



Newsletter

Volume V | January-February 2022

From the President's Desk

Land has always had a dynamic relationship with mankind, governing cultural, social, and economic development. This relationship is defined by the land policies and regulations of the time, which act as essential tools for allocating and controlling land rights, restrictions and responsibilities. Establishing and maintaining these tools effectively requires a sound spatial framework built upon reliable, accurate data.

As the core of the land administration system in India, land records have a long but marred history. Challenges such as multiplicity of records across departments, inconsistency in updates, inaccuracy and/or complete lack of data have troubled all stakeholders for years on end.

The present situation demands more focus on data quality, accuracy and speed in creating a central online database for land records. A forward-looking vision to integrate aspects of 4IR, IoT, Blockchain, BIM 3D and 4D for improved data collection, analysis, and visualization is also vital. This is where the 'Fit-for-Purpose' approach steps in – deploying scalable solutions considering both the urgencies of today and the developments of tomorrow.

The answer lies in a convergence of policymakers, private companies, scientists and field workers leveraging Geospatial technologies to build a single solid ecosystem that can be value-added upon. Digitalization of land administration on the shoulders of Geospatial technology will ensure scalability, inclusivity, community involvement, reliability, accuracy, and updates while maintaining cost and time effectiveness, irrespective of land use, occupation or geography.

The Association of Geospatial Industries (AGI) appreciates the liberalization of Geospatial data, setting up of countrywide CORS infrastructure, and increased government-private collaborations, which are steps in the right direction. Moving forward, we need to sustain this momentum, promote awareness about value creation through investments in Geospatial technologies and content, and work cohesively in the spirit of betterment of the industry.

As a forum for exchange of ideas, techniques, approaches, and experiences by those who design, implement and use Geospatial technology solutions, AGI calls for a sustainable, systemic transformation in the context of Indian land administration. An accelerated adoption of Geospatial technologies will ensure faster, reusable, optimized outcomes. We proudly present this edition of AGI's newsletter as a comprehensive document on the increasing relevance of Geospatial for Land Administration for all stakeholders from the government, industry, academia, and society as a whole.

We hope this edition comes across as insightful and enjoyable. Stay tuned for more insights, stories, and analyses from AGI in the coming months.

Enjoy Reading,

Agendra Kumar
President, AGI



In this Issue

President's Message

1

Interview

Shri Sunil Kumar

Surveyor General of India
(Additional Charge) and
Joint Secretary, Department
of Science and Technology,
Government of India

2

Interview

Sanjiv Jha

Principal Solution Architect –
Smart Infrastructure, Amazon
Internet Services Pvt. Ltd,
AWS India and South Asia

4

Special Feature

**Geospatial Data Revolution
is the Pillar for a Digitized
Land Administration
System in India**

6

Article

**Land Records, Registry
and Revenue: Indian
Experience and Way
Forward**

9

Case Study

IIC Technologies

12

Article

**Roter Group of
Companies**

14

Case Study

Secon Pvt Ltd

15

Updates from AGI

16

Policy changes are opening more opportunities for contribution by the Indian Geospatial industry

SoI would like to act as a facilitator in building a better Geospatial ecosystem in the country, remarks **Shri Sunil Kumar, Surveyor General of India (Additional Charge) and Joint Secretary, Department of Science and Technology, Government of India.**



For an initiative of such a vast scale as SVAMITVA, there are bound to be some challenges, one of which is data collection and processing due to lack of a robust IT infrastructure, inadequate number of drones, disruption because of the pandemic, and so on. How has the Survey of India planned to address these challenges and complete the ambitious project by 2024?

Survey of India (SoI) has planned for the execution of surveying and mapping works under the SVAMITVA scheme with a multi pronged strategy. The idea is to cater to timely augmentation of key resources, including manpower or material resources essentially required for the execution. However, with the scheme involving multiple stakeholders, the effective translation of any execution plan into tangible ground actions is a tough challenge. All stakeholders must demonstrate the same tenacity, commitment and vigour for accomplishing their targets.

Anticipating the resource gaps, SoI had started direct and indirect engagement with all Geospatial and drone related professional bodies, drone and Geospatial (product and service) companies and drone training institutes as early as March-April 2021, aiming to gauge the expertise and capacity available in the country. engagement activities included tendering under different business models [procurement of survey grid drones and data processing software], drone as a service on turnkey basis, end to end outsourcing, and engagement with GIS professionals.

SoI also conducted multiple workshops and seminars with the industry to understand the bottlenecks involved and strategize the timely completion of targets under the scheme..

Presently we are empaneling private firms to undertake future work execution activities. This was recommended by the industry itself to determine the best suited business model for scheme implementation.

As of date, SoI has already completed drone flying for more than 100,000 villages. This is a huge number considering the impact of the COVID-19 pandemic and other challenges. SoI is also learning from the villages covered so far in different States and is now more stable in terms of resources and workflow.

For the land administration sector in India, the other key component is the DILRMP project of the Department of Land Resources [DoLR]. What initiatives and collaborations has SoI been involved with for this program? How can industry increase its engagement for fulfilling the objectives of DILRMP?

DILRMP program has been going on in the country for past 15 to 16 years and SoI has been associated with this program ever since its formulation as NLRMP (now DILRMP).

SoI is a key player in the Core Technical Advisory Group (CTAG) as well as Project Monitoring & Sanctioning Group (PM&SG) at DoLR. We have been extending technical expertise primarily

covering the surveying and mapping aspect of the scheme implementation, focusing on using the best available technologies for cadastral surveying and mapping.

For example, SoI had presented for inclusion of the CORS technology under the DILRMP in 2015-16 itself, acknowledging the long-term significance and widespread application of Geospatial infrastructure in land records management.

DILRMP has three major components, out of which Resurvey of Revision Survey has been covered under the third component. The other two components focus on digitization of the existing revenue records and creation of the physical, it and Geospatial infrastructure at state, district and tehsil level for modernization of land records in their respective state.

We believe that Geospatial companies and other commercial industry players have been engaged quite successfully so far in the scheme implementation for all components of powering resurvey. The prescribed business models stipulates that execution will be done by respective State Governments only, who have been focusing almost entirely on components other than resurvey, as it involves serious technical challenges and deeper technical understanding of surveying methodologies.

Some states like Bihar Odisha, and Gujarat, however, have executed works under resurvey component of dilrmp through outsourcing and by engaging with Geospatial companies, and must be lauded.



Do you have a timeline in mind to complete implementation of CORS projects for the entire country? Are there any plans to further densify the network, which is currently pegged at a 60- 70 km grid?

