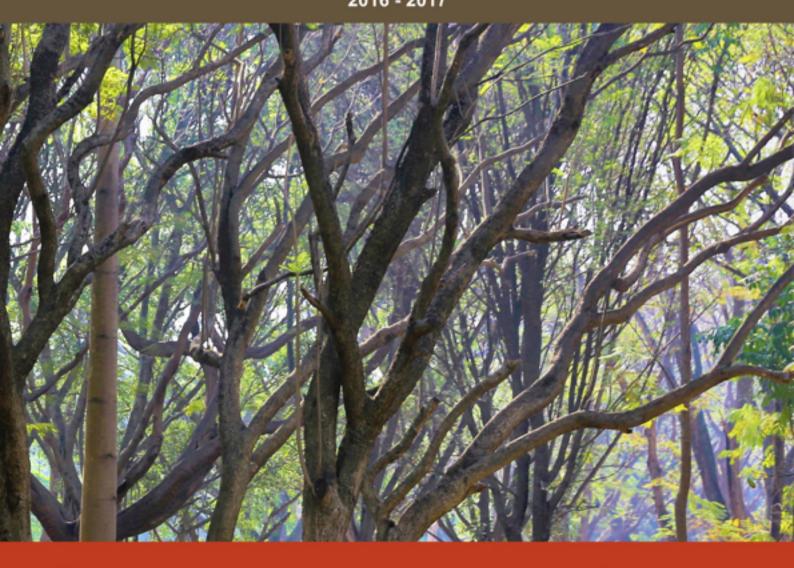


SPATIAL CENTRE RECOMMENDATIONS

Expert Committee : BBMP Restructuring 2016 - 2017

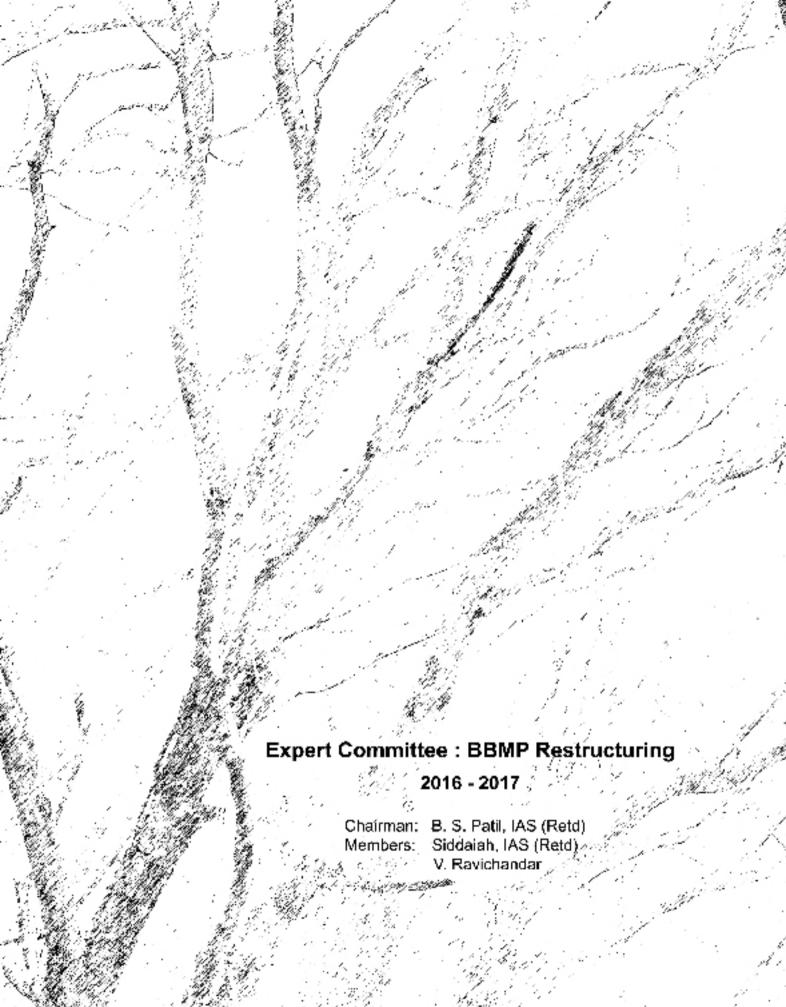




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Framework for Bengaluru Spatial Information Centre

Table of Contents

Executi	ve Summary	2
1. Re	commendations towards realising the 'Bengaluru Spatial Information Centre' (BASIC)	4
2. Ba	ckground	8
3. Sc	ope, Limitations, Approach, and Methodology	11
4. Ar	nalysis of Existing Situation	12
4.1	Spatial Data Platforms in the Indian Context	12
4.2	Geospatial data generated by Government agencies in Bengaluru	18
4.3	Geospatial data generated by private enterprises and citizen groups in Bengaluru	21
5. Ch	allenges and Opportunities	27
6. Fra	amework to setup Bengaluru Spatial Information Centre (BASIC)	30
6.1	Vision & Objectives	30
6.2	Infrastructure Requirements	32
6.3	Data Ownership, storage and sharing protocols	33
6.4	Organisational Structure	36
6.5	Funding & Institutional Mechanism	37
Annexu	re 1: 102 Spatial Layers collated by the BBMP-R Committee	37
Annexu	re 2: Major areas of Applications for City Planning, Implementation and Management	46
Bibliog	raphy	48

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Executive Summary

There are numerous spatial platforms being created in India in recent years by several government departments and agencies at national and state levels to act as decision support systems. The National Remote Sensing Center (ISRO), supports many agencies to build their specific portals through their Bhuvan platform. A National Geospatial Information System (NGIS) is being implemented to integrate geo-spatial data available with several organizations such as Survey of India, National Informatics Centre (NIC), National Remote Sensing Center (NRSC) and Ministry of Earth Sciences (MoES) to develop a GIS platform for e-Governance applications at the national level. The national vision, formalized in the National Centre of Geo-Informatics (NCoG), moves away from GIS as just a database tool or scientific software, towards GIS as a mapping tool for the governed. The agency's stated objective is to provide a national platform for developing geo-informatics related resources and capabilities across the country.

State governments too are competing to establish state wide Decision Support System (DSS). Delhi, Karnataka, Gujarat, Maharashtra and Rajasthan are ahead of the other States. Geospatial Delhi Limited (GSDL) for example is established with an act of law. Based on the Karnataka Jnana Aayoga-GIS Task Force recommendation, Karnataka too embarked on its own initiative to coordinate geospatial data infrastructure. Spatial data is part of the progressive "information regime" the state sees as necessary to meet predicted growth targets. The Karnataka Government has allocated Rs.150 crores in the financial year 2015-16 to establish a K-GIS portal, spread over three years and has assigned the task to Karnataka State Remote Sensing Applications Centre (KSRSAC).

Various state government departments in Karnataka and city agencies are incurring considerable costs in creating spatial databases by acquiring high resolution satellite images and hiring external GIS consultants. Prominent city agencies in Bengaluru like the BBMP, BDA, BESCOM, BWSSB, BMTC, BMRDA, etc. have their own spatial datasets. Many of these datasets created by multiple consultants are typically fragmented, inconsistent and seldom follow national spatial data infrastructure (NSDI) guidelines of India or vendor neutral and inter-operability formats.

Table-1 of the report for example indicates the duplication with regards to a single layer 'Roads' as spatially documented by various agencies (without considering NHAI, state level departments such as PWD, or even BDA's RMP-2015 data). About nine public agencies have the same 'Roads' data indicated in 18 ways and 6 different formats and most importantly none of them are an exact match to the other creating ambiguity about its accuracy and authenticity. This ambiguity during the coordination of a project, increases delays in execution, arriving at the right alignments, incurs time and resource losses and most importantly causes inconvenience to people.

In addition, several academic institutions, NGOs and citizen groups use spatial tools and applications typically to understand access to utilities and services within the city. Part of their resources are duplicated to build and recreate basic datasets which are already available with individual government departments and agencies. Both citizen groups and private agencies are recreating and adding to open data and developing valuable tools and applications with them.

With several such challenges related to the creation and maintenance of multiple spatial databases in the city, the BBMP Restructuring Expert Committee recommended the establishment of a



common spatial information centre in its report submitted to Govt. of Karnataka in June, 2015. As part of the same exercise, the Committee put in considerable efforts to put together spatial (and non-spatial) datasets across agencies (104 layers in all) onto a single platform. This needs to be furthered, kept current and disseminated (including to the public) based on accepted protocols.

As the epicentre of Karnataka's growth, Bengaluru's own rapid urbanization means the city urgently needs uniform, large scale accurate spatial datasets for planning and monitoring of development activity. More compelling than the demographic reasons for the information centre is the present state of data usage at the agency level. Disaggregated data with various agencies, data duplication, multiple file formats, large amounts of spending by individual agencies on decision support systems, and limited know-how of the staff are some of the challenges. Digital India, National GIS initiative, data sharing policy, launch of national and state geoportals, Karnataka GIS project and recommendations by high powered steering committees for establishing a unified spatial information centre are promising opportunities.

An independent statutory agency must be created to carry out data collation, creation, record keeping, maintenance and ensuring sharing protocols for agencies operating in the Bengaluru Metropolitan Region (covering Bengaluru Urban, Rural and Ramanagaram districts). Agencies and other departments will continue to retain ownership of their respective data whereas the spatial information centre will help in base map creation, data standardisation and sharing protocols. Most of the data will be exchanged across multiple departments, businesses and with the public. Open data formats and standard exchange protocols should be followed extensively keeping in view the common citizen with less or no access to software. Seamless data consumption and exchange should happen over browsers at the user end through web services. To enable this, web based service protocols should be followed to exchange spatial information such as WMS - Web Map Service, WMTS – Web Map Tile Service, WCS - Web Coverage Service, WPS - Web Processing Service, etc.

Spatial Information Centre will be a one-point source and custodian of all the geospatial databases for the entire metropolitan region. To meet this objective of creating a common geospatial database, the following key recommendations are made in this report:

- 1. Urban Development Department (UDD) of the Government of Karnataka should undertake the responsibility to initiate the process of setting up the Bengaluru Spatial Information Centre (BASIC) for a jurisdiction of the Bengaluru Metropolitan Region (BMR) through enacting a spatial act.
- 2. Pass a Geo-Spatial Act for Bengaluru to mandate the setting up of an independent agency at the Bengaluru Metropolitan Region (BMR) scale to be the single source and custodian of all geo spatial data for the city-region.
- 3. Set up the Bengaluru Spatial Information Centre (BASIC) as an independent statutory agency as per the provisions of the Geo-Spatial Act with appropriate infrastructure and professional staff.
- 4. Mainstreaming BASIC to become the preferred spatial data platform across varied stakeholders for data creation, updation, storage and sharing that is current and reliable
- 5. BASIC to transition into an open data platform opening data to the public, enabling crowd sourcing, and promoting geo spatial literacy.



1. Recommendations towards realising the 'Bengaluru Spatial Information Centre' (BASIC)

Government agencies are incurring considerable costs in acquiring high resolution satellite images and hiring GIS consultants to create spatial databases. These datasets created by multiple consultants are mostly fragmented, inconsistent and rarely follow established guidelines or vendor neutral and inter-operability procedures. At times, much of the work done by one agency gets duplicated by another as seen by the BBMP Restructuring Committee during 2014-15 while preparing its initial Way Forward Report. The Committee then put in considerable efforts to put together spatial (and non-spatial) datasets across agencies onto a single platform. This is necessary to make informed decisions about the current ground situation across multiple parameters (like demographics, infrastructure, revenue collection, public spaces, etc.), determine the size and shape of the proposed multiple Municipal Corporations and used extensively in planning and providing services.

