

iBhuGoal¹: Bihar Infrastructure Mapping-Geomatics Oriented Application Modelⁱ

Mr.Mahesh Joshi, the District Magistrate (DM) of Muzaffarpur, Bihar is having a review meeting with BDOs/COs and Revenue Department Officials of the district at 12:30 PM on a Monday. The DM is in the middle of the meeting when Mr.R.A.Thakur, the Local Representative(LR) of Baruraj Assembly Constituency enters his office along with a small group of his supporters and interrupts the meeting. He is carrying a bunch of papers in his hand and is slightly enraged.

LR : Sorry to interrupt you DM saab, we have a problem at hand. I have received a petition from the people of Motipur Block, Brahmpura Panchayat and Brahmpur Karman Census Village that their children are not able to attend school as there are no nearby schools in the area. Government is giving a step-motherly treatment to my constituency and necessary funds are not being allocated for basic necessities such as education, road construction, etc. Even bank branches are not easily accessible. It seems that the areas under my constituency are being deliberately neglected and despite repeated petitions being given by village folks as well as my office, nothing has happened. This is very disturbing as I am accountable to the public.

DM : Sir, we are really apologetic for the difficulty being caused to people of your constituency, but let me examine the ground situation. We have recently implemented a system through National Informatics Centre(NIC) which helps us monitor school expansion programme as well as roads being constructed under PMGSY and MMGSY. Just let me call in the NIC person who will be able to help us ascertain the actual position.

NIC Official, Mr. Navin Kumar is called by the DM, who comes with a laptop loaded with iBhuGoal software(<http://gis.bih.nic.in/>).

DM : Navin ji, can we have the actual situation of the complaints received from people of Motipur Block in Brahmpura Panchayat and Brahmpur Karman Census Village. List of schools in and around these areas as well as connectivity of these habitations through roads would provide us some information. I want to have all the mapped as well as uncovered areas in this constituency as per the established norms.

Mr. Navin Kumar prepares a scatter diagram and then maps the areas showing habitation pockets, road connectivity and school location, etc. The map also shows

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aerial distances between resources and demand pockets. DM finally reviews the maps and discusses the issues with concerned BDOs. During all this time the LR is watching rather restlessly.

LR : DM saab, I don't think we are here to keep waiting and watching your team looking at the print outs and screens of laptops. We are here to get a solution to the problems of my constituency. These technology toys can not really help solve the real life problems. We have to answer to public. Village children are really finding difficult to reach the school and most of them drop-out after some time. This has become a serious social problem which needs to be addressed by you.

DM : Sir, we do appreciate your concern, but please understand that we have designed a system help allocate our resources uniformly all through the state. As I see it, there are schools in the proximity of all these habitations and the Brahmpur Karman Village is already connected through a road via Rampur-ugan. Connecting it through Raghunathpur will result in multi-connectivity to the habitation, which is not permissible under PMGSY. The Core Network has already been approved by Central Government and it is not possible to add the proposed road at our level.

LR : In which case, I have no other option but to take up this matter with the Education Minister or raise it in the Assembly.

DM : I am really sorry, sir. This software which has been implemented across the state is having all the data for schools, roads and habitations. This helps us bring in transparency in allocation of resources to all areas uniformly. As per the state policy, the resources have to be first provided to the uncovered areas on priority as per the data available with the system. However, we are grateful to you for visiting us and apprising us with the grievances of people.

Mr.R.A.Thakur, the Local Representative(LR) leaves with his supporters and the DM continues with his meeting with officials. The DM instructs Navin(NIC) to map all district resources such as irrigation canals, PHCs, APHCs, Anganwadi Kendras, Haats, Waterbodies, Watersheds, forest areas, Schemes, roads etc. at the earliest and instructs the officials to prepare annual perspective plan based on mapping of resources.

On the other hand, Mr.R.A.Thakur, the Local Representative(LR) meets Hon'ble Education Minister(EM) of Bihar and complains about the non co-operation of the DM in opening the school in Brahmpur Karman Village of Motipur Block. Minister immediately calls a meeting of the Principal Secretary(PSEC) and other officials of the Education Department.

EM: Secretary Saab, Thakur Saab wants to open a school in his constituency and the DM has refused to help him as per the School Expansion programme. Can we help Thakur Saab in the matter?

