GEOSPATIAL WORLD

RE-MODELING CONSTRUCTION

How new innovations are re-defining construction and processes? *Page 12*
What is the difference between AR, VR and Mixed Reality? *Page 20*
Explore the various arts of possibilities in construction *Page 26*

P08

Corner Office: In Conversation with Dr Simon Raab, Co-Founder, CEO & President, FARO Technologies

IT'S HERE.

The newest, most innovative Total Station portfolio in the industry, right here at Trimble.

Accuracy and reliability has never been easier to attain with Trimble's complete suite of Total Stations. From the innovative SX10 scanning total station, to the highly specialized S-Series, all the way to the new mechanical C-Series, Trimble® has you covered. Coupled with our trusted software, you'll be fully equipped to make your mark.

SX10

S5

S9

C5

S7

C3

See them all at **trimble.com/totalstations**

◈ Trimble.

CONTENT

VOLUME: 08 ISSUE: 04

COVER STORY

12
RE-MODELING CONSTRUCTION

Digitization of the construction process will significantly reduce risks and enhance bankability of infra-structure projects, besides improving their viability and asset lifecycle

HEXAGON
GEOSPATIAL

INTRODUCING HEXAGON SMART M.APP®

Hexagon Smart M.Apps are streamlined and lightweight market applications that solve unique business problems. Each Hexagon Smart M.App combines multi-source content, sophisticated analytics, and tailored workflows, fused together into a dynamic user experience.

SMART CITIES, SMART NATION

BUILDING SMART CITIES THROUGH GEOSPATIAL INTELLIGENCE

- Create a common operational picture for both spatial and non-spatial data.
- Enhance livability, workability and sustainability by sharing data.
- Disseminate real-time data to desktop, web, and mobile devices for asset and infrastructure management, transportation, utilities, telecom, public safety, and security.

CONTACT US
in-sales@hexagongeospatial.com

LEARN MORE
hexagongeospatial.com

More use of geospatial required in construction

Prof. Arup Dasgupta
Managing Editor,
arup@geospatialmedia.net

Construction is big business and big business means big money. Considering the fact that cities are growing at a fast pace — 54% global population were in cities by 2014 and a growth rate of 1.84% per year till 2020 is predicted by WHO — the need is for the best planning and management technologies. But at times the needs of development become overpowering, overpowering enough to cut corners to save money and time.

An interesting story from *CBS News* is about the Millennium Tower in San Francisco, an up market building housing million dollar condominiums. It was found to be sinking and leaning — 17 inches and 14 inches towards the northwest. The reason — the tower is resting on sand and rubble of the 1906 earthquake 80 feet down and not on bedrock which is at 200 feet. Yet the plans were approved as the engineers estimated a sinking of 4 to 5 inches over 100 years. The city supervisor's summing up is classic: "Everybody is afraid to tell the truth. Because if we get to the bottom of this, they are worried that it is going to, in some ways, slow down the building boom that is happening in San Francisco."

A contrasting story is that of Boulder, Colorado which appeared in the November issue of *National Geographic* as a part of its article on *'Happiest Places'*. Decades ago, the narrative goes, the City Council decided to allow high rises downtown, but the citizens objected as this would block the view of the mountains and successfully overturned the decision. This and many other people friendly decisions, like bicycle paths makes for happy lives of its citizens.

Which brings up the topic of sensible use of geospatial technologies in the construction industry. It is of concern that such a big industry has the lowest investment in R&D as well as the lowest growth rate. Technologies like BIM have collaborated with geospatial to provide added value to construction planning and execution. Now, a building can be visualized in the context of its environment and analysis of the impact of the building on topics such as water supply, sewerage, parking, vehicle load and even the quality of life can be assessed even before a single shovel of earth is turned. Today these are further augmented through technologies like reality mesh and augmented reality. In fact, technologies like Hololens from Microsoft can allow multi-agent collaboration in a augmented reality environment.

Now imagine how these technologies could help in the two examples quoted above. While the Millennium Tower might not have had the benefit of these technologies then, future high rises can definitely learn from the Millennium Tower experience and make them safer and better while lowering costs. In the case of Boulder, AR, reality mesh and perhaps even Hololens could help the community and builders to come to an acceptable solution. I am reminded of the classic case of the alignment of the Richmond Parkway of Staten Island on which the community raised many objections. Landscape planner Ian McHarg, used the technique of map overlay to find the route that would have the least objection from the community. McHarg's work would become the basis of the evolution of GIS, one of the key geospatial technologies. If a solution could be found with such a simple process imagine what could be done with the plethora of technologies we have today.

Oh, and by the way, the world's three happiest countries are Costa Rica, Denmark and Singapore. The US, where Boulder is located, is not even in the top ten.

TOPCON RD-M1 COLLECT 2.0

Topcon announced an update on its data collection software for SmoothRide resurfacing workflow solution. RD-M1 Collect 2.0, the latest update, would facilitate and optimize road mapping of road conditions. The software now has an improved interface that simplifies the setup and detects the position of the wheel and sensor data automatically.

A new feature called Memos allows the operators to easily create balloons with the messages while creating data that is made visible in the process software. It enables to note specific site conditions.

KEY FEATURES

- RD-M1 Collect 2.0 graphical interface status bar that indicates the optimum speed for collecting road information
- Manage Runs feature is designed to enable operation without necessitating Windows explorer to be open
- Plan Route feature allows import of kml files of predetermined routes, that ensures nothing is missed on the drive

HxGN SMART Build

Hexagon recently launched HxGN SMART Build, an enterprise construction management software solution that is designed to alleviate cost overruns and delays. HxGN SMART Build is a simple and powerful platform that helps construction companies tackle some of the biggest issues that can potentially derail a project. It deals with problems like diminished productivity, breakdown of office-to-field communications and lack of project transparency.

SMART Build has been designed to resolve such challenges and help the developers deliver the project on-time by connecting and simplifying the construction management process.

It is a Cloud-based, software-as-a-service solution, which allows everyone who has anything to do with your project, access to information they need when they need it. Our powerful browser-based interface connects all relevant project information – including CAD drawings, 3D models, specifications, schedules, materials, workflows and instructions – to the thousands of people your project employs and the millions of tasks you manage.

KEY FEATURES

- Dynamic capture and aggregation of all changes throughout the life cycle of the construction project
- Collect important maintenance and repair data in one central depository for ease of management
- Import and aggregate 3D BIM models from various design and construction sources including Revit models and IFC models to create a unified model

TRIMBLE ECOGNITION SUITE 9.3

Trimble launched the new eCognition Suite 9.3, a software platform for advanced geospatial image analysis for environmental, agriculture, forestry and infrastructure applications. Version 9.3 leverages the latest image feature extraction technology to solve challenging problems faster and more accurately for remote sensing specialists, GIS experts, cartographers, photogrammetry and other geospatial professionals.

The eCognition software adds 3D point cloud analytics and deep learning technology so customers can perform a broader range of geospatial analysis with a greater level of control. eCognition's intelligent information extraction capabilities accelerate mapping, change detection and object recognition by delivering standardized and reproducible image analysis results. Trimble's eCognition extracts accurate geo-information from remote sensing data.

KEY FEATURES

- Intuitive user interface powered by Trimble eCognition image recognition engine
- Easily perform land-cover mapping tasks or execute change detection analyses based on imagery
- Guided workflows for effectively transforming image data into actionable intelligence
- Analyzes raster and vector data from a variety of file types
- Export high-quality, GIS-ready deliverables
- Access geospatial data via Trimble Data Marketplace

RIEGL VZ-2000I 3D LASER SCANNER

RIEGL launched the latest VZ-2000i 3D Laser Scanner. A terrestrial laser scanner, the VZ-2000i is a long range, high-speed 3D laser scanner that captures up to 1.2 million measurements per second, and covers ranges up to 2,500 m, with 5 mm accuracy and 3 mm precision.

RIEGL's unique Waveform-LiDAR technology enables high-speed, long-range, and high-accuracy measurements even in poor visibility and demanding multi-target situations and delivers reliable data even in harsh environments.

The new processing architecture enables execution of different background tasks (such as point cloud registration, geo-referencing, orientation via integrated Inertial Measurement Unit, etc.) on-board in parallel to the acquisition of scan data.

KEY FEATURES

- High laser pulse repetition rate of up to 1.2 MHz
- High-speed data acquisition up to 500,000 measurements/sec
- Eye safe operation at Laser Class 1
- Wide field of view, 100°x360°
- Range up to 2500 m, accuracy 5 mm
- High accuracy, high precision ranging based on echo digitization, online waveform processing, and multiple-time-around processing
- Innovative processing architecture for data acquisition and simultaneous geo-referencing in real-time

TRIMBLE GNSS

In an another new launch, Trimble introduced its R10, R8s, R2 and R1. The systems collect more accurate data faster and easier. Together these solutions form GNSS systems.

Backed by a legacy of GNSS technology leadership and surveying expertise, Trimble provides surveyors with reliable, innovative GNSS survey solutions that meet their distinct requirements. For more than 30 years, Trimble has been setting the standard when it comes to positioning technology—and that tradition continues today and into the future.

KEY FEATURES

- Trimble CenterPoint RTX delivers GNSS corrections via satellite or internet connection anywhere in the world with unprecedented speed and accuracy for a PPP solution
- Trimble xFill ensures less downtime in the field, with continuous RTK coverage during connection outages from an RTK base station or VRS network
- Trimble SurePoint fully compensates for pole tilt. Conveniently measure points that were otherwise inaccessible with complete quality assurance

PIX4DMAPPER 4.0

Pix4D announced the new features of its Pix4Dmapper 4.0. The latest Pix4Dmapper 4.0 comes with easy to get machine-learning tools for photogrammetry applications. It allows users to classify 3D point clouds into categories like buildings, roads or vegetation. With Pix4Dmapper, you can use the point classification function to separate all the above-ground objects and improve the classification using the point editing tools. To get an accurate volume measurement, it is crucial to remove vegetation or human-made objects from the point cloud. With the point classification, it would be more time-saving to achieve more reliable volume calculations.

KEY FEATURES

- It comes with machine-learning point cloud classification that automatically classifies dense point cloud into five groups: ground, road surfaces, buildings, high vegetation and human-made objects
- 680% faster tiled LoD mesh generation and saves 89% of the processing time
- Full drone camera support in camera database

Construction companies can now scan continuously and immediately point out if a pillar is being incorrectly placed or that floor is not quite flat or that girder is not supporting correctly. 3D scanning is revolutionizing the way construction is being done, and FARO® is prepared to make digital engineering and construction more efficient with its innovative hardware and software technologies, says **Simon Raab PhD, Co-Founder, CEO and President, FARO® Technologies**

Deeply bound **Ethically** and Intellectually to the **Technology**

What are the benefits of using 3D scanning in digital engineering? How does it help in civil infrastructure and building construction?

The entire process is an evolution of a process that has been happening in the factories for a long time. Before an object is built in a factory, it starts off as a complex CAD drawing or CAD design. During the manufacturing process, this object will undergo quality control, which involves the assembly being checked and compared against the original CAD drawing or design, using scanning technology.

The same scenario is now prevalent in part in the construction industry. All designs are prepared using CAD. These could be based on existing designs that are reverse engineered or newly created designs. Similarly, using scanning technology, these CAD designs can now be used to monitor and check against the CAD and the actual as-built can be monitored and recorded during the construction process.

3D scanning has taken a longer time to penetrate the industry probably because of the nature of the technology.

Accuracy and resolution of the data is of paramount importance and ease of use is essential. In factory metrology, while working around a car or an aeroplane or an engine, we work in microns accuracy. In the realm of the construction and surveying, we work in millimetres accuracy but in often more challenging and difficult circumstances.

Today, our scanner products are highly enabling in the sense that physical size is optimized for the construction and surveying industry, with accuracy in the millimeter or sub millimeter range, which is suitable for the industry applications and the software is developing to mimic the typical workflows of the construction site.

FARO has a wide range of laser scanner products depending on the application requirements, whether you are indoors or outdoors, whether they require long range or short range, or need high accuracy or low accuracy.

In addition, we have taken our metrology software, which was developed around CAD and measuring objects against CAD, and transformed that into, let's call it, metrology software for the construction environment.

You can call it construction validation or survey validation; it's really the same thing. You are building according to CAD, and since you can scan during the entire project, you can achieve total quality. In the construction environment, the process becomes far more complete as at every step that you are doing 3D scanning, comparisons to CAD and making sure that you don't have errors. There is an additional value in the construction industry, which is not seen in

the factory metrology industry, and that's called the "as-built documentation".

So with the as-built documentation, you can take a part of the building, dial back in time and actually see through the walls to all the underlying construction -- where are the pipes, where are the wires -- and this provides a high degree of accuracy. This represents, really, a new level of value because the as-built documentation will be valuable to everybody involved in the life cycle of a construction project and the maintenance and modification throughout a building's lifetime.

Construction has always been typically laggard in adoption of new technologies or going digital rather. How do you project the adoption of these new technologies, laser scanning in particular, in the years to come?

Rather than criticizing the construction industry about being laggard, I would say that the enabling technology was really not available. Only in the last decade, with the introduction of less expensive, more rugged and accurate 3D scanning devices, has the market been enabled. It's only recently that we are coming up with relevant software to allow construction-oriented 3D measurement (to be compared) against the CAD information. So, there is tremendous rush right now to take advantage of these efficiencies in the construction industry.

When our (FARO) first protocol measurement technology was introduced in 1993 in the factory metrology environment, it took time for people -- almost a whole generation - to get accustomed to it and be re-awakened to the possibilities of 3D. People are trained in the old way, and they have to learn and adopt the new way; this usually requires a generational change.

Our industry is now supplying products and tools that drive better efficiencies and the receptiveness in the market has been really impressive.

How do you think these technologies can be leveraged to advance the AEC industry? Can you give some projections?

> *It's only recently that we are coming up with relevant software to allow construction-oriented 3D measurement against the CAD information. So, there is tremendous rush right now to take advantage of these efficiencies in the construction industry.*

At the moment there are very few tools available for avoiding, what we call in the manufacturing industries, scrap and rework. Scrap is when the part made incorrectly beyond repair and it has to be thrown out. Rework is when you find an error in your assembly and you have an opportunity to rework it. These two elements are profoundly important in construction. The tolerance for problems of scrap and rework in construction is very high right now because it's considered part of the normal business. This will no longer be tolerated to the same degree in the near future.

By avoiding rework, approximately 50% reduction can be achieved in cost. With 3D scanning, construction companies can scan continuously and immediately point out if a pillar is being put in the wrong place or the floor is not quite flat or the girder is not supporting correctly. Such early detection makes contractors and architects perform better. Errors do not stack up and cost of rework is subsequently reduced.

One area where scanning is going to be of utmost important is the high definition maps like the way it has made a mark in automated cars, IoT, etc. How do you see the market shaping up?

There are two parts to this market. There is the autonomous vehicle market, which has driven a tremendous drop in cost in using semi-conductor-based LiDAR, which works in the centimetre-range in object identification.

Then there is another realm, which is the high-definition. High-resolution data is required for making intra-manufacturing or construction calculations and observations in the forensics business, where a great level of detail, both image and 3D, are required.

So, the market is really bifurcated into two parts -- high speed, low resolution, low accuracy market for the autonomous market; and a very high resolution, high accuracy market for surveying grade imaging and 3D measurements. We do not intend to be in autonomous low resolution, low accuracy market. We will focus on the high resolution, high accuracy market.

You as the co-founder of FARO served as the chairman of the board of directors since its inception in 1982. You also have served as the CEO from the company's inception until January 2006. What drove you to return to take charge of the day-to-day operations?

As a founder and originator of some of the technologies, I am deeply bound ethically and intellectually to the technology and the importance of the marketplace. Since the inception of the company, I have been involved in almost every important matter. When FARO Technologies' growth rate started faltering during late 2015, and new competitors started entering the market with the latest technologies, the management team decided to reconfigure and restructure the company to be able to better compete in new markets, one of which is the construction BIM-CIM market. In that capacity I agreed to take on the charge of CEO and help the company to organize and harmonize its efforts to enter into new verticals and generally reinvigorate the company and its technology road map going forward.

It's been almost two years since you took charge again. What key steps have you taken to reshape the company and prepare for a successful future?

Principally an examination was undertaken to assess the competitive and organizational deficiencies. After the analysis, an initiative called "Going Vertical in Harmony" or GVH was introduced. This comprises of two primary components.

One is to define the vertical businesses in which the company predominantly operates.

FARO, at its core, is a three-dimensional measurement company and hence it was found that the products that were primarily focused around factory metrology, while extremely effective, were too generic in addressing key requirements for other market segments. In order to configure the products and our development in a manner to become better aligned with other, specific market segments, such as public safety or construc-

tion BIM-CIM, the organization needed to develop products and sell them in a manner which was appropriate to these verticals.

So, a number of vertical business groups were created based on specific customer focus areas that included Factory Metrology, Construction BIM-CIM, Public Safety Forensics and Product Design. Also, a new vertical was introduced for more custom solutions, which is called the 3D Machine Vision.

During this time it was also discovered that the organization had become geographically disconnected into three moderately different companies around the world. This caused certain inefficiencies and the market was concerned about the company's profitability. It was necessary to globalize and harmonize the efforts to maximize the growth and optimize administrative and research expenses through global harmonization, which was the second component of this initiative.

FARO GVH initiative constituted an 18-month effort and it has successfully completed most of the objectives that were set by mid-2017.

What are your key success criteria/ metrics where you could eventually conclude that your return as CEO has been a success?

I would like FARO to return back to a mid-teens revenue growth rate, and at the same time would like to see that by 2019 operating margins are also in the mid-teens area. In addition, the company wants to ensure that the gross margin returns to the historic averages of around 60%. So, there are three components — the mid-teens top line growth rate, gross margins of 60% or greater, and mid-teens operating margins. Finally and most importantly I want Faro to continue to lead its chosen verticals with best in class

solutions which provide excellent value propositions.

Where do you expect to see FARO five years plus in the future?

FARO intends to be the most trusted and leading solution provider for 3D measurement. We strive to be a leader in the technology and want to play a major role in the verticals that we have identified. I believe the Construction-BIM-CIM market will be a multibillion-dollar business. The addressable market is actually substantially larger than the factory metrology market. The public safety market is also becoming much more important. We are capable in all those areas, we intend to retain our leadership and become, hopefully, a multibillion dollar company over the next 10 years facilitated by our success in these particular verticals.

FARO's success is undoubtedly related to the leaders who drive the organization. What has been your leadership style to keep this going, make it a success and for so long?

I believe everybody should be imbued with a desire to lead in the technology and to transform the world we work in. You have to be inspired by the capability of technology to transform our lives and the industries of interest. It's that inspiration which makes you constantly look for new and innovative approaches and discover how to be part of that revolution. That's the kind of spiritual inspiration I have tried to bring back to the company. We aim to be always at the leading edge, providing value-added propositions, and providing highly productive tools at very reasonable prices. We intend to lead in providing products that are simplified for anybody's use. That's what keeps us motivated to excel. 🌐

> *FARO intends to be the most trusted and leading solution provider for 3D measurement. We strive to be a leader in the technology and want to play a major role in the verticals that we have identified. I believe the Construction-BIM-CIM market will be a multibillion-dollar business.*

RE-MODELING CONSTRUCTION

Digitization of the construction process will significantly reduce risks and enhance bankability of infrastructure projects, besides improving their viability and asset lifecycle. **By Shilpi Chakravarty**

The construction industry is ripe for disruption. Large projects across asset classes typically take 20% longer to finish than scheduled and are up to 80% over budget. Construction productivity has actually declined in some markets since the 1990s; financial returns for contractors are often relatively low and volatile.
— IMAGING CONSTRUCTION'S DIGITAL FUTURE, a report by Mckinsey

I t's a well-known fact now that construction is one of the least digitized industries. R&D spending in construction runs well behind that others — less than 1% of revenues, versus 3.5% to 4.5% for the auto and aerospace sectors. Productivity in construction industry has grown a meagre 6% since 1945 compared to manifold in agriculture or manufacturing. According to Mckinsey, by digitizing construction $1.6 trillion additional value could be added through higher productivity, in the process meeting half the world's infrastructure demands.

Gone are the days where construction was mostly dependent on a piece of paper defining the design and architecture. Today 3D modeling, reality mesh and digital engineering have revolutionized the infrastructure sector with precision being the key factor.

Digitization of the construction sector can significantly reduce risks and enhance bankability of infrastructure projects, besides improving their viability and asset lifecycle. There is a massive incentive for players in the construction industry to identify solutions to transform productivity and project delivery through new technologies and improved practices.

The next-generation BIM
Building Information Modeling (BIM) has been part of the construction industry for some time now. It is the process of designing a building collaboratively using one coherent system of computer models rather than as separate sets of drawings. With continuous technological advancements, next-generation 5D BIM is one of the

essential aspects of creating a flawless futuristic construction. However, what is going to revolutionize and has already done in many cases, is the technologies and processes that digitize the whole process by real-time visualization, thereby taking it to the new level.

Agrees **Ted Lamboo, Senior Vice President, Strategic Channel, Bentley Systems**: "Originally BIM was all about designing a new building right, the process to design in 3D and the process to go from design to construction. BIM in the context of reality, in the context of its environment — the existing roads, infrastructure, vegetation and utilities – and how all that hooks up, is a fantastic additional dimension that enriches processes like BIM to make them better inform processes."

