

EMPOWERING INDIA THROUGH GEO-SPATIAL TECHNOLOGIES

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ABSTRACT:

Technological advancement is a key driver for economic growth and sustainable development. Geospatial technologies with proven capabilities for supporting decision making can effectively support governance, enable sustainable development, assist in better management of business process as well as bring location based information closer to the people. As India endeavours to achieve its developmental goals, the multifaceted and specialised capabilities offered by geospatial technologies will play a defining role for information management in future with applications of great social and national significance.

Today, geospatial technology applications have become more pervasive impacting everyday life. The utility of this technology has caught the attention of the masses - be it through Google maps or geo-enabled social networks. Complex GIS applications are being developed and consumed by common man during emergencies, while businesses are realising efficiencies in using the technology right from planning strategies to analysing results.

Key words: *Geo-Spatial, GIS, GPS, Geo-Visualisation, Technology, Empowerment*

INTRODUCTION

As India progresses towards high industrialization and technological advancement, decision makers will continue to face several challenges for effective governance such as rapid growth in population, environmental concerns, resource shortages and security issues. India will require an efficient and advanced information and knowledge regime to brace itself for the envisaged economic growth. Geospatial technologies, with their unique ability for acquisition, integration and analysis of geographically-referenced spatial information, have in recent times been recognised as an effective tool for planning, management and decision making locally and globally. Among various other technologies, geospatial technologies with proven capabilities for supporting decision-making would be fundamental for information management in future with applications of social and national significance. Geographic information has application in practically all walks of human existence. This technology is therefore relevant to a multitude of sectors such as agriculture, telecommunications, oil & gas, environmental management, forestry, public safety, infrastructure, logistics etc

Geospatial technology broadly includes mapping and surveying techniques, remote sensing, photogrammetry, cartography, Global Positioning Systems (GPS) and Geographical Information Systems (GIS). With its unique ability for acquisition, integration and analysis of geographically referenced spatial information, this technology has in recent times been recognised as an effective tool for planning, management and decision making locally and globally. Geospatial technology has made inroads across various sectors in the public as well as private domain in India. The major sectors using geospatial technology in India are: agriculture, telecommunications, oil & gas, environmental management, forestry, public safety, infrastructure, logistics etc. As stakeholders across sectors realise the utility and long term cost effectiveness of using geospatial tools and technologies, the geospatial industry is set to progress by leaps and bounds in the coming years. Well-articulated policy mechanisms, Government support and the everincreasing domestic demand would go a long way in popularising geospatial technology in India and bring it into the mainstream an aid for effective governance and developmental planning.

RESEARCH METHODOLOGY

The paper is based primarily on secondary data. Works done by variousscholars are the bases that have provided data .Various Government websites comes handy with regards to data collection. Other sources apart from book comes in the form of e journals and newspapers and magazines

LITERATURE REVIEW

Biodiversity conservation, global environmental changes and globalization issues, such as climate change, land use and land cover change, and sustainable development are the key issues for conservation (Gude et al. 2007; Liu et al. 2011). Over the last century humans have been changing ecosystems more rapidly than in any comparable period in history, as a result biodiversity or the variety of genes, species and ecosystems has declined rapidly (Balmford et al. 2003). This loss is compounded by the loss of knowledge also. India is known for its genetic and species. Acquisition of remote sensing images of earth from space has opened up new frontiers for conservation and management of biodiversity. The multispectral satellite images provide definitions of vegetation patches, which are related to phenological types, gregarious formations and communities occurring in unique biodiversity setup (Behera 1999). The temporal satellite images provide information for vegetation mapping, monitoring and understanding ecosystem functions, primarily through the relationship between reflectance of vegetation structure and composition (Joshi et al. 2003). Landsat Multispectral Scanner (MSS), Thematic Mapper (TM) and Enhanced Thematic Mapper Plus (ETM+) data have been broadly employed in studies towards the determination of land cover since 1972, the starting year of Landsat program, mainly in forest and agricultural areas. The rich archive and spectral resolution of satellite images are the most important reasons for their uses.