SoI had chalked out a clear road map for establishing a countrywide CORS network to modernize the National Spatial Reference Frame of the country (NSRF). About 40% of the country has already been covered. Tenders have been finalised for the remaining parts of the country for which work orders will be placed by mid February 2022. The entire country is likely to be covered before December 2022.

Almost all geographical areas in the country are being covered and outsourcing packages have been prepared considering the common challenges related to access terrain weather challenges etc. CORS is a positioning infrastructure, with its present density being worked out as a cost effective “Fit for Purpose” solution to meet the objectives of modernizing the existing NSRF and facilitating the foundation data generation, supporting on land and topographical surveying project works executed for various sectors by SoI or other agencies, facilitating the land records modernization and management in the country, and so on.

Further densification of this position infrastructure and promotion for widespread users in the future will be the primary focus of SoI. However, such future augmentations would be strictly in line with user requirements to

ABOUT 40% OF THE COUNTRY HAS ALREADY BEEN COVERED. TENDERS HAVE BEEN FINALISED FOR THE REMAINING PARTS OF THE COUNTRY FOR WHICH WORK ORDERS WILL BE PLACED BY MID FEBRUARY 2022. THE ENTIRE COUNTRY IS LIKELY TO BE COVERED BEFORE DECEMBER 2022.

ensure optimum cost effectiveness of the infrastructure we would like to explore all feasible collaborative participatory mechanisms for development, operation, management of this key infrastructure of the country.

SoI has witnessed a significant change in leadership, with an exciting year in the backdrop. There have been multiple on field and online initiatives, industry engagements, as well as commendable progress with schemes like SVAMITVA together with conducive policy changes. What will be the collective vision from this point on that SoI wishes to work towards?

SoI has indeed made considerable progress under the SVAMITVA scheme. An exercise of this scale has never even been thought of anywhere in the world, let alone undertaken or accomplished.

The Geospatial Guidelines Issued in February 2021 were announced at an opportune time, facilitating multiple industry engagements there on. Drone rules have also seen a revamp. these policy changes do have a bearing on the execution of this scheme, besides opening more opportunities for contribution by the Indian Geospatial industry.

SoI has already started outsourcing the Data Acquisition (Drone Flying) activity, and more such activities are in the pipeline. Empanelment of Firms for Drone Services is under way, which would bring many firms on the list of SoI service providers.

What more can the industry expect from SoI in the days to come?

The Department of Science and Technology, GoI, issued the new Geospatial Guidelines with a motive to liberalize the Geospatial ecosystem and democratize Geospatial data generation and map making in the country. Keeping this spirit and the long-felt need to make SoI data/services available to all in view, SoI has planned more interactions with industry members to assess their potential and readiness for providing platforms and solutions for effective utilization of SoI data. SoI being a national mapping agency would like to take a leadership role and act as a facilitator in building a better Geospatial ecosystem in the country.

Unavailability of the right software and skilled cloud architects is hindering adoption of Cloud Computing Geospatial segment

Technology innovation is outpacing skill development, reflects **Sanjiv Jha, Principal Solution Architect – Smart Infrastructure, Amazon Internet Services Private Limited, AWS India and South Asia**



With the huge volume of Big Geospatial Data and vast number of stakeholders involved in the digitization of land administration, the “cloud” appears to be the much-needed solution. And yet, Geospatial cloud computing is still in its infancy in India. Where is the gap?

There are two major challenges facing the faster adoption of cloud computing in the geospatial segment, and preventing it to scale. The first reason is the unavailability of the right software to process geospatial data on the cloud. The software to process these data are decades old and mostly desktop based. Vendors are now building cloud-optimized versions of the software, but this is still in a very early stage. One can still deploy the software but they are yet to evolve to take advantage of native cloud benefits of elasticity and dynamic scaling. So, the true value of cloud transformation is yet to be realized.

The second reason is general awareness and lack of availability of skilled cloud architects in the industry. Doing a lift and shift of the workloads from an on-premise deployment does not achieve the full value of cloud transformation, we need to have cloud optimized architecture to fully realize the potential, and skilled cloud talent is important here. The reality is that technology innovation is outpacing skills development. AWS understands this, and we are deeply committed and invested to developing a skilled talent pool in the country. We are doing this by – collaborating with education institutions to offer integrated computing curriculum in undergraduate and post-

graduate degree programs at scale across states in India, training faculty and providing students industry-recognized cloud curriculum and access to AWS certifications through the AWS Academy program, and offering the AWS re/Start program.

Talking about various cloud deployment models (public, private, hybrid, multi-cloud, community), is there a single solution that offers advantages of security, accessibility, control, affordability, and compatibility at the same time?

A public cloud has the advantage of economy of scale, and over time, it has evolved as the one stop solution for security, accessibility, control, affordability and compatibility. AWS has been the world's most comprehensive and broadly adopted cloud offering for over 15 years and is serving millions of customers globally.

At AWS, security is always our top priority. AWS has been architected to be the most flexible and secure cloud computing environment available today. Our core infrastructure is built to satisfy the security requirements for military, global banks, and other high-sensitivity organizations.

In contrast to the past, where data was scarce, today we have a multitude of resources offering Geospatial data in various formats, resolutions, and quality standards. Is the compatibility/ interoperability of these different

A PUBLIC CLOUD HAS THE ADVANTAGE OF ECONOMY OF SCALE, AND OVER TIME, IT HAS EVOLVED AS THE ONE STOP SOLUTION FOR SECURITY, ACCESSIBILITY, CONTROL, AFFORDABILITY AND COMPATIBILITY.

types of datasets mandatory for moving them to the cloud? If yes, how can organizations ensure this?

Compatibility/ interoperability is not the blocker for cloud adoption; there are emerging standards which make storing these large datasets on cloud efficient. One of the evolving standards is COG (Cloud Optimized GeoTIFF). A COG is simply a GeoTIFF (a public domain metadata standard) that has an internal organization that supports efficient access via HTTP, i.e., it is formatted to work on the cloud.

This internal organization is combined with an HTTP feature called 'GET range request' that allows only the portion of the file that is needed to be retrieved. Similarly, the Spatio Temporal Asset Catalog (STAC) specification provides a common language to describe a range of geospatial information, so it can more easily be indexed and discovered. While moving data to cloud, it is advantageous

to think in terms of cloud optimized data formats for ease of discovery and sharing.

The AWS cloud platform itself includes a variety of cloud-based data storage options which companies have to choose from. Which of these solutions come across as the most befitting for Geospatial imagery processing and analytics, considering the dynamic mosaicking and on-the-fly processing requirements of land imagery?

