

Arc India News

Vol 13, Issue 2 | For private circulation, not for sale

GIS and the Vision for New India



CASE STUDY

India Urban Observatory enables evidence-based planning

GLOBAL VIEW

The evolution of smart communities

SPOTLIGHT


Esri India User Conference 2019

SEE HOW TO DESIGN TOMORROW'S SMARTEST CITIES, TODAY

By 2050, two-thirds of the world's population will live in cities. Today, Esri location technology is helping governments and urban developers better utilize limited space to grow smarter, better, and even greener.

If Esri can help the world's leading urban developers see how to run and future-proof their cities, what could you see?

See what's possible at:
esri.in/smart-cities



SEE
WHAT
OTHERS
CAN'T



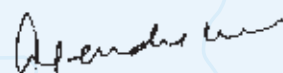
Agendra Kumar
President, Esri India

GIS is 'the' enabling technology for achieving the government's vision of \$5 trillion economy and for driving India's efforts to meet country's sustainable development goals (SDGs). We have already seen the applications of GIS across programs like Direct Benefit Transfer, Swachh Bharat and Smart cities. Automation of GIS data creation, mapping and dissemination via service delivery platforms like Bharat GeoHub is expected to exponentially drive the utilization of GIS data for various initiatives by government, businesses as well as citizens.

Geospatial Technologies enables us to visualize patterns, complexities, relationships and associations - bringing it all together to the 'Science of where', empowering us to understand and respond intelligently during a disaster situation and build a sustainable society. The government of India envisions 'New India' which is clean, healthy, secure, inclusive and robust by 2022. While GIS systems are expected to support the effective implementation of massive programs such as Ayushman Bharat and Pradhan Mantri Jan Arogya Abhiyan, there is lot more potential for using GIS in health sector in India. GIS can be used for collecting disease data, its spatiotemporal analysis to get a good understanding of trends and population under risk, and then in resource allocation and actions for mitigating the risk. Use of GIS based analytics over a period can help in controlling out-break of recurring epidemics like Dengue. We have seen Polio eradication and controlling the spread of Ebola as live examples of the role that GIS has played in the Health sector.

In other sectors like Agriculture, where doubling farmers' income, better land management are few of the priority areas identified by government, GIS can play very critical role. It will drive informed decision making to leverage best in class farming practices. Also, GIS is expected to be adopted at a whole new level by the private sector organizations such as banks, insurance companies, automobile, real-estate, construction, retail, and logistics.

As we step into a new decade, GIS is becoming mainstream, we need a forward looking GIS vision, culture of collaboration through platforms to share content and applications while building a stronger foundation of GIS skills and technical know-how. Leading startups in India are already using Geo intelligence to build innovative solutions with GIS capabilities at their core. The integration of GIS with new technologies such as Artificial Intelligence, Machine learning, IoT, Data Science and the integration of GIS with BIM and enterprise systems such as BI, ERP, and CRM will further drive new dimensions of GIS applications across various sectors. With GIS technology, You, our users, are best positioned to "See what others can't" and lead this new wave of transformation through GIS in building a New India.


Agendra Kumar

CONTENTS

03 President's Desk

05 News

- Scottish High International School launches India's First GIS Club with Esri Technology
- Esri India Inaugurates GIS Data Management Centre in Panchkula
- Esri chosen to support department of defense JAIC emergency response program
- Esri India wins ET Government Annual Smart Cities Award
- Salesforce selects Esri as key geospatial partner
- Esri releases ArcGIS Quick Capture

08 Case Study

Urban Observatory enables evidence-based planning

12 Partner Showcase

Ceinsys and Esri India - Shaping a new future towards 'New India Vision 2022-23

14 Product Review

ArcGIS EXCALIBUR-Discover solutions for enhanced web- based imagery

16 Technology Update

What's new on the Esri Platform?

20 Cover Story

GIS and the Vision for New India

27 Customer Speak

GIS and Agriculture: The IARI perspective

29 Spotlight

Esri India User Conference 2019

33 Research Paper

Integrating Elastic Search with ArcGIS web applications

36 Global View

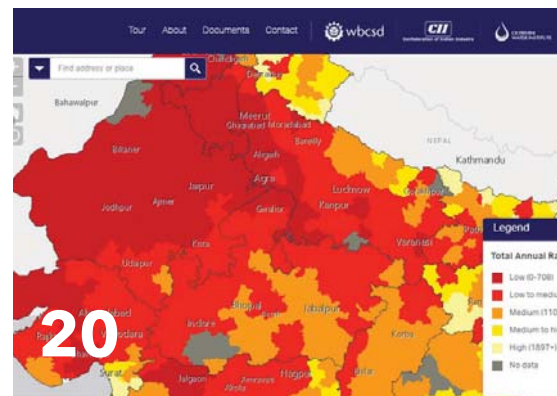
The evolution of smart communities

40 Tips & Tricks

Smart Mapping - easy ways to improve your maps

42 Transforming GIS Education

Empowering school students with GIS





Scottish High International School Launches India's First GIS Club with Esri Technology

In November, Scottish High International School in Gurugram announced the launch of India's first-ever GIS club in a school. The club aims to train future professionals on the dynamics of GIS technology and how to use it to better understand subjects like IT, science, history, civics and literature alongside geography.

Since 2016, the school has been training its students on GIS techniques through Esri India's K-12 programme. Under the programme, software access is provided, workshops are conducted and hands-on training sessions are held on Esri StoryMaps and ArcGIS.

More than 1,300 school students have been trained through these workshops. In 2017 and 2019, students from Scottish High won awards in Esri India StoryMaps Contest using ArcGIS technology. Students have also presented their work before a distinguished audience in the Esri India User Conference.

"Our vision is to impart quality education to our students and bring them on par with global standards. Under the aegis of this vision, we have partnered with Esri India to set up the first GIS Club in a school in India. Through this partnership, our students will be able to learn and use latest geospatial techniques," said Sudha Goyal, director, Scottish High International School, "Esri India has always been a strong support, providing us with facilitators for training our students and free software access."

"With the demand for GIS skills coming from both the private and government sectors, it is imperative to impart geospatial knowledge to the next generation right from the school level," said Agendra Kumar, president, Esri India. "We are very impressed with the work done by the students of Scottish High International School in last three years. GIS Club is a breakthrough idea that would give students an opportunity to learn all their subjects on maps. We would be happy to support other schools that start similar initiatives." ■

Esri India Inaugurates GIS Data Management Centre in Panchkula

Esri India recently announced the launch of its latest Global Delivery Centre for GIS data management in Panchkula, Haryana. The centre will provide GIS data management services to global customers in power, telecommunications and government sectors.

Offering a good opportunity for local talent to work on global GIS projects, the Global Delivery Centre will have about 150 employees. Esri plans to double this number in the next two to three years.

"The use of GIS technology across areas such as smart cities, water management, agriculture, health, education, disaster management and urban development can take India forward on the path of overall development. GIS technology is a key enabler for e-governance and sustainability," said Agendra Kumar, president, Esri India.

At a time when pollution has reached alarming levels in several parts of the country, particularly north India, many organisations are using Esri's software to map the reasons behind this spurt. Esri's software is helping these companies map stubble-burning cases, large construction sites that create a lot of dust and areas where high vehicular traffic gives rise to traffic jams and pollution.

Kumar said: "There are 23 to 24 power utilities in the country and Esri is working with most of them under the Restructured Accelerated Power Development and Reforms Programme for improving the distribution network in India." ■

Esri chosen to support department of defense JAIC emergency response program

Esri, the global leader in location intelligence, announced that Esri and partner Figure Eight Technologies, Inc. have been awarded a contract in support of Department of Defense, the Joint Artificial Intelligence Center (JAIC), prototyping advancements in rapid damage and consequence assessment during disasters.

The world is faced with what emergency response professionals call the new normal. This means disasters are occurring with both increased frequency and massive impacts to communities at a scale which cannot be readily understood and mitigated through traditional methods used today by first responders, NGOs, government partners, and commercial entities.

Under the JAIC, the Humanitarian Assistance/Disaster Relief (HADR) National Mission Initiative (NMI) leads the fielding of Artificial Intelligence/Machine Learning (AI/ML)-powered, problem solving prototypical applications to quickly identify and locate people and infrastructure impacted by natural and manmade disasters. The development of HADR AI/ML capabilities aims to streamline the processes and architecture of data aggregation, conditioning, and interpretation.

Esri's ArcGIS platform uses the predictive power of location intelligence combined with AI to provide new insight that enables personnel to make better, data-driven decisions through near-real time situational awareness. Costs to lives and livelihood will be reduced by shrinking operational timelines for search and discovery, resource allocation, and rescue or relief execution efforts.

In support of the HADR NMI providing global humanitarian assistance, training of deep learning models and inference against imagery sources will happen at scale. This solves the complex spatial problem of massive deployment of resources by rapidly distinguishing object and areas for issues such as locating flood affected areas, or identifying at-risk infrastructure and people in need of help.

ArcGIS provides a geospatial AI foundation that will enable JAIC's analysts, data scientists, and decision makers to collaborate closely together in an iterative fashion. They will be able to quickly test and validate ideas, prototype models, deploy them to production, and build meaningful information products including Dashboard, Maps, and Apps. ■

Esri India wins ET Government Annual Smart Cities Award

ET Government Annual Smart Cities Awards has been instituted to recognize the outstanding works done by government and private entities to transform our smart cities into citizen-friendly futuristic cities.

Esri India has won under the Category 'Private



work - Best Urban Transformation by a Municipal Corporation' for initiative 'One MCGM'. This strengthens our confidence on the transformational work our customers are able to do with Esri ArcGIS technology. ■

Salesforce selects Esri as key geospatial partner

Esri, the global leader in mapping and location intelligence, announced that Salesforce has selected Esri as the key geospatial partner for Salesforce Maps. Salesforce is integrating Esri's ArcGIS Living Atlas, the foremost collection of global geographic data and basemaps. Salesforce Maps users will be able to access Esri's ArcGIS Online, the leading geospatial cloud, giving businesses the ability to analyze and visualize massive amounts of geographic and demographic data.

"Geo-services are becoming mainstream. Now Salesforce customers will unlock new insights and patterns in their customer data, enabling them to 'See What Others Can't' through geographic visualization, using maps that contain Esri's dynamic Living Atlas," said Jack Dangermond, Esri founder and president. "The Salesforce and Esri technology integration will enable organizations around the globe to combine their business data with geospatial analytics and mapping for competitive advantage."

Salesforce Maps will bring a geographic context to

the enterprise for categorizing and understanding the customer and business needs. By integrating demographic, economic, and behavioral data from Esri, businesses can gain unique insight into new market opportunities.

Esri is a privately held, multi-billion dollar company that provides over 350,000 organizations of every size and industry the tools to get deeper insights from their geographic and transactional data to improve operational and business results. In the US and globally, Esri is deployed in most local, regional and state governments. It is also used across most national governments including all of the US Federal executive departments. In the non-government sectors, customers include the majority of the Fortune 1000 companies, most utilities, and all the leading colleges and universities. Esri users also include thousands of NGOs around the world. With this new partnership, Salesforce customers will be able to access critical geospatial intelligence and perform spatial analysis inside Salesforce using Esri technology. ■

Esri releases ArcGIS Quick Capture

Esri, the global leader in location intelligence, today announced the release of ArcGIS Quick Capture, a mobile app designed for rapid and at-speed field data collection workflows. Data can be collected from a moving vehicle with the touch of a button and sent back to the office for real-time analysis, leading to faster and more effective decision-making. The new app is ideal for road inspections, aerial surveys, monitoring vegetation encroachment, and more.

ArcGIS Quick Capture allows users to configure a customized interface that suits their specific project requirements, eliminating unnecessary features and options. This personalization helps users take advantage of the single-tap, big-button system to capture details and photos as they go. The app is intuitive and user-friendly, eliminating the need for extensive crew training.

"ArcGIS Quick Capture builds upon and enhances our existing field data collection offerings in ArcGIS," said Ismael Chivite, senior product manager at Esri. "Field crews are demanding user experiences that are tailored to the way they work. Quick Capture is designed to capture GIS data with the tap of a button, while on the go. At-speed road asset inventories and quick damage assessments are examples of workflows where Quick Capture excels."

The new app integrates with the user's existing IT infrastructure and ArcGIS platform, which simplifies implementation. It uses the existing GPS and camera on smartphones and tablets, and it is compatible with iOS, Android, and Windows devices. For high-accuracy data collection workflows, Quick Capture is also compatible with external Global Navigation Satellite System (GNSS) receivers. ■



India Urban Observatory enables evidence-based planning

A state-of-the-art India Urban Observatory has become operational in the Ministry of Housing and Urban Affairs. As cities begin to implement 'smart' solutions, data is becoming a significant asset and an enabler for data-driven governance, leading to urban transformation. The Observatory will plug into various sources of data from cities both from real-time and archival sources for generating insights through analytics for cities, academia, industry, and governments. This will greatly contribute to evidence-based decision making and policy making.