The images also provide digital mosaic of the spatial arrangement of land cover and land use and difference in surface phenomenon over time can be determined and evaluated by visual interpretation with local knowledge (Garg et al. 1988).

OBJECTIVES:

- To identify areas of application of geospatial techniques for Indian society
- To highlight challenges of geo spatial technology and find smart solutions to the problems
- To find out feasibility of Geo-spatial technology and its role in empowerment of the Indian society

The common perception regarding the utility of Geographic Information Systems (GIS) is in the form of web applications that are used for maps and directions, but these tools have several features which go beyond location based services. Geospatial technologies as a tool for decision making can add immense value to planning and development. This multifaceted technology can effectively support governance, enable sustainable development, assist in better management of business process as well as bring location based information closer to people. In the present economic scenario, there is an increasing demand for cost effective solutions for decision-making which is likely to propel the usage of this technology across sectors in the near future. According to the Indian Geospatial Market Report 2009, the market for GIS based technologies has been expanding at such a substantial pace that it is estimated to touch the figure of USD 10 billion by 2019. Geospatial sector is now a full-fledged industry in itself and not a niche area of IT. Major IT companies have started dedicated practices in geospatial technologies.

Geographic information system (GIS)

Geographic information systems are used to collect, store, analyze, disseminate and manipulate information that can be referenced to a geographical location. It provides the way to overlay different 'layers' of data. The most widely used definition of GIS is a computer-based system that captures, stores, manages, analyses, and displays geo-referenced data (geographic data). It provides possibilities to extrapolate observations *e.g.*, to automatically define and map the potential area of a given species and to compare it with the locations where, it has been actually observed. GIS provides a database structure for efficiently storing and managing data over large regions. It also assists in location of study plots. GIS supports spatial statistical analysis of spatial distributions. It improves remote sensing information extraction capabilities, and provides input data and parameters for conservation and management of environment.

Global positioning system (GPS)

Global positioning system has received much attention in the past several decades, due to their broad appeal across a wide spectrum of both industry and research. It is a satellite-based positioning system. GPS allows the collection of information about the geographical position of any location using a network of satellites. It has a great potential in conservation and management of biodiversity, as well as in many other disciplines related to biological study which require geographical locations of the objects. Integrating with GIS, it acts as a powerful tool to describe the geographical characteristics of environmental systems. GIS is the core platform of many critical infrastructure and development projects worldwide and serves as a valuable tool for civil society.

The holistic understanding of the complex mechanisms that control environmental systems, as well as their spatial and temporal dynamics, requires synergetic adoption of measurement approaches, sampling designs and technologies. These technologies include Geographic Information Systems (GIS), Remote Sensing (RS), and Global Positioning System (GPS). There are various types of remote sensing satellite data, having different spatial and temporal resolutions in generating inputs for assessing various environmental parameters.

Geospatial techniques provides a powerful tool for assessing geospatial information for monitoring land use and land cover changes, changes in landscape, mapping potential, species distributions and monitoring and biodiversity losses.

Businesses today are increasingly adding a spatial dimension to data to help make critical decisions. Enterprises seeking geospatial solutions are not restricted to geospatial companies but also potential end-users that can utilise data for planning and management. India offers several advantages which enhance the prospects for this industry manifold. The Government has whole heartedly accepted this technology as being pivotal in facilitating good governance. State government departments are more aware with respect to the benefits and are gradually emerging as the major users. India is recognised for its IT skills and space programmes. It offers good infrastructure and expertise for collection of geospatial data. Players in this domain are already providing solutions to several end-users thus propagating the utility of the technology. Several trans-national companies have outsourced their operations to India in order to harness the significant technical expertise in the geospatial sector. Large numbers of institutions in the country provide courses in geospatial technology and applications to sustain technically sound human resource base.

