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Corrigendum

In Geospatial World magazine edition May-June 2018, we inadvertently published an advertisement of a GNSS receiver showing consumption of alcohol and tobacco. This was an overlook and we apologize to our readers for the same.

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BRINGING MORE SPACE UNDER THE AMBIT

Prof. Arup Dasgupta
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The impact of Space on Geospatial Systems is to be expected. Space imaging has resulted in rapid creation of maps and is now tending to nearly real time mapping with the advent of constellations which image every square meter in hours not days. GNSS has enabled location activities and applications while space communications has made access to geospatial information global. So what will be new?

A look at the Space Policies of the leading space faring nations show a renewed commitment to the peaceful uses of space, interplanetary exploration and colonization and stronger cooperation with new entrants in the field through space based industry. NewSpace has become a catchword as entrepreneurs, many of them young first-timers, seek to conquer this frontier, both upstream and downstream. The use of space technology ranges from the determination of the vulnerability of different areas of the earth to powering wearables in the FIFA World Cup. Sadly, militarization of Space has also raised its ugly head as we head towards commercial utilization of the Moon and planets.

However, it will be some time before commercial entities on Earth grab a bigger slice of space imaging. Studies show that governments across the board dominate this market and it will not be before 2025 that commercial demand will at least become equal to the government requirements. Space imagery, GNSS, IoT, space and terrestrial communications will come together in an environment of Big Data Analytics, AI and Cloud and feed this commercial demand. Meanwhile ancillary services are also picking up as space transportation becomes a big business. In a lighter vein, it seems that the diameter of the American Space Shuttle's solid boosters was decided by the width of a Roman chariot.

As demands pick up, space assets will become too valuable to be used and then consigned to a 'death orbit' once their lifetime is completed. Space situation analysis has become an important endeavor as space junk begin to threaten launch services and in orbit safety. With a thrust in manned missions to the moon and beyond also calls for a more sophisticated space situation management. Space detritus collection is already being tested and may become another commercial opportunity. Space maintenance and repair may become a major business where space assets may be refurbished and repaired to extend their life. It was done for the Hubble Space Telescope.

Prediction in this field is a dangerous game. In 1960, when NASA launched TIROS, the first meteorological observation satellite, no one could have imagined that in 57 years we would have satellite swarms looking down on the earth. When Arthur Clarke proposed three geostationary satellites in orbit for global communications in 1945 he predicted that it would take 100 years to achieve this scheme. Today there are more than 400 satellites in this orbit, aptly called the Clarke orbit.

So, are we looking at Space 4.0? Only time will tell.

Hexagon announces Xalt to harness potential of IoT data

Hexagon AB announced Xalt, a powerful new framework for accelerating digital transformation — fast-tracking a customer's ability to fully leverage IoT data. The goal of Xalt is to create Autonomous Connected Ecosystems (ACE), a state where data is connected seamlessly through the convergence of the physical world with the digital, and intelligence is built-in to all processes — from the core to the edge of a customer's network.

"Perhaps the single greatest need in business today is autonomous insight. This means much more than operational line of sight — it means being able to leverage vast amounts of data behind the scenes, where connected devices and machines interpret what's happening and why, and then act accordingly autonomously," said Ola Rollén, Hexagon President and CEO.

Key Features

- Xalt leverages disruptive technologies — enterprise integration; Cloud orchestration; data visualisation; built-in mobility; intelligent edge connectivity; and AI
- Xalt will significantly accelerate a customer's ability to extract the full potential and value of IoT data across businesses and industry

Leica's first 3D laser scanner with automatic in-field pre-registration

Hexagon AB will soon launch RTC360, a laser scanner equipped with edge computing technology to enable fast and highly accurate creation of 3D models in the field. It was announced in HxGN LIVE 2018. The RTC360 combines high-performance laser scanning, edge computing, and mobile app technologies to pre-register captured scans quickly and accurately.

"We designed the Leica RTC360 for maximum productivity. For construction professionals, plant operators, public safety officials, and other professionals who face complex projects with tight constraints, it provides a better way to digitally capture the reality of their sites – and process and visualise that data for faster, immediate decision making," said Ola Rollén, Hexagon President and CEO.

Key Features

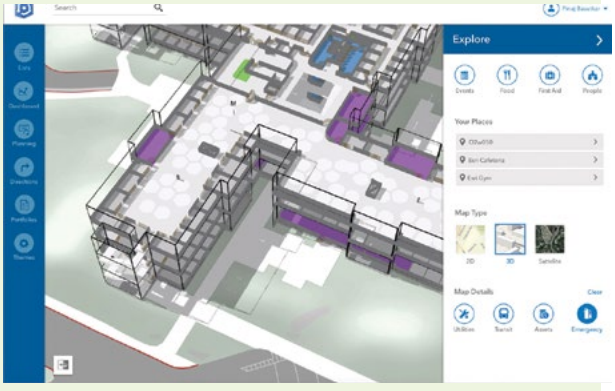
- Two million points per second of High Dynamic Range (HDR) imagery can be captured to create a full-dome scan in under two minutes
- Laser scanner movements between setup positions are automatically tracked by a Visual Inertial System (VIS)
- Scans are combined and pre-registered on a mobile device, where they can be viewed and augmented with information tags

Topcon's new data controller T-18 with advanced speed, power functionality

Topcon Positioning Group introduces the new T-18 handheld controller designed to drive geopositioning, construction, mapping and vertical construction applications. The controller includes a 3.7-inch sunlight-readable display with a 1GHz processor, 1GB of internal storage, and up to 10 hours of battery life. "For MAGNET Field data collection, the T-18 controller offers a durable ergonomic solution with faster processing, a larger screen, better connectivity and longer battery life than previously available comparable systems," said Ray Kerwin, director of global surveying products.

Esri and Waze deliver near real-time data for smarter cities

Esri announced Waze live alert data that will now be available in Esri's ArcGIS Marketplace for free to members of the Waze Connected Citizens Program. The Connected Citizens Program, a two-way sharing of publicly available traffic and road condition information, offers governments a stream of data, constantly updated in real-time, whenever they need it. This enables personnel to make data-driven infrastructure decisions and improves the efficiency of incident response.



Waze, the free, crowdsourced traffic and navigation app, is now fully supported by ArcGIS Online, where its live feed of mapped traffic alerts and other information, such as accidents, congestion, and street damage, can be used in applications in minutes.

Key Features

- Mapped Waze data is available immediately in all ArcGIS apps, where traffic engineers, city planners can use it to maintain and build safer transportation systems.
- Municipalities can leverage near up-to-the-minute reports without having to write code or purchase additional software.
- Data can be used to analyze where the biggest problems exist on the roads so they can create targeted solutions.

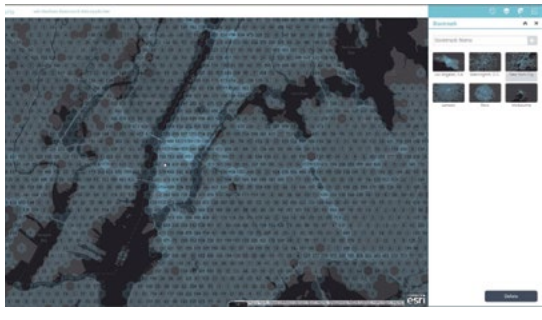
Key Features

- Features 3.5G cellular modem for connectivity with Topcon MAGNET solutions for sending and receiving data to the cloud company account
- Includes standard Bluetooth and Wi-Fi connectivity, as well as an IP65 rating for dust and water protection in demanding job site conditions
- The modem can be used for RTK (real-time kinematic) correction services

Esri announces new indoor mapping product

Esri will soon release ArcGIS Indoors, which will enable interactive indoor mapping of corporate facilities, retail and commercial locations, airports, hospitals, event venues, universities, and more. By applying the latest location technology, ArcGIS Indoors makes life easier for employees, customers, travelers, and visitors by allowing them to see and share where assets, rooms, departure gates, and offices are located. This information, combined with navigation, scheduling, and analytic capabilities, will allow buildings to operate at an increased level of efficiency and safety.

ArcGIS Indoors uses data streams, real-time processing, and location intelligence tools to help businesses and other organizations understand how to better coordinate space and other resources with their facilities and campuses.



Key Features

- Insights from sensor networks deliver real-time information to managers and executives through interactive dashboards.
- Floor-aware, 3D maps allow building operators and occupants to quickly access and explore critical business information.
- Brings the interior building space into the future by placing data about employees, schedules, meetings, customers, and events into a geographic context.

An industry hungry for Innovation

What are the latest trends in the Earth Observation (EO) industry?

The EO sector is increasingly becoming a strategic, innovative and globally orientated sector, predominantly government-orientated though experiencing increased venture capital/private sector investment. As a consequence, it induces a diversification of funding models to support infrastructure needed due to private/public sector interaction. A related trend is the increased focus of capabilities on achieving societal, security and economic returns on investment.

In commercial terms, the market will increasingly be dominated by operators offering 30cm resolution imagery as standard serving defense intelligence applications as well as to the commercial and civil

government sectors. The market will also constantly seek data that is updated and refreshed more consistently and delivered in near real time.