A very good example to support this is the Crossrail project. Described as Europe's one
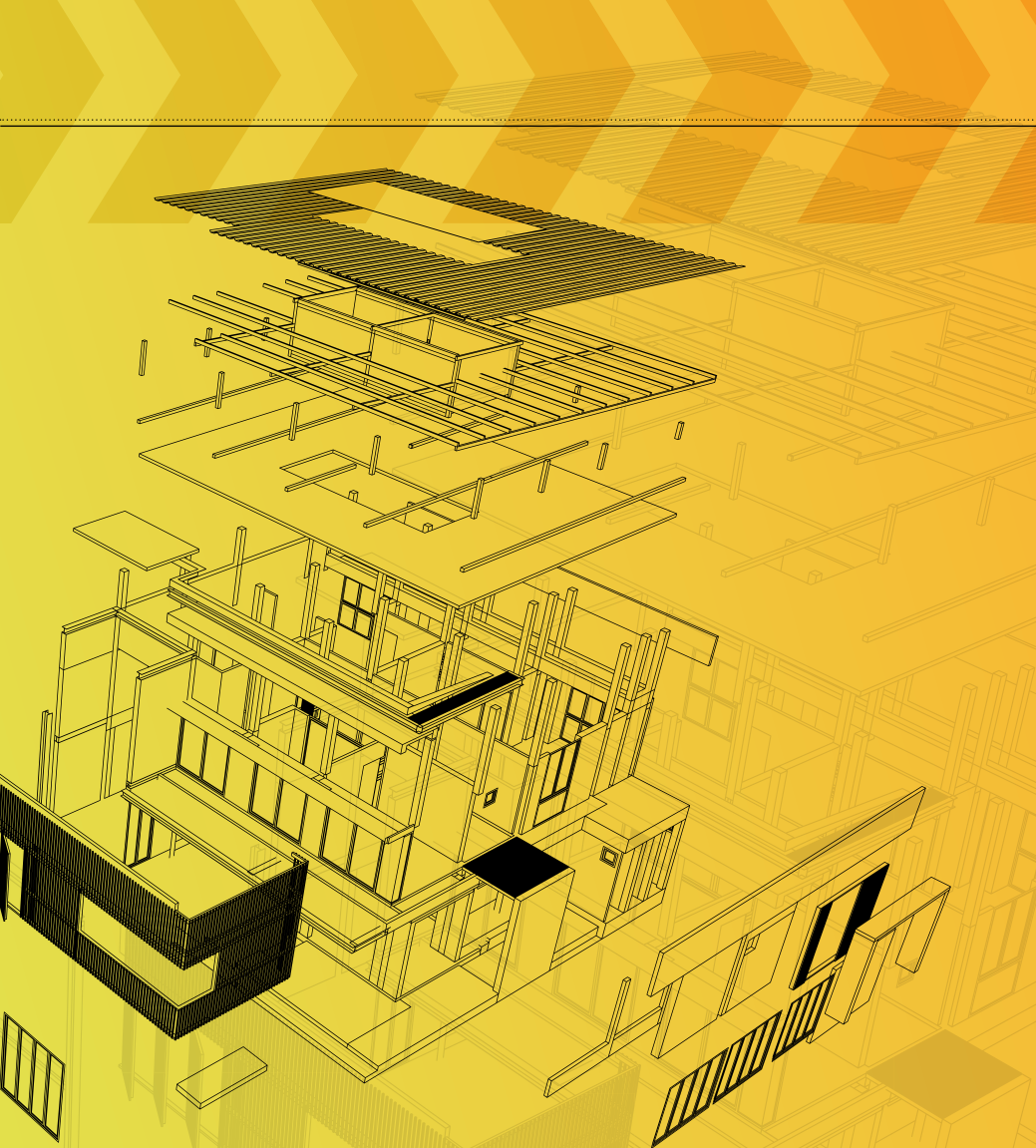
Productivity in construction industry has grown a meagre 6% since 1945 compared to manifold in agriculture or manufacturing. According to Mckinsey, by digitizing construction $1.6 trillion additional value could be added through higher productivity, in the process meeting half the world's infrastructure demands.

of the largest infrastructure construction projects, Crossrail is a 118-km railway line under development in England, running through parts of London and the home counties of Berkshire, Buckinghamshire and Essex. It is supposed to be the most innovative digital engineering project.

Just before it was to start, the project faced a 15-20% funding cut. That's unique in the infrastructure world, where projects crossing initial budgets are a regular. The only way the project could go ahead was by adopting BIM level III, where a digital twin of the asset and infrastructure was to be created before going into construction. So, before the construction began, a virtual metro line was built. Now, as the project progresses, the models keep on getting updated. These models will also go into operations and

maintenance environments, thus making change implementation and maintenance processes much easier.

This is where the world of engineering is changing, says **Peter Loeffler, Vice President and Global Head, Trends and Industry Affairs, Siemens Building Technologies.** Technologies used in Smart Cities or even individual infrastructure projects/buildings, instantly can evaluate a city's composition like buildings, vegetation, roads, airport, water, etc. They can also evaluate individual buildings, such as the height of windows, surface areas, and sun exposure. Besides, it can also provide a global traffic model and micro-simulations of specific areas.

"In construction even though the physical aspect is crucial like you need concrete walls,

FIVE TRENDS THAT WILL SHAPE CONSTRUCTION AND CAPITAL PROJECT

Higher-definition surveying & geolocation
Rapid digital mapping and estimating

Next-generation 5D Building Information Modeling
Design platform for the future

Digital collaboration and mobility
Moving to paperless projects, from the office to the workforce

DIGITAL CONSTRUCTION ORGANIZATION
Developing next generation of digital-native leaders to deliver projects of the future

Future-proof design and construction
Designing with materials and methods of the future

The Internet of Things and advanced analytics
Intelligent asset management and decision making

Infographic: Subhash Kumar

> You need to streamline the work processes and the data flow so that people can collaborate in the same model and drive that down into a 5D virtual construction.

CHRIS GIBSON
Senior Vice President, Trimble, USA

steel beams, etc. but how you plan that can be improved. In order to streamline the construction process you need digital components. The next big step will be off the construction, i.e. running a building," he explains.

Today, a lot of things are still done manually. In the future, important assets will tell a Cloud-based system about their health and about their state, and then different things can be done in terms of services — not only time and material services, but predictive and prescriptive services. "Maybe things can in future heal themselves or may be a robot will go there and change it. The future will be different from the today's present. We will see those digital changes everywhere and also in the building industry," he adds.

What is digital engineering and reality mesh?

Digital engineering is the process that delivers an integrated set of geometric model data and documentation that builds over the life of a project capturing all knowledge related to a particular asset during the design manufacturing construction and the asset management phases. In the process it provides a collaborative environment for all project stakeholders, enabling innovative solutions to be identified, and developed and rapidly validated.

A reality mesh, on the other hand, is the combination of real and virtual worlds that produces new environment and visualization. In a reality mesh, physical and digital objects meet and

Reality mesh is the capture of the current situation; this capture can be done with drones, satellites, scanners, and even with iPhones by taking pictures, and the engineering data is then inserted on top of it. Engineering-ready reality meshes can help in managing maintenance records

interact in real time to help professionals plan, design, construct and operate projects better.

Lamboo makes it simpler: For the past couple of decades engineering was taking an empty piece of paper and designed whatever was required. Then the teams went into the fields and tried applying those designs on the new constructions that were being planned. Reality mesh or reality modeling refers to capturing the existing situation first and putting the newly designed infrastructure that you plan in the context of the existing reality. "You get the reality of today and the design of tomorrow together, and then the resulting outcome is the reality of tomorrow," adds Lamboo.

Reality mesh is the capture of the current situation; this capture can be done with drones, satellites, scanners, even with iPhones by taking pictures, and the engineering data is then inserted on top of it. Engineering-ready reality meshes can help in managing maintenance records or ownership records.

"There is an increasing effort being made to turn the construction process into a manufacturing process," says **Chris Gibson, Senior Vice President, Trimble, USA.** This work process and the data flow is being streamlined so that people can collaborate in the same model and understand exactly what is going on so that one can drive that down into a 5D virtual construction. "As an owner or contractor, you are getting almost real-time information on the changes in the overall project based on the changes that you are making upstream in the process," he adds.

For instance, Bentley's Context Capture generates the reality model. The model's data type is a mesh. "That means in that output you have the triangulated meshes, you have the texuarization of what you see like the façade of a building, picture of the trees, etc," Lamboo adds. But behind it is also the point cloud that you can generate. So the process of making photos of different elevations and type combining with scanned data and creating a reality model.

Is the construction industry ready for the change?

The good news is large organizations are taking to some of the new capabilities and technologies pretty quickly, and a fair amount of adoption and penetration are beginning to take off. These organizations have been running numerous pilots around the world.

Jason Hutchings, Senior Director, Atkins, Hong Kong, gives a good example of how virtual world was used in a construction site to make the whole process simple and accurate: "A project in Hong Kong that was under construction and there was a requirement to check whether the rivets were placed appropriately. So, they did a LiDAR scan of the as-built condition and cross-checked the rivet model from which the contact was built and identified whether rivets were put in the right place or bolts had been tightened up." The degree of resolution can help the construction industry retrospectively as well as proactively through the assembly process. "We are already there in many cases. It is the question of the application of that technology and getting into the right environment."

Hutchings thinks that the industry is in the transition phase: "Design is typically a process and as we transition into a world of BIM and accurate modelling, there is an investment of time in doing that. I think we are in a transitional stage within the industry. Some people have jumped in harder and failed quickly, which is also a good thing to do, but we need to remember that as a community we need to somehow educate ourselves how to work together differently to be able to embrace the technologies and the information available."

What is driving the adoption?

To start with, lightweight, cost-effective equipment is making the impact. Noteworthy advancements in the laser scanning hardware has made the adoption of reality capture process easier. For example, scanning hardware in last 10 years reveals significant change in the trend. A scanner in 2007

> " The reality mesh or reality modelling refers to capturing the existing situation first and putting the newly designed infrastructure that you plan in the context of the existing reality.

TED LAMBOO
Senior Vice President, Strategic Channel, Bentley Systems

> " In future important assets will tell a Cloud-based system about their health and about their state and then you can do different things in terms of service.

PETER LOEFFLER
VP & Global Head, Trends and Industry Affairs, Siemens Building Technologies

THE CONSTRUCTION INDUSTRY IS RIPE FOR DISRUPTION

Large capital projects typically take

...and are up to

20% longer to finish...

80% over budget
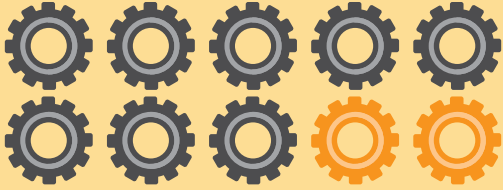
and R&D spending in construction runs well behind other industries

<1% 3.5% 4.5%

5 BIG IDEAS ARE POISED TO DISRUPT CONSTRUCTION

1 HIGHER DEFINITION SURVEYING & GEOLOCATION

2 5-D BUILDING INFORMATION MODELING

3 DIGITAL COLLABORATION AND MOBILITY

4 THE INTERNET OF THINGS AND ADVANCED ANALYTICS

5 FUTURE-PROOF DESIGN AND CONSTRUCTION

FOR THE INDUSTRY TO DO BETTER IT NEEDS TO EMBRACE 4 PRINCIPLES

Transparency and risk sharing in contracts

Return-on-investment orientation

Simplicity and intuitiveness in the design of new solutions

Change management
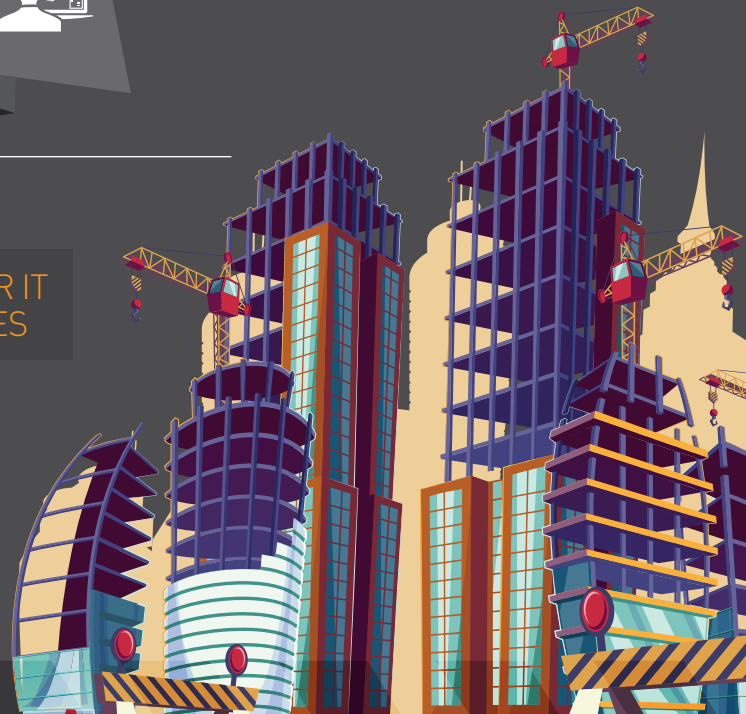
Infographic: Subhash Kumar

Specialized technology providers offer cost-efficient survey packages, including drone and UAV equipment, data uploading, and processing services, as well as software to manage drone flights, data capture, and dashboards to visualize information

was about $80,000 each and need a whole team to carry it around. But now, hardware and software partners are launching lightweight scanners. These devices are so light and small that anyone could slip them in a backpack, go to a site, start scanning, and immediately begin processing scan data using mobile software. Similarly UAVs have drastically reduced the cost of scanning a site. While it would earlier take about $40,000 to do a one-time scan of a site by a professional company or LiDAR-equipped plane, now the same job can be done by owning a commercial drone starting at $1,500.

From the software side, software packages have increased functionality at a fraction of the price and made much easier. For example, a product which does 3D city model creation, can now run it as a Cloud service. So if you are a user and want the data, then you can put your photos or point clouds together, upload them on the website and it processes everything and sends it back to you, making the whole process simple.

Specialized technology providers offer cost-efficient survey packages, including drone and UAV equipment, data uploading, and processing services, as well as software to manage drone flights, data capture, and dashboards to visualize information. Some government agencies and nongovernmental organizations have started providing free LiDAR maps.

The next step would be tools that can make it faster and more away from the hands of experts. The traditional world of photogrammetry needed someone who understood the software and science. On the other hand, in automated processing like creating 3D buildings or 3D city models, maybe just 10% of human intervention is required, the rest of being taken care of by computer vision, machine learning and lot of other algorithms.

Another technology which is heavily helping adoption of reality capture is Internet of Things. Sensors and wireless technologies enable equipment and assets to become "intelligent" by connecting them with one another. On a construction site, IoT allows construction machinery, equip-ment, materials, structures, and even formwork to "talk" to a central data platform to capture critical performance parameters. Sensors, near-field communication (NFC) devices, and other technologies can help monitor productivity and reliability of both staff and assets.

Challenges in the way

There are a few hurdles hindering the adoption of these niche technologies.

1. Lack of collaboration and seamless data flow: A major challenge is inability to achieve greater collaboration and seamless data flow. Agrees Gibson, "A large construction engineering organization may operate with 30 or 40 different applications in their organization, but the challenge for them is how seamlessly they can migrate the data from one application to another." This issue can be solved with effective collabora-tion at every level.

A very good example of a successful collabora-tion could be a construction firm working with a software company to build a predictive analytics engine to prevent equipment breakdowns on-site for its fleet of construction vehicles. This could save millions of dollars in downtime, fuel costs, and maintenance expenses.

2. Accessible and simple tools: Easy accessi-bility and operability of equipment is also a major factor. User-friendly tools are the buzzwords here. For the design and construction industry, a true Scan-to-BIM workflow will get you from push-button scan to deployable BIM model in a few hours. With no previous experience, any industry professional can navigate the workflow because of its user-friendly nature. As **Andreas Gerster, Vice President BIM/CIM and Product Design, FARO, Germany** explains, "Construction is all about measurement. Traditionally, there were dedicated professionals or surveyors. These people where the only ones who would know about meas-uring and would keep the art as a secret. So one of

"

It is not necessarily about being technologically advanced. We are already there in many cases. It is the question of the application of that technology and getting into the right environment.

JASON HUTCHINGS
Senior Director, Atkins, Hong Kong

"

It is critical that the user in the field does not require a surveying degree or any special degree. We need to be user friendly and capable to train workers in couple of days.

JOHANNES RIEGL JR,
Chief Marketing Officer, Riegl, Austria

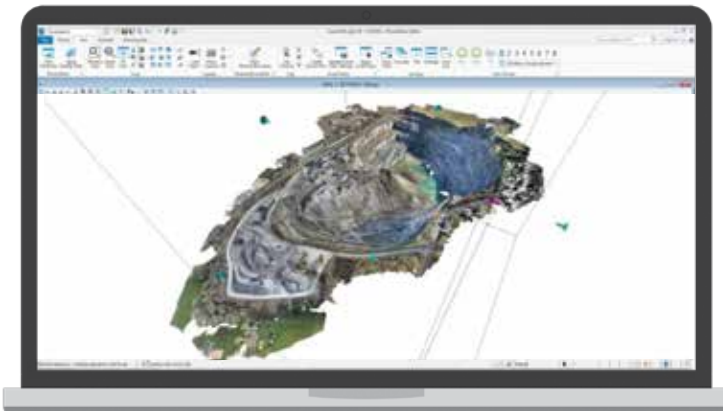## Three aspects of Reality Modeling

Connecting "Virtuality" and Reality

Capturing Context

Digital Engineering

What is reality Mesh?

| 3D SURFACE MODEL | GEO-REFERENCED | ACCURATE | REALISTIC | INTERACTIVE |

While there are a plenty of success stories in the developed world where these technologies have made an impact, there are very few examples in the developing countries. The challenge is to make them available to masses

these technologies have made an impact, there are very few examples in the developing countries. The challenge is not only to make these technologies cost-effective but to make them available to masses or workers who are mostly illiterate or less literate in the developing countries.

Hutchings thinks one of the answers lies in use of smartphones. Smartphones have the potential to reach the masses irrespective of which country they belong to. "Using smart phones you can track journey time. So, this mega data can be used to improve the way in which we design. You can also take photographs and scan. May be 10 years down the line, mobile devices are completely going to change the industry."

4. Connecting with the right users: While technological innovations have given an impetus to the construction and digital engineering world, these innovations need to be adopted by the right professionals to get appropriate results. As **Brian Nicholls, Executive Director, AAM Group, Australia,** points, "As a surveying and mapping company we understand this technology very well. But do the guys on the other side know us? I recently bought a book on BIM. In the entire book, the word GIS is mentioned only twice and the word laser scanning only once." No wonder at conferences of civil engineers they hardly talk about digital engineering. "So I think that as a mapping spatial technologist we are still not always connecting with the professions that actually we have to interact with."

Bridging the gap

This leads to the question: Is there a disconnect between the companies and the customers that they serve?

> "
> One of the challenges is definitely to democratize what I would call as the art of construction because you only can control the things that you can measure.

ANDREAS GERSTER
VP BIM/CIM and Product Design, FARO, Germany

the challenges is definitely to democratize."

Agrees **Johannes Riegl Jr, Chief Marketing Officer, Riegl, Austria,** while emphasizing that the tools must be made user friendly. "All that matters to a customer is productivity. So, we need to provide them the equipment and review the existing workflow with them. The tools must empower them to make changes to their existing workflows and speed up the process." Sometimes this is a challenging task as this takes a while to really prove that technology is worth the investment. It is also critical that the user in the field does not require a surveying degree or any specialized degree to handle these tools.

3. Cost-effective solutions: Technologies like reality mesh and digital engineering are expensive. This limits their adoption. While there are a plenty of success stories in the developed world where

REALITY MESH A SUBSET OF REALITY CAPTURE

Reality capture involves making real measurements of 3D points of an object along with things like color and texture of that object. Once the points are reality captured, surfaces or geometrical objects or CAD-based objects can be created from them. This is done on the basis of certain assumptions, for instance one can take a whole bunch of points on a wall and look at those as point cloud of a wall, or can turn that into a geometrical object of a wall, which can fill in the points with tessellation or meshing and assign values to each of those little triangles of a mesh. All these things are the same; one is the subset of the other. Thus, it can be easily said that reality mesh is a subset of reality capture, where reality capture is the true raw format of the 3D point.

What is the difference between Reality Capture and Reality Mesh?

While doing a reality capture you take high-resolution 3D point measurements, including color of larger structures. Depending on the degree of resolution, one can either look at it as a point cloud or create a mesh. A mesh creates these miniature surfaces between each of the measured points and colors them according to the protocol relating to the image that was taken. So, in effect they both are the same thing.

Useful tools

The mesh is much more usable from an observational point of view. It creates these nice close surfaces, whereas point clouds are kind of misty objects with spaces between them. Data is provided to both formats because sometimes visualization with meshing is much more appropriate than, for example, of just a 3D point cloud.

Nicholls thinks that although this disconnect majorly depends on case to case, but this trend of large disconnect mostly prevails.

Gibson points out that this trend allows and enables significant amount of collaboration to take place effectively. "The challenge we have amongst ourselves is to ensure that we have the connectivity and interoperability between our various applications because the process in terms of engineering construction is complex." Some of the big players around the world may well be having 30 or 40 different applications that this data is flowing through — it is not just about interfacing around the geospatial engineering aspects, it is going into their ERP systems, Oracle or SAP systems or project management systems — and at the moment it's very difficult for them to get a seamless flow of data. Customers care less about how you get the answer than that the answer is correct and going to help solve their problem. So, those touch points are significant and this is part of the ongoing challenge and future that we have to create."

Reality capture is the future

Fields like architecture and engineering are always evolving. So, what technology and digital platforms are allowing us to do is probably do more than we had previously done. As Hutching says, "We are all embracing technology as fast as we can. We recognize that we can do more and we can do it quicker but there are dangers to be aware of as well."

The benefits of new technological innovations outweigh the challenges. So, the industry needs to gear up and adopt the technologies as soon as possible. To be more productive, construction has to move from being a conceptual model to a constructible model, and this is where technologies like augmented reality or mixed reality will play a big role in enabling the digital engineering process.

Along with this, new building materials, such as self-healing concrete, aerogels, and nanomaterials, as well as innovative construction approaches, such as 3D printing and preassembled modules, can lower costs and speed up construction while improving quality and safety.

Fusion of the real and digital worlds provides the user with immersive virtual experience. Will this hybrid be the future of BIM? The future will only tell 🌐

Shilpi Chakravarty, Assistant Editor
shilpi@geospatialmedia.net

> "
> As a mapping-spatial technologist we are still not always connecting with the professions that actually we have to interact with.

BRIAN NICHOLLS
Executive Director, AAM Group, Australia

THREE
SHADES OF
REALITY

What is the difference between Virtual Reality,
Augmented Reality and Mixed Reality?
By Anusuya Datta

Three reality modes that are today ruling the world – virtual, augmented and mixed reality are nothing less than magic. The way these technologies are transporting humans to a virtual world, enabling them to accomplish much more than usual is a world worth exploring. While their application areas remain wide, the transformation they are bringing in the architecture, engineering and construction (AEC) industry is stupendous. Incredibly, these were the terms that few years back were mainly used in the domains of entertainment and gaming, but today are important components of the AEC industry!

So what essentially are augmented reality, virtual reality and mixed reality? Are they the same? Though often used together, and often used interchangeably, there exists some fundamental differences between virtual reality, augmented reality and mixed reality.

All three have one basic thing in common – they fundamentally alter our perception of the surrounding world, or what we are seeing and experiencing. Where they differ is in the extent to which this alteration takes place.

What is Virtual Reality?

As per Wikipedia, "Virtual reality (VR) is a computer technology that uses virtual reality headsets, sometimes in combination with physical spaces or multi-projected environments, to generate realistic images, sounds and other sensations that simulate a user's physical presence in a virtual or imaginary environment. A person using virtual reality

Trimble's DAQRI Smart Helmet integrates mixed reality applications to enable companies from architecture, engineering, construction, and operations industries see first-hand how the applications can improve team communication, data interpretation, and collaboration in their work.

equipment is able to 'look around' the artificial world, and with high quality VR move around in it and interact with virtual features or items."

