

Case Studies on e-Governance in India

i-Bhugol Bihar Infrastructure Mapping Geomatics Oriented Application Model

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i-Bhugol

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About the Initiative

This publication is a part of the Capacity Building initiative under the National e-Governance Plan (NeGP) by NeGD with an aim to draw out learnings from various projects implemented in various States/ UTs and sharing this knowledge, in the form of case studies, with the decision makers and implementers to benefit them, by way of knowledge creation and skill building, from these experiences during planning and implementation of various projects under NeGP.

Conceptualised and overseen by the National e-Governance Division (NeGD) of Media lab Asia/DeitY these case studies are submitted by e-Governance Practitioners from Government and Industry/Research Institutions. The cases submitted by the authors are vetted by experts from outside and within the Government for learning and reference value, relevance to future project implementers, planners and to those involved in e-governance capacity Building programs before they are recommended for publication. National Institute for Smart Government (NISG), working on behalf of this NeGD provided program management support and interacted with the authors and subject matter experts in bringing out these published case studies. It is hoped that these case studies drawn from successful and failed e-Governance projects would help practitioners to understand the real-time issues involved, typical dilemmas faced by e-Governance project implementers, and possible solutions to resolve them.

Acknowledgment

NISG sincerely thanks all the authors for documenting and sharing their rich experiences in terms of challenges and lessons learned and allowing us to publish and use these case studies in various training programs of NeGD and NISG. NISG also thanks all the external and internal experts who helped review the submitted cases, providing critical observations and for helping in articulating and presenting the case studies, both for class room use as well as a reference article.

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NISG-CBKM 100-200/Case Study/10-2014/V2

Printed & Published by
National Institute for Smart Government
www.nisg.org
on behalf of the
National e-Governance Division (NeGD)
Department of Electronics & Information Technology
Ministry of Communications & IT
Government of India

TABLE OF CONTENTS

Abbreviations	24
Abstract.....	1
Note to Practitioners/Instructors	1
Project Context	2
Project Overview.....	4
Objectives	6
Stakeholders	7
Implementation Strategy	10
Technology.....	12
Training and Capacity Building.....	14
Outcomes and Benefits Realized	16
Challenges in Implementation	18
KEY LESSONS	20
Research methodology	22
Conclusion.....	23
References	24
Case fact sheet.....	26
Annexure i - Questionnaire	28

Abstract

i-Bhugol is a web-based Geographic Information System (GIS) that provides single window access to topographical, geographical, infrastructural and social information for the state of Bihar. It is the first GIS enabled application implemented for the state and is the first in the country that provides information at the 1:4000 scale or cadastral level. It is also the first time the concept of spatial planning and decision-making has been introduced in the state.

The system is being currently used by eight government departments for a host of developmental functions. Planners and decision-makers use the portal to view the spatial distribution of assets, infrastructure and demographics. This enables data-driven decision making and brings in more equitable development. The system is also used for monitoring and evaluation as it tracks physical and financial progress on worksites. It is dynamically updated by the departments that use it and can be updated by citizens as well.

i-Bhugol was implemented by NIC Bihar and became operational in 2011 after successful testing through various pilots. It was awarded the Gold Medal in the National e-Governance Awards 2012-13 under the category of 'Innovative use of Technology in e-Governance'.

Key words: Bihar, NIC, GIS, GPS, geomatics, planning, decision-making, monitoring, topography, geography, infrastructure

Note to Practitioners/Instructors

This case study seeks to provide operational details about the i-Bhugol initiative of the Government of Bihar and technical details of the project. It provides an overview about the strengths and challenges faced by an initiative like this, as also the key lessons that can be drawn from its implementation so far.

Instructors can raise the following questions to trainees:

1. At what point, should a project such as this be deployed and what arguments can be used to overcome the hesitations of stakeholders?
2. If the project had to be replicated in a different state, which would be a better choice for an implementing agency: a Central level body such as the NIC or a state level body such as the IT Department? Assess the pros and cons of each choice keeping the scope and scale of work in mind.
3. How can field level operatives be motivated for such a project?

Project Context

Bihar is one of the fastest growing states in India with a population estimate of around 103 million.¹ However, its exponentially increasing population is challenged with chronic socioeconomic problems, thereby, impeding the overall development of the state. The World Bank Report on Bihar² published in the year 2005 highlights the challenges of unequal growth and development that the state is facing due to persistent poverty, poor infrastructural facilities, weak governance, corruption and inadequate implementation of plans and policies. It faces immense developmental challenges due to regional disparity, low agricultural production, vulnerability to floods and famines, limited opportunities in the services sector, low literacy levels, and increasing migration.

One factor that limited the government's response to these developmental challenges was the lack of an effective *knowledge management system* that monitored the state's natural resource base as well as physical and social infrastructure. The existing knowledge management system was largely manual and siloed. Data would be stored in manual records and registers and there would be limited information sharing across departments. As a result of the manual system, data could not be instantly accessed, collation and analytics became difficult and the security of data was also at risk owing to the vulnerabilities manual records face.

In planning developmental activities, information on the existing resource base as well as the available physical and social infrastructure is essential. Effective planning cannot be carried out without knowing what resources are available, how they are distributed and which areas and sectors are facing deficits. While a few departments within the Bihar government had taken initiatives to digitise their knowledge management systems and transition to Management Information Systems (MIS), there was still a lack of a single, comprehensive, state-wide database that provided planners and decision makers with this information in a way that was easy to obtain and use.

It was to address precisely this deficiency that the concept for developing i-Bhugoal was put forward by the NIC state unit of Bihar. Drawing upon the Hindi word 'bhugoal' which means geography, i-Bhugoal was conceptualised to be a single source of knowledge that integrated data from different sources and provided planners and decision makers with an *asset register* containing the existing natural resource base of the state and social and physical infrastructure. It was also envisaged as a *monitoring tool* that tracked the implementation of sectoral schemes and developmental works. This information could enable the identification

¹ UNDP portal. 'About Bihar'. Web. 5th April 2013.

http://www.undp.org/content/india/en/home/operations/about_undp/undp-in-bihar/about-bihar/

² The World Bank. 'Bihar: Towards a Development Strategy'. 2005.

of areas that required attention and bring a more scientific and rational element to the planning process as well as facilitate a holistic approach to development by integrating sectoral and spatial interdependencies.

A key difference in i-Bhugol was that it was to be a *geo-spatial* database, displaying this information *spatially*, in the form of geographical, physical and administrative maps. In most e-governance digitisation initiatives the approach is generally to go for MIS-oriented knowledge management where data is depicted in tabular form and analysed through various charts. Geo-spatial databases such as Google maps on the other hand depict information spatially using Geographic Information System (GIS) technology, enabling a richer understanding of data. GIS is a tool used for creating, editing, querying, analysing and displaying spatial data.³ Decision making issues which have a spatial component such as land management, property lines, land values, business site selection, advertising, etc are addressed by GIS technology. As i-Bhugol was envisaged to be a holistic database, it was designed to incorporate *both* MIS and GIS data.

To mobilise funds for the project, the state of Bihar made an application to the Planning Commission of India for providing grants for creating a centralized geo-spatial database. The request was accepted and project implementation began in 2010. The move towards using GIS in governance is still nascent and Bihar joined the small GIS club of Assam, Madhya Pradesh, Orissa, Tamil Nadu and Uttar Pradesh.

³ National Spatial Data Infrastructure India. 'Introduction'. Web. 23rd December. 2013.