AWS has many storage options which one can choose to architect their solution. We recommend a multi-tier storage pattern for geospatial image processing. While Amazon Simple Storage Service (Amazon S3) is the ideal choice for storing and building geo-data lake for large scale data, customers also can use Amazon Elastic File System (Amazon EFS) or Amazon Elastic Block Store (Amazon EBS) for storing and gaining faster access to operational and transactional data. This approach gives the most cost-effective storage strategy for large scale geospatial image processing.

With a conducive policy environment liberalizing the Geospatial sector, we will

STARTUPS NEED TO LOOK AT MOVING FROM CAPEX MODEL FOR INFRASTRUCTURE TO THE OPEX MODEL. WE BELIEVE THE CLOUD IS THE BEST PLACE TO BUILD STARTUPS, AND THAT THE AWS CLOUD IS THE BEST POSSIBLE ENVIRONMENT FOR THEM TO FLOURISH.

be witnessing a new era of business development powered by innovative Geospatial mobile applications, but challenges around scalability and infrastructure management of these applications continue to hinder startups and small businesses. Is there an affordable way forward for them?

Startups need to look at moving from capex model for infrastructure to the opex model. We believe the cloud is the best place to build startups, and that the AWS Cloud is the best possible

environment for them to flourish. Cloud services are incredibly cost-effective and can quickly give startups access to computing resources as they need them on a pay-as-you go basis. Second, cloud is inherently meant for dynamic scaling, this isn't a challenge.

At AWS, we offer a broad range of programs and initiatives to support startups at every stage of their lifecycle, from early-stage through to maturity. These programs provide startups with a host of benefits, including AWS credits, technical support, and training. We also offer extensive cost optimisation services to our customers. We've reduced prices 111 times since AWS launched in 2006. Our team members are actually tasked with reducing a startup customer's cloud bill, ensuring startups make the most economically efficient use of our services.

Cloud infrastructure costs can represent a large portion of a startup's regular expenditure, and our team has been able to achieve savings for customers of up to 40%. We do this by offering a range of pricing models, including spot pricing for Amazon EC2 Spot Instances, which startups particularly appreciate because they can deliver up to 90% discounts over On-Demand pricing.





Geospatial Data Revolution is the Pillar for a Digitized Land Administration System in India

By Sakshi Singh

Land has held immense socioeconomic relevance throughout the history of humankind. In modern-day India the access, ownership and documentation of agricultural and non-agricultural land impact a large majority of rural and tribal areas. At the same time, land policy and administration have a crucial role to play in residential and business developments, and management of natural resources.

Having said that, India has been struggling with complicated and inefficient land administration for decades. This has become especially relevant in the aftermath of the COVID-19 pandemic, as India awaits global manufacturers and businesses to set up shops on its soil. While the Central and State Governments attempt to reform laws and processes governing the land market, there is greater demand for secure land and property rights for all – a critical component for achieving the UN Sustainable Development Goals by 2030.

Establishing an effective and efficient land administration in the country will have to be based, however, on the pillars of accurate land information. India, like many other developing countries, is computerizing its cadastral records, paving the way for an exhaustive national

database on land-related data. This database can then be used for reforming revenue, planning, service delivery, infrastructure development, and beyond.

Interestingly, it is the wave of Geospatial technologies and information that is fueling this paradigm shift.

The Meaning and Need for Effective Land Administration

Land administration systems provide countries with the infrastructure for implementing land policies and management strategies aligned with the principles of sustainable development. It comprises an extensive range of systems and processes to administer:

- ✓ **Land Records:** the allocation of rights in land, Records of Rights (RoR), delimitation of parcel boundaries for which rights are allocated, the transfer from one party to another through sale, lease, loan, gift, or inheritance, and the adjudication of doubts and disputes regarding rights and parcel boundaries.
- ✓ **Land-Use Regulation:** land-use planning and enforcement and the adjudication of land-use conflicts.
- ✓ **Land Valuation & Taxation:** the gathering of revenues through forms of land valuation and taxation, and the adjudication of land valuation and taxation disputes.

Effective land administration caters to all, developing confidence and trust, promoting safety and security, and facilitating equitability and transparency in land value capture. It serves to make both rural and urban societies smart and resilient, while enabling multi-disciplinary and multi-sectoral involvement of all stakeholders.

The United Nations Framework for Effective Land Administration (FELA) describes how land administration relates people to the land, informing on the “how, the ‘what’, the ‘who’, the ‘when’, and the ‘where’ of land tenure, land use, land value and land development. It is an umbrella term covering the entire spectrum of rights, restrictions, responsibilities and relationships tying together people, policies, and places.

Needless to say, these relationships are ever-changing, calling for adaptability and dynamism when designing an efficient land administration system. This requires data on the many millions of parcels, spatial units, persons, and parties that

Figure 1: Sustainable Development and Land Administration



Illustration Source: Author; Inspired from UN FELA document

are a part of the ecosystem, data on ownership and transfers, data on market trends from one location to another, data on utilities and land use, data on the environment, soil and agriculture - data that is accurate, interlinked and updated from time to time.

Where Geospatial Fits In

Revamping obsolete and ineffective land administration systems, Geospatial technologies are enabling faster, more reliable, and manageable collection, update and distribution of land-related data – a much-needed transformation.

Geospatial technologies like satellite imaging and mapping, drone imagery, positioning and GIS can help manage all aspects of land information and records, including land tenure, value, management and use. With such extensive information collated, stored and analyzed on easy-to-interpret visual platforms, Governments can improve land information management, property valuation and analysis as well as public communications from head to toe.

Deven Laheru, President, Scanpoint Geomatics Ltd, remarks, “Geo-enabled digital land records that accurately mirror the ground scenario, along with systemic interventions using Geospatial technologies for recording changes in revenue records in real-time have far-reaching impact on two fronts.

One, this will help unlock the economic value of finite resources like land assets, especially in rural areas. Two, it will usher in a new era for effective implementation of government initiatives and welfare schemes in the agriculture sector. Together, they can spur enormous growth in rural India and positively impact almost 65% of the population of our country.”

Land Records

The complicated system of maintaining land records in India dated back to colonial times until recently, required to be updated every 30 years through survey and settlement operations. Most of the data existing with authorities are inaccurate, sometimes completely far from reality.

Geospatial technologies have revolutionized conventional surveying methods. GNSS is being used in topographic surveys to determine precise locations in any weather conditions at any time of the day. Geodetic survey equipments have become smaller, faster and more accurate.

