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#geospatialbydefault

The world economy runs on GPS, Bloomberg wrote in 2018. This underscores the indispensability of location and geospatial data in a world that is getting increasingly digitalized. With new technologies, geospatial is going to get even more ubiquitous in the near future. **P18**

P06

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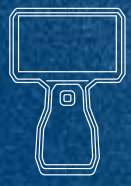
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Geospatial by default: Right precision at the right time

Prof. Arup Dasgupta
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When you want to measure the distance between two points, do you reach for a ruler or a vernier calliper, or the app in your mobile? This begs the question, what is by default? Could it be that what you are convenient with becomes 'by default'? But default changes with the situation, the precision and the tools at hand. Therefore, if you are just measuring distance on a map, a ruler might do, but in a precision machine shop, you would go for a vernier calliper. If you had neither, you might opt for the app.

Geospatial becomes by default when it is the right tool providing the right precision at the right time. How often do planners, decision makers and analysts reach for digital spatial data when they need some information? I believe the jury is still out on that. Digital spatial data is not easy to use. It needs expertise and tools which many or may not be readily available. In my last editorial, I had said that the time has come to define Geospatial 4.0, which would be appropriate for IR 4.0. It may be recalled that IR 4.0 is essentially coming together of machines and citizens in a synergetic manner such that the boundaries are blurred.

Perhaps the best example of such synergy is location applications, which enable citizens to navigate to points of interest using technologies like GPS, GIS and communications seamlessly, to satisfy their human need of, say, finding a Chinese restaurant. That is what I would call a geospatial by default usage. Location is not just for the common citizen but also for precision positioning required for surveying, precision agriculture and even in a battlefield. Which perhaps explains the brouhaha over the denial of the use of precision signals from Galileo, now that the UK is going to exit the European Union. Of course the UK could still use the US GPS, but precision GPS is not available by default, an issue that impacts mission-critical applications. Therefore, the call is out for a regional system for the UK.

Geospatial by default is subject to jurisdictional and regulatory issues, apart from the issues mentioned above, and perhaps the most important of issues that is forgotten in the euphoria of applications is the issue of privacy. It is well known that many countries have objected to street view images on the grounds of privacy. Blurring of car number plates and faces might be a solution, but what about security installations? As the UAV becomes ubiquitous, it also adds to the security and privacy issues. Would anyone be ready to have one's residence imaged at centimeter resolution for a smart city project?

24X7 tracking of mobile phones might be very useful to monitor traffic, but becomes invasive when the tracking goes individual and maps out a personal journey, as is the case with Google. Willingly sharing one's personal information, including place and time for a service, like roadside breakdown assistance, is one thing, but if that information is shared without permission to say a car dealer, then there is a problem. Many of these problems arise because of application of Artificial Intelligence on the huge volumes of data we generate unknowingly. Our digital life leaves a huge data trail from location to financial details and even food preferences.

In her book, *The Big Nine: How the Tech Titans and Their Thinking Machines Could Warp Humanity*, Amy Webb describes the way China is on the rampage with State supported AI. Among other things, it is also using AI to create an obedient populace where the 'trustworthy' will be allowed to roam 'everywhere under heaven' while the others will find it hard to 'take a single step'. This is a very chilling application of location.

However, once these issues are understood, analyzed and corrective measures taken, then geospatial can well become the default in a wide range of citizen-oriented applications. Many NGOs are overcoming the paucity of spatial information using satellite imagery and tablets to serve marginalized rural communities. UAVs are being used to map remote areas within forests to establish the rights of tribal populations. But the greatest technology that will help realize Geospatial 4.0 is AI-based analytics. The ultimate goal will be a deep learning system that will learn on its own without human programmers having to train the system. That is when we will have achieved geospatial as default.

REMOTE SENSING KEY TO SUSTAINABLE DEVELOPMENT

Artificial intelligence and Cloud computing will add wings to remote sensing applications and promote satellite data to play a greater role in our daily lives, feels **Xu Wen, President, China Siwei**

What are the main characteristics and advantages of China's earth observation system?

China has established three major earth observation systems dedicated to land, ocean and atmosphere, along with a comprehensive operation and management model integrating reception, processing, distribution and sharing. According to the technical characteristics of different loads and user needs, we have developed remote sensing applications in different fields such as land, ocean and atmosphere. These systems have helped in gaining advantages of high temporal, spatial and spectral resolution.

What is the position and core business of China Siwei Surveying & Mapping Technology Corporation (China Siwei) in the country's earth observation system?

China Siwei manages the country's land observation satellite image data resource. This includes formulation and implementation of observation planning, data receiving and processing, data distribution and sharing. The spatial resolution of our satellites ranges from 0.5 m to 30 m that corresponds with high, medium and low scales. Spectral bands range from visible light, infrared to microwave, and spectral resolution ranges from multispectral to hyperspectral. GF-4 is the only geostationary orbit earth observation satellite in the world in terms of time resolution. SuperView-1 is

the first commercial remote sensing satellite constellation with a high resolution of 0.5 m running on the same orbit plane that already has four satellites in orbit, with a revisit cycle of less than 24 hours.

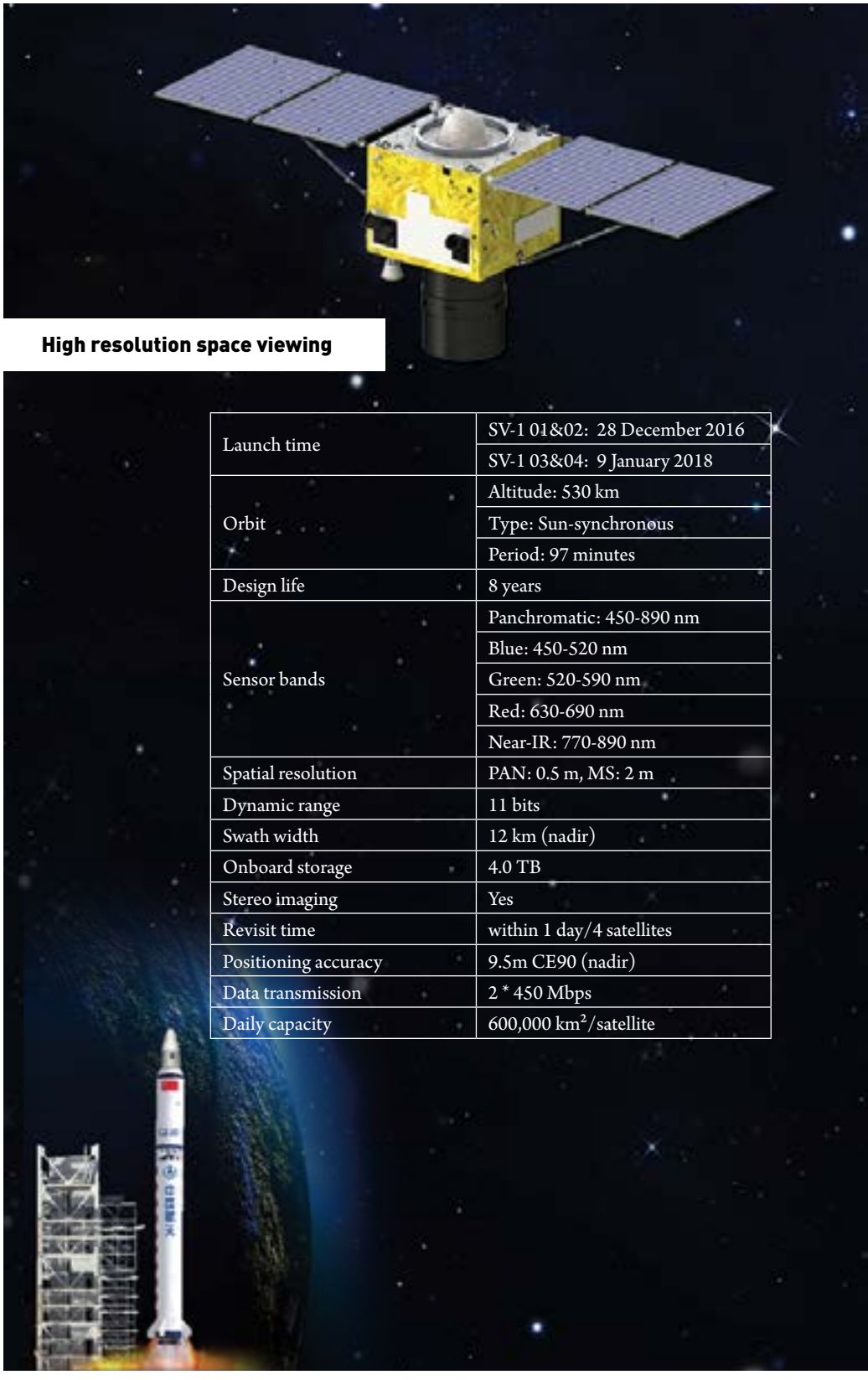
What are the main applications of your products?

These satellite data resources have been widely used in several fields, including national defense, security monitoring, energy industry, financial insurance, scientific research, national infrastructure, natural resource management and environmental monitoring.

What is the future development plan for SuperView-1 satellites and constellation?

SuperView-1 satellites are high resolution commercial satellites designed, developed and operated by China. They run along the same orbit at an altitude of 530 km and can revisit anywhere in the world in one day. These satellites are capable of collecting images on a swath of 12 km with a resolution of 0.5 m (nadir) in panchromatic and 2 m (nadir) in multispectral. SuperView-1 constellation is China's first commercial satellite constellation with high agility and multi-mode imaging capability, which offers four acquisition modes, including long trip, multi-strip, multi-point and stereo. The multi-strip mode can obtain images up to 60 km x 70 km at a given time.

SuperView-1 constellation is a huge project that will include more high resolution satellite clusters such as optical, radar, hyperspectral and video. In the first phase of this project, we spent two years to set up the four-star constellation and established the corresponding commercial operation service system. In future, we will gradually implement the constellation



High resolution space viewing

Launch time	SV-1 01&02: 28 December 2016
	SV-1 03&04: 9 January 2018
Orbit	Altitude: 530 km
	Type: Sun-synchronous
	Period: 97 minutes
Design life	8 years
Sensor bands	Panchromatic: 450-890 nm
	Blue: 450-520 nm
	Green: 520-590 nm
	Red: 630-690 nm
	Near-IR: 770-890 nm
Spatial resolution	PAN: 0.5 m, MS: 2 m
Dynamic range	11 bits
Swath width	12 km (nadir)
Onboard storage	4.0 TB
Stereo imaging	Yes
Revisit time	within 1 day/4 satellites
Positioning accuracy	9.5m CE90 (nadir)
Data transmission	2 * 450 Mbps
Daily capacity	600,000 km^2/satellite

> These satellite data resources have been widely used in many fields, including national defense, security monitoring, energy industry, financial insurance, scientific research, national infrastructure, natural resource management and environmental monitoring.

construction plan according to the market demand and changes. Meanwhile, we will optimize and improve the commercial service system to build it further into a high performance and high efficiency commercial satellite constellation.

SuperView-1 has been around for over two years. How has the market responded to it?

In the past two years, SuperView-1 has played an important role in many big domestic and international projects, especially in key national projects such as the third land and resource survey, national geo-information monitoring, etc. In the international market, SuperView-1 has been sold in more than twenty countries through cooperation with 10 resellers. Especially in Copernicus Space Component-Data Access-Very High Resolution Image 2018 project for the European Space Agency SuperView-1 has provided more than 1 million square kilometers image data. This shows that it is very popular in the international market. This is a good beginning, and we believe that SuperView-1 will have a bigger scope for development in future.

What is the relationship between China Siwei and SpaceWill Info?

SpaceWill is a holding subsidiary of China Siwei, acting as an experienced and dynamic marketing service team responsible for the commercialization of China Siwei's services in the global market. China Siwei fully supports SpaceWill in all businesses.

Do you intend to adjust your company's strategy so that artificial intelligence and Internet of Things can be applied to your products? How does your company use the new technology?

We are making use of modern information technologies such as big data, cloud computing and artificial intelligence to enhance the capability of satellite data processing. Some achievements have been made in the application of machine learning-based ground object recognition, dynamic change monitoring and other aspects. With the development of information technology, artificial intelligence and cloud computing, we believe that we can realize the transformation from data product sales mode to information application service mode. We can also promote the transformation of remote sensing application from B2B to B2C, and form a commercialized and industrialized development angle.

What are your prospects for the future?

After decades of development, remote sensing technology has become one of the key technologies for human beings to maintain ecological sustainable development. I believe that artificial intelligence and cloud computing will add wings to remote sensing applications and promote satellite data to play a greater role in people's daily life in future. I also hope that China Siwei and SpaceWill will have more opportunities to provide better services to users around the world.

航天世景
SPACE VIEW

BEFORE

2019

SPACE WILL

AFTER

SPACEVIEW IS SPACEWILL NOW

From January 28th 2019, SpaceView changed into **SpaceWill**.

SpaceWill is the global marketing operator for **SuperView-1** constellation, the resolution is 50 cm and revisiting in 1 day with 4 satellites. SpaceWill is authorized distributor for other Chinese EO satellite data, including **GF-4, GF-3, GF-2, GF-1, ZY-3, ZY-3 02C.**

Starting from 2016, SpaceWill have developed more than 40 resellers worldwide, the Chinese satellite data has been sold to more than 20 countries.

Based on the satellites resources, SpaceWill provides complete solution for various projects.

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Cyient, BlueBird launch unmanned aerial system

Cyient Solutions & Systems, a joint venture between Cyient and BlueBird Aero Systems, launched WanderB Vertical Take-Off & Landing (VTOL) UAS. The WanderB VTOL is a technologically advanced solution for military, disaster management and commercial applications.

The WanderB VTOL is an electric mini-UAS specially optimized for covert, "over-the-hill" operations, supporting extensive day and night ISR missions. It combines the advantages of fixed-wing operation with vertical take-off and landing, supporting significant range. WanderB offers a tactical advantage to defense, paramilitary and security forces for real-time critical intelligence.

Key Features

- The WanderB VTOL can operate even in strong winds and harsh weather conditions.
- The system offers high operational availability of 2.5 hours and has a mission range of 50 km (extendable up to 80 km).
- The system relays GPS-marked imagery to ground forces in real-time, enhancing situational awareness and mission execution capability.

FARO introduces SCENE 2019 for advanced 3D Reality Capture

FARO recently released SCENE 2019 — an advanced, integrated software platform. SCENE 2019 is especifically designed to evolve 3D reality capture, analysis and documentation experience across the public safety forensics segment for crash, crime, fire and security planning and traceable construction for Architecture, Engineering and Construction markets.

Its advanced functionality enables a section of a point cloud to be exported from SCENE into FARO Zone 3D software or other third-party software packages, where they can be displayed in color and manipulated as a 3D model. The innovation in SCENE 2019 allows the laser scanner CPU to be leveraged at nearly 100% of capacity and reduces scan processing time by up to 50%. This efficiency scales up as additional CPU cores are added.

Key Features

- Enables automated ghosting or easy removal of undesirable object.
- Enables a section of a point cloud to be exported from SCENE into FARO Zone 3D software, or other third-party software packages.
- 50% faster process scanning.

Topcon's MAGNET gets new 5.1 upgrade

Topcon Positioning Group has released the newest edition of its suite of software solutions — MAGNET 5.1. New updates to MAGNET Field include support for the new HiPer VR GNSS receiver, piping and trenching module with new capabilities specifically for the oil and gas segment, as well as the ability to orient and scale a PDF directly on a field controller and set it as a background image.

New additions to MAGNET Office include a reconfiguration of the portfolio, designed for simplicity, integrated workflows and better service plans. The service plans and subscriptions for MAGNET Office now include MAGNET Enterprise, license check-in and check-out, direct email support and an e-learning fundamentals course.

Additionally, the e-commerce user experience has been greatly improved with a new webstore. Direct email user support is currently offered at this web address.

Key Features

- Vast library of import / export file formats.
- Calculate, contour, and compare surfaces.
- Surface staking with automatic Digital Terrain Model creation.

Trimble unveils T7 Tablet for construction surveying

Trimble has introduced Trimble T7 Tablet, a lightweight and versatile device for construction surveying applications. Using Trimble Siteworks Software for construction surveying, the T7 Tablet provides real-time data to visualize cut/fill levels, calculate material volumes, check grade and communicate work orders to increase productivity and enable better decision making.

The tablet is the next step in the evolution of data collection portfolio. The T7 leverages the power of Windows 10 Professional, driven by an Intel Pentium 64-bit quad-core processor. The processor and operating system make it easy to process data in spreadsheets and run office software programs. Using third-party apps, front-and-rear-facing cameras allows contractors to video conference from the field for on-the-job support and capture high-definition videos and images.

Key Features

- 7-inch screen that supports pinch, tap and slide gestures and a digital keyboard.
- Meets the stringent MIL-STD-810G for drops, vibration, immersion and temperature extremes.
- Built can withstand wear-and-tear of daily construction work in various weather conditions.

Rightware, HERE Kanzi Maps for advanced visualization

Rightware and HERE Technologies announced the launch of Kanzi Maps — the new map renderer from Rightware, with fresh mapping data from HERE for evaluation and development by joint customers. The solution is available as a Kanzi Maps pre-release from Rightware and under a HERE Open Location Platform (OLP) evaluation license.

Automakers now have the opportunity to visualize advanced automotive data, including highly accurate maps, lane data, and other location-based information creatively across next-generation digital cockpits. Kanzi Maps integrates directly into the Kanzi UI development toolchain, enabling future autonomous driving use cases by fusing map, sensor, ADAS and other data, while remaining true to the OEM's visual brand identity.

Key Features

- Brings rendering of maps and the main automotive UI into the same scene graph.
- Enables quick design iterations and efficient development of production-quality HMIs.
- Provides interconnectivity and the ideal means to implement navigation scenes of the future.

Airbus releases new version of OneAtlas Platform

Airbus has come up with a new version of OneAtlas Platform. The platform is a unique collaborative environment to easily access premium imagery, perform large-scale image processing, extract industry-specific insights and benefit from Airbus assets for solution development.

The OneAtlas Platform provides access to data within the Living Library as well as value-added layers, Basemap and WorldDEM. The Living Library contains multi-resolution and premium optical satellite data, updated on a daily basis and immediately available via streaming, download and API.

Key Features

- New change detection capabilities that allow monitoring and analysis using machine learning.
- Ocean Finder for maritime-focused applications that allows users to directly order satellite-based maritime detection reports.
- New API service that delivers detailed crop analytics with easy-to-use vegetation maps.

The platform also combines premium imagery and industry-leading expertise to deliver thematic services.

BRITAIN'S BREXIT BIND

OWN GNSS OR NOT?

There is no denying that the United Kingdom has the technical know-how to build its own satellite navigation system, but spending billions and decades on a totally new setup just doesn't sound rational.