VR replaces your whole worldview with a simulation in some way or another. Usually, the effect is created by VR headsets that consist of head-mounted goggles with a screen in front of the eyes. Facebook's Oculus, Samsung's Gear or Google Cardboard are all VR devices — they involve looking into a headset with lenses that look at a virtual screen. In the simplest of terms, the virtual screen has a stereoscopic view which the eye adjusts to see as a 3D image.

Virtual reality replaces your world with a virtual one — the headset tracks where you are looking and reflects those movements in the virtual display. VR makes you completely immersed in another world and blocks everything else.

In an interesting case, a team of researchers (Image 1, Page 22) from the European Space Agency at its mission control center in Darmstadt, Germany, are investigating new concepts for controlling rovers on a planet and satellites in orbit. One approach is to assess the latest developments in augmented and virtual reality and how they can be applied to the stringent operational and safety requirements of spaceflight, both robotic and human. "In one case, we are looking into emerging technologies such as virtual and augmented reality, working together with colleagues from ESA's European Astronaut Centre in Cologne," says **Mehran Sarkarati, Head of Applications and Special Projects Section, ESA**. The team is developing prototypes in astronaut operations and training while identifying scenarios for interactive spacecraft and robotic control.

The Esri CityEngine released last year allows urban planners, architects, and GIS professionals to quickly create VR experiences on mobile devices. These experiences can be viewed in a free ArcGIS 360 VR app that is available from Esri Labs.

What is Augmented Reality?

Wikipedia description goes: "Augmented reality (AR) is a live direct or indirect view of a physical, real-world environment whose elements are 'augmented' by computer-generated or extracted real-world sensory input such as sound, video, graphics or GPS data. It is related to a more general concept called computer-mediated reality, in which a view of reality is modified (possibly even diminished rather than augmented) by a computer."

Simply speaking, AR supplements your world with digital objects of any sort. Google Glass which is an AR heads, overlays data, 3D objects and video into your vision in some way or another. All this while continuing to let you see the world around you. Airline pilot helmets that display data within the pilot's view as they fly are AR headsets.

Then there are Spatial Augmented Reality (SAR) systems, which are capable of augmenting real-world objects and scenes without the use of special displays such as monitors or head mounted displays. In SAR, digital projectors are used to overlay graphical information onto physical objects, and therefore the display is not linked to the user individually. Because the displays are not associated with each user, SAR allows for collaboration between users.

Reality-altering terminology gets a little confusing at times as these different technologies definitely overlap. Augmented reality and mixed reality, specifically, share a lot of space and similar use-cases

Image 1: ESA's data systems engineer Steffen Bamfaste demonstrates how astronauts might train in future to extinguish a fire inside a lunar habitat.

Courtesy: ESA

Image 2: At Oakland Medical Center, users simply scan one of the QR codes with a smartphone or tablet computer and instantly immerse themselves in the up-to-date, as-built 3D BIM model or 3D laser scan of that space.

A very interesting example of AR is the Oakland Medical Center Replacement Project (Image 2). To help field personnel quickly access 3D BIM models and other project documents, general contractor McCarthy Building Companies placed hundreds of QR codes throughout the Oakland Medical Center Replacement Project complex. Users simply scan one of the QR codes with a smartphone or tablet computer and instantly immerse themselves in the up-to-date, as-built 3D BIM model or 3D laser scan of that space.

Augmented Reality is also transforming the world of education, where content may be accessed by scanning or viewing an image with a mobile device.

What is Mixed Reality?

According to Wikipedia, "Mixed reality (MR), sometimes referred to as hybrid reality, is the merging of real and virtual worlds to produce new environments and visualizations where physical and digital objects co-exist and interact in real time."

Thus, MR integrates digital objects into your world making it look as if they are really there. It is somewhere between AR and VR. Mixed reality takes place not only in the physical or the virtual world, but is a mix of actual reality and virtual reality, encompassing both augmented reality and augmented reality via immersive technology.

MR produces new environments and visualizations where physical and digital objects co-exist and interact in real time. The best example of MR is Microsoft Hololens.

Another interesting example of MR is Trimble's DAQRI Smart Helmet (Image on Page 21) that integrates mixed reality applications to enable companies from architecture, engineering, construction, and operations industries see first-hand how the applications can improve team communication, data interpretation, and collaboration in their work.

The first fully immersive mixed reality system was the Virtual Fixtures platform developed at US Air Force, Armstrong Labs in 1992 to enable human users to control robots in real-world environments that included real physical objects and 3D virtual overlays called fixtures.

Microsoft further escalated the mixed reality battle with the launch of its 'Windows Mixed Reality'. Windows Mixed Reality is available in the Windows 10 Fall Creators Update, and headsets are now available to buy. While Microsoft has called its product 'Mixed Reality', they are only capable of virtual reality experiences right now. Microsoft has picked the Windows Mixed Reality name because it believes the experiences of virtual reality and augmented reality (HoloLens) will eventually blend together. While the existing Windows Mixed Reality headsets don't offer any augmented reality experiences or a passthrough mode like the Gear VR, more headsets will arrive in the future that are more capable.

Of all the realities discussed here, mixed reality seems like the furthest from fruition.

Reality-altering terminology gets a little confusing at times as these different technologies definitely overlap. Augmented reality and mixed reality, specifically, share a lot of space and similar use-cases.

While MR devices can be described as AR, MR offers a more specific definition. It can be considered a sub-category of advanced AR, as MR augments the reality one sees but in a far deeper and integrated fashion. While AR provides an added layer on top of reality that one sees, MR mixes everything more seamlessly and provides a greater amount of user interaction.

Anusuya Datta, Executive Editor
anusuya@geospatialmedia.net

esri™ India
THE SCIENCE OF WHERE™

UC Esri India
User Conference

The Leela Ambience Convention Hotel, Delhi
13-14 DECEMBER, 2017

THE SCIENCE OF WHERE

BEGINS HERE

Where the **brightest minds** and **top leaders** in GIS industry connect

Register Today

esriindia.com/indiauc   +91 120 428 5935

Don't miss the pre-conference seminars on 12th December 2017.

WHAT IS REALITY CAPTURE?

For centuries, builders, architects, and engineers followed the traditional method of capturing site conditions — generally involving a level, a tape measure, a theodolite to gauge horizontal and vertical angles, and a lot of number crunching. It's a tedious, time-consuming process for surveyors to collect data point by point. The outcome is documentation that's often incomplete or inaccurate.

Why is this a problem? Growing numbers of public buildings and infrastructure around the world are aging and in danger of failing. Many were built before CAD, using traditional survey methods, and it's difficult to manually cross-check old paper blueprints with real-world site conditions to get repair and rebuilding efforts underway.

Reality capture — the process of scanning an object, building, or site and producing a digital model representation — allows today's builders to capture site data quickly and more accurately than ever before and connect it directly to the digital design process. The result is a comprehensive 3D model based on millions of data points mapping the entire site, whether it's a building renovation or an infrastructure project, often including a look at the systems that function below the surface.

Here is an introduction to the tools and techniques of reality capture, showing how this technology was used to protect the aging infrastructure at Glen Canyon Dam.

Thousands of dams were constructed all over the globe after World War II, before the dawn of computer-aided design (CAD). Built without digital models, the task of maintaining and protecting these designated critical-infrastructure assets-and the people they serve with water and power-is difficult and costly. But it's becoming more urgent in a era of escalating climate change.

Enter reallty capture: Through technology, civil engineers can collect highly detailed data, create 3D models, and use them to repair and maintain dams for hundreds of years.

Detailed Data + **3D Model** = **Pepair & Maintain**
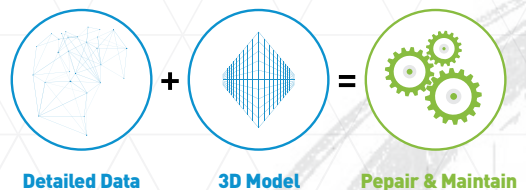
REALITY CAPTURE TECHNOLOGY

To create a 3D model of the Glen Canyon Dam near page, Arizona, the Bureau of Reclamation collected data about the dam's condition using airborne photogrammetry from a medevac helicopter, drone-based photogrammetry inside the hydropower plant, terrestrial laser scanning of the dam and canyon walls, and multibeam side-scan sonar of the dam's underwater surfaces from a remotely operated vehicle (ROV)

PHOTOGRAMMETRY

A photographer using a professional-grade digital camera (or even a smartphone) take overlapping photographs of an object, space, or landscape that can be stitched together into a 3D digital model.

As the laser pulsates, it creates a point cloud-millions of photorealistic dots, much like pointillism in painting-and compiles an accurate picture of an object or landscape to aid in the design process

LASER SCANNING, OR LIDAR

This technology captures measurement data using a laser that pulses up to a million times per second.

SIDE-SCAN SONAR

Sonar uses a device that emits pulses of sound in a conical or fan-shaped pattern to scan for underwater surfaces. The data is recorded in slices to form an image for the digital model.

This article originally appeared on Autodesk's Redshift, a site dedicated to inspiring designers, engineers, builders, and makers.
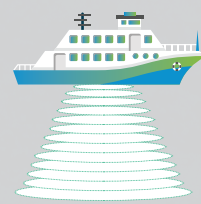
DAMS AROUND THE WORLD

There are more than 800,000 dams (58,519 of them large dams) on the planet. More that have operated for more than 50 years and many need maintenance and repair. Here's snapshot of five large dams on four continents that could be better maintained with help from reality capture technology.

MAUVOISIN DAM
Dranse de Bagnes Rive near Valais, Switzerland

Height	Reservoir capacity	Completed
820 ft.	171,500 acre-ft	1957

JINPING-DAM
Yalong River in Liangshan, China

Height	Reservoir capacity	Completed
1,001 ft.	6.29 million acre-ft	2013

BHAKRA DAM
Sutlej River in Bilaspur, India

Height	Reservoir capacity	Completed
741 ft.	7.57 million acre-ft	1963

CAHORA BASSA DAM
Zambezi River in Tete, Mozambique

Height	Reservoir capacity	Completed
561 ft.	45.2 million acre-ft	1974

GLEN CANYON DAM
Colorado River near Page, Arizona, US

Height	Reservoir capacity	Completed
710 ft.	27 million acre-ft	1966
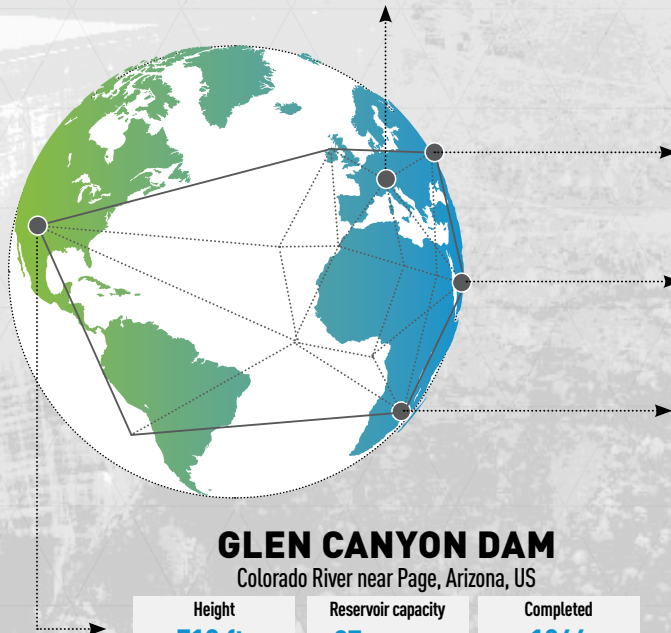
Accurate Measurements + **GPS data** + **images** = **3D model**

Once engineers capture accurate measurement, GPS data, and images, they can use the information to create a 3D model. Then they can merge the model with real-time performance data, which becomes an invaluable tool for dam operators to manage facilities, identify issues, and mitigate risks.

Infographic: Subhash Kumar

Exploring the art of the Possible

BIM plus the power of Cloud-enabled technology fosters innovative projects.
By Tabby Ellett

Do you find yourself saying things would be better "if only..."? You could have a better design, a shorter schedule, or be more profitable, if only you could have X or if only Y existed. It's time to start removing "if only" from your vocabulary; all of your wishes are possible now. Autodesk solutions help make the art of the possible a reality.

Are you and your firm still designing and building the way you've always been doing things? It's time to consider moving away from old workflows and processes unnecessary that can result in lost time and profits and increased project risk. Design isn't a linear process; it requires the input of multiple stakeholders consecutively and sometimes with little notice. The industry is trending towards collaborative design as a best practice, even instituting contracting methods to force collaboration, and away from working in silos. Technology continues to advance at an increasing pace, with the aim to assist designers, stakeholders, contractors, etc. in overcoming barriers to collaboration, minimizing schedule issues, and improving profitability. It is innovative and new, but it's also what makes sense for improving project design, construction, and management. Today's technology solutions are not your dad's CAD. It's not even your older sister's CAD anymore.

Capture

In the last few years, the barrier to entry for Reality Capture has become almost non-existent. As of January 2017, over 670,000 drones have been registered with the FAA. Previously, it cost $40,000 to have one aerial site survey done. Now, firms can buy a drone and survey software for $1.5k and use it for the lifetime of the drone, not just once on one site. Laser scanners now cost only a fraction of what they did ten years ago and weigh a fraction of what they did. For example, Leica's newBLK360costs only $16,000 and weighs 2 lb. compared to the Leica model from 2007 which cost $80,000 and weighed24 lb. Firms and individuals can more easily implement one or multiple of these photogrammetry and LiDAR devices into their practice and don't need to rely solely on survey firms and governmental departments anymore. Sites can be captured, easily, many times during the project and after the handover.

Owners in the driver's seat: Strathcona County

In response to their consultants' lack of experience and understanding of point cloud functionality, Strathcona County adopted the reality capture workflow internally. They are working with and educating consultants on

A rendering of the Portland Airport's future Concourse E expansion (to the right), paralleling the parking structure.

Photo credit: Portland of Portland

new projects on how to use this Cloud data to their mutual benefit.

Located near Edmonton in Alberta, Canada, surveying becomes a challenge in Strathcona County during the snowy months of the year. To mitigate the number of times they'd need to visit a site, the county started referring to the data they captured. They then moved into using scanning and ReCap for multiple purposes, such as determining the height of power lines, calculating excavation necessary to accommodate double-decker buses in a facility built for articulated buses, and identifying low spots on a skating rink. The consultants were able to bring the point clouds into Autodesk modeling software to perform measurements and seeing there was more capacity for added value from the workflow, the county added photogrammetry to their scans.

The county is currently working on a major roadway upgrade for several

intersections along Sherwood Drive. As there are many businesses along the route being upgraded, public engagement is a crucial component of the project. To that end, the county took a very detailed scan with the intent to use if for visualization in addition to engineering design. The scans of the businesses were imported into the InfraWorks model, including signage and storefronts. With local landmarks and real life building facades, business owners can easily figure out where they are and determine the impact of the project on their property. Several of the businesses will be more heavily impacted due to road closures and lane expansions. The county was able to visually show the impact of changes like adding a road where there is currently a drive-through for a business.

The scan also allowed for feature extraction of the power poles down the roadway. The county had access to the data of what exactly is already there, without having to manually survey, which would have taken exponentially more time. And, data of existing buried public utilities could be added within the InfraWorks model.

The county has plans to incorporate their lessons learned and expand the workflow on future projects. A bridge rehab project is in the pipeline and the county is excited to see what they can do with reality capture on a project like that.

Short schedule, small budget: Bogerud Fitness Park

The city of Oslo plans to build a new, 2,300-square-meter outdoor fitness park in the city's Bogerud neighborhood. Instead of a prefab equipment and plans, the city asked COWI AS to do a feasibility study and provide preliminary costs for a custom park design that would appeal to the residents of the neighborhood, as well as be environmentally sustainable.

The project and budget were small limiting resources to just one staff. The design was simplified by taking photogrammetry and LiDAR capture and bringing the project into ReCap. In mere hours, AutoCAD Civil3D and InfraWorks were used to create a model of the area's existing conditions. Using this existing context, a 3D model was created of the proposed design.

In less than a week, COWI AS was able to deliver the project — including cost estimates, earthwork calculations, and high-quality project visualizations. This project was possible in the limited timing and budget allocated, only due to technology, reality capture workflows, and in-context visualization.

Model
Once the existing conditions have been brought into Autodesk software, such as Recap360, it can then be brought into complex modeling software. Complex modeling software, such as InfraWorks, will open your possibilities to the unlimited. Not only can it process massive amounts of data, it can quickly create unlimited design iterations through generative design. Use the Cloud to power this generative process to produce results in moments, rather than hours or days. Cloud-based modeling allows for quick feedback from project stakeholders.

Big Data: Intercity Sørli and Brummunddal
Technology solutions are crucial for the success of projects small and large; however, it's especially apparent in large infrastructure projects. Rambøll Sweco ANS leveraged Autodesk technology to make a project to lay 75 km of double track between Sørli and Brummunddal successful. The large 3D model required a powerful software solution that could aggregate huge amounts of disparate data and at the same time present this

Complex modeling software, such as InfraWorks, will open your possibilities to the unlimited. Not only can it process massive amounts of data, it can quickly create unlimited design iterations through generative design

Reality capture is not just for project initiation, it is a useful tool during the construction phase of the project as well

data and the proposed design alternatives in an easy to view and understable format.

Using InfraWorks, Rambøll optimized new, existing, and abandoned routes for economic and environmental gains. They also designed three separate corridor alternatives through the city of Hamar. The model assisted the team in predictive analysis of the alternatives. The model could be influenced to answer questions such as "What if I make this change?"; "How long will it take if...?"; "How much earthworks need to be removed?"; or "What if I have to fix...?", informing the stakeholders of the potential cost of each alternative.

Planning for flying cars: Mobility simulation

Densification of the population into urban environments, rapid adoption of ridesharing, and development of autonomous vehicles (for ground and air) cannot be ignored. While we aren't as far from the age of the Jetson's as we once were, the future is here and we have to plan and design for it.

Transportation projects are often lengthy in schedule from start to completion, which means that they need to be designed for future needs, rather than current needs, maybe even for flying cars in the near future. No matter the type of transport, a mobility simulator, such as Mobilityb Simulator for InfraWorks, can show how people in various types of transport interact within a fully multimodal analysis.

An airport is a prime example of multiple modes of modality intersecting, from transit getting to the airport to moving around inside the airport. Planning efficient routes that consider the type of traffic flow specific to an airport and moving passengers into and through the building is a challenge. InfraWorks' Mobility Simulator can address flow of traffic in the arrivals and departures area, including handicap access, valet parking, express trains into the terminal buildings, and passenger unloading and loading of buses. It can also help visualize crowd control and queuing in areas such as the check-in counters and security and baggage screening.

The City of Oslo plans to build a new, 2,300-square-meter outdoor fitness park in the city's Bogerud neighbourhood.

Project collaboration in the Cloud: Portland International Airport

Collaboration is the key to any project's success then and now. Autodesk has focused on creating technology that enhances collaboration through Cloud access. BIM 360 Team, formerly A360 Team, is a single source for project communication, collaboration, and design, instantly up-to-date for all project stakeholders. The Cloud allows anytime, anywhere access. For example, urgent questions can be reviewed and answered without having to wait for team members to return to the office and look at plans located on a local server.

The Portland International Airport (PDX) Terminal Balancing project is being delivered as a collaborative design partnership between Fentress Architects, headquartered in Denver, Colorado and Hennebery Eddy Architects based out of Portland, Oregon. Fentress and Hennebery Eddy worked together as one single design team, enabled by BIM360 Team, to best utilize the strengths of both firms to deliver a complex public infrastructure project for the Portland International Airport.

Hennebery Eddy Architects and Fentress Architects used BIM360 Team and Collaboration for Revit to centralize their two design teams in the Cloud. Communication, design reviews, file sharing, version history tracking and model coordination was all done using BIM360, eliminating the need to physically co-locate the two offices.

Construction goes virtual: NDOT Bridge

Reality capture is not just for project initiation, it is a useful tool during the construction phase of the project as well. As drones can be flown on an on-demand basis with just a UAV pilot's license, instead of contracting a surveyor to do occasionally site surveys through construction, construction progress can be monitored on a much more finite timeline, from daily to hourly. Utilizing UAV data or a laser scan can remove the need to have personnel capturing data or inspecting hazardous areas. You can capture conditions from a safe distance.

COWI was able to finish the Bogerud fitness park in limited time and budget only due to technology, reality capture workflows, and in-context visualization.

The Nevada Department of Transportation (NDOT), in conjunction with Autodesk, is using a UAV to capture site condition and construction progress. The project involves a bridge being constructed over the existing terrain and then excavating the dirt from underneath the bridge. Reality capture is helping NDOT monitor construction progress of the bridge and the greater road project, as well as decreasing risk on the construction site. Reality capture allows you to easily and quickly capture changing site conditions through comparison modeling and creating a visual log of construction progress.

Manage

Reality capture can also aid in delivering high-value as-built models/verifications at project handover. Redlines on a blueprint aren't as valuable as a dynamically updated model. In other words, current conditions from a capture always trumps as-builts that should be called as-designed. Reality capture is a great tool for documenting construction and improve what is delivered to the owner. Not only do you get visual information, but it complements the model, with more accurate spacing and dimensions of the installation throughout the process and after handover.

Reality capture is also a great way to monitor a site or facility against the original capture. The scanning process, with either LiDAR or photogrammetry, makes it easy to take continual scans for comparison purposes, making it easier to monitor change. Additionally, it can decrease on-site risk through a workflow that mitigates personnel safety. Instead of taking in-person measurements, a UAV or LiDAR can capture the measurements, removing the risk factors.

The confluence of capture model manage: Glen Canyon Dam

The US recently had a taste of what the catastrophic effects would be should a National Critical Infrastructure (NCI) site fail with Oroville Dam crisis. Autodesk is working with the Bureau of Reclamation to create a process of capturing the existing conditions, making a model, and monitoring

and managing its assets. Glen Canyon Dam, located upriver from Hoover Dam and of the same dimensions, is a categorized as National Critical Infrastructure. It manages the flow of the River into Lake Mead, which in turn is what Hoover Dam uses to create hydroelectric power. Lake Mead is extremely low, meaning that Hoover is almost at the point where it can't generate power which has serious far-reaching effects, like on providing power for Las Vegas.

Glen Canyon Dam was designed in the 1950s, before the age of CAD not to mention BIM. It was the last of the major dams that the Bureau built along the Colorado River. While the Bureau maintains the facility, the Department of Homeland Security manages it and all other NCI sites.

Autodesk and the Bureau are using the capture, model, manage methodology to create a dynamic model the Bureau can use to monitor the ever-changing conditions at the Dam and project outcomes of different potential events. In the interior of the dam, a UAV — drone— was flown and captured the 8 hydro electric generators. This capture was imported into Revit and overlaid on the original blueprints.