The SVAMITVA scheme has shown how lightweight, easy to handle drones can be used to obtain aerial imagery for accurate mapping of property boundaries, corroborated with manual inspection. Traditional land surveys are now being combined with advanced tools like 3D modelling, HD imagery, terrestrial

scanning, and LiDAR for achieving greater accuracy and faster data collection for land parcels.

No wonder the volume of data collected is humongous. It is here that a robust cloud GIS architecture can power applications for data storage, transfer, analytics and visualization, besides offering easy scalability for evolving data types and volumes. Land registry information can be objectively monitored because Geospatial technologies are helping organize the so-far chaotic and scattered datasets.

Land Use Regulation

Geospatial platforms can prove valuable for local governance. Data collected, analyzed and interpreted on GIS can help authorities ascertain whether developments are in line with regulatory frameworks. Integrated spatial modelling using Remote Sensing data, GIS databases and positioning infrastructure can also help realize and predict spatial development and changing urban land use patterns.

Information on key aspects of land administration can be made publicly available for citizens and private sector participation, performance comparisons across units and sub-units, facilitating suggestions for improvement.

Land Valuation and Taxation

The determination of accurate property tax and value depends on relevant up-to-date information on the land parcel concerned. Land ownership information is of little use if not spatially referenced or when transactions such as mortgages and tax liabilities are not recorded. Geospatial technology helps fill such gaps in recordkeeping.

At the same time, it provides a reliable framework for precise identification and verification of data from multiple sources for accurate valuation.

Challenges to Effective Land Administration in India

The failure to realize an effective land administration system in the country so far needs to be viewed from a systemic, besides a technological perspective.

Data Quality is not Uniform

In the absence of any standardization for data collected by various stakeholders, it is difficult to assure expected outcomes. Most of the land-related data in India ages back by decades. Conducting surveys and re-surveys of these datasets is not happening at a uniform pace throughout the country for the preparation of a comprehensive database.

Different Types of Land to be Administrated

In India, land administration can be categorized into that for urban, rural and tribal areas. Each of these categories demands a unique perspective of administration, rooted in unique mapping technologies. While urban areas abound in vertical developments and multiple owners of the same piece of land, rural areas have different issues for agricultural and non-agricultural lands. The tribal areas demand an entirely different flavor interlaced with cultural, political and privacy concerns. A broad-based comprehensive policy keeping different regulatory approaches in view needs to be developed.

Corruption hindering Administrative Modernization

Most countries around the world are grappling with the issue of corruption that stems from institutional opacity. While land administration needs to be modernized on the pillars of a digital transformation, there has also been tremendous resistance against it because of the transparency it will bring about in terms of land records, ownerships, sales and purchases.

Misconceptions about Geospatial Technology abound

For a long time, governments and authorities have been viewing Geospatial technologies or even digitization, for that

matter, as an unnecessarily expensive affair. While such misconceptions have prevented them from gauging the true return on investment that these technologies can offer, they have also resulted in lesser awareness and participation of Geospatial in the mainstream.

Geospatial tools and technologies have become widely indigenous, and their cost of implementation has reduced significantly. The ongoing SVAMITVA scheme by the Ministry of Panchayati Raj, Government of India, is a vivid example, using modern Geospatial technology on a countrywide scale to benefit millions of rural property owners. The investments are sizable, but the scheme is completely transforming India's decades-old rural land administration system.

What next?

Raghavendra Boyapally, Founder & Managing Director, Marvel Geospatial Solutions, notes, "Until now, GIS technology was considered too sophisticated, required specialist users, and seemed difficult to integrate into mainstream information technology. This severely restricted its widespread adoption by those involved in land administration."

"As GIS and associated technologies have been liberated with the implementation of the new Geospatial Guidelines, the traditional challenges around Data Ownership, Data Protection, Data

Quality and Adoption of Standards have either been eradicated or minimized. The result is that more data has become available in digital format, and the use of GIS for integrating land-related data has become more opportune."

Existing land administration systems in the country require extensions into 3D and 4D functionality to better capture both horizontal and vertical developments on land parcels. The concept of the 'digital twin' holds tremendous potential for redefining the conventional land administration approach, enabling the integration of real-time data, reports, analyses, and user experiences for past evaluations, present observations and future predictions.

Advanced technologies like blockchain can be leveraged in tandem with Geospatial technologies for land administration in the future, for ensuring transparency and organization of transactions on a single, decentralized, corruption-free framework. A 'Fit for Purpose' approach must be adopted for addressing the most pressing needs at the moment through adaptable tools that can be gradually scaled up based on evolving needs.

Substantial work is being undertaken and completed on these lines by governments, private sector companies, global organizations and NGOs, and yet more needs to be done to realize the vision for an effective and sustainable land administration system in the country.



Land Records, Registry and Revenue: Indian Experience and Way Forward

By Megha Datta

With insights from Pankaj Mishra, Deputy Surveyor General, Survey of India

Land registration is one of the biggest sources of revenue collection for a majority of States and Union Territories (UTs) in India, and yet one of the most complicated administrative areas that authorities have been handling for years.

The Digital India Land Records Programme (DILRMP) has been conceptualized as a major system and reform initiative by the Department of Land Resources, Ministry of Rural Development, Government of India. The scheme has been brought under the 'Digital India' flagship programme to build on the commonalities existing in the arena of land records in various States/UTs for state-specific yet unified solutions.

While the scheme is currently under implementation, there are some challenges that have prevented accomplishment of all its broad objectives.

Land Administration in India: A Complex Affair

An insight into global developments in cadastral mapping and land administration in the recent past shows greater emphasis placed on adopting the "Fit for Purpose" approach. The same approach finds mention in the Framework for Effective Land Administration (FELA) Report prepared by the UN-GGIM Working Group for Land Administration and the UN-IGIF

Framework for Geospatial Information Management at the country level.

The principle behind the "Fit for Purpose" (FFP) concept is designing a framework of land administration system to meet the motive of tenure security using tools and techniques for addressing the most pressing needs at the moment, and then gradually scaling them up based on evolving needs. FFP has three chief components – time, costs, and accuracy – of which you can focus on any two at a time.

Land administration in India has continuously fallen behind because of the failure to realize an integration of frameworks, data and attributes with technical and conceptual accuracy in line with such global best practices.

The Digital India Land Records Modernization Programme (DILRMP)

DILRMP was launched as a centrally sponsored scheme for the modernization of the land records system in the country. The ultimate goal of the programme is to usher in conclusive titling system with title guarantee, replacing the current presumptive title system in the country.

Earlier known as NLRMP (National Land Records Monetization Programme), the scheme was revamped and renamed as DILRMP in April 2016 as a central sector scheme, and its validity extended

up to 2019-20. The funding model was changed from a sharing basis (between Centre and State) to a 100% centrally assisted model with the primary objective of promoting and encouraging States for active participation without any funding constraints.