By Anusuya Datta

March 31, 2019. That's when Brexit comes into effect. That's also when UK will no longer be part of the prestigious Galileo satellite navigation program of the European Commission. That is unless some other deal is hammered out, albeit on a later date. But as of now, this is final.

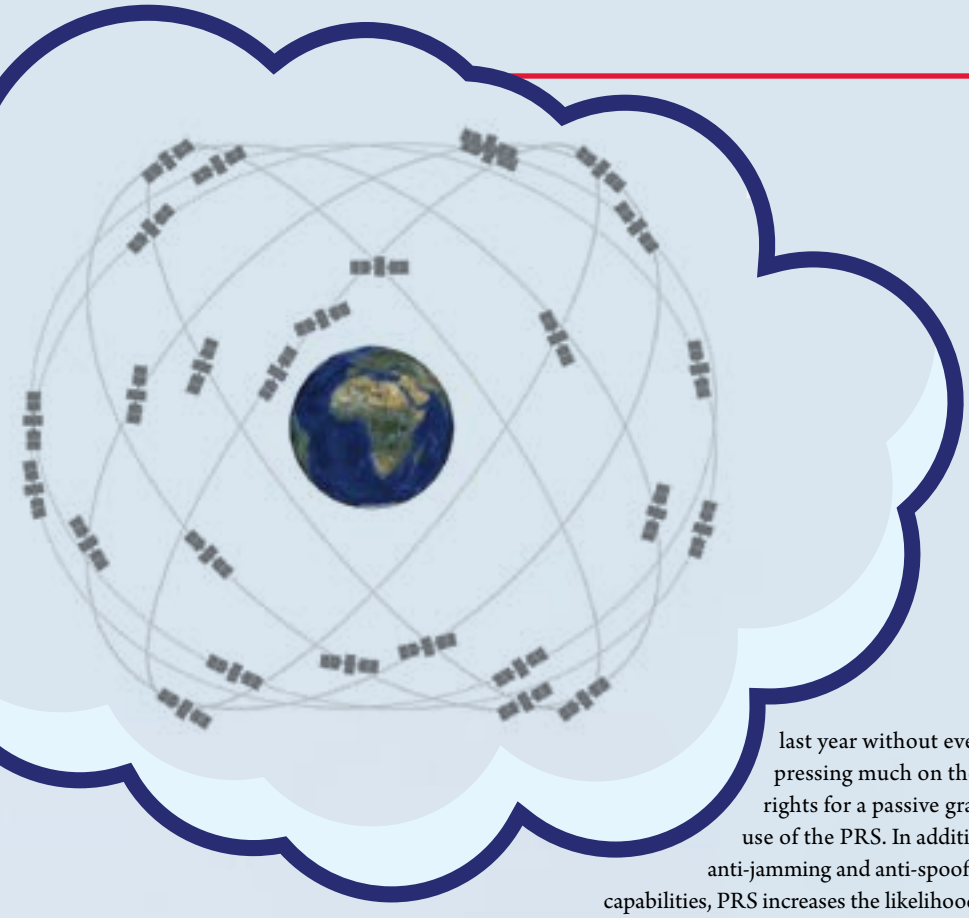
After investing £1.4 billion and years into Galileo, Britain finally walked away from the project in November 2018. Now, the UK government has set up a taskforce to look into the proposal to launch a satellite navigation constellation of its own. It has even gone one step ahead and earmarked about £92 million for the project ($118 million) from the Brexit readiness fund.

While there is no denying that the UK has the technical know-how to build its own satellite navigation system, spending billions and decades on a totally new system just doesn't sound rational, unless of course it becomes a matter of prestige.

Why it makes little sense?

Satellite navigation systems are expensive and complicated affair. They are usually known to face delays and cost over-runs. Galileo itself faced decades of delays, difficulties and additional costs. It would have taken 18 years to build before being fully operational in 2021. In this background, it would take many, many years before UK can even have a system in orbit.

The cost of building Galileo has already touched almost $11.6 billion from its initial estimate of $3 billion. Then there is an annual maintenance cost. For Galileo, it is estimated to be around €800 million ($927 million). This is way



more than double the current total budget of the UK Space Agency, which was £371 million ($477 million) in 2017.

"This is pie in the sky: the costs would dwarf the entire UK space budget, all for a system redundant, and likely years behind and second tier, to that of its close allies!" Planet CEO Will Marshall wrote in a recent blog post.

There is more — UK doesn't launch its own satellites. Either the US, Europe or India has to do the job for it. Galileo satellites are currently launched from ESA's site in French Guiana.

Will Galileo be inaccessible to UK?

Not yet. Not in the near future. The civilian service signals of Galileo are free, accessible to all — including UK — and are not at the center of dispute. What EU has refused to grant to UK post Brexit is access to the Public Regulated Service (PRS) of Galileo — a secure and encrypted signal for defense and government purposes that is meant solely for EU member states.

Also, UK gave away the game too early when it walked out of the negotiations late last year without even pressing much on the rights for a passive grade use of the PRS. In addition to anti-jamming and anti-spoofing capabilities, PRS increases the likelihood of continuous availability of the Signal-in-Space and is therefore beneficial to military and security agencies.

Further, British companies can't participate in contracts for developing and building PRS anymore, because the terms and conditions bar companies of "third countries" — which is what UK will become post Brexit — from participating in the development of security-sensitive projects. This is simply because access to PRS is limited to only EU members and not to a "third country". And this is not some overnight development. Britain has always known the terms and conditions when it signed on the dotted line.

How PRS denial doesn't really affect UK armed forces?

It is not as if denial of Galileo PRS services to UK will severely impact the British armed forces. This is because the Galileo PRS doesn't exist yet and is expected to be operational only around 2020. The British military can simply keep on doing what it has been doing so far — rely on GPS services.

It is true that governments don't want to rely on "outsiders" when it comes to military or other security related matters. While the whole world was running on GPS — the satellite navigation system owned and operated by the US Air Force — Russia built its own satellite system called GLONASS, which has been operational since 1993 and is global in coverage. China has BeiDou, which went global in January 2019. Currently, Galileo's coverage is nearly global with only a few gaps.

Other countries like India and Japan have built their own regional satellite systems. The Indian Regional Navigation Satellite System (now called NavIC) has been operational for some time now and offers coverage over the Indian subcontinent. The Indian Space Research Organisation (ISRO) was asked to work on an indigenous satnav system after the US denied GPS signals to India during the Kargil war with Pakistan in 1999. Japan has been working on its own Quasi-Zenith Satellite System (QZSS) for some years now. Regional satnav systems are independent positioning systems whose main objective is to provide reliable position, navigation and timing services over a particular country and its neighborhood.

But in the case of UK, there seems to be hardly any military compulsion. It is a close political ally of the US, and it is highly unlikely that the two will ever get on the wrong side of each other, let alone get into a war. Similarly, there is little chance of UK entering into a war with EU in the near future, making the hoarse cries for "super sensitive signals" for military unnecessary.

Post Brexit, EU has refused to grant UK access to the Public Regulated Service (PRS) of Galileo — a secure and encrypted signal for defense and government purposes meant solely for EU member states

What are the alternatives?

Instead of building a totally new system from scratch, UK can look at setting up a regional navigation system like India or Japan to boost local coverage. But then Europe already has the European Geostationary Navigation Overlay Service. EGNOS is Europe's regional satellite-based augmentation system that is used to improve the performance of existing GNSS systems such as GPS and Galileo. It has been deployed to provide safety of life navigation services to aviation, maritime and land-based users over most of Europe.

However, this augmentation works only over Europe and not outside. Another alternative before UK is to go for further strengthening of ties with the US, committing to complete reliance on GPS. UK, along with Australia and Canada, already participates in a combined space command with the US and this could be taken forward.

Space rivalries have often been less about rationale and more about countries' prestige. As Marshall categorically spelt out, with Brexit, the UK will be a country lost in space. "The UK space industry represents €12B in business and about 40,000 UK jobs, all of which are at risk with Brexit." This is when the UK space sector is very closely woven with the rest of Europe.

Galileo is funded by the European Union but managed and operated by the European Global Navigation Satellite Systems Agency (GSA) and European Space Agency (ESA). ESA functions independently of EU and therefore the UK will remain a member of ESA, but can't participate in any EU-funded work of ESA. UK's relationship with the ESA could be the next casualty since ESA's agenda is set by the EU.

"To be a member of ESA and not the EU will be like Norway in single market but not in the EU: accepting all the plans and rules (and payments!) but without a voice at the table." Marshall couldn't have said it better.

Anusuya Datta, Executive Editor
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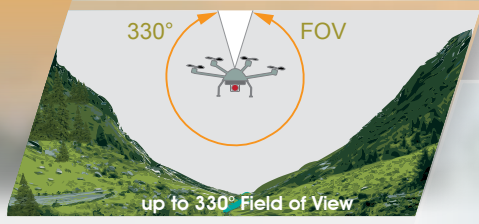

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Satellites Intrinsic to Life as we Know on Earth Today

Do you think satellites today have become increasingly vital for businesses?

Life on earth, as we know it, is possible only with satellites. Telecommunications, navigation, agriculture, weather forecasting, oil & gas exploration, disaster response and recovery, all rely on satellites and space technology. And our dependence is only growing. Autonomous vehicles, 5G, wireless technology and the Internet of Things, all require satellites to fulfill their promise. Fortunately, the demands being placed on satellites and space are being enabled by advances on the ground. For example, the vast amount of data generated from space can now be processed and transformed into actionable insights with the benefit of low-cost storage and computational power from cloud infrastructure providers and advances in machine learning.

There is a lot of talk of "democratization of space". What exactly does this entail?

There was a time when space-based technology was only available to governments. Today, satellite imagery, GPS-enabled navigation and satellite communications are widely available and used by billions of people every day. These technologies are enhancing the quality of life on earth by improving connectivity, transparency, decision making, safety, security and access to resources.

How can we create a more humane and just world by democratizing access to space-based technologies?

Spaced-based technologies are already making a meaningful contribution to a more humane and just world: helping small holder farmers in Africa become more productive, supporting efforts to eradicate polio, improving access to clean water and sanitation, documenting war crimes, thwarting illegal poaching and freeing modern day slaves from illegal fishing boats in Southeast Asia.

What is the mission of the World Economic Forum's Global Future Council on Space Technologies and what all is being done to achieve this mission?

The World Economic Forum has identified space technology as one of the critical enabling technologies of the Fourth Industrial Revolution. The World Economic Global Future Council on Space Technologies, which I co-chair, is focused on identifying and addressing important global governance gaps. One of those gaps relates to the fact that an increasing number of countries and companies are launching satellites, including some very large constellations with hundreds of satellites. As a result, the risk of collision with space debris is increasing. In order to help ensure the future viability of Earth orbit as a global commons, we have developed a Space Sustainability Rating framework.

In partnership with the XPRIZE Foundation, we have also developed new global competition. With this, we are seeking to increase awareness about the importance of space technology and inspire development of new ideas to use space technology to advance Sustainable Development Goals.

Jeff Tarr is the former CEO of DigitalGlobe and current **Co-Chair of the World Economic Forum Future Council on Space Technologies**. He is also senior advisor to TPG. We caught up with him in San Francisco, where he was moderating a panel of space industry leaders. During a brief interaction, Tarr told us about the current state of the industry and important future trends.

The geospatial industry, earth observation in particular, is going through massive transformation. What are the major trends that you see?

The most important trend, in my view, is the availability of increasingly inexpensive storage and computing capabilities in the Cloud and advances in machine learning that can make sense of the vast amount of data from space. A few years ago, this data was locked away in data centers. Now it is accessible everywhere and is being used by thousands of developers around the globe to unlock new insights to drive advances in decision making, enable new commercial applications and improve the state of the world.

There has been a rise in the number of startups and new companies in the last few years that are driving dramatic innovations such as nanosats, reusable boosters and new software technologies for real-time data access and analysis. How is this changing the space industry and opening up further innovation?

More satellites mean more data, which means more opportunities for innovation on the ground.

Which are the companies that can stay relevant in this disruptive environment?

There's a common saying in our industry: "space is hard." When people hear this, they first think about technological challenges. I don't want to underplay these. But equally daunting are financial and go-to-market challenges. Those who are in the satellite business must invest a lot of capital and do so years before the launch. They then must not only generate some revenue — they must generate enough revenue to replenish their constellations and deliver a return to investors. In my view, in this race, the advantage goes to the incumbents, who already have revenue-generating satellites on orbit and existing sales channels and customer relationships.

> The most important trend is the availability of increasingly inexpensive storage and computing capabilities in the Cloud and advances in machine learning that can make sense of the vast amount of data from space

As for new entrants, I believe the best opportunities lie in data and analytics. It is easier than ever for early-stage software and analytics companies to access large geospatial data sets from multiple satellite operators without having to invest capital in satellites. This is where I believe we will see a lot of new business formation, innovation and attractive returns. I am especially excited about new players with a strong vertical focus.

Where do you see the satellite and EO industry heading? How do you see its growth five years down the line?

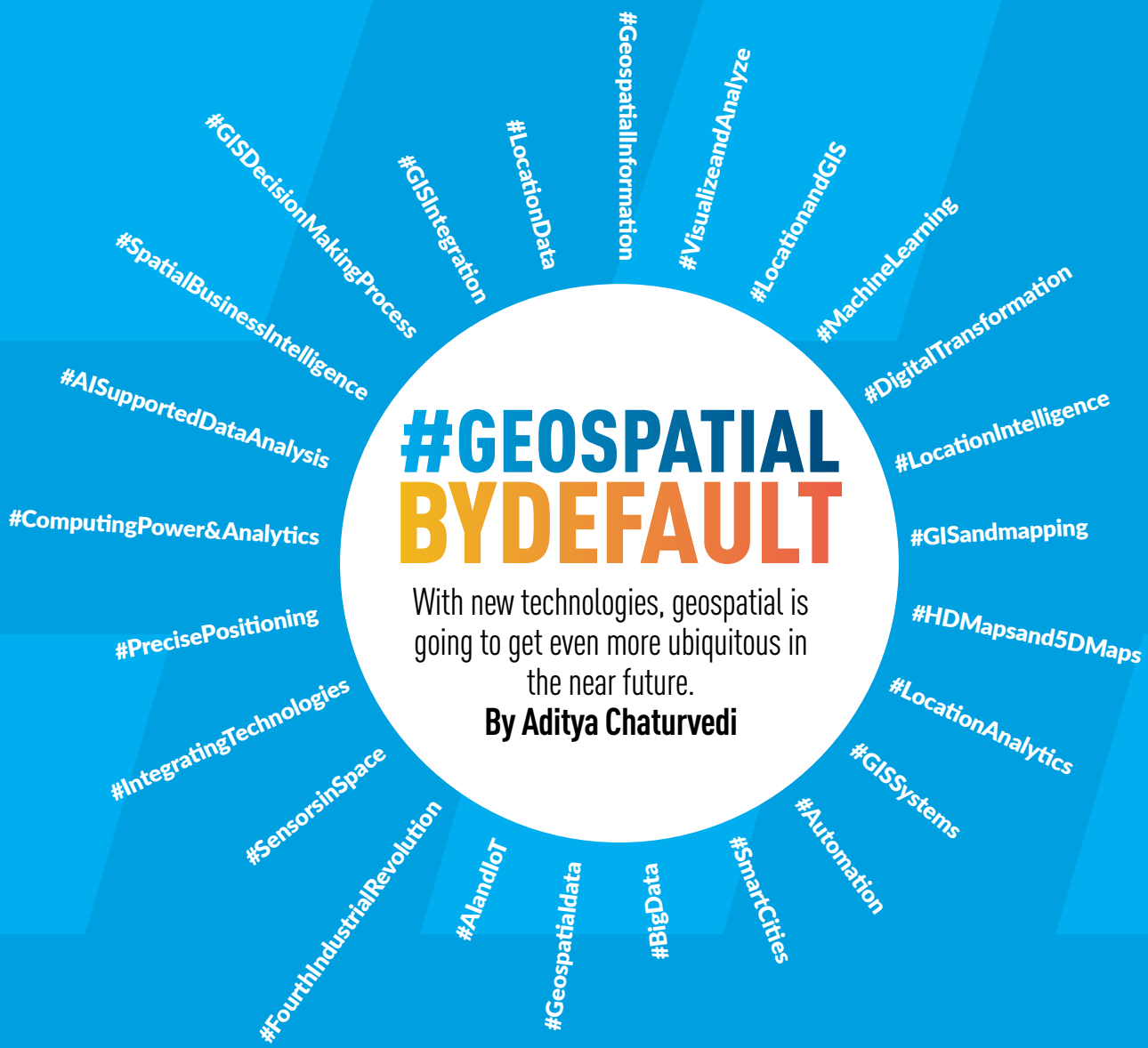
I believe we will see continued advances in spatial, temporal and spectral resolution. We will also see continued reductions in the cost of storage and compute, and advances in analytics. Taken together, we will continue to evolve towards the creation of a true "Digital Globe" — a term coined by Walter Scott, the founder of DigitalGlobe, the company. This will be a constantly updated digital representation of our changing planet that will be queried with increasingly sophisticated tools and analytics. The result will be a robust ecosystem of innovators, bringing continued advances in transportation, communication, environment, food and water security, global health and disaster response and recovery.

How has geospatial become by-default in the digitalization process that the world is undergoing?

An important aspect of the Fourth Industrial Revolution is the digitalization of everything. In order to express everything in terms of data, one needs both location and geospatial context. Autonomous mobility and the Internet of Things are two important technological trends that require location and geospatial context. This requires both satellites in space and a wide range of geospatial technologies on the ground.

Does the future lie in integrating technologies? How should geospatial companies make themselves more responsive towards such technological advancements, more from an enabler point of view?

The most successful companies start with customer needs and then bring together technologies and data sources that meet those needs better than any alternative. Those that do will win. And the winners will make our world a better place.



"I will stop the motor of the world." Atlas Shrugged, 1957
"The world economy runs on GPS." Bloomberg, 2018.
So quite literally, switching off the GPS would be tantamount to stopping the motor of the world economy. This underscores the indispensability of location and geospatial data, and its utility in a world that is getting increasingly digitalized.

As we move towards the Fourth Industrial Revolution, geospatial is becoming ubiquitous and by default the go-to technology in all domains. #GeospatialByDefault embodies this reality and positions geospatial as the great enabler, and the linchpin of future innovation. Be it our day-to-day activities or cutting edge futuristic research, modern day agriculture, construction, or business planning, geo information has become an essential prerequisite in every field.

"Geospatial technology has always been the backbone of society," says Steven W Berglund, President & CEO, Trimble. However, the transformative potential of this technology is yet to be fully harnessed. "Geospatial data allows us to create digital versions of the

physical world via sensor technology for reality capture. This opens up a world of possibilities," says Ola Rollen, President & CEO, Hexagon.

While the industry leaders have spoken highly of the technology, its adoption is principally dependent on government agencies, including defense. Though private industry and NGOs are also taking this up increasingly, they have not yet reached the level of governmental usage. For example, consider the usage by one department of the Government of India.