Challenges

The Indian government's Smart City Mission, launched in 2015, acknowledges that a city can become truly smart if its plan, design, operation, maintenance and governance are data-driven. There was a need to create a system that can collect data from various IoT devices and sensors, the Integrated Command & Control Center (ICCC) and other urban indicators and analyze them to generate insights for all stakeholders and city planners. This system will also help in creating shareable plans illustrating various urban data starting from housing maps, street network maps, electric grids, water supply maps, and other essential infrastructure.

The objective behind establishing the Urban Observatory is to:

1. Provide a cognitive intelligence to the data generated over a period through use of GIS technology.



2. Provide an impetus to evidence based planning by generating spatial insights to different problems of cities.
3. Provide an insight into the impacts of the urban mission programs on the city's overall development in terms of ease of living and ease of doing business.
4. Give a visual analysis of the performance assessment against the benchmarks of urban services.
5. Provide a live medium of doing capacity building of the data champions to give them an understanding of how the data visualization can drive to the knowledge and decision making.
6. Share and spread the best practices of Urban Management

Solution

Ministry of Housing and Urban Affairs, recognised, that as cities begin to implement 'smart' solutions, data becomes a significant asset and enabler for data driven Governance, leading to urban transformation. They recognised GIS as a foundation technology for planning, designing and construction to operation, maintenance and governance, of a modern city and partnered with Esri India for creating the India Urban Observatory.

The India Urban Observatory, is an interactive showcase of collective insights on cities across various parameters, collected from data obtained through APIs, open-source databases, sensors and third-party sources, including citizens and social media. The urban observatory provides reliable information on a varied set of indicators, ensuring propagation of best practices, efficient planning and timely interventions.

The GIS based insights and intelligence offer the following to India Urban Observatory:

(a) National Indicators

- Geospatial Insights of various urban development parameters like Smart City project cost per capita and per unit area, ease of living index of cities, vehicle registration in cities, mode of transportation in cities etc.
- Geospatial Insights for near real time urban issues like pollution status in different cities, traffic situations in different cities.
- Geospatial Insights into various socio-economic development features of the city, like urban density, urban literacy, urban sex ratio, slum population of cities and access to basic amenities.
- Geospatial Insights into the urban development



projects like houses constructed and occupied under PMAY project.

(b) City Level Indicators

The Geospatial frame is created to compare two smart cities at time for different parameters of urbanization

- The comparison of socio-economic indicators like ward wise literacy, sex ratio, urban density and workforce.
- The comparison of urban services and infrastructure like ward wise water supply, sanitation, housing, source of lighting, LPNG.
- The comparison of city wise phenomena like

solid waste generation in city.

(c) Mission Projects Details

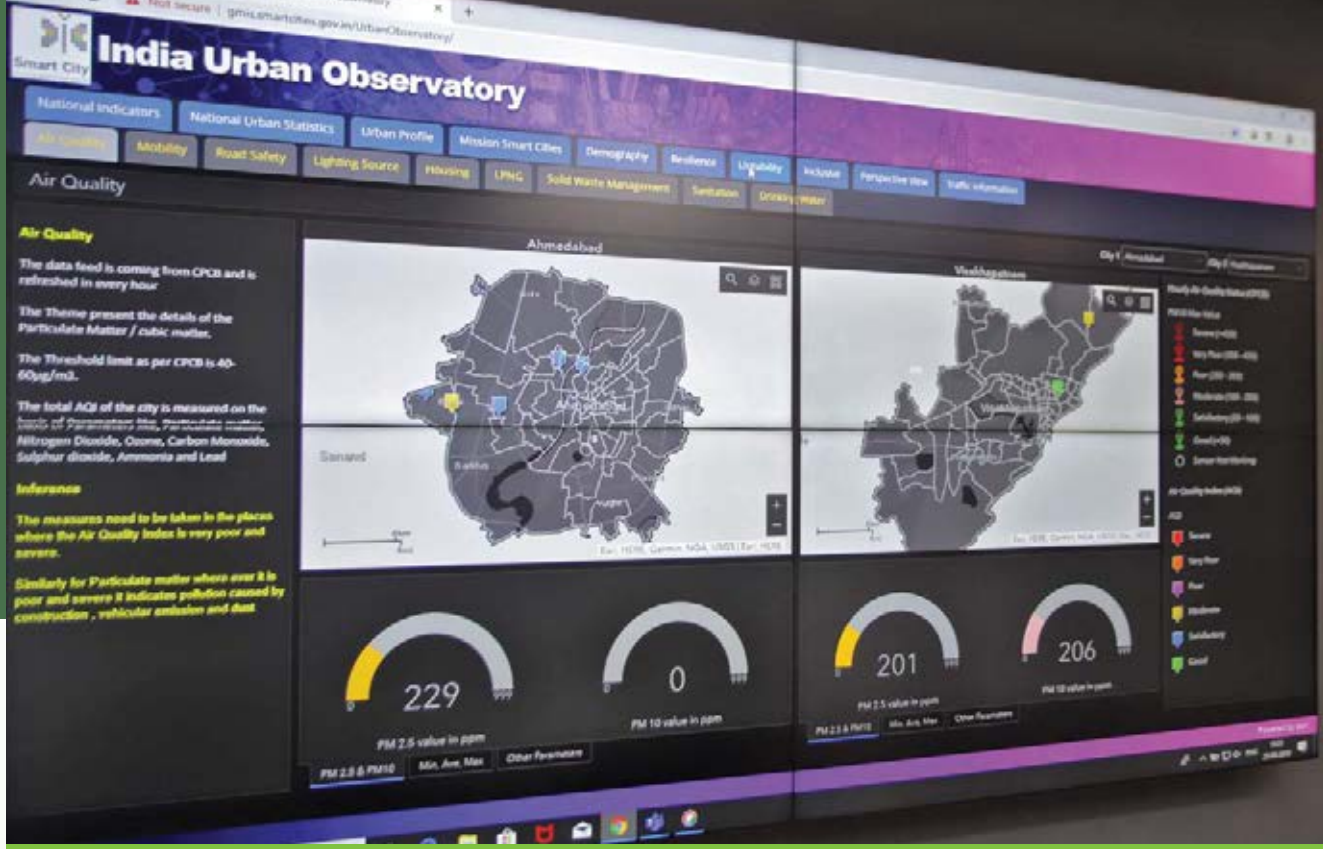
The web application and geospatial insights to undertake monitoring and evaluation of mission projects like Smart City

- National level project schedules.
- City wise project status in terms of DPR, tendering, project initiation.
- Project expenditure.
- City wise rankings of smart city development.
- Sector wise project implementation status in cities.

“

India Urban Observatory is the data analytics and management hub of the Ministry of Housing & Urban Affairs to study insights & trends for Indian cities on various parameters. It leverages the analytical capability of Esri GIS platform for evidence based planning and data driven governance while engaging the stakeholders - government, citizens, academia, and industry. ”

Kunal Kumar,
Joint Secretary, Ministry of Housing & Urban Affairs



Key Benefits

India Urban Observatory is a lab to convert data into meaningful insights for evidence-based planning.

- The Observatory is helping in getting reliable, up-to-date information on a meaningful set of indicators over various domains such as transport, health, environment, water, finance and so on, which will further assist in developing best practices, future strategies and policy interventions as and when required.
- The first-of-its-kind observatory leverages data analytics to optimize city operations, improve governance and enhance economic performance of cities across the country. The conceptualization of this observatory recognizes the value of enhancing engagement among all four stakeholders of the 'quadruple-helix' model – Government, citizens, academia, and industry, along with improvements in the internal workflow and decision-making processes of city Governments.
- India Urban Observatory will progressively become the chief data analysis and management hub of the ministry and would enable evidence-based policy formulation,

capacity building of ecosystem partners on data-driven governance, foster innovation through development of newer and better use cases thereby enabling solutions at scale and speed.

- It will further provide scientific response to the complex challenges to urbanization through use of state-of-the-art technologies and collaborations.
- It connects city services through public digital data, app data, social media data and sensor data to GIS based visualization.
- It opens up new ways for cities to collect, integrate, plan and visualise data by adopting innovative design and planning tools created by researchers, academics and the industry
- It enhances citizen participation in decision-making, improving transparency and accountability while ensuring privacy through Spatial Insights into the data.

This India Urban Observatory is an experiment of how Geospatial technology can support monitoring and evaluation of programs, how it helps in studying the impacts of development on life of citizens and the physical progress of city. ■

Esri India Technical Services

Experience the best of Esri technology along with
best of technical expertise.



Email Support

customercare@esri.in



Support Helpdesk

Toll Free: 1800 - 102 - 1918
(9:00 a.m. - 5:30 p.m. IST, Monday-Friday)



Online Support

esri.in/tech-support



Ceinsys and Esri India - Shaping a new future towards 'New India Vision 2022-23'

India, with its strategic vision for New India @75, is taking a big step towards sustainable development and modernization. The strategy for New India @ 75 put together by Niti Aayog is an attempt to bring innovation, technology, enterprise and efficient management together, at the core of policy formulation and implementation. At present, the government has laid its focus on New India which is clean, healthy, secure, inclusive, and robust. All these aspects require an amalgamation of GIS-based technologies.

Strong ecosystem to work towards New India Vision 2022-23

Esri India Partner Network is a rich ecosystem of organizations that work together to amplify The Science of Where. Ceinsys Tech Limited is one of the premier organizations, which has been working with Esri India in providing GIS-based solutions in multiple Government & Industry led projects. Major business operations of Ceinsys are carried out on a GIS-based platform developed by Esri India. This has been possible owing to the support and latest technological know-how of 20 Ceinsys resources skilled on the Esri Platform. "Ceinsys has uniquely positioned itself in India through its capabilities and association with Esri, to become the only company of this size and capacity with 100% focus on the domestic market," says Dr. Abhay Kimmatkar, Jt. MD, Ceinsys Tech

Limited.

Esri India and Ceinsys have been working together on lot of projects in the power sector, disaster management, urban development, and water sector.

The availability of relevant data has a huge impact on better policymaking and good governance. The Government of India has given due importance for creating relevant data in various areas. Ceinsys is contributing to the new India Vision by providing end to end enterprise solutions through its capabilities comprising of GIS-based Decision Support System, data creation by digitizing and geo-referencing cadastre maps, conducting physical and DGPS surveys, measurement, and linking of RoR data, and among others.

The infrastructure development for facilitating economic growth is another very important area the government has laid its focus on. The recent run electrical distribution reforms program called RAPDRP has a major role of Geospatial technology. Ceinsys together with Esri India has successfully implemented it in different states of India. Similarly, Ceinsys in collaboration with Esri India worked on Andhra Pradesh Disaster Management Project - to enhance the capacity of state entities to respond promptly and effectively to a crisis or emergency.

Way Forward

The corroborative efforts

of Esri India and Ceinsys Tech Limited are playing a pivotal role in taking India to the next level. The execution stage would have been impossible without the support of the GIS platform provided by Esri. As mentioned by Dr. Abhay Kimmatkar, Esri has played a key role in bringing geospatial technologies and incorporating GIS with the different aspects of engineering modeling, hydrological modeling, and others based on the various requirements.

Over the years, new capabilities have been developed in GIS for integrating Big data, Artificial Intelligence, Augmented Reality, the Internet of Things, etc. IoT is integrated into Smart City projects, which provide basic command and control of the network. It acts as seamless data flow from GIS to the end-user. Esri has been contributing towards better data visualization tools to enable various departments & citizens in understanding the current scenario and increasing the transparency of work.

Whether it's the routine day-to-day activity or data-driven futuristic research, none can be achieved without geospatial information. As organizational decisions become more data-driven, businesses need to ensure decisions are made with the most accurate data. Esri India and Ceinsys have been working together with the aim to enhance geospatial technology applications to deliver intelligent decisions backed by data. ■

ArcGIS EXCALIBUR

Discover solutions for enhanced web-based imagery

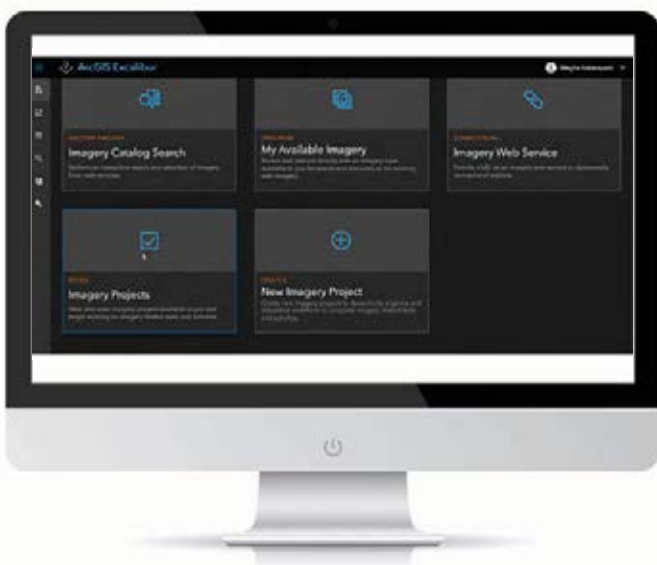
ArcGIS Excalibur is a project-based imagery application that modernizes and enhances image-based workflows through intuitive experiences. It provides the user with a new, modern web-based experience to work with imagery layers in Web GIS. Powered by Image Server, users can perform on-the-fly processing and dynamic enhancements through raster functions.