<<http://nsdiindia.gov.in/nsdi/nsdiportal/questionnaire/THE.pdf/>>

Project Overview

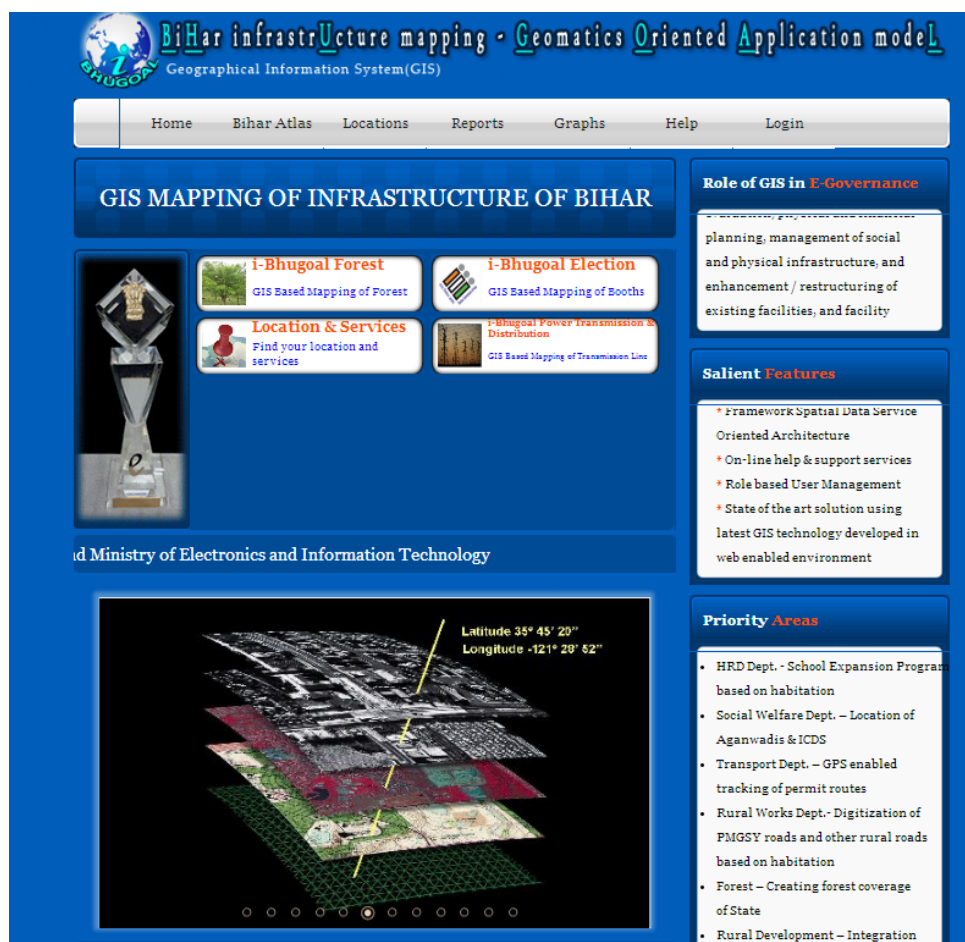


Figure 1: i-Bhugoal home page

Source: i-Bhugoal portal. gis.bih.nic.in

Project Description

i-Bhugoal was started with the objective of providing a geo-spatial database for the state of Bihar. It provides a single window for detailed information on topography, geography, infrastructure and socioeconomic indicators. Planners and decision-makers can use the portal to know the assets available, view their spatial distribution and also view the socioeconomic accessibility of these assets. For instance, planners can view school buffer zones and know the number of citizens who fall within the buffer zone. Demographics can be analysed on the basis of age, income, caste and other categories available.

Topographic indicators are also available such as parliamentary and assembly constituencies and district, block and village boundaries. i-Bhugoal is unique as it is the first GIS system in the country that provides data upto the 1:4000 levels. Such detail, used mainly for cadastral⁴

⁴ Cadastre, in terms of mapping, refers to lines showing boundaries, property lines etc.

purposes, is a pioneering effort and is all the more laudable as it has been implemented in a state with no prior GIS coverage. It also provides geographic information on various indicators such as soils, forest cover and watersheds.

This information, accessible on a single portal (<http://gis.bih.nic.in/>), enables *data-driven decision-making*. It removes errors that occur owing to lack of information, eliminates duplication of efforts, and enables a scientific approach to planning and management. Furthermore, as it is based on GIS, it is also used for monitoring and evaluation purposes, and is used by various departments to keep track of physical and financial progress.

The system is dynamically updated through backend re-engineering that has enabled it to be updated automatically as the various user departments update their own information. Citizens can also update the spatial database.

Initiated in: 2011

Number of departments using it: 8

Salient Features:

1. Provides a comprehensive framework for spatial and MIS data through a service- oriented architecture.
2. Helps in using GIS technology for spatial mapping of key areas.
3. Generates thematic maps on key infrastructural aspects across various levels.
4. Facilitates a role based user management system.
5. Provides online help and support services for users.

i-Bhugoal's impact has been immediate and significant and it has fulfilled an urgent need felt by the government of Bihar. It was developed by NIC Bihar beginning in 2010 and was finished in a year and a half, with funding provided by the state government's Department of Information Technology (DIT). For its contributions the project won the Gold Medal in the National e-Governance Awards 2012-13 under the category 'Innovative Use of Technology in e-Governance'.

i-Bhugoal is currently being used in the following ways for eight priority departments:

1. Human Resource Development: School expansion programmes are assessed based on habitation data.
2. Social Welfare: *Anganwadis* and Integrated Child Development Centres (ICDS) are being located using i-Bhugoal.
3. Transport: Permit routes are being tracked using Global Positioning System (GPS) technology.
4. Rural Works: Records of Pradhan Mantri Gram Sadak Yojana (PMGSY) roads and other rural roads based on habitation are being digitised.
5. Forests: The forest coverage in Bihar is being mapped.
6. Rural Development: Below Poverty Line (BPL) and National Rural Employment Guarantee Act (NREGA) data currently available through MIS are being integrated.

7. Irrigation: Works pertaining to embankment and canals are being carried out using i-Bhugol.
8. Land Registration: Minimum Value Register (MVRs) are being mapped.

Objectives

i-Bhugol aims at achieving the following objectives :

1. Creating a digital spatial database for the entire state. i-Bhugol comprises of primary layers⁵ and the ability to generate secondary layers⁶ and composite maps based upon those. The database would also enable the generation of location-specific thematic maps and Action Plan maps for location-specific problems.
2. Developing a GIS-based query system and enabling GIS analysis.
3. Introducing 'entitlement-based' planning on the basis of authentic data so as to enable balanced regional development and the creation of uniform infrastructure across the state.
4. Moving towards data-driven decision-making.
5. Enabling monitoring and evaluation of work sites.

The long term objectives of the project are not only state specific but have national level applications as well. i-Bhugol aims to continue the existing online platform for research on rural development, and assist planners and decision-makers in the following ways⁷:

1. Analyse regional divergences in the economic, social, demographic and environmental development of the nation by applying a multi-disciplinary approach.
2. Analyse and project divergences between rural and urban-industrial areas in the nation so as to assist planners and decision-makers in formulating rural development policies both at the regional and national levels.
3. Further help the rural development of Bihar by identifying innovative initiatives in backward rural regions and developing alternative development scenarios that rely less upon traditional sectors.

⁵ Primary layers refer to resource data such as that on soils, land use, contours, geology and drainage.

⁶ Secondary layers refer to parameters such as slope, erosion class, soil depth and land capability.

⁷ Shailesh Kumar Shrivastava, Prabhat Kumar and Amar Nath Pandey. 'iBhugol - Bihar Infrastructure Mapping Geomatics Oriented Application Model'. *International Journal of Advanced Computer Engineering and Architecture*. Vol.1 No.1, June 2011.

Stakeholders

National Informatics Centre (NIC), Bihar: The NIC state centre for Bihar has designed, developed and deployed the project, and is also in charge of training and capacity building.

Information Technology Department, Government of Bihar: The Department has funded the project.

State Departments of the Government of Bihar: Various state departments use the facilities provided by i-Bhugol. Currently, the priority departments under the project are Education, Human Resources, Social Welfare, Transport, Rural Works, Rural Development, Forest, Irrigation and Land Registration.