The Department of Agriculture, Cooperation and Farmers Welfare in India established the Mahalanobis National Crop Forecast Centre, in 2012, for operationalization of technology developed in the Indian Space Research Organisation (ISRO), for crop production forecasting. The department has another center called Soil and Land Use Survey of India, which uses satellite data for soil resources mapping. Currently, it is using space technology for its various programs and areas, such as, Forecasting Agricultural Output using Space, Agrometeorology and Land-based Observations (FASAL) project, Coordinated Horticulture Assessment using Management using geoiNformatics (CHAMAN) project, National Agricultural Drought Assessment and Monitoring System (NADAMS), Rice Fallow Area Mapping and intensification, geo tagging of infrastructure and assets created under Rashtriya Krishi Vikas Yojana, and Crop Insurance.

"Geospatial information is beginning to play a role in this (digital) transformation and is being seen as one of the fundamental keys for enabling digital integration," emphasizes Jack Dangermond, Founder & President, Esri.

With such adoption of geospatial tools, not only from space, but also by using UAVs and other evolving technologies, Geospatial By Default is making significant progress. New trends in geospatial technologies are expected to impact multiple sectors and foster path-breaking innovation. What are these innovations and how do they impact Geospatial By Default?

Advancements in Data Analytics

As Big Data gets bigger and the world gets more digitalized, businesses must become more analytics driven to sharpen their competitive edge. While this is not easy for an industry that traditionally has been product-oriented, the geospatial industry has finally understood the need for analytics. The start-up community has fostered a rapid pace of innovation, and the Location Analytics and Space 2.0 communities in particular have completely challenged the incumbent business models and cost structures. This was reflected in a Geospatial World survey of 100+ CEOs and business leaders of the industry, where majority of respondents viewed increasing data analytical capabilities as one of their top areas for investment over the next three years.

AI, ML and DL: Like all technology domains, artificial intelligence tools like machine and deep learning will drive the next generation of intelligent applications across different verticals. Eric A Miller, President & COO, Laser Technology, says, "The ongoing focus for the geospatial industry should be to embrace new technologies while improving workflow efficiency and overall operator acceptance."

Naturally, the Geospatial World survey also saw business leaders voting for integration of artificial intelligence, machine learning and Big Data with geospatial as the next big thing for the industry. Further, they felt that the optimal use of Data Analytics and predictive technologies would be the top technology challenges facing the industry in the next three years.

Data is always more valuable in combination with more data, and proper machine learning requires all the data, all the time. So the integration of data — and the technology that makes it most useful — will continue to be a focus, underlines Mark Johnson, CEO of Descartes Labs, an AI-focused start-up which is building the first live atlas of the planet. "Geospatial data gives companies the ability to understand what's happening in the world around them. Data is becoming more critical to business success. Understanding the planet, supply chain and organizations' operations is only possible with data that has the critical context of time and place," he says.

Active sensors like Synthetic Aperture Radar (SAR) can provide day and night coverage and eliminate obstruction by clouds. An interesting application of SAR is in the detection of 'dark' ships, i.e. ships engaged in illegal activities. The small satellite constellation from Spire, an earth observation start-up, tracks ships through their Automatic Identification System. When such a transmission ceases then the data is merged with a SAR satellite data to get the position of the ship and track it down. Similarly, Capgemini has developed a machine learning framework that uses SAR satellite imagery to identify woodland with newly planted trees.

Efficient analytics in short time spans can lead to groundbreaking developments. Planet, which currently operates 200+ satellites, in 2017 completed its Mission One—to image the entire Earth every day

2.7 zetabytes
Of data exist in the digital universe today

90%
Of this data was generated in the last two years alone

3.5 billion
Searches are generated every day on Google which processes over 40,000 search queries every second

2.32 billion
Monthly active Facebook users, as of the fourth quarter of 2018

30%
Of the world's population share their views, what they like, their location, their vacation details on Facebook

24×7. In 2018, it also launched a platform to harness and analyze all this information. The platform, which will index physical change on Earth the same way Google indexed the internet, as Will Marshall puts it, aims to provide users ways to get the information they need to make smarter decisions.

Geospatial AI or Geo.AI: Geospatial AI, or simply Geo.AI, is a subset of AI that combines the exactitude of GIS with the razor-sharp analysis and solution-based approach of AI. It is a new form of machine learning based on geographic content. Through intelligent algorithms, data classification and smart predictive analysis, Geo.AI can come in handy in a number of sectors, including those that use location and GIS. Ride-sharing companies, logistics and supply firms, farming, surveying and infrastructure are some of the prominent examples. In logistics and supply chain, Geo.AI can plug the gaps and gather more accurate location information that can streamline product delivery and save time.

Constant flow of data

Analytics requires a constant flow of data from a variety of sources as well as opportunistic data like social media, transactional data, data from neo-geographers, volunteered data and data like smartphone locations, to name a few.

Among the data sources available are satellite data and UAV data. One of the banes of satellite remote sensing has been the unavailability of 24X7 coverage, the other one being the problem of cloud cover and the limitation of daytime imaging. While the latter has been solved through SAR satellites, the former continues to bedevil the remote sensing community. The roadblock to 24X7 coverage has been the cost of conventional satellites, both optical and radar. Enter small satellites, seamless data flow, drones and there is a host of possibilities.

Small Satellites: Planet spearheaded a paradigm shift in the satellite industry after it launched satellites as big as breadboxes using miniaturization and off-the-shelf parts. In the past seven years, 663 commercial small satellites have been built, over 80% of them for remote sensing, 75% by Planet and Spire.

Reduction in the size of satellites goes hand-in-hand with increased efficiency and reduced cost. For instance, with over 200 satellites in orbit, Planet is now capable of imaging the Earth once per day. Now, the company wants to turn their data into a search engine of the world via its next mission. Such advancements not only promote innovation and democratize access to space, but also mean easy availability of a lot of data. Profusion in the availability of EO data has led to better insights, improvement in data analytics and service delivery.

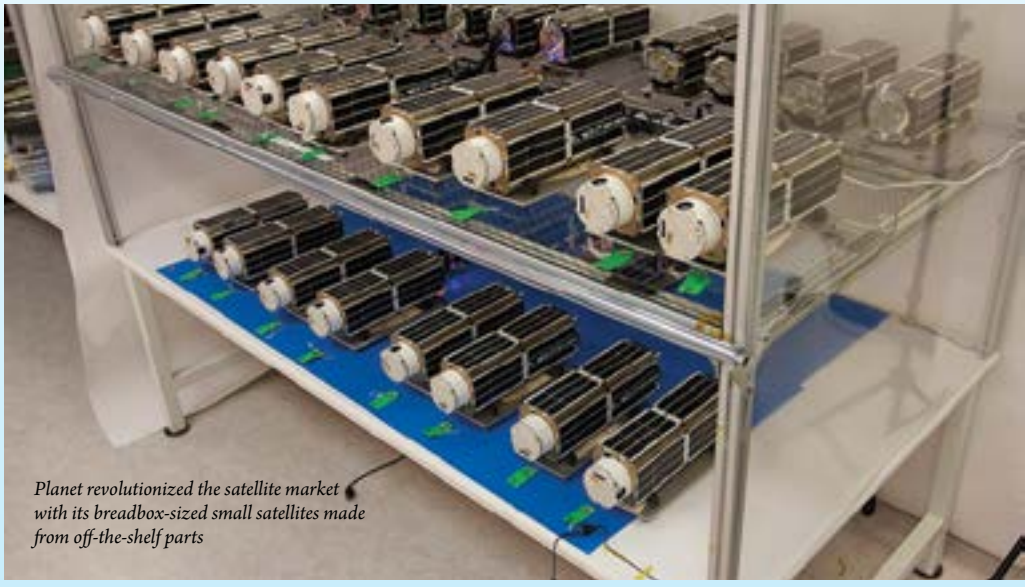
Robbie Schingler, Co-Founder and Chief Strategy Officer, Planet, says, "Miniaturization and pervasiveness of sensors have drastically decreased the cost of deploying sensors into space. Naturally, we now have more near real-time data about the world than we've ever had before. Today, we have very high-performing, yet very low-cost compact satellites and sensors in space. This trend is going to continue."

Such 24X7 coverage is found extremely useful when cloud cover is an issue, particularly for crop watching, disaster situations and where security is involved. We have seen how such imagery has been used to examine the effects of the recent aerial action by India against terrorist hideouts in Pakistan.

Drones: Drones are versatile as a platform for various sensors and are in use from logistics to defense. With favorable drone policies and lower prices, they are being used for aerial mapping. The industry is likely to witness rapid expansion of drone mapping in sectors like agriculture, mining and construction, and is expected to cross the $100 billion mark by 2020, according to a Goldman Sachs research report. "Use of drones as a data capture tool has been a big technology game changer for the geospatial industry in recent times," feels Anil Nanduri, General Manager, Drone Group, Intel.

Drones, equipped with high precision sensors, can be flown over farms to gather data, which could be utilized to map pest damage, crop stress and per hectare yield using GIS analytics. Drone imagery can help farmers remotely monitor activities on their land. AI, Virtual Reality and LiDAR sensors are some of the technologies that will radically transform drone applications. Convergence of drone technology with machine learning and AI helps infrastructure managers identify quality defects, malfunctions, or inventory shortages much faster than any other method.

Chinese drone manufacturer DJI has emerged as the leading drone maker and holds the lion's share of the drone market. Last year, DJI launched its smallest drone,



Planet revolutionized the satellite market with its breadbox-sized small satellites made from off-the-shelf parts

the Mavic Air, which was of the height of an average smartphone. The device is capable of a variety of features, the snazziest being "Asteroid", which creates a 32-megapixel 360-degree panorama that can be pulled back and viewed as a "planetoid".

Democratization of LiDAR: LiDAR sensors have been around for sometime and are being used extensively for aerial surveys and terrestrial mapping. Till about two years back, it was only the geospatial and infrastructure community that was talking about it. Suddenly, this new major sensor is disrupting the automotive industry. The escalating demand for driverless cars is providing the automobile industry with ample opportunities to embed LiDAR in their systems. Massive investments from venture capitalists and a flurry of partnerships and acquisitions in the LiDAR domain hint at the size of this burgeoning market. According to a December 2018 report by Market and Markets, the global LiDAR market is expected to cross $3 billion by 2022 and will witness a compound annual growth rate (CAGR) of more than 12.1% in the given forecast period.

And it is not just the automotive sector, the demand for 3D scanning and HD maps has seen LiDAR sensors going up on drones. This means that the traditionally bulky and expensive sensors had to be drastically modified, making them smaller, lighter and of course, cheaper. Professional LiDAR surveying scanners are now available for as little as $100,000 and weigh around 7kg.

Crowdsourcing: Smartphones in every hand has seen crowdsourced data emerge as one of the primary sources. Crowdsourcing of data can be both voluntary and opportunistic. Smartphone locations are harvested to determine traffic flow, thereby locating snarls and suggesting alternate routes. Another source of opportunistic data, apart from smartphones, is miniature wearable sensors in jackets, smart watches and fitness trackers that have become integral to sports, medicine and other related sectors.

With the help of simple smartphone applications, people can volunteer real-time conditions. For example, traffic congestion, current details, peak hours, time taken to cross a particular stretch, etc. is fed in real time to an analytics engine which can then suggest alternate routes. Post facto these data sets can be used to plan out road widening, accident zones, synchronization of traffic signals and so forth. Crowdsourcing ultimately enhances the accuracy because of thousands of users contributing to the database, thus reducing the occurrence of errors through a process of curation.

The escalating demand for driverless cars is providing the automobile industry with ample opportunities to embed LiDAR in their systems

Scanners: Other than smartphones and tablets, 3D scanners are a good example of handheld devices. The operating mechanism of a 3D scanner is similar to that of a video camera, but it captures an object in 3D while continuously scanning it. Companies like Xbox, Matter and Form and B&Q are manufacturing 3D scanners that are compact and lite — some of them weigh less than a pound.

Seamless availability of EO

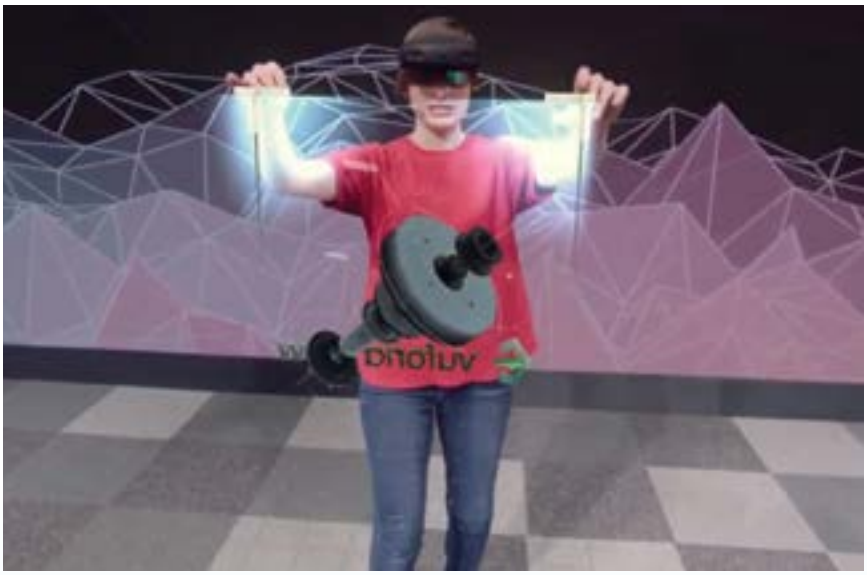
Innovative launch options: Ease of manufacturing small satellites has seen the number of such satellites ready for launch far exceeding the number of available launchers. For instance, in 2017, 50 British small satellites couldn't find a launcher. That is because big launchers like the SpaceX's Falcon 9 or ISRO's PSLV need a minimum payload weight to optimize the huge costs. Thus, small satellites need to wait till a piggyback opportunity is found. This may soon come to an end as many government and private agencies in USA, India, Russia and China are working on dedicated small satellite launchers to fill in the demand-supply gap. These small launchers can be assembled and launched very fast and will enable quick replacement of malfunctioning small satellites in orbit.

Other dedicated small launchers, ride-sharing options have also come up in a big way and will see major traction in times to come. The new chapter that started with ISRO launching a record 104 satellites – 103 of them small in size, of which 101 from foreign countries – has only advanced leaps and bounds in the past years. Smallsats piggy riding big satellites on a rocket has become a norm, and ride-share organizing on rockets a legitimate business. Last year, SpaceX set a new milestone when it launched a smallsat only mission called SSO-A: SmallSat Express. The mission was organized by SpaceFlight Industries and had satellites from more than 30 countries.

Ground station as a service: A ground station is a crucial intermediate link that receives transmitted information from satellites and then processes and distributes it. There are companies providing "infrastructure as a service" to the space economy by aggregating ground stations and enabling communications for satellite operators.

As Christopher Richins, CEO, RBC Signals, says, "RBC Signals is able to aggregate the excess capacity of ground stations all over the world and bundle that together and offer it as a single service. The platform that we have developed allows us to do it very simply for our customers. With a single API interface, they can access the global network of ground stations."

What initially began with ridesharing of small satellite payloads took a gigantic leap last year when Amazon launched its AWS (Amazon Web Services) Ground Station, thus pioneering another new trend that is poised to transform the commercial space industry. Amazon Web Service will provide ground



Microsoft Hololens 2 is an immersive, instinctual and comfortable experience for first-line workers.

station as a service through a network of 12 satellite facilities around the world, and by next year, the tech giant intends to start operations.

Better communication: Better space communication infrastructure enables faster data downloads. So, initiatives like SpaceDataHighway, touted as the world's first 'optical fibre in the sky', will be able to transfer very high-volumes of data from LEO and even from the International Space Station at lightning speed. As Evert Dudok, Head of the Communications, Intelligence & Security (CIS) business line at Airbus Defence and Space, says, "SpaceDataHighway is no longer science fiction. It will revolutionize satellite communications and help to keep the European space industry at the forefront of technology and innovative services."

Various 'Realities'

Virtual Reality, Augmented Reality and Mixed Reality are technologies that have moved from the gaming world to geospatial, thereby enhancing geospatial visualization and analysis. Virtual Reality provides an immersive experience in which the viewer can move around in a virtual environment and interact with virtual objects. Fly throughs enable close examination of terrains and walk throughs help in understanding levels of detail in a planned structure.

Augmented Reality enables the overlay of virtual objects on a real world scene. Perhaps the best example is the game Pokemon Go that has elements of location, hence geography built into it. A more serious example is the overlay of information about an object in the view of a smartphone camera, which utilizes the location of the viewer, the imaged scene and a library of information about the scene. The display of the information is on the screen or on a device like Google Glass.

Mixed Reality is like Augmented Reality with the addition of the ability to anchor the virtual imagery to the real world. Leica Pegasus Backpack is a wearable reality capture sensor platform. The backpack's ergonomic design combines five cameras offering fully calibrated 360 degrees view and two LiDAR profilers with an ultra-light carbon fibre chassis. It enables extensive and efficient indoor and outdoor documentation with high accuracy. Microsoft recently launched HoloLens 2 in an effort to bringing augmented reality into the workplace with its new Microsoft HoloLens 2 headset. It is "more immersive, instinctual and comfortable experience for first-line workers", according to Microsoft. With the new Azure Kinect sensor, the HoloLens 2 headset has optimized eye tracking. Paired with the Azure Digital Twins service, users can see machine information and data through IoT sensors with just a glance.

Maps for machines

Maps were earlier designed for human-to-human spatial interaction. However, with the advent of digitization and requirement for high precision, maps are now being designed keeping in mind the human-machine and machine-machine interfaces. Instantaneous maps are created, read and analyzed by machines, a typical example being a self-driving car or a robotic assistant to help you in a mall. "In the era of autonomous driving, cars will share and receive real-time data about what's happening on the road, and this is where HD maps and advanced connectivity will play a crucial role," believes Ian Huh, SVP IoT/data Division Head at SK Telecom.

"Making maps visually pleasing and readable for people has always been a top priority. However, machines do not need a positive user experience. They require high precision and up-to-date information," says Nikhil Naikal, CEO, Mapper, a start-up making globally scalable ecosystem for on-demand creation, validation and maintenance of highly accurate maps that are crucial to the success of self-driving vehicles. These maps also serve as digital infrastructure for safe, efficient and reliable automation across a spectrum of verticals.

There is, however, a downside to HD maps. Not only are they expensive, but also a huge amount of data cannot be transmitted over normal cellular networks. One way of dealing with this problem is categorization of information: the one that requires sharing real-time and the other that isn't worthy of it.

HERE is looking at building a global mapping system that will provide HD maps to autonomous cars. For this project, the company has forged partnerships in China, Japan and Korea. "Automakers building self-driving cars are thinking globally and want an HD map that can scale with them. This simplified way of sourcing the map will also help reduce development time and unnecessary cost," Ralf Herrtwich, SVP Services at HERE Technologies, had said recently.