Since drones weren't allowed to be flown outside the Dam, a helicopter was used to capture the exterior of the Dam through photogrammetry. SONAR was used to capture underwater conditions.

The capture of the Dam allowed us to create a model and the model allows us to do anything, only limited by our imagination. Based on visualization, simulation, and analysis (VSA) tools in the Autodesk portfolio, in the words of an Autodesk engineer, we could even model a scenario where Godzilla visits the Dam.

The model is intended to aid in management of the Dam. It can contribute to:

- O&M
- Security /SA (situational awareness)
- Facilities Management
- Education/Outreach
- Change Detection

Change detection was an unexpected benefit of the capture, model, manage methodology. The Bureau can capture the Dam and compare the output with the initial capture and use the changes between the two to monitor what is going on with the Dam like if things are moving, expanding, or contracting. InfraWorks can be used as Information Management System an (IMS) to monitor this process over time.

Capture, model, manage, and… (insert your possibility here)

While the capture, model, manage workflows are still being adopted, technology continues to evolve. Current technology trends focus on improving efficiency, predictability, and resiliency aligns with owners awarding bids based on best value rather than best price.

Soon, owners will expect what is currently considered innovative as a baseline requirement for their projects. So, what will be innovative in the future? It may not be flying cars or hover boards, but it will involve the Cloud and the interconnectedness of the Internet of Things (IoT). We'll see more telemetry and sensors on dams, bridges, and roads, resulting in smart assets. Smart assets are possible now. Have you incorporated the IoT or any other workflows that are in the art of the possible?

Courtesy: Autodesk
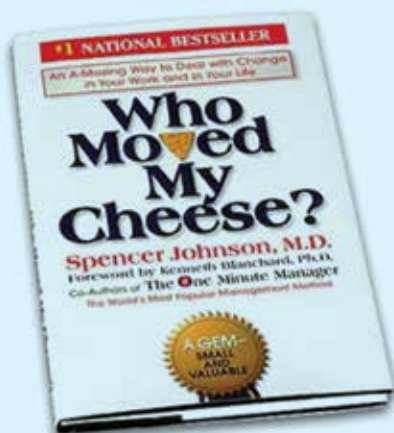*Infrastructure Reimagined blog*

Who Moved My Base?

It is well known that having your own base station near your job site provides you with faster, more accurate, more reliable and less expensive solutions. If you don't know the accurate position of your base, our DPOS service will find it. Read details in the following pages.

After you start your base, If during your survey somehow your base is moved, all your rover points will be inaccurate to the amount of the base movement. But...

...But Don't Worry, Be Happy:

We will let you know instantly during your survey if your base has moved. We use:

1. Inclinometer which shows the tilt value.

2. Accelerometer which shows motion and shocks.

3. We calculate displacement. This value is accurate to 2 cm.

By the way, a must read book for adult professionals

#1 NATIONAL BESTSELLER
An A-Mazing Way to Deal with Change in Your Work and in Your Life

Who Moved My Cheese?

Spencer Johnson, M.D.
Foreword by Kenneth Blanchard, Ph.D.
Co-Authors of The One Minute Manager
The World's Most Popular Management Method

A GEM—SMALL AND VALUABLE

Get to know J-Tip
Integrated magnetic locator in TRIUMPH-LS

No need to carry heavy magnetic locators any more. The J-Tip magnetic sensor replaces the tip on the bottom of your rover rod/monopod. Its advanced magnetic sensor send 100 Hz magnetic values to the TRIUMPH-LS via Bluetooth. TRIUMPH-LS scans the field and plots the 2D, 3D and time view of magnetic characteristics. It also shows the shapes and the centres of the objects under the ground and guides you to it.
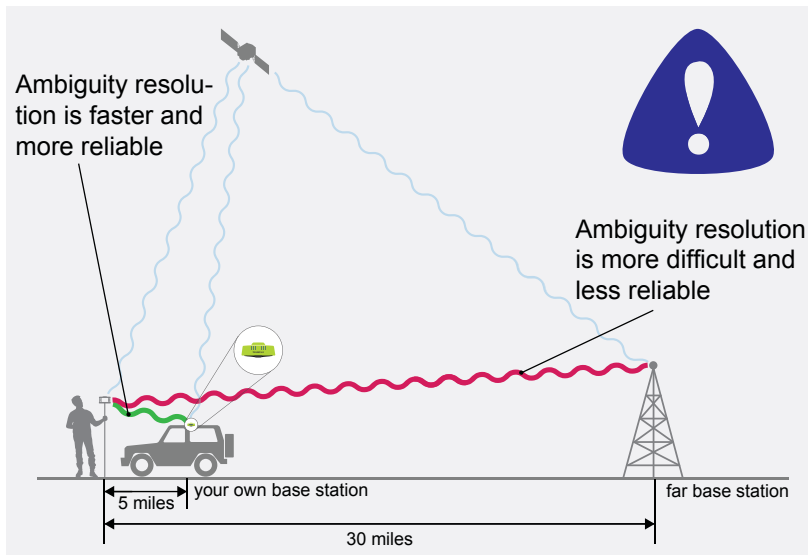
PATENTS PENDING

J-Tip advantages:

• J-Tip does not have "null" points around the peak and will not produce false alarms.

• J-Tip is fully automatic for all levels of magnets. There is even no "Gain" button to adjust.

• J-Tip senses the mag values in all directions. You don't need to orient it differently in different searches.

• J-Tip gives a 2D and 3D view of the field condition when you have RTK and will guide you to the object. You can actually see the shape of buried object.

• J-Tip, In Time View, shows positive and negative mag values of the last 100 seconds and the Min and the Max since Start.

• J-Tip shows the instantaneous magnetic vector in horizontal and vertical directions.

• J-Tip works as a remote control for the TRIUMPH-LS

• J-Tip weighs 120 grams and replaces the standard pole tip. In balance, it weighs almost nothing.

• The built in camera of the TRIUMPH-LS documents the evidence after digging.

• And... you don't need to carry another bulky device.

Advantages of your own base station...

Ambiguity resolution is faster and more reliable

Ambiguity resolution is more difficult and less reliable

5 miles

your own base station

far base station

30 miles

1. Shorter baselines provide significantly better **reliability** because the ambiguities are much easier to resolve and the correct ambiguity solution has an obvious contrast.

5 miles

your own base station

far base station

30 miles
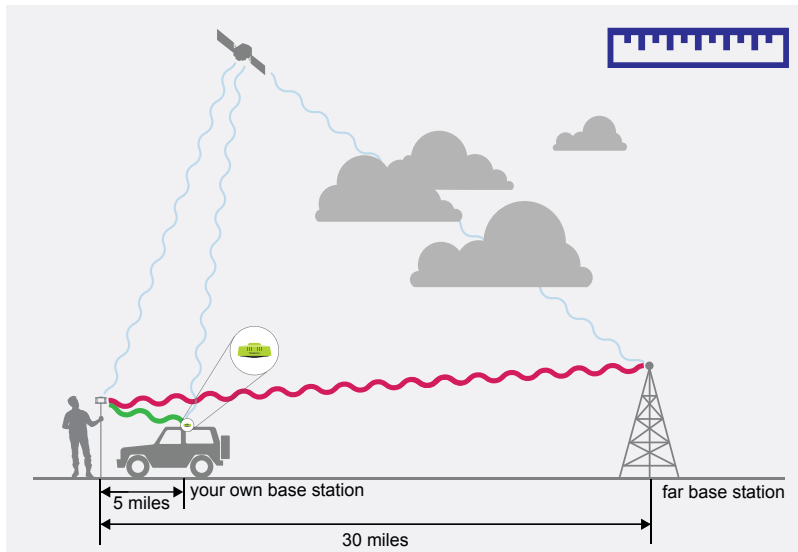
2. Shorter baseline has better **accuracy** because most of errors (like atmospheric and tropospheric effects) are common and cancel.

5 miles
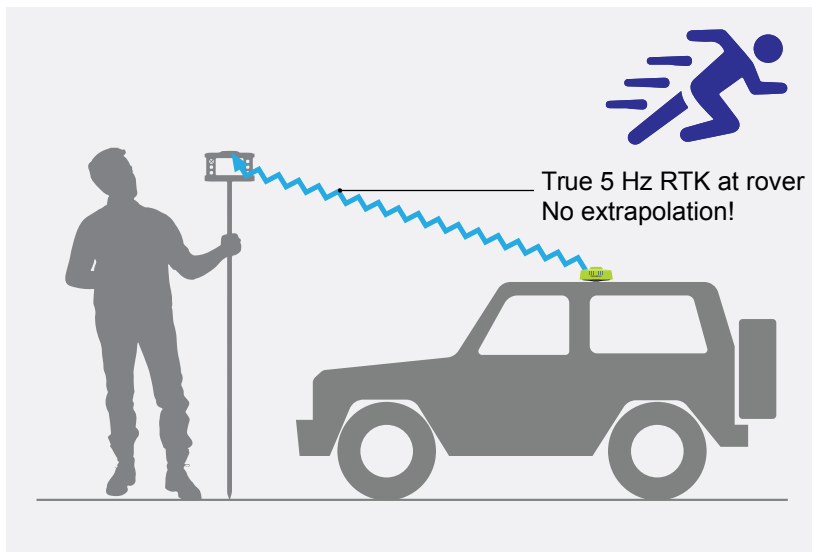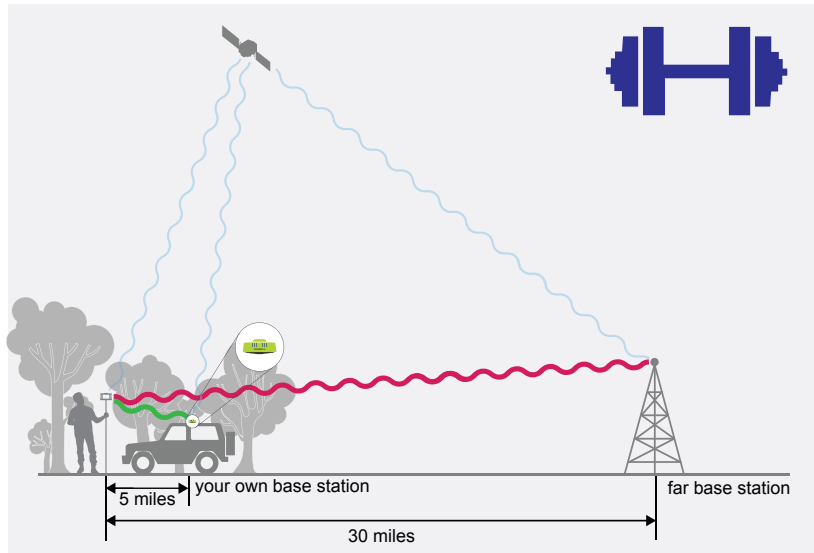
your own base station

far base station

30 miles
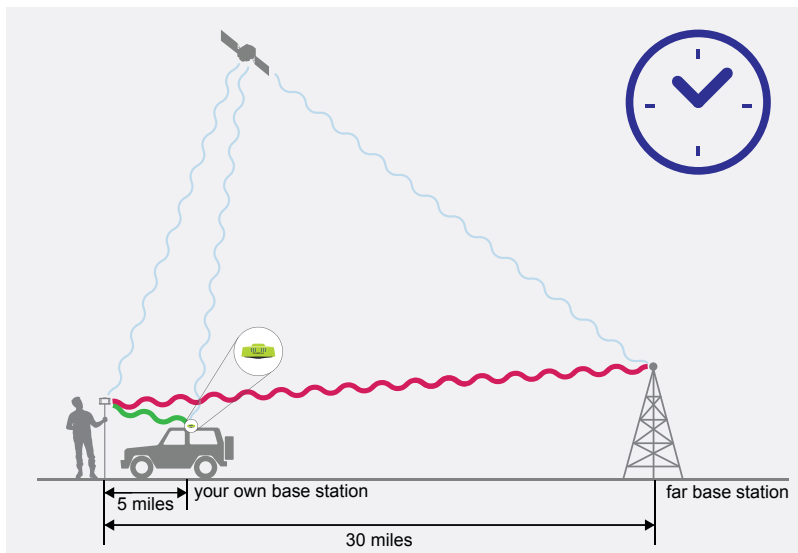
3. Shorter baseline ambiguities are resolved much **faster**. In longer baselines, incorrect ambiguities may pose as being correct in the statistical evaluations and it takes longer to isolate incorrect ambiguities.

4. Shorter baselines make it feasible to work in **difficult** areas (under tree canopy and in urban environments) because ambiguities have better contrast and are easier to resolve.

5. **Beast Mode RTK** is available only via our TRIUMPH-2 and TRIUMPH-1M base station.   It makes ambiguity resolution up to 5 times faster because base station transmits base data 5 times per second.   5-Hz Beast Mode RTK is totally different from the up to 100-Hz RTK that is done by extrapolating the same 1-Hz data 100 times per second AFTER the ambiguities are fixed. This extrapolation technique does not improve the ambiguity resolution speed and is mainly used in applications like machine control after the ambiguities are fixed.

5 miles | your own base station | far base station

30 miles

True 5 Hz RTK at rover
No extrapolation!

6. In addition to savings due to speed and reliability, it saves you RTN and communication charges. A complete system, Base + Rover + Radio + Controller & Controller Software, starts at $19,990. 0% financing available ($1,537.69 per month for 13 months) to active license US Professional Land Surveyors (PLS). Extended finance terms also available, contact sales@ javad.com for details.

...and ensure that your base has not moved

To setup for base movement alert, go to base rover setup screen and click on the left side of the screen

You can set up threshold limits for acceler-ometer, inclinometer (tilt) and displacement values to create alert when these thresholds are exceeded..

Set Acceleration limit here. The units are in milliG (mG). G is acceleration in free fall. "Off" means ignore this sensor.
Our default is 5 mG

Set the tilt threshold here. Units are in degree.
"Off" means ignore tilt.
Our default is 5 degrees.

...or be alerted immediately if it did.

Set the displacement threshold here. "Off" means ignore displacement.
Our default is 5 cm.
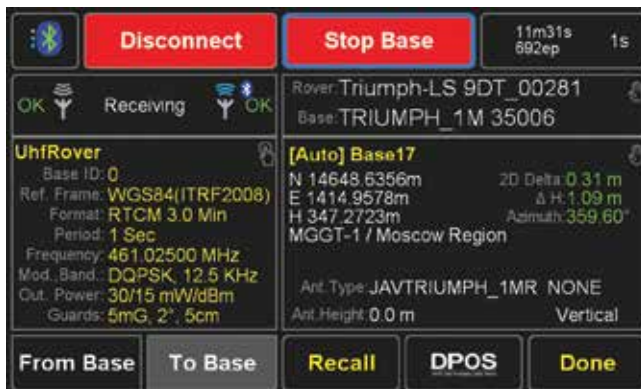
Click the "Start Base". it will change to "Stop base."
RTK corrections as well as motion values will be transmitted to the rover.
Maximum values of the motion parameters will be kept at all time.
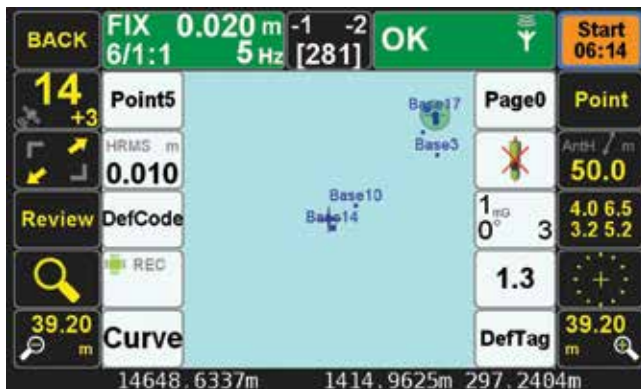
Maximum values of the three sensors can be shown in a white box in the action screen. Top left is the acceleration in milliG, bottom left is tilt and bottom right is displacement in centimeter.

If any of the threshold values exceeds, a pop up will alert you and shows the maximum value of the sensors since you started the base. The bottom number is time since the threshold(s) exceeded.
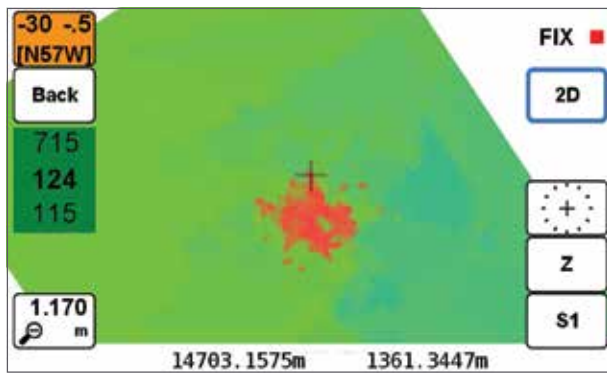
2D magnetic view of the field

Time view of magnetic variations

Unlike conventional magnetic detectors which sense magnetic values only in one direction, J-Tip has three dimensional magnetic sensors. You can view magnetic values in **XY** (horizontal), **Z** (vertical), and **XYZ** (combined) directions.

In addition to the audio notifications, J-Tip shows magnetic values in "**Time View**" (always), and in "**Spatial Views**" (**Mag**, **2D**, and **3D** views) when you have RTK solutions.

When you have fixed RTK, hold the monopod vertical (within 5 degrees) to tag mag values with their coordinates. J-Tip scans the area 100 times per second and stores the highest mag values and shows them in a large grid. In Spatial Views, the **graphs are centered on the cell with the highest**
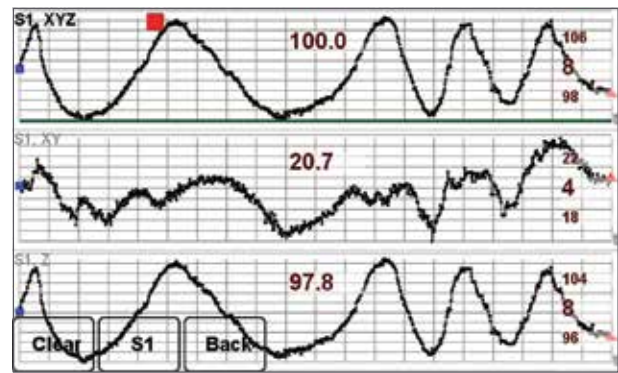
mag value. Only points that fit in the grid will be shown. The number of such points is shown above the progress bar. The "Clear" button restarts the process.

In Mag mode, pole tilts are corrected automatically and RTK is set to extrapolation mode.

The calculated coordinates of the object is shown in the bottom of the Mag screen.

Time graphs (above) show the magnetic values of the selected sensors in Z, XY and XYZ directions during the past 100 seconds. It also shows the Min and Max values since the Start/Rest. Click on any of the three graph component to expand it.
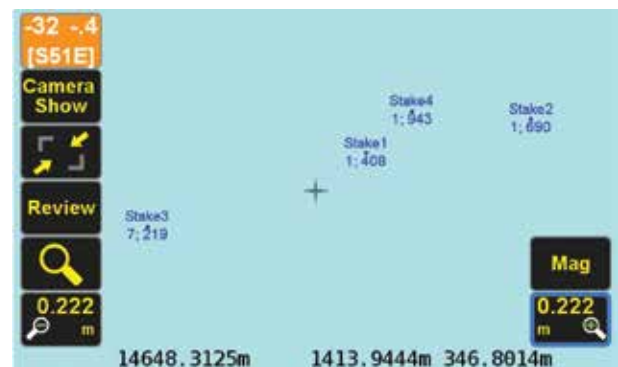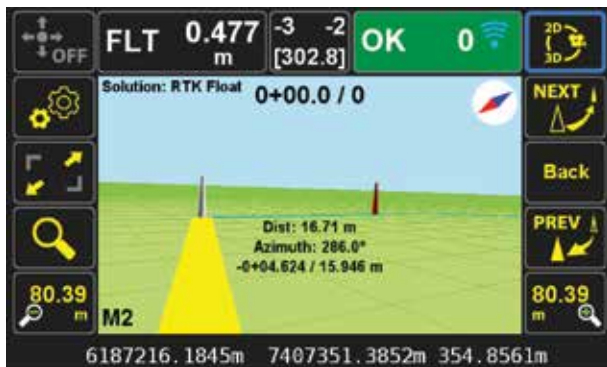
When you scan a large area, you can save all possible peak points, view them on the map and select the point with the highest peak to dig.

When you save a point, you can also save all the raw Mag sensor data for future view and research. We also plan to give you the ability to share that data with us by transferring it directly to our server for analysis and improvement.

We have not only integrated a sophisticated magnetic locator in the TRIUMPH-LS, but we have also streamlined the whole process. First the "Stakeout" screen will guide you toward the target.
Then the "Mag" screen locates your underground target and gives you its estimate of the coordinates of the underground target and a button to save it "as staked".
And finally in the "Collect" screen you can survey the target point which you have dug up and exposed. This is also the time to use the built in camera of the TRIUMPH-LS to photograph and fully document the evidence which you have recovered.

TRIUMPH-1M

$8,990

864 channel chip, equipped with the internal 4G/LTE/3G card, easy accessible microSD and microSIM cards, includes "Lift & Tilt" technology.

TRIUMPH-2

L1 $1,990

L1/L2 $3,490

with RTK $4,990

Total 216 channels: all-in-view (GPS L1/L2, GLONASS L1/L2, SBAS L1) integrated receiver.

The one and the only Digital Radio Transceiver in the world!

Unique adaptive digital signal processing, which has benefits: the full UHF frequency range and all channel bandwidths worldwide • the best sensitivity, dynamic range, and the highest radio link data throughput • embedded interference scanner and analyzer • compatibility with another protocols. Cable free Bluetooth connectivity with GNSS receivers and Internet RTN/VRS access via embedded LAN, Wi-Fi, and 3.5G

And all this with competitive prices!

HPT435BT/HPT135BT/HPT225BT*

$2,710

35 W UHF/VHF Transceiver

HPT404BT/HPT104BT/HPT204BT*

$1,640

4 W UHF/VHF Transceiver

HPT401BT/HPT101BT/HPT201BT*

$2,040

1 W UHF/VHF with internal battery

L-Band/Beacon*

$1,550

Receivers for multiple applications

JLink 3G LTE BAT*

$2,735

Web-interface Wi-Fi, Ethernet, 3.5 G, UHF/VHF/FH915, internal battery

OEM Solutions

$840

902-928, 360-470, 225-255, 138-174 MHz

*Power, data cables and antenna are included.

Back

www.javad.com

BUILDING
WITH DRONES

Drones can quickly and easily perform an inspection of a job site in lesser time and at a cheaper cost than ever before.
By Sanskriti Shukla

Construction sites around the world depend on inspections and surveys to obtain a comprehensive look of a construction progress, and to ensure that strict safety standards are being met in the process. With upcoming drone technology, operators can perform inspections in a cost-effective and efficient ways, while also keeping employees away from dangerous environments.