Program Components

i-Bhugol is an information generating portal used by the Bihar government to map, organize and manage data spatially on infrastructural and policy related services up to the village level. It uses comprehensive GIS software which enables viewing, understanding, interpreting and visualizing data in ways that reveal relationships and patterns in the format of extensive maps, reports and charts. The main program components of i-Bhugol are:

1. Generation of spatial maps

i-Bhugol enables users to map spatial entities coterminous with data quantities. In doing so, the user can relate spatial locations to particular quantities. For example, public health officials might want to map physicians per thousand people in each census tract in order to identify which areas are inadequately served. Election booth mapping can be used by Election Commission officials while planning elections. Spatial activity in defined locations can also be mapped. For example, the crime rate and pattern in a particular location can be mapped and incidence with other factors can be matched using the GIS mapping service. Figure 2 shows samples of the various map types that can be generated using i-Bhugol.

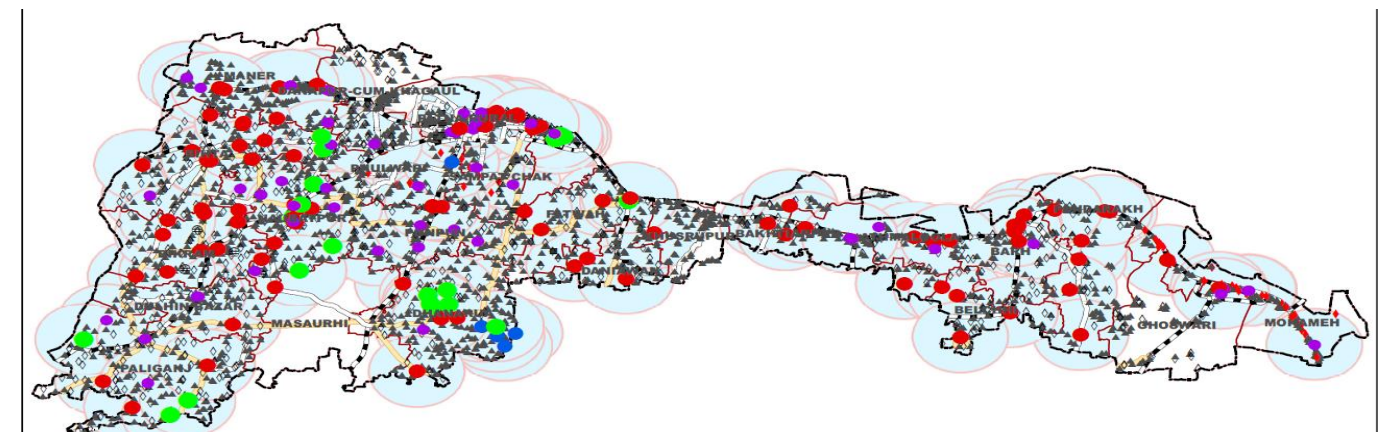
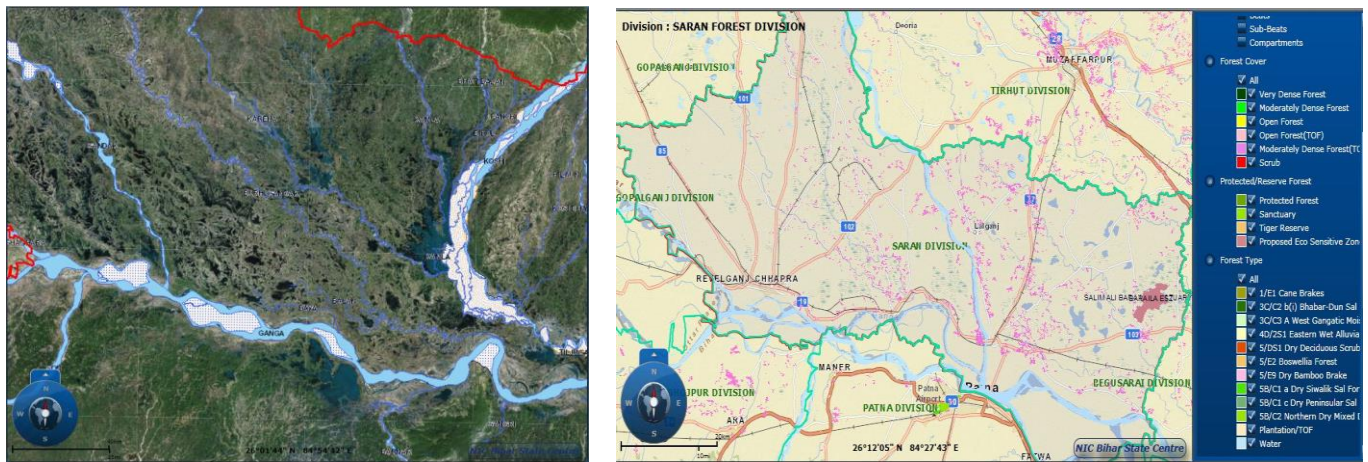


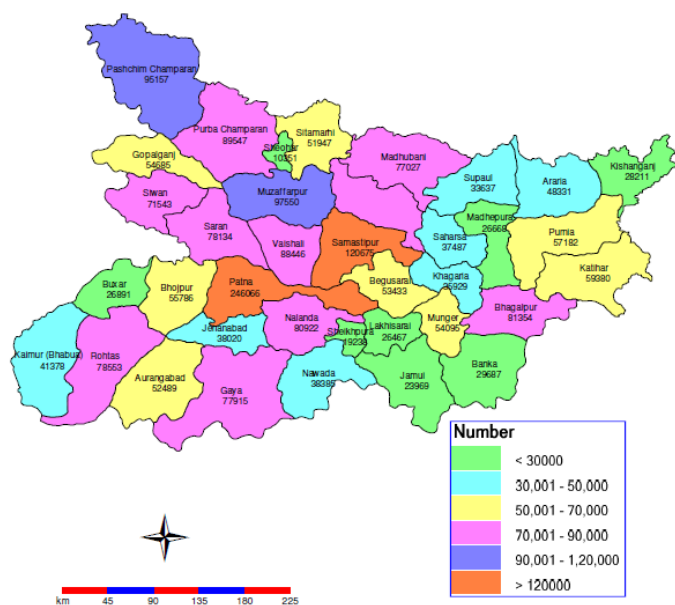
Figure 2: Clockwise from top. 1) Rivers of Bihar 2) Saran forest division 3) Patna school proximity analysis
Source: i-Bhugoal portal. Gis.bih.nic.in

Conversion of social and geographic data into GIS information

The aim of GIS mapping is to convert geographic data from a vector structure to a two dimensional or a three dimensional digital map. The i-Bhugoal interface is a user friendly application designed to provide easy access to information regarding infrastructure in the villages of Bihar.

Figure 3: Total number of workers in Bihar

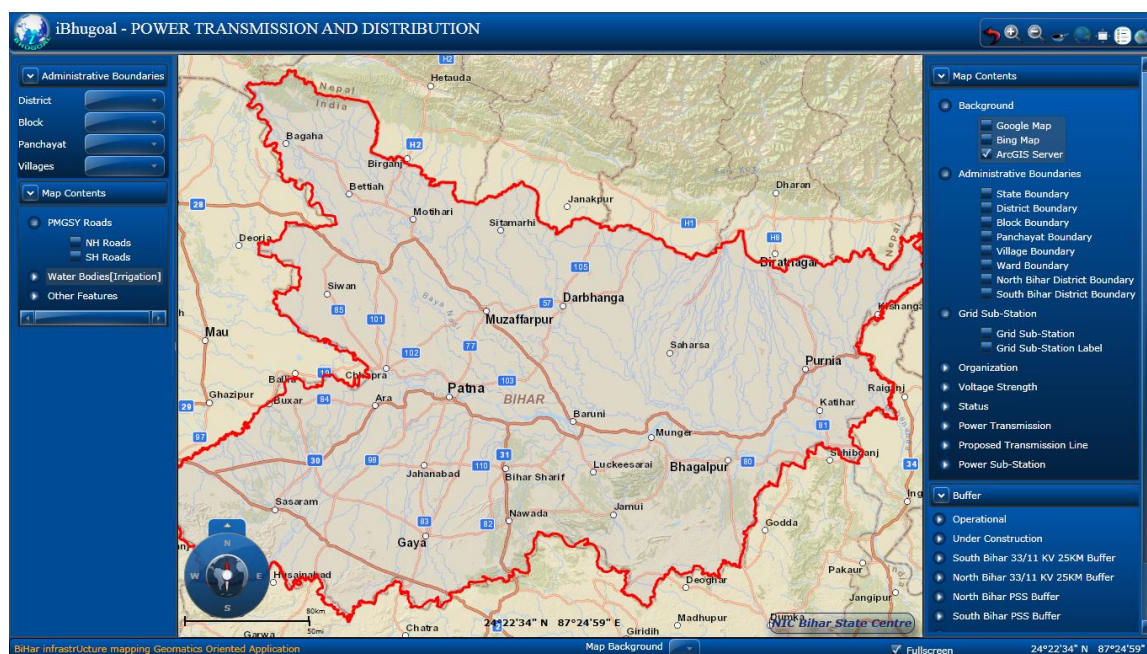
Source: i-Bhugoal portal. Gis.bih.nic.in