The geospatial industry is presently witnessing tremendous opportunity within the country as the government has initiated reform projects in several infrastructure segments like rural development, power, land and natural resources and mandated the use of geospatial technologies in these projects. There are various other fields such as, schemes for construction and maintenance of roads, railways and waterways, civil aviation, public utility services, education, health, command area development, flood management programme, flood control, urban renewal, urban water supply, rural water supply, Integrated Watershed Management Programme (IWMP) etc. that essentially use geospatial tools and technologies for spatial planning, management and decision-making. As the country attains new milestones in industrial and economic growth, there is an intense ongoing debate on development versus environment. In this context, geospatial technology is perhaps the only technology that can provide a holistic approach to the understanding of the interactions and inter-linkages between the earth's biophysical and social elements to strike an optimal balance between developmental and environmental goals.

The geospatial market comprises four identifiable components – data, software, hardware and services. Of these two segments, hardware and services have shown significant growth in India. The major software providers in India are ESRI, AutoDesk, Bentley Systems, Leica Geosystems, InterGraph and PCI Geomatics. The major companies that produce GIS compatible hardware in India are HP, Trimble, Sokkia, Leica and Garmin. The largest segment in the geospatial market is the services segment and the major companies in this space include Rolta, RMSI, Infotech Enterprises, TCS etc. The Indian geospatial industry consists of two distinct but mutually supporting segments. The larger, international segment is geared to provide geospatial data and software development services for international organisations, primarily in North America and Western Europe. The other segment, the domestic segment, caters to providing geospatial capabilities to the Indian data providers/users.

Modern information technology has also greatly enabled complex and advanced mathematical analysis and modelling to devise management plans for natural resource conservation as well as environmentally sound economic development, while considerably economising on time and cost invested in collection, physical storage and manual processing of data. Ongoing advances in GIS functionality and the convergence of network computing and wireless communications with geospatial technologies are expected to further unleash the hitherto untapped potential for applications in development planning. Geographical information is a ubiquitous part of the governance. The primary role of Governments is decision making in public interest which involves geographically related issues, therefore, GIS can play a critical role in all spheres of good governance. Several local governments have now come to depend on geospatial technologies to not only organise and manage spatial data, but also for dissemination of information and services to citizens. In India, this technology is being used extensively for forest mapping, ground water survey, ocean productivity, environmental impact, land and water management, and disaster management. It is gradually being used for infrastructure inventory, transportation route planning and improved public service delivery by few state governments and departments. Slowly and steadily new frontiers for the usage of geospatial technologies for governance are also being explored in India. Few of the newer applications are in tax collection, property assessment, housing, rural employment schemes, local level planning, checking encroachments, tourism and urban planning including water supply and sewerage. However, despite the acceptability that this technology has found amongst different stakeholders and end-users in India, the benefits of this technology are yet to go beyond specific projects to find applicability within the entire gamut of governance, decision-making and nation-building.

CHALLENGES

In relation to the development happening in the country the actual demand for the application of geospatial technology domestically is far from adequate. The awareness and acceptance of the technology has not actually translated into sustained domestic demand for geospatial solutions from prospective end-users. This has somewhat deterred the growth of geospatial industry in India. No doubt, the technology is being used for various applications, but only in segregated pockets and not across the board. It still remains to be incorporated as an indispensable tool for decision-making in business and government. Several potential sectors are yet to adopt the technology and make optimal use of its huge potential for better and cost-effective planning and management.

It continues to be seen as a niche technology requiring huge investment and specific expertise leading to an aversion to adopt geospatial tools. The long term benefits such as economy of time, effort, resources and cost for data collection and analysis are often not understood by the end-users.