Information collected by a drone provides users with an opportunity to view a site in real time as it helps manage resources and keeps projects on schedule. This makes it easier for different parties to work together and collaborate to improve decision making.

Cutting cost and improving safety

Before the advent of drone technology, gathering aerial data and imagery was a tough and expensive task in comparison to traditional on-foot or manned aerial vehicle methods. Now, drones can quickly and easily perform an inspection of a job site in lesser time and at a cheaper cost than ever before. This saves time wasted on inspections. Operators can maximize efficiencies and review projects without disrupting work, while preventing their men from risks at sites and keeping them safe.

"People ask for return on investment. And they can see the benefits of using drones. It's two or three times cheaper than using terrestrial products for the same work," **says Matthew Wade, Marketing Director, senseFly**.

With pre-programmed flight paths that can be repeated on a daily basis, operators can view real-time imagery of projects as they are built to better monitor sites, optimize efficiencies, and quickly identify problems before they develop.

Operators through drones can record conditions of a job site from beginning to end

Ease of operations

It has already been established that drones are an effective tool for surveying and inspection that can help operators record conditions of a job site from beginning to end. The amount of time spent collecting data can be cut in half using a drone, and the information collected can be generated into geo-referenced digital images. A quick drone survey can benefit every stage of the construction process.

Before construction begins, a drone can fly over a site to gather data and 3D maps of an area, which helps in planning. Once construction starts, daily or weekly autonomous drone flights can monitor the different stages of a build and help operators better manage their resources. At the end of a build, the images of the final product can
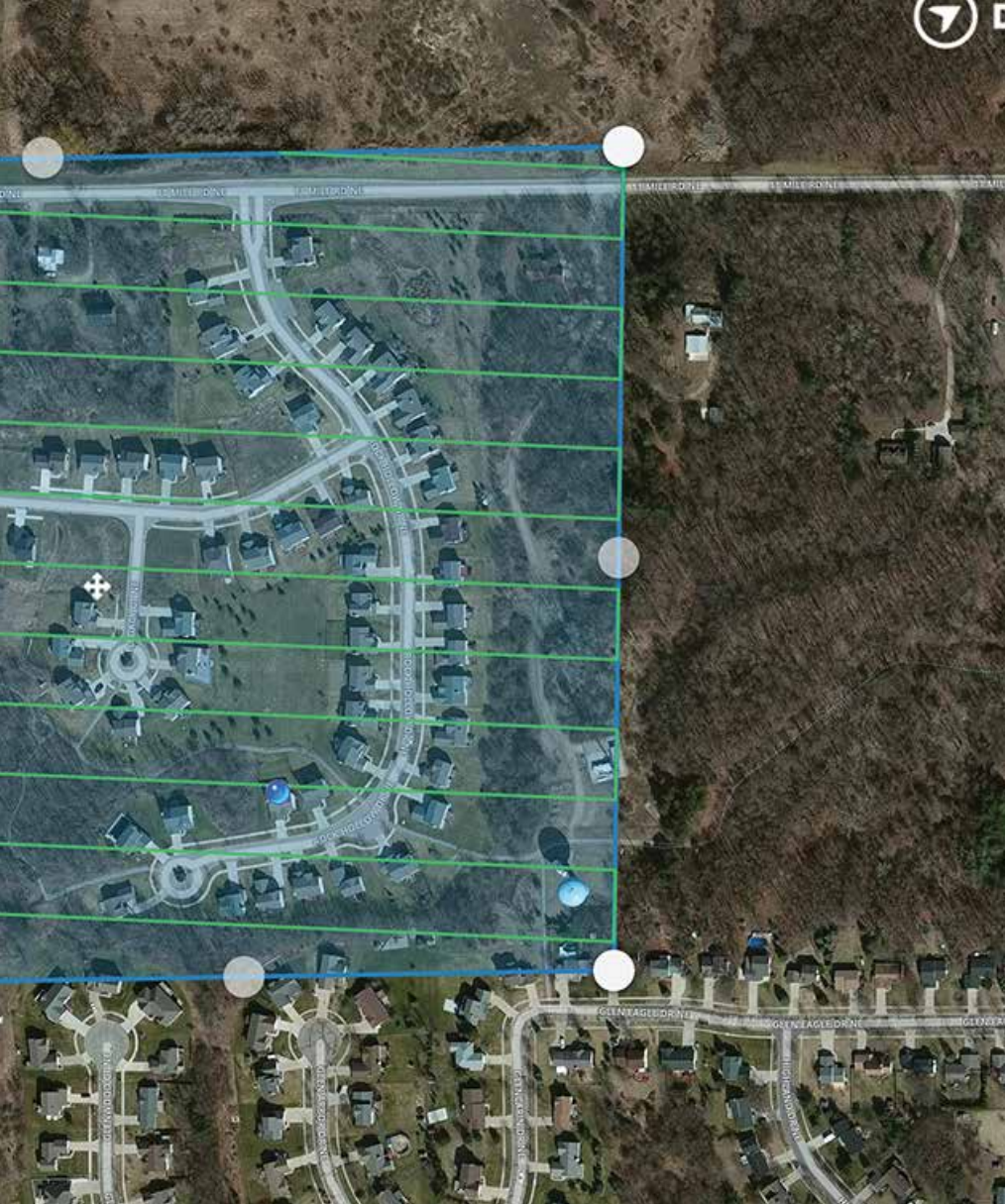
SMART DRONES IN VOGUE

While reality mesh and digital engineering have given a much-needed impetus to the construction sector, drones have made the whole process of engineering and maintenance much easier. However, what has made them all the more viable is the ability to create 3D reality mesh models by taking photos from a smart phone mounted on them. So now, you can quickly render 3D asset information models without any hassle.

Compact and intelligent results

A very apt example is of Bentley Systems' Acute 3D software than can dramatically enhance productivity, turning a simple series of digital photos taken with a smart camera (mounted on a drone) into a 3D reality mesh model. The result is a compact, intelligent representation of the asset in its current operating context.

Staying up-to-date

There is always the possibility of taking up a plant project which has archaic designs created on 2D models. These smart cameras can quickly create 3D models. And when these are mounted on drones they can give you a 360 degree overview of the project. Once these models are created, they can be used to improve the construction of new facilities as well as in ongoing operations. This also makes the inspection process much easier and allows engineers and designers to work on a 3D model that is always up-to-date for their enhancement or maintenance plans.

— **Shilpi Chakravarty**

be compared to original plans, or shared with clients for review.

A drone can give users a clear picture to compare a project's current conditions versus the original plans. **Radovan Stejskal, Marketing Director- Europe, DJI,** elaborates, "Construction industry can make the surveying of the existing facilities or the new construction site much easier by using drones. The industry can use our smaller drones like Phantom 4 to map the progress of the construction. They can capture data on weekly basis, monitor how construction site is evolving and progressing, process new models and show it to the developers or customers. This is a value added-service that they can offer. Also, it helps the management side of the construction…to have precise data and a holistic view of how the construction is progressing. For construction works, they prefer smaller and readymade solution."

Monitoring the progress

With the information collected by UAVs, clients, managers, and investors, one can easily keep a track of the work being done. The data collected can be used to create models to compare original plans with construction work to show users how a site is progressing and what parts of a project may be falling behind. All of that can be reviewed conveniently from anywhere around the world, without physically being present at the construction site.

"There are major benefits of using drones in construction industry. Most industries appreciate that this is an efficient

DRONES FOR CONSTRUCTION

There are a lot of drones available on the market today that can vary on factors like their features, appearance, performance, and battery life.

DJI PHANTOM 3

TRIMBLE UX5

DJI INSPIRE 1 PRO

MATRICE 600

DJI PHANTOM 4

and quick way of capturing the full data of your site. It's a snap shot in time, it's digital and if you do that every day, week or month, then you can really have a timeline of the evolution of your site,' says Wade.

Elevation data, 3D maps, etc. can be updated on interactive maps to give users an idea about the progress being made. By closely monitoring and analyzing up-to-date imagery and data, construction projects can save time and money, while also improving correspondence and collaboration between different parties to improve decision-making. "One of our clients in Ireland, a huge construction company

who used our drones for road construction, said that using the drone has revolutionized the way they work compared to being on the site with terrestrial instruments," he adds.

Drones are the future

There are numerous applications for drone usage in the construction industry. And the industry is discovering more ways in which the technology can be used to reduce expenses, save time, and prevent safety hazards. As a result, drones are enabling a user to monitor and track construction progress, which was never possible before. Automation will be

a key advancement in the future of drone technology. Drones will also play a crucial role in smart city applications, as they can be used for geospatial and surveying activities, traffic and crowd management, agriculture and environmental management, urban and civilian security, as well as natural disaster control and monitoring disaster situations like fires, floods, and earthquakes. 'Drones for Smart Cities' will be a trend to watch in the upcoming years.

Sanskriti Shukla, Marketing Manager
sanskriti@geospatialmedia.net

IN A FAST-CHANGING WORLD
GOING DIGITAL
is not a choice but a necessity

IF YOU WANT

- to reach out to more people
- to connect directly with your consumers
- higher conversion rates
- transparent analytics

By 2019, digital spending will account for more than 50% of overall media spend.
- McKinsey -

SO, YOU GET A HIGHER ROI

To get your **FREE** life-time
copy of **"Geospatial World"** digital magazine

Register@ **www.geospatialworld.net/godigital**

Choose the No. 1* geospatial media platform for your all digital engagements
*As per ALEXA Ranking January 2017

CONTACT:
Vaishali Dixit
Email: vaishali@geospatialmedia.net

f @GeospatialMedia   in Geospatial World

y @geoworldmedia

GEOSPATIAL JUSTICE

Geospatial Systems offer drastic transformations in the field of technology that have immense potential to change human lives, but the flip side of the coin is the alarming possibility of its misuse.
By Prof. Arup Dasgupta

Geospatial systems is an important arm of Information Technology that adds the element of spatial location to general IT services. integration of GPS, GIS, remote sensing and sensor networks with modern mobile communications enables services which could be imagined only in science fiction.

Myriad applications of geospatial systems

Baby care centers provide personalized Internet links to working parents so that they can keep an 'eye' on their children while at work. Elderly living alone can be monitored over the Internet through indoor mapping, movement and sound activated cameras and RFID. In addition, they can be monitored for their health parameters and reminded to take their medicines on time, go for a walk (which can be tracked) or take a nap. Pets can be tracked as well. The same technology also tracks criminals out on parole. IoT will take this further and enable the control of appliances including healthcare instruments in homes. Remotely controlled robots can take the place of human caregivers for routine tasks.

A new revolution or a nightmare?

Into this Sci-Fi world enters a rude reality that such systems can also be used to oppress and dominate weaker people. Each of the technologies outlined above can also be used for illegal surveillance and control. A paper, very provocatively titled Geoslavery, written by Jerome E. Dobson and Peter F. Fisher which appeared in the *IEEE Technology and*

These smart watches can be used to track children

Society Magazine, Spring 2003 deals with the dangers of misuse of LBS devices to control people. For example, by adding an element of feedback, which could be administering a shock, a person could be controlled, in effect turning the individual into a slave. While this may appear far-fetched, even in 2003 such technology was available across the counter in many countries. What is worse is that even without such feedback the LBS could be used to track a person's movements and punishment could be meted out later if the track showed a visit to 'forbidden' places.

Professor Yola Georgiadou, in an interview titled Geo-ethics Requires Prudence with Private Data, published in *GIM International*, addresses this aspect in a different manner. She recognizes that in a digital world we leave our digital presence in many places to be used quite legitimately by the intended recipients, but what if these find their way to unauthorized entities?

In fact, though Dr Georgiadou expresses confidence in authorized entities like governments; such a confidence is not fully justified.

The governmental 'nudge'

In an article in *Scientific American*, "Will Democracy Survive Big Data and Artificial Intelligence?" by Dirk Helbing, et al, states, "These technologies are also becoming increasingly popular in the world of politics. Under the label of "nudging," and on massive scale, governments are trying to steer citizens towards healthier or more environmentally friendly behavior by means of a "nudge" — a modern form of paternalism. The new, caring government is not only interested in what we do, but also wants to make sure that we
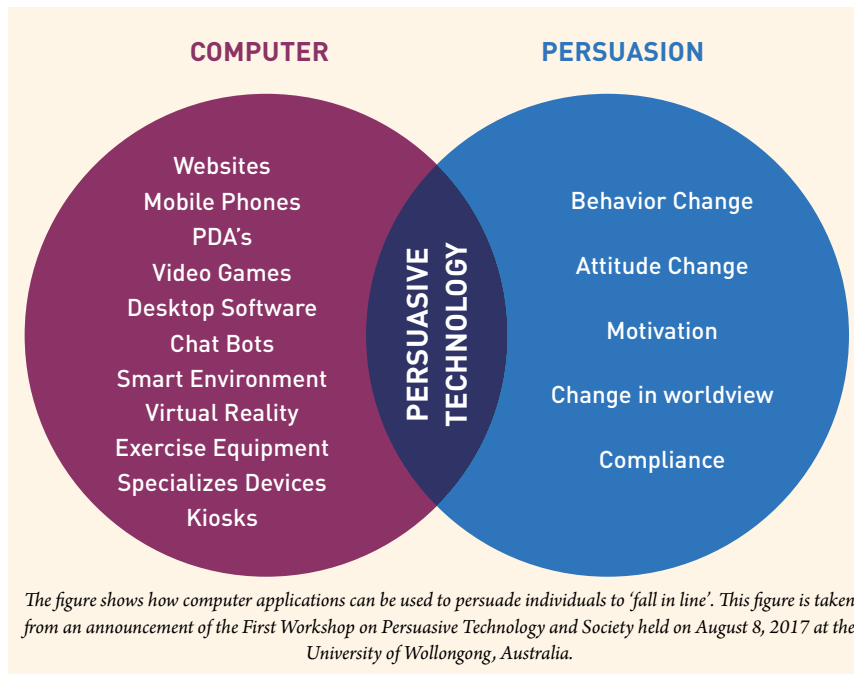

**Location Based Services —
A BOON OR BANE**

The LBS-based tracking devices can also be used for illegal surveillance and control

By adding an element of feedback, a person could be controlled, thereby turning him into a slave

LBS could be used to track a person's movements and punishment could be meted out later

COMPUTER

PERSUASION

Websites
Mobile Phones
PDA's
Video Games
Desktop Software
Chat Bots
Smart Environment
Virtual Reality
Exercise Equipment
Specializes Devices
Kiosks

PERSUASIVE TECHNOLOGY

Behavior Change

Attitude Change

Motivation

Change in worldview

Compliance

The figure shows how computer applications can be used to persuade individuals to 'fall in line'. This figure is taken from an announcement of the First Workshop on Persuasive Technology and Society held on August 8, 2017 at the University of Wollongong, Australia.

do the things that it considers to be right. The magic phrase is "big nudging", which is the combination of Big Data with nudging. To many, this appears to be a sort of digital scepter (sic) that allows one to govern the masses efficiently, without having to involve citizens in democratic processes. Could this overcome vested interests and optimize (sic) the course of the world? If so, then citizens could be governed by a data empowered "wise king", who would be able to produce desired economic and social outcomes almost as if with a digital magic wand."

In fact, an interesting WhatsApp post doing the rounds in India talks of taking care not to discuss controversial matters on social media as the government is snooping into all these platforms! This is unverified and most likely untrue but what is important is to note that common citizens are aware of and discussing such a possibility. The fact that common citizens miss is that this information is already available to the operators of the social media platforms and is being used to promote ads and direct specific posts depending on individual preferences and tendencies. Facebook has admitted the latter using their AI tools.

Dr Georgiadou is not so much worried about governments in developed countries because they have developed a strong data security policy but more about data brokers on whom we have no control and who are not accountable to us. Typically, a high resolution UAV record of land holdings can be used to secure a person's property but in the wrong hands could enable land grabbing. She feels that three aspects need to be addressed while gathering data. First it should be relevant to a specific context and under explicit laws; second, data collection should be done under the control of a supervisor and third, the consent of those on whom data is being collected should be sought.

Data security, privacy and state regulations

Though these recommendations look useful they are potentially dangerous. There are arcane laws that actually discourage data collection. For example, there are countries which have banned use of GPS and drones are being put under various controls. Data may be gathered for a specific purpose but if not reused for other applications, will result in data duplication. Remotely sensed data becomes more useful and cheap through reuse. Therefore this will actually push up the cost of such data if reuse is not

allowed. Secondly, a supervisor can become a gatekeeper. We have seen this in the case of National Mapping agencies and to some extent with government controlled data distributors. The third assertion of permission to collect data is something the UN grappled with in its Principles of Remote Sensing and is more observed in its breach!

These articles, separated by 14 years and written by renowned geospatial professionals, are thought provoking because they raise an issue we tend to brush under the carpet; the security and privacy of individuals in an uncontrolled, data rich environment. However, such an environment is also needed for legitimate commercial and administrative purposes. Proponents of the theory that data is the panacea for all ills in society and the environment are all for collecting data by mapping every centimeter of the Earth's surface and geotagging every object, animate and inanimate to the IoT. On the other hand such massive spatial databases will be very difficult to manage in terms of its safety from misuse. Safety is sought to be enforced through several means but biometrics is supposed to be the best to ensure the safety of an individual's personal data.

Or is it? In a piece appearing in *The Guardian* in December 2014 an ethical hacker addressing the Chaos Communication Congress, an annual meeting of hackers in Germany, showed how she could 'steal' the fingerprint of the German Defence Minister using commercial software, VeriFinger. The same report also revealed that a software called Corneal Keylogger can access a smartphone front facing camera and collect the iris pattern.

A third concern is not so much security and privacy but loss of identity. In an article in *IEEE T&S Magazine* of March 2015 Usha Ramanathan points out that biometrics are not very dependable particularly in cases where people are engaged in manual labor or in case of people suffering from eye conditions like cataract. Unfortunately, these conditions are most prevalent among the poor. Ramanathan's forebodings are coming true as some people in India are being denied access to the Public Distribution System because their fingerprints do not match.

Geoslavery – the potential of misuse and abuse

So where do we stand? The article on Geoslavery states that LBS could be misused to deny Human Rights and in particular Women's and Children's Rights. The article goes on to quote UN resolutions dealing with such misuse. Articles 4, 5 and 13 of the Universal Declaration of Human Rights address specific issues of slavery, cruelty and restriction of right of movement. The Declaration of the Rights of the Child also implies such restrictions. At national levels the study suggests that electronic tracking may be brought under the laws prohibiting stalking and implanting tracking devices could be brought under the ban on human branding.

The issue is not technology per se but its misuse, according to both articles. The article on Geoslavery insists that technology developers, marketers and deployers should recuse themselves if they feel that the technology is likely to endanger human rights. They further felt that precision GPS data should be restricted to specific users through a process of licensing. This is what is being followed by Galileo, IRNSS and QZSS and will require special receivers to access the high precision services.

This is not enough. When it comes to geospatial systems there are many regulations but all these are oriented towards government processes. Take the case of UAVs. The laws start

A file photo of an Aadhaar center. Safety is sought to be enforced through several means but biometrics is supposed to be the best to ensure the safety of an individual's personal data.

from a simple 'No, you cannot fly UAVs' to 'you can fly but…' followed by restrictions on weight, height, line of sight, payloads and no fly zones which are almost always strategic assets. Where the laws which protect individuals and more importantly what are the avenues of redressal where human rights to privacy, security and identity are violated? Street views may blur car number plates and human faces but how secure is the original data?

Empowering citizens or a surveillance machinery?

The *Scientific American* article concludes, "We are at the historic moment, where we have to decide on the right path—a path that allows us all to benefit from the digital revolution." Dr Georgiadou feels that data must not only be used so that it does no harm but it should empower people to make decisions autonomously. She concludes,

"The world has changed. Big corporations are determining our lives much more than before. They are becoming more powerful than nation states and the data they collect about us, without us noticing, may be used to influence us. This takes away our freedom and our fundamental right to make decisions for ourselves, autonomously and with the people we love, and not because somebody predicts our behavior and influences us to vote for this person or to buy that product. So we are losing our freedom. We are instrumentalized. We are becoming products. We have to be aware of that – not just in our personal life, but also in our professional life because it influences that as well."

Which path will allow us all to benefit from the geospatial digital revolution? Data must be collected and used for humanity, for a 'better quality of life'. The freedom to make decisions that Dr Georgiadou talks of must not be compromised. Citizens cannot be treated as passive beneficiaries but must become active participants in the decision making process as a matter of right.

To ensure this we need to develop Geospatial Justice which will place the citizen at its focus and enact enforceable laws and establish viable processes of redressal when individual freedom, security, privacy and identity are violated deliberately or inadvertently. It is not enough that scientists and technologists recuse themselves from development of systems which might be misused. They have to be proactive and ensure that such systems are not developed or if developed, are regulated to protect individual freedom. 🌐
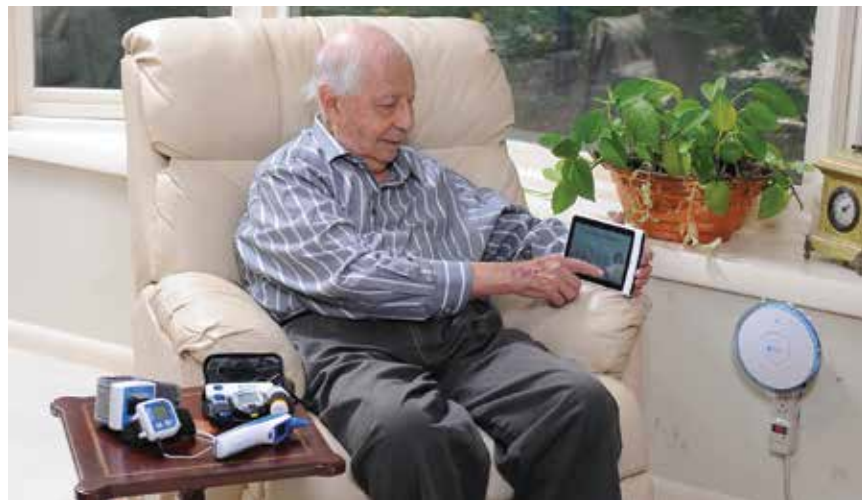
Elderly living alone can be monitored over the Internet through indoor mapping, movement and sound activated cameras and RFID. In addition, they can be monitored for their health parameters and reminded to take their medicines on time, go for a walk, etc.

Prof. Arup Dasgupta, Managing Editor
arup@geospatialmedia.net

While the Indian government has taken numerous steps to capitalize the LBS sector, Indian tech start-ups have also jumped into the bandwagon.
By Shilpi Chakravarty

LBS
MAKES WAY FOR
INNOVATION TO
GROW

Use of Location based services (LBS) has become an inseparable part of our everyday lives. The popularity of smartphones has all the more triggered this trend. While there has been a marked increase in LBS-based apps, which has breached into common man's day-today lives, the technology has become favourite amongst government agencies, corporate giants and start-ups too.