Objectives of Spatial Information Centre:

- A single agency is to be responsible for collating, creating and sharing authoritative GIS datasets which is to be made available to all agencies, enterprises and citizens;
- Integrating and standardising fragmented data from individual departments, mapping procedures and establishing data sharing protocols;
- Developing 2D and 3D geospatial information, data analytics and user friendly visualisation applications;
- Obtaining updates from Government agencies, Departments, public sources and ensuring datasets are up to date;
- Following vendor neutral, platform neutral and interoperability principles for easy sharing across the agencies and public at large

Important recommendations towards realising Bengaluru Spatial Information Centre:

1. The Urban Development Department (UDD) of the Government of Karnataka should initiate and undertake the responsibility of setting up the Bengaluru Spatial Information Centre (BASIC) for the Bengaluru Metropolitan Region (BMR) through a Government Order (GO)

As Bengaluru is growingly rapidly, it urgently needs uniform, highly detailed and accurate spatial information for proper planning and monitoring of various developmental activities. Setting up a new centre (Bengaluru Spatial Information Centre, BASIC) which collates spatial information and coordinates with all the agencies and shares information on a single platform is necessary. This is also essential to provide consistent and reliable citizen centric services across all agencies within the corporation limits and contiguous areas beyond it. Hence it is recommended that the UDD of the State, should take the initiative as several critical government agencies operating in Bengaluru are functioning under this department. While it is necessary to formulate an Act to enable this process, in the interim, the State government should pass an Order to enable setting up of Bengaluru Spatial Information



Centre, for a jurisdiction of not less than Bengaluru Metropolitan Region (BMR) (covering Bengaluru Urban, Rural and Ramanagaram districts). There should be a mandate made in the GO, so that all agencies compulsorily share a copy of their datasets (spatial and non-spatial) whose jurisdictional limits falls in whole or part, anywhere inside BMR. This will hence be in line with The National Data Sharing and Accessibility Policy, 2012, leveraging Geospatial Information Systems (GIS) for decision support systems & development (as part of the Digital India Initiative). To establish the Centre, a task force should be set up on a priority basis and assigned the task of adopting a consultative process for the smooth operation of the Centre and to come out with appropriate frameworks for enacting the Geospatial Act.

2. Pass a Geo-Spatial Act for Bengaluru to mandate the setting up of an independent agency at the Bengaluru Metropolitan Region (BMR) scale to be the single source and custodian of all geo spatial data for the city-region.

Establishing the Bengaluru Spatial Information Centre (BASIC) enabled by the spatial repository act and housed in an appropriate organization is essential not just for seamless coordination among the government agencies but also to expose as much data as possible to the public to enable data analytics and build applications that collectively helps improve the citizen experience in the city. This is also one of the proposals made by this committee in the earlier report submitted to the Karnataka Government in July, 2015.

- Conformity of the Geo-Spatial Act to various policies and related Acts: This Act should be passed along the lines of 'The Delhi Geo-Spatial Data Infrastructure (Management, Administration, Security and Safety) Act, 2011', the National Data Sharing and Accessibility Policy, 2012, Karnataka GIS initiative by Department of IT, BT and ST, Government of Karnataka, Digital India Initiative, leveraging Geospatial Information Systems (GIS) for decision support systems & development, etc.
- Key aspects to be addressed in the Geo-Spatial Act: This act should clearly address the setting up of a regulatory authority, it's mandatory and additional functions, data sharing by all agencies, data creation, level of details (scale/resolution), ownership, sharing protocols (Government-to-Government: G2G, Government-to-Citizen: G2C, and Government-to-Business: G2B), opening data for public, crowding sourcing and verification, budget, intellectual rights, data updating, emerging technologies and standards, etc.
- Institutional aspects to enable enactment of the Geo-Spatial Act: An independent
 agency should carry out the data collation, creation, record keeping, maintenance, and
 sharing activities for the Bengaluru Metropolitan Region (BMR). Training and capacity
 building needs of officials from all the parastatals agencies with respect to Geospatial
 technologies should also be considered.



- 3. Set up the Bengaluru Spatial Information Centre (BASIC) as an independent statutory agency as per the provisions of the Geo-Spatial Act with appropriate infrastructure and professional staff.
 - **Objective**: Provide Geospatial information for the benefit of all citizens to meet their day to day needs and promote use of geospatial technologies by government agencies. Integrate and establish mapping procedures and sharing protocols. Act as a single window agency for all spatial information within the city and its region.
 - State of the art Infrastructure: Establish a 'GIS Platform' with state of the art computing and networking structures as a multi-tiered platform with a front-end portal offering various GIS data and applications services, and at the back-end a high-capacity data centre for storage, and server architecture to maintain security and controlled access.
 - Skilled and Professional Human Resources: Lateral entry should be allowed for recruiting qualified and established professionals to take charge and lead the center.
 Skilled man power is essential for developing emerging applications in data analytics, visualisation and improved security to protect the data from being misused.
 - Institutional requirements for BASIC: The institution should have technical sections which separately consider (data) collation, creation (of new data, applications) and sharing (across agencies, public and enterprises). These verticals would create the standards for each area of work and address capacity building. These are apart from administration and other services for running the center.
- 4. Mainstreaming BASIC to become the preferred destination across varied stakeholders for data creation, storage and sharing that is current and of high quality.
 - Reducing functional overlaps between agencies: Some of BASIC's proposed functions
 may overlap with existing services currently being provided by state agencies such as
 KSRSAC under K-GIS project. The task force that will be set up for BASIC must conduct
 discussions with such agencies to prevent redundancy.
 - Data collation from stakeholders: In most cases, the BASIC server will hook on to the servers of participating agencies rather than separately storing data. Wherever this is not possible the center will use its dedicated storage facility to host the data.
 - Sharing protocols: For sharing, the BASIC portal will act as a dual gateway, segregating traffic of Government-to-Government (G2G, this includes intra agency only access), Government-to-Citizen (G2C), and Government-to-Business (G2B) access based on log-on procedures and an Access/Service Policy which would be user-friendly. Open data formats and standard exchange protocols should be followed extensively keeping in view the common citizen through web services. Web based service protocols could be



deployed for exchange of spatial information like Web Map Service (WMS), Web Map Tile Service (WMTS), etc.

- **Data ownership:** City departments retain ownership of their respective data. As custodian and service provider, BASIC is the vehicle for facilitating the usage of this data by the owning department and its accessibility to other city departments.
- **Funding Mechanism**: Initially depend on government funds in the short to medium term, and then move to being self-sustaining in the long term (through consultancy works for government & private sector, intellectual rights, training programs).
- Quality Assurance: One of the BASIC's primary value additions will be its quality guarantee. It will establish sharing protocols and identify the relevant agency responsible for the authenticity of any information (such as BWSSB for water and sanitation lines, the Revenue Department for administrative boundaries, BBMP for roads, etc.) and accordingly re-evaluates the quality of other department information to assure overall quality.
- 5. BASIC to transition into an open data platform opening data to the public, enabling crowd sourcing, and promoting geo spatial literacy.
 - Opening data to the public: BASIC in the long term will seek to empower citizens with
 access to maps, images, geospatial information, e-governance and public services.
 Informed participation of citizens in city development will thereby be enabled with
 feedback loops as well as crowd sourcing of information to better monitoring,
 evaluation and accountability of various agencies operating in the city.
 - Promote geo-spatial literacy: Allocate resources to provide outreach and training for government officials, different citizen user groups and at education institutions to expose students from schools to the university level to GIS. Involving educational institutions with special courses and classes would promote geo-literacy and an open governance paradigm among the next generation of citizens.



2. Background

Over the years, many initiatives have been undertaken by various State Governments and Central Ministries to usher in an era of e-governance. Sustained efforts have been made at multiple levels to improve the delivery of public services and simplify the process of accessing them. E-governance in India has steadily

- Aadhaar project helped to save Rs.50,000 crores on subsidies (by investing Rs.10,000 crores)
- Railway's digital platform is estimated to save
 Rs.60,000 crores (by investing Rs.12,000 crores)

evolved from computerization of Government Departments to initiatives that encapsulate the finer points of Governance, such as citizen centricity, service orientation and transparency. For instance, Unique Identification Authority of India's Aadhaar project helped to save Rs.50,000 on subsidies (Business Standard 2017) by investing Rs.10,000 crores. Railway's digital platform is estimated to save Rs.60,000 crores by investing Rs.12,000 crores (The Hindu 2017).

The National e-Governance Plan (NeGP) was approved in 2006 to take a holistic view of e-governance initiatives across the country, integrating them into a collective vision. Around this idea, a massive countrywide infrastructure reaching down to the remotest of places is being developed, and large-scale digitization of records is taking place to enable easy and reliable access over the internet. The ultimate objective is to make all government services accessible to the common man in his locality, through common service delivery outlets, and ensure efficiency, transparency, and reliability of such services at affordable costs to realise basic needs.

Six elements are crucial for ensuring that governance and services are made available on demand to all citizens and other stakeholders in the country:

- 1. Seamlessly integrated services across departments or jurisdictions;
- 2. Availability of services in real time from online & mobile platforms;
- 3. All citizen entitlements to be portable and available on the cloud;
- 4. Digitally transformed services for improving ease of doing business;
- 5. Making financial transactions electronic & cashless;
- 6. Leveraging Geospatial Information Systems (GIS) for decision support systems & development.

2.1 Understanding GIS and its potential application

What is Geographical Information (GI)?

Any information that has a geographical reference, consisting mainly of satellite images, aerial images, maps – topographic and thematic, ground survey data, positioning data, geo-tagged attributes, and any derivatives from their processing. All these formats are amenable to visual display, integration, processing and serving as spatial imagery (Karnataka Jnana Aayoga 2013).

What is Geographical Information Systems (GIS)?

GIS pertains to the "total system" for GI – technologies for creating, storing, archiving, accessing, processing, and disseminating GI (Karnataka Jnana Aayoga 2013). A geographic



information system integrates hardware, software, and data for capturing, managing, analysing, and displaying all forms of geographically referenced information.

Why GIS?

GIS Applications can strengthen planning activities, contribute to sustainable development, and improve the private sector's management capacity. Not just a powerful technology for analysis, GIS also holds great potential for inclusive state-building. If made available to the public, geospatial repositories can power open-governance by crowd-sourcing citizen data and engendering accountability from city agencies.

What is a GIS portal?

An internet based geospatial data clearinghouse that allow the users of the system to share and use the information of all supplying entities.

Applications of GIS can be critical to many aspects of governance and development and can help in reaching the gains of development to the most needy people at the most needy locations in the most scientific and transparent manner. Thus, GIS can power and support open-governance methods by involving citizens, opening information in easy-to-understand map formats and to assist in bringing accountability and responsibility to public and governance activities. At the same time, GIS can also help enterprises by enabling spatial solutions in support of their enterprise activities (be it in private participation of state-development or in the efficiency of businesses). Citizens benefit from the GIS greatly by enabling the mapping of their aspirations, demands, complaints and suggestions and become important stake-holders in developmental efforts.

GIS can be a major differentiator for decision-making at all levels of governance — be it in government, in enterprises or by citizens; be it state-level, district/panchayat or local-body levels or be it for long-term planning or for immediate decisions/actions. Hence, when it comes to GIS, the focus must be on Decision Support and a further emphasis on improving quality of decision making and empowering citizens.

2.2 Geospatial platforms as critical architecture for modern day governance

Today there is increasing global consensus that a government that leads in GIS systems leads in innovation and economic growth as well. With the power to dimensionalise data, spatial information is important to today's new IT regime. Cities and states around the world are capitalizing on the financial and efficiency benefits of dissolving municipal silos in order to streamline and operationalize spatial data. Called "mapping portals," "geospatial hubs," and "geoportals," these repositories are increasingly considered critical architecture for modern governance. Several state and national governments have already adopted these platforms in one way or the other.

State and National government GIS platforms are expected to provide a single gateway for an integrated view of information across all departments for local level planning. This will facilitate a single window service to citizens to increase the efficiency and productivity of all departments/agencies such as Agriculture, Medical & Health, Law Order & Police, Energy & Utilities, Revenue & Commercial Taxes, Urban Development, Water & Waste Water, Environment & Forestry. It will further develop and maintain up-to-date geospatial and non-geospatial datasets for dissemination of the right information to the right people (including govt. agencies, NGOs, RWAs, private sector and citizens) at the right time for faster analysis and decision making. The system needs to be designed with open standards & workflows to facilitate interoperability with existing applications.



The primary objective of State-GIS platforms is to establish and implement a web based single gateway integrated GIS platform to access, acquire, process, store, distribute and improve the utilization of geospatial information through:

- Intelligent web services being generated and published by various agencies;
- Advanced tools for GIS based analysis;
- Web & mobile maps & apps;
- Segment specific solution templates;
- · Executive dashboards and
- Spatial information for further integration with other enterprise applications and empowering citizens.

