smart City. The evaluation of the key design principles shall be as per Table 4. The Table has 6 columns, the 2nd Column describes the system design principle, the 3rd column mentions the individual parameters of system design. Column 4 provides the meaning the parameter of the design. Column 5 provides an indication of how the city can evaluate the parameters and column 6 provides the marks against each of the parameter. The last column indicates the applicable score if the capability is available. A maximum score of 22 can be obtained for implementing all the parameters.

Table 4 Evaluation of Key design principles

	Key Design Principals	**Parameters**	**The capability required in the Enterprise GIS system**	**If the capability is available (Yes/No)**	**Score (If Col (5) is "Yes")**
(1)	(2)	(3)	(4)	(5)	(6)
1	Scalable	Vertical	Increasing the number of Users/Data/Applications without impacting the existing set-up	YES or No	1
		Horizontal	Adding the capabilities to the modules, without disturbing the existing one	YES or No	1
2	Secured	Secure from Unauthorised Access	User and access management tools	YES or No	1
		Web Tier Authentication	a) Configure the City portal to use Windows Active Directory. b) Adding enterprise accounts to the portal. c) Verifying portal access using Integrated Windows Authentication (IWA) d) Prevent users from creating their own built-in accounts	YES or No against each of the items	1 for each YES.
		GIS Tier Authentication	Allows for connections to be made to all services, secured and public, from both inside the local domain, and from the internet.	Yes or No	1

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		Enterprise Log in	Provision for organization specific Logins, like Security Assertion Markup Language (SAML) based authentication	Yes or No	1
		Enterprise Groups	Database of Users and Group Information. Active Directories and LDAP	Yes or No	1
3	High Availability	Active-Active	High availability is a technique to ensure system uptime and to minimize or prevent data loss in the event of a machine failure. In Active-Active deployment, the Enterprise GIS servers are to be deployed in multiple machines.	Yes or No Note: High Availability shall be ensured through Active-Active or Active-Passive technique	1
		Active-Passive	Active-passive architecture works to clone a single-machine site and place two or more independent instances of it behind a load balancer.		
4	Standard Based	Compliance with OGC Standards	The Cities need to check how many of the OGC features are met by their Designed Enterprise GIS.		
		WMS	Web Map Service	Yes or No	1
		WFS	Web Feature Service	Yes or No	1
		WCS	Web Coverage Service	Yes or No	1
		WMTS	Web Map Tile Service	Yes or No	1
		WPS	Web Processing Service	Yes or No	1
		KML	Keyhole Markup Language	Yes or No	1
		GeoJSON	JavaScript Object Notation (JSON)	Yes or No	1
		i3s/OGC 3D Tile service	Indexed 3D scene layer/3D tile service	Yes or No	1
		SOA Architecture	Adoption of Service-oriented architecture (SOA- a method of software development that uses software components called services to create business applications	Yes or No	1

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		Provides Open APIs & SDKs	The GIS system shall provide APIs and SDKs	Yes or No	1
5	Modularity	Adopt Change in Business Processes	Modular system: a collection of building blocks that can be configured in different ways, adapting for different customer needs.. This is a process of analyzing features and functions, and matching those with end user requirements and deployment options. Check if the adopted Enterprise GIS system is modular in nature.	Yes or No	1

5.1.1 Calculation of Maturity in adhering to the Key Design Principles

The percentage of maturity of the Enterprise GIS system in adhering to the Key Design principles can be calculated as follows:

$$\frac{sum\ of\ the\ mark\ obtained\ in\ the\ last\ column\ of\ \text{Table 4}}{22} \times 100$$

5.1.2 Calculation of maturity level

The maturity level shall be calculated as indicated in Table 2.