The Indian Government has mandated use of GPS in all smartphones by January 2018, will push the LBS market exponentially. According to a report published by Internet and Mobile Association of India (IAMAI) and market research firm IMRB, the number of mobile internet users in India is estimated to touch 420 million by June 2017 with the rural India growing at a much higher rate than urban India.

Inclusion of the new feature may initially cause prices of mobile phones to rise by about 50%, but the GPS chipset market will see a huge growth, given that India has roughly 934.6 million mobile phone users. Moreover, the 'location data' in the GPS enabled phones will aid the government vastly in improving the quality of life. With all manufacturers making such phones, cost will also not remain an issue, as eventually, 'economy of scale' will be achieved.

"Location Based Services are crucial. We are looking at right from global climate models to individual communities or individuals. So that is the power of LBS. One of the important components of LBS is Geo-tagged data, which when it combines with business practices provides a lot of intelligent outputs," says **Uday Raj, Chief General Manager of NRSC, ISRO, Department of Space**, at a seminar organized by FICCI on Location Based Services 2017.

Transparency is the key word today in the business and economic sector, and geo data provides that transparency. So everything from evaluation to monitoring can be done by using geotagged data. For this, you need high-resolution data as image base and maps in the background. With the rapid advancement of technologies, today satellite image data with high resolutions

The GPS chipset market will see a huge growth, given that India has roughly 934.6 million mobile phone users

straight away form image maps and no further inputs are required.

Improving accuracy

If we take the example of driverless vehicles, to make this concept really useful and efficient, it needs a very accurate location otherwise the car is bound to crash. So, when the dot moves on the map, it requires database at sub-centimeter level. This is a major challenge and ISRO is looking at resolving this problem. "We essentially need what is called foundation layers to make sense out of LBS. ISRO is looking at creating some highly accurate foundatious ways, which are available freely in the public domain. Even though everyone is used to Google Maps, ISRO is looking at indigenous maps of high accuracy," says Raj.

ISRO's value-added services like GAGAN provides very high accurate GPS system. The GPS system available in mobile phones may not be as accurate as it is required to be. The main culprit for GPS error budget is atmospheric corrections. India gets most of the data from global models and since the country is located in the tropical area, where ionospheric disturbances are much more, India needs to work on real-time atmospheric models to remove the error. A very good solution that ISRO has come up with is the option to integrate GAGAN dongle with mobile phones to improve accuracy.

Some of the new initiatives that ISRO has under taken or will be undertaking based on LBS are agriculture insurance, mapping Indian heritage and monument sites, working on remote dashboards that can create automatic reports on traffic violations, fishermen warning systems, crop intensification, crop distribution, high-value crops, horticulture, etc.

In order to cater to the growing demand of LBS sector a huge constellation of satellites is required. Meeting the expec-

tations, ISRO is actively working with other players like Planet Labs for a heavy constellation of satellites, so that data available now is of high resolution and can be delivered on a daily basis, which was not possible earlier.

Stakeholders of LBS

To understand this rapid yet steady growth in LBS-based technologies in every sphere, let us look at the primary stakeholders of LBS:

Government: An enabler and provider of LBS infrastructure such as CCTV cameras and sensors, it is the primary entity that decides the governance and implementation of the infrastructure required for the LBS framework. The administration also decides the privacy and confidentiality of the information available and governs the usage of the information and the manner in which it is used.

Citizens: Citizens are the core targets for LBS. They receive information and services over mobile devices and are the most dynamic and variable part of the LBS stakeholder system.

BENEFITS OF THE MANDATE

- Real-time tracking will expedite aid in emergency situations
- Location data will be available from approximately 420 million mobile users
- Mobile users with 'not so fancy' phones will also contribute to location based analytics
- More location data would mean more specific identification of issues
- A strong step towards better mapping of the country for community welfare
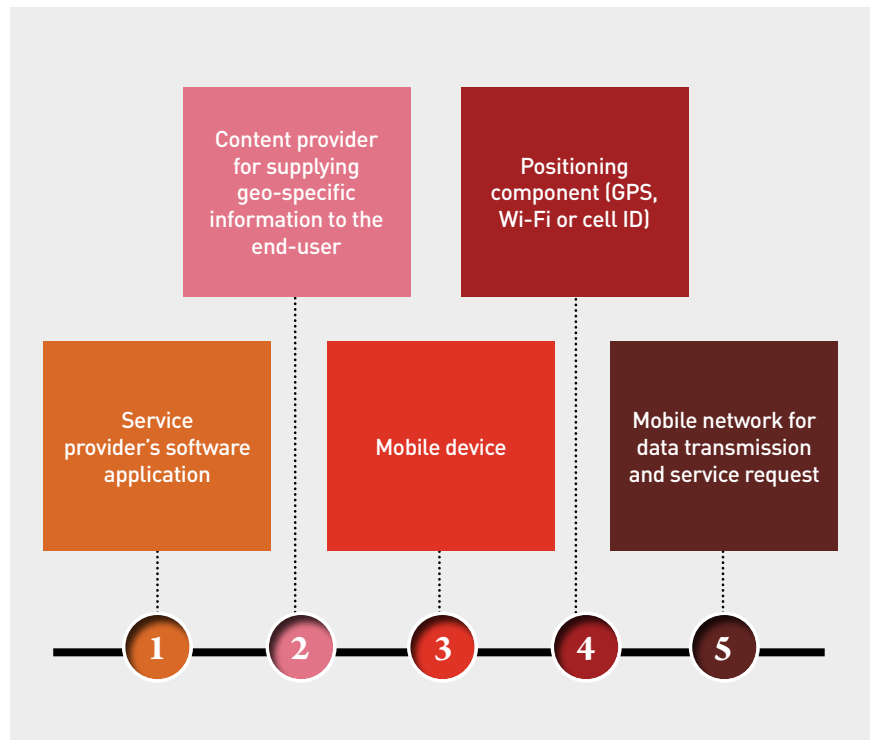
Businesses: Businesses include both the advertisers and mobile service providers. The data obtained through LBS is analysed and explored by businesses in various ways in order to predict their preferences and behaviours for various products and services that might be useful to them.
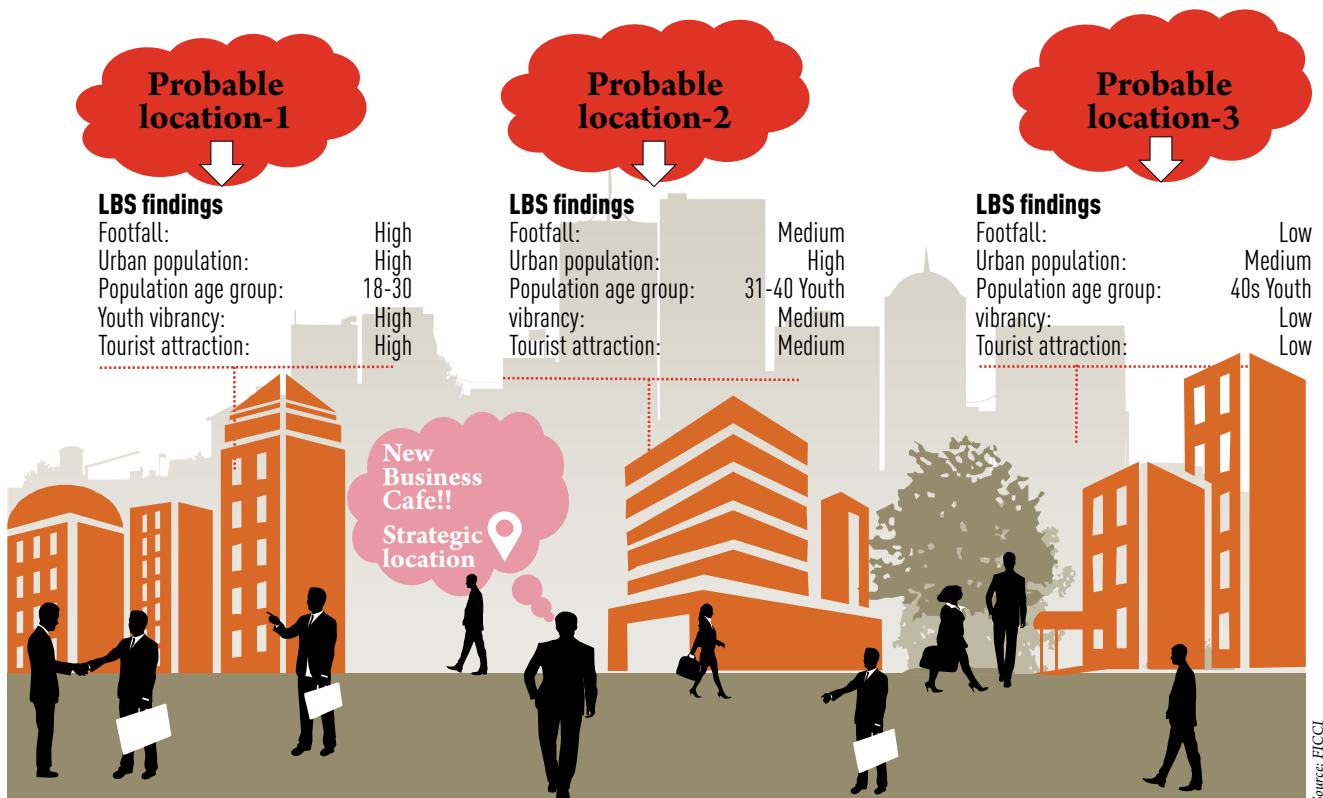
Service providers: Telecommunication service providers supply the communication infrastructure and the underlying processes that enable the transfer and identification of data. They have the information repository of both real-time and historical data of users enrolled into their services.

While the Indian government has taken numerous steps to capitalize the LBS sector, Indian tech start-ups have also jumped into the bandwagon. The steady proliferation of GPS enabled smartphones in India has boosted their morales further.

The *Geospatial World* spoke to five such start-ups who have used LBS technology to fulfil their innovative missions.

Content provider for supplying geo-specific information to the end-user

Positioning component (GPS, Wi-Fi or cell ID)

Service provider's software application

Mobile device

Mobile network for data transmission and service request

1 2 3 4 5

LBS are attracting the interest of various stakeholders and industries

Probable location-1

LBS findings
Footfall:	High
Urban population:	High
Population age group:	18-30
Youth vibrancy:	High
Tourist attraction:	High

Probable location-2

LBS findings
Footfall:	Medium
Urban population:	High
Population age group:	31-40 Youth
vibrancy:	Medium
Tourist attraction:	Medium

Probable location-3

LBS findings
Footfall:	Low
Urban population:	Medium
Population age group:	40s Youth
vibrancy:	Low
Tourist attraction:	Low

New Business Cafe!!
Strategic location

Source: FICCI

Using LBS for setting up new business

MYLES
DRIVE YOURSELF

SAKSHI VIJ
Founder and CEO, Myles

Myles is a pioneer in the Indian self-drive car segment and an offspring of Carzonrent India Pvt Ltd (CIPL), India's personal ground transportation service provider. The term Myles in itself is a combination of 'miles' and 'my' own car. And as the name suggests, Myles eliminates the hassles that come with maintaining a vehicle and provides an option to consumers to own a car only on need basis. With a fleet of more than 1,200 cars, starting from the smallest and the basic of hatchbacks to the most luxurious and premium sedans, and super premium SUVs, Myles offer consumers an option to take their pick.

Myles delivers the most affordable access to a car. From the consumer's perspective, they have to pay for a car only for the dura-tion for which it is used. So, they could hire a car for as little as two hours or as long as three months. Additionally, the company lets con-sumers choose from more than 39 models of cars across 21 cities in India. To top it up Myles cars are available without any kilome-ter capping or security deposit. So as a con-sumer, there is flexibility to drive a Mercedes on a date night, a Fortuner for a road trip and a Maruti Swift for everyday trips. Services such as GPS Systems, Child Seats and Home Delivery ensure that the system is extremely convenient for the consumer.

Additionally, Myles has also brought onboard private car owners, who rent out their idle cars, through the Myles Angels Program. While this increases the options available to the consumer, it also creates an opportunity for car owners to become entrepreneurs.

However, what makes the company stand up amongst the other start-ups is the use of LBS technology in its smooth functioning.

"We use Location based Car Search on our website, mobile site, iOS app and android app. We also use LBS technology to auto detect a customer's city and push/show her/him relevant city specific notifications," says **Sakshi Vij, Founder and CEO, Myles**.

This has helped the company in achiev-ing operational efficiency by showing a customer cars in a particular distance from her/his location. This helps the company negotiate well with driver sourcing companies; which then can deliver a car from Myles hub location to a stipulated maximum distance.

This way the clients get better user expe-rience by not being worried about specifi-cally submitting their locational preferences. The clients get better user experience by not risking their bookings to cancellation due to a reason like "hub location being very far from the client's selected pickup location".

"LBS will help us in planning each step of a customer's journey well from our end. We can show a customer customized offers and other ancillary services. We can also make the journey more secure and safe by LBS technology," says Vij.

However, she adds," The Android devices are far too many and differ greatly on the hardware quality and specifications. Due to this reason there is no standardization possi-bility in accurately detecting the Location."

The car rental business in India will only race ahead from here on and with the kind of technology Myles is been developing, the com-pany hopes to spread its wings exponentially.

KAHA HO

ABHINAV TANDON

Chairman, KahaHo

The Indian answer to Snap Map — KahaHo app — is the new location based social messenger that can help you track your near and dear ones at the click of a button. Apart from tracking ability, the app is an excellent tool that takes care of your safety in case of emergencies (ICE). The SOS button automatically sends alert to your ICE contacts and help them track you in real time to ensure you receive help on priority.

While KahaHo answers the "where" part aptly, it has many fun features too, like you can create a time bound group say for a meet-up you are planning, whereby the group members can see the route from their location to the destination i.e. the event location, can also see who has reached, who is how far, etc. Using Nearby feature, one can give a shout out to the friends in the vicinity of your location and plan impromptu or "Just in Time" meetings, discussions, etc.

The app has two versions to address B2C and B2B use cases, hence, KahaHo and KahaHo Enterprise has been devised respectively.

Location being the primary element of the app, KahaHo Enterprise is a field force tracking app that allows an organization to improve businesses and increase operational efficiencies while reducing leakages.

Abhinav Tandon, Chairman, KahaHo says, "It's a hierarchy-based system. Here a user can assign tasks to his team along with the route and location of the task. The user can monitor in real time the movement of the team, task completion status and also has AI-based analytics and dashboards that can give a snapshot view of operations, performance, activities as well as reduce overhead leakages. This is done by linking billing with actual distance traveled and geofencing the check-in checkouts of attendance. All this in an easy to use messenger like app in frontend and a customizable admin module at backend giving complete freedom to the organization to design and monitor the field force tracking program."

He further explains, "The app can also be integrated with existing enterprise applications to deliver more bang for the buck that the organization has spent." KahaHo is quite user-friendly and is SMAC compatible, so the app can leverage Cloud-based efficiencies.

"We use one of the most used API in the world, which takes care of up to date content, ultra-fast Location analytics and high degree of user familiarity as we are focused on android only and hence makes sense to utilize the Google based framework as much as possible," says Tandon.

Location Based Services (LBS) is the core of KahaHo business and through this app, the company wants to showcase "how through LBS a company can be built, solve problems and be profitable as well".

The start-up company plans to continuously release user-friendly updates every quarter, which will increase the usability of the app. Some of the defined features to be rolled out include AI and ML based predictive analytics, integration with billing systems and ERPs for operational improvement in the Enterprise version and Smart Notifications, Augmented Reality based gamification engine, CoolChat, User Rewards, Smart Check-Inns, etc. in Social version.
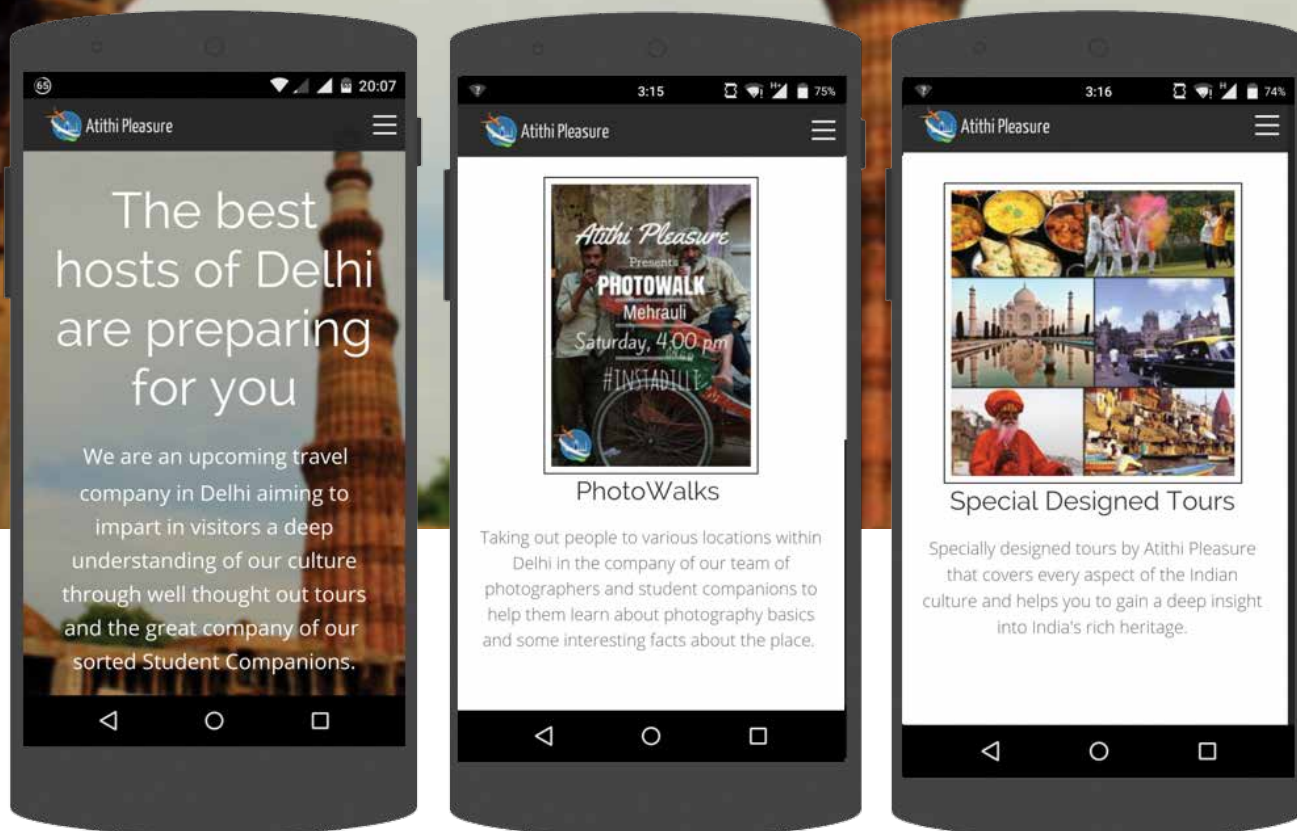
atithi pleasure

SHUBHAM KUMAR
Co-Founder & CEO, Atithi Pleasure

Atithi Pleasure is a tourism start-up that aims at innovating the travel experience for tourists through its exclusive tours, student companions and personalized tours using a mix of geospatial technologies and artificial intelligence.

Atithi Pleasure is in the process of developing tourist-centric and highly personalized tours. The tours will be automatically generated for each customer based on his/her preferences.

"We will map the customer's digital footprint across different platforms on the Internet to get an idea of what he/she likes, to give them a highly personalized experience. This digital footprint is converted into an on ground footprint and a tour is made. Time optimization of the tour is made through GIS technology. The tour guides, who will be knowledgeable and tech-savvy youngsters, will take them on these tours to give the tourists a fresh and young perspective of the place. Thus, creating a combination of technology and offbeat tours," says Shubham Kumar, Founder, Atithi Pleasure.

GIS is used to find the best optimal tour path and GPS is used to reduce the time of the tour and get the best transport combination to undertake the tour. These technologies will also help the tourists to track real time positions and traffic as well as distance information.

Shubham thinks that LBS has a huge market capacity in India and companies need to tap this vast opportunity.

Taking que from this trend, Atithi Pleasure has already started working on next phase where the company is looking come up with more LBS-based products.

"What we are trying to do is feed the digital footprint of a tourist into a profile account and using GPS, track the tourist's real time location to suggest micro/mini tours or adventures to tourist within the city based on his or her location. Every new location will uncover a new tour/adventure based on your digital profile of what you like and merging it with your current location to give you a complete tailor made, self guided, mini adventure specific to your location. That's something I believe will be a revelation in the tourism industry," says Kumar on a positive note.

get my PARKING
you drive, we park
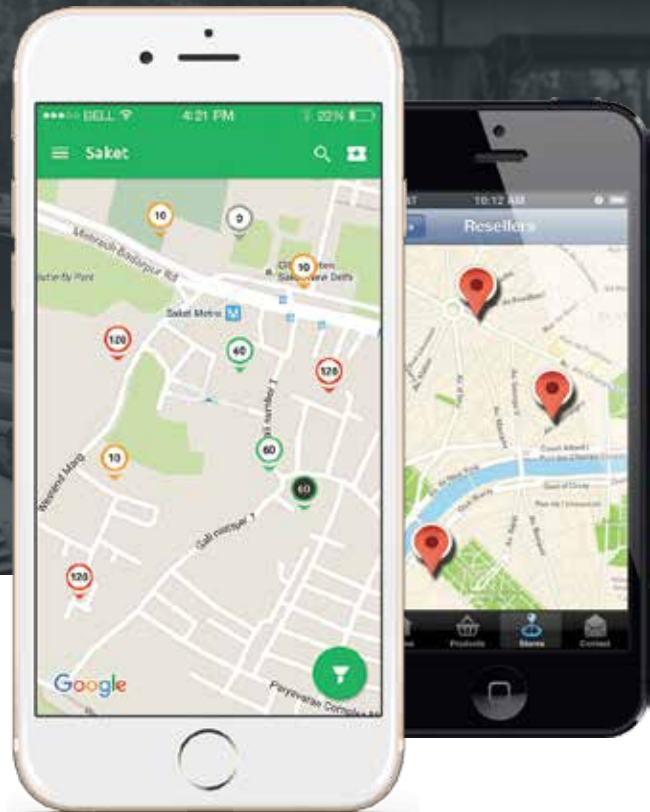
CHIRAG JAIN

**Co-Founder & CEO,
Get My Parking**

Worried about parking your car? Get My Parking has the answer. The Cloud-based mobile parking technology start-up operates an app that provides real time updates of parking information to commuters, enterprises and public administration firms.