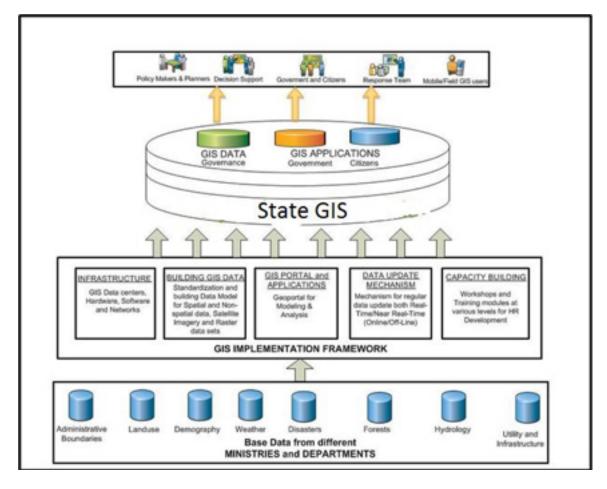


Figure 1: Key Elements of State-GIS Image Source: (ESRI, ArcIndia News 2014)

2.3 Importance and increasing relevance of Open data

Open data has the potential to transform governance and accelerate economic development. Uses for open data are ever expanding, but include transparency in public procurement, election monitoring, and searchable performance indicators in a range of sectors from health care to transportation. The bulk of existing evidence about the impact of open data focuses on high-income countries, but is increasingly demonstrating impacts in low and middle income countries.



The global conversation around mobilizing the data revolution revolves around not just spatial data, but "open data" more broadly. As per the Open Government data division, "A dataset is considered to be open if it is accessible and free to use, reuse, and redistribute. Open data should be machine readable and easily accessible. Open data can be used to launch commercial and non-profit ventures, to do research, make data driven decisions and solve complex problems." (World Resources Institute India, Embarq 2015)

3. Scope, Limitations, Approach, and Methodology

Aim and Objectives

- To understand the need for creating a unified spatial information centre for Bengaluru;
- To establish frameworks for an independent and unified spatial information center;
- To recommend key aspects to consider while drafting the geo-spatial act for Bengaluru;
- To demonstrate the potential of data analytics by combining datasets from different agencies;
- To showcase how data can be visualised (multiple layers or information used within BBMP).

Scope and Limitations

Data and research is limited to secondary sources, that are available in the public domain. This includes accessing government websites, journals, research papers, and open source maps. The report does not focus on aspects of computer and hardware architecture, programme codes, proprietary and other specially developed tools; existing departments functioning within BMR, their databases, expenditure on creating and maintaining spatial datasets and human skill sets available with them, etc. Study area is limited to Bruhat Bengaluru Mahanagara Palike (BBMP) and the agencies functioning in all or part of the Bengaluru Metropolitan Region (BMR) (consisting of Bengaluru Urban, Bengaluru Rural and Ramanagaram districts).

Approach and Methodology

The report suggests the need and ways to establish a unified, integrated and synchronised geospatial database for the city for better management and governance.

The following tasks were conducted as part of this report

- Data and research is from secondary sources, importantly the Delhi Geo-Spatial Act, 2011, National Data Sharing and Accessibility Policy, 2012, K-GIS vision document, K-GIS standards volume-1 (Karnataka GIS initiative by Department of IT, BT and ST)
- Interactions were held with a limited number of government agencies such as BBMP, BDA, BMRDA, KSSIDC, BMRCL and BWSSB to understand the issues related to project coordination, data inaccuracy, respective departmental initiatives in usage of geospatial technologies, challenges and opportunities to be part of proposed spatial information centre. Multiple consultations were conducted with KSRSAC experts to understand detailed domain expertise.



4. Analysis of Existing Situation

Applications of GIS have great national and local relevance to support governance activities, help prepare sustainable development strategies, involve citizens in participatory democracy, enable enterprises to manage business better and bring geographical knowledge to citizens. Thus, GIS has become not only an important technology but is also becoming a tool that assists in governance, development of society and supports citizen activities

Leveraging Geospatial Information Systems (GIS) for decision support systems & development is one of the six elements that are crucial to ensure governance and services is made available on demand to all citizens and other stakeholders in the country as part of Digital India initiative.

4.1 Spatial Data Platforms in the Indian Context

There are numerous spatial platforms created in the last few years by multiple government departments and agencies both at national and state level to act as decision support system (DSS). National Remote Sensing Centre (ISRO) is supporting many agencies to build their specific portals on its Bhuvan platform. Similarly, National Geo-Informatics website and Bhuvan home page. Bhuvan homepage also provides links to specific departmental and agencies geoportals.

a) National GIS Vision

The National Government has planned to leverage Geospatial Information System (GIS) for decision support systems (DSS) & development. Various government services can be offered in a better way by proper use of GIS technology in the e-governance applications. National Geospatial Information System (NGIS) is being implemented to integrate geo-spatial data available with several organizations such as Survey of India, National Informatics Centre (NIC), National Remote Sensing Centre (NRSC) and Ministry of Earth Sciences (MoES) to develop a GIS platform for e-Governance applications.

This GIS platform will be leveraged as a service for the benefit of various mission mode projects and other e-governance initiatives. NGIS can also be leveraged for monitoring the physical progress of projects, disaster management and specialized needs of public safety agencies.

Today's national vision, formalized in the National Centre of Geo-Informatics (NCoG), moves away from GIS as just a database tool or scientific software, and toward GIS as a mapping tool for the governed (Government of India n.d.). The new agency's stated objective is to provide a national platform for developing geo-informatics related resources and capabilities across the country (Government of India 2016).





Figure 2: Screenshot from National Centre Of Geo-Informatics Website

Source: https://ncog.gov.in/



Figure 3:Screenshot from National Centre Of Geo-Informatics Website

Source: https://ncog.gov.in/edistrict





Figure 4:Screenshot from BUVAN, Indian geo-platform of ISRO

Source: http://bhuvan.nrsc.gov.in/bhuvan links.php#

b) Delhi State Spatial Data Infrastructure

Initiated in 2011, the Delhi State Spatial Data Infrastructure (DSSDI) project is accessible to the public online (The Delhi Geospatial Delhi Limited, A Govt. of NCT of Delhi Company n.d.).

The entity's objective is to leverage all contemporary and emerging geospatial technologies for policy implementation and to provide geospatial information for the benefit of Government agencies and Delhi citizens. The portal currently offers a limited suite of applications for governance and is expected to grow as its user base expands to include more agencies as well as the private sector.



Figure 5:Screenshot from Delhi Geospatial portal Source: http://gsdl.org.in/Application.html



Geospatial Delhi Limited (GSDL), an independent company under the Delhi government is created to provide Information Technology Enabled Services (ITES) and solutions for Govt. Departments in Utilities, Social, Environment, Land & Property, Demographic, Emergency and Transport segments for better governance. It utilizes all contemporary and emerging technologies to provide geospatial information for various applications by using tools such as GIS, GPS, Remote Sensing, etc.

Case study: Delhi Act as Necessary First Step towards setting up the Geospatial Delhi Limited

The Delhi Geospatial Data Infrastructure (management control, administration, security and safety) Act, 2011 established the foundation for the formulation of the "Geospatial Delhi Limited" (GSDL). In this way, Delhi leveraged a legislative mechanism in order to establish the entity and to specify its structure. In addition to its legal configuration, the act details the purpose, the administration and the authority of GSDL. The Act outlines the entity's governing body, the NCTD Department of Information Technology, and the constitution of its regulatory authority, a cabinet of department secretaries headed by the Chief Secretary of the Government. To ensure enforcement of the act, the governing body formulated rules and the regulatory authority issued regulations, which may be re-issued as needed.

Geospatial Delhi Limited is Registered under the Companies Act,1956. By incorporating it as a private entity, GSDL was able to offer shares to the public, raising its own capital. With this autonomous funding, GSDL has sufficient resources to create its own data, rather than collect and standardize existing departmental data. As designed, the GSDL then sells these data to city departments.

c) Open Data in India

The National Data Sharing and Accessibility Policy (NDSAP), enacted in 2012, was designed to expand access to all shareable, non-sensitive data generated with public funds. The resulting 'Open Government Data Platform India' boasts over 27,330 resources with 7.3 million views and 2.9 million downloads since inception (Government of India 2016). However, in practice, the NDSAP has not been implemented equally across all agencies and departments. The website's data catalogue shows that in practice some ministries have shared dramatically more data than others: contrast the Planning Commission's 777 shared datasets with the Ministry of Commerce and Industry's 16 datasets or the Ministry of Information and Broadcasting, which has made available only 9 datasets.

One of the unique features of India's Open Data portal is that users can demand a specific dataset from the government and others looking for similar data can endorse these requests. It becomes mandatory for a department to release that data if 1000 such endorsements are raised for a particular dataset (World Economic Forum 2015). To encourage a new way of approaching government data, the Ministry of Electronics and Information Technology administers the Digital India Awards, acknowledging exemplary practices in e-governance (Government of India 2016).

Outside of the national project, India is behind the open data curve. Only one state has an open data portal: The State of Sikkim became the first Indian state to launch an open data portal using the http://www.data.gov.in/platform in June of 2016 (Government of Sikkim 2016). As for city level open data, only private foundations and citizens have taken on the task to date; Open City is the most recent attempt (http://opencity.in/) (Bangalore 2016).



Case Study: Open Data in Mexico Attracts Private Sector Investment

Making previously inaccessible information available is a major public service, but the critical next step is enabling citizens to act on that information. An exemplary product of Mexico's open data is the *Mejora Tu Escuela* ("Improve Your School"), an online platform that provides citizens with information about school performance. Launched in 2013, *Mejora Tu Escuela* is a public, independent, nonprofit initiative with investments from the Mexican Institute for Competitiveness (IMCO) and Omidyar Network. It helps parents choose the best option for their children, empowers them to demand higher-quality education, and gives them tools to get involved in their children's schooling. It also provides school administrators, policymakers and NGOs with data to identify areas requiring improvement and hotbeds of corruption, in the process raising the overall quality of education in Mexico. The impact of *Mejora Tu Escuela* is evident in the amount of traffic the site receives — between 40,000-45,000 unique visits a day.

d) Karnataka GIS (K-GIS)

Karnataka embarked on its own initiative to coordinate geospatial data infrastructure and approached its K-GIS design anticipating sustained high rates of growth into the future. Spatial data is part of the progressive "information regime" the state sees as necessary to meet the predicted growth. The Karnataka Jnana Aayoga-GIS Task Force described their goal as "a regime powered by modern metrics systems, efficient informatics and analytics with real-time information delivery and a constant interaction between government and citizens — such a regime will have to be the foundation for the governing as well as the governed." (Karnataka Jnana Aayoga 2013). Funds of INR 150 crores were allocated in FY 2015-16 to establish the K-GIS portal (Government of Karnataka 2015). Once accessible, it will offer seamless state-wide GIS data layers as well as a wide range of GIS applications.

Karnataka GIS in detail

K-GIS will be implemented in a phased manner by Karnataka State Remote Sensing Applications Centre (KSRSAC) in association with Karnataka State Council for Science and Technology (KSCST) and Karnataka State Natural Disaster Monitoring Centre (KSNDMC). An apex body-Karnataka GIS Council- would be set-up under the Chairmanship of a renowned GIS expert, who will guide, define procedures and suggest a detailed plan of activities, under K-GIS. Important stakeholders in the project include line Departments, Industry and Academia. K-GIS is a "public and merit good" - serving the larger good for the larger majority. K-GIS is "mission critical" for State Government and enterprise level GIS activity and should also provide a premise for future public and private collaboration within the state in the critical area of GIS. It serves the basic needs of and empowers citizens by serving state-wide maps/image/geo-spatial information; geo-enabling e-governance and public services and enabling a "crowd-sourced" interactive/participatory process of citizen involvement in development and state-building and providing feedback/inputs/data as a virtual geographical ingest.

It is a major support to high-quality state governance by embedding GIS in different aspects of governance - planning and implementation at national/state/local levels; bringing GIS support in decision-making; enable a sound process of monitoring development and identifying "gaps in development"; make GIS data available at all levels - that helps bringing accountability and responsibility in state's governance. It also supports the accelerated development of a number of Enterprise-GIS solutions being undertaken by private enterprise and help align them to state/national development - by allowing integration of



the K-GIS into enterprise solutions in an appropriate manner and also contributes innovative GIS software and data content/applications for larger and wider use. K-GIS precisely addresses these aspects and aims at bringing a new paradigm for development and supporting a new model of governance by providing GIS Decision Support Systems (DSS).