Who benefits from ArcGIS Excalibur?

ArcGIS Excalibur is intended for analysts, imagery specialists, and imagery managers who need to discover, analyze, report and disseminate information derived from imagery analysis and focused workflows.

Benefits of ArcGIS Excalibur:

- Perform image interpretation and exploitation including dynamic image manipulation, enhancements and measurements.
- Work with orthorectified and oblique imagery side-by-side, which includes display of your GIS features providing context and increased value when working with your imagery layers.
- Enable feature creation and editing capabilities when working with imagery to facilitate effective image interpretation workflows like collecting and recording observations from imagery.



ArcGIS Excalibur Catalogue

A quick look through the features of Excalibur:

1. Search for Imagery

Search and discover imagery by connecting directly to an imagery layer, an image service URL, or even through the imagery catalog search. The imagery catalog search allows you to quickly search for imagery layers over areas of interest to discover and queue images for further use.

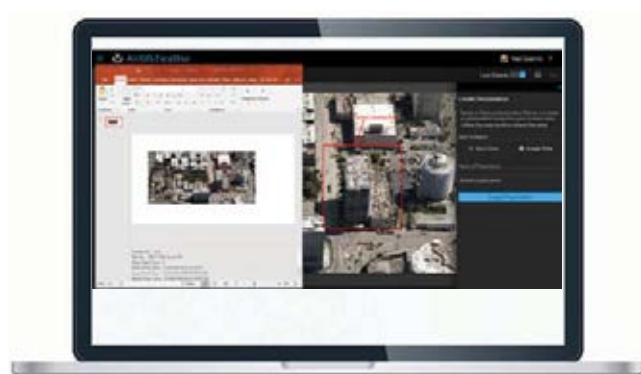
2. Work with Imagery

Connect to the imagery exploitation canvas to utilize a wide variety of tools and begin working with imagery. The imagery exploitation canvas allows you to view your imagery on top of a default basemap. This is where the imagery is automatically orthorectified and aligned with the map.

3. Excalibur Tools

- The image display tools include image renderers, filters, the ability to change band combinations and even apply settings like DRA and Gamma.
- Exploitation tools enable highlighting the key areas of interest through mark up, labeling and measurement.
- The create presentation tool exports your current view directly to a Microsoft PowerPoint presentation, along with the metadata of the imagery

4. Introducing an Imagery Project



Steps to Create Presentation

ArcGIS Excalibur introduces an imagery project, a dynamic way to organize required resources and complete an image-based task in a single location. Imagery projects include geospatial reference layers that provide context to your imagery task



Collecting Observations

and tools to streamline image-based workflows. ArcGIS Excalibur also allows you to compile and create presentations that can be exported, used and shared with others in your organization for imagery-related reports and briefings.

Using ArcGIS Excalibur helps:

- Use a focused, web-based imagery application that is integrated with ArcGIS Enterprise.
- Streamline your search, discovery and use experiences.
- Work with fully integrated, side-by-side visualizations of imagery in map space and image space.
- Use image annotation and sketching capabilities with automatic, accurate transformation to geographic features.
- Create and use imagery project workflows for efficient image analytics. ■



What's new on the Esri Platform?

GIS and BIM integration leads to smart communities

Part of the Esri Geospatial Cloud, ArcGIS Experience Builder empowers you to quickly transform your data into compelling web apps without writing a single line of code

BIM has been around since the 1970s. The early BIM information technology industry tended to focus on the paper documentation that drove construction and design processes, resulting in computer-aided drafting (CAD) products that helped users create drawings.

The architecture and engineering industries are moving beyond drawings to 3D models with project-centric attribution as the focal point of communication during construction and design. The Architecture, Engineering and Construction (AEC) industry now focuses more on BIM, an

information-rich approach that attempts to capture project details in a robust model. This may combine graphics about the designed real-world asset along with rich metadata for purchasing, scheduling and even simulation of how assets may behave in their environment after construction. BIM has become the process for increasing efficiency and saving cost through collaboratively creating and using detailed information about built assets throughout their life cycle.

Power of GIS and BIM together

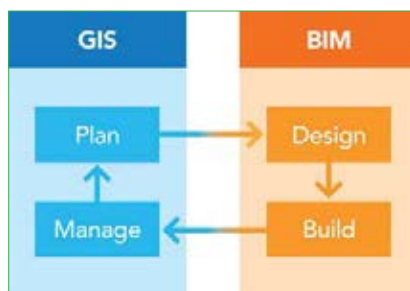
BIM and GIS together have the potential to bring about smarter

outcomes for communities and more efficient projects for AEC services providers. This will require more than just the collaboration of software vendors. Local governments and asset management organisations will need to establish specifications for BIM information. They can then introduce attributes early during the design process to be used later in operations and management workflows.

For major urban areas, this means creating multiple standards across transportation, utilities and architecture projects that may impact many agencies. Using Autodesk and other tools, Esri will have to build workflows that allow users to reliably access, update and use standardised BIM data in a spatial context throughout the life cycle of assets.

Work done by Esri customers and partners are great examples of creating value from the integration of BIM and GIS information. Based on their feedback, Esri is working to make it easier for GIS professionals to query, visualise and connect timely BIM data in familiar GIS experiences. Similarly, Esri is already working on delivering to architects and engineers better access to GIS data from within industry-standard design and construction tools.

Esri users should be able to combine geospatial information, field auditing, data capture workflows and detailed design information to achieve comprehensive awareness and understanding of sustainable projects that improve the world around us.



Life cycle of Data



Diagram shows that GIS and BIM data flows throughout the operational and construction life cycle of assets

Integration of IoT with ArcGIS Platform

With billions of connected sensors designed into products and places across the world, leading executives in business and governments know that the value of IoT lies in its vast quantities of data. But the most competitive organisations are transforming performance, decision-readiness and scalability by taking advantage of the hidden value of their IoT data, which is location, the 'where' factor.

In an era of billions of data-generating products, assets, buildings and devices—each with a unique location—the need to use advanced location technology to collect, process and analyse data for business and operations insights will only grow. Thanks to machine-to-machine communication and machine learning, as well as predictive (what will happen?)

and prescriptive (what should be done?) analytics, IoT's value proposition is accelerating. It is already changing the landscape across industries like retail, manufacturing and utilities, and even governments.

Retail: Location intelligence and real-time sensor data enable retailers to improve operations, inventory, product mix, market planning and customer engagement.

Manufacturing: Sensor technology and real-time location data offer extensive advantages to organisations involved in manufacturing and supply chain logistics, where location - and the efficient movement of goods and assets between locations—is the mission.

Utilities: With networks of power lines, water and gas pipes, meters and workers, utilities can benefit significantly from IoT by collecting real-time data across assets and visualising it on digital maps. This helps prevent service disruptions, streamline failure and the like.

Government: With networks of power lines, water and gas pipes, meters and workers, utilities can benefit significantly from IoT by collecting real-time data across assets and visualising it on digital maps.

Real-time location intelligence powered by GIS

Because location is such a crucial facet of IoT data, many organisations and businesses

find that a modern GIS, fed by real-time data, can be a powerful tool for operations. By ingesting, processing, analysing and visualising tens of thousands to several million events per second, real-time GIS empowers decision-makers and stakeholders. They have access to the latest information and insights to drive immediate and future ideas and strategies. Real-time GIS takes IoT's high-velocity, high-volume data and brings it to life, revealing patterns, connections and opportunities that are difficult or impossible to decipher otherwise, enabling a speedier, next-generation level of decision-making and problem-solving.

ArcGIS Monitor

A part of the Esri Geospatial Cloud, ArcGIS Monitor is a tool uniquely tailored to monitor the health of ArcGIS implementations throughout their life cycle. It provides awareness of system usage and performance, helping you get the most from your GIS and IT investment.

What can ArcGIS monitor do for you?

- **Return on IT investments:** Reduced cost with more efficient business operation
- **Monitor all system tiers:** Observed databases, networks, GIS software
- **Alerts and notifications:** Detect and resolved problems or prudential problems

- **Updates:** Deliver system updates to staff and management

ArcGIS Quick Capture

ArcGIS Quick Capture is the fastest way to collect field observations. With this simple app, you can quickly record field observations from a moving vehicle while you scout locations, conduct aerial surveys or assess damage. Send data back to the office for analysis in real time and eliminate time spent manually processing handwritten notes. ArcGIS Quick Capture is integrated with ArcGIS, so new data from the field can be used instantly for better decision-making.

What we can do

- Record field observations on your mobile device from a moving vehicle
- Perform fieldwork faster and more efficiently than ever
- Get better results with accurate, real-time data from the field
- Effortless to use and easy to configure

How it works

Download the app

Works on Android, iOS and Windows mobile devices. ArcGIS Quick Capture leverages the built-in GPS and camera on your smartphone or tablet.

Collect data

Open the app and tap a button to use ArcGIS Quick Capture. No time is spent writing notes or finding GPS coordinates—the app knows where users are.

Analyse data

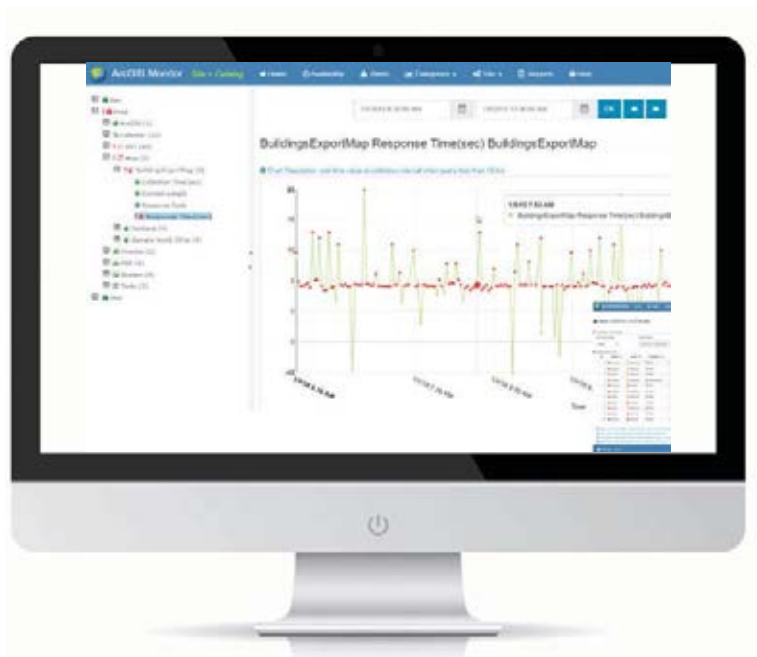
ArcGIS Quick Capture is integrated with your existing IT infrastructure and the ArcGIS platform, so data can be transmitted from the field instantly.

ArcGIS Experience Builder

A part of the Esri Geospatial Cloud, ArcGIS Experience Builder empowers you to quickly transform your data into compelling web apps without writing a single line of code. Build map-centric or non-map-centric apps and display them on a fixed



ArcGIS Monitor Dashboard



Capture data with the touch of a button



A new way of building web apps



3D Visualisation

or scrolling screen, on single or multiple pages. Perform a drag-and-drop operation to choose the tools you need from a rich set of widgets, design your own templates and interact with your 2D and 3D content—all within one app. With ArcGIS Experience Builder, your web apps look great and run seamlessly on mobile devices.

Properties

- A platform for apps - Create, deploy and manage apps in a single place
- Built by you - Choose the type of apps you want to build
- Integrated 2D and 3D - Interact with both types of content in one app
- Modern interface - Build easily with drag-and-drop components
- Mobile-first design - Deploy responsive, functional apps to any device
- Configurable- Customise widgets and templates to meet your needs

ArcGIS Experience Builder is built into ArcGIS Online and ArcGIS Enterprise, so it leverages all your existing data. Choose a software as a service (SaaS) or on-premises deployment to fit your needs. In addition, ArcGIS Experience Builder is built on an extensible framework, so developers in your organisation can build their own widgets and templates. This results in agile web apps that aid decision-making across multiple projects. ■



GIS AND THE VISION FOR NEW INDIA

GIS is playing a critical role in ushering in a new era of development by 2022-23

India has embarked on an ambitious journey to transform into a Rs 4 trillion economy by 2022, the 75th year of the country's Independence. Niti Aayog, the policy thinktank of the central government, charted the route of this journey by unveiling in December 2018 a comprehensive national strategy for New India that spelt out the objectives to be achieved by 2022-23.