The chief components of DILRMP are as follows:

- Computerization of land records
- Survey/resurvey and updating of the survey and settlement records
- Computerization of registration
- Modern record rooms and/or land management centres at Tehsil/ Taluka/ Circle/ Block levels
- Training and capacity building for core GIS
- Legal changes
- Programme management

While the computerization of land records has progressed well, survey/ re-survey work has not shown relatively significant progress down the years. As per the DILRMP-MIS, survey/re-survey work has been completed in only 11.5% (75,135) villages out of 6,56,141, whereas computerization of land records has been completed in 93% of the total 6,56,141 villages so far.



Why Survey/Resurvey is a Critical Requirement

Survey/resurvey has a pivotal role to play in terms of achieving the ultimate objective of GIS-based programme management – the integration of all verticals in revenue administration for conclusive titling and for ensuring transparent, effective land transactions.

Cadastral maps in India are very old, dating back from 30 to 100 years, and were originally prepared in a different spatial reference frame. No physical reference points or survey monuments representing the old spatial reference frames exist today for cross-checks or resurvey work. None of the past survey records or ancillary traverse records are available either. This makes the task of geo-referencing existing records without resurvey a daunting challenge.

Original survey work will also be required in areas with no existing revenue records, either because those areas were not covered, or their revenue records were lost, damaged, or destroyed in the past. And yet, for more than five decades after independence, there has been absolutely no focus on resurveys or modernization of revenue processes, barring sporadic efforts by some states at a much smaller scale.

To be able to critically analyze the Indian experience with land records, registry, and revenue, one must acknowledge that the situation in the country is quite complex. It demands a thorough understanding of the context and challenges, associated technicalities, existing institutional structures, policy scenario and, most importantly, stakeholder accountability.

The Context and Challenges

It would be prudent to analyze the DILRMP progress in three phases for better clarity of context and associated developments.

- First phase (2009-2016): Primary focus was on the creation of requisite infrastructure, training, and computerization of land records whether in-house or through outsourcing. No focus or progress in the survey/resurvey component.
- Second phase (2016-2019): Similar focus as above, with sole emphasis on land records and registration computerization. Notable attempts from a few states like Gujarat, Haryana, Bihar, Kerala, Maharashtra, and Tamil Nadu, which never got concluded as per planned output delivery and timelines.
- Third phase (2019 onwards): Currently under progress; but hampered significantly due to the unprecedented COVID-19 situation in the country. The diversion in the Government's focus from core survey/resurvey work in year 2016 has finally been recognized, along with restoration of special focus with funds for survey/resurvey in 2019.

Associated Technicalities

Survey/resurvey component requires detailed and accurate understanding of technologies for better decision-making. However, the programme suffered due to adoption of shortcuts against surveying best practices and inadequate knowledge about correct surveying approaches in the

first two phases, particularly in QA/QC and acceptances stages at state/UT level.

The result is in the form of preparation of georeferenced cadastral records using HRSI (high-resolution satellite imagery), with no rigorous ground validation surveys to determine data absoluteness. HRSI-rectified and geo-referenced maps were to be used solely as village index maps for purposes other than land transactions. Only ground-verified Geospatial data prepared as per existing/modified State/UT-specific revenue codes and laws had to be used for the core GIS for final planimetric accuracy.

The unavailability of the right kind of data, therefore, is the primary bottleneck, and not unavailability of technology. This leads to negative developments like non-payments, delayed execution, arbitration proceedings, non-completion of contracts, etc. in various outsourcing cases under the project.

Existing Institutional Structures

State-specific institutional systems for revenue administration have been in existence for a long time in the country, but their role and importance have seen significant change post-independence, in the light of administrative reshuffles and policy changes. The capacity and expertise available in present revenue institutions across a majority of the states/UTs has seen considerable depletion over the last four to five decades.

The gradual deterioration of work processes, capacities, expertise and attitude of revenue institutions has affected both data maintenance and net

land revenue collection across the country. Huge volumes of datasets of all types and forms are lying with revenue institutions in the country left to be duly incorporated. Poorly maintained, outdated and erroneous revenue records abound.

It seems the biggest reason for this gap is the lack of intent, focus, prioritization and will for modernization, updation and management of land revenue systems across the country.

Procedural Stipulations

Since independence, land revenue collection has been majorly limited to the registration of sale/purchase of commercial land transactions through a mutually exclusive process. There was never any compulsion for completing inherently associated revenue processes like ROR entries, or timely updates to mutation records and cadastral maps in sync with land-related transactions.

Component-wise costing worked out for the 1st phase of the scheme was found to be very unattractive to private firms, as evident from the feeble response to outsourcing tenders of the states/UTs. In states/UTs with the capacity and determination to absorb additional financial burden over and above the DILRMP, funds allocation could really start survey/resurvey activities. These rates were enhanced in the second phase but there was no focus on the survey/resurvey component. Therefore, real advantage could never be leveraged in tangible terms.

Further, there were other procedural stipulations on the release of funds to states under the scheme as Centrally Sponsored Scheme, corrected later when the scheme was made a Central Sector Scheme by the Central Government in the year 2016.

Stakeholder Accountability

The prescribed DILRMP implementation model stipulates survey/resurvey execution by respective state/UTs only. Funds are directly provided to them by DoLR primarily based on their project proposals approved by PM&SG under the scheme.

Now, there was no scope for direct involvement of any central agency like SoI in the project, which resulted in execution of the scheme as per state/UT-specific focus alone. No priority was placed for any changes in technical methodology. Most states/UTs were not equipped with a deeper technical understanding of surveying methodologies and mapping processes.

There is also a major gap in awareness among Government officials about global developments and examples such as FELA or the Fit-for-Purpose approach, or the latest technological advancements in cadastral mapping and revenue system modernization. Revenue laws of most states are also yet to be updated in purview of such developments.

Central agencies like Survey of India had been there as part of monitoring mechanism to extend the technical expertise of surveying and mapping in DILRMP scheme implementation, but real technology infusion using latest surveying and mapping technologies have not been easy in the rigid project structure.

The Bright Side: Positive Developments in the Field

Over the last few years and especially in the current and third phase of the DILRMP, several positive developments have been witnessed on the land administration front. Textual or Records of Right (ROR) data is presently being integrated with the registration process across all states at a commendable pace under DILRMP.

States/UTs are also facilitating quality citizen services with web-based access to mutation and land records to view and certify non-encumbrances, ensure time-bound auto-mutation, and seeding of registration processes with biometric Aadhar records to eliminate fraudulent transactions, for instance.