• Infrastructure

It comprises of GIS Platform for computing and networking, which will be developed, hosted, and based in a suitable place in Karnataka. As part of the K-GIS infrastructure, it is also planned to position K- Dashboards for key dignitaries such as the Chief Minister's Office (CMO) and the Chief Secretary for high-level reviews/meets etc., and promote GIS usage to key dignitary-levels. The K-GIS infrastructure will be a bank of specialized computing facilities, necessary GIS engines and other software, a high-capacity Data Centre, a comprehensive User Portal and an Administration/Management Portal with appropriate security and risk management solutions.

Framework

Spatial Framework (SF) is a common geographically referenced GIS foundation spatial data on which assembly and maintenance of a seamless coverage of the best available, most current and authoritative, well organized, standardized and quality controlled GIS data is available. It is the frame work of ground control for latitude, longitude and height throughout the state of Karnataka. Spatial Framework (SF) is the most critical asset for seamlessness of the spatial database, integration of multi scale spatial data, exchange of geospatial information among government and other organizations of the state. The Spatial Framework consists of datum, projection and bounding limits and allows accurate registration, transformation and visualization of the spatial information. Under the K-GIS mission, it is planned to create a spatial frame work for the state of Karnataka consisting of precisely controlled primary, secondary, tertiary, TRPs and CPs to meet the accuracy as defined in the Karnataka Geographical Information System (K-GIS) standards.

K-GIS Portal & DSS

K-GIS Portal will be developed as a single gateway for access - with detailed modules of GIS metadata search, GIS data access and GIS applications access by integrating the K-GIS Applications. K-GIS DSS Applications provide service for different state departments in government; target groups in private enterprises and to citizens. The National GIS DSS (which are more suited for central ministries/departments) would also be integrated with the K-GIS DSS.

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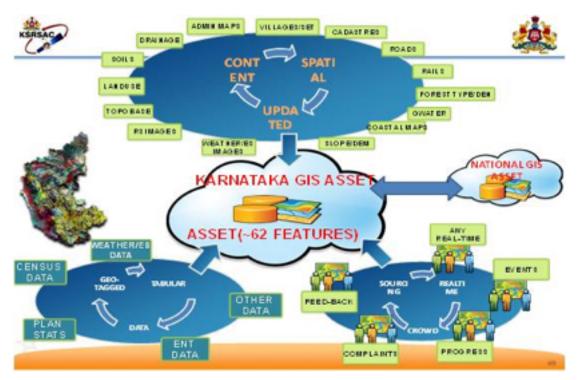


Figure 6: K-GIS DSS Applications

Source: http://www.karnataka.gov.in/ksrsac/project-karnataka_gis.html

Capacity building

K-GIS Capacity building and training to different departments and user groups would be taken up. K-GIS will link with Karnataka Knowledge Commission and other Knowledge building institutions for training, education and research needs as part of the overall capacity-building.

4.2 Geospatial data generated by Government agencies in Bengaluru

Karnataka state government departments and agencies are incurring considerable costs to create spatial data by acquiring high resolution satellite images and hiring GIS consultants. Most of the prominent agencies working in Bengaluru like BBMP, BDA, BESCOM, BWSSB, BMTC, BMRDA, etc. have their own spatial datasets. Karnataka Geoportal by Karnataka State Council for Science and Technology (KSCST), WebGIS Portal for data visualisation by Karnataka State Natural Disaster Monitoring Centre (KSNDMC) are few other examples which have state wide spatial information.

Most of these datasets (especially agencies working locally for Bengaluru) are created by multiple consultants and are mostly fragmented, inconsistent and don't follow national spatial data infrastructure (NSDI) guidelines of India or vendor neutral and inter-operability procedures.



Table 1 shows the duplication with regards to one layer, "Roads" from major agencies (without considering NHAI, state level departments like PWD, etc.). About nine public agencies have the same roads data in 18 ways and 6 different formats and most importantly none of them exactly match with each other creating confusion about the accuracy and authenticity. This generally creates ambiguity during project coordination time, increasing delays in project execution, incurring huge losses and most importantly causing inconvenience to the public.

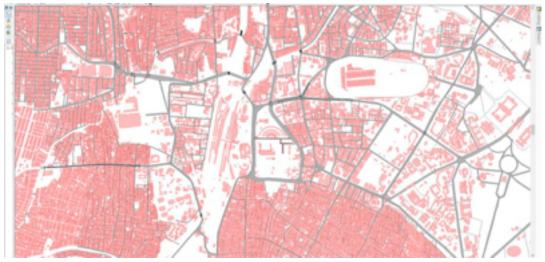
	Agency	Layer Classification	Sector / subsector	Geospatial Information	Projection System	Feature Class	Data counts
1	BESCOM	RoadCenterLine	Mobility /	Road network with flyovers, bridges, type (NH, SH, major, minor, track)		Line	16,161
2	BESCOM	Road Edge	Mobility / Roads	Extents of road edge	WGS_1984_UTM_ Zone_43N	polygon	38
3	BMRCL	Mobility / Metro	Mobility / Metro	Alignment drawings	AutoCAD		
4	BMRDA	LPAs	Mobility / Roads	Master plans of LPAs in BMRDA, Road alignments			
5	ВТР	Corridors	Mobility / Roads	Corridors	KML	Line	21
6	KSRSAC	Roads Centre line	Mobility / Roads	Alignment	Everest_Bangladesh _Polyconic	Line	78,895
7	KSRSAC	Roads Polygons	Mobility / Roads	polygons	Everest_Bangladesh _Polyconic	Polygon	327
8	BWSSB	New Roads	Mobility / Roads	Road name (for some roads), length and type	PCS_Transverse_ Mercator	Line	2,18,067
9	BWSSB	Road	Mobility / Roads	Road alignment	PCS_Transverse_ Mercator	Line	1,85,683
10	вмтс	Big10routes	Mobility / BMTC	Big 10 bus routes	GCS_WGS_1984	Line	13
11	вмтс	Routes	Mobility / BMTC	Bus stop name, location and bus route no.	GCS_WGS_1984	Point	5,451
12	ВВМР	Zone wise - New Roads	Mobility / Roads	Road name, type, length (with ward name, no. zone name)	GCS_WGS_1984	Polygon	1,07,394
13	ВВМР	Zone wise - Roads Center line	Mobility / Roads	Road name, type, length (with ward name, no. zone name)	GCS_WGS_1984	Line	92,825
14	BDA	BDA	Mobility / Roads	Orthorectified image for BMA, road center line, edges			
15	BDA	RMP - 2031	Mobility / Roads	Flyovers/bridges in BMA limits	WGS_1984_UTM_ Zone_43N	polygon	1,071
16	BDA	RMP - 2031		Location of trees along major road corridors		point	2,75,589
17	KSRSAC	Flyover	Mobility / Roads	Type of Flyover	Everest_Bangladesh _Polyconic	Line	127
18	KSRSAC	Flyover Polygon	Mobility / Roads	Type of Flyover	Everest_Bangladesh _Polyconic	Polygon	97

Table 1: Bengaluru road information with multiple agencies in varying formats

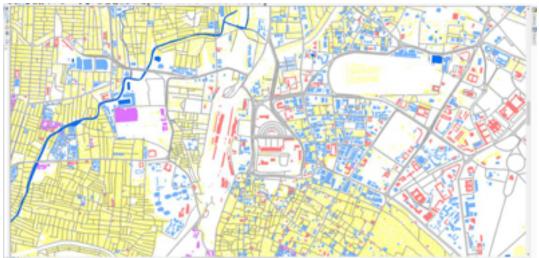
Data Source: Information collected by BBMP expert committee, (Expert Committe: BBMP Restructuring 2015)



Another dataset example of building footprints and land use details for the same area compiled by BDA and BESCOM differ.



Data Source: BDA, BBMP



Data Source: BESCOM



Source: (Clear Value n.d.), BDA - Revised Master Plan - 2015

Figure 7: Building footprints generated by multiple agencies



Agencies also use geo spatial technologies to manage resources, operations and maintenance. The BWSSB mapped its entire network more than thirteen years ago in GIS. Currently experts from National Informatics Centre (NIC) look into updating this database. Several other agencies too in the city use geospatial technologies such as the BDA for its Master Planning efforts, BMRDA for its Revised Structure Plan etc.

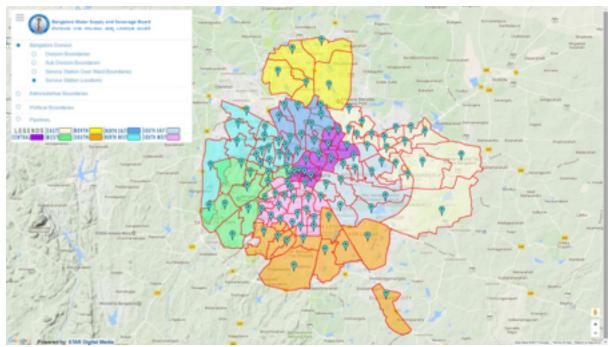


Figure 8: Service station locations of BWSSB in Bengaluru

Source: http://stardigitalmedia.co.in/bwssb4/

4.3 Geospatial data generated by private enterprises and citizen groups in Bengaluru

Institutions, public and civil societies saw the potential geospatial technologies with the introduction of Google Maps, Google Earth and other similar applications. Online E-tailers (like Flipkart, Amazon), taxi aggregators (like Uber, Ola, Meru), logistics delivery agencies (FedEx, DHL, Bluedart) also depend on spatial tools and many small and large private enterprises too are investing in such technologies for commercial and business purposes. Academic institutions, NGOs and citizen groups use spatial tools and applications typically to understand access to utilities and services within the city.

Government datasets are often more comprehensive whereas private enterprises and citizens groups update the data more regularly (Compare figure 7 and figure 9)





Figure 9: Openly available spatial Datasets of Bengaluru in Open street maps Source: http://www.openstreetmap.org/#map=16/12.9776/77.5727

Figure 10, Figure 11 and Figure 12 shows the value addition created by giving a spatial dimension to public information. Figure 13 showcases the Opencity initiative by citizen groups and currently available datasets. Figure 13 and Figure 14, show building encroachments on Rajakaluves to the public. Citizen could easily check the status of their buildings based on their postal address. Agencies like CSTEP, IISc, IIMB, Janaagraha, Oorvani Foundation and many others are creating spatial datasets for Bengaluru..

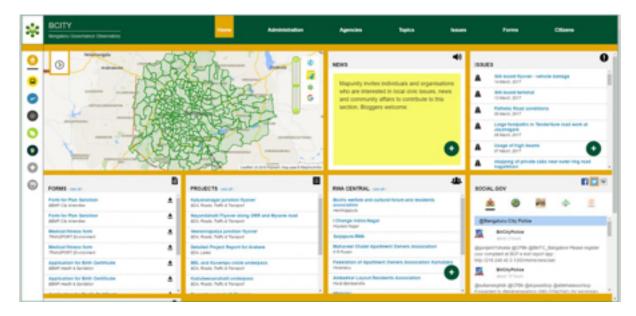
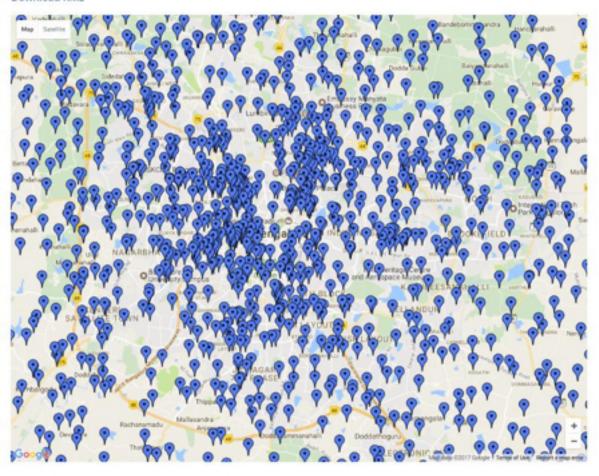


Figure 10: Screenshot-Ward level information of Bengaluru Source: http://Bengaluru.mapunity.com/Government



Locate a school on the map and search by the school name in the table below the map to get the details of that school.