The Strategy for New India @75 defines 41 areas of intervention under four sections: drivers, infrastructure, inclusion and governance. Drivers are the engines of economic performance; infrastructure

focuses on physical infrastructure as the foundation of growth; inclusion is about investing in the capabilities of the citizens to bring about a significant change, and governance aims at streamlining and reforming the way tasks and businesses are carried out by the government.

According to the Prime Minister, the Strategy for New India @75 is an attempt to bring innovation, technology, enterprise and efficient management together at the core of policy formulation and implementation. As Agendra Kumar, the president of Esri India, highlighted at the company's User Conference earlier this



year, a transformation will bring every citizen tangible benefits in the form of ease of living; lead to broader development of states and regions thanks to new technologies, faster innovation, upskilling, and modernisation of agriculture, making India a formal economy that facilitates investment and innovation; and bridge the gap between public and private sector performance.

In technology, Geographic Information System (GIS) has a key role in driving this vision of digital transformation. GIS is already being used across various government initiatives which are not only driving the economic and social transformation of our

nation but also helping us to be resilient and sustainable. GIS is being used to monitor and meet the country's Sustainable Development Goals (SDGs), enabling better infrastructure, accessibility and a better standard of living.

With technology as a core foundation, the New India vision aims to solve core challenges across various sectors such as agriculture, water, health, necessary infrastructure and governance addressed across 41 areas.

Transforming the agriculture Sector

New India @75 identifies the modernisation of agriculture as vital to increasing India's annual growth rate. With a focus on technology, defining an enabling policy framework and transforming the rural economy through the creation of modern rural infrastructure and an integrated value chain system, the aim is also to double the farmers income.

Agriculture sector, though, has been facing multiple challenges such as a reduction in cultivable area, unpredictable weather patterns, droughts, and flooding driven by climate change, which are impacting the overall agricultural output of the country. Besides, the inefficiencies in the supply chain are resulting in significant post-production losses from farm to table. The way forward involves smarter agriculture practices bolstered by technology which not only helps in better yield

but also helps transform the entire supply chain to minimise wastage.

The application of remote sensing and GIS techniques is significantly increasing beyond precision agriculture practices and enabling multi-agency collaboration across various stakeholders responsible for overall agricultural transformation. In addition, many state departments have setup central GIS-based portals for publishing agricultural information such as soil health cards and groundwater levels. AgriTech is emerging as one of the leading trends with more than 500-plus start-ups focused on it.

Use of GIS, integrated with IoT devices/sensors and UAVs/drones, is helping with rapid, better and near real-time information. This real-time information combined with historical data and emerging technologies such as artificial intelligence and machine learning are driving informed decision making to leverage best in class farming practices. With smartphone penetration and cheap data availability, is causing farmers to be a part of the informed decision-making process not only as a consumer of information but also sharing on-ground information. GIS is being used for a better and transparent crop insurance planning & payouts, thus significantly mitigating risk for farmers. GIS-based surveys via apps like Survey123 are significantly improving the productivity and transparency for insurance companies as well.

Ensuring sustainability of our natural resources - water

India's rapidly increasing population, urbanisation and industrialisation is driving the need for water. On the other hand, the average availability of water is reducing steadily. The government recently has formed a new Jal Shakti (water) ministry, which aims to tackle water-related issues with a holistic and integrated approach. Following this, the government has also announced an ambitious plan to provide piped water connections

to every household in India by 2024.

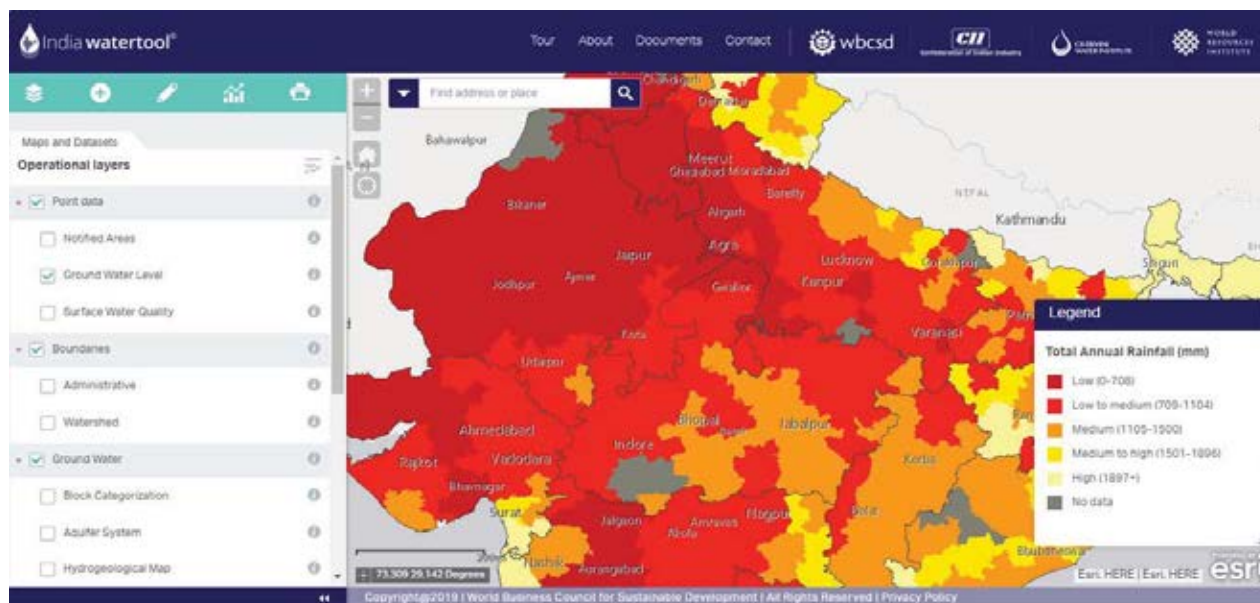
GIS can help in a better understanding multidimensional complexities of water ecology, socioeconomic challenges of our communities to ensure renewal of our water resources, water quality, as well as define a long-term view for sustaining our water resources. Even water utilities can better understand and manage their water distribution network and minimise leakages and ensure the availability of water to all. GIS can help in effectively communicating

with policymakers and other stakeholders.

GIS-based operations dashboards can provide a consolidated view of achievement/progress of SDGs at the city, state as well as the country level. At city/ward level, utilities can track water conservation activities in a single application such as water outages, leaks and water violations. Selective dashboards can be exposed to citizens as well for sharing the progress of various initiatives of water conservation and management and helping them participate in the conservation efforts.

India Water Tool

India Water Tool 3.0 (<https://www.indiawatertool.in/>) is helping businesses, and other water users understand their water risks and plan solutions for water management across the country.



It includes:

- Over 20 datasets from key Indian government authorities and other organisations
- A dataset on real-time satellite capture of surface water availability from NASA and U.S. Geological Survey (USGS)
- Water stress models developed by the World

Resources Institute (WRI) and Columbia Water Center (CWC).

- It also brings results from two local water-balance studies to give a complete picture of the watershed health and determine the potential for water recharge and demand-side management. All water users and stakeholders can openly access this data and plan management interventions.

Leading the urban transformation

The New India Vision focuses on various aspects of urbanisation with a focus on smart cities and housing for all. Various programs by Government of India such as Smart Cities, Atal Mission for Rejuvenation and Urban Transformation (AMRUT) are conceptualised towards

management, property taxation, citizen engagement and utility infrastructure planning and management. With its ability to integrate various data types including imagery, 3D, big data, real-time data from sensors and unstructured data, makes GIS a core technology platform that integrates and drives planning and decision making for all aspects of city functions.

development programs such as Bharatmala, Sagarmala, Port cities and Airports development and utility programs like R-APDRP and City Gas Distribution.

From identifying the right areas of infrastructure development, environmental compliance management, infrastructure development & project monitoring to

MCGM

Municipal Corporation of Greater Mumbai (MCGM) uses Web-GIS based apps which are deployed by 16 departments including Solid Waste Management, Development Planning, Roads and Traffic, Sewage, Water, Property Tax, Vigilance, Disaster Management Planning, Tree Authority, Healthcare, among others.



meeting and preparing cities for the urbanisation trends. GIS is already at the heart of these mission programs.

GIS supports the entire city lifecycle from master planning to city development and management. In addition, GIS technology already powers various core processes of ULBs and utilities in areas such as land

An enabling backbone for the nation's infrastructure

Infrastructure is one of the core pillars of the New India vision. Given the complexity, capital requirement and long-term nature of the infrastructure development projects, the use of GIS is indispensable. GIS is already a core component in major infrastructure

infrastructure maintenance and operations, GIS plays a vital role by integrating technologies and workflows across all phases of an infrastructure project life cycle thus reducing time and cost. The studies also show that the ROI in terms of savings on project costs can be up to 7 to 10%, which is substantial, considering the scale and the total investments involved.

e-Pathai

Tamil Nadu Highway's Department uses GIS to rationalise their decision making in planning, programming, funding and allocation of resources, allowing to make the best use of public funds in preserving the road networks at an acceptable level of serviceability.



Fostering an inclusive healthcare revolution

The vision for New India focuses on Public Health Management and Action and setting up necessary infrastructure and policy framework for comprehensive primary healthcare and universal health coverage. This would include successfully implementing Ayushman Bharat programme including establishment of 150000 health and wellness centres across the country including rolling out the Pradhan Mantri Jan Arogya Abhiyaan.

GIS can support these initiatives by helping in identifying the underserved locations for establishing the

health and wellness centres, thus focusing on inclusion and accessibility. In addition, it can help better understanding of the distribution of skills and capabilities available for efficient distribution and coverage of healthcare facilities. Public health centres and states already have a considerable health MIS data which can be leveraged in GIS system for deeper insights.

Beyond this, GIS can help agencies to track the effectiveness of various initiatives such as child immunisations, management, control and pre-emptive steps to contain vector-borne diseases such as dengue and malaria. In addition, GIS can help in a better understanding of disease

patterns, health care service needs and service utilisation patterns.

Building the foundation for new skills for tomorrow

More than half of India's population is below 25 years, and 62% is between 15 and 59 years. This demographic dividend is expected to last the next 25 years. New India @75 focuses on making India the skill capital of the world.

Technology, specifically, GIS can not only help to ensure efficient coverage of education focussed initiatives such as Sarv Shiksha Abhiyaan. Agencies can identify the underserved locations for building new schools, define

the right mix of teacher's skills, including monitoring other important school infrastructure development such as toilets. GIS also serves as an aide in

educational administration and policy, including other services to schools such as mid-day meals can be managed and tracked. Matching skill sets with industry

and geographic requirements is another area where GIS can help.

Bolstering better governance

Opepa

Odisha Primary Education Programme Authority uses GIS to ensure continuous and accurate delivery of school education to every child within the ambit of the RTE Act.



Better governance is a crucial pillar for New India vision that delves deep into how the tasks/business of government can be streamlined and reformed to achieve better outcomes. It mandates a sharp focus on ensuring accountability and a shift to performance-based evaluation with all policy interventions and decision-making driven by evidence and real-time data.

Globally, GIS is used by governments worldwide for effective governance of the key initiatives. As already discussed, GIS can help the government to track and manage the progress of SDGs, or the progress of the mission

India Urban Observatory

India Urban Observatory uses GIS to visualise the impact of various urban development programs on cities by measuring factors such as ease of living, sustainability, economic development, inclusiveness and resilience.



programs such as Smart cities or Swachh Bharat or the progress of infrastructure development. Integrated dashboards at central, state and district level help in a transparent view of the progress of various programs and goals. Integration with other IT systems such as ERP, BI and CRM systems can provide a consolidated view for a more transparent outlook. The dashboards can even be created and shared with citizens to engage with them and to communicate the achievements and progress.

GIS is the heart of our nation's technology vision

The government of India has recognised the importance of a data-driven approach to policy-making. It is banking on it to uplift the current

GIS system to integrate variety of data source such as databases, 3D, unstructured, LiDAR, vector, raster and spreadsheets, to integrate with systems like ERP, BI and CRM, to enable collaboration and secure sharing with multiple departments / organisations and an open architecture makes it a core of the entire technology foundation for our nation.

If information is the fourth pillar of democracy, GIS has emerged as a critical component of that pillar, helping unify information infrastructures across the country. With GIS becoming a collective and interconnected system of systems, The Science of Where has become more relevant than ever before. It is shaping India's transformation into a global economic hotspot, from classroom to hospital,



condition and meet the future demands of economic and social development. The Science of Where, a data-driven approach that uses geography to unlock understanding, is thus a key element in achieving a New India @75. GIS serves as a holistic technology to analyse almost every aspect of urban transformation, economic development, environmental protection and sustainability, and resource management and monitoring.

Emerging computing technologies like AI, IoT and ML are able allies of geospatial technology in the country's transformation mission. Ability of a

agricultural land to forest, water conservation to urban planning.