SoI's advocacy for inclusion of CORS technology 2015-16 onwards has also finally been realized, with the establishment of the CORS network and use of Network RTK-based survey methodology for cadastral level record generation. This was introduced under the prestigious SVAMITVA scheme of the Ministry of Panchayati Raj launched in the year 2020.

In the recent past, SoI had taken up survey/resurvey-related large scale mapping work using drone-based photogrammetry survey technology for various states/UTs like Haryana, Karnataka, Andhra Pradesh, Andaman & Nicobar, etc, including establishment of CORS network infrastructure.

What Can be Done Better? The Way Forward

The modernization of Indian revenue system essentially entails rectification and amendments to:

1. Expertise and capacity-building at revenue institutions

Timely execution of target activities for modernization of various facets of land revenue system in the country can be achieved only when revenue institutions are strengthened with skilled manpower as per revised roles and mandates.

2. Policy-level interventions

The approach adopted for the implementation of the programme requires changes in terms of more clarity at Centre/State Government level about the strategic issues witnessed during the past 10-12 years of its implementation.

3. Capacity Building

Various stakeholders at various levels including Centre, State and Private agencies need to be equipped with skills in sync with proposed targets, technologies, and processes at large.

4. Deeper engagement of the private sector

Technology approaches like use of CORS network infrastructure combined with aerial data capturing for resurvey with realistic timelines considering the available capacity in the country and planned augmentation in partnership with the industry.

5. A novel approach

New frameworks and processes based on global land administration standards, best practices and available frameworks like FELA, IGIF, WB reports need to be implemented. Due focus should be paid to the larger public interest, with open involvement of subject experts to formulate a FFP approach.

The availability of financial resources, flexibility for use of latest technology options in programme implementation, technology adoption initiatives at revenue institution level for new roles, strong will and push for requisite policy changes by the Government and readiness to adopt practical Public-Private Partnerships mode of industry engagement for technology and technical expertise will help us achieve expeditious implementation of the programme in future.



Land Administration for Nagpur Municipal Corporation

The Nagpur Municipal Council (NMC) was established in 1864, with a population of 82,000 and jurisdictional area at 15.5 sq. km, which was expanded to 227.37 sq.km as per the Government Resolution dated 14th May 2013.

The key responsibility for providing Nagpur's citizens basic urban services lies with the NMC, including water supply, sewerage, waste management, slum improvement, land use planning, construction and maintenance of internal roads, street lighting, maintenance of parks and gardens, providing primary health and education facilities, etc. NMC co-ordinates with various other government organizations like NIT, MHADA, MSRTC, the Traffic Police, MPCB, etc. for delivering these basic urban services.

It was soon identified that there was a need to link resource mobilization with spatial development planning focusing on credit enhancement mechanisms. This made the preparation of land use maps the first step towards city development.

NMC assigned this task to IIC Technologies, India, based on the competitive merits for the preparation of Development Plan as per MRTP Act 1966 for NMC Area.

Project Objective

The main objective of the project was to develop a detailed GIS Base map on a scale of 1:1,000 for entire NMC area in stereo mode. All features like Buildings, Vacant Plots, Roads (National Highways, State Highways, City Roads and Streets), Bridges (Flyovers, Railway Bridges, etc.), Railway Tracks, Parks, Gardens, Stadiums, Slums, Traffic Squares, Water Bodies (Reservoirs, River, Lake, Pond, Drainage, Canal etc), Over Head Tanks, etc. to be extracted from Aerial imagery through stereo mode.

Scope of work

The project involved Desktop study, establishing precise Ground Control Network using Dual frequency GNSS/ GPS in relative static positioning method, Digital Aerial Photography $\leq 10\text{cm}$ GSD using fixed wing Aircraft, Geo referencing & Creation of DEM, Contour generation and \Ortho Photo, Geo Referenced Existing Land Use Map, Geo referenced Land Records System, Development & installation of EGIS system, Creation of Base map for entire NMC and Training.

Data collected during preparation of Base map was used for **planning purpose of all infrastructure projects** for NMC and other government departments. Maps/ data set/ information was prepared for existing Utility (such as Road, Railway,

HT & LT Power lines, OFC cable etc.) or existing water bodies, existing structures, slum, religious structures, industrial area, height of structures etc.

The collected data was also used for **slope analysis and finding out catchment area** of given location/ spot/ village/ river etc. with the help of 0.5m contours and Digital Elevation Model (DEM) generated. It was also useful for **analysis of structure density, type of structures, use of structure, area under structure as per its use area** under defense, industry etc. The ground surveys and collected attribute information were linked to the Final Base Map to create a comprehensive GIS database.

Deliverables

The Generation of Spatial Database Infrastructure includes the Inception Report, Ground Control Network (.shp), Aerial Imagery (Geo Tiff), Geo referencing & Creation of DEM \ Ortho Photo for entire NMC region, Index Plan, Key Plan on 1:50,000 Scale, Detailed Survey Plan on 1:5000 Scale, Existing Land Use Plan on 1:5000 Scale, Existing Land Use Report, Geo Referenced Existing Land Use Map & Report, Geo referenced Land Records System, Base map for entire NMC region, Development & installation of GIS software, All created Maps and Training.

Geo Referencing: All distributed ground controls used for Geo referencing of Aerial imagery, made with polynomial order 2 with suitable transformation method.

DEM Compilation: All photogrammetric Digital Elevation Model (DEM) collection carried out using Z/I ImageStation to meet the ortho photo standards. IIC converted final DEM (after the QA/QC steps) into 3D ASCII XYZ format. Cell sizes were 20m for 10m for rural and urban respectively.

Generation of Contours: High-accuracy contours generated at 5m thoroughly checked and corrected with the help of DTM/TIN.

Surface/DEM Generation: Surface generated using final DTM used for orthophoto and DEM generation.

Pre-Processing: Project setup to be done to define coordinate system information, rotation angle, ISPM project and its Orthorectification settings, seamlines, mosaic parameters etc.

Orthorectification: Performed to correct relief and tilt errors. Outputs from this task are ortho-photographs.

Feature Extraction: Digital Aerial imagery analysed under high zoom to identify features listed in data model using heads on digitization technique. All features extracted from imagery through on screen / Heads on digitization technique.

Digitization: Data capturing carried out by attaching input imagery from the server as a reference in the CAD environment. Base Map in geodatabase.

About the NMC EGIS Geo Portal Solution

The respective department's surveyed datasets are made available to internal and

external stakeholders of NMC through the EGIS GeoPortal Solution via Web, Mobile, Tablets Access.