2. User friendly portal

A user friendly portal is one that offers self-explanatory, extensive yet concise functionalities based on a sophisticated design and workflow to provide time efficient and easy access to information. Based on this definition of a user friendly portal, i-Bhugol allows systematic flow of information at each stage as it gives the user comprehensive details of spatial maps and their specific attributes.

The main components that the user can have access to under the main i-Bhugol portal are:



i. Login window and user interface

The login window provides access to the user interface which then allows the user to access further information.

ii. Location menu

The location menu gives the user options on the location for which a map has to be generated.

The location selection menu will give the user a detailed account of the options available under this portal. The user can select districts, blocks of *panchayats* or villages and get spatial maps on different schemes and facilities applicable in that region.

iii. Map contents menu

The map contents menu comprises of various options and sub options on which spatial maps are available. The options available under the contents menu are:

- Background: Generates maps either in Google Map, Bing or ArcGIS format.

- Boundaries: Provides information on state, district, block, *panchayat*, village and ward boundary.
- Mapping educational institutions, airports, railway tracks and constituencies in the region.
- Mapping development works: Roads, water bodies, schools, irrigation facilities, health wise schemes, habitations, region wise population dispersion etc.

3. Query builder

The i-Bhugol portal has an in built query builder under which the user can access sub-menus on key priority areas and existing schemes such as schools, roads and irrigation. This query builder will give customized data in the form of records on queries related to data entry and grievances related to implementation of schemes. Also, this portal is enabled with a 'Find Your Location' service. Citizens can login to the website, add a point description based on a set of categories available such as government building, health facility, school, etc and register their query. The latitude and longitude of the location is automatically tagged making it easier to track the request.

The data available on the portal is first validated through NIC's own channels and once validated the data is added. This enables the general public to search as well as add information on the i-Bhugol portal.

Implementation Strategy

The Bihar state government along with the NIC implemented i-Bhugol following the guidelines of the national GIS framework which focuses on developing web based GIS applications which would provide e-governance services in Government to Citizen (G2C) and Government to Government (G2G) categories. The first phase of i-Bhugol in Bihar began in the year 2010 with five priority departments: Rural Works, Education, Forest, Irrigation and Rural Development.

i-Bhugol required both spatial and non-spatial data. *Spatial* data identifies the geographic location of features and boundaries such as hills and oceans and is stored as coordinates and topology.⁸ *Non spatial* data, on the other hand, refers to tabular or attribute⁹ data and has no specific location in space although it can have a geographic component and be linked to a geographic location.¹⁰ In Bihar, spatial data did not exist prior to the implementation of the project. Non-spatial data existed only in the form of MIS data from certain departments.

⁸ Webopedia. 'Spatial data'. Web. 22 April. 2013.

<http://www.webopedia.com/TERM/S/spatial_data.html />

⁹ In computer science, attributes are specifications that define the property of an object.

¹⁰ RDL/GIS. 'How GIS works'. Web. 22 April. 2013. <http://www.sfu.ca/rdl/GIS/tour/gis_wrk.html/>

In addition, many attributes that were necessary for the database were missing. All of this data was generated by the NIC. Figure 3 shows the strategy adopted for generating the spatial database.

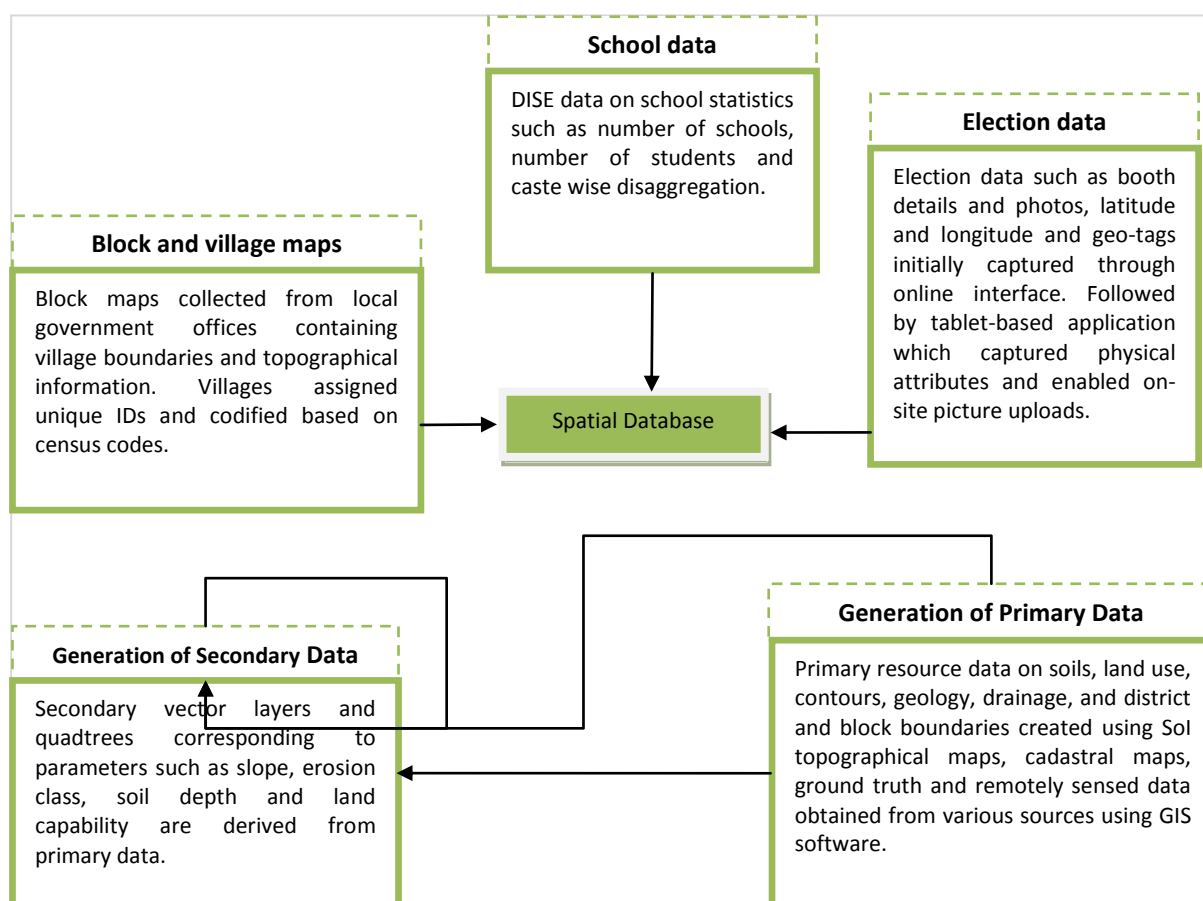


Figure 4: Strategy adopted for spatial database generation

Source: Shrivastava, Shailesh Kumar. Technical director, NIC Bihar. Personal interview. 20th March 2013. OneWorld Foundation India. Also from Shailesh Kumar Shrivastava, Prabhat Kumar and Amar Nath Pandey. 'iBhugol - Bihar Infrastructure Mapping Geomatics Oriented Application Model'. *International Journal of Advanced Computer Engineering and Architecture*. Vol.1 No.1, June 2011.