PSEC: Sir, with the help of NIC, a GIS software called iBhuGoal has been implemented which maps habitations and schools of the entire state. However, we need to ascertain whether data loading has been completed in the district for mapping all schools and habitations.

LR: Sir, we have to fulfill aspirations of public. The local public is demanding the school as I had promised this during my last election campaign.

EM: Thakur Saab, don't worry. Let me first get a status report from the DM, Muzaffarpur. Please leave your request with the Department of Education. We will get back to you soon.

A letter seeking report on the issue is sent to the DM, Muzaffarpur. DM again calls a meeting of all concerned officials.

DM: If you would recall the request of the LR regarding opening of new school at Brahmpur Karman Village of Motipur Block and providing alternate connectivity to Brahmpura Village, Motipur through Jagnathpur, now we have received a query from the Department of Education. Can we recheck the situation as we have to send a report to the Hon'ble Education Minister. All that we need to ensure is that School Expansion guidelines and the PMGSY/MMSGY guidelines are adhered to.

Navin: Sir, I have again prepared all the GIS maps for the area and discussed the same with Mr.Sah, the RWD Engineer(RWD). May be he can help us with his comments.

RWD: Sir, I have studied the maps and also physically inspected the area after the last meeting. The Brahmpura Karman Village of Motipur Block is adequately covered and connected. There are many other areas in the district which need schools as well as connectivity as per the guidelines. Accepting this demand will mean being unfair to those habitations. As we know, multi-connectivity to the habitation is not permissible under PMGSY scheme.

DM: Alright! Mr. Navin, please prepare a detailed map showing habitations, coverage and availability of schools and road connectivity for the area. Also, we need a detailed map of the entire district indicating distribution of schools and the road connectivity. Let us send a report to the Hon'ble Minister why this request can not be considered stating the facts and maps of iBhuGoal.

The iBhuGoal (<http://gis.bih.nic.in/>)

The software which was being used by Mr.Mahesh Joshi, the District Magistrate (DM) of Muzaffarpur, Bihar was iBhuGoal. iBhuGoal was started with the objective of creating a geo-spatial database for the state of Bihar. It provides a single window for detailed information on topography, geography, infrastructure and socio-economic indicators. Planners and decision-makers can use the portal to know the assets available, view their

spatial distribution and also view the socio-economic accessibility of these assets. For instance, planners can view school buffer zones and know the number of habitations, which fall within a specific buffer zone. Demographics can be analyzed on the basis of age, income, caste and other categories available.

Topographic indicators such as parliamentary and assembly constituencies and district, block and village boundaries are also mapped in the iBhuGoal database. iBhuGoal is the first GIS based system in the country that provides data upto a scale of 1:4000. Such detail, used mainly for cadastral 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 eliminates chances of errors which may occur due to lack of information. It encourages a scientific approach to planning and management leading to transparent civil administration. The system is dynamically updated through backend re-engineering as and when the user departments update their information. Citizens are also permitted to update the spatial database.

The Birth of iBhuGoal

There has been no concept of spatial data inventory or Spatial Data Infrastructure (SDI) in the state of Bihar. Individually, some officers have been trying to map the existing MIS data pertaining to infrastructure using drawing tools etc. for their personal reference in a disintegrated manner. These data and maps, however, do not conform to any mapping standards as there was no such policy in Bihar state which defined the standard procedures of mapping and their maintenance. The main drawback of such practice was that, integration of these maps was not possible. Such practices also fail to reflect the current functional status of infrastructure and senior administrators do not get information

Initiated in: 2011

Number of departments using it: 8

Salient Features:

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

support to make strategic and informed decisions. In turn, large investments are incurred to answer specific queries frequently made from various apex forums and internal planning. More so, results may also vary for similar queries raised at different points of time.

District administration is accountable to the public representatives who voice the demands and needs of the public. Due to lack of proper information, sometimes genuine demands may be neglected. On the other hand, some of the public representatives may

get away with serving their political goals by getting more than due share of public resources for their constituency due to undue influence. Such practices create regional imbalances and lead to lack of transparency in the civil administration. In the past, in the absence of appropriate MIS and GIS tools, district administration had no choice but to accept undue demands of local representatives.