Such imagery will more and more be used as a core enabler within increasingly complex ecosystems: heterogeneous sensors and non-geospatial datasets. The updated imagery, refreshed datasets and multi-source assets have fuelled markets that specialize in analytics and predictive behaviours. At Airbus we are investing in the needs of the market and look towards the future and beyond, with the Pléiades Neo constellation to be launched in 2020, and Zephyr, the High-Altitude Pseudo Satellite which will provide below 20cm resolution and video capacity to help drive these new markets.

It is said the ability of satellites to transform businesses and quality of life is significantly more relevant today than ever. Can you elaborate? How is Airbus helping in this sector?

Satellite imagery and derived datasets have already had a transformative impact on a citizen's quality of life. Urban density, land use, global warming, shorelines, natural disasters, development and retail activity are all examples that can be monitored by earth observation satellites. The quality and access to these datasets are improving, as well as the depth of analytics that can be derived from massive amount of data. As we listen to customer demands, we are expanding on our digital transformation to improve all facets of the geospatial business. Our OneAtlas platform will allow easy access to premium imagery, allow users to perform large-scale image processing, extract industry specific insights and benefit from Airbus assets to develop solutions. Together, OneAtlas will enable users, businesses and partners to build a better future.

There seems to be a lot of collaboration instead of competition between the satellite and EO players. What is driving this trend?

Collaboration brings more success, and more rapidly. As one resolution cannot fit all needs, one constellation cannot answer all revisit needs. That is why there is a commercial logic to collaboration where assets are complementary. When it comes to the development of new services, and especially analytics, the key is to find the right partners to work with, either the specialist in a given market or through technical compatibilities.

Our recent partnership with Planet is a good example of what can be achieved by combining forces. Our satellites are covering any place on Earth at least once a day at 0.5m and 1.5m, but are not capable of acquiring the entire landmass every day like Planet's Dove constellation. We have complementary assets.

Where do you see the business coming from / developing? What is your business model?

In our former commercial satellite imagery business, we mostly used to support a range of business models for the deployment of satellites and their operation. But today, our customers do not want only pixels or systems. They want us to solve their problems and create efficiencies or, improvements in their daily activities and

> Collaboration brings more success, and more rapidly. When it comes to the development of new services, the key is to find the right partners to work with, highlights.
> **François Lombard, SVP, Head, Intelligence Business, Airbus Defence and Space**

Airbus Intelligence is recognized as a World leader in geo-intelligence and delivers geospatial data and services, as well as defense intelligence across a comprehensive range of markets, addressing defence & security, commercial and civil institutional customers. The company is also the No. 1 European supplier of land command and control solutions as well as a lead supplier of ISR and Air Defense solutions to France, Germany and NATO.

Based on more than 30 years' experience in Earth Observation and Defence Systems, the company provides decision-makers with sustainable solutions to increase security, optimize mission planning and operations, boost performance, improve management of natural resources and, last but not least, protect our environment.

Airbus Intelligence is present around the Globe, with subsidiaries and offices in twelve countries across five continents. More than 140 authorized resellers are accredited worldwide, and selected partners operate their own direct receiving stations around the Globe. This ensures a premium customer service through local availability and expertise.

operations. Simply put, provide the right information to the right person and at the right time for the right decision, via simple and direct connections. To answer such market expectations, we are developing new services, new ways of doing business and new routes of going to market in order to deliver the actionable intelligence required by our customers.

We are currently in the process of rolling out a comprehensive range of Cloud-based digital solutions which will be made available via the OneAtlas platform. This includes data, processing, thematic services (for precision agriculture, forestry, maritime domain awareness, security and defense), analytics and much more. This platform will also allow easy API access and hosting ecosystem for our partners' algorithms and analytics.

Our business models offer the ability for our customers to procure imagery either directly or through access to our satellites, with a telemetry contract, often as part of a multi-satellite package. We also leverage the quality of our data and expertise of our business by building value-added solutions that serve markets with specialized products. Some of these solutions include Field Maps for precision agriculture, Starling for no-deforestation commitments, Stack Insight for mining evaluations, and many others.

There has been a rise in the number of start-ups and new companies in the last few years who are driving dramatic innovations, such as nano-sats, 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? Do you think this speed of expansion is sustainable in the long run for smaller/newer players?

It is exciting to be in an industry that is hungry for innovation. In the long-run, the companies that will be successful will be those that are able to deliver on their commitments and deliver what the customer requires. Airbus is well positioned in this market by virtue of its own capabilities, experience, long-standing customer relationships as well as a willingness to partner to deliver sophisticated offerings to fit customer needs across international markets.

Do you think we are on the verge of new space race where the players, technology and services are as diverse as it is innovative?

Yes, there is clearly more involvement in space and this could be termed a new space race. We are not "on the verge" rather we are in the midst of this race. We are seeing a profusion of initiatives serving many sectors from a range of different technologies.

A few years back the satellite industry was specifically divided into earth observation, communications and navigation. But now there is a trend where interdependence of these services has grown exponentially. Do you think cheaper launches, better communication services, easy dissemination of information and new technologies like artificial intelligence have made data cheaper and more accessible?

I think that the key trend we have observed over the recent past is that we are moving from an era where applications were siloed, to a cross-collaborative ecosystem that drives success. There is no doubt that technology is increasingly making data more accessible and there is a general trend that data is less expensive. The challenge that we all face is how to make these enhanced capabilities provide services that are better valued.

Airbus is a perfect example of a company who is into all these areas. Could you explain how your various divisions/platforms and interdependence have made data more accessible to people?

It is true that Airbus has a diverse portfolio and is positioned across the value-chain. Our business relies upon the ability of Airbus to produce world-class imagery, may they come from satellite, UAVs or Zephyr, and how we process and analyse them to transform them into actionable intelligence. Our remit is to work within the Airbus ecosystem and to maintain strong investment to grow our satellite constellation and our digital business though several industries. As an example, Pléiades Neo will offer enhanced performance and the highest reactivity in the market thanks to their direct access to the data relay communication system, known as the SpaceDataHighway, which is also developed by Airbus.

With so many satellites in space, do you think we have a deluge of data now which we do not know how to make sense of?

There has clearly been an expansion in the volume of data provision. It is also true that more and more emphasis is placed upon how to better process, fuse and analyse this data. Airbus is driving this activity with our efforts to deploy data processing capabilities on the Cloud through solutions like Pixel Factory Neo in the coming months. We are also developing our own multi-source and Cloud-deployed analytical capabilities to services industries such as defense, maritime surveillance or precision farming.

With Field Maps for example, customers can have direct access to satellite images acquired on their fields, as well as biomass and nitrogen information characterizing crop status, and which can easily be integrated into agrometeorological models to elaborate practical farming recommendations.

Access to lots of satellite data, with the capacity to go back in time is also valuable to establish abacus. That's how we develop our Fodder Production Index for monitoring grass production, using more than 10-year archived imagery over France to estimate, month after month, the fodder development, and therefore determine thresholds for possible lack of production, which could lead to severe troubles for farmers. This index is already being used by most of the French insurance companies, with data being acquired every 10 days.

Do you think democratization and commercialization of data can go hand-in-hand?

There is no choice. We have to continue the innovation on business models that make this possible. An essential component of this will be continued engagement between the public and private sectors.

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A WHOLE NEW BALL

Arriving a bit late to the party, soccer's governing bodies have finally recognized the importance of technology in contrast with many other team sports. Both on and off the pitch, the World Cup in Russia is seeing technology — GPS and location in particular — playing a bigger role than ever. ***By Anusuya Datta***

July 13, 2014. FIFA World Cup finals. Argentina and Germany were locked in a scoreless draw till the 112th minute when two relatively unknown substitutes, both first timers in a World Cup, took it upon themselves to rewrite the script. A 23-year-old Andre Schurrle made a blistering run down the left and sent that perfect cross into the Argentine box. In a perfect copybook style, Mario Gotze, all of 22, received the ball on his chest before turning to deliver that perfect volley into the net. One goal is all that took to Germany to win the World Cup, its fourth.

German coach Joachim Low ended up looking like a genius at the end because of those "magic" substitutions, with Gotze becoming the only substitute in the history of FIFA to score a World Cup-winning goal. But what many don't know the reason behind Lows' substitutions over his other more experienced options on the bench. As part of their pre-World Cup practice sessions, the German team wore GPS-aided wearable devices to monitor everything, from positional accuracy, speed, distance, to heart rates of players, among other things. The data was then analyzed to see how exactly each athlete performed


GAME
FIFA WORLD CUP
RUSSIA 2018
TELSTAR

at what point, and the information then used to plan future strategies for the team.

However, this story is typically what legends are made of. And legends are not repeated every day. Four years down the line, Joachim Low today must be one of the most hated men in Germany with his team's dismal performance in Russia making them the butt of all jokes and memes.

But, one thing that is running common is the reliance on technology by the planet's biggest game. The advantage that Low had four years back is today in the hands of every team manager.

Arriving a bit late to the party, soccer's governing bodies have finally recognized the importance of technology in contrast with many other team sports. Both on and off the pitch, the World Cup in Russia has seen technology — GPS and location in particular — playing a bigger role than ever. While goal-line technology, which has at its heart precise positioning, hit the headlines in the champi-onship, use of wearables, player positional data and metrics for tactical analysis are some of the others that made news.

Electronic performance and tracking systems

GPS-based wearables have been a common sight in practice sessions for some time now, but it was not allowed in competitive sports till very recently, including the previous World Cup in Brazil. It was only in February 2015, the International Football Association Board approved the use of electronic tracking in official fixtures, just in time for that year's Women's World Cup in Canada.