The non-spatial database was generated with MIS data taken from the following sources:

1. **BPL** data, based on a 2007 survey, was obtained from the Department of Rural Development.
2. **MGNREGS (Mahatma Gandhi National Rural Employment Guarantee Scheme)** data was obtained from the MGNREGA-Soft application that has been implemented across Bihar.
3. **MVR** data on land registration is obtained from the Registration Department.

After generation, the spatial and non-spatial databases were integrated. The tables of spatial village map and non-spatial census information were opened in Arc/View, the GIS software used for i-Bhugoal, and joined together using the table-join function available through the software. This resulted in a village map which displays boundaries as well as socioeconomic dimensions. The last stage was the development of a menu-driven interactive Graphical User Interface (GUI).

The portal is currently updated dynamically as the NIC has carried out backend re-engineering which has resulted in the i-Bhugoal portal being updated when departments update their databases. Bihar's Common Service Centres, called *Vasudha Kendras*, also play a role in updating the database. They identify *anganwadi kendras* in their local areas, take photographs and upload these to the site.

i-Bhugoal was completed in a year and a half. However, it is still very much a work in progress with new additions and innovations in the pipeline. Upon i-Bhugoal's successful implementation, the Centre for Good Governance (CGG) Bihar recommended the project's upscaling for the entire state and so, the final phase was carried out by the end of 2011. Currently, the project is being implemented across eight departments. The government of Bihar has extended the project for two years and notified authorities that if other departments want to integrate their data representation and monitoring measures then they can integrate their systems into i-Bhugoal. Additional details on scaling-up the i-Bhugoal portal have been mentioned in the section on Key Lessons.

Technology

i-Bhugoal's web-based GIS system is currently hosted on the NIC data centre and is based on five core components:

1. User interface for clients to access and analyse data
2. Web server and application server for getting the clients' request and sending it to map server
3. Data analysis and queries based on clients' request
4. Data server for retrieving data from a database and serving them to map server for analysis
5. Database that includes spatial data and non-spatial data

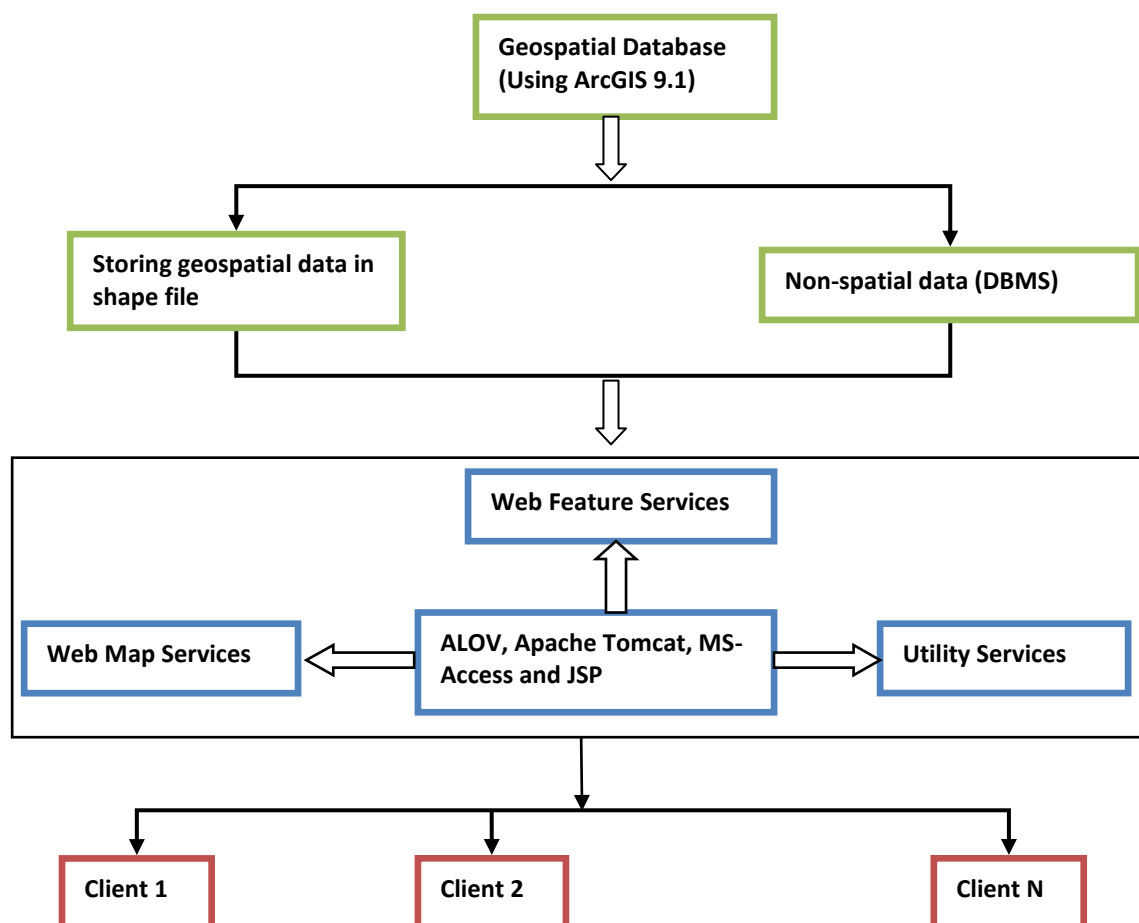


Figure 5: Web-based GIS infrastructure and software

Source: Shailesh Kumar Shrivastava, Prabhat Kumar and Amar Nath Pandey. 'iBhugol - Bihar Infrastructure Mapping Geomatics Oriented Application Model'. *International Journal of Advanced Computer Engineering and Architecture*. Vol.1 No.1, June 2011.

Functionality	Software
GIS Software	ArcGIS and other Arc products such as ArcInfo and Arc/View
Web development	Microsoft.NET 4.5 Microsoft Silverlight for applications
Database management	SQL Server 2010
Application development	Google API Bing API Microsoft Silverlight PHP

Table 1: Software used in developing i-Bhugol

Source: Shrivastava, Shailesh. Personal interview, 20 March. 2013.

The following measures are taken for data safety and security:

- The website has been audited.
- Separate facility management teams take care of the network, database and administration. This could result in a potential lack of co-ordination among the teams.
- System backups are carried out through outsourced agencies.

Training and Capacity Building

The NIC provides training to the officials involved. The training focuses on how to use GPS and GIS software. The NIC's knowhow of the already existing national level GIS framework was available to NIC Bihar to use as an initial stepping stone. The larger objective of the training program is to bring about a systemic shift in process orientation.

The i-Bhugol portal contains a user manual that provides detailed explanations to users on how its various functions can be used. This manual is also accessible to the public. In addition, training is provided on the following levels:

At the state level, the NIC trains officials to carry out data collection at the state level and helps them with their technical requirements. As part of trainer's training, nodal officers of all concerned departments were also trained and were assigned at least one assistant programmer to take care of day-to-day activities and modalities such as how the department should progress. For GIS handling, operators were trained by the NIC and stationed in departments for taking care of daily requirements.

- At the district level, the District Informatics Officer (DIO) is the NIC functionary and trains district officials as well as assists with data collection operations.

For officials located in remote areas, training was provided on:

1. Data entry onto the portal
2. Visualising data in spatial form

With respect to the time period involved, 2 – 3 months are required for an official to become well-versed in GIS applications and mapping. For officials in remote areas, a week's training is provided in sets of two days with three intervals in between.

Training review is carried out through common video-conferencing sessions where the NIC along with the Department Head review the progress of the capacity building exercise. The letters issued by various departments to their field functionaries are also passed on to the NIC so that it is kept in the loop of their training requirements.