It was with this background that the Bihar government decided to develop a Geographical Information System(GIS) based solution. The State Government as part of plan discussion at Planning Commission, New Delhi requested for sharing of digital maps available at NIC. Exhibit-1 shows major stakeholders of National GIS. As a continuation of this, a meeting was held under the chairmanship of the Chief Secretary, Bihar on 04/02/2010. Principal Secretaries of various departments and members of NIC team attended the meeting. In this meeting, a presentation was made by NIC, New Delhi on potential of Development and Implementation of a GIS based solution for Bihar State. And iBhuGoal was born.



Exhibit-1: Major stakeholders of National GIS

The Principal Secretaries of various departments of Bihar Government identified the priority areas listed in Table-1 for inclusion in iBhuGoal, to start with:

Table-1: Priority Areas for iBhuGoal

| S.No | Priority Areas |
|------|---|
| 1. | HRD Department - School Expansion Programme based on habitation data |
| 2. | Social Welfare Department – Location of Anganwadis & ICDS |
| 3. | Transport Department – GPS enabled tracking of permit routes |
| 4. | Rural Works Department - Digitization of PMGSY roads and other rural roads based on habitation data |
| 5. | Forest – Creating forest coverage of State |
| 6. | Rural Development – Integration of NREGA & BPL MIS data |

| | |
|----|--|
| 7. | Irrigation Department - Embankment & Canal |
| 8. | Land Registration Department-Mapping of Minimum Register Values(MVR) |

It was felt that development of inventory in all these sectors was a mammoth task and would be a time consuming exercise. Hence, NIC Headquarter proposed to initiate this exercise for one of the priority areas. As a result of this, DDG decided to constitute a team at NIC State Unit of Bihar to formulate requirement documents and convert into DPR with the active involvement of GIS Team from NIC, New Delhi so as to submit the proposal by the end of February, 2010. Chief Secretary, Bihar nominated Principal Secretary, Information Technology as nodal officer for GIS project to co-ordinate with NIC and other departments. To speed up the process, a GIS team from NIC, New Delhi arrived in Patna, Bihar on 17th February, 2010 for 3 days. The NIC team made detailed assessment of the requirements and existing infrastructure by consulting various Secretaries of the identified priority areas. The current implementation of iBhuGoal is the result of above effort and represents the beginning of collaborative process to facilitate data based location specific decision making through the use of GIS technology in the state of Bihar.

NIC is actively involved in the development of GIS solutions for various users in the Government sector at the national level. Planning Commission has granted a project "Multi-layer GIS for Planning" to NIC through which data at 1:50,000 scale for the entire country with 23 layers has been developed. One such G2C GIS web application has been developed for village level mapping of demography and amenities for the entire country. Now NIC is working with 4K to 10K Scale maps for resource mapping across States. It is largely meant to view MIS data spatially through thematic maps for making quicker and better decisions.

Specifically, the iBhuGoal is aimed at:

- Creation of Spatial Database Infrastructure for use among various departments of the State of Bihar.
- Integration of Geo-spatial data and MIS data from different departments namely Education, Rural Works, Social Welfare, Election Commission, Building/Construction, Irrigation etc.
- Integration of SDI maps with online mapping services such as Google, Bing, ESRI, etc.
- Development of Query facilities for Planning and Decision Making by various departments.
- Development of efficient and effective tools for planning rural road connectivity to habitations.
- Depicting coverage of habitations through various levels of Schools.
- Providing help in better management of facilities such as Schools, Anganwadi Kendra, PHCs, etc. which deliver citizen centric services.
- Achieve transparency and ease in planning and real-time monitoring of work-sites.
- Smooth and Effective Management of Election process through proper use of GIS maps.
- Offer scientific approach for irrigation facilities planning, flood management and management of embankments.

- Analysis of Forest Reserve and forest inventory so that clearance of schemes can be linked through GIS maps.

The Team - iBhuGoal

The idea of iBhuGoal originated from National GIS Framework being formulated by NIC, GIS Division. A request from Chief Secretary, Bihar to Planning Commission for creating State Spatial Infrastructure with the help of NIC pushed the idea. The following stakeholder departments partnered to develop the iBhuGoal.

1. **National Informatics Centre (NIC), Bihar:** The NIC state centre for Bihar has designed, developed and deployed the project. NIC is also in-charge of training and capacity building.
2. **Information Technology Department, Government of Bihar:** The Department has funded the project and co-ordinated the project on behalf of State Government.
3. **State Departments of the Government of Bihar:** Various state departments use the facilities provided by iBhuGoal.