As Jack Dangermond, President, Esri Inc. said: "GIS is waking up the world to the power of geography, this science of integration, and has the framework for creating a better future." ■

GIS and Agriculture: The IARI perspective

In conversation with **Dr. V. K. Sehgal**, Professor and Principal Scientist (Agricultural Physics), Indian Agricultural Research Institute, New Delhi

What all comes under the purview of IARI?

The Indian Agricultural Research Institute (IARI) is India's premier national research institute for teaching, training, and extension services in agriculture, with a special focus on crop production. The institute is headquartered within a sprawling campus at New Delhi, and has eight regional stations spread across India. IARI's activities span 22 disciplines, including genetics and breeding, plant protection, soil science, agronomy, meteorology, food technology, engineering, environment sciences, water science and agro-economics. The institute has one of the best research facilities in the country, at par with foremost global institutions in the field.

One of the major contributions of IARI lies in developing desirable plant varieties through plant breeding projects, especially in rice and wheat crops (e.g.: Pusa Basmati, HD-2967), contributing significantly to the food security of the country. The institute has lead, early and often, in the fields of geomatics and remote sensing applications in India.

As early as 1969, we have used remote-sensing technology to



conduct field studies and map root-wilt disease of coconut using aerial multi-spectral imaging. Today, the institute boasts of state-of-art infrastructure, equipment and laboratories, among which is an X & L Band satellite ground station to receive direct-broadcast telemetry from a range of international satellites for remote sensing applications in the country.

Additionally, IARI deals with extension services that disseminate agricultural technology and new developments to farmers, thereby helping implement them in-field.

How is GIS facilitating the management?

Today, almost all agriculture

projects are conducted in GIS environments, and are inseparable from the technology. At IARI, we use several GIS products, among which Esri is a notable platform. GIS processes disparate geospatial datasets, and generates unified maps to visualize data; this allows scientists and students to analyse spatially.

At IARI, we have been undertaking a project called ICAR-KRISHI. It is a centralized data management portal that has institutionalized GIS not just for visualization, but also for analytical applications.

GIS is also being used to develop advisories that are disseminated to farmers, fishermen, etc. Under the National Initiative on Climate Resilient Agriculture (NICRA), IARI is investing heavily to develop technology that can make the farmer resilient to variations of weather and climate. Remote sensing & GIS technologies are playing a major role in the vulnerability assessments of agriculture to climate change, monitoring of crop residue burning events across India, and analysing spatio-temporal patterns of climatic risk.

IARI is also attempting to improve agro-meteorological advisory services given to farmers. GIS and remote-sensing has been essential in developing live-updated crop condition maps for the whole of India, at a very high resolution. IARI is involved in a collaborative venture with the University of Nebraska, in association with the National Drought Mitigation Centre (USA). The venture aims to develop drought-monitoring indices for Indian agriculture, using GIS to combine ground-level and satellite data.

How is Esri India enabling you?

IARI stands among some of the oldest user-collaborators of Esri in India, and has been providing practical training in remote-sensing, GIS and GPS since 1984. Esri's solutions offer a process-oriented technology that allows sequential learning and efficient information delivery.

Most notably, Esri India addresses a major lacuna in Indian agriculture: many agricultural environments and sectors suffer from a situation where information exists, but is scattered; or, unavailable either on a unified platform, or for spatial visualization. Esri's GIS platform helps harvest, compile, analyse and generate new knowledge – this is indispensable for the improvement and modernisation of Indian agriculture. It is crucial as we move toward the goal of digital agriculture in India.

Currently what are the areas in which this platform is helping?

Esri's platform is a valuable aid for precision farming; plant phenomics; developing drought monitoring indices and new models for agricultural crop yield production; monitoring crop residue burning; watershed management; soil mapping, etc. The information generated by the platform aids national programmes and advisory projects. Classification and compilation of cropping data at several scales (district, block and village) is also done on this platform. The comprehensive inventory so generated is shared with the respective central and state departments for policymaking.

ICAR-KRISHI is another platform based on Esri technologies which combines the agricultural technology database with geo-spatial data, data generated through experiments, observational studies, publications, etc. Under KRISHI, analytical, experimental and visual data flows into a single database; it is accessible to IARI for coordinated and informed decision making. Significantly, the software was developed on an open-source platform, and then shifted to the IARI ArcGIS server. It is a long-term project with relevance for climate and sustainable management of natural resources.

How do you think the platform can be enhanced?

Esri's GIS and image processing platforms are components of an information system that holds relevance for an information-

driven society. Agriculture cannot be aloof from this information revolution. It is important to recognize that the platforms aids a collaborative process; integrates diverse information; aids in information extraction; and, allows for repeated data iterations.

As agriculture is a function of local environment, soil, agronomic practices, resource availability and socio-economic conditions, the platform needs to be enhanced with newer functionalities to allow the capture of diverse information types in a user-friendly way. It should be able to integrate stand-alone dynamic agro models which can generate information at a range of scales – from the farmer's field to a farming region.

Esri's team in India could also help develop a formal/informal network of agricultural experts and researchers to bring the necessary platform changes or enhanced capabilities, as per the requirements of different agricultural applications. For example, flagship programs of the Government of India which deal with "Irrigation", "Soil Health", "Crop Insurance", etc. need specific GIS capabilities to make them user-friendly to stakeholders who use GIS from different levels of expertise. Such customized functionalities will go a long way in bringing the fruits of technology to grassroots, and develop examples that can then be applied by Esri in different parts of the world. Real-time benefits in agriculture can be maximised when GIS platforms are inter-linked comprehensively, and used by public, researchers and experts. ■

Esri India User Conference 2019

The Esri India User Conference is one of the biggest gathering of GIS professionals in India. Sharing the common goal of making our world a better place to live, this year, GIS enthusiasts came together on Esri India User Conference (UC) 2019, organized in Hyderabad, Kolkata, and Gurugram (Delhi-NCR).

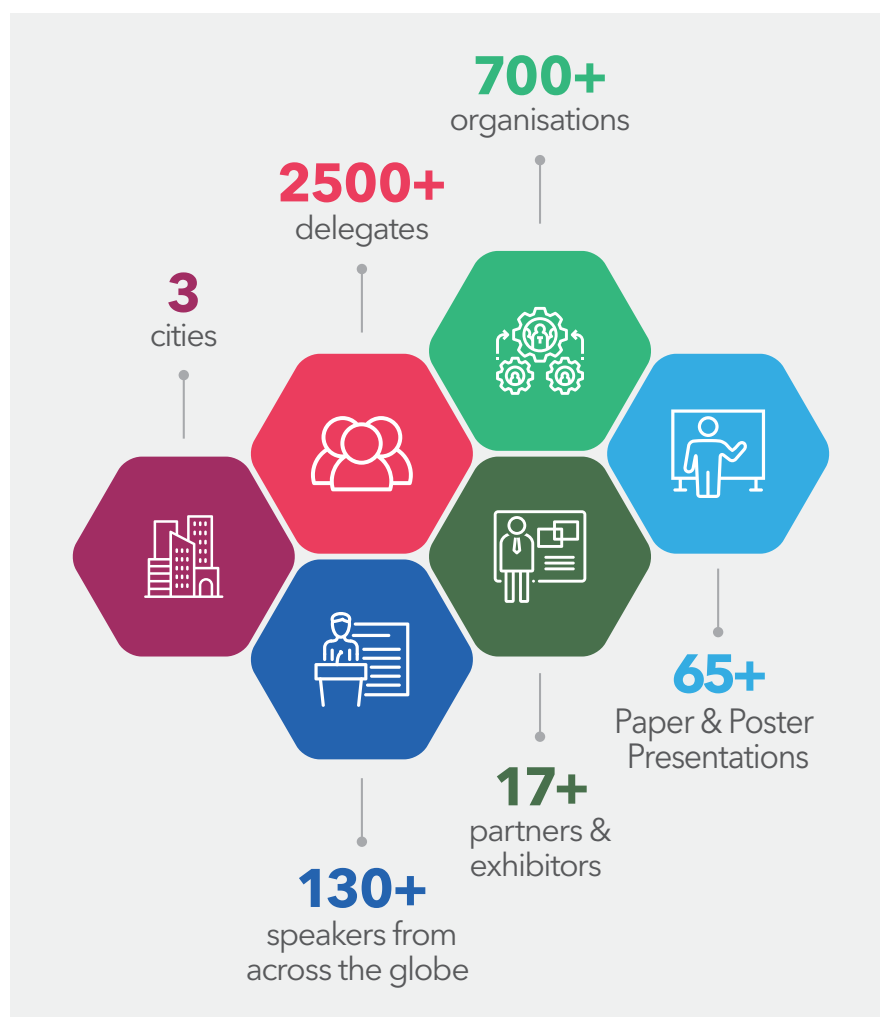
The User Conference was the perfect podium for GIS experts to unite and discuss the innovative applications in GIS technology. Altogether, the conference brought together over 2,500 decision-makers, policy-makers, senior officials, professionals, start-ups, users and technologists to experience the 'next big things' in GIS sector and how these can be applied to realize the vision of 'New India'.

Centered on the theme, 'GIS - Creating Vision for a New India', one of the biggest gathering of Geographic Information System (GIS) professionals, outlined the imperative and integrated role of GIS in realizing the government's vision for inclusive and sustainable growth across various regions and sectors. During the conference, experts got acquainted with latest advances in the GIS industry from sessions like Imagery

Summit, Solution Demo Theatre, Developer Summit, WhereNext Summit, and Education Forum and User Talks.

User organizations from diverse sectors were recognized for the exemplary work done using geospatial technology to address their respective community requirements - defining GIS best

practices. The paper presentations and story maps contest winners were also recognized at the Esri India User Conference 2019. The conference served as an excellent platform to explore how GIS helps to meet some of the greatest challenges faced by India today and Esri's vision of how GIS will continue to evolve and play a vital role in our lives ■



Track Sessions

Developer Summit



WhereNext Summit



Education Forum



Solutions Demo Theatre



Geospatial Data Science and Artificial Intelligence Summit



User Presentations: Innovations with ArcGIS



Awards & Recognitions

Special Achievement in GIS



National Hydrology Project,
Department of Water Resources, River
Development and Ganga Rejuvenation



Gurugram Metropolitan
Development Authority (GMDA)



HDFC Ergo General Insurance Company (HDFC Ergo)

Achievement in GIS



Department of Planning, Statistics
and Programme Monitoring (DPSPM)

Making the Difference Award



Maharashtra Remote Sensing
Applications Centre (MRSAC)

Young Scholar Award



Jayendra Praveen Kumar
Chorapalli

Storytelling with Maps Contest



Vaibhav Gupta
Cars24



Taranjot Singh Bhatia
Punjab Remote Sensing Centre



Satakshi Sharma
Wildlife Institute
of India



Hairanbh Vats & Maanas
Taneja
Scottish High
International School

Achievement in GIS



Dakshin Haryana Bijli Vitran
Nigam (DHBVN)



Aryabhata Geo informatics & Space
Application Centre (AGISAC)

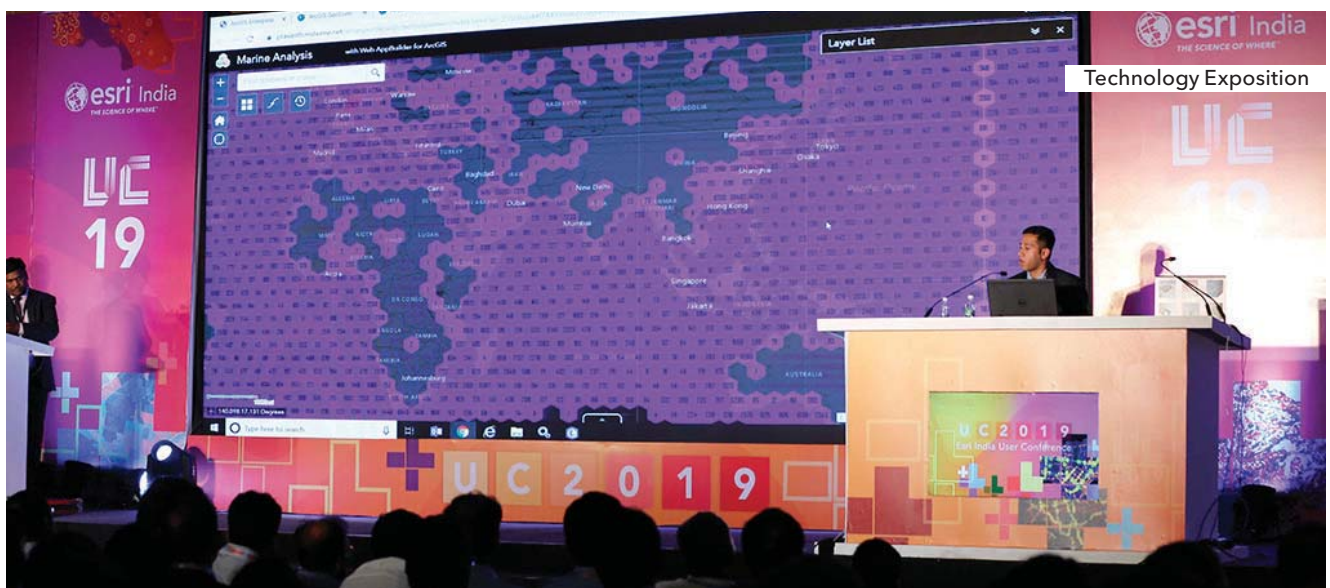
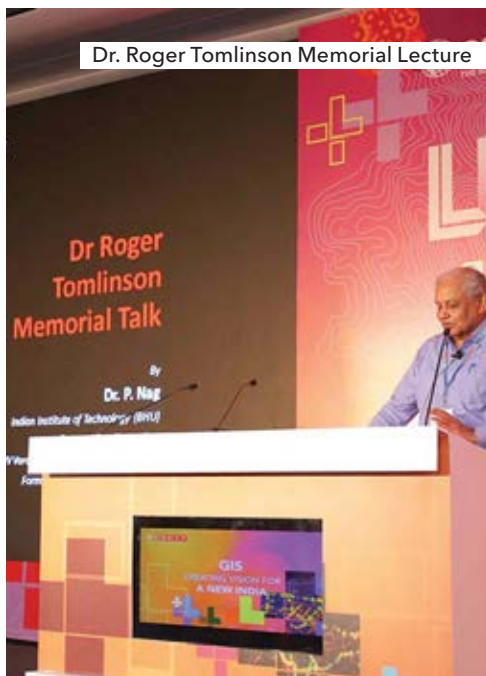