Monitoring and Evaluation

i-Bhugol has a four-layered monitoring and evaluation process.

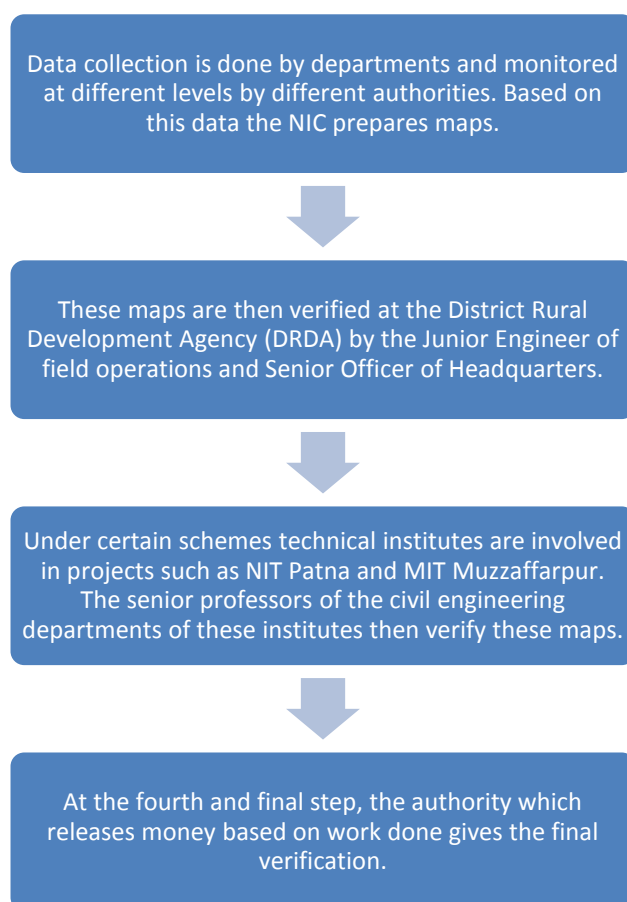


Figure 6: Monitoring process for i-Bhugol

Source: Shrivastava, Shailesh Kumar. Technical director, NIC Bihar. Personal interview. 20th March 2013.

Funding

The funding for the project was provided the Department of IT, Government of Bihar.

Total Project Cost	INR 1.99 crore
Actual infrastructural costs borne by the NIC	INR 50 lakh
Value of gratis services provided by the NIC Delhi	INR 45 lakh

Table 2: Funding disaggregation for i-Bhugol

Source: Shrivastava, Shailesh. Personal interview, 20 March. 2013.

As the application was developed by NIC which is a government-owned entity, no costs were incurred for development and system software. The application uses existing ICT hardware as it is cloud-based and the only additional expense was for the GPS devices used in mapping. The application is stored on the NIC cloud, again saving costs.

Outcomes and Benefits Realized

i-Bhugol is the first GIS-enabled application implemented in Bihar and has made it the first state in the country to have maps of up to 250 persons of the population in the 4000 scale. No other state so far has maps at such low levels of scale. The impact of this application is as follows:

Works carried out through i-Bhugol:

- Owing to lack of data on the core network the Centre did not release funds under PMGSY to Bihar for more than three years. However **after submission of satellite-image based core map of roads generated through i-Bhugol the Centre released funds over INR 4,000 crore to the state** under PMGSY and more is to be released.
- The application is being used to create a database for implementing Mukhya Mantri Gram Sampark Yojana which entails construction of 34,000 km of all-weather roads to connect more than 1 lakh habitations having population of 250 each at a cost of INR 23,881 crore.¹¹
- Departments for which infrastructure mapping has been carried out so far are Health, Education, Social Welfare, Rural Works, Road Construction, Rural Development, Minor Irrigation and Water Resources.

¹¹Telegraph India. 'Satellite images to monitor growth'. 26 December. 2012. Web. 21 March. 2014. <http://www.telegraphindia.com/1121226/jsp/bihar/story_16359899.jsp#.UyWgw_mSzSA>

- Integration of geo-spatial data and MIS data of different departments such as Education, Rural Works, Social Welfare, Election, Building Construction and Irrigation has been completed.
- Complete road network has been covered.

Improves planning and management

i-Bhugoal's first and foremost contribution is that it enables *data driven decision-making*. It provides planners and decision makers with information on available assets, and based on this realistic and accurate planning can be carried out. This was a major change from the previously dominant form of planning where there would be inefficiencies as assets would be unevenly distributed during the planning stage owing to lack of information.

Partially automated and open-access based thematic map updation

The system has been configured in such a way that data entry by one department would result in the updation of the maps on i-Bhugoal. As previously mentioned, the public can also update the map. This means that a centralised database is being dynamically updated from decentralised sources. This coordinates the activities of many different departments and eliminates duplication of work. The portal is centrally accessible and, therefore, all the stakeholders can benefit from each other's collaborative efforts.

Enables real-time monitoring of worksites

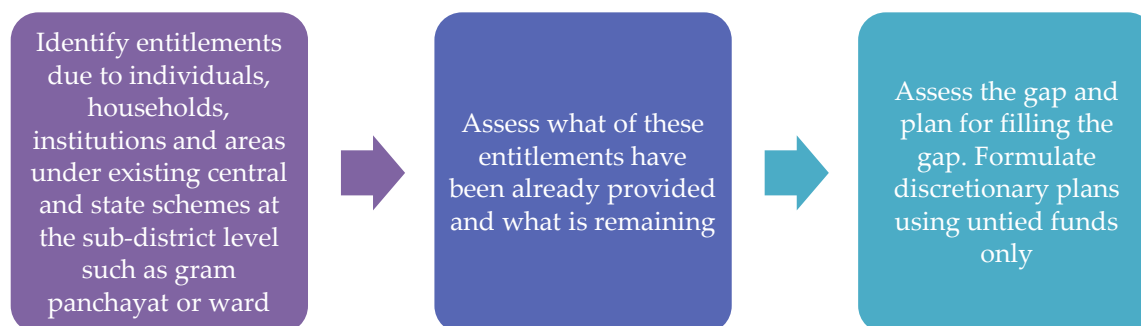
On-site monitoring is very important for various works departments. To this end, geo-tagged photographs are being captured, and physical and financial progress from worksites is being uploaded. i-Bhugoal is also being used to validate data about habitations generated during the National Habitation Survey, 2003.¹² Thus, i-Bhugoal also enables implementing agencies to carry out GIS-based monitoring and evaluation.

Systematic check on regional disparity

Often the same scheme is implemented multiple times within the same region while other regions are neglected. Political compulsions and demands on resource allocation, especially prior to elections, result in a somewhat haphazard regional distribution of development programmes. i-Bhugoal, by providing an asset inventory, helps planners and decision-makers view the spatial distribution of assets and enables them to allocate resources in a more equitable manner. Taking schools for instance, the system enables planners to view the proximity location or the area covered by the school, and accordingly allocates schools in a way that reduces the distance students have to travel.

¹² Telegraph India. 'Satellite images to monitor growth'. 26 December. 2012. Web. 21 March. 2014. <
http://www.telegraphindia.com/1121226/jsp/bihar/story_16359899.jsp#.UywGw_mSzSA>

i-Bhugol is providing the foundational data required for a new type of planning known as **entitlement-based district planning**. It is a three-step process:



Entitlement-based district planning showcases what are the **specific gaps in entitlements owed to each local unit such as a village or municipal ward**. On the basis of these gaps, higher administrative levels such as district and state allocate resources to overcome these disparities. **Bihar is the first state in India which is implementing this unique model of decentralised planning which is designed to address regional disparities and the data for this planning comes from i-Bhugol.**

Challenges in Implementation

The NIC and the state government of Bihar faced several challenges during the introduction and implementation of the i-Bhugol project due to several institutional and operational reasons which can be highlighted as follows:

- *Maintaining co-ordination among various departments*

One of the foremost challenges faced by the NIC was gathering and organizing data from the priority departments for spatial and infrastructural mapping so as to provide an asset register for the entire state. To make this spatial data accessible on a centralized portal required complete coordination between all the departments. The process of organizing and providing capacity building to various departments involved a long process of training and capacity building. According to the Technical Director of the project at NIC Bihar, it would require at least 2-3 years more to provide a complete state asset register and to bring more departments under the purview of i-Bhugol.