German automaker Daimler has partnered with HERE Technologies to make HERE HD Live Map an integral part of its autonomous

driving technology. BMW has also announced that it will be using these maps.

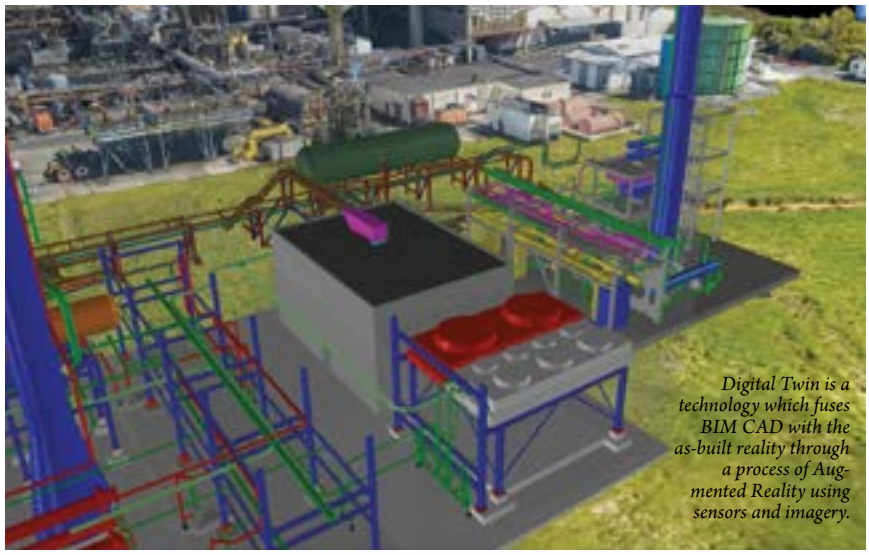
Impact on Applications

These technical developments have resulted in some very significant applications that were not possible to implement earlier due to the paucity of relevant data and the kind of computing power needed to run AI algorithms.

BIM: Building Information Modelling (BIM) has been around for quite some time, but its integration with geospatial technology has been slow. Nicholas Mangon, Vice President, AEC, Business Strategy & Marketing, Autodesk, is of the view that technology will change this scenario significantly. "Technological advancements collectively will transform the AEC industry, a sector which hasn't seen major productivity increase for over 20 years," he says.

Integration of geospatial information with design and engineering workflow data, 3D modelling, simulation, scenario analysis, change detection, etc. can deliver the much-desired seamlessness among different spatial and non-spatial datasets. The interface between geospatial and BIM creates a binding synergy between spatial, technical and commercial data attributes, helping the construction industry to devise cost-effective and timesaving models.

A combination of the latest developments in computation with geospatial enables precise analysis of projects, which fosters innovation, reduces cost and cuts down manpower requirement. Architects and engineers are beginning to use these models for better understanding of projects. With the increasing use of Augmented Reality and Virtual Reality, AR and VR, in BIM modelling, the utility of geospatial would further increase.



Digital Twin is a technology which fuses BIM CAD with the as-built reality through a process of Augmented Reality using sensors and imagery.

It also contributes in seamless data exchange among engineering and environment professionals, eliminates data redundancy and improves data integration workflows for better project planning. "The infrastructure sector is largely adopting location as an important element of the process of digitalization. In the construction world, everything built and left behind as location is coordinating finished products beautifully," says Matt Mann, Co-Founder & CEO, Construction Intelligence Service, Indus.AI

Digital Twin: Digital Twin is a technology that fuses BIM CAD with the as-built reality through a process of Augmented Reality using sensors and imagery. A Digital Twin is particularly useful to detect conflicts of the digital plan with the physical reality. It enables the trapping of potential problems and helps in realizing corrections before the problems become critical. Large structures e.g. offshore platforms, offshore vessels etc., Buildings and Utilities (Electric, Gas, Water, Waste Water Networks) are some of the possible areas for the monitoring, diagnostics and prognostics to optimize asset performance and utilization. 3D printing in the context of digital twinning is also one of the technologies that can be used for simulation of major constructions like factories and infrastructure like bridges to understand potential problems.

Smart infrastructure: Smart Cities have opened up a host of new possibilities, improving the quality of our urban spheres by making citizens more connected with their cities through technology. These cities would provide a holistic living experience by reducing congested spaces, pollution and taking the basic architecture of urban planning models to a citizen friendly trajectory. Smart Cities are perhaps the harbinger of Geospatial 4.0, where the citizen becomes the focus of all planning, building, monitoring and executing activities in urban spaces. Citizens become smart citizens with technologies like e-governance, crowdsourcing and volunteered information that enable participation by citizens in these activities.

Geospatial technologies provide the underlying foundation of infrastructure and ultimately the fabric upon which solutions can be built. It provides the necessary framework for collecting data through in situ sensors and applying analytics to these observations to facilitate management of infrastructure. George Zhao, CEO, CHC Navigation, says, "The geospatial industry is keeping pace with the technology challenges represented by the necessary combination of mass data and local detailed and specialized information."

Smart transportation uses a plethora of systems to manage systems like car navigation, traffic planning, security, container management and many others. The technolo-

Geospatial technologies provide the underlying foundation for all kinds of infrastructure and ultimately the fabric upon which solutions can be built.

Six major technologies that define the smartness of a city

gies include GIS, communications, IoT, in situ sensors, location based systems and crowdsourcing.

Location based services: Location based services are important for citizens, businesses, disaster management, farm and livestock management and C4ISR, to name a few important areas. The power of location influences multiple fields of life. Be it the most quotidian services like hiring an Uber cab, or niche data analytics for a business strategy, location is at the core of all processes. These needs are met through satellite based navigation services, accurate maps and a variety of devices. Location-based services are expected to reach a market size of $1.89 billion by 2022.

Emerging technologies like the Internet of Things (IoT), autonomous vehicles and sensors are capturing information that has never been captured before and creating new avenues for geospatial data collection. Location intelligence is providing the exactness of spatial dimension to businesses, enhancing customer experience and increasing revenue and operational efficiency.

"The practical applications for location technology are endless. Big Data, touted as the new oil, provides a landing platform from which we have only just begun to see the possible innovations of future," says Dr Steve Marsh, Founder and CTO, Geospock. "In the end, all industries stand to benefit from comprehensive location data and intelligence, and there are many fruitful partnerships that will be built," says Gil Elbaz, Founder and CEO, Factual.

The possibilities are endless and the sector's true potential is still untapped — the subterranean chunk is unexplored. Jeff Glueck, CEO, Foursquare, says, "While mobile penetration maybe close to saturation, we are just scratching the surface of possibilities that exist in the developed world at least."

The next phase of growth for the geospatial industry, where it will see mainstreaming, will require 'impact validation' of using location intelligence. "Customers would need to know how this technology is proving effective in their day-to-day life and businesses," says Sunil Kumar, Founder & CEO, GroundTruth.

Automation: The final frontier

As the world marches towards the age of automation, geospatial would be a key technological component. The Fourth Industrial Revolution would be a seamless integration of humans and machines and from piecewise automation to full-fledged automation, which Ola Rollen, President and CEO, Hexagon, calls "evolution from automation to autonomy". "Traditional GIS is hitting scalability limits due to emergence of Big Data. We expect a major shift in 2019 to address this issues," says Kathryn Guarini, Vice President, Industry Research, IBM. Indeed GIS database will now become database of algorithms to be applied to fast moving real time and near real time data.

Geospatial 4.0 seeks to seamlessly integrate geospatial services with humans in a connected world. There are many names associated with such a move. Internet of things will be replaced by Internet of Everything, where 'everything' will include humans. Artificial Intelligence will play a major role as has been stated earlier but human intelligence cannot be replaced. Amy Webb outlines a doomsday scenario in her book *The Big Nine* if to demonstrate what happens if we apply AI indiscriminately and individually. The solution she puts forth is to use the powers of AI in a collaborative manner for the best interests of humanity.

Geospatial advances are intimately tied to the betterment of the human condition. We need collaboration not only within the industry, but also with other industries and citizens for this to happen.

Aditya Chaturvedi, Correspondent
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Tracking Our Resources

Apart from translating Big Data into actionable insights, it's also important to make this data available to policymakers. **By Inga Petersen**

In Colombia, mechanized illegal gold mining is creating environmental challenges on an unprecedented scale

Looking up towards the stars at night, the sky can give the impression of being empty and infinite. In reality, space is getting more and more crowded every day.

According to the United Nations Office for Outer Space Affairs, there are currently 4,857 satellites orbiting the planet. Among them are two Sentinel-2 satellites, part of a space-borne mission provided by the Copernicus European Earth Observation programme. The two satellites visit the same spot on Earth every two to five days, depending on the location.

Their sensors acquire multispectral images with spatial resolution varying from 10 to 60 metres, depending on the spectral band. The data produced by Sentinel satellites is freely available to the public and the volumes of data are staggering. Between Sentinel 1, 2 and 3, over 10 petabyte of new data are made available for download every year. With a single petabyte equalling 500 billion pages of standard typed text, this is Big Data worthy of its name.

Satellites are providing more detailed information about the state of our planet, and businesses have long figured out how to use this earth observation data. The European Commission estimates that the cumulative benefits of the Copernicus programme by 2020 range between US$11.4 to US$15 billion (10 to 13 billion euros). Commercial applications of the data focus on a range of different sectors, including agriculture, where earth observation helps perform precision farming, or urban monitoring to serve smart city markets. Whilst earth observation is already routinely used by the public sector for forest and ocean monitoring at the national or regional level, a key question remains unanswered: how can we translate this wealth of information into tangible benefits for the environment at the local level?

In Colombia, small scale, mechanized illegal gold mining is creating environmental challenges on an unprecedented scale. Excavators and dredgers are digging up riverbeds for alluvial gold mining, contributing to wide-ranging deforestation and loss of natural wetlands. The mined material is processed at the same site, to separate gold from sediments. The highly toxic mercury used in processing contaminates air and water, and has accumulated in the food chain, posing significant threats to human health and ecosystems. Globally, artisanal and small-scale gold mining is the biggest anthropogenic source of mercury emissions, estimated to have introduced 1220 tonnes of mercury into the terrestrial and freshwater environments in 2015, according to UN Environment's 2018 Global Mercury Assessment. The Minamata Convention on Mercury aims to reduce mercury emissions worldwide. In 2018, Colombia made the use of mercury in artisanal gold mining illegal. A complete ban on industrial use is planned for 2023.

Despite significant risks to human health and the environment, artisanal and small scale mining areas are often hard to reach, and keeping track of new or abandoned operations can be a challenge for local government agencies.

To support the mapping of new and abandoned sites and identify opportunities for restoration, UN Environment is collaborating with the University of Liège, in Belgium, to leverage Sentinel-2

Artisanal and small scale mining areas are often hard to reach, and keeping track of new operations can be a challenge for the local government agencies

Copyright: Juan Bello/UN Environment

data for local-level decision-making and early warning. Funded by the European Commission (DG Grow) and EIT RawMaterials, the RawMatCop CopX project (Geospatial mining transparency through Copernicus and MapX) is analysing changes on land and water bodies, focusing specifically on mining ponds created on riverbeds.

These ponds offer clues regarding the status of mining activities. The ponds, which typically measure 60*40 meters, are excavated mechanically on mine-site adjacent land and riverbeds. They are filled with water, which is combined with the mined material to create an ore slurry used to wash the ore. Lead researcher, Elsy Ibrahim, from the Université de Liège, summarizes: "Through the use of satellite imagery, we are able to detect these mining ponds. Furthermore, we can follow the behaviour of several ponds from activity to abandonment and understand the implication of each phase on the reflectance spectra acquired by the spaceborne sensors. When there is active mining, the ponds are turbid, with lower water levels, and are sparse. Once abandoned, the ponds have algae bloom and reduction in turbidity. They fill up with rainwater and runoff and have a larger appearance. All these characteristics can be depicted using satellite imagery."

By collecting clues about the status of mining activities and the movements of miners in the area, we can gain important insights regarding the development of new mining areas. It can also help the government and environmental agencies identify recently abandoned areas that are most suitable for restoration activities.

Detecting and analysing these clues with the use of earth observation requires machine learning and image processing techniques in challenging, highly clouded areas. "Even though radar imagery can identify locations of mining activity, the optical sensors offer more information on the change in spectra as the ponds are abandoned," explains Ibrahim. The influences of varying levels in precipitation from rainy to dry season also make it more difficult to capture changing patterns in the ponds, though the images usually manage to capture the general trend. These techniques are key to understanding the dynamics in the mining area and to potentially automate the search to cover larger areas and track changes over time.

Testing of this innovative underlying methodology started in 2018 in the Bajo Cauca region in the Antioquia department. The project is being implemented in close cooperation with the Government of Colombia, including the Ministry of Mines and Energy, the Ministry of Defence and the Ministry of Environment and Sustainable Development, as well as other UN agencies and strategic partners. Once established, CopX will aim for the analysis to be applied at a larger scale and even offer the potential to establish an early warning system which can be adopted by the government as a key tool to tackle illegal gold mining and to monitor the implementation of restoration strategies.

However, translating Big Data into actionable insights is only a part of the solution. Making this data available to the relevant policy makers at the local and national level in a format that is accessible to non-experts is a critical step to enable evidence-based decision-making.

With this in mind, the project will use MapX, an online, open-source geospatial platform backed by the neutrality of the United Nations, to make the results available in easy-to-understand maps. The platform uses summary story maps to outline the interlinkages between the environment, conflict and natural resources.

Whilst MapX can host sensitive datasets in private projects, its mission is to increase global environmental transparency by making the best available data widely accessible. Access to information is especially important in places like Colombia, where the environment features prominently in the 2016 Peace Agreement.

In addition to showcasing the outcomes of the project, MapX provides a comprehensive data catalogue, including data on the environment, the socio-economic context and conflict interlinkages. Combined with a suite of analytical and visualization tools, platform users can easily analyse, contextualize and visualize interactions between different data layers to increase awareness and take informed decisions. Data, maps, narrative and multimedia files can then be summarized in interactive story maps to help tell the tale hidden in the data.

Inga Petersen, Senior Extractives Adviser, Crisis Management Branch, UN Environment, *inga.petersen@un.org*

All GNSS civilian signals

TRIUMPH 3

Based on TRIUMPH chip with 864 channels

• Spread Spectrum • Bluetooth • UHF • 4G/LTE Cellular • Wi-Fi • Integrated GNSS antenna

see back page >

J-Mate Overview

6 pages inside >

J-Mate Test Volunteer

We have delayed the introduction of the new J-Mate to enable us to add new features like replacing liquid vials with a highly accurate internal inclinometer to monitor and continuously compensate for level offsets.

We now are ready to send J-Mates to **20 volunteers in the United States**, who would like test the J-Mate with their TRIUMPH-LS and give us feedback over a period of up to two months.

As a reward for each volunteer's efforts, we will offer a **50% discount on the J-Mate** if they decide to buy it.

Please go to **www.javad.com**, to submit your volunteer application at "J-Mate Test Volunteer".

JAVAD

J-Mate Quick Overview and Update to Videos

First let's set the record straight: J-Mate is not a total-station. J-Mate and TRIUMPH-LS **together** are a **"Total Solution"** which is a combination of GNSS, encoder and laser range measurements that **together** does a lot more than a total station. At long distances you use GNSS and at short distances (maximum of 100 meters) you use the J-Mate along with the TRIUMPH-LS. Together they provide RTK level accuracy (few centimeters) in ranges **from zero to infinity**. Although the sensors are specified to work up to 100 meters, usage is quicker and more convenient for distances of up to 50 meters.

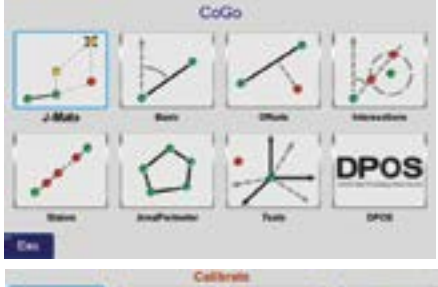
One burden that we leave you with is to focus the camera manually when you need it. If you are always more than 15 meters away from the target, you keep the focus button on maximum and leave it there. We will replace the focus button to make it easier to access if needed.

As with the TRIUMPH-LS, with the J-Mate we also provide software improvement updates regularly and free of charge. Download the J-Mate update in your TRIUMPH-LS and then inject it to the J-Mate. When you connect the TRIUMPH-LS to the J-Mate, the injection will be done automatically; but with your consent.

There are many new features in the J-Mate. We try to explain them in a few steps. Please also view the J-Mate videos in our website.

Connecting J-Mate to TRIUMPH-LS:

TRIUMPH-LS communicates with the J-Mate through Wi-Fi. Turn on both the TRIUMPH-LS and the J-Mate. Click the Wi-Fi icon of the TRIUMPH-LS Home screen to connect to the J-Mate, much the same way as you connect TRIUMPH-LS to your Wi-Fi access point. J-Mate has ID of the form JMatexxx.



After connection, try to get acquainted with the **Main Navigation Screen**: On the TRIUMPH-LS Home screen, click CoGo/J-Mate/J-Mate Collect/Capture Target points.

Finding the target automatically:

There are three ways to search and find the target automatically:

1) One is by laser to scan and snap to a point when range changes by the specific amount. This is particularly valuable to snap to cables, poles and edges of buildings.

2) Second is search for the object of the specific flat size and focus on its center.

3) Third is with the camera to search for the QR target that we supply. We will discuss these later.

Switching between the two cameras:

You can view the scenes by the wide-angle camera of TRIUMPH-LS, while sitting on top of J-Mate; or by the narrow angle precise camera on the Side of J-Mate. Click Button **"4"** of Figure 1 to switch between the two.

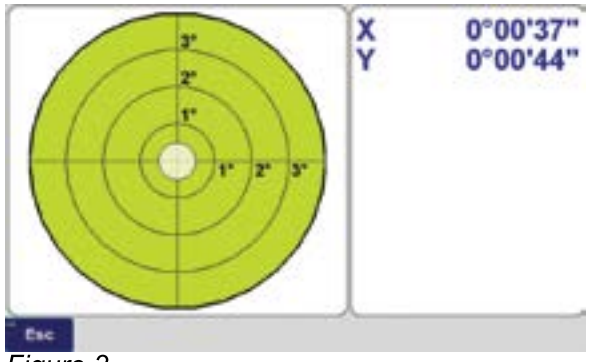


Figure 3

Viewing the embedded Inclinometer:

If you hold button **"4" of Figure 1**, you will see the embedded 0.001-degree electronic inclinometer of the J-Mate as shown in Figure 3. It updates 10 times per second.