Download KML



Scroll to the right in the table below to view concerned officers contact details.



Figure 11: Screenshot-Bengaluru school's distribution and information in 2013

Source: http://opencity.in/data/Bengaluru-schools-2013



FRAMEWORK FOR BENGALURU SPATIAL INFORMATION CENTER **O**penCitu MANUABLE DATA Open Bangalore AVAILABLE DATA Right click on the link and use save as to download the individual Content Type: Geotagged files. You can also download the entire database here. Bangalore Schools List 2013 with Map View GIS/Maps Education Public Transport Weather BBMP Parks 2016 Election Police Consus BBMP Toilets 2016 GIS/Maps We have both shape files and kml files of Bangalore Ward Maps. We also have SVG maps of Bangalore with all required attributes. BMTC Bus Stops 2016 1. Bangalore Ward Maps in KML format - 2012 Bangalore Ward Maps 2012 in Shape File format – bbmpwards.shx, bbmpwards.fix, bbmpwards.gix, bbmpwards.dbf, BBMP Ward Information with Map View bbmpwards.sql, bbmpwards.shp 3. Bangalore Ward Maps in SVG format - 2012 - Wards have been defined as paths and they have ward number as an attribute. WARD NO. Before BBMP there was BMP, BMP ward maps are available. Trees to be cut in Metro Reach 2 extension and Reach 4b, along Kanakapura Road and Mysore Road 5. Bangalore Pincode Area Download geojson map file or View it on 6. BWSSB (water board) Division, subdivision and main lines KML Maps obtained from BWSSB website. Bus stops 2014 Education 1. List of Pre Schools in Bangalore - has location information too. 2012 BMTC Bus stops

2. List of Schools in Bangalore - has location information too.

Public Transport

Download Everything from Github

1. >BMTC Bannalore Routes, Busstops and Routes-Stop in an SOUTE - 2015 - Has everything, use it if you are a developer...

Source: http://openBengaluru.org/available-data/

Source: http://opencity.in/content_type/geotagged

Bangalore Preschools

Figure 12: Screenshot-Open City initiative and available datasets on Bengaluru





Figure 13: Screenshot-Rajakaluve encroachment finder Source: http://rajakaluve.org/?village=18495&survey=1





Figure 14: Spatial illustration of encroachments visualised on google earth Source: http://rajakaluve.org/?village=18495&survey=1 (based on Revenue Dept. data)

Case Study: Singapore's Successful Dengue Cluster Map

The government of Singapore and the city's National Environmental Agency (NEA) use open spatial data to control the spread of dengue fever epidemics. In 2005, the NEA started sharing information on the location of dengue clusters as well as disease prevention information online, through a website now known as the "Dengue Website." That website assembled cluster maps that help authorities and the public geographically visualize locations where dengue is a problem. These maps help plan vector control operations, update the public, and enable the affected areas to take necessary precautions. The NEA's data-driven cluster map has evolved, becoming an integral part of the campaign against dengue. The site typically sees between 25,000 and 45,000 monthly visits, and almost 100,000 during peak season. The data was opened to app developers, who have filled in data gaps and used it to create a more nuanced and rich picture of the spread of dengue fever.

Source: (thegovlab.org 2016), (Singapore Government - National Environment Agency 2016)



5. Challenges and Opportunities

Challenges

- **Silos**: Government agencies use their own geospatial technologies in a vacuum, uninformed about the corresponding data of their partner agencies. Without sharing procedures, departments have no formal means of accessing extra-departmental data that might enhance or inform their own knowledge and administrative processes.
- Duplication: Each city department addressing its GIS needs on its own is both technology
 and labour intensive and typically requires downstream geoprocessing. There could be as
 many GIS data efforts in the city as there are departments. The same or similar GIS-data is,
 in all likelihood, being generated and maintained by multiple ministries. Such large-scale
 duplication and redundancy is an inefficient use of resources and encourages data
 inconsistency.
- Unstandardized data: Without any standardization across departments, the datasets are
 produced in varied formats, standards, projections and scales, rendering data effectively
 unusable across departments.
- Cost: Government departments spend considerable resources in acquiring high resolution satellite imagery and hiring GIS consultants. These datasets purchased from multiple consultants are mostly fragmented, inconsistent and often out of compliance with national spatial data infrastructure (NSDI) and inter-operability guidelines.
- **GIS-readiness**: There is very little "GIS-Ready" data that is both up-to-date and easily accessible. In spite of the large amount of survey data, topographic maps, satellite images, census data, etc., users must invest substantial technological processing of these data to produce useable content.
- Decision-making utility: The lack of easily accessible and serviceable data limits effective
 policy making. Currently, to obtain a cross-sector snapshot of local conditions, capturing
 demographics, infrastructure, transit, public spaces, etc., the data of over 23 city agencies,
 consisting of at least 102 layers would need to be collated and then processed into a
 universal format. As a consequence, a holistic view of the status on the ground or the state
 of implementation for any given sector or program is extremely difficult.
- **Limited know-how**: Existing staff in government agencies are often not capacitated to use newer technologies and rely on external consultants to prepare GIS databases.

Opportunities

- **Digital India initiative:** Leveraging Geospatial Information Systems (GIS) for decision support systems & development is one of the six elements that are crucial for ensuring that governance and services to be made available on demand to all citizens and other stakeholders in the country as part of Digital India initiative.
- National GIS initiative: The National Government plans to leverage GIS for decision support systems (DSS) & development. National Geospatial Information System (NGIS) is being



implemented to integrate geo-spatial data available with several organizations like Survey of India, NIC, NRSC and MoES to develop a GIS platform for e-Governance applications. The new agency's stated objective is to provide a national platform for developing geo-informatics related resources and capabilities across the country.

- National Data Sharing and Accessibility Policy 2012: The NDSAP-2012 policy is designed to
 promote data sharing and enable access to Government of India owned data for national
 planning and development. This policy will apply to all data and information created,
 generated, collected and achieved using public funds provided by Government of India
 directly or through authorised agencies by various Ministries / Departments/ Organisations/
 Agencies and Autonomous bodies.
- National and State Geo-portals: Several geoportals have been launched in the last five
 years. <u>Bhuvan</u> itself hosts multiple portals for many departments and projects of both
 national and state governments, <u>National Centre Of Geo-Informatics</u>, applications on <u>Delhi</u>
 <u>Geospatial</u> Ltd. for Delhi, <u>Karnataka Geoportal</u> by KSCST, <u>WebGIS Portal</u> for data visualisation
 by KSNDMC provide opportunities to learn and deploy.
- **K-GIS project:** Government of Karnataka has already allocated funds in FY 2015-16 to establish the K-GIS portal. Once accessible, it will offer seamless state-wide GIS data layers as well as a wide range of GIS applications. The Karnataka Jnana Aayoga-GIS Task Force described their goal as "a regime powered by modern metrics systems, efficient informatics and analytics with real-time information delivery and a constant interaction between government and citizens such a regime will have to be the foundation for the governing as well as the governed", which forms the basis for establishing K-GIS.
- **BBMP expert committee recommendation:** One of the proposal made by the committee in its Way Forward report submitted to the Karnataka Government in July, 2015 is for establishing Bengaluru Spatial Information Centre (BASIC). This enables seamless coordination among the government agencies in the city-region and to expose as much data as possible to the public. The Committee has compiled about 102 layers (Refer Annexure-1) which could work as a starting point towards establishing the information centre.
- Private and citizen groups initiatives: Academic institutions, NGOs, private agencies and citizen groups are contributing to building datasets, applications, tools, data analytics and value addition to such data. All these and other crowd sourced efforts are also opportunities for establishing the information centre.
- **Technology to use unstructured data:** Technology is being developed to see the patterns in unstructured data. Programming and other algorithms also help in bringing structure to unstructured data to strengthen and complete other data sets and find the patterns.

BBMP RESTRUCTURING

Case Study: NYC App Challenge Generates Innovation

NYC BigApps is the premier civic tech initiative of the City of New York. Led by the New York City Economic Development Corporation (NYCEDC), BigApps "challenges developers, designers, and entrepreneurs to create functioning, marketable tech tools that help solve pressing civic challenges." They request products around "Challenge Tracks", associated with city needs identified in Mayor de Blasio's OneNYC plan. In 2015 the Challenge Tracks included Affordable Housing, Zero Waste, Connected Cities, and Civic Engagement. The prize money varies by year depending on fundraising, but is sufficient (\$25,000 in 2015) to attract hundreds of ideas each year. The competition is sponsored by a broad array of private entities who contribute financially to the award funds. NYCEDC partners with over a dozen City agencies, policy advocates, and tech experts to offer mentorship to contenders; they also aggregate open data repositories and tools for city data and internet-based APIs.

The 2015 Grand Prize winner in the Connected Cities Challenge Track was an app called CityCharge, a solar-powered charging station for public spaces that uses Bluetooth and beacon technology to gather environmental data, while acting as a WiFi hotspot.

Source: (New York City Economic Development Corporation (NYCEDC) 2015)



6. Framework to setup Bengaluru Spatial Information Centre (BASIC)

An independent statutory agency must be created to carry out the data collation, creation, record keeping, maintenance, and enabling sharing activities for the entire Bengaluru Metropolitan Region (BMR) (covering Bengaluru Urban, Rural and Ramanagaram districts). This agency will be the one-point source and custodian of all the geospatial databases for the entire metropolitan region. This in turn helps in coordinated

Bangalore Spatial Information Centre has the potential to greatly reduce expenses of the exchequer by minimizing project delays and reducing the duplicity of works

planning and project implementation across agencies. Hence, Bangalore Spatial Information Centre has the potential to greatly reduce expenses of the exchequer by minimizing project delays and reducing the duplicity of works.

6.1 Vision & Objectives

"A new information regime supporting good governance, sustainable development and citizen empowerment offering GIS decision support services for government, private enterprise and citizens and maintaining a Bengaluru city-region wide, standardised, seamless and most current GIS asset positioning Bengaluru at the forefront in the use of GIS technology and applications." Adapted from K-GIS vision, (Karnataka-GIS: User Needs Document)

This agency, Bengaluru Spatial Information Centre (BASIC), could be created through enacting a "Geo-spatial Act" for Bengaluru along the lines of the "The Delhi Geo-Spatial Data Infrastructure (Management, Administration, Security and Safety) Act, 2011."

This is also in line with the 'National Data Sharing and Accessibility Policy, 2012' by Department of science and technology, Government of India and in line with Karnataka GIS initiative by Department of IT, BT and ST, Government of Karnataka. (Government of India 2012)

The primary objective of BASIC is to create an authoritative GIS database available to all agencies, enterprises and citizens (see application in Annexure-2):

- 1. Establish single agency
- 2. Integrate data by bringing together the fragmented data from individual departments, standardise the mapping procedures and sharing protocols
- 3. Collect data from above the ground, on the ground and below the ground. Develop 2D and 3D geospatial information, applications and share with all users
- 4. Obtain updates from government agencies, departments, public sources and keep the datasets up to date
- 5. Drive a shift in the city culture by highlighting innovative case studies, running an annual competition, etc., to motivate innovative use of spatial data (Lilian Coral 2016)
- 6. Provide Geospatial information for the benefit of all citizens to meet their day to day needs and promote use of geospatial technologies by government agencies and citizens; taking clue from the objective 3 of (Geospatial Delhi Limited (A Government of NCT of Delhi Company) 2016)



- 7. Provide Bengaluru with information and assistance for framing, decision making, and implementing policies for issues related to geospatial data; taking clue from objectives 1 and 3, (Geospatial Delhi Limited (A Government of NCT of Delhi Company) 2016)
- 8. Build capacity for effective use of geospatial technologies for city planning and development; taking clue from the objective 3 of (Geospatial Delhi Limited (A Government of NCT of Delhi Company) 2016)

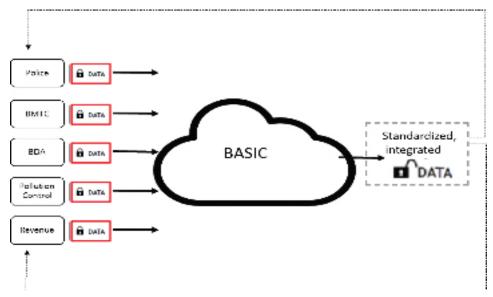


Figure 15: Vision of Bengaluru Spatial Information Centre (BASIC)

Source: WRI India



Figure 16: Secured data integration and exchange with spatial information centre Source: WRI India



6.2 Infrastructure Requirements

To truly transform data usage, the government must invest in up-to-date softwares, dedicated optical fibre cable (OFC) line for stable internet connection, supercomputers for hosting and processing larger datasets and able staff. Lateral hiring of staff must be enabled to run and manage the centre professionally.