- *Use of complex GIS technology*

i-Bhugol was the first ever GIS project implemented in the state of Bihar. Prior to the i-Bhugol project, the concept of spatial database did not exist in Bihar, and both the knowledge and awareness of spatial dimensions in decision-making was absent. Hence, initially it was difficult to convince top authorities that the use of GIS-enabled tools can be highly effective in decision-making on infrastructure, policy and other thematic concerns.

The NIC successfully overcame this challenge by demonstrating its effective functionality in the concerned departments.

- *Maintaining digital records*

The other important challenge faced during the implementation process was digitising spatial data. Prior to the i-Bhugol, most of the data records were maintained manually. One of the major concerns arose from the fact that i-Bhugol aimed to cover many departments but each had its specific way of functioning and managing data. So the NIC faced the challenge of streamlining the processes of each department and organizing it under a centralized web portal.

Thus, organising data from various departments, converting large volumes of manual data into a digital format and carrying out spatial mapping required a continuous and sustained process where different departments were progressively included.

- *Challenges in training and capacity building*

The effective implementation of a technology or practice requires building the capacity of public officials for strengthening its functioning and enabling a timely flow of services. The implementation of i-Bhugol was managed by the NIC but they faced a major technical challenge in terms of GPS handling. The staff/public officials particularly at the level of small villages and districts were not able to understand the technical functions and operations of the GPS system. The NIC conducted regular training sessions to capacitate the officials with software handling techniques. As part of follow-up monitoring, video conferencing was used to ensure that the technical challenges do not underscore the sustainability of the project.

- *Operational challenges*

In terms of access to technology, the NIC faced hardware issues related to -- ,

- Life of the GPS device's battery and its portability during village surveys was problematic.
- In remote villages and districts, receptiveness of the people towards GPS mapping and support in terms of logistical issues and information was crucial. In this regard, NIC officials faced several issues in remote villages of Bihar where people were not very receptive and accurate in giving information about projects. .

The implementing agencies however have worked towards sorting out these operational issues. In fact the GPS mapping device is in-built with verification and authentication tools.. For example, if an official is conducting a GPS mapping of *anganwadis* and have been misinformed with contradictory information, then the GPS system would check for fallacies and update the existing gap in information.

Key lessons

Need for a geomatics project

i-Bhugol filled an administrative gap felt by the Government of Bihar which requested the Planning Commission for a geo-spatial database. Thus, the project was not implemented for abstract, aesthetic reasons but rather filled a pressing, practical need which was felt at all levels. This initial condition had several ramifications which are given below.

Support from the top vital for ensuring a project's sustainability

i-Bhugol had support from the Chief Minister as well as the Chief Secretary. This ensured that the project was constantly in motion. According to the NIC, had the project been started at a lower level, it would have run into several problems and could not have reached the scope and scale it currently has.

Immediate benefits combined with comprehensive training catalyses stakeholder acceptance

The benefits of i-Bhugol have been immediate to its stakeholders who have seen it improve monitoring capacities, unlock Central funds, and optimise the planning and decision-making process, to cite a few of its functionalities. This made them eager to accept the new application. This intention was actualised through the comprehensive training made available by the NIC. The NIC is now planning to create 'GIS cells' in each department which would contain 4–5 dedicated permanent personnel who would assist with the management of i-Bhugol. This move would further strengthen capacity building.

To enhance i-Bhugol's features relating to decision-making, a Decision Support System (DSS) is being developed for decentralised planning at the district and block levels. A prototype community GIS tool is also being expanded in this regard.

Data sharing between departments becomes easier when uploaded on a common platform

Data updation is carried out through back-end process re-engineering which updates the i-Bhugol server automatically. This does not require any major administrative changes and in addition all the departments can benefit from the cumulative information made available on the spatial database. NIC Bihar's job was made easier as they drew upon already existing digitised data. An important planned upgrade to i-Bhugol is the integration of Survey of India maps with online map services such as Google, Bing and Environmental Systems Research Institute (ESRI) applications to ensure a wider source database for procuring spatial information.

State specific policy with consensus of all stakeholders must

Different works departments (such as public works and rural works) should first be brought on board. Components such as data sharing, updation framework, layer sharing and layer creation should come as a policy within the department and must be accepted by all the stakeholders.

Formalization of change is a standard principle of process re-engineering. This was widely followed by i-Bhugol as well and ensured that the changes it brought about became **systemic** and not **person-centric**. ‘Champion’ driven projects are helpful to the extent that innovations are given a thrust but once implemented the change has to be formally accepted as part of the system through policies or government orders. If this is not done, the system can wither away.

Increasing the outreach of the project would further enhance acceptability

The more i-Bhugol is shown to have an impact, the greater would be the demand for it.

There are many works being carried out through the system currently. They are:

- Schools: It is being used for proximity analysis in deciding where new schools are required.
- Irrigation: It is being used by the department works for checking requirements on the use and functioning of *baandhs* (dams). For this specification, a core network has been developed which is accessed through i-Bhugol.
- Agriculture: The state government of Bihar is planning to have a separate electricity network for agriculture. This will monitor connectivity to pumps and for this purpose a core network is being created.
- Forest Department: Earlier GIS mapping was used in forests only to capture boundaries. The expansion of the use of i-Bhugol to the Forest Department has allowed three important things –
 - Forest area and its classification.
 - Covering green spaces - Through satellite imagery the forest department wants to make an analysis of what the coverage was in 2007 and what it is presently to estimate how much greenery has been created because of different schemes, in which areas, and through which schemes.
 - In different areas there are many existing schemes running and i-Bhugol is being used to monitor implementation and identify gaps in these schemes.

- **Mapping habitations:** A very important usage of the GIS-enabled i-Bhugol would be to create a database for implementing the Mukhya Mantri Gram Sampark Yojana which involves constructing approximately 34,000 km all-weather roads to connect more than one lakh habitations having a population of 250 persons each in the next five years at a cost of INR 23,881 crore. i-Bhugol would provide information by generating maps of various types of existing roads connecting habitations and validate data on existing habitations generated during the National Habitation Survey, 2003.

A proposed addition involves Urban Local Bodies (ULBs) which want to expand their operations and carry out advanced functions using i-Bhugol. These departments are looking for mapping land patterns or habitations at highly detailed levels. There could be problems in disseminating information from various sources and maintaining synchronization of operations under i-Bhugol. However, there is an understanding that any data originating outside the purview of the current scheme should be shared with NIC Bihar.

Work must be done within a set time-frame

Poetically stated, the difference between dreaming and planning is that the latter is time-bound. Similarly, if one is to replicate a project such as this, it must be done with a clear goal and deadline in mind so that progress can be monitored accordingly.

Accounting for ample time and patience in the implementation of such a project

A project like i-Bhugol requires about 3–5 years before the state spatial infrastructure comes into existence and implementing agencies must have the requisite patience to see it through.

Research methodology

I-Bhugol has provided a comprehensive database on which users can access data on Bihar's natural resources, administrative typologies, physical and social assets and track the performance of ongoing projects as well as access demographic and statistical data. The unique element of the portal is its integration of MIS and GIS data and the consequent presentation of this information to the user in an easy to use yet comprehensive spatial format. For its efforts, it won a gold medal for its efforts at the National e-Governance Awards and accordingly was selected for documentation.

In order to document the innovation, the OneWorld research team conducted both primary and secondary research. The secondary sources comprised of credible media articles, scientific papers published on i-Bhugol and the portal's user manual. A list is provided in the references section. Based on this data, the OneWorld team identified gaps in the existing literature.