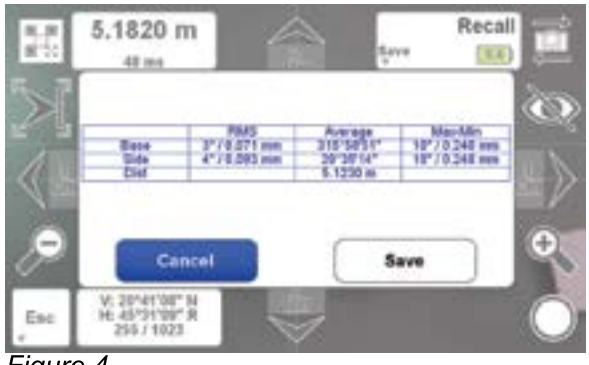


Figure 4

Taking a Point:

When you focus on your target manually or automatically, you can click the "Take" button (**"5"** in the Figure 1). The Encoders will be measured 10 times, the average, RMS and spread will be shown and you can decide to accept or reject (Figure 4). The accepted points will be treated like RTK points but labelled as "JM" points.

You can access and treat them like any other points in the TRIUMPH-LS.

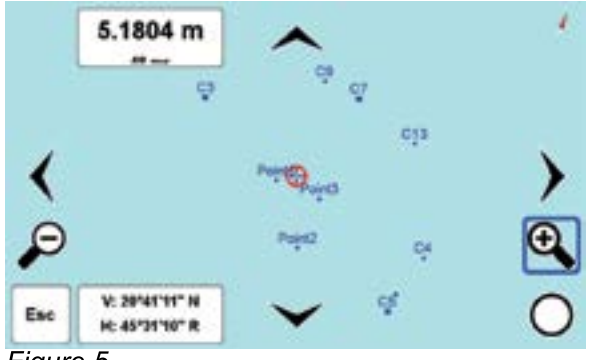


Figure 5

Viewing the Measured Points:

Clicking button **"6"** in Figure 1 will remove some of the items from the screen (Figure 5). Hold it long and you will see live view of the points taken by J-Mate.

Measuring angles quickly:

Aim at the first point and click button **“7”** of Figure 1. Then Aim to the second point and click this button again. You will see the horizontal angles between the two points.

Saving and Recalling Orientations:

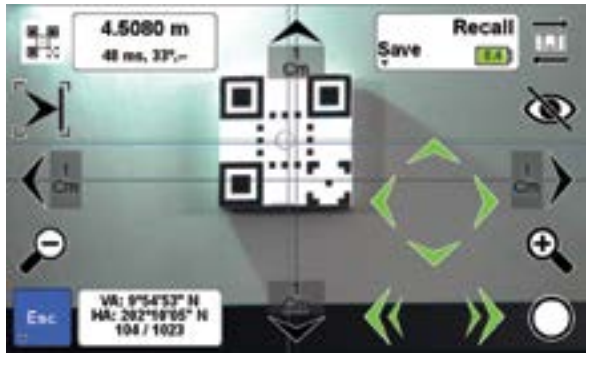
Aim at a point and hold long the button **“8”** of the Figure 1 to save the horizontal, vertical, or both of that orientation (Figure 6). Click this button to rotate to that saved orientation.

Figure 6

Scanning and Snapping to an object:

Click button **“9”** of Figure 1 and the left and right motion buttons (**“3”** on Figure 1) change to red which means when you click them scanning to snap will start. Hold long button 9 to get to the screen that sets the parameters for the Scan and Snap operation.

In this screen you can define the scan range and ask the scan to stop when range changes by the specified value. Then you can select the point that was measured before the stop or after the stop. By selecting a very large number you can scan the ranges that you have specified and record the 3D image. When you click button 9 to stop change the scanning back to normal motion, you will be asked if you want to save the scanned file. You can view the 3D image of the scanned file in the “File” icon of the Home screen of the TRIUMPH-LS.



Connecting and Re-connecting J-Mate to TRIUMPH-LS

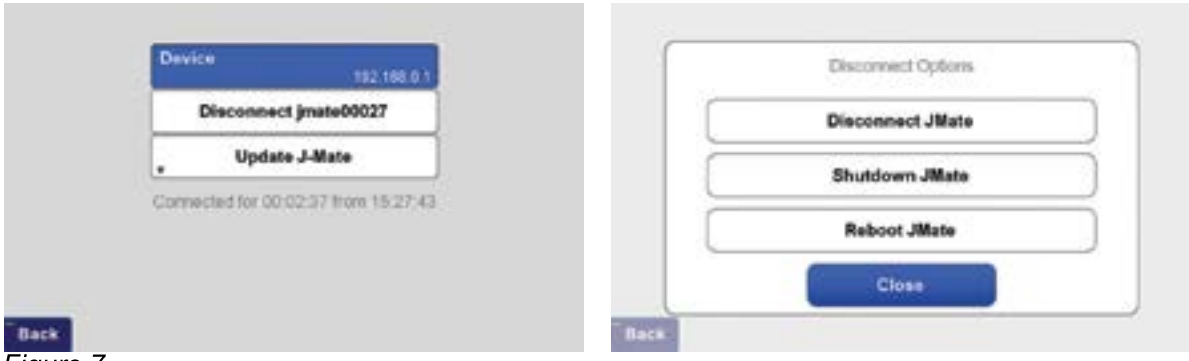


Figure 7

Holding the **"ESC"** button (**"10"** in Figure 1) will take you to Figure 7 which lets you disconnect J-Mate, Reboot, or turn off. Like all Wi-Fi connections, you may lose connection and need to use this screen to disconnect, re-connect, or re-boot J-Mate and in some occasions reboot TRIUMPH-LS too, especially when connection between the camera of the J-Mate and TRIUMPH-LS is lost.

View Range measurements

Box **"12"** of the Figure 1 shows the range measurements. It reads up to 20 times per second.

Automatic Finding of the Target:

Click the QR icon (**"11"** of the Figure 1). You will be guided through the following steps to aim at your target point. :

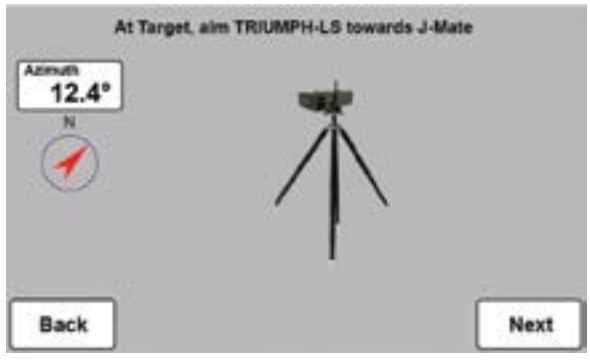
1. Put the TRIUMPH-LS on top of J-Mate (or slightly above it, but at the same orientation as the J-Mate, to be far from the motor magnets of the J-Mate) and click Next.

This step will transfer the compass reading of the TRIUMPH-LS to the J-Mate encoders.

You can skip this and the next step if you are in an area that the compass readings are not valid or you can aim manually in the next steps. .

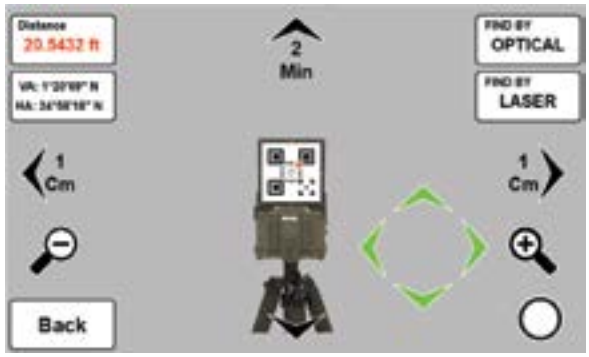
2. Go to your target, Put the QR accessory on top of the TRIUMPH-LS and aim the TRIUMPH-LS towards the J-Mate (with the help of the TRIUMPH-LS camera) and click Next.

This will help the J-Mate to know the general direction to the target and limit its search range. You can go back to previous step to fine tune view of the J-Mate. Or you can skip these two steps.



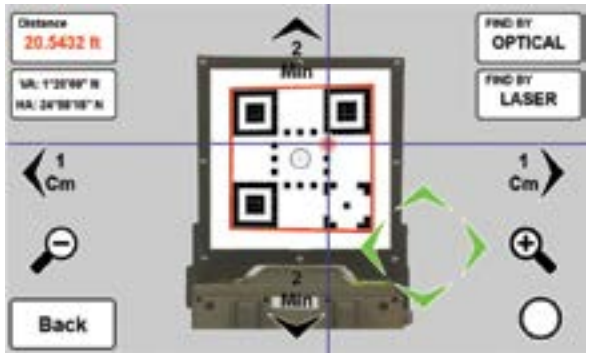
3. You will see the J-Mate camera view on the TRIUMPH-LS screen. You can fine tune the J-Mate view by the navigation buttons to make recognition faster. You can skip these steps if you don't want to make the search faster.

In here you can also manually aim at the center of the QR panel and take your shot.



4. Click "Find by Optical" if you want the QR panel to be scanned and centered automatically.

When J-Mate focuses on the center of the QR, you can click the "Take" button. You will be asked if you want to record the point.



5. If you also want to find the center of the QR by Laser scanning, you can click the "Find by Laser". If Laser scan is successful, you can click the "Take" button to replace the previous measurement with the current measurement done by laser scanning.

The center of the QR is vertically collocated with the GNSS antenna and you don't need to be exactly perpendicular to the J-Mate path. For safeguard, we measure the four sides of the QR and determine the angular offset, if we need it.

If light condition is such that camera cannot find the QR, chances are better that laser scanner can find it.

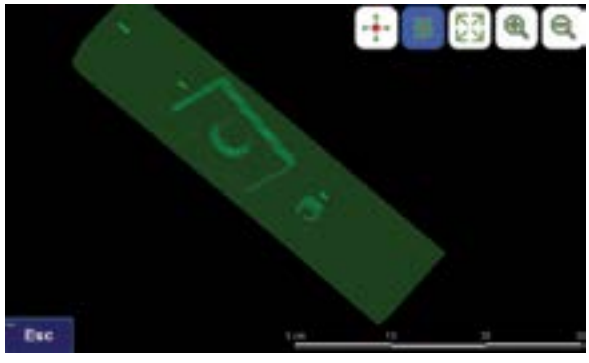
Finding the center of QR by laser and by the camera is a tool to calibrate these two sensors together.

You can run this feature periodically to re-calibrate their axis if you need to. This calibration is small portion of the factory calibration.

You see the 3 views of the 3D scanning

The first scan image is scan of a 1 cm thick and a 6 cm thick objects. 1 cm step resolution.

The last one is scan of a 12.5 x 8 cm object of 1 cm thickness.



This overview as also an update to videos at www.javad.com.

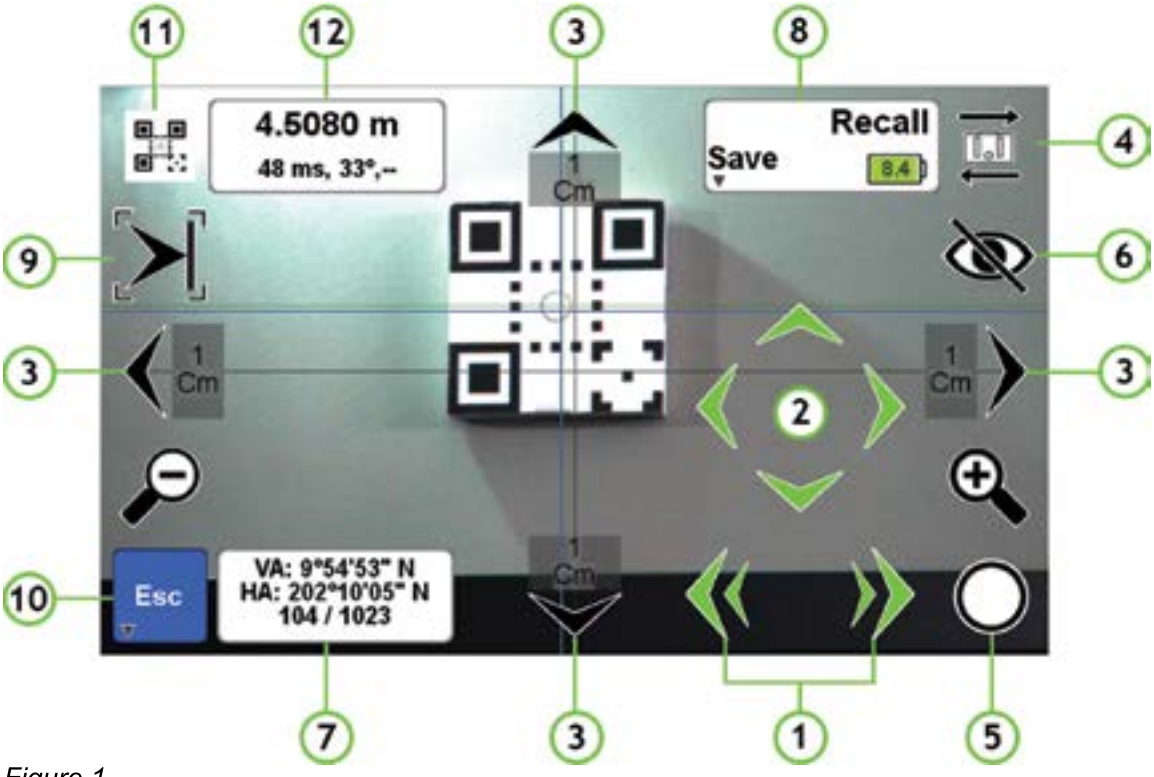


Figure 1

This is the **Main Navigation Screen**

Finding the Target:

You can find targets manually or automatically.

There are five ways that you can manually rotate the J-Mate towards your target:

1. On the bottom right of the Main View screen, there are left and right “Fast Motion” buttons. While you hold them the J-Mate rotates about 30 degrees per second. (**“1”** on the Figure 1)

2. Above them, there are slow Left/Right/UP/Down “Slow Motion” buttons. While you hold them, the J-Mate rotates about 5 degrees per second. (**“2”** on the Figure 1)

3. Then there are Left/Right/Up/Down buttons around the screen. Each click moves the J-Mate according to the value that users assign to them. Hold these buttons to assign angular or linear values to them (**“3”** on the Figure 1). The Value Assignment Screen is shown in Figure 2.

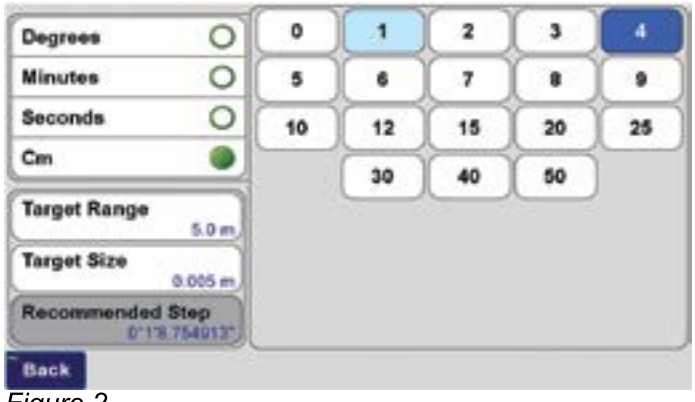


Figure 2

4. Touching points on the cameras and by gestures.

5. You can also rotate the J-Mate manually while it is not moving automatically, but limit that to the small rotations in the area of motor free motion, not to apply backpressure to motor as much as you can. Motor manufacturer does not prohibit manual motion, but we think it is better to avoid that as much as possible.

TRIUMPH-3

The new TRIUMPH-3 receiver inherits the best features of our famous TRIUMPH-1M.

Based on our new third generation a TRIUMPH chip enclosed in a rugged magnesium alloy housing.

The TRIUMPH-3 receiver can operate as a portable base station for Real-time Kinematic (RTK) applications or as a receiver for post-processing, as a Continuously Operating Reference Station (CORS), and as a scientific station collecting information for individual studies, such as ionosphere monitoring and the like.

It includes options for all of the software and hardware features required to perform a wide variety of tasks.

- UHF/Spread Spectrum Radio
- 4G/LTE module
- Wi-Fi 5 GHz and 2.4 GHz (802.11 a, b, g, n, d, e, i)
- Dual-mode Bluetooth and Bluetooth LE
- Full-duplex 10BASE-T/100Base-TX Ethernet port
- High Speed USB 2.0 Host (480 Mbps)
- High Speed USB 2.0 Device (480 Mbps)
- High Capacity microSD Card (microSDHC) up to 128GB Class 10;
- “Lift & Tilt”
- J-Mobile interface

Ideal as a base station

THE END OF PRIVACY?

Data privacy was one of the hot debates of 2018. In this progressively interconnected world, data is the new oil. It is your biggest asset and can also be the greatest liability, if not handled properly.

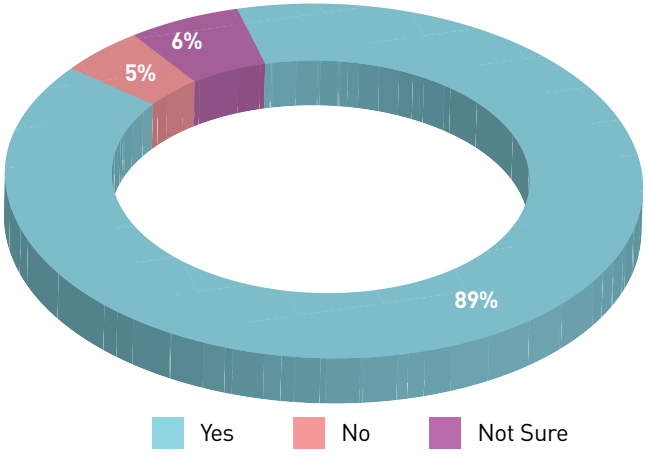
By Shilpi Chakravarty

A visibly uncomfortable Mark Zuckerberg grappling with a barrage of questions during his 12-hour Congressional hearing following the Cambridge Analytica data breach scandal would surely go down as one of the most eventful moments of recent times.

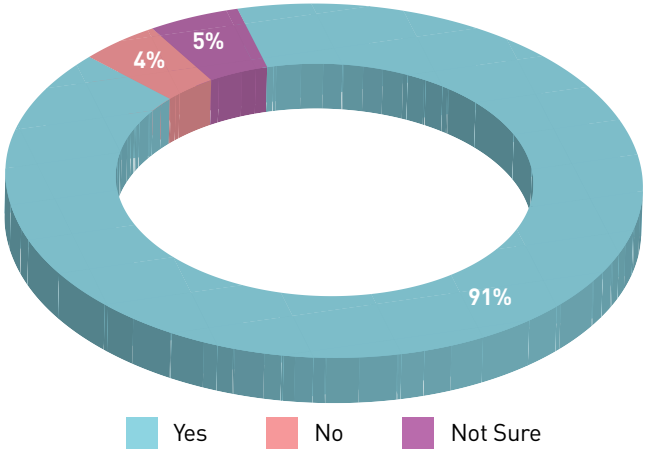
Data privacy was one of the hot debates of 2018. The most talked about exposé on personal data leaks were the Cambridge Analytica scandal that rocked Facebook, and Google's 24x7 location tracking.