In order to mainstream geospatial technologies for better governance and business operations in India, it is imperative to address the factors that are presently hindering the domestic demand for solutions:

- Access to comprehensive data is an important issue to be addressed. Users would require complete data in a convenient format for greater coverage. The data has to go beyond niche applications to mainstream applications for wider outreach.
- Policies and planning for geospatial projects being implemented by the Government is not adequate in certain potential sectors.
- Research outputs are usually stand-alone and there is a lack of unanimity. The results are therefore not getting streamlined for development planning and do not conform to specific requirements of departments. There is a duplication of efforts resulting in multiple sets of non-standardised data being generated at several institutions which eventually remain unutilised.
- Government departments are averse to creating internal capacities within departments resulting in a gap in understanding of processes. The utility of this technology therefore does not percolate within the department leading to a lack of awareness regarding the benefits.
- There is a need to apprise senior administrators and executives regarding the technology to enable the mainstreaming of this technology in development projects initiated by departments
- As we move from niche to mainstream application of geospatial technologies, the requirement of data would also increase manifold. There will be requirement for more technically trained human resource to meet the growing demand for geospatial solutions at varying levels of detail. Generation of skilled manpower and adequate education/ training for geospatial technologies in line with the practical requirements of industry is also a huge gap area that needs to be addressed.
- Geospatial companies would need to respond to the requirements of the end-users who may not have the technical expertise to understand or use the technology. GIS applications, solutions and interfaces must therefore be easy-to-use, tailor-made and familiar to these users. In case of location based services, it will also help to create applications that can run on multiple devices. With the unprecedented pace of economic development witnessed in the country, the demand for accurate and up-to-date maps and use of geospatial products has increased exponentially. Considering the capabilities of this technology for multifarious applications, it is apparent that it will not only power future businesses but will also become a formidable driving force for the global economy in the coming decades.

The Government of India proposes to set-up a National GIS that would benefit governance and areas of national security and strategic applications. It will also help enterprises to take better technical solutions in support of their activities. India needs to build upon the existing policy initiatives to shape an integrated GI Policy that will further National GIS and will be most conducive for the growth of GIS technology and its applications. We need enhanced inter-sectoral efforts to bring out the geospatial information in the public domain from a business perspective. The need is for the public and private domains to join hands for the development of a mutually conducive and innovative environment for mainstreaming geospatial technology in India. Indian geospatial industry is in a progressive mode and can make rapid growth with adequate support and encouragement from the Government by way of the right policies, incentives and initiatives. Well-articulated policy mechanisms,

government support and increasing domestic demand would help popularise geospatial technology in India and bring it into the mainstream as an aid for effective governance and developmental planning.

FEASIBILITY -The Road Ahead

The GDP in India is expected to approach \$9-10 trillion by 2025 and the Indian economy would be characterised by its transformation to being highly industrialised and technologically advanced. India will therefore require an efficient and advanced information and knowledge regime to arm itself for the envisaged economic growth. Geospatial technologies would be central to information management in India in future and the applications of this technology can have great social as well as national relevance. It can support governance, help prepare sustainable development strategies.

Several Indian states such as Andhra Pradesh, Karnataka, Rajasthan and Tamil Nadu are now using geospatial technology for good governance and efficient management. Until a decade ago in India, government departments and agencies were the only source for geospatial information. Opening up of mapping data and information by the state has enabled enhanced private sector participation in this sector. Several businesses and industries are now using geospatial services in India for analysis of demography, competitiveness, expansion, risk management, target oriented marketing, planning of route etc. The major sectors using geospatial technology in India are: agriculture, telecommunications, oil & gas, environmental management, forestry, public safety, infrastructure, logistics etc.

Some states have just launched their geoportals, others are on the verge and a few are in conceptual stage. There are lessons for the states that aspire to go for Skill Development Initiative like how to avoid duplication, form high level committees, bring stakeholders together, monitor line departments, generate demand for data and create standards. Maj Gen (Dr) R Siva Kumar points out that someone needs to champion the cause, create consensus among departments and take the concept to reality. Ultimately, an SDI is for the development of the society. Dr K Kasturirangan, Member (Science) Planning Commission and former Chairman, ISRO once said, "Make data that is required for decision-making available to the right person who needs it, at the right time, and for addressing a rightful need.