The primary source of data for the case study was the chief executive responsible for the implementation of i-Bhugol, the Technical Director of NIC Bihar, Mr. Shailesh Kumar Shrivastava. A semi-structured interview was conducted with him and he provided extensive details on the genesis and need for the project, the implementation strategy adopted, the process flow for the portal, the monitoring and evaluation mechanism used for the project, the training and capacity building mechanisms, the chief challenges faced, key lessons learnt from the initiative and future plans for the project.

Following the analysis of the secondary material and the information gathered from the interview questionnaires, the project was documented in order to ensure that it significantly contributes to the enhancement of available knowledge resources and practice.

Conclusion

i-Bhugol is a pioneering initiative in many ways. It is the first GIS-based initiative in the state of Bihar and is the first system which provides data at the 1:4000 cadastral levels. It has filled an urgent administrative need felt by the Government of Bihar. For this reason it received support at all levels of the government. The immediate and tangible benefits it brought about hastened its acceptance by the stakeholders and resulted in its winning a Gold Medal in just two years of its implementation. However, along with the demand side the supply side too played a major role in its implementation. NIC Bihar could draw upon the pre-existing expertise of the NIC in the sector and also provided valuable technical resources and training that were essential to the sustenance of the project.

Today, i-Bhugol is being used in a wide range of functions. Right from the planning stage to the monitoring and evaluation stage, it is providing planners, administrators and politicians with a powerful tool that in the long run enables a more balanced and equitable pattern of growth founded on sound scientific understandings.

Abbreviations

BPL	Below Poverty Line
CGG	Center for Good Governance
DBMS	Database Management Server
DIO	District Informatics Officer
DISE	District Information System for Education
DIT	Department of Information Technology
DRDA	District Rural Development Agency
G2C	Government to Citizen
G2G	Government to Government
GIS	Geographic Information System
GPS	Global Positioning System
GUI	Graphical User Interface
HRD	Human Resource Department
ICDS	Integrated Child Development Scheme
ICT	Information and Communications Technology
IT	Information Technology
MGNREGS	Mahatma Gandhi National Rural Employment Guarantee Scheme
MIS	Management Information System
MVR	Minimum Value Register
NIC	National Informatics Centre
NREGA	National Rural Employment Guarantee Act
PMGSY	Pradhan Mantri Gram Sadak Yojana
SoI	Survey of India
ULBs	Urban Local Bodies

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Case fact sheet

I. Demographic information:

Parameter	Bihar	India
Total population	103,804,637	1,210,193,422
Male	54,185,347	623,724,248
Female	49,619,290	586,469,174
Decadal growth in population	25.07	17.6
Sex ratio	916	940
Density of population	1102	382
Literacy rate	63.82	74.04
Male	73.39	82.14
Female	53.33	65.46
Population living below poverty line	42.60	26.10
Scheduled Caste population	13.05 million	166.64 million
Scheduled Tribe population	0.76 million	84.33 million

*Demographic profile of Bihar and its comparison with national level data;
Source: Provisional Population Totals. Census of India 2011. Government of India.*

II. Sector/field to which the project belongs: e-Governance

III. Stakeholders and beneficiaries:

i. *Stakeholders* – NIC Bihar, IT Department, Government of Bihar

ii. *Beneficiaries* –

a. **Government of Bihar.** The following departments are currently prioritised for the project:

i. Education

ii. Human Resources

- iii. Social Welfare
- iv. Transport
- v. Rural Works
- vi. Rural Development
- vii. Forest
- viii. Irrigation
- ix. Land Registration

b. Citizens of Bihar

IV. Calendar of major events:

Event	Year
First phase of i-Bhugol	2010
Final implementation of i-Bhugol	2011
i-Bhugol wins Gold Medal in National e-Governance Awards 2012-13 under the category 'Innovative use of Technology in e-Governance'	2013

Annexure I - Questionnaire

Background

1. What was the motivation behind the initiation of this project?
 - a. How were infrastructural facilities being mapped in the state prior to the initiation of the project? What were the challenges with the hitherto existing system?
2. When was the project implemented?
3. Is the project a new one or does it build on a pre-existing model?
4. What was the role of political support while initiating this project?
5. Was there a pilot phase in this project? If yes, please provide the following details: location, duration, components, key lessons and challenges faced.
6. Was the project introduced in phases? If yes, what villages/districts were selected for the initial implementation? What were the criteria for selection of these project sites?
7. How does mapping of spatial data contribute to better e-governance solutions? What measures have been taken to use mapped data for providing governance solutions?

Process Flow

8. What are the sources for obtaining data for the spatial database?
 - a. What is the update on these sources?
9. Who are the main government users of the portal and what do they use it for?
10. What is the query system on the portal?
 - a. What queries does it return information on?
11. What are the backend processes and changes that were made to facilitate implementation of the project (like digitizing data or converting manual data to digital maps)? How was this done, what was the time frame and what agencies were involved (besides NIC, if there were any)?
12. How do Common Service Centres act as sites for data collection for WebGIS?
 - a. What information is disseminated to the public at these CSCs?
 - b. Were any new personnel recruited?
 - c. Was there any additional hardware/software requirement?
13. The portal mentions role based user management. What does this refer to?

- a. What are the different roles assigned within the portal?
- 14. What are the bases on which key priority areas have been selected for mapping and archiving data?
 - a. Why was the need felt to focus on these areas only?

Technology

- 15. What is the GIS software used? Is there any prior technological model on which it is based?
- 16. Was it developed in-house?
- 17. If yes, how long did it take to develop it and what was the human resource involved?
- 18. Where is the portal hosted?
- 19. What steps are taken for data safety and security?
- 20. Are there provisions for data back-up?
- 21. How is the portal maintained in terms of periodicity and agency?

Capacity Building

- 22. Can you provide the following details regarding training: resource persons, content, methodology, participants, duration and follow up mechanisms.
- 23. What were the difficulties faced when training personnel and how were they overcome?
- 24. What has been the status of the three level Master's training program to management?
- 25. Have any new personnel been recruited?

Monitoring and evaluation

- 26. How is the data authenticated and verified?
- 27. How frequently is it updated?
- 28. Does the system have any in-built checks for authenticating the data and checking for mismatches and duplicate entries?
- 29. How is the data collected used? Is it accessible to the public?

Funding

- 30. Are there any other funding sources besides the IT department of the Government of Bihar? Who is funding the data sources from the various departmental information like HRD related information, social welfare, transport or rural works. Is there a funding collaboration with these departments as well?

31. What are the major heads of expenditure in this project?
32. Who is covering the managing costs and the technology upgradation cost for the portal?
33. What is the average monthly expenditure incurred?

Impact

34. How has WebGIS based i-Bhugol initiative helped in planning for infrastructural facilities?
 - a. Has it led to an upgradation of existing facilities?
35. Could you provide data to compare previous infrastructural records and current changes in facilities since the introduction of i-Bhugol?
36. How is the current information/reports/maps being used for effective evaluation and planning of social and physical infrastructure by the key departments listed?
37. What have the user experiences been about the portal?

What is the average learning curve for users? Can the users access information related to his/her use?

Challenges

38. What were the initial challenges faced during implementation? How were they overcome?
39. What are the current major implementation challenges and how are they being overcome? Was any difficulty faced in procuring and collaborating the data from various departments?
40. What are the challenges faced in organizing habitation data? Was any population census referred to in case of mapping various districts in Bihar?
41. What is the status of integrating MGNREGA data with i-Bhugol?
42. What is the status of capturing data on land registration?
43. What is the status of forest coverage area maps as a source of information for forest cover?
44. On canals and roadways, how has the information been organized and what are sources?

Planned Additions

45. What is the status of Web GIS G2C for Bihar State 1: 250 k and 1 : 50 k?
46. What is the status of GIS/ICT infrastructure project aka 'Geo Portal'?

47. What is the status of the framework architecture?
48. Are there any other planned additions?
49. Is this technology being used by any other state? has Bihar been contacted by any state governments for inputs on this?
50. What are the necessary conditions for the replication of a project like this?



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