NLC India Limited



State Crime Record Bureau
Odisha Police

What's Next in ArcGIS



Integrating Elastic Search with ArcGIS web applications

Organisations to enhance efficiency of their web GIS applications, improve customer satisfaction

By Tejasvi Nagaraj

Lead Consultant, Infosys Ltd., Hyderabad

The latest ArcGIS Pro and the GeoAnalytics extensions are an architectural evolution targeted towards working with large and complex data sets. However, when the same data and capabilities are published over the web and accessed by hundreds of users, speed, scalability and cost become critically important.

Modern utility and telecom companies give customer satisfaction utmost importance. The applications exposed to customers are expected to offer instant results, failing which they risk losing customers.

Web GIS workflows usually start with a search. Customers want to search for products available nearby, know how many cellular towers are installed within a certain radius of their location and find a service centre closest to their home. These were some of the capabilities our client exposed on their GIS-based customer portal and the GIS application used by customer care representatives.

Monitoring the usage and performance of the website, the ArcGIS Monitor highlighted a significant number of requests to be “search queries.”

To improve performance and reduce usage of GIS-server resources, our initial approach was to index the database tables, building custom geoprocessing services to optimize some of the attribute and spatial queries. While response times improved significantly, the solution was not scalable without adding additional licenses.

Elastic Search

Elastic Search (ES) is a search engine which offers distributed, RESTful, multitenant-capable, full-text search and analysis with an HTTP interface and schema-free JavaScript Object Notation (JSON) documents. When combined with ArcGIS, it can offload the burden on GIS servers, offering attribute-based and spatial search capabilities to web applications.

Features:

- (i)** Powerful indexing to provide fast search results
- (ii)** Open source and free for commercial use
- (iii)** No limit on the number of fields you can index unlike traditional relational databases
- (iv)** RESTful APIs enable easy integration with web and mobile applications
- (v)** Searches in both structured, unstructured data sources
- (vi)** Searches in one or multiple fields simultaneously, supports complex query expressions
- (vii)** Performs geometry-based searches
- (viii)** Sorts search results based on distance from a location
- (ix)** Distributed architecture makes it highly scalable
- (x)** Performs aggregations to help explore trends and patterns in data
- (xi)** Supports analysers, tokenizers, char filters, token filters to support smart search capabilities
- (xii)** Implicit support for structured query language (SQL) queries and pagination
- (xiii)** Well documented with a large user community

Solution Approach

The overall solution has the following steps:

Deploy ES

The ES can be installed on-premise with limited technical expertise. We opted to directly use the ES cloud service on Amazon Web Services (AWS) with all the benefits of a SAAS.

Automate indexing, mapping of spatial data

"Indexing" is the term used for storing data in the ES.

The term "mapping" is used for mapping data in the database to objects which will be serialised and stored in the ES.

Similar to a Google search, the ES returns results from various data sources or entities, such as point of interests (POIs), assets, products, categories and services.

The data comes from feature classes or tables in your geodatabase or from tables outside it. Initially, all searchable data sources are identified, diverse data is aggregated and some common properties are derived or extracted. We created spatial views combining data from spatial and non-spatial tables, generating an index for each logical view as in the ES.

The ES expects attribute and geometry data in JSON and GeoJSON formats respectively. The ArcGIS conversion toolbox has a "Features to JSON" tool that does just this.

However, further wrangling of JSON data is required to be able to upload it to the ES. After creating indexes on the ES, a daily upkeep of the same is necessary to accommodate day-to-day changes in GIS data.

The following diagram shows the entire process of creating and maintaining indexes on the ES, considering incremental/delta updates in the source data.

- (i) We used the "Feature Class to Feature Class" geoprocessing tool to extract the initial bulk of data and the day-to-day updates into separate insert, update and delete file geodatabases (FGDB). At this stage, we also had to convert the data to WGS84 projection system if the source GIS data was in a different projection system.
- (ii) We used the "Features to JSON" geoprocessing tool to convert each FGDB into JSON/GeoJSON files.
- (iii) We used JQ, a command line JSON processor, to convert the JSON output to an ES-compatible format using nested pipelines:

```
jq --compact-output ".features[] |
{index: {_index: \"servicecenters\",
_type: \"_doc\", _id: .properties.
OBJECTID}}, {id: .properties.
OBJECTID, geometry: .geometry,
name: .properties.SC_NAME,
servicecentercode: .properties.
SC_CODE, address: .properties.
SC_ADDRESS, district: .properties.
DISTRICT, town: .properties.
TOWN}]\" ServiceCenters.json\" > \"Ser
viceCentersFormattedforES.json\"
```


(iv) Using CURL, a command line tool to send URL requests, we added records to the ES indexes using POST, PUT and DELETE methods to update the indexed data on ES:

```
curl -XPOST http://localhost:9200/servicecenters/_doc/_bulk -H "Content-Type: application/json" --data-binary @ServiceCentersFormattedforES_Inserts.json
```

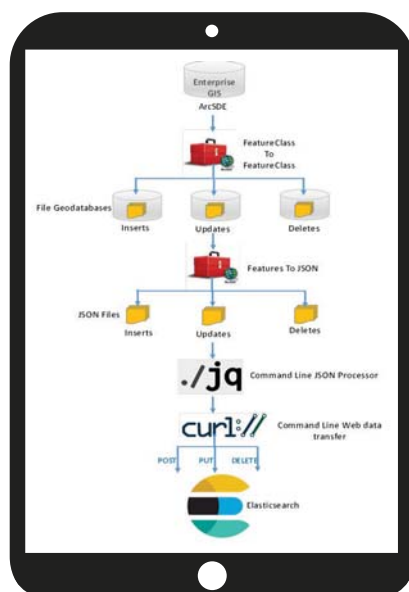
```
curl -XPUT http://localhost:9200/pipes/_doc/_bulk -H "Content-Type: application/json" --data-binary @ServiceCentersFormattedforES_Updates.json
```

This automated pipeline once set up, keeps search indexes on the ES up-to-date.

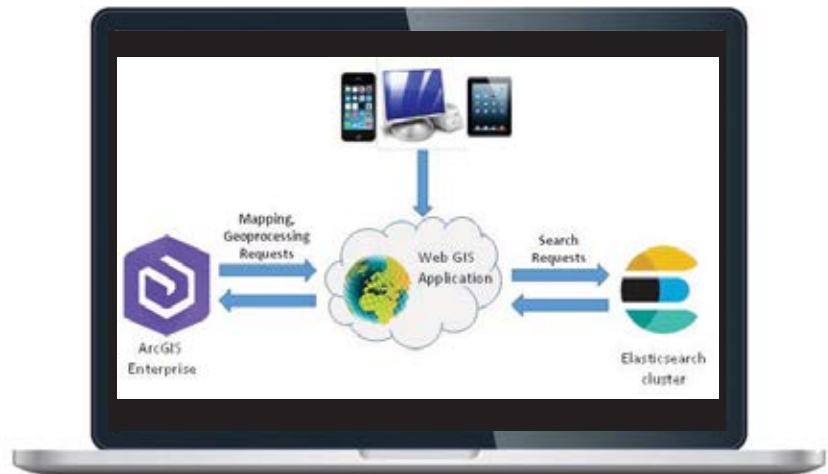
Integrate ES with web GIS applications

Developing the ES widget

The ES exposes its search capabilities in the form of REST



Indexing Tools Pipeline



Requests distributed between GIS Server and Elastic Search cluster

APIs, perfect for developing web applications using the ArcGIS API for JavaScript. Ready-to-use TypeScript definitions are available which offers all the ES modules needed to perform ES searches directly from an ArcGIS web app widget.

Below is a sample query performed within an ArcGIS web app widget:

The result is a high-performance spatially aware search tool (bottom image), a responsive website and a happy end user.

Conclusion

Improving overall performance of our client's GIS web applications by providing fast scalable search, the ES freed up resources on GIS servers for faster mapping and other critical spatial analyses. We saw an overall increase in website performance, with 90% of transaction response times below 100 ms.

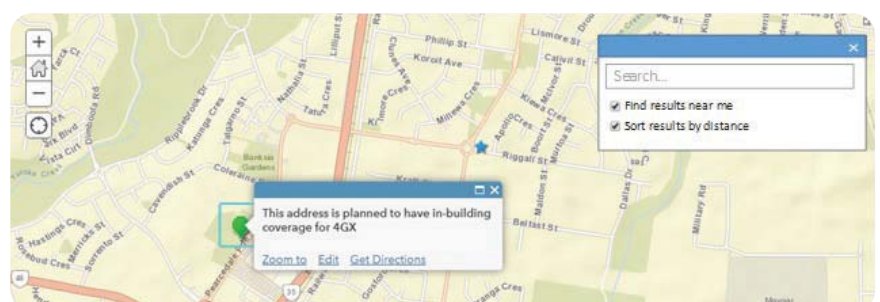
Organisations can use the integration approach suggested in this paper to enhance the efficiency of their web GIS applications, improving customer satisfaction. ■

```

108 private performESSearch(searchText:string){
109     this.esClient=new elasticsearch.Client({host: 'http://localhost:9200'});
110     this.esClient.search({q:searchText}).then((body:any)=>{
111         this.hits = body.hits.hits;
112         var timeTaken = body.hits.took;
113         this._renderDynamicSearchResults();
114     }, function (error:any) {
115         console.trace(error.message);
116     })
117 }

```

Sample ES query using TypeScript



Click & check service qualification widget and a search widget using ES

The Evolution of Smart Communities

In recent years, the concept of 'smart' has been evolving. Esri is refocusing the conversation around smart from vague promises to a specific geospatial strategy that can deliver the results communities seek. Smart, in the context of governments, is associated with the use of real-time data, 3D visualisation, the application of artificial intelligence (AI) for automation and optimisation, and other technologies being enlisted to improve the lives of citizens. These provide new ways to deal with challenges such as failing infrastructure, increasing demands on government services, threats to the environment, and the need for social equity.

By looking at communities that have truly become smart, patterns of adoption became apparent. Successful communities have a strategy connected to operational goals that enhance sustainability, resilience, liveability, health, safety, and prosperity.

Recognising that implementing a smart strategy requires both data and technology, Esri has developed a Smart Community Information System that encourages an integrated approach so communities can identify priorities, improve processes,

and achieve organisational goals.

Why Smart Is Spatial

Smart communities thrive when location is at the forefront of operations. Location plays a critical role in everything the government does, from long-range planning to asset management, from public safety response to addressing citizen requests. Smart devices, the Internet of Things (IoT), and cloud computing feed data on the locations of people, nature, vehicles, and infrastructure. Complex data needed for the government's myriad missions is brought together by GIS so that it is easier to understand, analyse, and act upon.

"We look at everything through the lens of geography," said Chris Thomas, director of government marketing at Esri. "Everything we do requires a focal point, which is where people live, work, and play. This is why GIS is recognised as a foundational part of every smart strategy."

Supporting Smart

Geospatial information is the foundation for building a Smart Community Information System and GIS is necessary for implementing it. Smart Community Information Systems

are organised around four technology tenets:

- 1. Planning and engineering**
- 2. Operational efficiency**
- 3. Data-driven performance**
- 4. Civic inclusion**

These systems encompass data and solutions, and require implementation, training, and partners.