GOVERNMENT INCENTIVES

India offers several advantages which enhance the prospects for this industry manifold. Most importantly, the growth of the geospatial sector has been supported by the Central as well as State Governments in India. Secondly, India is recognised throughout the world for its IT skills and space programmes. Additionally, it offers an excellent infrastructure and expertise for collection of geospatial data. The development and escalation of geospatial industry in the region has been significant with mature players having marketed the benefits of geospatial information over the past two decades. India's reputation as an outsourcing destination has enabled the development of significant technical expertise in the geospatial sector. Major trans-national geospatial companies therefore have a strong presence in India. There are also more than 35 institutions providing degree and diploma courses in geospatial technology and applications in the country. According to the Industry Outlook on Geospatial Industry 2011, the Indian geospatial market is expected to grow at an annual rate of around 20-25 per cent in terms of both software and services business.

The National Informatics Centre, or NIC, as it is popularly known, has established spatial infrastructure and services as an essential component of systems and support for national e-governance and planning in India. NIC has leveraged information and communications technology (ICT) to provide a robust communication backbone and effective support for e-governance to the central government, state governments, UT administrations, districts and other government bodies. It offers a wide range of ICT services. This includes NICNET, a nationwide communication network with gateway nodes at various departments of the Government of India, State/UT secretariats and all district collectorates to service ICT applications. NICNET has played a pivotal role in decentralised planning, improvement in government services, wider transparency of national and local governments and improving their accountability to the people. NIC assists in implementing ICT projects, in close collaboration with Central and state governments and endeavors to ensure that state-of-the-art technology is available to its users in all areas of ICT. NIC has established spatial infrastructure and services as an essential component of "systems and support" for national e-governance and planning.

Union Urban Development Minister M Venkaiah Naidu along with Union Minister of State for Labour Bandaru Dattatreya during Geospatial World Forum conference in Hyderabad on Monday 24 Jan 2017 said that The Centre would extensively utilise geospatial technology in realising its vision for betterment of human civilisation. Indian geospatial industry is expected to become a \$20 billion market by 2025, growing at a cumulative annual rate of 12-15 per cent. The estimated annual budget of government agencies for GIS services today stands at \$3 billion." Venkaiah Naidu further said the Centre had also launched several flagship programmes that would make use of geospatial technologies. These included the much-coveted Smart Cities

programme, skill development, Digital India, Start-Up India and Make in India. He said development and speedy governance were now the top priorities of the NDA government. The Centre, he said, was implementing the schemes MISIDICI - Make in India, Skill India, Digital India and Clean India. For achieving Digital India, geospatial science was the basic enabling technology. The Centre would extensively utilize geo-spatial technology in realizing its vision to build 100 smart cities across the country

The \$4 billion Indian geospatial industry in India is expected to become a \$20 billion market by 2025, growing at a cumulative annual rate of 12 to 15 per cent. The estimated annual budget of government agencies for GIS services currently stands at \$3 billion and this was expected to further increase with the government's push for leveraging space and location technologies for development and governance.

CONCLUSION

The geospatial industry is presently witnessing tremendous opportunity within the country as the Union government has initiated reform projects in several infrastructure segments like rural development, power, land and natural resources during the 11th Five Year Plan and mandated the use of geospatial technologies in these projects. Government projects such as AgRIS, JNNURM and NLRMP, R-APDRP etc. will boost growth in the sector. Besides, there are various other fields such as, schemes for construction and maintenance of roads, railways and waterways, civil aviation, public utility services, education, health, command area development, flood management

Successful implementation and integration of spatial and non-spatial data into a GIS framework with proper local level planning is critical for attaining sustainable development. Planners, managers and administrators should be facilitated with maximum information that they can utilise with proper geospatial tools. Dynamic thematic planning maps will provide a clear picture of any facility, as it would help the planners to gauge the effects of any plan and to effectively monitor the utilisation of funds. This approach for integrated decentralised planning at local level is presently totally dependent on government agencies for all kinds of information. With the unprecedented pace of economic development, the demand for accurate and up-to-date maps and use of geospatial products has increased exponentially. This will aid in achieving equitable development across the different regions of the state.

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ONLINE REOURCES

- <http://www.openstreetmap.org/about>
- <http://www.onomap.org/Software.aspx> > <http://www.slideshare.net/adnanned/icsin-pres>

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