The project is spearheaded by the Information Technology Department, Government of Bihar in collaboration with NIC, Bihar. At least one data entry operator is attached to each department for handling the GIS data entry and maintenance. This team is assisted by officers from different departments of the State Government. The team works under overall supervision of the Principal Secretary, Information Technology Department, Government of Bihar and State Informatics Officer, Bihar.

iBhuGoal Impact

iBhuGoal 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 allows viewing, understanding, interpreting and visualizing data in ways that reveal relationships and patterns in the format of extensive maps, reports and charts.

In order to empower citizens and providing them visual tools for social audit, iBhuGoal can be very effective. Citizens can know about various schemes and their implementation status. Spatial analysis helps to understand distribution, coverage and access to these facilities. Introduction of GIS technologies bring in focus existing spatial reality which result in dynamism and transparency in the nature of working, in order to overcome problems related to planning, development, monitoring and decision-making. The major services available to citizens include:

- Geographical Maps of State, District, Block, Panchayats
- Booth Details, ERO and BLO
- Bihar ATLAS containing various thematic maps
- Road and Habitations details of selected areas
- Water Bodies, Rivers, Canals, Rivers and Jamindari Bandhs
- Electricity Transmission Networks
- Optical Fiber Networks of Bihar

- Urban Boundaries of major cities of Bihar
- Integration of GIS maps with on-line GIS Services such as Google, Bing, ESRI etc.
- Profile of Rural Roads pertaining to their Physical and Financial progress
- Assembly and Parliamentary booth distribution maps for Bihar

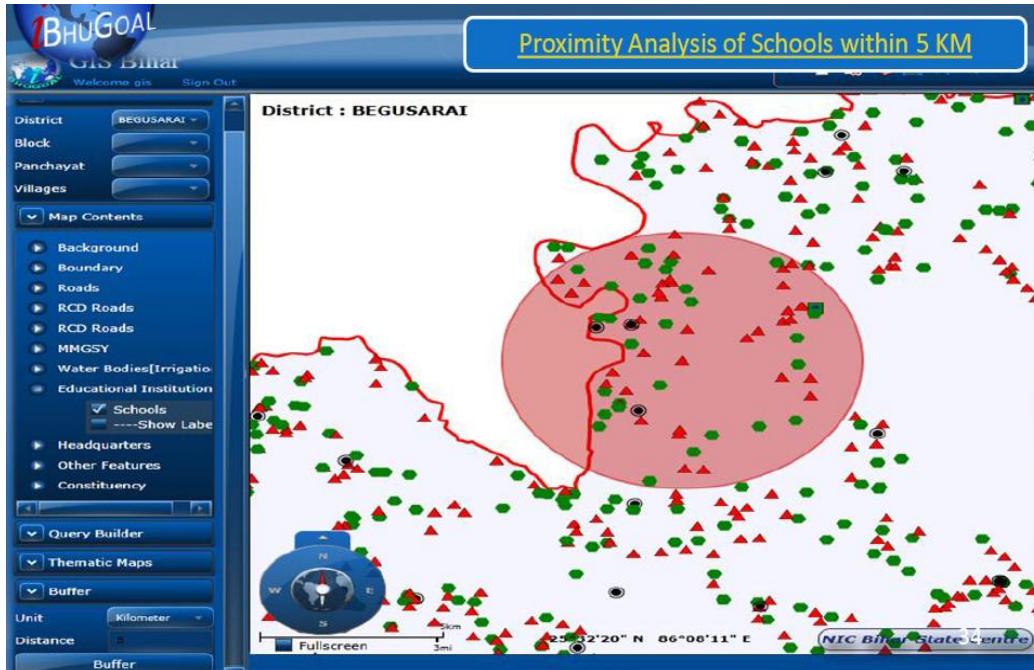


Exhibit-2: A Sample Map of State Resources through iBhuGoal

A sample map of state resources through iBhuGoal is shown in Exhibit-2. Though, every promise is yet not realized, it has started making a difference to the lot of common man. It will be some time before iBhuGoal is able to transform the entire state of Bihar.

Government of Bihar has sanctioned Rs.1.99 Crores for execution of the project for two years as shown in Table-2. The project has been further extended for a period of two years.