5.2 Enterprise GIS – Capabilities and functional architecture (4.2 of IS 18008 (Part 1):2021)

Enterprise GIS Capabilities take care of some basic essential capabilities that the city's GIS system shall have. It is not necessary that the city is using all the functions currently. But the adopted GIS shall have these features which will be used as and when required by the Cities. The evaluation of the GIS capabilities shall be as per Table 5. The table has 6 columns, the 2nd Column describes the Functional Compliance of Enterprise GIS, the 3rd column mentions the individual parameters of Functional compliance. Column 4 provides the meaning or definition of the parameter. Column 5 provides indication of how the city can evaluate the parameters and Column 6 provides the marks against each of the parameter. A maximum score of 27 can be obtained for implementing all the parameters.

Table 5 Evaluation of GIS capabilities and Functional architecture

	Enterprise GIS Capabilities	**Parameters**	**Definition of Parameters**	**If the capability is available**	**Score (If Col (5) is "Yes")**
(1)	(2)	(3)	(4)	(5)	(6)
1	Base Maps used	Satellite Images, Streets, Topo	Base Map services involves High resolution satellite Images, Topographic Base	Yes or No	1

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		Maps, City Base Maps	Map, City Boundaries, Road Maps etc. as a service. This is used to geo-reference/Project the other layers on same Base		
2	Data Ingestions		The Enterprise GIS system should be capable of ingestion of data from the sources listed down in the previous column (Not necessarily all the types of sources have been currently applied or need to be applied)		
		Government Databases		Yes/No	1
		Open Data Portal		Yes/No	1
		ERP		Yes/No	1
		Sensors		Yes/No	1
		e-Government Application		Yes/No	1
		Survey tools		Yes/No	1
		GPS		Yes/No	1
		DRONE		Yes/No	1
		GPR		Yes/No	1
		LIDAR		Yes/No	1
		REST APIs		Yes/No	1
		Map Data Sources like KML		Yes/No	1
3	Analysis		Check how many of the analysis types (given below) the Enterprise GIS system is capable to perform. (Not necessarily all the types of analysis have been currently applied)	Answer to be in YES or No	
		Trend		Yes/No	1
		Pattern		Yes/No	1
		Hotspots		Yes/No	1
		Concentration and Dispersions		Yes/No	1
		Interpolations		Yes/No	1
		Statistical Modelling		Yes/No	1
		What if Analysis		Yes/No	1
		Predictive analysis		Yes/No	1
4	Workflows		The Enterprise GIS system should be capable of		
		Generate Alerts		Yes/No	1

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		Linked with Dashboards	generating Alerts and Workflow based Apps.	Yes/No	1
5.	Visualizations		The enterprise GIS System should support the types of visualizations listed below. (Not necessarily all the types of visualization have been currently applied).	Answer to be in YES or No	
		Dynamic Dashboards		Yes/No	1
		Measuring against Thresholds		Yes/No	1
		2D and 3D visualization		Yes/No	1
		Live streaming of Sensors		Yes/No	1

5.2.1 Calculation of maturity in the GIS capabilities and functionalities

The maturity of the Enterprise GIS system capabilities and functionalities in percentage can be calculated as follows:

$$\frac{sum\ of\ the\ mark\ obtained\ in\ the\ last\ column\ of\ \text{Table 5}}{27} \times 100$$

5.2.2 Calculation of maturity level

The maturity level shall be calculated as indicated in Table 2.

5.3 Enterprise GIS functional reference model (4.3 of IS 18008 (Part 1):2021)

Enterprise GIS shall adopt SOA Architecture, where the Basic Layers shall be data layer at the bottom, On the top of it will be Business function Layers, taking the data from data layer and building up different Apps and Maps. There is a Presentation Tier which shall be accessed by Client Organization, Line Departments, Citizens and other stakeholders, through desktop, mobile, Web etc. The System shall be capable of integrating with different applications which are running in the smart city and it shall also integrate with the IoT Devices and Instruments via REST APIs. The Architecture of the system shall be created in that manner.

However, city may have different phases of integration. For this the City need to check how many of the Technical Architecture features they have adopted currently for GIS enablement of the City.