So, you can make online reservations, make online payments, go cashless and directly navaigate to the empty spot. It also helps in reducing overall stress on the city roads, thereby reducing the traffic. What Get My Parking does is that it installs mobile pause at the parking lot. This helps the operators in easier check-inut and check-out process. The information gathered goes to the Cloud. This also helps in keeping a check on the payment. After assimilation of data algorithms is run on them so that the real time information of the parking can be derived, like how many spaces are free in the particular spot.

With a spur in the concept of smart cities all over the world, proper parking of vehicles is a key issue. Get My Parking has capitalized this trend effectively. However, what drives this start-up to success is the efficient use of LBS technology.

"LBS acts as one of the basis of our company's existence. Google maps form the under layer of all our functioning. It is one of the core technology used in our app development, data collection and maintenance. Without GPS services, even thinking of fetching any data or tracking any information would not have been possible at all. More so, a single parking booked can also be traced easily with LBS, thus enabling us to get the real time scenario," says Chirag Jain, Co-Founder and CEO, Get My Parking.

The start-up's end-to-end smart parking solution includes mobile based parking management system, real time availability displays, dashboards, and mobile app and web app for online booking. The company uses GPS, WPS and Geo Fencing for successful operations. It has organized parking for some of the major events of the country like Get My Parking was partners of Delhi Daredevils for the Indian Premiere League matches held in Delhi for two consecutive years. It were the official smart parking partner of Kumbh Mela, Ujjain, etc.

However, Jain concludes by saying that even though LBS technology has plenty of scope in India, it has till a long way to go. "It has overall been easier for developers to use LBS while working on the application but one major setback witnessed is switching smoothly between two location based service providers. The apps using these technologies are in good sync with the needs of their respective users but for one user to work simultaneously with two or more apps is tricky."

20 MINS
ARE WASTED PER DRIVE
IN SEARCH OF PARKING

20-30 %
CITIES CAN INCREASE REVINUE
IN A YEAR

CO_2 10 %
INCREASE IN AVERAGE
VEHICLE EMISSIONS

60 % PLANS
ARE DROPPED DUE TO
UNAVAILABILITY OF PARKING

30 %
OF ROAD CONGESTION & POLLUTION
IS DUE TO VEHICLES LOOKING FOR PARKING

43 % LESS
TIME SPENT LOOKING
FOR PARKING

SURYANSH JALAN

Co-Founder Dipper

Dipper is an online ecosystem designed for inter-city logistics in India. The start-up provides turnkey solutions for all segments of the value chain, from freight management for consignors/consignees, load aggregation for third-party logistics (3PLs) to fleet management for vehicle owners.

By having integrated with over 15 plus OEM device providers and several ERP solutions, Dipper creates a unified solution for quick, transparent information and freight movement. The company organizes inter-city freight logistics within India and make it more efficient, convenient by leveraging technology.

Interestingly, Dipper has over 10,000 GPS enabled vehicles currently operational on its platform. The company leverages the data generated from all these devices and layers it with consignment information and performances to develop GIS that helps to visualize inefficiencies in freight and fleet performances.

This has widely benefitted the company to spread its wings further. **Suryansh Jalan, Co-Founder, Dipper** gives a valuable insight: "We are working on exploring how

Internet mapping and remote sensing technologies can further add value. The human mind finds it very tough to analyse raw data, however informative it is. But if we can put it onto a map/chart and code it with colors the magic starts and patterns appear. That is our key focus for future products."

The company's initial focus and proliferation lays along the NH2 route from the Indian states Haryana to West Bengal. Dipper currently operates in several cities in Uttarakhand, Uttar Pradesh, Haryana, Delhi NCR, Jharkhand, West Bengal and Odisha. The company intends to roll out services in Maharashtra, Tamil Nadu and Karnataka shortly.

However, the area where Dipper through its technology has made its major impact is Freight Management Solution. The technology is being accepted and deployed among the largest companies in the Indian manufacturing. Providing KPIs, analysis and MIS that impacts the efficiency and bottom-line of the customers has helped Dipper to make its mark. The Freight Management Solutions have been applied and used by Navratna, MNC companies in India. Applications range in domains such as manufacturing, FMCG, etc.

LBS being the core of Dipper, Jalan started the company in 2015 with **Ayush Syal, Co-Founder and CTO, Dipper**. "We decided to pursue the idea to start Dipper in June, 2015 and embarked upon a research of the industry in Hyderabad, Bangalore, Mumbai, Kolkata and Delhi. Based on what we

learnt, we decided to focus upon long-haul heavy freight industry from large corporates. It is that initial groundwork and knowledge imbided about the gears that move the industry, that has served us through navigate the unchartered waters through strategizing, implementation and operations," says Jalan.

But the journey was initially tough for Jalan and Syal. "It was initially a struggle to completely understand the large spectrum of logistics in India with a myriad array of options and activities. Processes are counter-intuitive and there is organized chaos with the operating principle apparently being that of Jugaad. Additionally, information was scarce and often competing. Competition was thick. But as we dug deeper to the root-cause the fog began to clear and the basic principles governing the processes took shape," explains Jalan.

Undeterred by the challenges, the future looks bright for Dipper as the start-up aims to create a complete digital ecosystem for freight movement in India. It is also developing a stack of relevant products and services by leveraging on IoT devices and predominantly LBS guided technology.
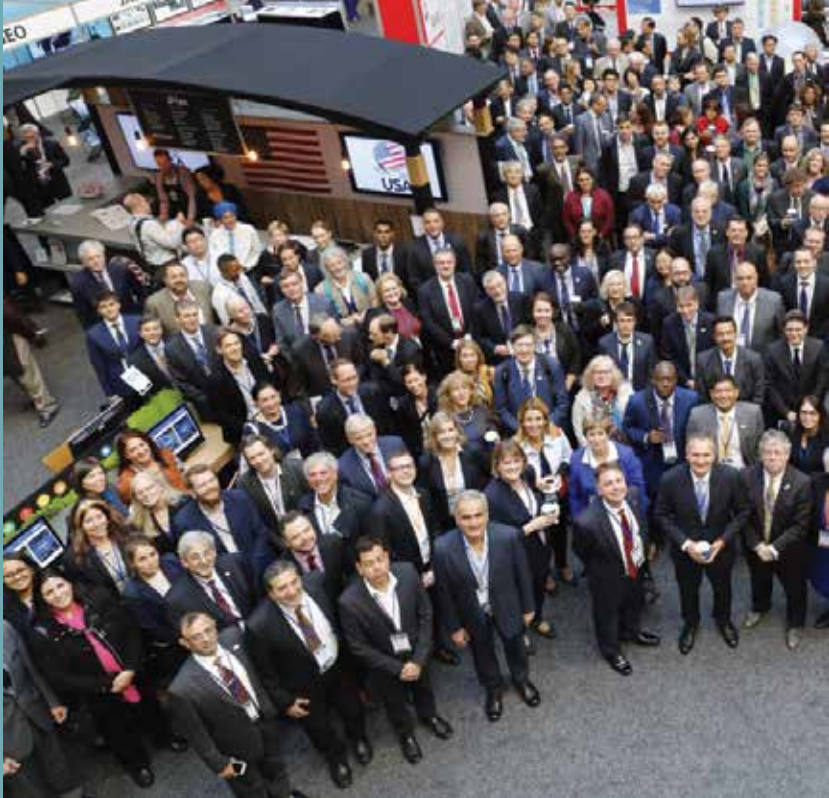
Shilpi Chakravarty, Assistant Editor
shilpi@geospatialmedia.net

Delegates at GEO Week 2017.

Photo Credit: GEO

With an aim to strengthen the coordination and cooperation among the global earth observing systems, the Group on Earth Observations (GEO) and the National Oceanic and Atmospheric Administration (NOAA) successfully concluded the GEO Week 2017, from October 23 to October 27, 2017, held at the Ronald Reagan Building and International Trade Centre, in Washington, D.C., USA.

Attracting 700 plus people, GEO Week 2017 consisted of the GEO-XIV Plenary, side events and exhibitions which efficiently highlighted and promoted the role, applications and opportunities to use earth observation (EO).

GEO ON A STRATEGIC MISSION TO
DELIVER INSIGHTS
FOR A CHANGING WORLD

The aim was to discuss the engagement of multiple stakeholders to make earth observation a critical tool for meeting global challenges.

The side events included discussions and technology seminars on wide range of topics such as, Open Data Cube, Regional Group on Earth Observation Systems of System (GEOSS) best practices, Demonstrating value of earth observations (applications and solutions), Earth Observation for Land Degradation, Earth Observation in Service of the 2030 Agenda for Sustainable Development, Ocean Applications, etc., among many others.

Some of the key events and discussions that took place at GEO Week 2017 are:

EuroGEOSS launch event

The most notable event was the launch of the EuroGEOSS on the first day of GEO Week 2017, i.e. October 23, 2017 by Robert Jan Smits, European Commission's (EC) Director General for Research and Innovation (DGRI). The launch of EuroGEOSS is aimed at benefitting citizens, businesses, research scientists and government by providing access to tailored advanced earth observation services, while simultaneously bringing in synergies within the existing European earth observation initiatives. The major element of the EuroGEOSS will be the Copernicus, the European Earth Observation Programme, which was emphasised by **Andreas Veispak, Head of EC´s Space Data for Societal Challenges and Growth Unit**, "EuroGEOSS will enrich and

In its pursuit to benefit the human kind through the use and applications of earth observation, the GEO community shifts its approach from being data-centric to user centric. **By Ananya Narain**

stimulate the link between Copernicus data and the end users."

Furthermore, the idea behind EuroGEOSS is to integrate the fragmented efforts of Horizon 2020, Copernicus, ESA, and other national programs and initiatives, by acting as an 'incubator' to test earth observation based services and applications for the future and to focus on the sustainable development goals and GEO's societal benefit areas. Supported by the European Commission, GEO participating countries and participating organizations, EuroGEOSS aims to boost the user uptake of earth observation data while simultaneously improving the forecasting capabilities of governments in the European context.

GEO in 12 years in 12 minutes

Presenting on, 'GEO in 12 years in 12 minutes', at the inauguration ceremony of GEO-XIV Plenary,

With 105 member countries, 118 participating organizations, 5,000 plus data providers, and 400 million earth observation resources, the GEO community is pivoting at an increased rate to provide useful earth observation information to the end user community

Barbara Ryan, GEO Secretariat stated, "We are moving largely from a data-centric approach to a user-centric approach. It's about closing the gap between users and providers." Furthermore, Ryan presented a powerful snapshot of GEO's impact by breaking down the GEO community into a set of highly impressive numbers. With 105 member countries, 118 participating organizations, 5,000 plus data providers, and 400 million earth observation resources, the GEO community is pivoting at an increased rate to provide useful earth observation information to the end user community.

Supported by its flagship initiatives at the programmatic level, such as GEOBON, GEOGLAM, GFOI and GOS4M, and regional frameworks such as AmeriGEOSS, AfriGEOSS, AOGEOSS, and EuroGEOSS, the community is working towards fulfilling the 2030 Agenda for Sustainable Development Goals at a pace much faster than many organizations. Additionally, Ryan stressed on the need for Open Data for Earth Observation, "You are inhibiting economic growth if you do not implement broad open data policies." Citing the example of the United States Geological Survey (USGS), Ryan stated that after the open data policy came into place in 2007, the economic benefits that accrue to USA via Landsat imagery downloads is approximately $1.7 billion annually. The

opening session concluded with the finalization of the GEO Draft Agenda and the Draft Report of GEO — XIII and the opening of the exhibition.

Earth observation in public policy, commercial sector and international development

The first panel, Earth Observation in Public Policy, discussed specific case studies from Colombia and Jamaica to highlight the need for open data policies for earth observation data in public policy frameworks. The panel also welcomed the increased participation of national statistical agencies – so as to bring together - the spatial and non-spatial data sets together for informed decision making. In the second panel on Earth Observation in Commercial Sector, Jack Dangermond, Founder and President, Esri, emphasised that data – earth observation data alone cannot suffice the needs of the end-users but the data needs to be analytics ready to have any value.

The panel emphasised that genuine focus must be placed on what is needed by the user community so as to focus on real people who are doing real things, focussing on real problems for real-time solutions. The panellists of the, Earth Observation in International Development, representing over $100 billion in development funding, emphasized day to day governance, international cooperation and collaborations among all stakeholders for efficient utilization of earth observation data. It was agreed that the potential of earth observation data was evolving, for conducting rapid assessments of socio-environment and economic status of developing countries.

Keeping in tone with the plenary theme, **Peter Head, Founder, Resilience Brokers**, emphasised on the value chain that open data creates for meeting the global goals by stating, "We need to turn data into wisdom." Various presentations highlighted the successful

implementation of programs under the GEO framework such as EO for Ecosystem Accounting, GEO's Human Planet Initiative by ESA and finally, the EO4Health initiative by NOAA. Additionally, a panel discussion on National Earth Observations deliberated on the need for developing the national earth observations capabilities in each country, the opportunities available and the perennial challenges countries face with respect to open data, data accessibility, data sharing and policy guidelines.

GEO legal status

The legal status of GEO which has been in debate for some time now, received a celebratory cheer and applause from the GEO community after Ryan announced that under a new standing agreement, GEO has a legal standing, covered by the Headquarters agreement concluded between WMO and Swiss Federal Council. In addition, the announcement of the next GEO XV Plenary at Kyoto, Japan 2018 was made. The GEO Week 2017 finally concluded with a standing ovation to Ryan for six years of inspiring leadership and service to the GEO Community as the GEO Secretariat.

GEO Week 2017 concluded with members ecstatic of the possibilities and opportunities available to their countries as a participating country or organization to leverage all that GEO has to offer to meet the biggest task at hand right now, the 2030 Agenda for Sustainable Development. In a nutshell, GEO is on a strategic mission to provide data to users to meet the most difficult of challenges on ground. With too many goals at hand, and time too less, open earth observation data, is the way to proceed. ◌

Ananya Narain, Research Analyst
ananya@geospatialmedia.net

HOW L&T BUILT
A PROGRESS MONITORING PORTAL FOR LINEAR INFRA PROJECTS

End users can simply login to the dashboard and geographically tag the work in progress along with other attributes like requirement of construction material, date and time the work has been completed, etc.

With constant increase in population in urban cities and the need for an efficient and urban infrastructure, especially in developing countries, linear infrastructure projects on roads, railways and utilities have gained popularity. Combined with ever-evolving technological advancements, this trend has gained momentum.

Construction companies across the world are working extensively on these projects. One such company which has earned great recognition in the field, especially in India, is L&T Construction. Over the past seven decades, the company has been transforming cityscapes with structures of immense size and grandeur. Its capabilities span the entire breadth of construction.

Amongst the company's most recent projects are a series of elevated bridges in the city of Hyderabad, India. In order to monitor the development across these linear infrastructure projects, the organization chose Hexagon Geospatial's products GeoMedia Professional and GeoMedia WebMap. These projects provided quick and full-featured maps for complex spatial analysis that helps in effective decision making. The solutions geographically tag location-based status, giving clarity and transparency on the work-in-progress at the construction sites.

Why use location-based systems?

L&T Construction uses 4D Building Information Model (4D BIM) dashboards that enable architects, designers, contractors and clients to visualize the entire sequence of events. Using these dashboards, crews at the building site update their log charts with status of the construction and various other field activities. This gives stakeholders a view into the progress of construction activities throughout the lifetime of the project. The BIM-centric approach helps to improve project management for construction projects of any size or complexity. But what could boost its efficiency and productivity further was integration of GIS.

The company needed a way to combine their BIM and GIS to monitor the project progress for linear infrastructure projects as this would lead to reduced cost of lifecycle management through effective asset definition. It would also avoid multiple uncontrolled copies of construction documentation and provide access to the right information at the right time. Hence, by this way it would empower resources to deal effectively with onsite problems.

L&T's Enterprise Project Progress Monitoring Application provides a unified platform that assists in improved collaboration, transparency and efficiency from project planning to execution.

Traditional BIM systems focussed on developing objects with the maximum level of detail in geometry, whereas, GIS systems could provide locations for the assets and information about the topography and relations between the objects in the GIS. This would open the possibility for sophisticated analysis on assets in the 4D BIM. For instance, it would allow L&T to combine their BIM with ecological impact studies. It would also allow them to minimize the cost.

Aligning geospatial with 4D BIM

Addressing the requirement to integrate GIS with BIM, L&T kicked off an initiative application to craft an in-house GIS-based platform to align geospatial and 4D BIM technologies. While other 4D BIM technologies provide updates on the series of events at the construction sites, L&T sought to include geographically-tagged data into their system.

Hexagon Geospatial, which provides an apt platform to design, develop, and deliver solutions that solve complex, real-world challenges, helped L&T to resolve this issue. The company chose Hexagon Geospatial's GeoMedia to connect to their GIS, and perform dynamic queries and analysis of the data. GeoMedia WebMap provides a powerful online map of the whole site, communicating the location and availability of assets. All of this combined provided L&T a powerful tool for understanding the current status of the project and keeping it inside the guidelines.

The Enterprise Project Progress Monitoring Application provides a unified platform that assists in improved collaboration, transparency and efficiency from project planning all the way to execution. This environment acts as a 'single source of truth', making it a powerful and effective tool for construction progress monitoring.

Brighter future with GIS

Linear infrastructure projects can have widespread ecological impacts. These projects can extend deep into forests, adversely affecting whole ecosystems. Moreover, infrastructure projects represent huge investments, and any delay in project can result in immense cost overruns. Balancing these two concerns-- minimizing the environmental impact and maximizing the cost savings -- is a challenge. The new solution helps in managing both the ends.

Also, initially, the communication at client construction site was verbal. However, with GIS-based platform, communications have become easier. End users can simply login to the dashboard and geographically tag the work in progress along with other attributes like requirement of construction material, date and time the work has been completed, etc. The system helps to bring transparency at the construction site and monitoring of the manpower becomes easier by analysing the data/ information fed in the system.

Additionally, GeoMedia's intuitive, dynamic analysis functionality enables concatenation of analysis processes. This results in one operation feed directly into the next process, as well as dynamic updating of results in response to data changes aided in building robust workflows for the project.

With special features of Login, users can be authenticated to avoid any frauds, thereby providing more reliable and effective results. Along with this, GIS helps in identifying the encroachment areas with visualizing the location based status. With GIS measurement tool, it becomes easier to map engineering drawing with the GeoMedia WebMap solution to ensure whether the infrastructure (rail, road, ports, metros) can be built or not, considering the exact location available.

By seamlessly integrating real-time locations of all the assets on the construction site into 4D BIM dashboards, L&T have latest data feeds available 24/7 for analysis and reports. This ensures enhanced planning and aids timely decision making, optimized resource allocation and better mitigation of risks. This provides a clear understanding of both "when" and "where" activities happen in their workflows.

The solution aims to maximize its application in the field of GIS and BIM in terms of integrating it with RFID, supply chain management, 3D GIS and BIM, seamless integration of 4D Schedule Integration and 5D representation of data with cost.

The Enterprise Project Progress Monitoring Application, a culmination of L&T's thought leadership and technical expertise of Hexagon, is enabling L&T to manage its construction projects more efficiently as it empowers the stakeholders to take more effective decisions at the appropriate time. 🕐

Courtesy: *Hexagon Geospatial*

AAM

POWERLINE
VEGETATION STUDY

PLS-CADD model, built from captured data, shows vegetation and clearances.

LiDAR network mapping; power line and vegetation modelling can help Improving vegetation management to reduce bushfire and outage risks

The safe operation of its 11,000 plus kilometre transmission network is the highest priority of an Australian transmission owner and operator and AAM client. With assets located in high fire danger areas, and sections of densely vegetated transmission line corridors at risk of bushfire, risk minimisation is an integral part of its asset management strategy.