Smartphones with GPS chips in every hand, connected vehicles and miniaturized sensors, have turned the whole world into a digital network. In this progressively interconnected world, data is the new oil. It is your biggest asset and can also be the greatest liability, if not handled properly. No wonder a majority of 1,500 professionals who participated in Geospatial World Readers' Survey agree to this (*See Graph1, Pg 36*).

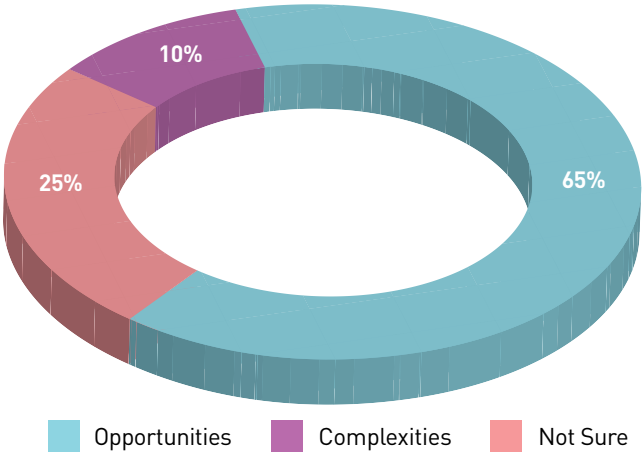
Graph 1: Do you think data can prove to be dangerous if companies don't utilize it properly?



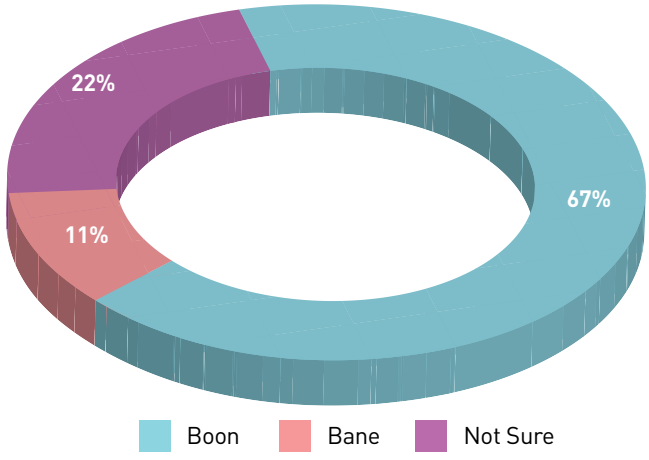
Graph 2: Do you think investment in data and analytics can help understand customers' needs?



Graph 3: With apps resorting to crowdsourcing, will there be new opportunities or complexities?



Graph 4: Everything happens somewhere. Is location tracking a boon or a bane?



Location has become fundamental to business processes and a collaboration of location analytics and business intelligence is the key to growth. Marketers around the world know the power of this data to identify audiences, gain competitive insights and observe offline consumer behavior (*See Graph 2*).

There is no discussion around how businesses are extensively using location data, which is also considered "personal data". The moot question, however is, are companies taking adequate steps to protect this data. Shouldn't consumers be given greater leeway to monitor how, when and where their personal data is being used?

Privacy – Is it an emotional issue?

Given this background and the backlash that Facebook, Google and other such companies have been facing in recent times, one can easily assume that majority of the common masses do not want to share data. However, that's not completely true. The way the common masses view the issue of data privacy is quite intriguing.

On the one hand people are appreciative of more and more apps collecting crowdsourced data to make their features more advanced and appealing, thus opening up more opportunities (*See Graph 3*), on the other hand, a data breach like the Facebook or Google scandal upsets them.

A recent study by US Center for Data Innovation released in January found that 58% of Americans are "willing to share their most sensitive personal data" (i.e. biometric, medical and / or location data) in return for services or benefits that they want.

While the survey found that 70% of Americans would not allow a mobile app to collect their biometric data without tradeoffs, that dropped by 6.7 percentage points if it was to make it easier to sign-in to their accounts, and by 19.6 percentage points if it would make their account more secure.

Even a study conducted by Accenture in 2018 had arrived at the

same conclusion. The study found that consumers only get wary if the brands don't deliver desired results. It also revealed that the most invasive approach is using consumer location to offer personalized deals.

The Geospatial World Readers' Survey also shows that a vast majority of respondents (67%) think that location tracking is a boon (*See Graph 4, page 36*) rather than a bane. But when asked if they were okay with being tracked 24x7 (*See Graph 5*), they were split (47% said yes, 43% no, while 10% weren't sure).

What they were clear about was transparency regarding handling of this data — a whopping majority (87%) thought they had the right to know when they were being tracked and what companies were doing with that data. (*See Graph 6*)

An apt example is of Google. An investigation by Associated Press in 2018 found that the search engine giant was tracking users 24×7 even when their "Location History" was turned off. Google accepted it, but the clarification came three days after the AP report. The company revised a detailed description on its website enumerating how "Location History" setting works and clarified that it continues to track users even if they have disabled the setting. It also acknowledged that some location data might have been saved as part of the users' activity on other services like search and maps. But again, this disclaimer came only after immense media hype. Till date there has been no clarification as to what Google does with such data.

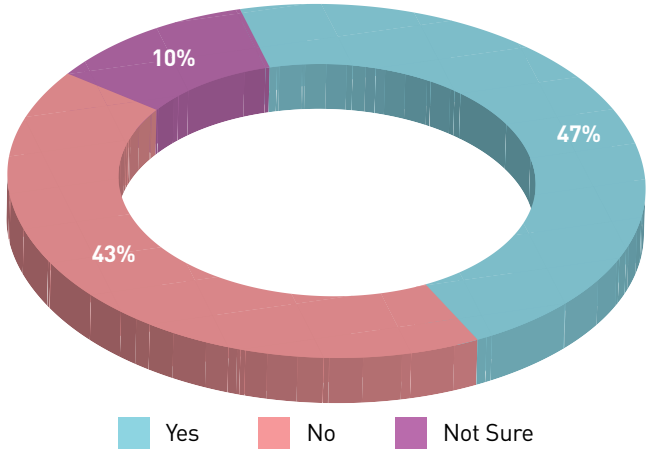
Google has also recently been pulled up by the US Senate Commerce Committee. The Senate has sent a letter to the company seeking answers about a microphone that was undisclosed till January this year. Interestingly, the search engine giant didn't discover this recently. It was aware when the Nest Secure was shipped. After the launch of Google Assistant integration, questions were raised. The company didn't apprise the users that a microphone might record their conversations. US Senate Commerce Committee is investigating whether Google was actually aware and in case it was, what steps were taken by it.

It's not just Google, many popular apps are misusing user data for profits. For example, iPhone apps share user data with third-party data monetization companies, making millions of iPhone users vulnerable. Every time you open Firefox on your smartphone, it asks if it has the permission to record videos or phone calls. While installing any new app, users are asked if they are okay with the said app accessing their personal information, including location. But it is nowhere mentioned that the app might share data with consumer brands, retailers or third-party service providers, which, more often than not, is the case.

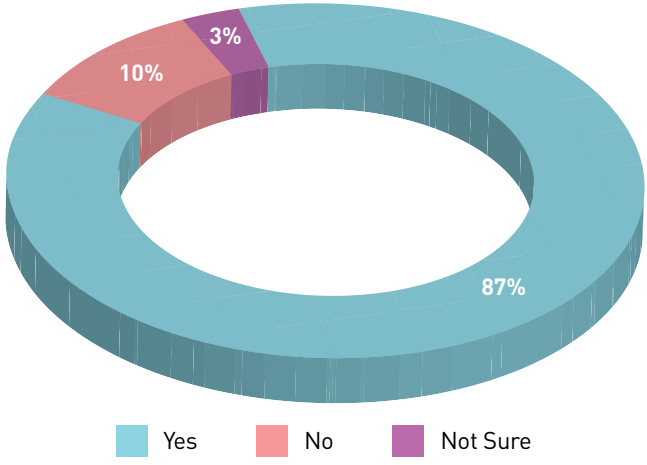
The Facebook-Cambridge Analytica scandal is the biggest case in point. Facebook provided British political consulting firm Cambridge Analytica with data of its users. The firm then harvested personalized data of a staggering 40 million Americans and extrapolated it to match with other user profiles. The information was then used to target them with news and campaigns suited to their psychology.

The key question is, why transparency and clarity can't be a virtue

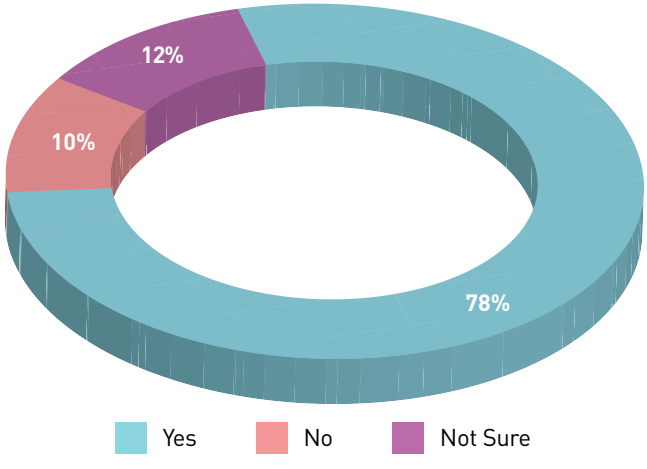
Graph 5: With location data being used in myriad of services, do you approve 24x7 location tracking?



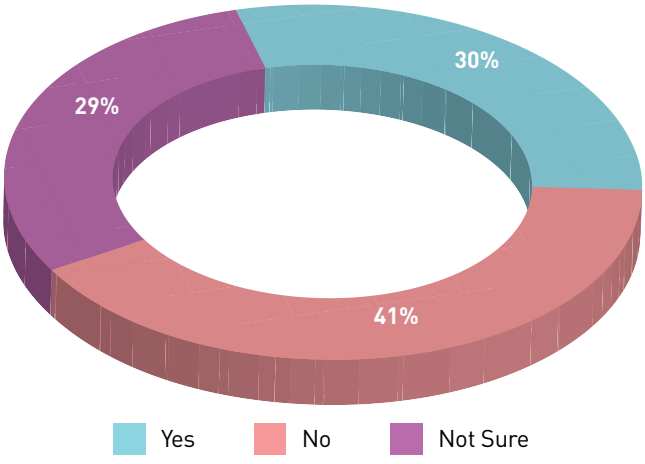
Graph 6: Is it important to know when you are being tracked and what are companies doing with the data collected?



Graph 7: Do you think digital innovation has strengthened connectivity, but has also led to more vulnerability?



Graph 8: Are most companies prepared to take on a cyber attack?



and shouldn't users be informed as to what is being done with their data? This is that grey area where most companies shy away from answering straight questions concerning data misuse.

Cybersecurity — How safe is your data?

While digital innovation is paving the way for greater connectivity and services, it is also increasing data vulnerability (*See Graph 7, page 37*). For instance, in 2017, cybercriminals gained access to the servers of Equifax — one of the largest credit bureaus in the world — and stole personal data of 145 million people. The hacking was seen as one of most lethal security breaches of all time because of the sheer volume of information that was compromised, stolen and exposed. Equifax took two months to recover from the hack.

Hacking and spoofing lead to an estimated loss of $300 billion every year. And this is not all! Other than the financial loss, companies often lose confidential information and thus their image is dented or their quality of services is compromised. From hacking financial transactions to stealing classified information and creating a virtual profile, hackers manage to do it all despite cybersecurity measures and the abundance of anti-phishing and anti-virus, malware software.

It is estimated that by 2020, over 24 billion devices would be connected to the Internet. This makes it all the more risky if you come to imagine the consequences of security breach when all of our devices, smart homes, public transport systems, heavy machinery and autonomous cars, would be connected to the Internet. This would lead to something catastrophic and not just financial loss or identity theft.

Consider this: spoofing is a major risk as smart electricity meters that are used in Spain were hacked so that they would under-report energy consumption. A massive denial-of-service (DDOS) attack on Dyn's servers took down many companies, including PayPal, Twitter and Spotify. This incident demonstrates that a lot needs to be done for protecting IoT devices. This brings us to the issue of preparedness of the technical workforce in case of a cyber attack. Unsurprisingly, the survey shows that a majority of professionals (41%) are unprepared to handle such a situation. (*See Graph 8*).

Take a look at the controversy over India's Aadhaar system — a 12-digit unique identity number for all residents which contains their biometric and demographic data. While it is a great idea to link Aadhaar data with banks for social security benefits, in the recent past, it has garnered a lot of criticism due to the government's inability to protect this data. After complaints of telecom companies using this data for their advantage surfaced, the matter was taken to the Supreme Court, which restricted the use of Aadhaar by private entities.

Surveillance — Is Big Brother watching?

Can the state spy on you at work or monitor private chats with your family? Data privacy is not just about chocolate advertisements on Facebook, but concerns a whole lot of other things. "The FBI/NSA knows everything" jokes may be old, but the Snowden revelations five years ago did make a thriving democracy like US appear suspicious. In countries like India, alleged social media monitoring by powers that be has continued to be an issue of debate for some time now, while in countries like China or Russia (not to take into account the repressive Middle East nations), this is not even a matter of debate — surveillance is a given thing there.

The problem varies from country to country and societal setups there. For instance, the world's only smart nation, Singapore, diligently collects citizen data and extrapolates new information every day to build on further citizen-centric services. Such a setup would be unthinkable in the US, or even in India.

In June 2018, the American Civil Liberties Union, along with Amazon shareholders, launched a campaign urging the company to get out of surveillance business. The issue was Amazon's Rekognition service that uses facial recognition to identify people, which the tech giant sells to governments. Facebook, Google, Microsoft, Apple and everyone else has been time and again accused of handing over data to the US government.

Data privacy is a complex issue and increasing digitalization of the world and interconnectivity is making things more intricate. In this background, data privacy legislations need to be an ongoing balancing act, with security interests on one side and the interest of the people on the other.

Data legislation — Is that the answer?

It seems the companies are yet to understand the gravity of the issue. So, it is not surprising that business leaders find data privacy to be least important in their strategic priorities list, reflects a survey in which 200+ CEOs and business leaders took part, conducted by Geospatial World (*See Graph 9, Pg 39*).

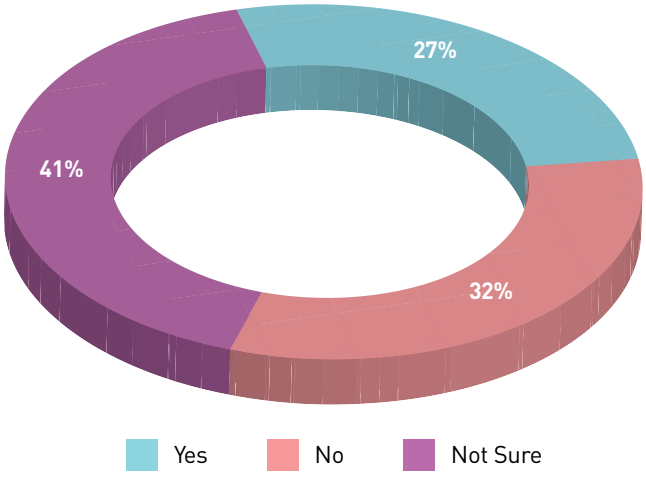
The complicated scenario has seen lawmakers sitting up to take matters in their own hands. While the European Union implemented the General Data Protection Regulation (GDPR) in April 2018, California in the US passed a similar regulation in June, which is likely to come into effect by the end of 2019. There are talks of strict data privacy norms in India.

GDPR requires enterprises to protect the personal data and privacy of EU citizens for transactions that occur within EU member states.

Graph 9: What is the topmost area of concern for business leaders?

(This graph is an input form 200+ CEOs' survey)

Graph 10: Do you think data laws like GDPR can really solve privacy issues globally?



It also looks into the exportation of personal data outside the EU. According to GDPR, location data is considered as "personal data" in Article 4 (1). Under this clause, personal data is granted extended rights, including the right to access and the right to erasure. Under the right to access, users can obtain confirmation about whether data concerning them is being processed, where and for what purpose. The right to erasure can put an expiration date on the data already collected. GDPR consequently describes requirements for data processing companies and organizations. Processors are required to offer explicit and transparent notification about their data practices. The regulation emphasizes on the importance of consent.

Not surprisingly, one of the most prominent victims of GDPR is yet again Google. France's data authority, CNIL, has announced a fine of €50 million (around $56.8 million) for the search engine giant. The authority said the amount of the fine was "justified by the severity of the infringements observed regarding the essential principles" of the GDPR.

Intriguingly, there seems to be little public support for such laws. In the US, there is an ongoing debate and mixed sentiment around regulation. The Geospatial World Readers' Survey finds that a vast majority of respondents were not confident that a GDPR-like regulation can really solve privacy issues. While 40% said they were "not sure", 32% were clear that it was not a solution (*See Graph 10*).

Data, especially, location data, is extremely personal and valuable. Considering its complexities, it is difficult to foresee as to in how many ways location data can be used or misused. Hence, this issue needs to be researched and there is a dire need to educate people about privacy rights as well as data science. Organizations can use GDPR as a guideline to evaluate their data practices and to ensure that their external communication gives users all the information they need to provide consent.

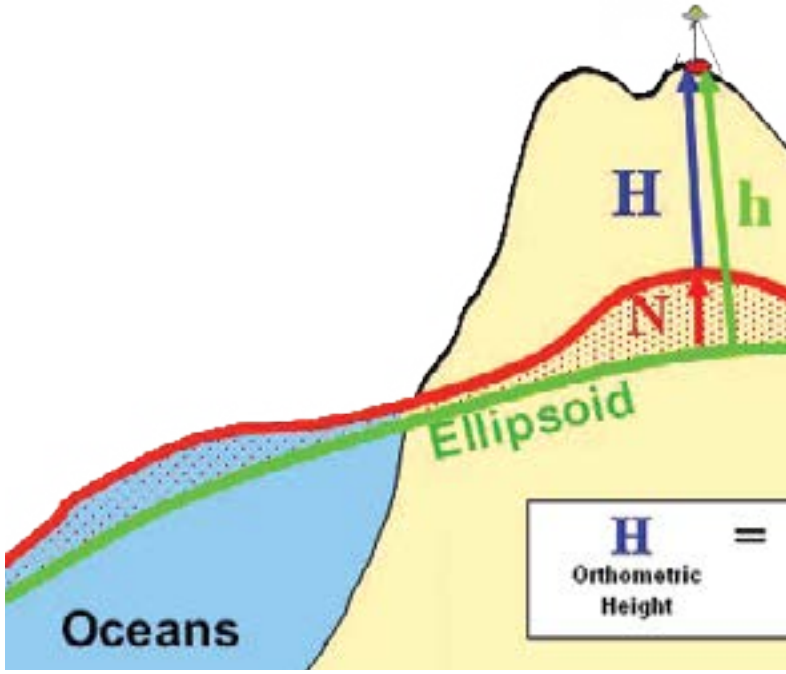
Technology can play a major role in managing data productively. With the vast amount of data that is coming in, it is quite impossible for humans to be able to sort and reconstitute a lot of that data. This is where technologies like AI and data analytics can play a vital role.