The Table has 6 columns, the 2nd column describes the adopted functional compliance of Enterprise GIS by the cities, the 3rd column mentions the individual parameters of enterprise GIS adopted by the cities. Column 4 provides the meaning or definition of the parameter. column 5 provides indication of how the city can evaluate the parameters and column 6 provides the marks against each of the parameter. This is designed to increase the GIS usages by the cities. A maximum score of 22 can be obtained for implementing all the parameters.

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Table 6 Evaluation of Enterprise GIS Functional Reference Model

	Adopted Functional capabilities of GIS by Smart Cities	**Parameters**	**Definition of Parameters**	**How to evaluate**	**For Every Yes**
1	Web GIS Apps		The city need to assess if the existing Enterprise GIS is being used just for visualization or for the GIS Apps have been created. 1 Mark is there for creating Apps through any of the methods		
		Configured Apps		Yes/No	1
		Plug in Apps for GIS visualization		Yes/No	1
		Customised Apps using APIs and SDks		Yes/No	1
2	Distributed Web GIS adoption		The city need to assess if the GIS is using one single visualization or Apps have been Configured/customised for different departments. Or Multiple GIS Apps are created. 1 Mark for any number of Apps created		
		Multiple GIS apps		Yes/No	1
		Multiple Departments Use		Yes/No	1
3	Enterprise Integration	GIS Integration with ERP systems or legacy database	If the GIS of the Smart city is Integrated with any ERP systems or legacy database. 1 Mark for Enterprise Integration	Yes/No	1
4	Automation using APIs and Scripts	Integration with REST API services or Scripting language	If the City is using any services-based integration like Map service, feature services, API services of sensors or using any scripting language (like Python or R etc.) to integrate with GIS	Yes/No	1
5	Environment Isolation Adopted	Production, staging and development are separated	The city need to verify if the production servers, staging servers and development servers are separated in Architecture for system security	Yes/No	1

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6	Data Management		The city needs to check if the data management layer in the technical architecture is following these parameters		
		Access by Mobile Apps		Yes/No	1
		short and long transaction editing capabilities			1
		Data replication Capabilities		Yes/No	1
		Extract, Transform, Load (ETL) procedures		Yes/No	1
7	Analysis Capabilities		The City Need to Check how many of the mentioned functional analysis are put to use by the existing GIS system of the Smart city		
		Vector data Analysis capabilities		Yes/No	1
		Raster data analysis capabilities		Yes/No	1
		Imagery analysis		Yes/No	1
		Network analysis		Yes/No	1
		3D analysis		Yes/No	1
		Real time data analysis		Yes/No	1
		Big data analysis		Yes/No	1
8	Data Storage		The cities need to check if their existing technical architecture of GIS has made provisions for the Data store of different types		
		Relational Data Stores for Vectors		Yes/No	1
		Tile cache data stores for Raster's		Yes/No	1
		Big Data stores		Yes/No	1

5.3.1 Calculation of Maturity in adhering to Enterprise GIS Functional Reference Model

The percentage of maturity of the Enterprise GIS system in adhering to the Functional reference model can be calculated as follows:

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$$\frac{sum\ of\ the\ mark\ obtained\ in\ the\ last\ column\ of\ \text{Table 6}}{22} \times 100$$

5.3.2 Calculation of maturity level

The maturity level shall be calculated as indicated in Table 2.

5.4 GIS Information Reference Model (4.6 of IS 18008 (Part 1):2021)

GIS data is the base for all the applications and spatial decision support system. The Base Map of city need to be at least at the scale of 1:1000. It needs to have substantial number of GCPs for georeferencing of different layers of information captured from different sources. In the toolkit in the reference data model part the number of GIS layers the city should have, has been mentioned. The layers have been divided as mandatory and optional. The city needs to assess how many of these layers are being created by the city as GIS information layers. The Table has 6 columns, the 2nd Column describes the Information reference model, the 3rd Column mentions the individual parameters of information reference model adopted by the cities for creation of GIS database. Column 4 provides the meaning of the parameter. Column 5 provides indication of how the city can evaluate the parameters and Column 6 provides the marks against each of the parameter. A maximum score of 172 can be obtained for implementing all the parameters.