In March 2018, just three months before the World Cup in Russia began, FIFA allowed electronic performance and tracking systems in matches. Team analysts were now allowed to transmit data and communicate with coaches during the match itself.

Consequently, the 2018 World Cup in Russia saw all the 32 teams making the best use of this technology. Each team was allowed three tablets — one for an analyst on the stand and one on the bench, and the third for the medical team — which had real-time information (subject to a 30-second delay) about player metrics, positional data, and video footage.

GPS-based wearables — whether shirts, watches or any other sensor on the body of the players — record some hundreds of data per second — from position of the player, distance covered, speed and number of accelerations, heart rate, kick accuracy, to impact from tack-les. By running this data on analysis platforms, coaches can plan team strategies, substitutions, design physical workouts sessions and such, according to the demands of each player's position. GPS can also track game fatigue by showing the difference between the highest running intensities during first and last 15 min-utes of the game. The differences can indicate player exhaustion and team fitness.

A number of teams, including Germany, Brazil, Euro champions Portugal, Belgium, England, Poland, Denmark and Morocco were availing of STATSports technology

The 2018 World Cup in Russia saw all the 32 teams making the best use of electronic performance and tracking system in matches.

Brazilian team using STATSports Apex

STATSports

STATSports has a number of products including Apex and Viper Pod.

Apex is a black compression vest which is worn under the regular jersey. The vest has a tracking device slotted into a pouch between the shoulder blades containing an array of sensors. These include GPS to track posi-tion, accelerometers to gauge pace, gyroscopes to measure orientation in three dimensions and magnetometers to record the direction of travel. The device also contains an embedded processor that synthesizes the raw data and computes, in real time, performance metrics such as distance covered and number of sprints completed. The Brazilian team is using Apex in the Russia World Cup.

Viper Pod is a small sensor which is inserted into specifically designed Viper garments (vest/base layer) to collect data on the player's perfor-mance. Already widely used in the English Premier League and Spanish League, it was being used some of the major teams in Russia also. The sensor collects player performance data and which is streamed in real-time through the Viper Live Streaming software and logs it for post-session download. It also has real-time analytics capability to see player position and motion from a bird's eye view on a screen. One of the main features of the app is it automatically produces a post-game summary. It also has a Team Game mode where multiple players connect by enabling their location.

during the World Cup, which is a black compression vest worn under the regular jersey. Various other teams were using a number of other products from companies such as Catapult, Zepp, FieldWiz, etc.

Goal-line technology

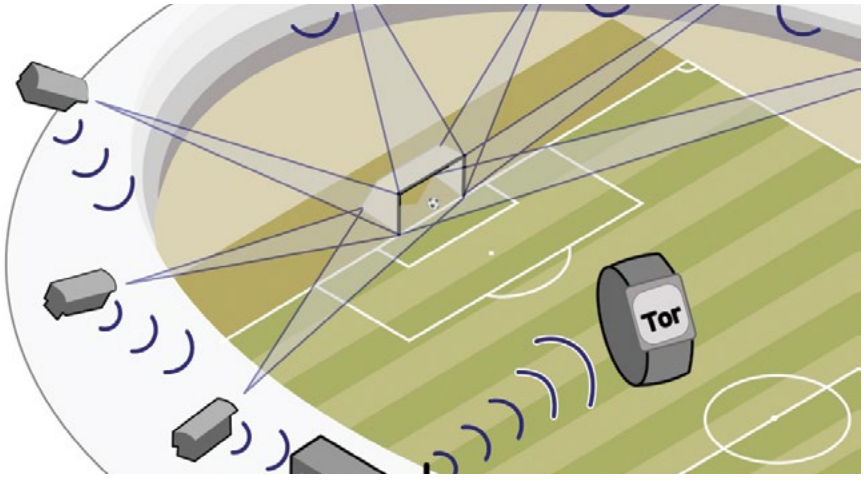
Goal-line technology or GLT, which made waves at the World Cup, is the use of technology to determine if the ball has crossed the goal line or not. This information is then transmitted within a split second to a special watch worn by the referee to ensure immediate response. There are no stoppages or other forms of interference in the game. The match officials are the only ones to receive a signal. Viewers can see replay if the match organizers decide to show it.

Compared to use of similar technology in other competitive sports, GLT is recent addition to soccer — goal-line technology was approved in July 2012 provided it did not interfere with the game. Following this, the technology was adopted to be used in FIFA Word Cup 2014 in Brazil. Because of the high costs associated, GLT is used only at the highest levels of the game like the top European domestic leagues.

There are two types of GLT — Camera based and magnetic field based.

▶ **Camera-based:** FIFA currently uses the GoalControl technology for the World Cups. There are 14 high-speed cameras located around the ground, with seven cameras focusing on each goal to detect the ball's exact location around that area. A software then analyzes all the footages to give a verdict on whether the ball has crossed the goal line or not. All this within a second!

The computer uses triangulation method to calculate the ball's precise position. Triangulation is a geometrical method of calculating the position of an object by measuring a network of triangles. The process involves measuring the length of one side of each triangle and then deducing its angles and the length of the other two sides by observation from this baseline. The system software then creates a 3D image of the ball relative to the goal line by calculating the ball's location in each frame by identifying the pixels that correspond to the ball.



There are 14 high-speed cameras located around the ground, with seven cameras focusing on each goal to detect the ball's exact location around that area

Big Bang Referee Smartwatch for GLT

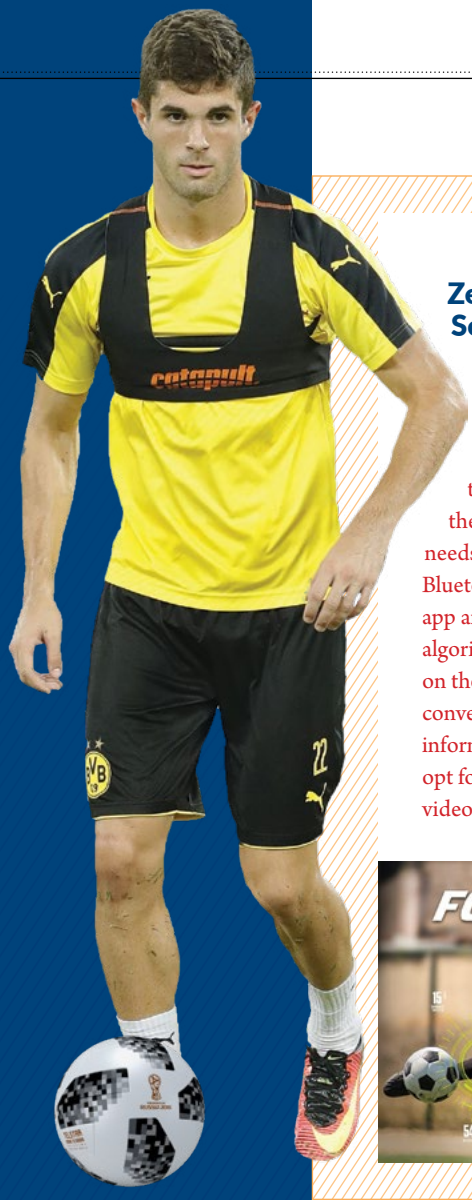
The smartwatch worn by the referee for goal-line technology is connected to the goal-line sensors. The smartwatch allows the referee to know within a second if the ball has indeed crossed the goal line fully. The official smartwatch for referees in FIFA 2018 was the Big Bang Referee from Hublot. It is a limited-edition watch that runs Wear OS and help referees the ability to interface with goal-line technology. There is a commercial version also at a hefty price tag of $5,200 that displays real-time info on scores, cards, names of goal-scorers and substitutes, time left for the match to end and more.

Camera technology via triangulation produces highly reliable results even when the players' bodies are obstructing the views of some cameras. Because only three cameras are required to implement triangulation, even if the view of a few cameras is hindered, the others can take over seamlessly. If the ball has fully crossed the goal line, an encrypted signal is immediately transmitted to the referee via a watch or an earpiece.

▶ **Magnetic fields:** For magnetic field system, cables are placed underground and around the goal. The ball also has electronic sensors in it. The interaction between the receptors in the ball and the magnetic fields created through the underground cables allows the software to calculate the exact position of the ball and determine when a goal has been scored.

This technology has been developed by Cairos Technologies AG in partnership with Adidas. The ball, specially designed by Adidas, has a suspended delicate sensor inside it that can withstand vigorous kicks.

The sensor inside the moving ball disturbs the magnetic field around the goal mouth. This signal is then transmitted to a computer which decides whether the ball fully crossed the line or not. An affirmative answer is immediately followed by a goal alert on the referee's watch. However, FIFA or top soccer leagues are yet to use this technology widely since there have been doubts over its accuracy.



Catapult OptimEye

The OptimEye range developed by Catapult Sports are used in over 20 sports at elite level for fitness, tactical, rehabilitation and technical analysis. The range includes a number of different models — OptimEye X4, G5 and S5 models and the OptimEye T5 Indoor Local Positioning System.

The G5 is the world's first monitor exclusively for goalkeepers. Used by more than 400 sporting organizations around the world, the Catapult G5 measures dives by goalkeepers including their direction and intensity, jumps, accelerations and decelerations, direction changes, etc. It is a chest strap that the goalkeeper has to wear under his jersey.