Table-2: Financial Outlay for iBhuGoal

| | Costs(Rs. in Crore) |
|---|---------------------|
| Project Cost – Sanctioned by State Government | 1.99 |
| Infrastructural costs borne by the NIC | 0.50 |
| NIC support through Manpower | 0.65 |
| Total Cost | 3.14 |

Some of the key benefits that the state is likely to realize from implementation of iBhuGoal would include:

- State Level Planning and Management
- Data driven decision-making
- Integrated thematic map updation

- real-time monitoring of worksites
- Systematic resource distribution for regional parity

Major challenges & Roadblocks

Implementation of iBhuGoal was not without hurdles. The NIC and the state government of Bihar faced several roadblocks during the introduction and implementation of iBhuGoal project. These were both institutional as well as operational issues.

- *Co-ordination among Stakeholder Departments*

Gathering and organizing data from the priority departments for spatial and infrastructural mapping to create an asset register for the entire state was an uphill task. To make this spatial data accessible on a centralized portal required complete coordination between all the departments and this is always a very painful process. As per the Technical Director of the project at NIC Bihar, it would require at least 2-3 more years to create a complete asset register for the state and to bring more departments under the purview of iBhuGoal.

- *Complex GIS technology*

iBhuGoal was the first ever GIS project implemented in the state of Bihar. Prior to the iBhuGoal project, the concept of spatial database did not exist in Bihar and both the knowledge and awareness of spatial dimension in decision-making was absent. Hence, selling this idea to the top administration of the state required quite an effort. Top administrators took their time before they were convinced that GIS-enabled tools can be really effective in decision-making on infrastructure, policy and state matters. The team successfully overcame this challenge by demonstrating its effective functionality in the concerned departments.

- *Creation and Maintenance of Spatial Data*

Prior to the iBhuGoal, most of the data records were maintained manually. Though, some departments adopted the MIS format. Still, records were not maintained digitally. Each department had its own way of managing data. The team, therefore, faced an arduous task of streamlining the processes of each department and organizing the digitized data under a centralized web portal, iBhuGoal. Thus, organizing data from various departments, converting large volumes of manual data into a standard digital format and carrying out spatial mapping required a continuous and sustained process discipline where co-ordination among different departments was an important issue.

- *Training and capacity building of stakeholders*

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. Imparting capacity building training to employees of various government departments proved to be a time consuming as well as deterring task as they were not willing to undergo the change in mind set. The staff and public officials, particularly at the level of villages and districts, were not able to understand the technical functionalities and operations of the GPS system. The NIC conducted regular training sessions to

capacitate the officials with software handling techniques. As a part of follow-up monitoring, video conferencing was used to ensure that any shortfall in technical training does not vitiate the sustainability of the project.

- *Operational challenges*

Cost effective functioning of the project within a stipulated timeframe required easy access to technology and adequate technical know-how. In terms of access to technology, the team faced some operational issues related to the hardware:

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

The team was successful in mitigating all these issues and challenges. Some creative solutions were worked out by the team. For example, the GPS mapping device is pre-loaded with verification and authentication tools. If an official is conducting a GPS mapping of *anganwadis* with this tool and has been misinformed with contradictory information, then the GPS system would check for fallacies and update the existing gap in information automatically.

Strategy & Status of Implementation

iBhuGoal 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. *Non spatial* data, on the other hand, refers to tabular or attribute data and has no specific location in space although it can have a geographic component and be linked to a geographic location. 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. In addition, many attributes that were necessary for the database were missing. All of this data was generated by the team. Exhibit-3 shows the strategy adopted for generating the spatial database.

Some of the achievements through the use of iBhuGoal are listed as under:

- In-house development of WEBGIS portal for Bihar [<http://gis.bih.nic.in/>] for hosting GIS applications to support Service Oriented Architecture to departments under national GIS framework used for GIS mapping and Integration with GPS data, digitized and mobile based data.
- GIS mapping of Rural roads has led to release of Rs. 6500 Crores to Bihar under PMGSY from Central government. Rural Development Ministry, Government of India has acknowledged this effort. This is being used as a basis for initiating MMGSY through State funds in which non-IAP districts with a population of 250 and IAP districts with a population of 100 are connected.