The above diagram depicts the overall proposed logical technical Solution architecture for NMC EGIS web-enabled GeoPortal System with Mobile Client access. It displays accurate Surveyed outputs in various Spatial layers and supporting Integrations with current IT systems, Data and Spatial systems in scope of EGIS Project.

Layer 1: Outputs of all approved spatial surveyed datasets, collection of any/all spatial datasets, access to documents from servers, integration of existing Systems in NMC with integration to both spatial and non-spatial information of respective land systems.

Layer 2: Application Data and Integration Layer - usage of verified Spatial Data files and approved for usage in the geoportal solution.

Layer 3: Data Storage Layer - centralized distributed storage where PostgreSQL PostGIS RDBMS server is proposed to be used for storing both spatial and non-spatial data and the centralized file storage server.

Layer 4: Data Analytics Layer - static and dynamic report generation and dynamic dashboard with statistical computations as needed for the Nagpur NMC EGIS Geo Portal Solution.

Layer 5: Business Layer - Geospatial server and QGIS server-side computational layer. Both spatial and non-spatial functionality like User, Roles, Security single sign on, spatial layers access, OGC compliant access of attributes, etc. are supported in this server-side layer.

Layer 6 and Layer 7: Presentation Actual UI Access Layers. Users can login, query and retrieve the respective datasets

from catalogue for spatial and non-spatial views, and export the dataset into required formats where needed.

Innovation Techniques Adopted

- **Pre-Flight Panelling:** Performed to save time and costs of aerial mapping and surveying for saving time and costs. Panels visible in photographs were reduced, runtime errors nullified, nearly 100% accurate datasets and permanent markers obtained.
- **Ground Control Points:** Obtaining GCPs usually consumes a lot of time, affecting final project delivery. A simplified technique was used instead for establishing GCPs in project areas while obtaining permissions.
- **Base Map preparation:** Tasks and requests with NMC's requirements kept in mind, rather than creating a generic Base map.
- **Tool Development:** Focus was on automation of work and avoiding manual errors. Data Migration played an important role for transferring of data into the Database.
- **Auto Migration of data into the database**
- **Auto QC using spatial tools**
- **Robust Architecture:** Focus on website efficiency. Highly scalable and reliable web-portal established that was flexible, easily integrable with third-party.
- **Knowledge Transfer:** Multiple levels of knowledge transfer to NMC staff conducted for better understanding of the usage and process of the application, making them become self-sustainable.
- **Project Management:** Tools developed to monitor online progress of the application using Mobile application for easy navigation access by citizens as well.

Indicative NMC EGIS Geoportal Screen showing the list of Illegal Constructions in selected AOI





Land Administration Modernization for Rajasthan under DILRMP Scheme

Land administration management is the process of managing the use and development (in both urban and rural settings) of land resources. Multiple sectors require effective land administration and management, including survey/resurvey projects for urban and rural development, national highways, expressways, and road projects, canals, water resources projects, riverfront management, public health engineering, sewerage and wastewater management projects, pipeline/oil & gas, and other infrastructure projects, to name a few.

Despite its crucial role, land administration has struggled with several challenges across regimes. These include the lack of uniform land and revenue records, many of which presently date back to the 1950s-60s. Urban planning and revenue administration objectives are greatly undermined. Data collection and sharing are still facing complications, while linking between text records and maps through robust Geographic Information Systems is lacking in many places.

Project Objective

Considering the above challenges and gaps, the need of the hour is to upgrade, enhance and update land records all over India through modernization and digitization of the entire system. The Government of India's flagship programme, Digital India Land Records Modernization (DILRMP) has initiated the conversion of old land records into a new digital format using modern hybrid survey methodologies, such as

use of High-Resolution Stereo Satellite Images (HRSI) followed by Ground Survey using Differential GPS (DGPS) and Electronic Total Survey Station (ETGS) for rural and urban areas in the country.

The RBAAS & Settlement Commissioner – Jaipur, Government of Rajasthan, has awarded the work of Establishment of Ground Control Network, Conducting Survey/Re-survey, and Updation of Survey & Settlement (Records) operations under the DILRMP for Ajmer and Kota zones to SECON Pvt Ltd, Bengaluru.

Scope of work

The project involves pre-survey activities and establishment of control points across the state in Ajmer and Kota zones. This is followed by the preparation of up-to-date GIS-compatible land parcel maps for districts through hybrid method – HRSI, DGPS and ETGS – including various attributes/metadata. A dedicated module was also to be prepared for land records, settlement operations and project management progress updation.

Solution

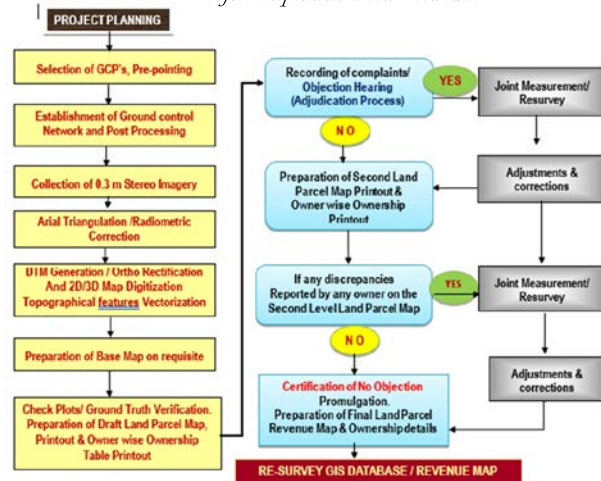
To generate the automated land records, the team at SECON developed a robust GIS-based land management software application that enables generation of various forms/revenue records as per the State Revenue Portal. The following modules were created to support the comprehensive GIS application.

Post Re-Survey Challenges

Post implementation of the project, the biggest challenge being faced by the State's Revenue Department was facilitating and updating revenue records at regular intervals on a day-to-day basis. This was because of frequent changes in the field/charge of ownership, along with other technical aspects related to land administration.

The State Government of Rajasthan and the Government of India are seeking solutions to overcome these challenges in land management for handling enormous revenue records. The development of an efficient land management software will help resolve a majority of these challenges such as digital records of change of ownership, generation and updating of land records, mutation entries, and property survey records with the objective of providing employment at every District Revenue Records office.

Project Implementation Flowchart





Empowering our 'Gramas' with High-Resolution Geospatial Data using Drones

Inching for an Atmanirbhar Bharat

The drone industry was in a nascent phase until the end of first decade of 2000s. Today, it is one of the trendiest topics when talking about technologies of the future and has managed to catch the attention of the common man with its myriad applications. Also termed as 'Unmanned Aerial Vehicles' (UAVs), drones have been used widely in military operations for long. In recent times, they have forayed into other fields like inspection, law enforcement, shipping, surveying and geographic mapping, and even aerial photography and videography.