As for the concerns around ethical issues like social, economic or racial prejudices creeping into AI, well, that's another debate!

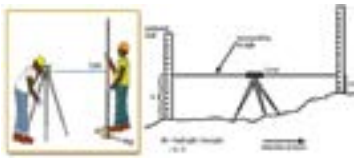
Shilpi Chakravarty, Assistant Editor, *shilpi@geospatialmedia.net*

Geoid Model of India

"Geoid is an equipotential surface of Earth's gravity field which best fits in a least square sense, global mean sea level. To realize this hypothetical surface, Survey of India has been conducting field works on massive scale which includes high precision levelling, GNSS observation & Gravity observation all over India. Recently Survey of India has released Indian Geoid Model (β-Version), which is the major step towards the development of pan India Geoid Model."

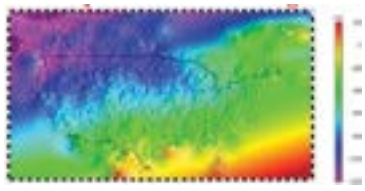


High Precision Levelling

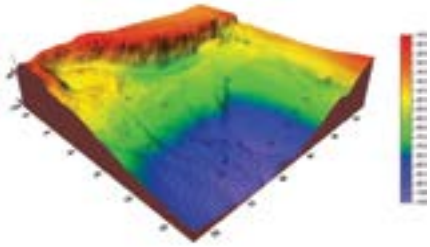


GNSS Observation

Hybrid Geoid Modeling

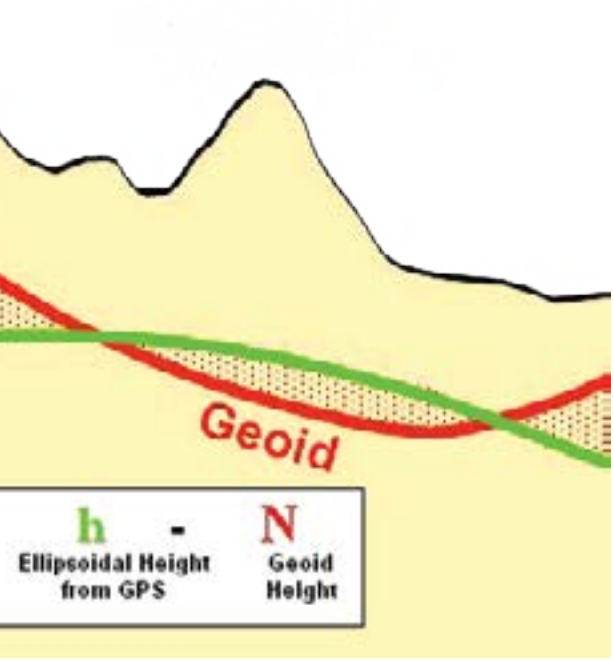


IND Geoid (β-version)

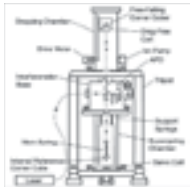


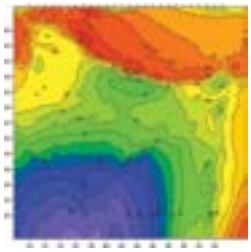
&

(β-version)



Gravity Observation





BENEFITS

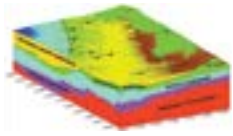
High resolution geoid will generate geoidal undulations of high accuracy all over the India.

Orthometric height will be easily derived using GNSS observation

$$H = h - N$$

The time consuming & tedious work of levelling will be reduced

Subsurface geological condition may be analysed



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One Size Fits All Approach can't Work with Farmers

Farmers the world over need to be part of the digitization process. That's possible only if they have access to affordable technology and appropriate skills. A sustainable future is not possible without this, underlines **Arianna Giuliodori,** Secretary General, World Farmers' Organisation.

How does World Farmers' Organisation work and what is its mission?

The World Farmers' Organisation (WFO) is an association created by the farmers themselves to advocate for their interests. It currently represents 1.5 billion farmers from all over the world, from smallholders to agribusinesses. Our mission is to ensure that the farmers' voice is heard and respected at the global stage on the most relevant issues that are affecting their present and could also impact their future.

Our vision is to enhance the economic viability of farming activities to improve the living conditions of farmers, their families and the rural communities they work and live in. Our aim is also to strengthen the contribution of the farming community in tackling the challenges faced by humankind.

Technology has become a by-default part of the digitization process that the world is undergoing. How is it affecting or helping evolve agriculture the world over?

Digital technologies have tremendous potential to achieve the transformative change required in agriculture and rural development. The digitalization process is expected to increase agricultural production and productivity. It can help farmers adapt to or mitigate the effects of Climate Change. It can also bring about more economic and efficient use of natural resources, reduce risk and improve resilience in farming, and make agri-food market chains much more efficient and transparent.

However, there are several issues that remain unresolved, the first being developing and securing farmers' access to these technologies.

How can geospatial technology benefit agriculture?

With the use of remote sensing, Geographical Information System (GIS) and Global Navigation Satellite System (GNSS), farmers can

manage their business with great precision. For instance, through these technology tools, they can determine what inputs to distribute exactly where, when and in what quantity.

Despite the benefits this technology could potentially deliver, when it comes to digital innovation, farmers feel the risk to be the target of someone else's choices, instead of being a key actor involved in the innovation process. This is why it is necessary to ensure that they are sitting at the table, making their contribution count, voicing their needs and expectations.

How far has modern day agriculture embraced geospatial technology?

Farmers know we are reaching a breakthrough point with these technologies, but the level of adoption is still low. Innovations should be made more widely available to them, taking into account the huge diversity of situations they are facing in different regions across the globe.

Farmers who have access to the right tools and technologies are able to make better decisions that support both productivity and sustainability in its three dimensions (environmental, social and economic). There is a lot more to be done to ensure that all the farmers of the world can embrace this transformation.

The global industry landscape is going through massive transformation. How do you plan to remain relevant in this disruptive environment?

We need an ambitious framework particularly for farmers in developing countries so that they can embrace innovation, adopt new technologies and improve their livelihoods through better access to market. It is about financing their empowerment, their investments and their skill acquisition.

It is necessary to invest in R&I from the perspectives of the farmers so that their very specific needs and expectations can be met, and the best available knowledge can reach each one of them on their farm. True transformation requires greater ambition, innovation and scaling up to ensure no farmer is left behind.

Farmers who have access to the right tools and technologies are able to make better decisions that support both productivity and sustainability

How have you factored in agility and resilience as part of your strategy?

In the farming world, agility and resilience are our bread and butter. We are facing continuous challenges that force us to relentlessly improve our responsiveness.

Coping with Climate Change and delivering food security within a framework of growing environmental and demographic pressure is a clear example of how the farming community has to continuously adapt and fine-tune its production patterns and growth strategy. In the case of farming, there is an additional binding pressure deriving from the need to guarantee a sustainable approach through every political and economic decision.

If innovation is the key to success, how can we make farmers part of this process?

If innovation is the key to success; we need to close the gap between R&I and farming sector, strengthen the interaction between farmers and research centers and give them the opportunity to share their expertise and experience. To start with, it's important to see how farmers are already innovating themselves and how they are experimenting with their existing resources. These experiences need to be highlighted so that farmers can sit at the table and participate in setting research and innovation agendas.

Farmers are a diverse group and this diversity must be taken into account, with special attention to tailor-made local solutions. It's important to understand that "one-size-fits-all" approach can't work in this case.

Furthermore, young farmers have to be involved and their talent and dedication has to be mobilized to innovate the agricultural sector that needs to be modernized continuously to provide sustainable solutions to the world's most urgent challenges.

How can we work towards sustainable development using geospatial technology?

When it comes to the process of innovating the agricultural sector, the main gap to be filled is the involvement of farmers in the process. Involving farmers means understanding their expectations, supporting them in overcoming obstacles that are different in high-income and lower / middle-income countries, North and South, livestock, arable crops,horticulture, forestry, fisheries...

Overcoming obstacles requires ensuring adequate and ongoing investment in up-to-date infrastructure, investing and supporting skills and capability development to utilize technology and make it accessible and affordable to all farmers regardless of scale, sector or location.

Working through the entire value chain in a joint bottom-up approach, including all the actors, is the only way to get win-win solutions for a sustainable future.

Do you think the future lies in integration of technologies? If yes, how can we move towards that?

The future lies in inclusive and coherent cross-sectoral approaches involving all relevant actors. Broadening participation in the technology advancement process is the real innovation, overcoming siloes both from the technological and management point of view.

We are not looking at one particular technology, but at a combination of technologies that can break siloes and operate in a synergic way to deliver greater advantages to the agricultural business. This is important because it can help in achieving sustainability from its three angles: environmental, social and economic.

How Geospatial Technologies are Improving Lives, Sustainability

Geospatial technologies now play a key role in our everyday lives. They help us drive. They help us work. They help us find critical services nearby.

Indeed, geospatial technologies are now an integral part of the information and communication technology (ICT) sector that fuels today's digital economy.

From banking to transport to healthcare, entire new business models are emerging around personalized and localized services that meet people's specific needs on mobile devices. This will only increase as Big Data explodes in the era of artificial intelligence, 5G and the Internet of Things.

What's most exciting for us at the International Telecommunication Union (ITU), however, is the great potential for ICTs to drive progress on the United Nations Sustainable Development Goals (SDGs) — and improve lives for everyone, everywhere.

ITU's mission is to connect the world, and through its membership of 193 governments and over 800 private sector entities, academia and other members, it develops common standards for telecommunication technologies and services, harmonizes the use of the radio-frequency spectrum and satellite orbits, and assists developing countries with infrastructure and policy development. All of ITU's work relates directly to the achievement of the 17 SDGs.

> As we work together to build a sustainable global economy, geospatial data from earth observation could unlock tremendous opportunity for progress

Connecting the world to improve lives

ICTs, including many powered by geospatial technologies, are already empowering billions of individuals around the world – by providing access to education, healthcare, e-government and mobile banking, among many other key services.

Today, more than 80% of the world's population is covered by at least 3G services offering broadband access to the Internet through smartphones. However, only about half the world's population is connected, either due to cost, lack of awareness, absence of necessary digital skills, or unavailability of relevant content in the local language.

Most of these people live in remote, rural or isolated communities. Connectivity is difficult in these areas not only due to terrain and their isolation, but also due to poor return on investment compared to urban areas.

The good news is that innovative solutions to connect the unconnected are in sight with several projects underway, such as low-earth orbiting satellites and high-altitude platforms, which offer great potential to cover these areas more economically. International agreement on the spectrum for these networks will be the subject of negotiation at the ITU World Radio Conference in Egypt next year, along with the spectrum allocations and standards for 5G. I believe, with these developments, we will see huge improvement in the situation in the coming years.

Indeed, the core function of ITU is to provide international interoperability and interconnection so that services and products can enter the global market and everyone can benefit from the resulting economies of scale.

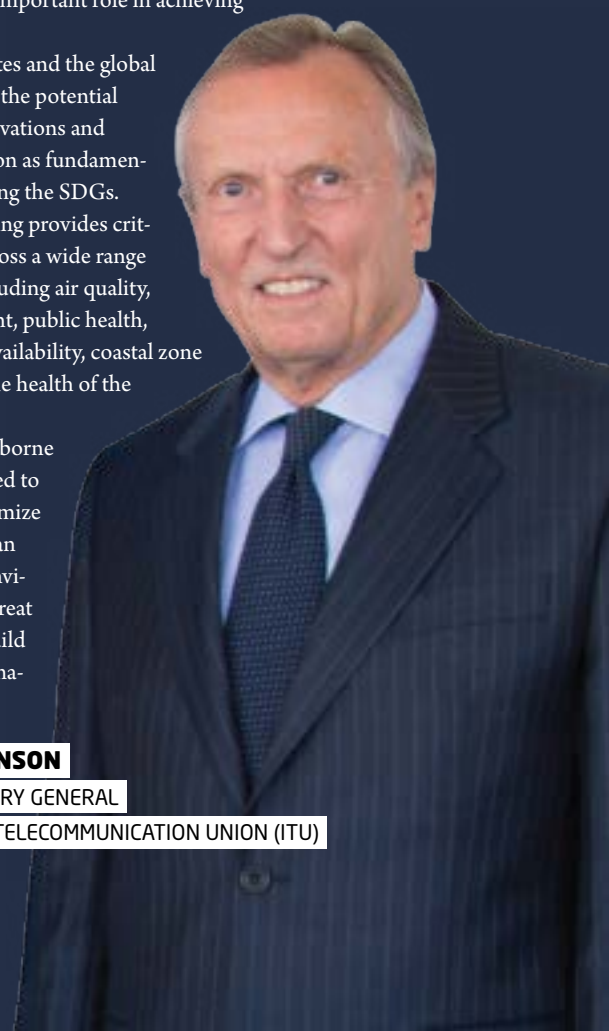
Geospatial for a sustainable planet

As we work together to build a sustainable global economy, geospatial data from earth observation could unlock tremendous opportunity for progress.

From helping herders find green pastures in drought-stricken areas to assisting scientists make critical observations about climate change, geospatial data from spaceborne remote sensors are poised to play an increasingly important role in achieving the SDGs.

ITU member states and the global community now see the potential for using earth observations and geospatial information as fundamental inputs for achieving the SDGs. Indeed, remote sensing provides critical information across a wide range of applications, including air quality, disaster management, public health, agriculture, water availability, coastal zone management and the health of the Earth's ecosystems.

Data from spaceborne remote sensors is used to guide efforts to minimize the damage that urban growth has on the environment. This is of great help as we seek to build smarter, more sustainable cities.



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Geospatially-enabled analytics are becoming increasingly critical to DHS missions, says **David Alexander, Senior Technologist, Science & Technology Directorate, Department of Homeland Security**

Tech Advances Have Enhanced Homeland Security

What role does geospatial data play in the Department of Homeland Security (DHS) and how has the department incorporated geospatial analytics in its operations?

Location-based data and geospatially enabled analytics are becoming more and more critical to Homeland Security missions and community public safety functions. These technologies are deployed across all mission sets to support more effective strategic planning, tactical decision-making and automated emergency measures. New advances in location-enabled technologies are also improving the effectiveness of current capabilities for Homeland Security law enforcement functions, cyber and infrastructure security and information sharing across stakeholders. DHS is rapidly moving from a consumer and outsourcer of analytics to in-house capacities complimented by public and private sector partners and resources.

There is a growing trend of people becoming more geo-aware. How critical is location data to counter-terrorism or solve issues like refugee settlement or migrant tracking?

Citizens, civic organizations and non-governmental organizations have always played an important role in keeping communities safe. Homeland security and public safety have been enhanced by advances in technology, monitoring and communications systems that enable, leverage or compliment citizen reporting (i.e.: E911, Wireless Emergency Alerts, security cameras, satellites, drones, etc.). "The See Something, Say Something" initiative is a prime example of using crowd-sourced information to enhance public safety. There are some issues and challenges that need to be overcome such as security, confidence and integrity of the data, analytics and platforms generating this new type of information. I believe social media and crowd sourcing offer a viable opportunity to augment current public safety reporting and monitoring systems. You wouldn't rely on these sources alone, but combined with other bounded sources, this information can provide more accurate context and improve situational awareness.

With Google accepting that it tracks location data 24x7, do you approve of constant location tracking, even if it is for security purpose?

There needs to be a debate on the distinction between public safety systems and general-purpose solutions. There should also be a discussion on decoupling of devices that

enable collection of such data and solutions that are leveraging these devices.

A combination of location technology and disruptive technologies like AI and Big Data are leading to new innovations. How can DHS leverage this trend and strengthen its internal security system?

Homeland Security is already taking advantage of innovations in smart technologies, AI and machine learning. The research arm of DHS, Science and Technology Directorate is also investing in new science, engineering and solutions to further enable internal homeland security operations and national public safety capabilities. This research interest includes strengthening the integrity and security aspects of these new and emerging technologies.

Data is termed the new oil, but if misused, it can bring catastrophe. In the raging controversy over data privacy, do you think citizens would trust government controlling data?

There is always a healthy distrust in government regulation and administration of economic markets. The data privacy market is not different. That debate needs to take place and include transparency, opt-in strategies and distinguishing public safety systems with general purposes solutions.

Do you think data laws like GDPR can solve privacy issues?

As noted in a previous question, data is a new currency in the global economy. I think you phrased it as "data is the new oil". Initiatives like GDPR play an important role in the discussion and resolution of data privacy in the information age and rise of an interconnected world. I don't think there is a single solution to the data privacy issue, but the debate needs to take place. There is much that can be learned from correlated industries like healthcare. Transparency and opt-in needs to remain focal points of that debate.

What are your views on the US Geospatial Data Act? Can it emerge as a great enabler and foster further innovation?

The main benefit of the Geospatial Data Act is it institutionalizes a function for cross-agency geospatial coordination. The geospatial community needs to discuss how to leverage the reporting function of the Act to spur innovation. Oversight is usually not the most effective pathway for driving innovation or catalyzing new approaches. The geospatial community needs to discuss in collaboration with the private sector the best ways for the government to support, stimulate and grow the geospatial profession and marketplace.

Since NGA's mission is to collect, analyze and distribute geospatial intelligence in support of national security, what role does the agency play in the functioning of Homeland Security?

DHS is a member of the intelligence community. Many of the department's functions are enabled and empowered by NGA capabilities and other national technical means. NGA is an important mission support partner in that context.

What are the new innovations by which geospatial technologies can be used in internal security?

Enhanced way-finding powered by indoor GPS, radio frequency technologies, self-forming mesh networks, remote sensing and detection of aerosols, mini-drone capabilities combined with AI and machine learning that have embedded location-technologies, will form the next generation of public safety capabilities. New multi-dimensional computer visioning will encapsulate these technologies to support more effective tactical decision-making and automated emergency measures.

Does the DHS geospatial data model need an update for enhanced interoperability?

Yes. The Homeland Security and Public Safety communities and its traditional practices need to embrace analytics (human to automated intelligence), sensor diversity

> DHS is taking advantage of innovations in smart technologies, AI and machine learning, and is investing in new science, engineering and solutions to further enable international operations

(from in situ, aerial, space, and on-body devices and platforms), new rendering capabilities, and interoperability to support the rapid and expanding transition from data/information at rest (static) to data/information in motion.

How do you think situational awareness can be enhanced in the age of AI and IoT?