OptimEye X4 is the entry system monitor that helps calculate force, turn rate, orientation and backward/forward/sideways running. Reports include graphic tools such as plotting player position, velocity, heart rate, effort lengths and recovery time.

OptimEye S5 is advanced model that has been tested by military organizations also. It has all the features of OptimEye X4. But where it scores over others is that it remains the only athlete tracking monitor that measures collisions. It also connects to Open Fields product, which is a highly customized solution for data analysis and performance measurement.

OptimEye T5 device enables both indoors and outdoor tracking. With many stadiums these days having closed roof or large overhead stands, getting GPS signals becomes difficult. The T5 solves this issue with about 10-15cm absolute positioning accuracy.

Zepp Play Soccer

Play Soccer from Zepp is a small sensor that can be slipped inside the shirt sleeve of the player. The device needs to paired with Bluetooth to a smartphone app and appropriate algorithms are then run on the data collected to convert into actionable information. One can also opt for game reports and video highlights.

Smart Ball

From the outside, it looks like a normal soccer ball. But Adidas, which has been manufacturing the official ball for the World Cup since 1970, decided to go smart with the ball this year. The Adidas Telstar 18, the official ball for the Russia World Cup, has an embedded Near Field Communication (NFC) chip. At present, it is purely for consumer use and won't have any impact on the matches themselves.

It is more of a fan experience that works with both Android and iOS devices. A user has to connect the smart ball to his Android or iOS device to get instant feedback on power, spin, strike and trajectory of his kicks, along with tips and guidance. The app instructs a player where and how his foot should strike to curve the ball. The trajectory can be mapped out for a user to see exactly where the ball has travelled. One can zoom in via a two-finger pinch on the smartphone's screen and even rotate as a 3D model to get an in-depth look at what's going on.

However, one wonders what's so great about the Telstar 18 when the Adidas Mi Coach has been around for a while now. Mi-Coach had a built-in sensor that could give information to the players about their kicks and headers. Thousands of data points could be collected and synthesized into training feedback.

The game's getting exciting

This is only the beginning. Wearables are a growing field in sports, and even though it is late, FIFA is eager to cover up. To this end it is looking to establish a standard for electronic performance and tracking systems (EPTS) and thereby looking to provide guidance to football's stakeholders in regard to the use of EPTS in competitive matches. Though the FIFA guidelines for now maintains that "information and data collected transmitted from the devices/systems is not permitted to be received or used in the technical area during a match", with time some of this technology would make way into live matches.

Will too much of technology let the beautiful game remain as beautiful? The debate is on!

Anusuya Datta, Executive Editor
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- **Josef Aschbacher,** Director of EO Programs, **European Space Agency**
- **Leendert Bal,** Head of Operations Department, **European Maritime Safety Agency**
- **Payam Banazadeh,** Co-Founder & CEO, **Capella Space Corp.**
- **Gregg Black,** Senior GEOINT Advocate Commercial Imagery Services, **NGA**
- **Philip Briscoe,** COO, **Rezatec**
- **Sebastian Carl,** CEO, **GAF AG**
- **Hervé Clauss,** Director MAPS Global Sourcing, **TomTom**
- **Massimo Comparini,** CEO, **E-Geos**
- **James Crawford,** CEO/Founder, **Orbital Insight**
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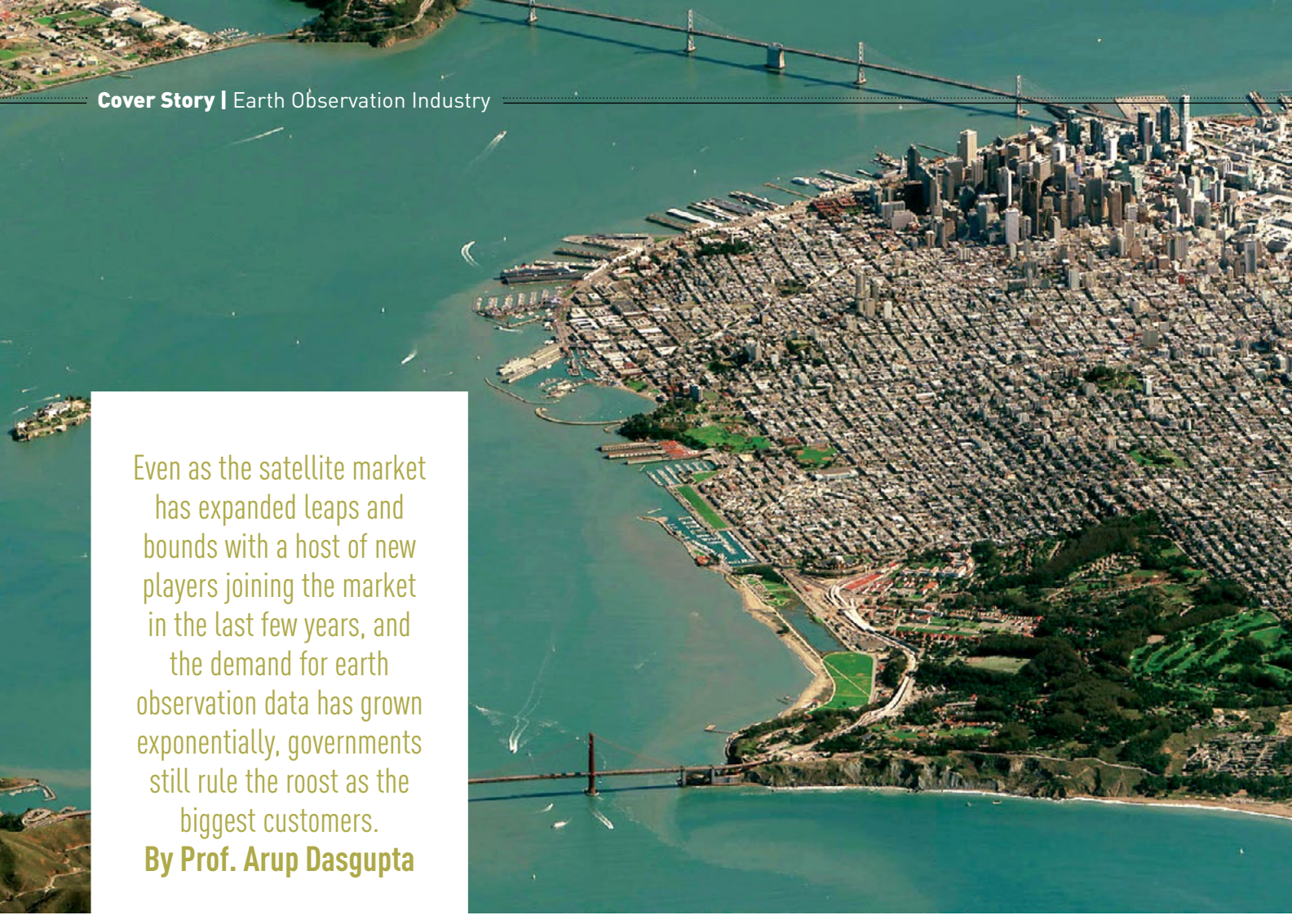


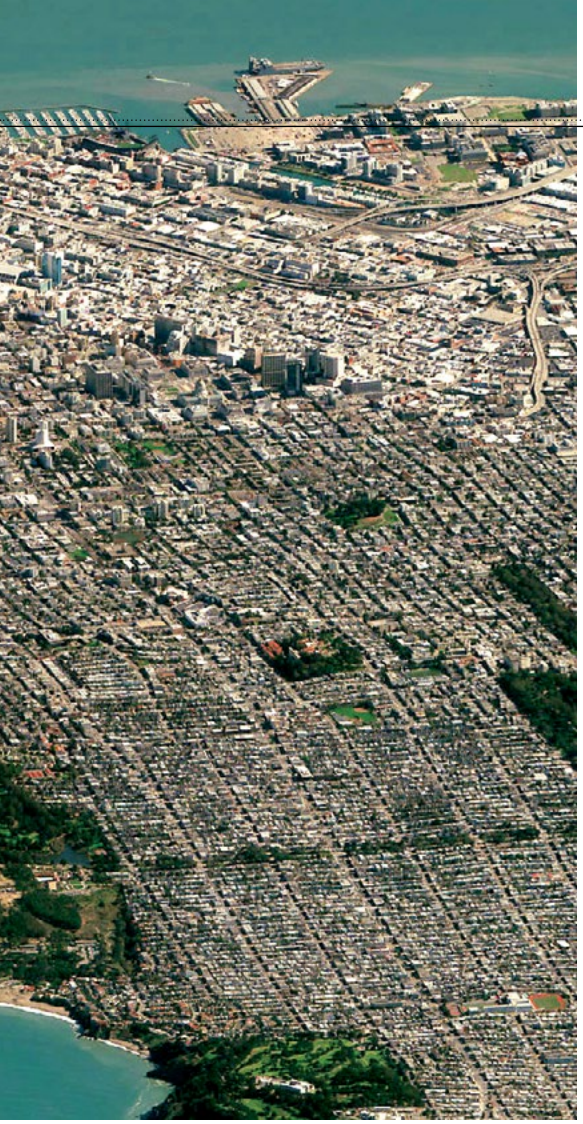
Even as the satellite market has expanded leaps and bounds with a host of new players joining the market in the last few years, and the demand for earth observation data has grown exponentially, governments still rule the roost as the biggest customers.