Why UAV in Surveying?

Survey-grade drones, also called mapping drones, provide real time data of the land area under concern. Using mapping drones like Trinity F90+ specifically designed for the surveying and mapping industry can produce topographical survey results of the same quality as the accurate measurements collected using traditional methods.

Further, Trinity F90+ drones can collect data of over 700 hectares in less than 90 minutes, in a single flight. In other words, the time consumed is only a fraction of the time utilised in case of conventional surveying methods. Drones supply high-resolution imagery and an accurate input for land information. The cost of site survey as well as workloads are automatically reduced.

Using professional survey grade UAVs like Trinity F90+ is fast becoming a preferred method of collecting high resolution, quality geospatial data and information in a very cost-effective

manner. It provides a flexible, transparent methodology for collecting data for a range of applications including village boundaries, land cover, infrastructure, utilities, public facilities, etc.

Drones in India for Land Records – SVAMITVA Scheme

Survey of Village Abadi and Mapping with Improved Technology in Village Areas (SVAMITVA) is a property survey programme launched nation-wide by the Hon'ble Prime Minister on the National Panchayati Raj Day, 24th April 2020. A Central Sector Scheme of Ministry of Panchayati Raj, it is an antidotal step towards establishing a clear property ownership in rural inhabited (Abadi) areas.

To establish property ownership, surveying, and mapping of the defined area of land is done using survey drones. This is followed by providing 'Record of Rights' to the village household owners. High resolution orthophotos are generated using drone photogrammetry surveys by Survey of India (SoI) for demarcating property boundaries in this manner.

Professional survey grade drones, such as TrinityF90+ are the main work horse for field data collection. Property boundaries extracted by SoI (with the help of chuna markings) are verified by village authorities and villagers. Further, legal ownership cards/Title deeds/property cards are issued to the property owners. The SVAMITVA scheme is indeed a milestone towards achieving Gram Swaraj.

Future of Drone Data for Land Administration and Management

High resolution orthophotos collected for SVAMITVA can be used for many other purposes by the village authorities., including as a base map for checking and approving any new building construction, calculating building areas and accurate building taxes, detecting illegal construction/encroachment to public property, and so on. DEM or 3D terrain prepared through SVAMITVA scheme can be used for infrastructure scheme planning, such as new road construction, water flow regulation structures, and so on.

In addition to better planning and sustainable habitats, SVAMITVA is also paving the way for reformed land governance and socio-economic upliftment, thereby reinforcing economic growth. The backbone of this entire process is the data collected via drones.

The recent liberalization of Geospatial and Drone policies is set to give a great boost to technology-based surveying and mapping. Drones play a critical role in the field of Geospatial data collection for large scale topographic mapping, urban and rural planning, infrastructure, etc. Drone survey has transfigured the area of surveying and mapping, aiding in the planning of topographic settlements, and studying the land relief features with better clarity and precision across the world. It has found profound application in land administration through the SVAMITVA scheme which is a giant leap towards India's goal of 'Atmanirbhar Bharat'.



Updates from AGI

Commemoration of One Year of Geospatial Guidelines

On 15th Feb 2022, a year after the release of the Geospatial Guidelines, the Association of Geospatial Industries (AGI) in association with the Department of Science and Technology (DST) co-hosted an interactive session to reflect upon how the Geospatial Guidelines have made a difference to the Geospatial industry and the users, whether the intended changes have indeed taken effect and what more can be expected from each stakeholder given the reformed outlook.

The session was graced by Hon'ble Union Minister Dr. Jitendra Singh, Secretary, DST, Dr. Sivari Chandrasekhar, Surveyor General of India (SGI) and Joint Secretary, DST, Shri Sunil Kumar, IFS, Smt Anju Bhalla, Joint Secretary, DST, among other notable dignitaries from the Government, private sector, and academia.

Impact of Guidelines

Atmanirbharta: Many companies like MapMyIndia, Genesys International and Esri India have increased investments in developing 3D data, street-view, real-view content and locally developed GIS-based solution products.

Boost to Indian industry ecosystem: Confidence of users and Indian citizens has seen a massive boost, for instance MapmyIndia's successful IPO that was oversubscribed by 150 times.

SVAMITVA Scheme: SoI opened a call for empanelment of Geospatial companies to finish the entire 6 lakh village mapping within the challenging timeframe because of liberalization of Geospatial data regulations

Large-Scale Mapping (LSM) Projects: Several state governments are now looking at undertaking LSM projects for generating high-resolution maps of entire state regions.

Urban Mapping Projects: Opening of regulations and liberalization of Drone Rules have given a boost to Masterplan creation projects using Geospatial technology.

Geo Portal: SOI has started discussions with leading commercial companies to develop a comprehensive geoportal that maintains and disseminates all data available with the national mapping agency at present.

Industry Expectations and Recommendations

Geospatial Impact Study: A comprehensive study about the socio-economic impact of the technology is needed to understand growth opportunities and build a roadmap for proper utilization of Geospatial technology.

Industrial Development Strategy for the Geospatial Sector: A Board or a Think Tank can be set up for coordinating and monitoring the implementation of an Industrial Development Strategy, and formulation of a National Geospatial Master Plan.

Data Sharing and Improvement: Greater government and industry collaboration is required to set up systems for sharing data and content with different users to ensure effective use across sectors, greater economic and social value, time and costs savings.

Data Creation Efforts: With the establishment of a positive policy environment, data creation efforts need to be strengthened by the industry as well as government entities.

Data Availability and Accessibility: Data should be made available to users and the industry for maximum value realization. Access must be a mix of free and paid depending on the value of the data, just like some roads are free to access and some carry a toll.

Collaborative Environment: Innovative business models need to be thought of and presented for the purpose, such as Public-Private Partnership (PPP) for bigger projects. Startup ecosystem must be invested into.

Geospatial Education and Awareness: Industry requests to develop a National Geospatial University, or Indian Institute of Geospatial Technology for developing core professionals along with more Bachelor level courses.

Policy Integration: There is a need to update policies such that compliances can be met with, both remote sensing and geospatial data. The apprehensions of foreign companies need to be addressed, giving more clarity for working in the Indian environment.

Mark your Calendar for AGI's Annual Industry Conclave!

India Geospatial Leadership Summit 2022

April 25-26, 2022

Eros Hotel, Nehru Place, New Delhi

For details contact:

megha.datta@agiindia.com