The following infrastructure recommendations are largely based on the results of the Karnataka-GIS (K-GIS) User Needs Assessment report (Government of Karnataka 2013). In the K-GIS Vision Document, a multi-disciplinary Task Force performed a comprehensive initial assessment of GIS Decision Support System (DSS) requirements for governance, enterprises, and citizens through a process of user-level consultations. Consisting of meetings with state departments, the private sector, academia and NGOs, the consultations produced a set of recommendations. The insights captured are of great value to Bengaluru's Spatial Information Centre design process.

• Physical Infrastructure

The Centre's Infrastructure can be described as a "GIS Platform" with computing and networking infrastructure. As envisioned, it is structured as a multi-tiered platform with a front-end portal offering various GIS data and applications services, a back-end high-capacity Data Centre for storage, and server architecture to maintain security and controlled access (Government of Karnataka 2013).

Hardware

The specific hardware supporting the system should be selected based on the expert recommendation of the Bengaluru Department of Information Technology and in compliance with any agency hardware requirements. The BASIC's specialized hardware should comply with the following basic parameters for long-term functionality:

- Integrated: Datasets generated by various agencies should be hosted on information centre systems or accessible and seamlessly integrated into the system architecture through hooking onto agencies servers
- **Future-oriented**: The GIS DSS framework should use web-based GIS and database technologies with inherent extensibility for future growth. The framework must be state of the art so as to support the state GIS activities for decades to come (Karnataka Jnana Aayoga 2013).
- **Virtual**: the system should be entirely in the cloud for superior consistency, maintenance, and access (Karnataka Jnana Aayoga 2013).
- **High bandwidth**: High bandwidth capacity will be necessary to manage the data traffic (Karnataka Jnana Aayoga 2013).
- Locally Hosted: The BASIC Infrastructure should be developed, hosted and based in Bengaluru in order to safeguard the system as well as provide GIS Data and Application services on 24x7 basis (Karnataka Jnana Aayoga 2013).

Software

The BASIC framework should be based on a Service Oriented Solution architecture. Drawing on the Karnataka-GIS Vision Document, the information centre's specialised software should comply with the following basic parameters for optimal usability:

• Minimize data translations and system conversions.



- Provide tools for seamless integration of both spatial and geo-tagged non-spatial features.
- Provide GIS data and GIS App services on both mobile and desktop platforms.
- Configure multilingual capability.
- Provide tools for Security Management to configure Role Based Access Control.
- Ensure interoperability.
- Integrate and encourage use of Open source GIS programs (such as QGIS) and open source web mapping (such as OpenLayers and MapBuilder) with BASIC.
- Store metadata (the narrative information about the spatial data) alongside the geodata in the same database, ensuring that geodata always retains its metadata when transferred, shared, or downloaded.
- Elect a vendor-neutral model so that the best technology can be used at any time.

6.3 Data Ownership, storage and sharing protocols

Data ownership

City departments retain ownership of their respective data. BASIC will own any data it creates outside of or in conjunction with existing agency datasets. As custodian and service provider, BASIC is the vehicle for facilitating the usage of this data by the owning department and its accessibility to other city departments. As part of ongoing K-GIS project, each department is identified for some specific datasets like Survey of India responsible for administrative boundaries of state & district whereas state Revenue Department for sub-districts, hoblis, villages/cities; electoral boundaries by State Election Commission of Karnataka, etc. Data from these identified agencies is considered authentic in case of any discrepancy with other datasets.

Data storage and sharing

To achieve the intended seamless interoperability, all departments will be required to adopt the standards designed (in consultation) in a timebound manner. These standards are to be followed for datasets, maps, tools, and programs wherever possible and adopted in the medium to long term (or custom designed by BASIC to suit individual agencies requirements).

The precise means for data sharing with the centre is at the discretion of each department:

- It may provide the raw data to the centre for formatting, ingestion, and storage. This happens physically and hence not updated daily. Data is stored on BASIC servers.
- Agencies may continue to manage the data themselves and provide hooking facility with its server. In this case the data will be fetched in real time from respective agencies (not stored on BASIC servers)

• Data Sharing Protocols:

BASIC to follows mandated ISO standards, National GIS, National Spatial Data Infrastructure, National Natural Resources Management System, Open Geospatial Consortium (OGC), etc. Further it draws upon the standard protocols already designed for K-GIS.



Most of the data will be exchanged across multiple departments, businesses and with public. Open data formats and standard exchange protocols should be followed extensively keeping in view of common citizen with less or no access to software. Seamless data consumption and exchange should happen over browser at user end through web services. For this follow web based service protocols for exchange of spatial information like,

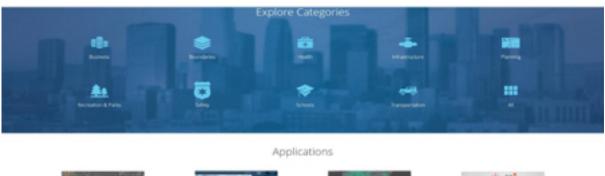
- **WMS** Web Map Service
- WMTS Web Map Tile Service
- WCS Web Coverage Service
- WPS Web Processing Service
- WFS & WFS-T Web Feature Service & Web Feature Service transactions
- **City GML** City Geography Markup Language, open standardised data model and exchange format to store digital 3D models of cities and landscapes.

Refer the information boxes for data sharing, user interface and applications for Los Angeles city

Case Study: Hands-off Approach to Collaboration and Innovation in Los Angeles

In 2016 Los Angeles launched the GeoHub as part of it efforts to keep up with its regional competitor and global "tech hub," the San Jose-San Francisco-Oakland metropolitan area. The Mayor enacted Executive Directive 3 to launch the open data program. Los Angeles GeoHub, an open data web portal, allows the public to download datasets as shapefiles, KML files, or into spreadsheets. They can also visualize the data as online maps using ArcGIS. This location-as-a-service (LaaS) platform, means users can access live, continuously updated data directly from the city as a service—rather than as a static download. The mayor's mapping team hopes this will encourage citizens and entrepreneurs to create dynamic applications for public and commercial use. Developers can access the city's data, along with open APIs, to build apps that they can bring to market. The GeoHub is an effort to harness the existing entrepreneurial activity for the benefit of the city.

LA GeoHub sharing protocol: City staff can join groups to collaborate and create maps together. LA's sharing protocols are not prescriptive, instead they encourage cross-departmental collaboration and expect to see groups come together organically to visualize multifaceted city issues. The GeoHub has only been operational since April 2016, so this collaboration model is as yet unproven. The platform allows users to assign different roles to users to maintain quality control. The Mayor's Data Team functions as administrators of the Hub, but each city department can appoint an administrator for their "organization" and city staff can either be publishers or users added to the various organizations or groups they've joined.





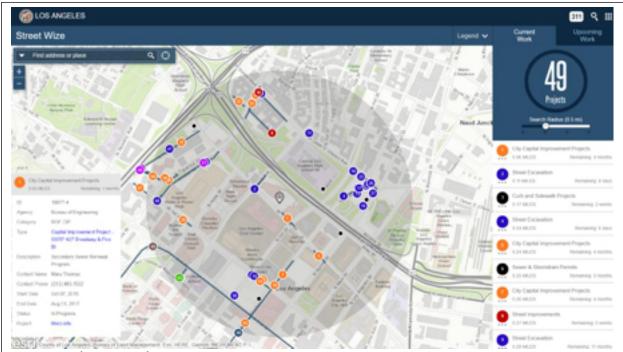






Source: (Esri ArcNews 2016), (Office of Mayor Eric Garcetti, City of Los Angeles 2016) and (Lilian Coral 2016)





Street Wize (Application): View construction and permit activities around any location

Source: http://laways.s3-website-us-west-1.amazonaws.com/



CleanStat (Application): Rate your street cleanliness

Source: https://lahub.maps.arcgis.com/apps/MapJournal/index.html?appid=4b62eb4528944af9ac1535817da965c4



6.4 Organisational Structure

Reflecting its government-wide reach, every department that works (in Bengaluru and its region) and provides spatial data will be represented in the statutory agency's organisational structure. In the proposed structure a governing body is made up of principal secretaries representing all the city level agencies and departments to oversees BASIC, ensuring leadership buy-in and coordination.

An Executive committee is proposed with the principal secretary of UDD and all administrative heads of the organisations working in Bengaluru and its region. Experts from state agencies like K-GIS, KSNDMC, KSCST, NIC and experts from national agencies like NCoG, NIC, Bhuvan, academia will be on executive committee to advise on administration and on technical aspects. Considering the continuously evolving nature of the technology, technical expert members of the executive committee needs to be revised on a regular basis.

BASIC will be headed by a Director and have four verticals - Administration, Projects, Quality Control & Standardisation and Training and Capacity Building Teams will be fully staffed with its own management structure. BASIC will be overseen by a director's office, determining roles, staffing needs and workload distribution for each team.

Preventing Institutional Redundancy

Some of BASIC's proposed functions may overlap with existing services currently provided by state agencies such as K-GIS, KSRSAC, KSNDMC, etc. Task force committee in consultations with such agencies will facilitate the coordination necessary to prevent redundancy.

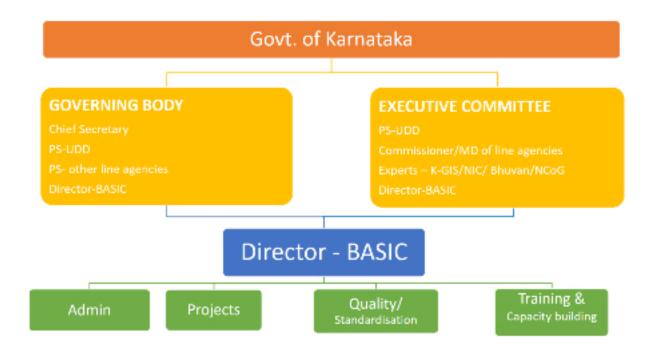


Figure 17: Proposed Organisational structure



6.5 Funding & Institutional Mechanism

Funding Pattern

Funding should come from Karnataka government through Urban Development Department as most of the major city agencies like BBMP, BDA, BMRDA, BWSSB, DMA, DTCP, KUIDFC, etc., directly report to UD principal secretary. The establishment and initial operations of the agency need to be supported over a minimum initial period, for example the first three years, followed by an annual recurring expense for BASIC operations. The funds for establishing the Centre will be committed through the enactment of geospatial legislation.

BASIC administration should prepare blue print to manage its own resources beyond seed funding period and steer the institution in that direction like offering value addition, intellectual property rights, developing tools and applications, training and capacity building, research & consultancy services, etc. For this centre should be led by an able administrator through a lateral hiring system.

Institutional Mechanism

• Initiate establishment process with Government Order

- Pass Government Order to enable setting up of Bengaluru Spatial Information Center
- Jurisdiction should not be less than Bengaluru Metropolitan Region
- Mandate all the agencies to compulsorily share a copy of their datasets

• Set up a task force with an able leader

- Setup task force to establish the center
- Identify a champion to lead the task force.
- Adopt consultative process for smooth running of the center
- Prepare draft bill for enacting the Geospatial Act.

• Pass Geo-Spatial Act for Bengaluru

Like Delhi, Karnataka envisions enacting legislation for Bengaluru Spatial Information Centre (BASIC). A requisite procedural step to achieve the mandate necessary for the entity to be effective. Bengaluru needs to enact legislation enshrining the objective, structure, administration, budget, authority, and enforcement mechanism for BASIC. Prepare blueprint for future where BASIC provides technological edge to the city and manage its own resources (beyond initial period) and steer the institution on a successful path achieving and serving its intended objectives.