By Prof. Arup Dasgupta

Who's **Buying** all that **Satellite Imagery?**

The privatization of the upstream earth observation industry has proceeded apace from the 1980s with the initial thrust provided by the National Oceanic and Atmospheric Administration (NOAA) of the US Department of Commerce, followed by several efforts by American, European and Canadian companies. Today, Morgan Stanley believes that there are 93 companies that are reshaping the space industry. Interestingly earth observation accounts for 14% of the total space industry market, which includes launchers, satellite Internet and eight other areas. Increasing demand and plummeting costs to access make this industry "a highly relevant domain of disruption," according to the report by Morgan Stanley. The report also predicts that by 2040 the Global Space Economy Revenue will rise to $11.1 trillion led by Internet, ground equipment and government *(See Graph 1 and Graph 2)*.

However, when it comes to the privatization of the downstream earth observation data market, it is another story. In the paper on "*Towards disruptions in Earth observation? New Earth Observation systems and markets evolution: Possible scenarios and impacts*" by Gil Denisa, et. al. which appeared in Acta Astronautica 137 (2017) 415–433, the market projections show that in 2015 the dominant market for EO data was defense (61%) followed by infrastructure (10%) and natural resources (9%), all government related activi-



ties. Even the value added services market is dominated by environment monitoring (21%), defense (15%) and natural resources (13%) *(See Graph 3 and Graph 4)*.

Note that these figures are from "*Satellite-Based Earth Observation: Market Prospects to 2025*", a report by Euroconsult 9th edition, September 2016 and refer to the situation 2015.

Even the *Geobuiz 2018* report published by Geospatial Media and Communications, shows that out of the top ten drivers of the earth observation downstream market, defense, internal security, e-governance and infrastructure — all government activities — lead the list well into 2020. Looking at India as an example, from the *India Geospatial Economy Report of 2018* by Geospatial Media and Communications, more than 50% of the earth observation market is government driven *(See Graph 5, Graph 6 and Graph 7)*.

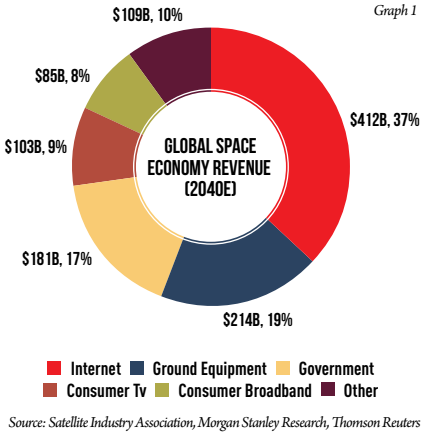
This situation is further reinforced by two major private players in the earth observations market. Quoting from the Planet Labs website (accessed on June 29, 2018): "To have the US government as a customer for a commercial service isn't just a win for Planet — it's a boon for all innovators and new players participating in this space renaissance — whether they're building powerful new satellites, increasing access to launch opportunities, or developing novel imagery analysis methods".

It continues, "As the resurgence of commercial space continues, we're eager to help commercial companies, humanitarian organizations, and organized governments around the world harness the power of space for the benefit of life down here on Earth."

This is reinforced by Maxar Technologies statement in their Annual report of

Global Satellite Industry Revenue

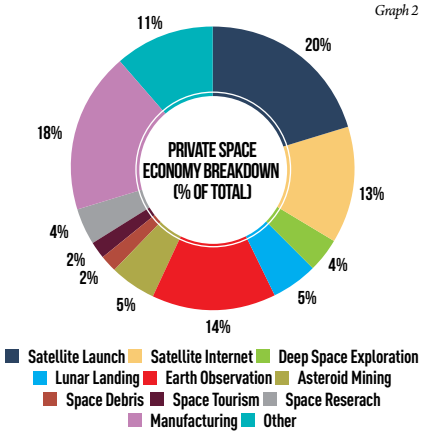
Graph 1



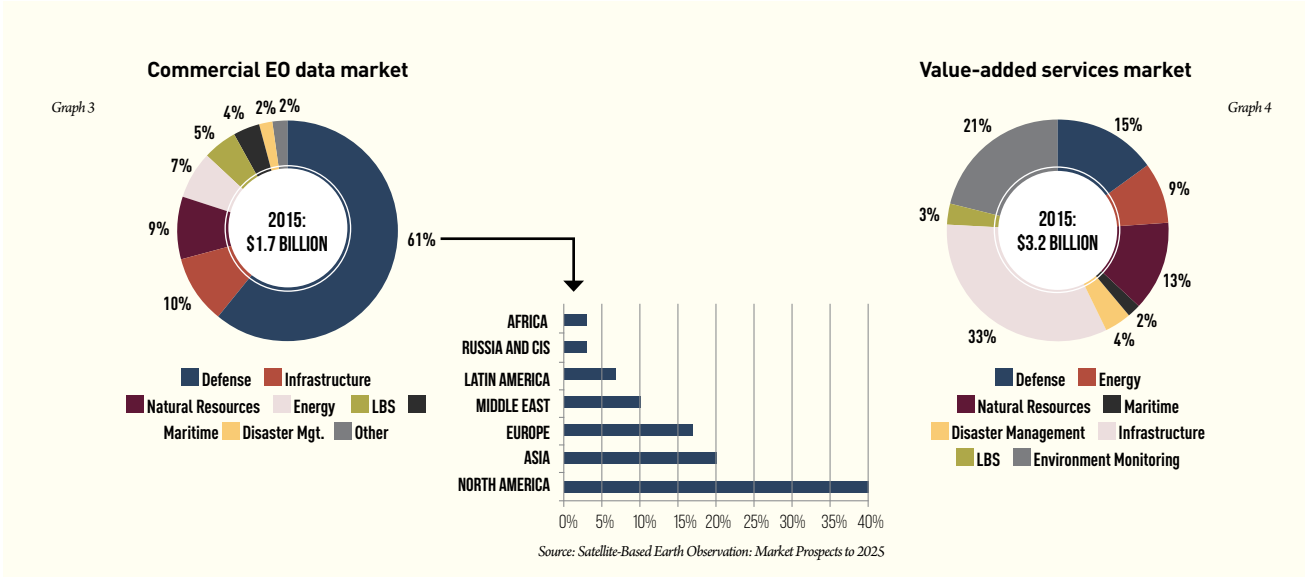
Source: Satellite Industry Association, Morgan Stanley Research, Thomson Reuters

Private Space Economy Breakdown

Graph 2



Source: Morgan Stanley Research



Source: Satellite-Based Earth Observation: Market Prospects to 2025

The total imagery market is estimated to be $2,639 million in 2016 which is expected to rise to $9,696 million by 2021, forecasts Geospatial Imagery Analytics Market — Global Forecast to 2021 by Markets and Markets

> Currently most of the sales are to governmental organizations, but we expect the B2B fraction to increase significantly in the next few years.

FABRIZIO PIRONDINI
CEO, DEIMOS IMAGING

2017 that "… Maxar's principal customers in the Imagery segment are US, Canadian and other international government agencies, primarily defense and intelligence, as well as a wide variety of commercial customers in multiple markets". Maxar's primary customer in the services segment is the US government, but many capabilities also support intelligence requirements for other international governments, global development organizations and commercial customers.

Planet Labs and Maxar represent two companies on opposite ends of the spectrum in imaging from space. Planet is young and brash, Maxar is comparatively mature. Yet both private sector companies ultimately count the government as their major customer. The story of privatization of remote sensing imagery acquisition wended its way through mergers and acquisitions from EOSAT, Space Imaging, GeoEye, DigitalGlobe to Maxar. Of these the merger of GeoEye and DigitalGlobe was the most interesting as it was precipitated by the loss of a major contract for imagery with the US Government's National Geospatial Agency.

In "*Geospatial Imagery Analytics Market — Global Forecast to 2021*" by Markets and Markets, the total imagery market is estimated to be $2,639 million in 2016 which is expected to rise to $9,696 million by 2021. Out of this, defense and government take up the lion's share of the global geospatial imagery analytics market. In fact, the share is shown to increase by 2021 at a CAGR of 24.9% and 30.3% respectively.

Given this scenario, what is it that earth observation data producers and value adders look forward to from the private sector?

A study of the Markets and Markets report shows that while the absolute numbers are low, the CAGR of the commercial sectors do show a healthy CAGR of 30 percentage points to 35 percentage points in the same period. However, the data producers, aggregators and value adders are very cagey about market prospects.

The *Geospatial World* circulated a questionnaire which elicited responses ranging from silence to "does not pertain to us" to very general statements sans any numerical projections. However, one fact emerged from the responses; the way forward is not just from selling data but selling actionable information for decision support.

Changes in the market composition from 2020 to 2025

"Currently most of the sales are to governmental organizations, but we expect the B2B fraction to increase significantly in the

next few years," says **Fabrizio Pirondini, CEO, Deimos Imaging**. On the future, his prediction is that by 2020 the company will have a 50%-50% split between B2G and B2B, while for 2025 the expectation is around 65% B2B, 25% B2G and 10% B2C. With the launch of UrtheDailyTM Constellation in 2020, which will collect high quality multispectral imagery daily, it will be possible to use M2M and AI for daily change analysis and innovative solutions enabling B2B services.