Planning and Engineering

Smart communities must balance the often-competing demands of built and natural environments with the additional challenges of economic stress and climate change. In implementing smart communities, the focus on planning and engineering is not limited to the work traditionally done by municipal departments but more broadly refers to meeting community needs through human-centred urban designs. Incorporating 3D visualisations, benchmarks, and analysis, allow communities to balance the needs of people, infrastructure, and the environment by modelling the impacts of proposed development, adjusting plans to accommodate changing demographics and lifestyles, and accounting for the effects of climate change and economic shifts.



(Left) The City of Oshkosh, Wisconsin, devised an economic development plan to replace vacant buildings on its waterfront. (Right) A 3D visualization of a proposed entertainment district along the waterfront was created using Esri CityEngine.

Seeing the Future: City of Oshkosh, Wisconsin

The City of Oshkosh, located on the shores of Lake Winnebago in northeast Wisconsin, was founded in the 1800s as a centre for lumber and other industries. As these industries declined in recent years, taking jobs away and leaving behind dilapidated and vacant buildings, the city realised it needed a plan for reinvigorating the local economy.

It responded with Imagine Oshkosh, a 10-year strategy for promoting growth and investment in the greater downtown area. This strategy relies on GIS to plan and visualise a vibrant and prosperous future. Esri Community Analyst and Esri Business Analyst provided a deeper understanding of Oshkosh's demographics and economic strengths that could be shared with developers and other investors.

For example, a developer hoping to attract a minor league baseball team to the city turned to Esri partner Houseal Lavigne Associates, which used Esri CityEngine to create a 3D visualisation of the proposed entertainment district along the waterfront that would house offices, retail, multifamily homes, and an arena for the team. City residents, who could see Imagine

Oshkosh's vision thanks to 3D visualisation, were enthusiastic supporters of the project.

Operational Efficiency

GIS supports a broad range of technologies—from field mobility to the use of virtual assistants for open data access—that promote operational efficiency. Improved workflows support more responsive services by intelligently allocating resources where they are most beneficial.

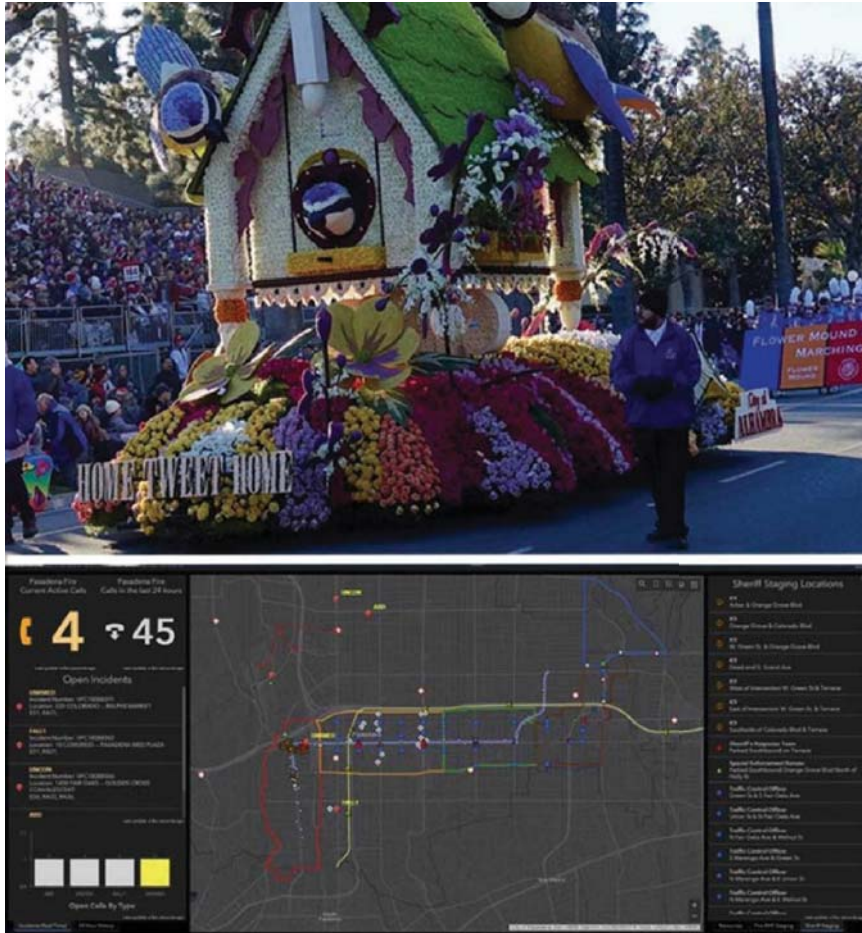
AGIS-based Smart Community Information System collects data in real time, performs analysis, and makes the resultant information available as the basis for better decisions through performance dashboards. More efficient workflows come from collecting data directly in the field and making it centrally available so it can be acted on immediately, eliminating inefficient and potentially error-prone paper capture and manual updates.

Streamlining processes saves time, maximises resources, and improves response times. By using dashboards, story maps, and web apps, the information produced can be shared with government staff and constituents in ways that are easy to understand, widely accessible, and convenient.

Optimising Coordination and Decisions for the Rose Parade

Each year, hundreds of thousands of people line Colorado Boulevard in Pasadena, California, to view the Pasadena Tournament of Roses, a parade billed as "America's New Year Celebration," as another 76 million around the world watch the event on television. Departments across the City of Pasadena and planning committees work together to coordinate the event and ensure the well-being of spectators and the people participating in the parade. In the decades since the parade debuted in 1890, its success and the safety of the fragile floral floats that are the event's centrepiece have been threatened by rain, high winds, and wildfires.

"In the past, we've only had information in paper format," said Oscar Sepulveda III, captain-paramedic with the City of Pasadena Fire Department. The city moved to a GIS-based strategy that uses mobile devices and dashboards. The Pasadena Fire Department uses Tracker for ArcGIS to capture real-time data about parade floats, fire department assets, and medical incidents. Live maps are shared with multiple fire chiefs, the Federal Bureau of Investigation, the Department of Homeland Security, and officers working



(top) The City of Pasadena moved to a GIS-based strategy to coordinate safety activities for the Pasadena Tournament of Roses. (bottom) Each year, hundreds of thousands of people converge on Pasadena, California, to view the parade.

at the event. This improves coordination across various agencies and response to potential hazards.

“For the past four years, we’ve been working on utilising technology to give us the up-to-date information that we need to make decisions that are going to impact safety,” said Pasadena fire chief Bertral Washington.

Data-Driven Performance

In 2000, Martin O’Malley, then mayor of Baltimore, Maryland, used a GIS-based tool called CitiStat that brought performance management and accountability to the city and reduced waste

and inefficiency in government operations.

The difference now is the great increase in the amount of data that can be analysed, incorporated, and communicated and the great decrease in the time required to do this using GIS. With the Smart Community Information System, real-time data harvested from mobile devices and device sensors connected through the IoT is analysed using an ever-growing toolset that includes AI capabilities and rapidly shared with decision-makers using dashboards and other visualisation tools.

Esri provides current-

year estimates and five-year projections of demographic data with 2,000 variables; tapestry market segmentation; and data on consumer spending, market potential, business locations, major shopping centres, traffic counts, crime indexes, United States Census, and American Community Survey.

Using Real-Time Data to Improve Traffic

Instead of relying on historic traffic data to time its traffic signals, Cobb County, Georgia, is improving transportation management across the community by modifying traffic patterns in real time. The county has incorporated GIS into its Sydney Coordinated Adaptive Traffic System (SCATS) and can manage the flows of both automotive and pedestrian traffic by changing traffic signals.

The system incorporates the variables that cause congestion and applies AI to optimise system coordination. Real-time road closure, traffic accident, vehicle, and pedestrian data is fed to an operations dashboard monitored by traffic managers who adjust traffic flows as necessary.

Civic Inclusion

Smart communities use technology to improve lives of citizens. Citizens want to work with the government to meet community needs and challenges and shape their future. By using story maps and ArcGIS Hub sites on topics that range from capital improvement projects to the opioid overdose epidemic,



(Left) County traffic managers monitor conditions using dashboards with real-time road closure, traffic accident, vehicle, and pedestrian data feeds. They adjust flows as necessary. (Right) Cobb County models traffic flows in 3D.

GIS enables smart communities to more effectively communicate with citizens, enlisting their participation.

With tools such as ArcGIS Insights, governments can analyse data on demographics and behaviour to inform policies, so services reach the people that most need them.

Mitigating Burden of Homelessness

The San Bernardino County Sheriff's Department's Homeless Outreach and Proactive Enforcement (H.O.P.E.) programme links homeless people with the resources they need to transition from life on the street, and reduces the costs associated with crime and

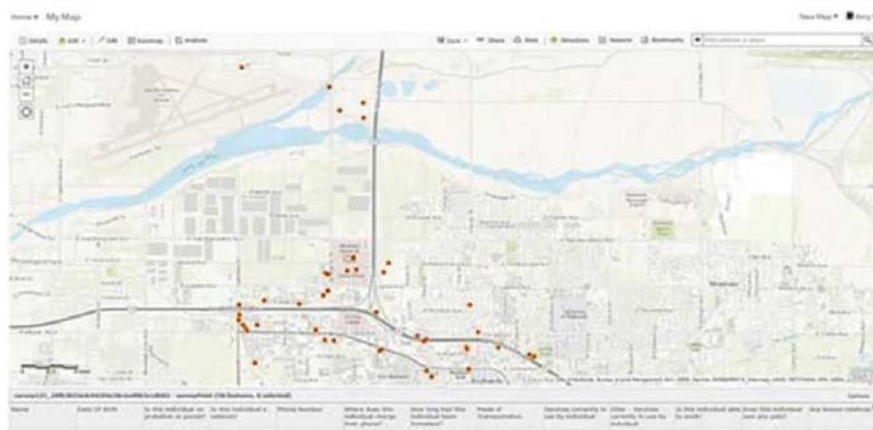
blight related to homelessness. The programme's goal is to improve the quality of life for all citizens in the Southern California county.

By using solutions that are configurations of mobile apps, such as Survey123 for ArcGIS and Collector for ArcGIS, with Operations Dashboard for ArcGIS, deputies document and share information on homeless persons and track the location of their camps. This GIS-based strategy provides an overview of contact with the homeless people over time and space that can be queried by name, age, timeline, or other factors.

This information was critical when water being released from a dam threatened homeless people camping in the riverbeds. The information was shared with county agencies so homeless people in the floodplain could be warned and relocated.

Smart Is a Process

GIS is fundamental for building smart communities. Smart communities don't result from one app or one project. They are the result of an iterative process that builds on successes and learns from failures, with the goal of a more responsive, effective, and inclusive community in mind. Smart is a journey enabled by GIS. ■



(top) This GIS-based strategy provides an overview of contact with homeless people and the location of camps. (bottom) San Bernardino County, deputy sheriffs use ArcGIS solutions to document and share information on homeless persons.



Thematic mapping for easy data interpretation

Smart Mapping - Easy ways to improve your maps

Smart mapping like ArcGIS lets anyone quickly discover patterns from their data attributes and make meaningful maps. Analyse multiple columns of related data, determine which has the highest or predominant value for each feature.

When choosing “Change Style” in ArcGIS Online or ArcGIS Enterprise Map Viewer, smart mapping analyses your data to provide suggestions based on fields and values. These defaults produce an effective map quickly and with a few more minutes to adjust, you make subtle changes to reveal and enhance the story hidden within your data.

Here are some tips and tricks for getting the most out of your smart mapping experience:

Think about colour

ArcGIS contains basemap-specific colour ramps to showcase your data, many being colour-blind friendly. When switching the basemap, smart mapping automatically suggests a suitable colour ramp. Designed to draw focus to your data, the Light

and Dark Gray Canvas basemaps are a good place to start. Enhance your story by choosing an alternative colour ramp to match context of your data. The following map is an example showing changes after the governor proclaimed 25% necessary reduction in water usage. Blue parts show more water than brown. Here colours used associate with the story we tell.

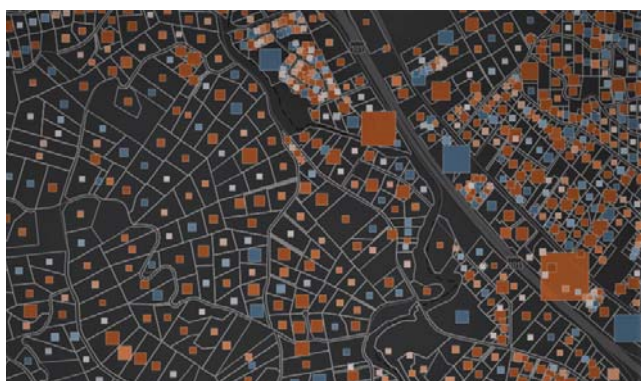
Tip: For thematic mapping, change theme to see your data differently. Use options Above and Below or Centered. Mapping something with important high or low values? Try High to Low or Extremes. Each theme has colour ramps and a current basemap on your screen. Click on a colour ramp, think whether your audience gets the first impression you want them to have with the map’s colours.