Annexure 1: 102 Spatial Layers collated by the BBMP-R Committee

Sector	Sub sector	Layer	Geospatial Information (available)	Projection	Feature	Count	Limits	Source
Development_Plans	BDA_Landuse	Existing_la nduse	Residential, commercial, industrial, Agriculture, Forest, villages, wasteland, others	WGS_1984_UTM_Zone _43N	Polygon	3685	BDA	BESCOM
Development_Plans	Layouts	BDA_layou ts	Name of BDA Layout with village and hobli name, area, approval date, survey nos., no. of plots	GCS_WGS_1984	Point	232	BDA	CSTEP
Development_Plans	Layouts	Private_lay outs	Name of layout with village and hobli name, area (acres-gunta), registration date, survey nos., no. of plots	GCS_WGS_1984	Point	256	BDA	CSTEP
Development_Plans	Layouts	Unauthoris ed_layouts	Location and address of unauthorised layouts with village name and status	GCS_WGS_1984	point	123	BDA	CSTEP
Environment	Drainage	Watershed s	Extents of basins, watersheds, subwatersheds, mini watersheds and microwatersheds	Everest_Bangladesh_P olyconic	line	779	BDA	BDA
Environment	Drainage	Watershed s	Extents of basins, watersheds, subwatersheds, mini watersheds and microwatersheds	Everest_Bangladesh_P olyconic	Polygon	303	BDA	BDA
Environment	Drainage	Network	Length of natural drinage (network)	Everest_Bangladesh_P olyconic	line	3473	BDA	BDA
Environment	Forests	Reserved_F orests	Name and location of Reserved forests in BMR limits	GCS_WGS_1984	Polygon	174	BMR	Forest Department
Environment	Geology	Soil_types	Soil type, location and classification (order, suborder, group, subgroup, family, series, soil depth, texture, classification nos., etc)	Everest_Bangladesh_P olyconic	polygon	1721	BDA	BDA
Environment	Geology	Lineaments	Data on structures/ILineaments	Unclassified	Line	1380	BDA	Mines & Geology
Environment	Geology	Groundwat er_prospec ts	Extents of ground water prospects (good to poor)	WGS_1984_UTM_Zone _43N	Polygon	703	BDA	BDA



Environment	Landuse_landcov er (LULC)	Landuse and	Landuse and Landcover (NRSC classifications - type-1,2 and 3)	Everest_Bangladesh_P olyconic	Polygon	2849	BDA	BDA
Environment	Openspaces	BDA_Parks _openspac es	Location of park/open space with layout name, area (with measurements in E-W and N-S directions), date of handover to municipality	GCS_WGS_1984	Point	574	BDA	CSTEP
Environment	Openspaces	Parks_play grounds	Location and type (park or playground)	GCS_WGS_1984	polygon	287	ВВМР	CSTEP
Environment	Trees		Location of trees along major road corridors	WGS_1984_UTM_Zone _43N	point	275589	BDA	BDA
Environment	Waterbodies	Lakes	Location and extents of waterbodies	Everest_Bangladesh_P olyconic	polygon	565	BDA	BDA
Environment	Waterbodies	Lakes	Type, location and extents of waterbody	WGS_1984_UTM_Zone _43N	polygon	452	BDA	BESCOM
Environment	Waterbodies	Rivers	Location of rivers	Unclassified	polygon	3	BMR	CSTEP
Jurisdiction	Administrative	Hoblis	Hobli jurisdictions and names in BMA	WGS_1984_UTM_Zone _43N	polygon	16	BDA	BDA
Jurisdiction	Administrative	Taluk	Name and extents of Taluk boundaries	WGS_1984_UTM_Zone _43N	polygon	4	BDA	BDA
Jurisdiction	Administrative	ULBs_cens us_2001	Name, location and primary census abstract details of census 2001 for ULBs in BMA	Unclassified	Polygon	8	BDA	BESCOM
Jurisdiction	Administrative	BBMP_bou ndary	BBMP boundary	WGS_1984_UTM_Zone _43N	polygon	1	ВВМР	ВВМР
Jurisdiction	Administrative	BBMP_zon es	BBMP zones	WGS_1984_UTM_Zone _43N	polygon	8	ВВМР	ВВМР
Jurisdiction	Administrative	BBMP_war ds _MLAs	BBMP ward boundaries	WGS_1984_UTM_Zone _43N	polygon	198	ВВМР	ВВМР
Jurisdiction	Electoral_Constit uencies	Assembly	Name and extents of assembly contituencies in BMA limits	Unclassified	polygon	28	BDA	BDA



Jurisdiction	Electoral_Constit	Parliament	Name and extents of parliament	Unclassified	polygon	5	BDA	BDA
Jurisdiction	uencies Electoral_Constit uencies	BBMP_ML As	contituencies in BMA limits MLA constituencies within BBMP		Polygon	198	ВВМР	BDA
Jurisdiction	Fire	Fire_statio	Name and location of fire stations	WGS_1984_UTM_Zone 43N	Points	13	ВВМР	CSTEP
Jurisdiction	Police	Division_li mits	Name of the division	WGS_1984_UTM_Zone _43N	Polygon	7	BDA	Police Department
Jurisdiction	Police	Subdivision _limits	Name of the subdivision and corresponding division name	WGS_1984_UTM_Zone _43N	Polygon	21	BDA	Police Department
Jurisdiction	Police	Police_stati on_limits	Name of the police station, its limits with subdivision and division names	WGS_1984_UTM_Zone _43N	Polygon	103	BDA	Police Department
Jurisdiction	Postal	Pincode_li mits	PIN code jurisdictions and post office name	WGS_1984_UTM_Zone _43N	Polygon	100	BDA	Open Source
Mobility	Bus	Bus_depot s	Location of bus depot, Rickshaw stand	WGS_1984_UTM_Zone _43N	point	8	BDA	BESCOM
Mobility	Bus	Big_10_rou tes	Bus route number and number of stops (en route)	GCS_WGS_1983	Line	13		ВМТС
Mobility	Bus	Bus_shelte rs	BMTC bus shelter name and location	GCS_WGS_1984	Point	1076		ВМТС
Mobility	Bus	Bus_stops	Bus stop name, location and geocode ID	GCS_WGS_1984	Point	7686		ВМТС
Mobility	Bus	Bus_statio ns	Major BMTC bus deports/stations/stops	GCS_WGS_1984	Point	116	ВВМР	ВМТС
Mobility	Bus	Bus_depot s	Bus depot name, number, status, category, area, survey no., hobli, taluk, district	GCS_WGS_1985	Point	38		ВМТС
Mobility	Bus	Routes	BMTC draft bus route number, origin, destination, distance, number of stops (en route)	GCS_WGS_1986	Line	2426		ВМТС
Mobility	Bus	Bus_stops	Bus stop name, location and bus route no.	GCS_WGS_1984	Point	5451		ВМТС
Mobility	Bus	Bus_Termi	Name and location of Interstate bus	GCS_WGS_1985	Point	2	ВВМР	CSTEP



		nals	terminals					
Mobility	Grade_separator s	Flyovers_br idges	Flyovers/bridges in BMA limits	WGS_1984_UTM_Zone _43N	polygon	1071	BDA	BDA
Mobility	Metro	Alignment	Alignment drawings in DWG format					BMRCL
Mobility	Metro	Alignment_ phase-1	Metro alignment		Line			BMRCL
Mobility	Metro	Stations_p hase-1	Metro stations		Point			BMRCL
Mobility	Railways	Stations	Stations Name and location	WGS_1984_UTM_Zone _43N	Point	89		Railway
Mobility	Railways	Network	Railway track alignment and guage type	WGS_1984_UTM_Zone _43N	line		BDA	BESCOM
Mobility	Railways	Stations	Schematic alignment with existing stations names and proposed new lines in Bangalore division (in DWG format)					Railway
Mobility	Railways	Network_p olygon	Railway track alignment and gauge type		Polygon	1		Railway
Mobility	Roads	Arterial_ro ads	Bangalore arterial roads	GCS_WGS_1984	Line	19	BDA	CSTEP
Mobility	Roads	Road_Edge s	Extents of road edge	WGS_1984_UTM_Zone _43N	polygon	38	BDA	BESCOM
Mobility	Roads	Extents	Same as above in polygons		Polygon	327	BDA	BESCOM
Mobility	Roads	Names	Road name (for some roads), length and type	PCS_Transverse_Merca tor	Line	218067	ВВМР	ВВМР
Mobility	Roads	Center_line s	ID, Name, Type , Ward no, Ward name, Zone, Length		Line	92825	ВВМР	ВВМР
Mobility	Traffic_Police	Surveillanc e Cameras	Surveillance Cameras	kml	Point	160		ВТР
Mobility	Traffic_Police	Signals	Signal Lights (Old and New)	kml	Point	299		ВТР
Mobility	Traffic_Police	Major_corr idors	Corridors	kml	Line	21		ВТР
Properties	ВВМР	BBMP_offi	Name, location, address and contact	GCS_WGS_1984	point	126	BBMP	CSTEP



		ces	no. of BBMP offices					
Properties	BDA	BDA_office s	BDA office locations with address and contact nos. zonewise	GCS_WGS_1984	point	5	BDA	CSTEP
Properties	BESCOM	BESCOM_o ffices	Location of BESCOM office with address and phone number	GCS_WGS_1984	point	115	ВВМР	CSTEP
Properties	BWSSB	BWSSB_off ices	Major BWSSB office location with address and contact no.	GCS_WGS_1984	Point	77	ВВМР	CSTEP
Properties	вмтс	BMTC_Pro perties	BMTC property name, area (as per records), survey no, hobli, taluk, district, status, category, photo	GCS_WGS_1984	Polygon	235		ВМТС
Properties	Buildings	Individual_ buildings	Individual building location, height and plinth area	WGS_1984_UTM_Zone _43N	polygon	1E+06	BDA	BDA
Properties	Buildings	Buildings	Individual building location, type of use, footprint (plinth)	WGS_1984_UTM_Zone _43N	polygon	37220	BDA	BESCOM
Properties	Plots	Individual_ Plots	NPLNO,NPID, Street ID, Ngrid No, Notice no,Apl_no, OPID, OPLNo,NwardNo,NwardName, Zone, Usage, No_Floors, Floors, type, aplno0809, owner, address, no, category id, apt name, remarks,usage from date, npid old,		Polygon	1E+06	ВВМР	ВВМР
Properties	Buildings	BBMP_offi ces	Name, location and address of BBMP offices	GCS_WGS_1984	Points	126		CSTEP
Properties	Buildings	BDA_office s	Zonewise and BDA head office location, address with contact nos.	GCS_WGS_1985	Points	5		CSTEP
Properties	Buildings	Farm_hous es	Name and location of farm houses	GCS_WGS_1984	Point	43	ВВМР	CSTEP
Properties	Grade_separator s	Flyovers	Type of Flyover		Line	127		CSTEP
Properties	Grade_separator s	Flyovers	Type of Flyover		Polygon	97		CSTEP
Properties	Fire	Fire_statio ns	Name, location and contact no. of fire stations in Bangalore	GCS_WGS_1989	point	13	ВВМР	CSTEP



Properties	KEB	KEB_offices	Name and location of KEB offices in Bangalore	GCS_WGS_1990	point	14	BDA	CSTEP
Properties	Police	Police_stati ons	Name of the police station, PS no., division, subdivision, contact no., CUG no.		Point	107	BDA	CSTEP
Properties	Traffic_Police	Stations	Police station name, location and contact details	kml	Point	33	BDA	Police Department
Properties	KSPCB	KSPCB_offi ces	Location, address and contact no. of state pollution board offices	GCS_WGS_1984	point	3	ВВМР	CSTEP
Utilities	BESCOM	BMAZ_limi ts	Extents of BESCOM Bangalore zone	WGS_1984_UTM_Zone _43N	polygon	1		BESCOM
Utilities	BESCOM	Zone_limits	Bangalore Zone boundary	WGS_1984_UTM_Zone _43N	polygon	3		BESCOM
Utilities	BESCOM	Division_li mits	Name and extents of BESCOM divisions in Bangalore zone	WGS_1984_UTM_Zone _43N	polygon	12		BESCOM
Utilities	BESCOM	Subdivision _limits	Extents of BESCOM subdivisions in Bangalore zone	WGS_1984_UTM_Zone _43N	polygon	42		BESCOM
Utilities	BESCOM	Circle_limit s	Name and extents of BESCOM circles, divisions and subdivions in Bangalore metropolitan area zone	WGS_1984_UTM_Zone _43N	polygon	48		BESCOM
Utilities	BESCOM	Section_li mits	Name and extents of BESCOM sections in Bangalore zone	WGS_1984_UTM_Zone _43N	polygon	131		BESCOM
Utilities	BESCOM	Sections_hi erarchy	Name and extents of BESCOM circles, divisions, subdivions and sections in Bangalore metropolitan area zone	WGS_1984_UTM_Zone _43N	polygon	131		BESCOM
Utilities	BWSSB	Subdivision _limits	Name and subdivisions number	PCS_Transverse_Merca tor	Polygon	31		BWSSB
Utilities	BWSSB	Division_li mits	Name of the division	PCS_Transverse_Merca tor	Polygon	9		BWSSB
Utilities	BWSSB	Service_sta tions_limits	Name of the service stations with division details	PCS_Transverse_Merca tor	Polygon	110		BWSSB