According to **Fritz Schlereth, Head of Product,Descartes Labs,** which in their own words "positions its platform and solutions for geospatial science and machine learning applications to a variety of commercial, governmental, and non-governmental organizations," involvement with defense-related agencies in the US federal government is set to increase by 2020. He mentions that Cargill and other forward thinking organizations will continue to be commercial user base of Descartes Labs. However, by 2025 the company "anticipate a blended portfolio of customers among commercial enterprises, government, and research/academia. Large commercial enterprises with significant exposure to the physical world, for instance in industries like oil & gas, metals, agriculture, mining, construction, and shipping, will continue to make up a significant part of our target market". These organizations have become more aware of the competitive advantage of persistent insight and predictive analytics based on remote-sensing-enabled visibility across their supply chains.

> "BlackSky's customer portfolio will be varied. We anticipate geospatial information to become more mainstream, and that a variety of industries and organizations, including venture capitalists, media and environmental groups, will have a better understanding of how to gain insights from this data to create innovative solutions.

NICK MERSKI
VICE PRESIDENT
SPACE OPERATIONS, BLACKSKY

> "Involvement with defense-related agencies in the US federal government is set to increase by 2020. Large commercial enterprises with significant exposure to the physical world, for instance in industries like oil & gas, metals, agriculture, mining, construction, and shipping, will continue to make up a significant part of our target market.

FRITZ SCHLERETH
HEAD OF PRODUCT
DESCARTES LABS

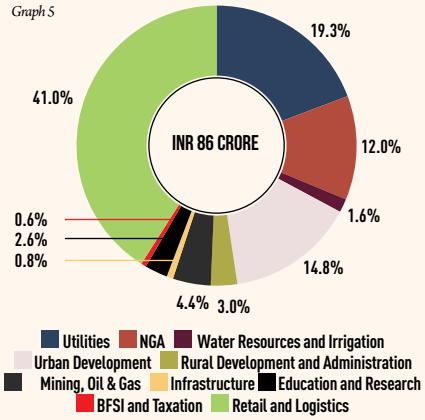
Nick Merski, Vice President, Space Operations, BlackSky, expects that by 2020 "… a nearly even balance between traditional consumers of geospatial information, such as government agencies and academic institutions, as well as new customers who are discovering the power of geospatial insights". Further he projects that by 2025 BlackSky's customer portfolio will be varied. "We anticipate geospatial information to become more mainstream, and that a variety of industries and organizations, including venture capitalists, media and environmental groups, will have a better understanding of how to gain insights from this data to create innovative solutions," he adds.

Impact of AI and Big Data Analytics

Schlereth feels that with the explosion of data from satellites, sensors and IoT, comes opportunities to solve long-standing business problems in ways unthinkable earlier. Big Data analytics and AI will come to the aid of processing such huge and varied data almost in real time and at global scale. He

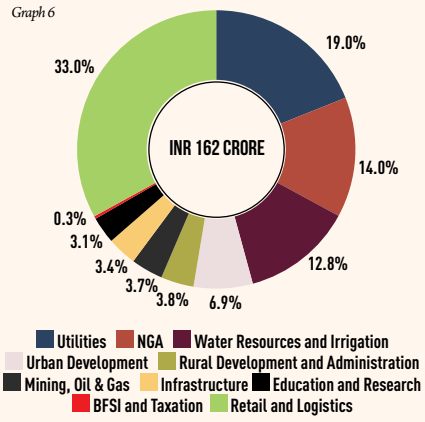
IGE-18: Market Distribution by Application Areas in FY 2014-15

Graph 5



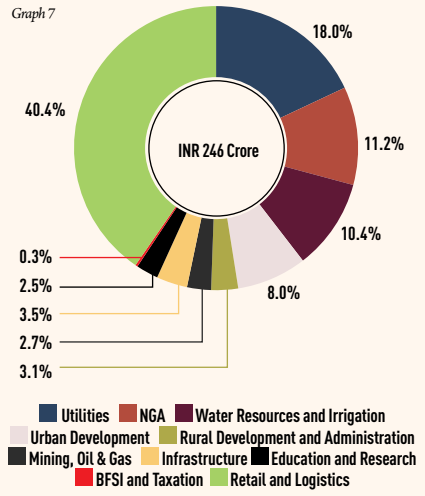
IGE-18: Market Distribution by Application Areas in FY 2017-18

Graph 6

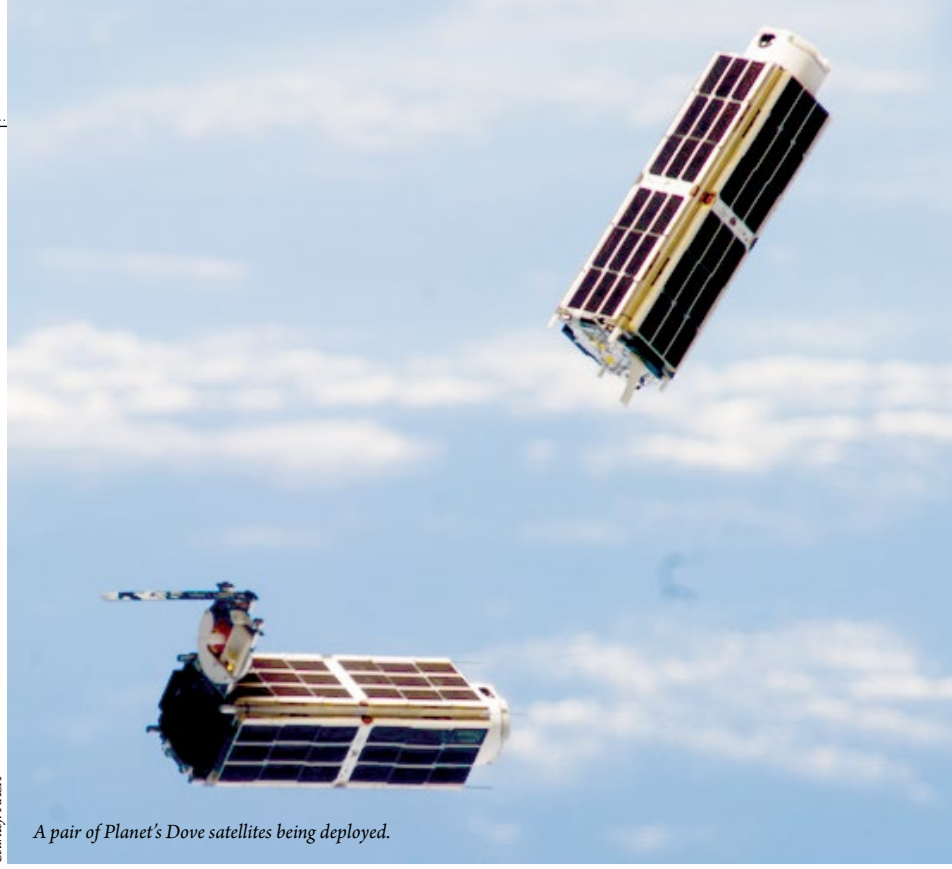


IGE-18: Market Distribution by Application Areas in FY 2020-21

Graph 7



Source: Geospatial Media Analysis



Courtesy: NASA

A pair of Planet's Dove satellites being deployed.

quotes examples like "predicting corn yield across the US, developing a near-real-time feed of wildfires as they develop, monitoring environmental variables nationwide for infectious diseases… global monitoring of freight, crop production schedules, construction activity, manufacturing output; all of which have a location-component, and all require platforms capable of delivering sensor-fusion and frequent and consistent geospatial analyses." He envisages that decision making for global physical supply chains of tomorrow will be enhanced through continuously iterating analysis using data from always-on sensors, analytic platforms powered by machine learning and computer vision algorithms.

UrtheDailyTM of UrtheCast (Deimos Imaging's parent company) is the world's first earth observation system planned to truly power machine-learning and artificial intelligence-ready geo-analytics applications, on a global scale. "It will be a paradigm shift in utilizing EO data, allowing people to plug-in to a consistent flow of high-quality, scientific-grade data, every day, exploding the application possibilities," claims Pirondini.

> "The efforts by small countries to have their own satellites will marginally impact big players but will also have an impact on themselves as well.
>
> 
>
> LILY XU
> CEO, SPACE VIEW

Merski expects that Big Data analytics and AI will play an important role in geospatial technology. While currently BlackSky's end product is geospatial data, the ability to process not only the EO data but data from other sources including social media with AI and machine learning will lead to increased intelligence and the evolution of entirely different products that can provide answers to business and operational questions. Data-driven insights from geospatial data will provide another layer that can be incorporated into business or operational workflows impacting a wide variety of industries.

Governments started the space imaging boom. Governments encouraged privatization of the space borne imaging industry. It is to be expected that governments would therefore be the biggest market for space imagery

Lily Xu, CEO, Space View also indicates that in terms of artificial intelligence and other technologies, "AI will satisfy the precision demand of statistic Big Data analytics in the short future, but still long way to meet the demands of mapping".

Constellations vs individual smallsats

Expanding on this, Merski avers that a country might opt for a mix of sources depending on their needs. They might buy some geospatial services from large enterprises while depending on their own satellites for their unique requirements. The bottom line is that with affordable satellite capability the number of space-proficient nations will grow and so will the power of geospatial information.

Pirondini has an interesting take when he says that the approach of the PanGeo Alliance of federating incumbent players into a large virtual constellation capable of providing a consolidated service to the customer base will continue to incorporate smaller countries and even small commercial operators. "The resulting federated resources are already starting to impact the biggest players, and this trend is likely to continue," he adds.