Find signal within the noise

Reveal patterns within your data. Whether or not you classify data, be deliberate when assigning colour or symbol size to data. Choose values to make things clear. Use handles within the histogram to quickly adjust the map and find patterns in your data.

The following maps show average household income. The first image uses a continuous ramp through all values of data. The second map shows larger circles only once a value is above average. In comparison, the second map is more definitive pattern of above-average incomes.

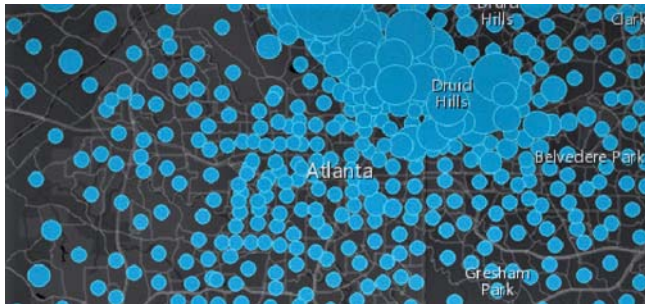
Tip: Have an outlier in your data? Zoom in to see values closest to the mean in the histogram. Pull the handle away from the outlier value to see how it affects your map.



Water usage pattern after Governor’s announcement



Household income below an average threshold amount

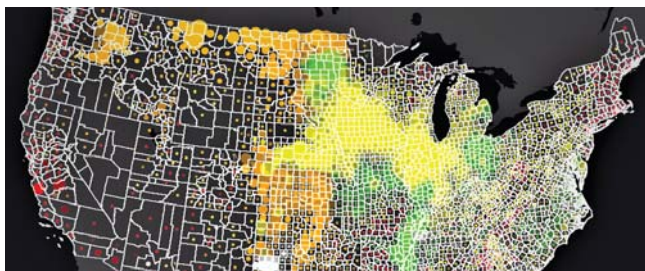


Household income above an average threshold amount

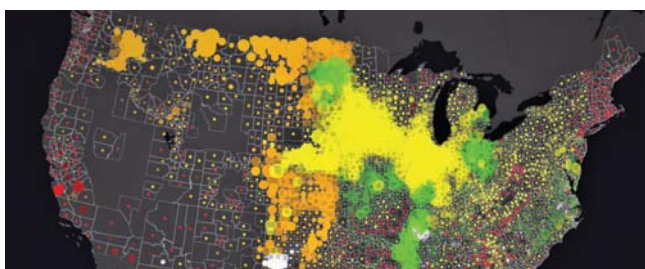
Adjust outlines

Outlines on points and polygons sometimes become distracting taking your audience away from the focus of your map. Play around with colour and transparency on your boundaries to easily maintain their importance and draw attention to the map. For example, change your boundaries or circle outlines to a slightly transparent value or a colour similar to the basemap. Also try full transparency if boundaries or outlines don't help support your story.

The first map below is an example of overbearing boundaries and outlines, while the second map uses transparent circle outlines and boundaries with a colour similar to the basemap. Patterns within the data become more distinct and comprehensive. See how strong outlines interfere with patterns maps want to reveal.



Map showing jarring boundaries



Map showing subtle boundaries

Utilize transparency

Transparency add emphasis to patterns in your data. Whether you highlight patterns or a statistically significant value, transparency makes patterns more understandable. Choose an attribute field from your data to control and adjust the transparency.

The following maps show subtle differences achieved using transparency. The second map uses same attributes for size and transparency, revealing the busiest highways allowing less busy roads "recede" into the map (due to data-driven transparency).



Confusion created by similar looking lines



Transparent lines clearly indicating less busy roads

Tip: widen the gap between the highest and lowest value to get a more intense transparent effect.

Use size and colour

Previously, showing two topics in the same map was challenging. Now with smart mapping in ArcGIS, show patterns using colour and size easily. Select variables you want to view, and smart mapping provides an option to show colour and size.

Forexample, to explore patterns of single-parent households, size can show total numbers, while colour can highlight where the highest percentage exist.



Size indicates highest numbers and colours indicate highest percentage of single parent households.

Tip: When starting a multi-variate map, use a count attribute for the size and a normalized attribute for colour. This helps you see patterns quickly. An example of a normalized field is a ratio, average or percentage. Select a field to normalize your data once within the options interface. ■

Empowering school students with GIS

The relevance of GIS and its adoption as a foundational technology across various industries is increasing rapidly. Integrating with other emerging technologies – including Big Data, Artificial Intelligence, IoT, Drones, Cloud Computing, and Robotics – the importance of GIS as a core future skill is growing exponentially. Educators realise the importance of spatial thinking as a behavioral and problem-solving tenant to be inculcated in students early on to prepare them for 21st-century challenges. As per Bloom's taxonomy for outcome-based education, there are six levels of cognitive skills: knowledge, comprehension, application, analysis, synthesis, and evaluation – the topmost cognitive skill. Geospatial thinking nudges students towards the top of the pyramid.

GIS – either as a specialisation or as a mandatory skill – is making deep multidisciplinary inroads in higher education. Globally, multiple initiatives have been taken to bring GIS into mainstream education at elementary school level. A new drive, 'Learning to Think Spatially', focuses on incorporating spatial thinking at all educational stages. In some schools, GIS is already an integral part of teaching geography. Students are encouraged to complete projects involving field surveys and data collection using geospatial technologies. Similar initiatives are becoming more common worldwide.

Esri India is working with schools to educate students on GIS technology through workshops on Story Maps on its ArcGIS Online platform. Story Maps connect geographic information with multimedia features, telling stories interactively and efficiently. Using maps in teaching aids spatial, critical, and analytical thinking, engaging students in richer conversations that transcend traditional disciplinary boundaries. Students understand the impact of current events and history on a local and global scale.

With the use of different mobile applications, location-based survey and fieldwork have become easy and interactive. Students now portray their



understanding of a context by efficiently using survey data and analysis. The approach to understanding a subject has become output-oriented, enabling students to think critically while using real data.

Esri workshops trained more than 1,300 school students across Delhi-NCR. A notable Story Map made by school students, 'Study on Glacier Decline', won the Esri India Story Map contest. The winners presented their work at the Esri India User Conference, Gurugram.

Another remarkable initiative is the launch of India's first-ever 'GIS Club' in Scottish High International School. Through this launch, the school aims to train tomorrow's professionals on the dynamics of GIS and how it can be used to enhance understanding of various subjects.

GIS-as-a-skill is unlocking career opportunities across industries. As per Wikibrands' Digital Periscope study and surveys, geospatial technologies are among the top 20 emerging technologies in the next ten years. The New India Vision, 2022, focuses on skill-building in aspects having higher industry demand. Maps being rich sources of data and storytelling, spatial thinking using such technology can help students fathom the next technological wave of Automation, Big Data, Machine Learning, and Artificial Intelligence. ■

SEE HOW PEOPLE AND NATURE CAN THRIVE, TOGETHER.

The stewards of our planet's most important ecosystems depend on Esri location technology for a holistic view of the relationship between humans and natural landscapes. By mapping the wildlife and surrounding areas, rangers and conservation groups can ensure the future of our most precious species for generations to come.

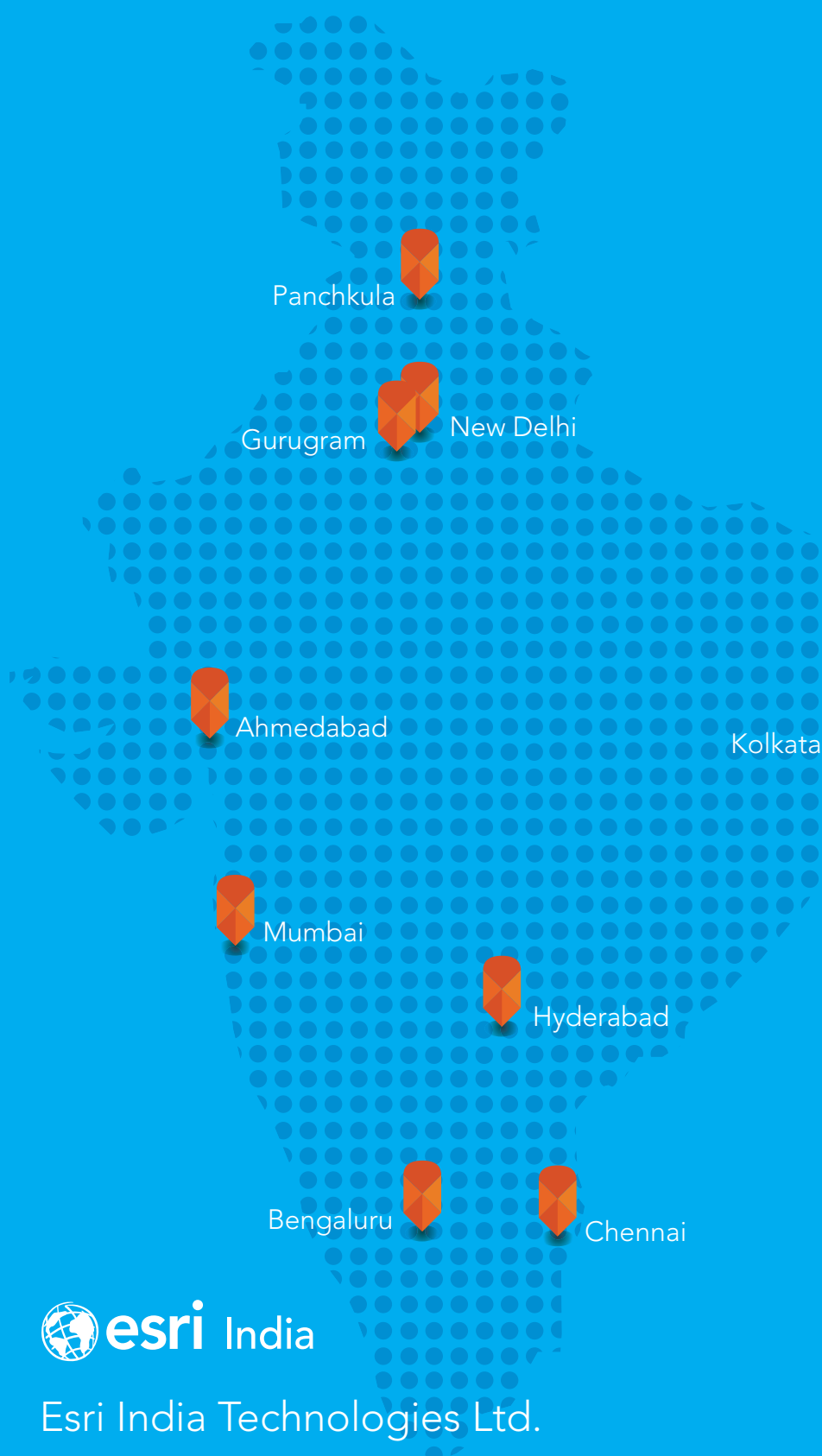
If Esri can help conservationists see how to monitor and protect vital habitats, what could you see?

See what's possible at: **esri.in**



SEE
WHAT
OTHERS
CAN'T™

Esri India Locations



Esri India Technologies Ltd.

H-7, Sector 63
Noida - 201301, Uttar Pradesh (India)
Tel : + 91 120 4285000 / 5200
Fax : + 91 120 4285333
Email : info@esri.in
Web : esri.in

Ahmedabad

505, Shree Balaji Heights, Beside IDBI Bank,
Near Tanishq showroom, C.G. Road
Ahmedabad - 380009, Gujarat

Bengaluru

70, 1st Floor,
Above ICICI Bank,
45th Cross, 8th Block, Jayanagar
Bengaluru - 560082, Karnataka

Chennai

Room No - 101 & 105,
HQ10 - Primus Building No. SP - 7A,
South Phase, 1st Floor, Guindy Industrial Estate,
Chennai - 600032, Tamil Nadu

Gurugram

We Work, DLF Forum Cyber City, DLF Phase 3
Gurugram - 122002, Haryana

Hyderabad

Apeejay Business Center, Tresorie,
1st Floor, The PARK, 22, Raj bhavan Road,
Hyderabad - 500 082, Telangana

Kolkata

Block DN - 62, Sector - V, 12th Floor, Tower II,
Millennium City Information Technology Park,
Bidhan Nagar, Salt Lake
Kolkata - 700 091, West Bengal

Mumbai

EFC Business Center,
D wing, 14th floor, Empire Tower Reliable Clouddcity
GUT No.31 Airoli
Navi Mumbai - 400708, Maharashtra

Noida

H-7, Sector 63
Noida - 201301, Uttar Pradesh

Panchkula

Plot no - 16, Sec - 22, 3rd Floor, Panchkula IT Park,
Panchkula - 134114, Haryana

Other Branch Offices

Bhopal
Dehradun
Lucknow
Thiruvananthapuram
Vijayawada