- Proximity analysis has been done for identification of habitations outside 5 Km radius of High schools and habitations outside 1 KM radius of Primary Schools for opening new schools.
- Mobile based application has been developed for capturing physical and financial progress of schemes along with geo-tagged time stamped photographs.
- Digitization of 1,05,620 KM National Highways, State Highways, Major District Roads, Rural Roads under PMGSY on a scale of 1:1000 with integration of key indicators has been completed for all 534 blocks of Bihar.
- Digitization of Irrigation Canals, Rivers, and Streams on a scale of 1:1000 has been completed and integrated with the Bihar GIS System leading to irrigation facility planning.
- Mapping of Health Facilities such as Primary Health Centres, and APHC with their respective coverage areas has been completed.
- Mapping of 1,08,000 Habitations as per National Habitation Survey has been done for micro level planning.
- Pilot project has been initiated for creating core network for Agriculture Transmission Line for supply of electricity for Pumping sets available in village areas.

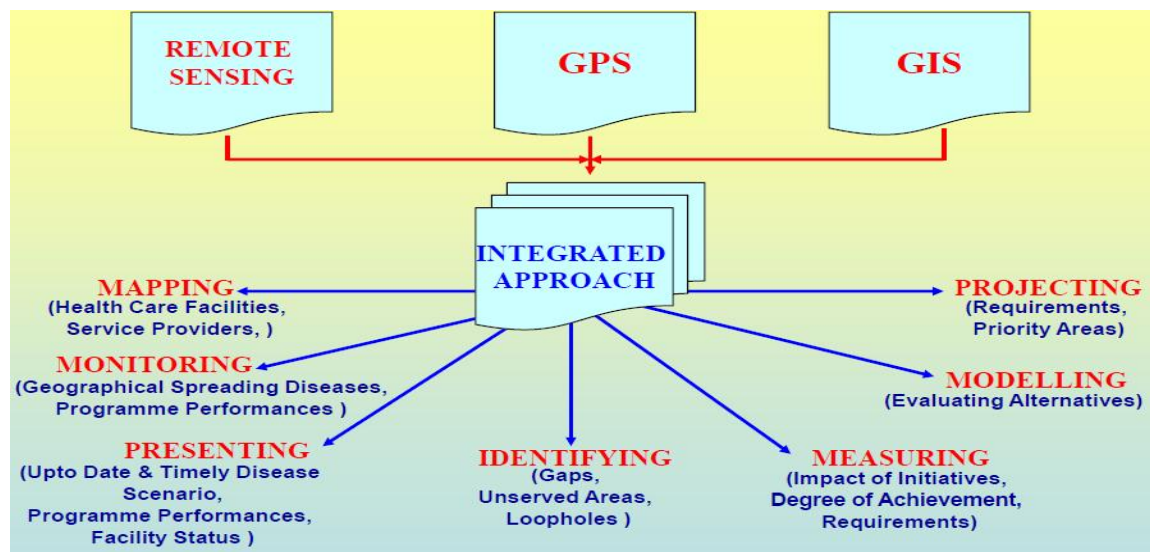


Exhibit-3: Strategy adopted for spatial database creation for Health Department

As per the key learnings of the team, the Critical Success Factors for the development and implementation of such a solution for a state necessarily include:

- Support from the top to ensure sustainability
- Availability of a geo-spatial database
- Comprehensive capacity building for stakeholder acceptance
- Common platform for effective data sharing between departments
- State specific policy and shared vision among all stakeholders
- Champion driven projects
- Working on a pre-decided time-frame
- Continuity of thought over a period

Scalability & Way Forward

iBhuGoal has made Bihar the first Indian state to have maps of up to population habitations upto 250 persons in the scale of 1:4000. Metcalfe Law would operate on this initiative. More people having an access to it would result in better acceptance level for it. Higher the impact of iBhuGoal, greater would be the demand for it.

iBhuGoal received support at all levels of the government. The immediate and tangible benefits it brought about accelerated its acceptance among the stakeholders in just two years of its implementation. It essentially means, to fundamentally change as to how the government operates, and this implies a new set of responsibilities for the executive and politicians. It will require basic change in work culture and goal orientation, and simultaneous change in the existing processes. Foremost of them is to create a culture of maintaining, processing and retrieving information through an electronic system and use that information for decision making. It will require skilled navigation to ensure a smooth transition from old processes and manual operations to new automated services without hampering the existing services. The proposed changes are likely to be met with a lot of inertia which can not be overcome by lower and middle level officials with half hearted attempts to diffuse the technology. The change in the mindset to develop and accept the distributed and flat structured e-governance system is required at the top level system to beat the inertia.