Schlereth feels that individual nations owning their own satellites through contracting out to private industry for building, launching and operating them cannot impact the larger trend of constellations. No country or satellite, he adds, can stand alone in addressing the multitude of problems that require geospatial data.

In contrast, Lily envisions that the efforts by small countries to have their own satellites will marginally impact big players but also impact on themselves as well.

Regulatory hurdles

Privacy concerns can limit the proliferation of data sources and so impact the analytics process. However, satellite data has not yet been affected because of the regulatory environment that effectively prevents any invasion of privacy, feels Schlereth,.

On regulations Lily says that while it is necessary, the policies should be clear.

Merski takes a positive approach to regulations and while working within the regulatory framework they also look ahead and monitor space management issues relating to space traffic and frequency utilisation. It is important to note that regulations are not static and there is a need to be prepared for future changes. Technical design must be strong but also aligned to future policy so that operations become easy in changing regulatory environments.

Governments to be biggest market

Governments started the space imaging boom. Governments encouraged privatization of the space borne imaging industry. It is to be expected that governments would therefore be the biggest market for space imagery. As technology advanced, the use of such imagery for commercial use began to grow. Such use is at the doorstep of an explosive growth that might see industry demand becoming as big as the government demand in the next five years. The key to this explosion will be the use of Big Data Analytics and AI to power decision making processes using space imagery, location, in situ sensors and sources of opportunity like social media. The future is exciting.

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

HELLO SATELLITE

here's your on-call repair agent!

Though still a niche technology, on-orbit servicing is fast coming up as a transformative and disruptive capability that provides operators with unprecedented flexibility and resilience for their space assets.

By Mahashreveta Choudhary

- *The iconic Landsat 5, which successfully set the new Guinness World Records title for 'Longest-operating earth observation satellite', outlived its three-year design life, to deliver high-quality, global data of Earth's land surface for 28 years and 10 months, before it was decommissioned in 2013.* **Imagine it lasting forever!**

- *ISRO launched IRNSS-1A satellite in 2013, which was the first in the seven-satellite constellation to provide regional navigation services to India and its neighboring countries. In 2016, ISRO had to discard the satellite altogether and launch a replacement when all the three rubidium atomic clocks onboard IRNSS-1A failed.* **Imagine a robotic arm changing the clocks instead!**

Canadarm2 supports astronauts working in space and services instruments and other payloads attached to the ISS

Imagine dumping your car when it runs out of fuel or develops a snag on the highway. Imagine throwing away your television set if a fuse goes off. Imagine abandoning your house if the pipelines are leaking. We don't do any of that, right? We call relevant service providers to fix the problems.

If everything can be refurbished and serviced, why not satellites?

Of course, they can be. Here's how. On-orbit satellite servicing entails servicing, refueling, repairing, and even upgrading satellites that are in orbit. The major components here include an advanced spacecraft with a specialized toolkit and robotic arms for capturing, interacting with, and manipulating a client, software for managing semi-autonomous servicing tasks, and an advanced sensor suite for careful rendezvous and proximity operations.

Though still a niche technology, on-orbit servicing is fast coming up as a transformative and disruptive capability that provides operators with unprecedented flexibility and resilience for their space assets.

The capability is the gateway to an entirely new infrastructure for earth observation, communications, space exploration, space travel, and habitats, and integral part to build a better world.

The application area of on-orbit satellite servicing is very broad where each application area has its own importance based on scientific, economic, strategic, and societal benefits. Repair and maintenance of the satellites in space keep a unique and valuable asset operational, essentially improving it beyond its design lifetime or the reliability of its subsystems. It improves overall mission robustness and offers a unique capability to improve risk posture through post-launch operations.

"On-orbit satellite servicing is an exciting new area and a great technological transformation in the space sector. The technology will not just impact geospatial domain but can be used for all satellites. It is a great capability that will elongate the life of some very expensive satellites," says **Robert Zitz, Senior Vice President & Chief Strategy Officer, SSL, a Maxar Group Company.**

SSL is a pioneer in satellite servicing, and its sister company Canada-based MDA (then known as Spar Aerospace) built the Canadarm for the Canadian Space Agency way back in 1980s. Today, Canadarm2 plays a key role in station assembly and maintenance on the International Space Station. Launched to the ISS in 2001, the Mobile Servicing System, Canadarm's technical name, moves equipment and supplies around the station, supports astronauts working in space, and services instruments and other payloads attached to the space station and is used for external maintenance.

When did it all begin?

The first in the list is Skylab. Launched in the year 1973, Skylab was NASA's first space station and also the first human satellite servicing endeavor. In the mission, the parasol was successfully deployed that restored an acceptable thermal configuration saving the mission.

A similar operation was carried in the year 1984 to extend the life of Solar Maximum Mission. Solar Maximum Mission was launched on February 14, 1980. After nine months of its launch, it was observed that the satellite's attitude control system had stopped working. On April 10, 1984, the satellite was captured by the Shuttle's RMS arm, and was sent back to orbit when the problem was solved by astronauts.

The most eminent among on-orbit satellite servicing is the famous Hubble Space

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> 
>
> **ROBERT ZITZ**
> Senior Vice President & Chief Strategy Officer, SSL, (A Maxar Group Company)

An artiste's impression of SSL's Restore-L spacecraft approaching a satellite for refueling.

Courtesy: NASA

Telescope. Launched in the year 1990, HST was developed by NASA in collaboration with European Space Agency. After the launch, some optical flaws were observed in Hubble's primary mirror. Along with this, Hubble also encountered thermally tempted "jitter" or shaking from its solar arrays during orbital sunrise and sunset. Both these glitches were resulting in blurred images. To fix the problem, NASA initiated a striving program to restore the capabilities through astronaut servicing. In this servicing mission, Corrective Optics Space Telescope Axial Replacement (COSTAR) was installed to restore the observatory by replacing the High-Speed Photometer instrument to correct the faulty vision. In 20 years of Hubble Space Telescope mission, many such unexpected issues arose which were more than just changing hardware designed to be serviced. Each of these repairs required accessing interfaces that were not designed for servicing but were fully successful accomplished.

Today, thanks to technology advancements and miniaturization, on-orbit repair and refurbishment have reached a point where it can be employed on a varied number of satellite systems even without human presence, as against early days when astronauts were required to aid the servicing station in space. For instance, when the Solar Maximum Mission developed some problems, mission specialists George Nelson and James Van Hoften had make a space travel to repair it.

> "The vision for on-orbit servicing and assembly is to create a robust and resilient space ecosystem that drives humanity toward a new era of space exploration, ultimately lowering the cost of access to space, and helping to build a better world.

RICHARD WHITE
President, SSL Government Systems

The first successful end-to-end robotic satellite servicing was performed by Defense Advanced Research Projects Agency (DARPA) in 2007 when two systems — Autonomous Space Transport Robotic Operations (ASTRO) vehicle and a prototype modular NEXT-generation serviceable Satellite (NEXTSat) — were launched. ASTRO and NEXTSat were designed keeping on-orbit servicing in mind.

Till date, the International Space Station (ISS) is unarguably the perfect example on-orbit robotic satellite servicing, with robots playing a significant part in the space station's construction, maintenance and operations.

Why adopt the technology?

On-orbit satellite servicing leaves little room for satellite failures. The idea facilitates cheaper and faster development of satellites and enables repair missions which extend the life expectancy of the spacecraft by replacing damaged blocks or those run out of fuel. Old satellites can even be refitted for new missions that help to reduce space debris and the cost of launching new systems.

"The vision for on-orbit servicing and assembly is to create a robust and resilient space ecosystem that drives humanity toward a new era of space exploration, ultimately lowering the cost of access to space, and helping to build a better world," **says Richard White, President, SSL Government Systems.** The technologies resulting from the development of this capability are critically important to accelerating innovation for the NewSpace economy, enhancing national security, bolstering economy, and enabling next-generation space missions, he adds.

The tools and methodologies developed to enable these successes apply equally well to a broad range of customer satellites. In the near future, the benefits of on-orbit satellite servicing will become increasingly imperative as the longings in space increase and the price and achievability of major projects become commensurately more challenging.

On-orbit satellite servicing validates how to successfully use nominal mission planning, preplanning for contingencies, in-situ contingency assessment, and detailed simulation tools to help ensure success. On-orbit satellite repair mechanism will also decrease space debris, and as **Dr Peter Swan, President of International Space Elevator Consortium,** says, will have a remarkable business growth in the GEO orbit region.

How the technology works?

For on orbit-servicing, a service spacecraft is built with robotic arms. These arms are just like human arms, and in case of a satellite developing a snag, the servicing spacecraft is made to approach it, grab it, pull it close, and repair or exchange the faulty part with a toolkit it is carrying. If a satellite runs out of the fuel, similar technology is used to refuel it.

"The actual servicing process changes depending on the design, orbit, and needs of the client spacecraft, but generally include rendezvous and gentle capture of the client, com-

pletion of servicing tasks using the servicer's robotic arms and toolkit, and then release of the client within a few days," explains White. The client continues to operate during most on-orbit servicing procedures.

An important question that comes up here — can all satellites be serviced on orbit or do they need to be assembled in a specific way? Dr Swan feels it will be difficult to replace or refuel currently-existing satellites that were not built specifically for on-orbit servicing. "It is a very difficult task as all those attributes will have to be designed in and built," he adds.