Utilities	BWSSB	Manholes	Manholes - location, type, material, depth, month & year of installation, cover state, cover material, SSID, etc.	PCS_Transverse_Merca tor	Point	164368		BWSSB
Utilities	BWSSB	Sewer_net work	Sewer Lines - pipe alignment, length, flow type, diameter, material, month & year of installation, joint type, ss managed, replaced year, name of contractor, etc.	PCS_Transverse_Merca tor	Line	54424		BWSSB
Utilities	BWSSB	Valves	Valve location, type, diameter, material, operation type, month & year of installation, etc	PCS_Transverse_Merca tor	Point	31437		BWSSB
Utilities	BWSSB	Water_pip es	Water pipe line alignment, type, length, diameter, material, month & year of installation, joint type, SSID, etc.	PCS_Transverse_Merca tor	Line	64354		BWSSB
Utilities	BWSSB	Drainage_n etwrok	Name, location and length of drain network	PCS_Transverse_Merca tor	Line	1339	BDA	BWSSB
Welfare	Education	Schools	School name, location,administration type, year established, staff and student nos., medium of instruction, no. of computers, classrooms, toilet nos. (sepeartely for girls & boys), etc	WGS_1984_UTM_Zone _43N	Point	5443	Bangalo re urban and rural districts	Akshara Foundation
Welfare	Food_Civil_suppl ies	KFCSC	Name, location, address, contact no. of food and civil supplies corporation units		Point	5	ВВМР	CSTEP
Welfare	Health	Hospitals	Name and location of hospitals	GCS_WGS_1984	Points	454		CSTEP
Welfare	Health	Hospitals	Hospitals name, location, address, speciality, certified status, no. of beds, type - Govt./Pvt., contact no., etc	GCS_WGS_1984	point	135	ВВМР	CSTEP
Welfare	Amenities	Civic_amen ities	Layout wise civic amenity site location with site area, no., allotee and purpose	GCS_WGS_1984	point	890	ВВМР	CSTEP
Welfare	Birth_Death	Cremation _burial	Name and location of cremation/burial grounds in Bangalore	GCS_WGS_1984	Point	12	ВВМР	CSTEP



		grounds						
Others	Facilities	Landmarks	Name, location, address and contact nos. of facilities (clinics, clubs, colleges, hotels, libraries, pharmacies, temples, police stations, pubs, restaurents, etc.)	unclassified	Points	12705		CSTEP
Others	Facilities	Railway_ Reservatio n_Centers	Name, location and address of railway ticket reservation counters	GCS_WGS_1984	Point	8	ВВМР	CSTEP
Others	Landmarks	Landmarks	Name and location of major landmarks	WGS_1984_UTM_Zone _43N	point	448	BDA	BESCOM
Others	Landmarks	Landmarks	Landmarks withaddress		Points	54889		ONZE
Others	Landmarks	Landmarks	Landmark name and location	PCS_Transverse_Merca tor	Point	14341	BDA	ONZE
Others	Settlements	Village_geo codes	Location of settlements in BMR (No data inside Bangalore urban district and partial data outside)	GCS_WGS_1984	Points	1473		ONZE



Annexure 2: Major areas of Applications for City Planning, Implementation and Management

	Areas	Applications
1	Safety & Security: The twenty-first century is more complex, intricate, and reliant on technology than ever before. A safe community embraces a methodology and infrastructure where all sectors of the community work together collaboratively to safeguard citizens' well-being and property. Sharing information fosters partnerships that enhance safety, manage risk, and increase overall communal engagement. As governments work toward collective integration, their combined resources help anticipate crime and other outcomes before they occur.	1) Disaster Response 2) Health Threats 3) Crime Management 4) Community resilience 5) Infrastructure protection 6) Event Security
2	Healthy: When it comes to community health, many different services, departments, and nonprofits interact for the benefit of the public. Before they act, they pull data from all available sources to justify decisions during planning or moments of crisis. To predict future illnesses before people become sick, find transmission patterns by visualizing real-time and historical threat data. By accessing shared insights through a central platform, multiple audiences stay informed and are readied to fulfill their roles if needed.	7) Public Health 8) Human Services 9) Health Care Providers 10) Food quality inspection
3	Liveable: Municipal and utility professionals do the difficult jobs that make their communities livable. Their daily operations include everything from making the movement of people, goods, and services flow safely to maintaining the aesthetic character representative of an area's quality of life. Even though their work is essential to business and the lives of every person, it's not uncommon that their efforts go unrecognized or without enough support. Citizens can change this. When GIS connects the community to government programs, crowdsourced information can combine with enterprise data and IOT feeds to proactively assess where necessary infrastructure repairs and other opportunities to improve livability exist.	 11) City Asset Management (Roads, buildings & bridges) 12) Vector surveillance 13) Weather Management 14) Solid Waste Management 15) Parks and Playgrounds 16) Water and sanitation 17) Energy and other utilities and services
4	Sustainable Planning: To the benefit of sustainability, GIS connects citizens to their government so they may work together to fight deforestation, uphold community health, and preserve living standards. Planners and urban designers use this technology to balance competing interests, fuse data from a variety of sources, and communicate their intentions to multiple audiences. By incorporating geodesign into planning, communities are better positioned to provide citizens a sustainable future that won't compromise the land, water, or air quality they hold dear.	 18) Comprehensive Planning and development 19) Environmental Planning & implementation 20) Transportation Planning & management 21) Urban Planning and Design
5	Prosperous: Communities prosper when they use authoritative data to identify market trends that attract investments. Whether appealing to potential residents or businesses, economic development planners help communities grow by emphasizing the importance of location. To better prepare a community for prosperity, connect entrepreneurs to information so they may reveal investment opportunities.	22) Attract Business 23) Capital investment 24) Research and Development 25) Branding and tourism 26) Employment opportunities 27) Social Cohesion
6	City Management	28) Urban insight



A well-run community identifies opportunities to achieve advantageous collaboration. If data and developments are shared openly, both citizens and infrastructure providers benefit from events such as road resurfacing. When multiple agencies can inspect and repair assets simultaneously, time and money are saved while reducing future disruptions in the process.

- 29) Capital Investment
- 30) Project Proposals and priorities
- 31) Intelligent response
- 32) Citizen engagement
- 33) Field Services
- 34) Educational facilities
- 35) Open Government (& open data)

Data Source: http://www.esri.com/smart-communities



Bibliography

Bengaluru, Citizens Matter. *Launching OpenCity.in - a data portal for Indian cities* . 14 April 2016. http://Bengaluru.citizenmatters.in/blogs/editors-blog/blog_posts/launching-opencity-in-a-data-portal-for-indian-cities?utm_source=copy (accessed August 8, 2016).

Clear Value. Clear Value. http://www.clearvalue.in/cdp/cdpMap.html?Loc=BlrCore (accessed 03 03, 2017).

Esri ArcNews. *India: A Vision for National GIS*. Fall 2013. http://www.esri.com/esrinews/arcnews/fall13articles/india-a-vision-for-national-gis (accessed August 8, 2016).

—. "Los Angeles Launched GeoHub." Spring 2016. http://www.esri.com/esrinews/arcnews/spring16articles/los-angeles-launched-geohub (accessed August 8, 2016).

ESRI, ArcIndia News. *ArcIndia News | Geo-Enabling Digital India*. 2014. http://www.esri.in/esrinews/publication/vol8-issue3/articles/state-gis-an-integrated-and-collaborative-platform-for-geo-enabling-governance (accessed March 03, 2017).

Expert Committe: BBMP Restructuring. *Bengaluru: Way Forward*. Government of Karnataka, Expert Committe: BBMP Restructuring, 2015.

Geospatial Delhi Limited (A Government of NCT of Delhi Company). *About GSDL.* 2016. http://gsdl.org.in/Aboutus (accessed August 8, 2016).

Government of India. *Digital India Awards 2016.* 8 August 2016. http://digitalindiaawards.gov.in/ (accessed August 8, 2016).

—. "Launch of National Centre for Geo Informatics ." *Department of Electronics and Information Technology - Digital India*.

http://www.digitalindia.gov.in/writereaddata/files/ggd/deity/1%20Launch%20of%20National%20Ce ntre%20for%20Geo%20Informatics.pdf (accessed August 8, 2016).

- —. *National Centre of Geo Informatics (NCoG).* 17 March 2016. http://negd.gov.in/national-centregeo-informatics-ncog (accessed August 8, 2016).
- —. "National Data Sharing and Accessibility Policy 2012." *Department of Science & Technology.* 2012. http://ogpl.gov.in/NDSAP/NDSAP-30Jan2012.pdf (accessed August 8, 2016).
- —. Open Government Data (OGD) Platform India. 8 August 2016. https://data.gov.in/.

Government of Karnataka. *Karnataka - GIS (K-GIS): Unique tool for governance and citizens services.* 2015. http://www.karnataka.gov.in/jnanaayoga/Pages/ini-kgis.aspx (accessed August 8, 2016).

—. "Karnataka-GIS: Stakeholder Consultation and User Needs Document." February 2013. http://www.karnataka.gov.in/jnanaayoga/Archives/KJA%20Reports%20Sep%202008-March%202013/KGIS%20Stakeholder%20Book.pdf (accessed August 8, 2016).



Government of Sikkim. *Open Government Data Portal of Sikkim*. 8 August 2016. https://sikkim.data.gov.in/ (accessed August 8, 2016).

Karnataka Jnana Aayoga. "KARNATAKA-GIS: VISION DOCUMENT." *Karnataka - GIS (K-GIS): Unique tool for governance and citizens services.* February 2013.

http://www.karnataka.gov.in/jnanaayoga/Archives/KJA%20Reports%20Sep%202008-March%202013/KGIS%20Vision%20Document.pdf (accessed August 8, 2016).

Lilian Coral, Chief Data Officer at Office of Mayor Eric Garcetti, City of Los Angeles, interview by Kate Traynor. Los Angeles GeoHub objectives, establishment, and process (4 August 2016).

New York City Economic Development Corporation (NYCEDC). *Connected Cities: Data Sets & Other Tools*. 2015. http://bigapps.nyc/p/resources/connected-cities-data-sets-other-tools/ (accessed August 8, 2016).

Office of Mayor Eric Garcetti, City of Los Angeles. "Los Angeles GeoHub." City of Los Angeles. 2016. http://geohub.lacity.org/ (accessed August 8, 2016).

Oracle. *Data Visualization*. https://www.oracle.com/solutions/business-analytics/data-visualization.html (accessed 03 03, 2017).

Singapore Government - National Environment Agency. *The Dengue Website*. 2016. http://www.dengue.gov.sg/ (accessed August 8, 2016).

The Delhi Geospatial Delhi Limited, A Govt. of NCT of Delhi Company. *Geospatial Delhi Limited - Home*. http://gsdl.org.in/index (accessed August 8, 2016).

thegovlab.org. *Singapore's Dengue Cluster Map.* 2016. http://odimpact.org/case-singapores-dengue-cluster-map.html (accessed August 8, 2016).

World Economic Forum. *How is open data changing India?* 19 February 2015. https://www.weforum.org/agenda/2015/02/how-is-open-data-changing-india/ (accessed August 8, 2016).

World Resources Institute India, Embarq. "Open Data In Urban Transport As A Driver Of Innovation And Entrepreneurship." http://wricitiesindia.org/our-work/topics/innovation, 2015.

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