Table 7 Evaluation of Enterprise GIS Information Reference Model

S.No.	Information Reference Model	Parameters	Definition of Parameters	How to evaluate	Score
1	Base Maps	Scale of 1:1000 Datum : WGS84 Projection : UTM		Check if the Base map is available as per the Parameters mentioned	5
2	GCPs	At least 1 GCP per 5 Sq. Kms.	The City Need to check how many GCPs are available for georeferencing as per the area of the city. Area of the city/GCPs	If availability is 1 GCP per 5 km^2	2
				If availability is 1 GCP between 5 to 10 km^2.	1
3	Mandatory Layers	45 Mandatory Layers (Refer Table 3 of IS 18008 (part 1))	The Enterprise GIS shall make available all the Mandatory GIS layers	For each Mandatory Layer 2 Marks	90

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	Optional Layers	75 optional Layers (Refer Table 3 of IS 18008 (part 1))	The City need to check how many optional GIS layers are currently available with the city (Numbers)	For each Optional Layer 1 Marks	75

5.4.1 Calculation of Maturity in adhering to Enterprise GIS Information Reference Model

The percentage of maturity of the Enterprise GIS system in adhering to the Information Reference Model can be calculated as follows:

$$\frac{sum\ of\ the\ mark\ obtained\ in\ the\ last\ column\ of\ \text{Table 6}}{172} \times 100$$

5.4.2 Calculation of maturity level

The maturity level shall be calculated as indicated in Table 2.

5.5 Use Cases (Annex A of IS 18008 (part 1):2021)

Annexure A (clause 4.2) of IS 18008 (Part 1):2021, provides a list of 21 Use Cases that can be enabled by the Enterprise GIS. IS 18008 (Part 1) also indicated three levels of implementation of these Uses Cases that are listed below.

a) Level 1 is Visualization Layer over portal for use by stakeholders,
b) Level 2 is Integration with Department wise data and functions, and
c) Level 3 is data analysis reporting and intelligence built by integration of GIS with IoT systems and sensors.

The score for the implementation of the use cases is calculated based on the following two parameters,

a) the number of use cases implemented and
b) the Level of implementation

While part 1 of this standard describes three levels of implementation of the use cases, for the assessment purpose, 4 levels are prescribed. A mapping of the levels in IS 18008 (Part 1) against Four levels prescribed in this standard is given below.

Table 8 Mapping of the levels in IS 18008 (Part 1) against the levels prescribed for assessment

Levels in IS 18008 (Part 1)	**Levels prescribed for the assessment**
Level 1 - Visualization Layer over portal for use by stakeholders	Level 1 - Use cases with only visualization
Level 2 - Integration with Department	Level 2 - Use Case with API integration of departmental data
Level 3 - Data Analysis reporting and Intelligence	Level 3 - Use Cases with API integration and analysis
	Level 4 - Use Case with API integration with Application development

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The evaluation parameter is designed with the objective to enable the cities in step by step adoption of GIS based use cases for data driven decision support system. The score for implementation of the use cases listed in Annex A of IS 18008 (Part 1) shall be given as given in Table 9. The maximum score for the implementation of the use cases is 200.

Table 9 Evaluation of Use cases

No of use cases adopted ↓	**Score against Level of GIS integration →**			
	Use cases with only visualization	**Use Case with API integration of departmental data**	**Use Cases with API integration and analysis**	**Use Case with API integration with Application development**
1 – 4 use cases	50	75	100	125
5-10 use cases	75	100	125	150
>10 use cases	125	150	175	200

5.5.1 Calculation of Maturity in implementing the use cases

The percentage of maturity of the Enterprise GIS system in implementing the use cases can be calculated as follows:

$$\frac{marks\ obtained\ in\ \text{Table 9}}{200} \times 100$$

5.5.2 Calculation of maturity level

The maturity level shall be calculated as indicated in Table 2.