Creation of Geo-Tagged State Asset Register would help government departments avoid duplication of works. This project integrates GIS, GPS, Satellite Imagery and Mobile/Tablet based technology to capture location specific information. A snapshot of Android Based Tablet Application is shown in Exhibit-4.

Android based Tablet Application

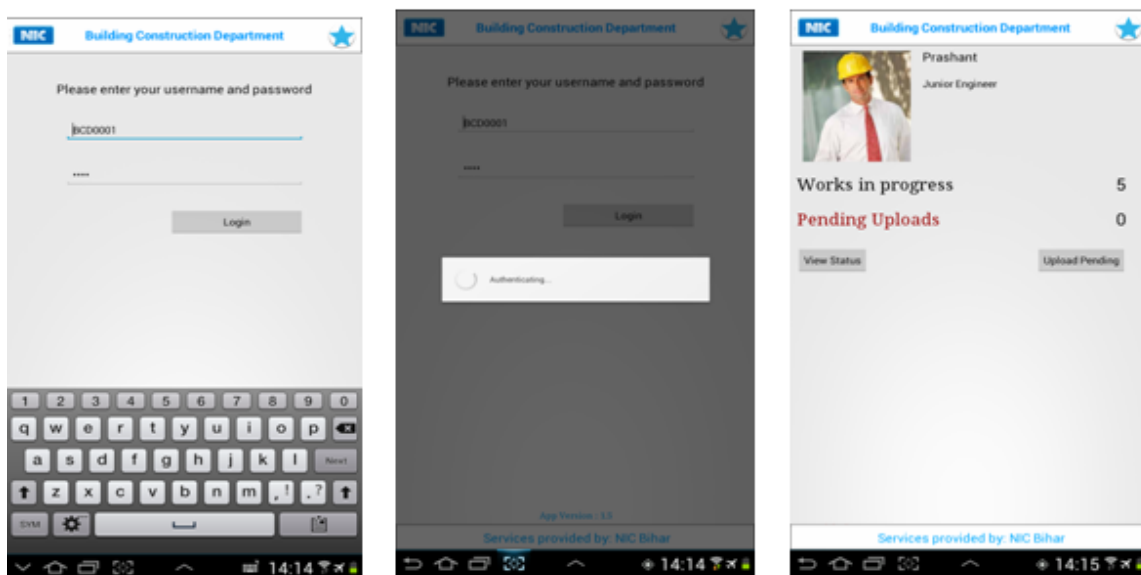


Exhibit-4: Android Based Tablet Application

With a mandate from state government to map most of the resources on GIS and recognition from the Planning Commission which has identified Bihar as one of the five pilot states to map total resources in next one year through funding support of the central government, iBhuGoal has received a shot in the arm. To top it, the current Principal Secretary of Bihar(Information Technology), is focusing all efforts of the team to take it to the next level of implementation so that more and more departments are able to benefit from this project.

Accolades & Replication

Significantly, the project has won 'Gold Award' under the category "Innovative use of Technology in E-Governance" under National Award on e-Governance 2012-13 through a rigorous process of selection by DAR&PG, Government of India. The most crucial appreciation of the project is the decision of many other state governments to replicate the project and decision of the State of Bihar to continue as well as extend the project under the State Plan. The Centre for Good Governance has notified to extend the scope of the project to all departments of Government of Bihar so that State Asset Register can be created. In addition the iBhuGoal software has been notified for implementation for Indira Awas Yojana, MGNREGA, Anganwadi Kendra Monitoring, Project Management of Building Construction Department, Schools Monitoring etc.

The project has been acknowledged by many agencies both within and outside the state. Ministry of Rural Development, Government of India has released Rs.6,500 Crores for construction of rural roads in Bihar based on the outcomes of this project. National Rural Road Development Authority(NRRDA), Government of India has identified this project for replication in states like Uttar Pradesh, Jharkhand, Orissa and West Bengal. Teams of officers from these states have already visited Bihar. J&K Government has already requested for adoption of the project. National Institute of Technology, Patna has verified all the maps generated through this system and certified that these maps are as per requisite standards of PMGSY.

i This is a real-life case. The names of the places are real. However, names of persons have been changed.