I think the key term here is "convergence". In the near term, I think innovation and advancement will come from convergence of multiple technologies and the novel approaches and applications will be the game-changers, not any single technology. An example of this can be the integration of on-body systems connected to fixed sensors and orbiting systems that interface with media platforms to provide fuller, richer, individual situational awareness and enhance regional situational awareness through shared context. AI and machine learning will have significant contributions in these types of scenarios.

For compiling data, do you think crowdsourcing is a viable option to increase reliability?

Social media and crowdsourcing has, and will continue to make an important contribution to public safety. "The See Something, Say Something" initiative is a prime example of using crowd sourced information to enhance public safety. Social media and crowdsourcing offer a viable opportunity to augment current public safety reporting and monitoring systems.

Geospatial Integral to Public Transportation

MOHAMED MEZGHANI
SECRETARY GENERAL
INTERNATIONAL ASSOCIATION OF PUBLIC TRANSPORT

With more than 1600 members around the world, UITP — International Association of Public Transport — is a broad church of many different stakeholders. All of those with a vested interest in the future direction of public transport take great interest in new advancements in technology.

When it comes to geospatial technologies, the wide range of tools involved in the geographic mapping of the Earth, this technology is more closely connected to the public transport sector than some may think.

Geospatial technology has been evolving in various forms for a very long time and the role of location technology is a core component in moving people around our cities.

Location key to planning and monitoring

When it comes to planning the journey of public transport modes, location plays an extremely important part in defining routes. Various transportation bodies, such as departments of transport and local operators, will factor in geospatial technology when defining their urban mobility plans.

The Geographical Information System and the Global Navigation Satellite System (GNSS)are important technologies for complex transportation planning and management. Both technologies are used to define public transport maps and routes, allowing local authorities and operators to best identity strategy and capacity for moving people around our cities.

The most obvious manner in which to consider the role of this technology in public transport is that operators must know where a bus can go. Real-time information is available and this technology is excellent for planning and monitoring public transport routes. It also allows for on-board information to be shared that can accommodate for accidents or disruptions. Technology that assists in keeping people moving is a must for our cities.

Topography is also important when developing a city's public transportation and technology such as geospatial assists in the geographical and environmental aspect. For example, Singapore, where UITP has more than 40 members, is a city excellent at public transport planning. They use technological developments based on the knowledge of the land. The information they take from areas can determine where public transport needs to go. To source the most relevant information to meet the needs of the people is an excellent example to all. Our cities are for the people.

> "Various transportation bodies **like departments of transport** and local operators factor in geospatial technology when defining their urban mobility plans"

Geospatial important for sustainability

It's not just the more traditional mass transit that involves geospatial technology — modern mobility develops with this technology. The advancement of autonomous vehicles remains a very topical talking point within the sector and GIS will have a crucial role in the path forward for autonomous vehicles. The AV sector is growing at a very fast rate and data is extremely helpful in the development stage, and beyond.

Geospatial information is also closely connected to another important topic for UITP and our members, sustainable development. Geospatial technology and information is relevant for sustainability in policy-making, programming and project operations. The 2030 Agenda for Sustainable Development supports strengthening the capacity to ensure access to reliable and quality data.

It's clear that bringing the role of geospatial technology to a wider audience is the key to better understanding.

Public transport is constantly evolving, and the more information operators, authorities and the industry has available to them, the planning and operating of our cities will continue to advance, benefiting all who live in them.

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USING GEO DATA TO SECURE LAND TENURE

Cadasta's use of geospatial technology helps communities and their stakeholders make better decisions **By Amy Coughenour Betancourt**

Cadasta provides affordable, simple mobile data collection tools and access to geospatial imagery and a global platform to store and manage land data at the community level

Cadasta's mission is to advance global land and resource rights of vulnerable communities through innovative technologies and services, including geospatial technologies. Satellite imagery and data layers help communities visualize and drop boundary points, and to link geospatial information to household and community-level survey data on land and its inhabitants and uses. Cadasta's use of geospatial technology helps communities and their stakeholders make better decisions, advocate for their land rights and safeguard sustainable access to land and natural resources from the bottom-up.

For the over 1.5 billion people in the world who are tenure-insecure, geospatial data and information systems have long been inaccessible and far from the reality they face on the ground. Only in recent years have GPS-enabled devices and access to mapping technologies allowed people in remote and marginalized rural, urban, and peri-urban areas to visualize how geospatial data matters to them.

Cadasta provides affordable, simple mobile data collection tools and access to geospatial imagery and a global platform to store and manage land data at the community level. It partners with communities left out of formal land systems and groups that work with them to help get them and their needs on the map. Cadasta trains communities and their partners to map their own rights and to use the data to advocate for and secure land tenure.

So how is geospatial data relevant to the land-related SDGs? First of all, it is important to note that land and resource rights are foundational to the majority of the SDGs. Of the 17 SDGs, 13 relate to land. That includes 59 targets and 65 indicators directly related to land and resource rights. It warrants mentioning the top few:

Goal 1, No Poverty, states that "all men and women … have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources." For Goal 2, Zero Hunger, the indicator talks about "secure and equal access to land." Goal 5, Gender Equality, says women will have "equal rights to economic resources, as well as access to ownership and control over land and other forms of property…" Goal 11, Sustainable Cities and Communities, calls for inclusive and sustainable urbanization and sustainable human settlement planning, and

Cadasta is bridging the gap between the geospatial industry and extreme poverty

finally, Goal 15, Life on Land, focuses on protecting, restoring and promoting sustainable land use.

Too many communities around the world face the threat of eviction, land grabs and illegal extraction of resources. People without formal land documents live with the insecurity of not knowing whether they can continue to live on, farm, or run their businesses on the land or in the homes they live.

Why is this? Governments in developing countries are not reaching the most vulnerable people with land administration services. The government's traditional top-down methods of requiring a handful of professional surveyors, lawyers, and notaries to survey and register the land using conventional tools, multiple steps, and numerous fees are largely failing to reach all the people who need land

GPS-enabled devices have allowed people in remote areas to visualize how geospatial data matters to them

Cadasta calculated that to map and legally register the 15 million parcels of undocumented land in Uganda, with the level of productivity of the few surveyors in the land ministry, it would take more than 1,000 years

services. It is not surprising that a recent study from the Property Rights Index known as Prindex, found that one in four people in developing countries feel insecure about their property rights.

There is ample evidence that tenure insecurity hinders development. People don't invest in their homes, farms, or businesses if they feel insecure about their land tenure. Without basic documentation of communities or secure tenure, governments don't provide basic services like water, plumbing and electricity. Businesses don't provide services such as loans, mortgages, or critical inputs. And people fear losing their land and resources, cutting off their livelihoods and way of life.

To cite one example, Cadasta calculated that to map and legally register the 15 million parcels of undocumented land in just one country, Uganda, with the level of productivity of the few dozen surveyors in the national land ministry, it would take more than 1,000 years to complete the job. Furthermore, the problem with SDG reporting is that it is the responsibility of national governments. However, governments can't report on data they don't have. In the land sector, it is well known that the data are lacking. Governments need data from the ground and efforts like Cadasta's help provide it.

In the same way, Cadasta bridges the data and access gap between governments and communities, it also bridges the gap between the geospatial industry and vulnerable households. Using Cadasta's platform built on an Esri stack, Cadasta makes state-of-the-art geospatial technologies such as high-quality satellite, drone and other remote sensing imagery, available to people who would otherwise not be able to access or afford it.

Communities know their land rights best. When trained to use Cadasta's tools and platform, they can easily and securely map, document and store their land information. And though only governments can issue full deeds or titles to land and property, there are other ways to advance tenure by documenting claims. For example, Cadasta and its partners have been working in India, Zambia, and Indonesia with local and state-level authorities who can issue intermediate documents such as occupancy certificates, production permits, and land use permits. While not full title or deed, these steps support people's land and property claims and build evidence for further formalization.

Cadasta is bridging the gap between the geospatial industry and extreme poverty. It is important to remember that while the geospatial industry is making great advances technologically to revolutionize our societies, almost half the world — over three billion people — live on less than $2.50 a day. At least 80% of humanity lives on less than $10 a day. Societies, governments, companies and citizens have to constantly challenge themselves and not leave vulnerable people and communities further behind in this data-driven age. One way to do this is to bring these technologies to the people, teach them how to use them and empower them to advance their own development aspirations. By doing this in the land space, Cadasta and its partners can support the SDGs and unlock billions of dollars of potential for future development by advancing people's tenure security.

How can the geospatial sector contribute to Cadasta's mission?

- Invite Cadasta to share its work at international fora like GeoBuiz and the Geospatial World Forum
- Invite Cadasta to conduct workshops at the national level in developing countries interested in employing new technologies to solve critical issues
- Contribute to Cadasta's challenge and innovation grant fund that provides small grants to local organizations so they can map their rights
- Provide Cadasta access to software, imagery and technical assistance to advance its mission
- Connect Cadasta with high-level stakeholders in government, business, social investment and philanthropy who can help forward its mission
- Host Cadasta trainers for in-country training of trusted local partners
- Host a global or national training of mapping and local organizations interested in using Cadasta's platform
- Tell Cadasta's story to business partners and through communication channels
- Volunteer as a Cadasta trainer in developing countries

As one reflects on the various ways to make real progress in the land space, the geospatial world has a unique contribution to make. The vast knowledge, skills and technologies are available to advance the land and resource rights of millions of people and to make a better, more sustainable world.

Amy Coughenour Betancourt, CEO
Cadasta Foundation, *acoughenour@cadasta.org*

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- Galileo: E1 / E1a / E5a / E5b / E6
- SBAS: WAAS, EGNOS , GAGAN, MSAS, SDCM
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GNSS

Testing Takes a New Route

Using the record and replay of 'live-sky' satellite signals to test GNSS receivers

The explosion in use of GPS in both high technology applications and consumer electronics since Selective Availability was removed by the Clinton administration in 2000 naturally led to testing requirements for a host of new products. Until LabSat arrived there were only two alternatives: field testing and laboratory simulation.

Traditional simulators which emulate satellite signals had been regarded as a luxury; LabSat's ability to record and replay 'live-sky' signals in a laboratory environment made GPS testing much more accessible and affordable. Chip and cell phone manufacturers are increasingly placing a LabSat on each of their developer's desks, with the one button start/stop functionality enabling developers to concentrate on the test results rather than managing the simulator.

The reproduction of GPS signals allows for such parameters as receiver sensitivity,

LabSat is exceptionally useful for doing live signal testing. Compared to traditional testing methods, it was found that using LabSat resulted in three to five times more increased efficiency. This is thanks to a number of reasons, principally:

- **Simplification:** LabSat is very easy to connect to what is normally a very complicated hardware setup for the FPGA.
- The ability to carry out testing as if we were driving out on the open road – in Xi'an we normally have to plan our testing around the rush hour traffic and can waste valuable hours. With LabSat we just play the 'live' scenario into the device and don't waste any time at all. We no longer take a whole morning to conduct two hours of testing – it now takes... two hours!
- The consistency we get by replaying a scenario many times allows us to analyse and pinpoint any issues present within a device's hardware and firmware.

signal acquisition and firmware consistency to be developed and then tested in the laboratory. The prime benefit is convenience, but this isn't the only argument for using a GPS record and replay device: consistency and repeatability are vital. By enabling engineers to test using a difficult reception environment or recreate signal anomalies time and again, it allows them to understand and correct potential product pitfalls before release. Thereby providing an easier, quicker and more cost-effective method of validating the performance of satellite receiver chipsets.

Multi-frequency

As the number of satellite constellations continue to grow and the number of frequencies transmitted by each satellite increase (e.g. GPS L1, L2, L5), there is a requirement to ensure that the growing number of multi frequency, multi-constellation chipsets now coming to market are comprehensively validated before release.

To provide a consistent and cost-effective method of testing devices with multi-frequency, GNSS capabilities, Racelogic have developed the LabSat 3 Wideband. With three channels, a bandwidth of up to 56MHz and 6-bit sampling (3-bit I & 3-bit Q), LabSat 3 Wideband can handle almost any combination of constellation and signal that exists today, with plenty of spare capacity for future planned signals.

Case Study: Huaxun Technology Company

LabSat is found in use the world over in a vast array of applications, from sports performance measurement to rocket science.

Huaxun Technology Company is a GNSS chipset and device manufacturer based in Xi'an, north-western China. They design, develop and assemble a range of products for GNSS applications as well as their own navigation and transport recording systems and have been at the forefront of GNSS receiver production in China for many years.

A GNSS simulator is a vital element in their test and development programmes, and Huaxun have two double-constellation record and replay LabSat 3's which they use within several key areas.

Engineer Liang Rong Zhou explains how LabSat has brought about significant time savings:

"Before we can complete chip tapeout (the signoff for a new circuit board) we need to test hardware logic and software systems on the FPGA and we do this in two ways: in the lab, and live.

Courtesy : Racelogic

EXPANDING CAPABILITIES WITH THE FARO® LASER SCANNER

Provides millimeter-accuracy measurement of large environments and objects within a few minutes, enabling to achieve significant project time savings of up to 50%

As technological advancements continue to gather pace, businesses often face the challenges of managing rapid new product developments and ever-changing consumer behavior. In this climate, innovation is now more than just a buzz word. It has become a vital effort for businesses that want to gain a competitive edge.

Amnex Infotechnologies (Amnex) believes this to be true. The Ahmedabad-based company was established in 2008 as Infinium Solutionz and started out by providing its clients with end-to-end solutions for Urban and Mining solution, engineering, and construction through the use of Global Positioning System (GPS) and Radio-frequency identification (RFID) technologies. Amnex subsequently invested in new Geographic Information System (GIS) and Light Detection and Ranging (LiDAR) solutions to offer clients more options and to better meet their needs. Over the past decade, Amnex has amassed a wealth of experience through various projects, including many government sector and municipal corporation assignments such as the Smart Cities initiative, and projects across a variety of industries, such as mining, ship building, and ports.

More recently, the company went through a rebranding process to cement its direction for the future. As part of the rebrand, Amnex began offering solutions that more prominently featured Artificial Intelligence (AI) technology and the Internet of Things (IoT). The company now provides its clients with a full suite of services — such as surveying, database preparation, post-processing, maintenance, and web application reporting.

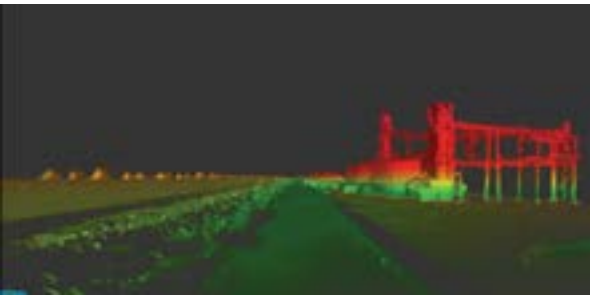
Recognizing the need for change

In the past, the surveying and mapping work that Amnex would undertake required the conventional technique of using Total Station survey instruments. These instruments involved at least 2 people — one to handle the reflector while the other handles the machine. When surveyors were done for the day, the data then had to be mapped based on the .csv format provided by the machine.

The FARO Focus^{3D} X 330 is highly portable and lightweight. It functions accurately either indoors or outdoors, and offers ease of use and fast data collection speeds.

This process was both time consuming and laborintensive. In addition, due to the reliance on human intervention with this method, where errors could be made in the handling of either the machine or the reflector, the accuracy of a whole day's work may easily be compromised. This could then impact the overall output of a project and put it at risk of poor results.

Shravan S Bhati, Vertical Head GIS & Remote Sensing, Amnex Infotechnologies shared, "When we first started out, Total Station instruments were sufficient, though



the process for project completion was often quite lengthy. However, it didn't take us long to decide that 3D laser scanning technology would be the right innovation for us to reduce the issues we had with human intervention errors."

Improved efficiency with FARO Laser Scanner Focus3D X 330 Investigations

In 2016, Amnex was commissioned by the Gujarat Maritime Board (GMB) to scan and document all of its 49 ports along the Gujarat waterfront, the longest portsline in India. Amnex decided then to adopt 3D scanning as it believed that existing technologies would not grant the success it desired.

"As a company, we believe that holding on to older technologies won't allow us to succeed," Bhati commented. "At Amnex, we have always looked forward in terms of being in-line with the latest technologies available."

Amnex had 2 key requirements when searching for a suitable 3D scanning solution. First, the scanner had to cover a distance range of up to 330 meters. At the same time, data quality was a non-negotiable factor.

Cloud Point Data collected using the FARO Laser Scanner Focus^{3D} X 330.

Bhati added, "We viewed FARO's demo and felt that the data quality was good when compared with others. FARO offered a solution that was cost effective yet uncompromising when it comes to data quality, which was exactly what we wanted."

The project proved to be a huge task, due to the multiple sites that had to be scanned and documented. Armed with the FARO Laser Scanner Focus^{3D} X 330, Amnex found that its capabilities had expanded significantly. Other than the assets on the Gujarat ports, the team was also able to capture scans of the jetty where vessels offload their goods, along with information on GMB's offices and employee residential areas. Amnex provided GMB with the base map that it required for all the ports of Gujarat. The result enabled GMB to resolve the 3 major issues that it faced — not having a specific base map for all its ports, the lack of awareness about its current asset situation, and the lack of awareness regarding the boundaries of their land which had led to the issue of encroachment.

Bhati revealed, "With the FARO Laser Scanner, we were able to provide results that satisfied GMB needs. They were able to view all their ports on a single screen as a base map, and even access this information from other areas outside Gujarat."

The use of the FARO Laser Scanner greatly reduced manpower needs for the project, requiring just 1 person to handle the device, compared to 2 to 3 people for a Total Station instrument. This manpower saving is attributed to the portability, simple operability, and high accuracy of the FARO Laser Scanner. The device's measuring range of 330 meters and measuring speed of up to 976,000 points per second allowed the Amnex project team to cover large areas in a shorter amount of time. The high-speed FARO Laser Scanner provides millimeter-accuracy measurement of large environments and objects within a few minutes, enabling Amnex to achieve significant project time savings of up to 50%. The team was also assured of the accuracy of the scan results, as data is kept within a ranging error of ±2 mm. This allowed Amnex to repeatedly produce highly precise point cloud data for efficient post-processing.

Potential of 3D scanning

As a forward-thinking company, Amnex recognizes the true potential of 3D scanning and its applications in Building Information Modelling (BIM).

Commenting on the company's direction for future growth, Bhati said, "Looking ahead, we feel that 3D scanning and BIM are two areas that will continue to grow in India. Being a technology-based company, we're not limited to a single vertical and are already involved in multiple verticals, including smart cities and 3D mapping of underground assets.

"We're keen to explore various other sectors to broaden our scope, should the opportunities arise, and with our good experience so far, we're certain that FARO's innovative solutions will continue to be beneficial for our future projects."

Courtesy : FARO Technologies Inc.

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