6 OVERALL MATURITY OF ENTERPRISE GIS IMPLEMENTATION

The overall maturity of the enterprise GIS implementation is the final assessment, based on the total score received in all the four components and use cases (as per Clauses 5.1 to 5.5). The five components of maturity level will also represent where the cities stand in standard adoption in each of the areas. This in turn will also help the cities to focus on the parameters where it is lagging and improve in the next round of GIS maturity assessment.

6.1.1 Calculation of overall maturity of enterprise GIS

The percentage of overall maturity of the Enterprise GIS can be calculated as follows:

$$\frac{Sum\ of\ marks\ obtained\ in\ Table\ 4, Table\ 5,\ Table\ 6,\ Table\ 7,\ and\ \text{Table 9}}{443} \times 100$$

6.1.2 Calculation of maturity level

The maturity level shall be calculated as indicated in Table 3.

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ANNEX A

(Foreword)

COMMITTEE COMPOSITION

Smart Infrastructure Sectional Committee, LITD 28

Organization	Representative(s)
Indian Institute of Science, Bengaluru	Shri Inder S Gopal (Chairperson)
ARM, Noida, Uttar Pradesh	Shri Kumaar Guhan
Amravati Smart City Development Corporation Limited, Mumbai	Shri Siddharth Ganesh
Aveva Software Private Limited, Bengaluru	Shri MSNR Harish
Centre for Development of Telematics, New Delhi	Shri Aurindam Bhattacharya Smt Anupama Chopra (Alternate)
CyanConnode Private Limited, Bengaluru	Shri Manish Widhani Shri Deepak Nimare (Alternate)
ERNET India, New Delhi	Dr. A. Paventhan Shri Hari Krishna Atluri (Alternate)
Ericsson India Private Limited, Gurugram	Shri Sendil Kumar Devar
Esri India Technologies Private Limited, Noida	Shri Vijay Kumar Shri Rupesh Kumar (Alternate) Smt Seema Joshi (Alternate)
Fluentgrid Limited, Visakhapatnam	Shri Harikrishna. B Shri Vikas Narahari (Alternate)
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India Smart Grid Forum, New Delhi	Shri Reji Kumar Pillai Smt Parul Shribatham
Indian Institute of Science, Bengaluru	Shri Vasanth Rajaraman

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Ministry of Housing and Urban Affairs, New Delhi	Shri Kunal Kumar Shri Padam Vijay (Alternate)
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National Smart Grid Mission, Ministry of Power, Gurugram	Shri Mr Arun Misra Smt Kumud Wadhwa (Alternate) Shri Gyan Prakash (Alternate)
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Pune Smart City, Pune	Shri Manojit Bose
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Renesas Electronics, Bengaluru	Shri Ravindra Chaturvedi Shri Saurabh Goswami (Alternate)
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Secure Meters Limited, Gurugram	Shri Madhur Kumar Srivastava Shri Puneet khurana (Alternate) Shri Kaustubh Patil (Alternate) Shri Uttam Kotdiya (Alternate) Shri Anil Mehta (Alternate)
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System Level Solutions (India) Private Limited, Anand	Shri Dipen Parmar Shri Foram Modi (Alternate)

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Telecommunications Standards Development Society India, New Delhi	Smt Bindoo Srivastava
e-Governments Foundation, Bengaluru	Shri Krishnakumar Thiagarajan
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Scientist 'D' (Electronics and IT), BIS

Panel involved in the Finalization-LITD 28/P10 GIS Reference Architecture

Organization	Representative(s)
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AECOM India Private Limited, Gurugram	Shri P Vijay Kumar
Narnix Technolabs Private Limited, New Delhi	Shri Kishor N. Narang
National Spatial Data Infrastructures, New Delhi	Shri R. N. Nanda Shri S. K. Bohra
PricewaterhouseCoopers Private Limited, Gurugram	Shri Farhan Patel

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