The Challenge

Improving vegetation management to reduce bushfire and outage risks

Ground inspection has proven a slow and expensive method of detecting vegetation and easement encroachment. Cost and time effective aerial inspection was required to assist with:

- Vegetation easement encroachment
- Maintenance of conductor-to-vegetation clearances in all environmental conditions and line loadings
- Development of maintenance programs for effective removal of all infringement vegetation based on growth rates
- Work order preparation for maintenance crews

The Solution

LiDAR network mapping; power line and vegetation modelling; work order automation

- **Precision LiDAR mapping:**
vegetation and asset data across the transmission network
- **Power line modelling:**

PLS-CADD using LiDAR data, load levels and weather conditions
- **Vegetation profiling:**
incorporating growth rate data, possible future vegetation infringements
- **Tailored scenario modelling:**
vegetation infringements under 'typical', 'excessive' and 'maximum' line load and weather conditions
- **Maintenance work orders:**
contractor work orders to meet the organisation's asset management standards

Results

Improved vegetation management, efficient staff deployment and risk minimisation

- Prioritisation of vegetation maintenance tasks and efficient maintenance crew deployment
- Identification of priority infringements and creation of typical to maximum conditions risk mitigation strategies
- Complete set of PLS-CADD transmission line models, ready for use in future maintenance and management tasks
- A detailed, auditable vegetation management program that meets organisational, board and industry regulator standards
- Reduced risk of power outages, infrastructure damage and bush files
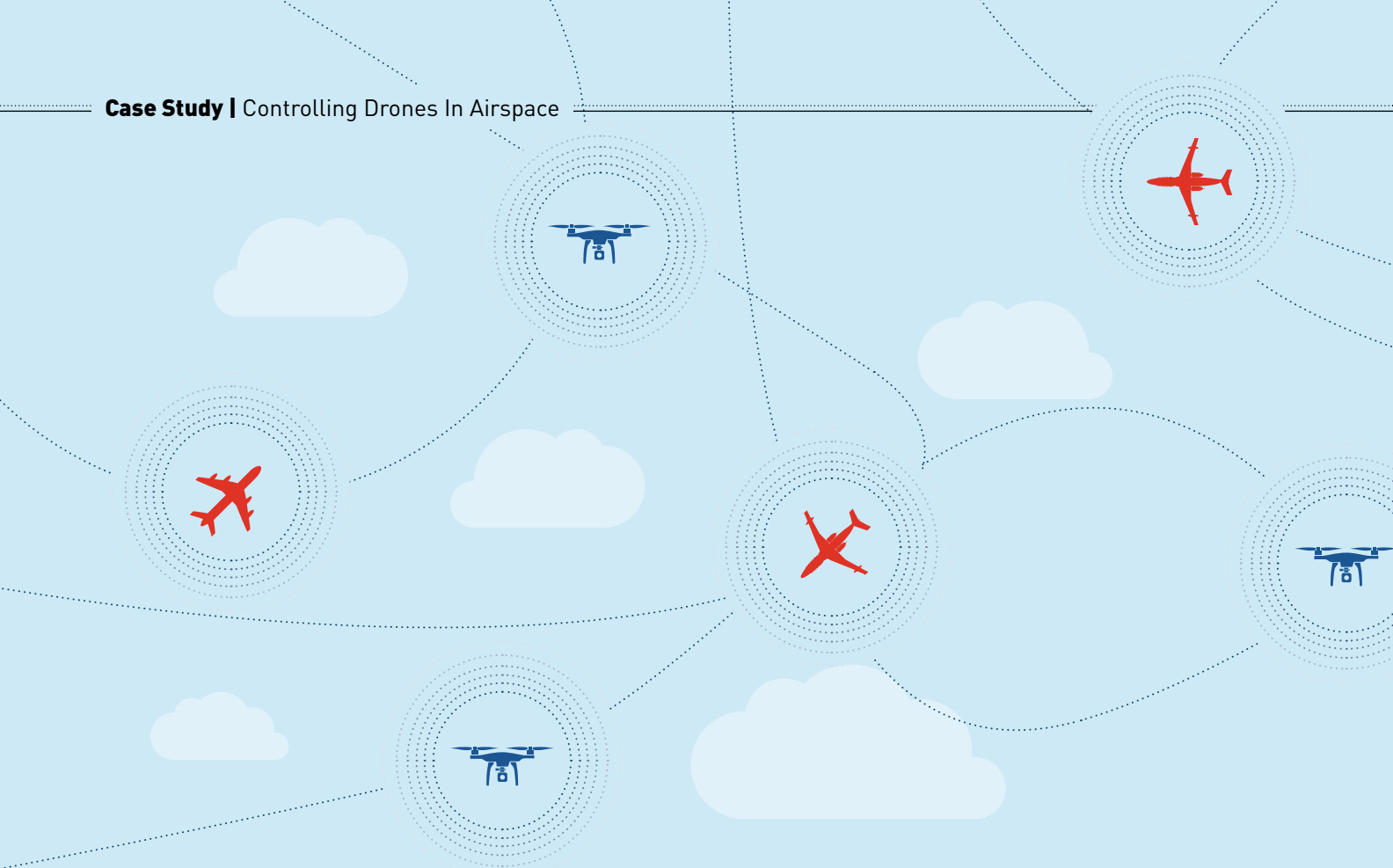
Courtesy: *AAM*
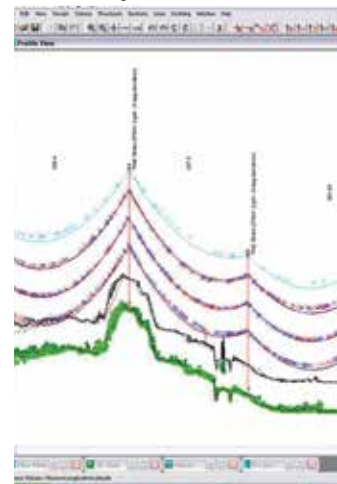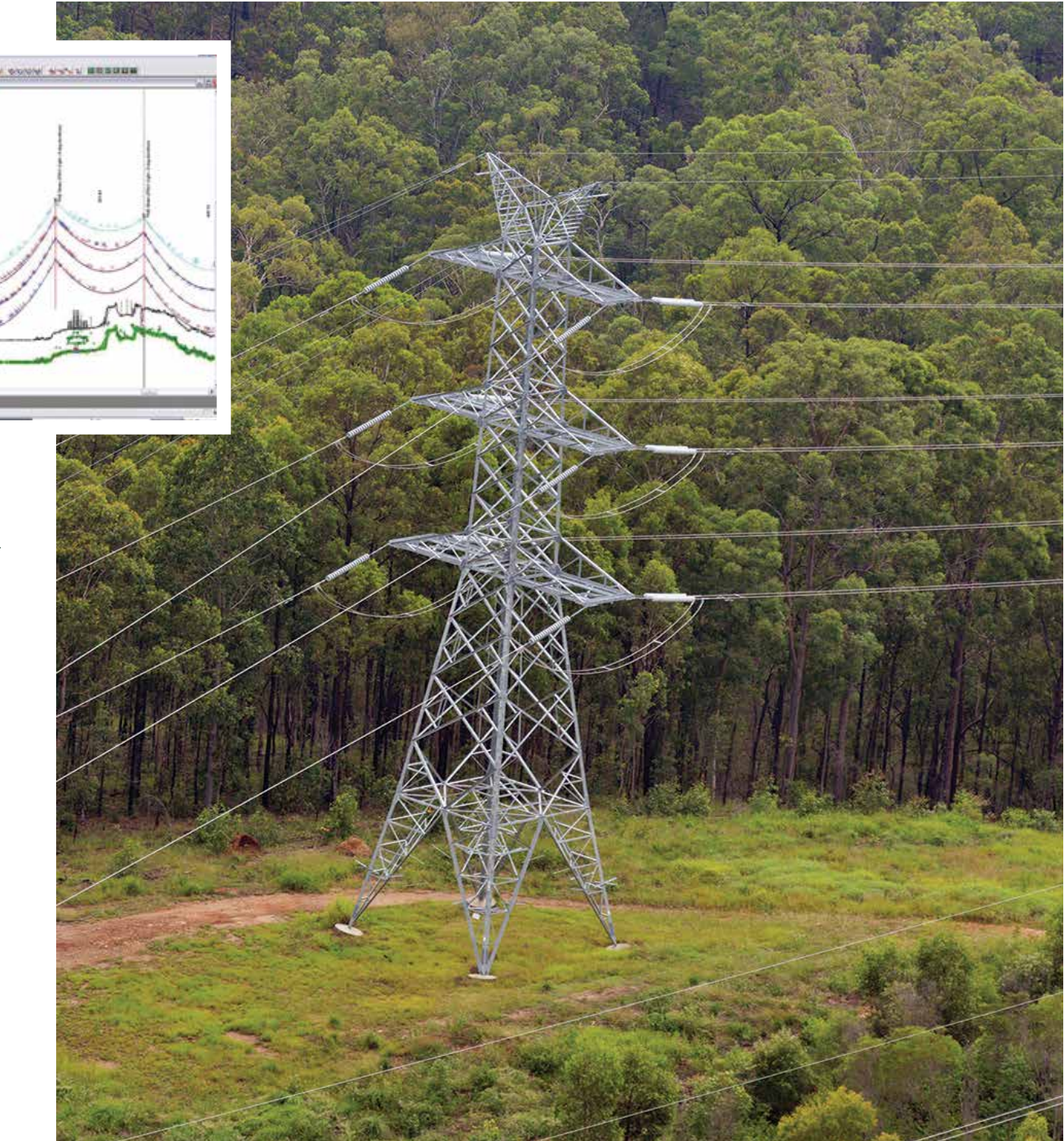
Unifly shaping
drone space with Luciad at the core of its
Innovative Platform

The interesting drone management platform allows drone users to safely plan and fly UAV in today's commercial airspace.

While drone flying has gained exponential momentum in last few years, the probability of drone crashing into aircrafts or near misses has increased too. This trend has added one more worry in the air traffic controllers' kitty. Enter a team of aviation experts and engineers with a vision. The leaders of Unifly have created a way to facilitate integration of drones into the manned aviation system.

Developed with Luciad technology, Unifly's innovative drone management platform allows drone users to safely plan and fly UAV in today's commercial airspace.

Unifly, based in Antwerp, Belgium, specializes in drone traffic management and drone operations. The company is a spin-off of the Flemish technology research institute VITO. Unifly's leadership includes a unique mix of air traffic controllers, licensed professional pilots and software engineers.

Founded in August 2015, the company introduced a Cloud-based software platform
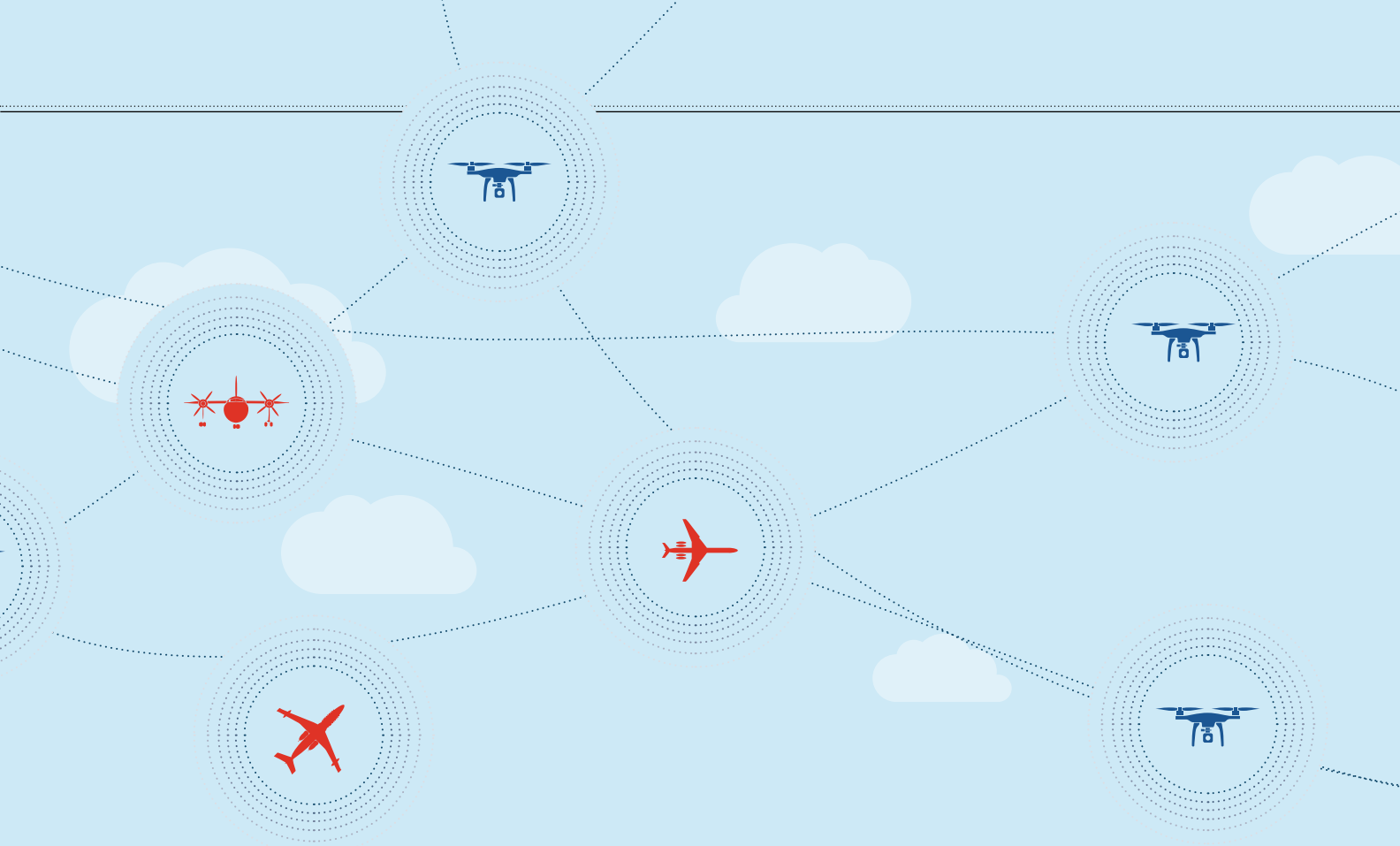
for unmanned air traffic management just eight months later. Unifly already has attracted more than 1,000 registered users, 30% from outside Europe.

In November 2016, Terra Drone, a major Japanese drone operator and system integrator, invested 5 million euro in Unifly. The company now is the most well-funded unmanned traffic management software business in Europe.

How Unifly's system works

The concept is simple. The real-time position of a drone operation is shared into the aviation system. This makes it possible for air traffic controllers and pilots to intervene if a dangerous situation arises.

The Unifly app interfaces with the manned air traffic management world – Luciad's world. Luciad, whose clients include Boeing, Airbus, NATO and Eurocontrol, helped Unifly build a system compliant with international aviation standards. Luciad developers worked directly with Unifly to launch the product in the shortest possible time.

No need to reinvent the wheel here!

Unifly puts information into the manned air traffic managements system, then retrieves data relevant to drone pilots. This results in excellent coordination between unmanned and manned aviation. There are features for private drone users, professional users, policing bodies, aviation authorities, air traffic controllers and drone manufacturers.

Unifly and Luciad: A great partnership

Unifly facilitates the flow of information between drone pilots and operators and the manned air traffic system. More information equals fewer accidents.

In a European competition for air traffic management software in early 2016, Unifly finished second in a field of 81 contenders. Airbus, another Luciad partner, finished first.

"We help air navigation service providers know where drones are," says Mark Kegelaers, CEO, Unifly. "In addition, drone users can be informed about the regulation of aviation — where they can fly and not and where it is safe to fly."

Unifly used existing technologies created by Luciad to build the platform. "Luciad has been instrumental from the beginning of the development of our project," Kegelaers says. "One of the big challenges is to take complex aviation data and present that to end users who have no knowledge of aviation. Thanks to Luciad, we created a welcoming environment for beginning aviators."

What next?

Unifly is the leader in Europe for sales of software for unmanned air traffic management. In future the company will use the investment from Terra Drone to build an international sales force. The main aim of the company is to become the de facto standard for professional drone operators.

Luciad leads the industry in the development of situational awareness applications. The company creates applications from start-to-finish and also partners with companies like Unifly to provide expertise to new products. ♺

Courtesy: Luciad

QUICK DATA ACCESS & RIGHT TOOLS KEY TO SMART URBAN GOVERNMENT

A Smart Urban Government must make effective and wise decisions to deliver quality services to citizens. By integrating the GIS, MIS and ERP services, Urban Local Bodies can glean insight and perform detailed analysis at state-level, believes **Atanu Sinha, Director, India and SAARC, Hexagon Geospatial**

that might be affected. Third, they must be informed. That means we need tools that provide you with all of this information so you can arrive at the best answer and implement intelligent action.

Improving efficiencies and effectiveness are the essential strengths of Smart Urban Governance. How are you contributing in this sphere?

Hexagon Geospatial provides centralized monitoring and assessment on a GIS-based platform. For Urban Local Bodies (ULB), it is vital that they can see a big picture. They need access to live streams of data for a variety of sources and sensors so they can make quick decisions. From live streams of sensors in the Internet of Things (IoT) to applications like Mobile Alert that encourage citizen engagement and crowdsourcing, the

With the increasing demand of Smart Cities, Smart Urban Government will play an important role. What according to Hexagon Geospatial makes urban governance smart?

Urban governance is just doing things the way we have always done them — wait for something to happen, then try to react to it and minimize the overall effect. There's not

much smart about it. Smart Urban Governance on the other hand is characterized by quick, efficient and informed decisions. There are three aspects to that.

First, the decisions must be quick. That means we need access to data as soon as possible. Second, they need to be efficient, which means that we must understand all of the limiting and mitigating factors, such as location and activities in other departments

company's technologies have always tried to facilitate connections to as many data sources as possible, regardless of source or format.

Improving efficiencies and effectiveness is another pillar of Smart Urban Government. This involves cross-department monitoring, planning, sharing and collaboration. Using maps which include standard business intelligence tools are already used to monitor other applications, creating an intuitive and efficient way to communicate. By making it easy for different departments to access and build their own Smart M.Apps on a single platform, Hexagon Geospatial is able to provide a common operational picture, ensuring that all the departments of an ULB are operating from a single source of truth. Currently, the company is also working with the World Bank for the Indian state Andhra Pradesh's Municipal Development Project that aims at providing a smart e-governance to its citizens by redressing citizen's grievances by effective workflows using geospatial intelligence.

A Smart Urban Government must make effective and wise decisions to deliver quality services to citizens. By integrating the GIS, MIS and ERP services, ULBs can glean insight and perform detailed analysis at state-level. Because the company's Smart M.App technology makes it easy to rapidly prototype information services, these analytics can also be tailored to inform governments on the ULB/ward/block level. This provides enhanced situational awareness and actionable intelligence to stakeholders.

The easy-to-use rich map-based consolidated dashboards and reports and map-based analytics enable the users to identify spatial patterns, trends and their dependencies, making it easier to pinpoint root causes and facilitating early elimination. This results in improved allocation of resources, planning, and management of municipal resources and assets.

Can you give some global reference cases which you are looking to replicate here in India?

In the Netherlands, watershed management is a vital issue. Hexagon Geospatial's partner IMAGEM has used the company's technology for years to model and predict the flow of water. And with the combination of the tech-

nology and new rapidly updated data sources – like 3D data collected from LiDAR sensors or extracted from high-resolution stereo imagery – the company can begin modeling and predicting events before they happen. Another example that impacts Smart Cities is the sewer infrastructure. Using Hexagon Smart M.App technology, the company's partner Planetek Italia has built a sewer and water pipeline monitoring system that automatically analyses data from radar satellites and can identify places where leaky pipes are causing ground subsidence of as small as a millimeter as soon as new data becomes available. That allows ULBs to address dangerous problems like sinkholes before they become disastrous.

Australian customers are using M.App Enterprise to monitor and plan construction and building change. They automate change detection to locate additions or property change so they can target where to send the field agents from the building inspection and tax assessor's offices, simultaneously saving time, coordinating across departments, and increasing the tax revenues. Customers in Canada use Hexagon Geospatial's technology to map, inventory, inspect, and maintain all of the assets (signs, berms, guardrails) along their roadways with mobile-enabled devices. Hexagon's technology drives some of the largest railway systems in Europe, such as German Rail.

The company is seeing a growing interest in being able to connect to live data feeds and automatically update the maps in real time, especially in areas like roads and real estate. Smart M.Apps are ideal for that kind of job, and the technology can help cities become Smart Cities.

What are some of the new technologies that can be used in Smart Cities?

There are several. All of the technology is based on quick access to a wide variety of data sources. This will continue to

grow in importance as the company sees the continued explosion of sensors and connected devices. As we move forward, ULBs will need to enlist their constituents in the information-gathering steps, and mobile apps like Mobile Alert, which allows any smart device to send a geotagged photo with incident information subscribing ULB.

We need a way to make efficient, informed decisions, and this means that we need a platform that allows multiple agencies to host, adapt, and deliver the tailor-made applications for their workflows. Maps are great communicators, but they try to do too much at one time, and they take too long to make. The Hexagon Smart M.App attempts to fix that problem by enabling governments to rapidly prototype solutions and then connect them to live data sources. This provides a real-time connection to content, business workflows, and geoprocessing in a single application to produce powerful visualizations.

M.App Enterprise is a Cloud or on-premises deployment that allows Smart Urban Governance to for stakeholders. This platform empowers ULBs or developers to design, develop, and deliver their own Hexagon Smart M.Apps. If data security is an issue, then host it on-premises. Create powerful visualizations and then share them with stakeholders in a way that is easy for them to understand. Set up public views that give citizens insight into how the common resources and government services are being utilized to improve their safety, well-being, and helping them to thrive.

Hexagon is equipped to help the cities solve their daily problems using location intelligence. It is continuously evolving to come up with technologies that are essential for planning and execution of Smart Cities. 🌐

By integrating the GIS, MIS and ERP services, urban local bodies can glean insight and perform detailed analysis at state-level

The Indian Space Programme

Book Review By / Prof. Arup Dasgupta

Authors / Gurbir Singh

Publisher / Astrotalkuk Publications

The Indian Space Programme is a very interesting read. The book describes the evolution of India's activities in space in the context of Indian and global scientific and technological evolution. Reading the book is like walking down a broad avenue and exploring interesting side streets that appear from time to time. For example, the chapter on the rise of National Space Programmes opens with Tipu Sultan and his rocket battery and explores its improvement by Sir William Congreve and its subsequent use by the British in various battles including the American War of Independence. An interesting aside is the chapter on India's unknown rocketeer, Stephen H Smith who experimented with rocket mail in the 1900s in Calcutta and Sikkim.

The rise of rocketry during and after WWII covering legends like Goddard, Korolev, Oberth, Tsiolovsky and of course Von Braun are discussed and their contribution to the development of rocketry for both war and peace are highlighted. Vikram Sarabhai is introduced as a contemporary of Korolev and von Braun and as the man who, though not a rocket engineer, dreamt of Space for India.

The second chapter traces the growth of astronomy in India from Vedic times through the middle ages up to the renaissance in Europe which coincided with the colonial consolidation in India. One of the features of this period is the opening up of several modern observatories in India to serve the East India Company and later Great Britain. One of the significant outcomes of this period is the Great Trigonometrical Survey. Subsequent chapters describe the rise of Indian scientific institutions in detail both in the pre Independence and post-independence periods. This includes Indian scientific organizations like the Aligarh Scientific Society, the Indian Association for the Cultivation of Science and the Astronomical Society. Life and contributions of leading Indian scientists starting with J.C. Bose and including Homi Bhabha and Vikram Sarabhai have been covered in detail.

The role of Bhabha and Pandit Nehru, the then Prime Minister in putting India on the Space Map is discussed at length. It was Bhabha who appointed Vikram Sarabhai to lead INCOSPAR which was later to become ISRO. Physical Research Laboratory was the cradle where INCOSPAR and later ISRO were nourished. INCOSPAR was formed to consolidate India's contribution to COSPAR, an international body set up in 1958 to focus on international cooperation in space research. This is where the story of India's leap into space begins.

The book explores the many twists and turns, successes and failures of TERLS which started so modestly in the Church of Mary Magdalene in a little known hamlet called Thumba. In this narrative the introduction of the space activities of Pakistan is a bit jarring and out of place. Perhaps the author wished to contrast the space activities of the two newly independent nations but it really doesn't fit into the sequence of events. Also the inclusion of SITE in this chapter of the initial years is equally jarring. In fact, SITE and INSAT studies were contemporaneous and deserved a separate chapter.

ISRO Centres are dealt with in detail in Chapter 8 but the inclusion of Antrix in this section is misplaced. Antrix is not a part of ISRO and could have been dealt with in the chapter of commercialization. Nevertheless the story of Antrix is also the story of the coming of age of India's space program. The author's bias towards rockets becomes apparent again with three full chapters on SHAR, launch vehicles and the saga of the development of cryogenic engines. The treatment is detailed and very informative.

ISRO's Earth satellites and their applications, in contrast, are covered in one chapter entitled 'Satellites and Saris'. The title is rather confusing and the coverage, though comprehensive does not do justice to the achievements of ISRO in terms of peaceful uses of remote sensing, communications and broadcasting. Again, IRNSS gets a full chapter as does Human Spaceflight which as the author himself point out, is not on the priority list of ISRO activities. The chapter on Moon, Mars and Science gives an excellent account of these missions. The kind of in depth recounting is missing from 'Satellite and Saris'.

Space and National Security is dealt with sensitively. The dilemma of Peaceful Use of Outer Space promoted by Vikram Sarabhai and the demands of the protection of the nation is well covered. The symbiotic connection between ISRO and DRDO cannot be wished away but nor can the fact that India has played a leading role in three UNISPACE conferences which deal with the peaceful uses of outer space.

Overall, the book is very interesting, not only for its compilation of ISRO facts but also because it gives a synoptic view of India's space efforts in the background of geopolitics and national perceptions. Definitely a book worth buying to complement the several other books that are being published on the same topic by retired ISRO personnel.