However, SSL is now developing a technology which can service every satellite in the orbit. "Servicer designed by SSL will be compatible with most government and commercial spacecraft that are currently in orbit, even those not designed to be serviced in space," emphasizes White.

That being said, SSL envisions some of the future satellites to be heading in the direction of standardized and modular architectures, with external plug-in interfaces. This would facilitate both planned and unplanned upgrades, modifications and repairs, for changing missions and technology updates.

In the near future, many government and private missions are gearing up to fully demonstrate these technologies in orbit. NASA is coming up with Restore-L as one of its kind. Zitz reveals the US space agency has signed a contract with SSL to build Restore-L which will refuel the aging Landsat 7 remote sensing satellite launched back in the year 1999.

Orbital ATK, the commercial spaceflight provider is also in the game but with a marginally different approach. The Robotic Servicing System designed by the company is Mission Extension Vehicle (MEV). MEV will dock a satellite and will also provide attitude control, station keeping and end-of-life disposal.

> "On-orbit satellite repair mechanism will not only decrease space debris but will have a remarkable business growth in the GEO region.

DR PETER SWAN
President, International Space Elevator Consortium

What are the challenges?

Every technology comes with a challenge and so does on-orbit satellite servicing. Since satellite servicing entails few new technologies, the key challenge lies in integrating communication system with regard to distance increase between the satellite repair system and ground station. In such a case, it becomes tough to locate and then rendezvous dock spacecraft that has to be serviced. The path to this goal requires a strong system engineering approach to combine the available technologies, tools, and procedures to overcome which brings together some economic challenge. Maintenance or upgrade without any technical glitch means launching a new satellite to replace something that may have a fully functional set of subsystems which increases their cost. The real economic challenge lies in determining the value of servicing like comparing the cost of a servicing mission to the cost of replacing the failed satellite as well as the potential returns from the serviced satellite.

The space segment is expanding at a fast pace. Every day numerous satellites are being shot in the space, some of them are destined for long distance and due to any glitch abandoning those satellites is a huge loss. Retiring satellites because of failure also create a lot of space junk. On-orbit satellite servicing comes as a magic solution to these issues, and could go onto become the base of future economic development of space, delivering increased benefits from space to the world.

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Off the Beaten Track

Like all other industrial sectors, the space sector also depends on transportation for moving satellites and other components from one place to another. And there are specialized service providers for that. **By Aditya Chaturvedi**

It would either be a crude joke or a grotesque parody of science fiction if one even envisages satellites huddled in a decrepit-seeming wagon or truck and taken to their destination.

The intricate technological sophistication, use of sensitive components and sensors in satellites means that they cannot be simply loaded on the back of a lorry like other heavy goods and taken to their final destination to be unloaded. The need for safety, security, alertness, vigilance goes along with cutting-edge technology in special trucks and a state-of-the art monitoring, tracking and surveillance system.

Who is responsible?

In countries where satellite transportation is not privatized, the national space agencies carry out the task themselves. For instance, ISRO in India transports its satellites on its own. ISRO has built its own indigenous Satellite Transportation System (STS) that protects satellites against environmental hazards. STS is built with a suspension cradle that attenuates shock and vibration while handling loads.

But in most of the western world, space agencies, such as NASA, rely on private satellite transportation companies.

In the US, the Department of Defense certifies the companies based on various parameters, quality controls and standards. Only the companies that are up to the benchmark set by Defense Department get contracts for transporting satellite, unlike bidding contracts for transportation of other goods which do not have to abide by so many regulations and guidelines.

Bradley Worthington, Vice President, Aerospace & Defense Services, McCollister's Transportation Group, a leading satellite transportation company in US, says "Beyond basic registration, the US Defense

Department criterion also includes financial health of the organization and appropriate insurance coverage, among others. Performance is graded and scored at the end of each transport."

Other companies like Satellite Specialized Transportation and Harbor Freight Transport Corporation also agree on the need for maintaining high standards in satellite transportation mainly due to the high level of investments involved.

Safety, compliance and quality

Loading and unloading satellites require feasible conditions, like a particular temperature, air pressure and atmospheric pressure that have to be maintained inside the truck. With high-precision microchips and sensors there is an increasing need of stabilizing temperature in the truck and installing a temperature controller that also gives updates about the temperature.

"Satellites are loaded and unloaded in controlled environments. This is typically done in an airlock adjacent to a 'clean room' area. The temperature, pressure, and humidity inside the shipping container is controlled by our clients' on-board 'Environment Control Unit' (ECU). These ECU's are integrated into the shipping container," shares Worthington.

While transporting satellites, precision for detail is very crucial at each level. As Jeff Roberts, Senior Mission Manager, Spaceflight, confirms, "Throughout our years of launching with domestic and international launch vehicles, we have always taken extra care to ensure the successful and safe delivery of our customers' valuable spacecraft."

The necessary document warnings like 'handle with care' or 'hazardous materials' is to be prominently displayed. The big containers used to carry satellites should be of perfect quality. For example, in the case of air cargo, a pressure relieving valve is used so that the satellite doesn't touch the contours of the cargo box.

No margin of error

A single malfunctioning chip or circuit in a satellite could make the whole satellite permanently dysfunctional and scuttle the ambitious projects. There has to be bare minimal probability of exposure to harsh climate or wear and tear of the satellite components during transportation.

"The main requirements for transportation include performing a route survey in advance of the transport to insure the load envelope can be safely transported along a prescribed route. Other requirements include oversize permits, lead and rear escorts, and pre-planned 'safe haven' locations in the event of weather or equipment issues", says Worthington emphasizing the strict security measures and high level of preparedness for a worst case scenario.

The journey of the satellite truck may range from a few hundred miles to a thousand miles. To nullify the chances of error, even the twists, turns; roundabouts in the route are examined and surveyed.

Satellite transportation companies usually determine the final dimensional envelope of the transport, and then send a crew out to take measurements of potential obstructions – low hanging trees and utility wires, underneath bridge overpasses, construction zones, narrow surfaces, and turns with a potentially challenging turn radius. Once the surveying of the routes is done and the best possible survey path is examined, the cargo follows the same route and directions. During transport, the lead escort has the responsibility of identifying these areas along the route, and dictating the convoy's course of action, based on the script developed from the results of the route survey.

The expectation for margin of error in the aerospace and defense industry is extreme. It has a set point of 'Zero.' A company's training and process discipline is the key to achieving a target zero performance expectation.

Still, there is no ideal scenario or system that cannot fail, notwithstanding the exceptionally low probability. For these rare cases, there are safeguards and protocols that are followed, along with taking prompt action and liability.

It's not all rosy

In case of a mishap or unforeseen event that leads to an inadvertent delay in the transportation, or if a truck gets struck midway for a long period, most satellite transportation companies respond on a real-time basis and also look for safe havens along the routes.

Satellite transportation companies also grapple with the pressing issue of trained manpower constraint and talent retention in a hyper competitive business. To keep pace with the current rate of growth and to fulfil customer expectations, companies need huge influx of trained manpower.

"The trucking industry, in general, is faced with a unique predicament. The demand for transportation services is ever increasing, and at the same time, the industry is struggling to recruit and retain qualified drivers," concurs Worthington.

What the future holds

With near ubiquity of satellites in multiple domains, the need of satellite transportation would grow rapidly but this may not lead to automatically new start-ups taking a plunge in satellite transportation.

The manpower challenge might further intensify in the future as autonomous vehicles disrupt the conventional transportation sector and self-driving trucks hit the roads. But this is not happening anytime soon. And even when it happens, trucks that carry satellites would rely on human drivers till the time self-driving trucks are established and trusted to undertake arduous journeys.

The 'Transporters' with their ability to move on briskly, to reimagine the industry's orientation, when required, and provide excellent delivery – will keep on mesmerizing us as the world strives to achieve higher penetration in the Space. We just hope they don't drive rash and stay miles away from dare-devilry unlike Jason Statham!

Aditya Chaturvedi, Correspondent
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LIVE at www.javad.com

G’day, Mate!

Redefining Total Stations and GNSS workflow.

The “Total Solution”

From the company who brought you the best GNSS receiver on the planet, our latest innovation will allow you to break away from decades-old methods of measurement and positioning. Why employ a workflow designed for yesterday’s gear?

See the video at www.javad.com for proof!

JAVAD

www.javad.com

Introducing J-Mate

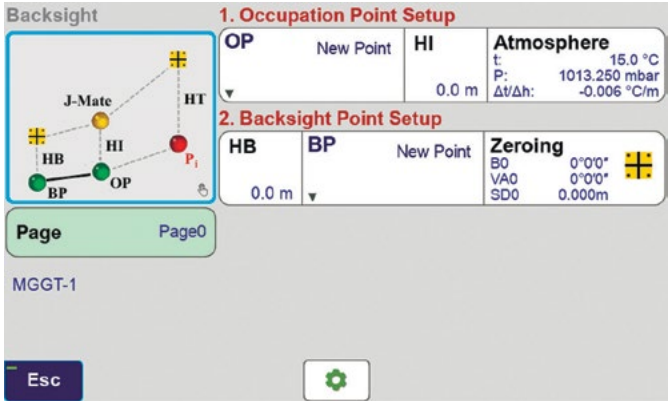
This is J-Mate

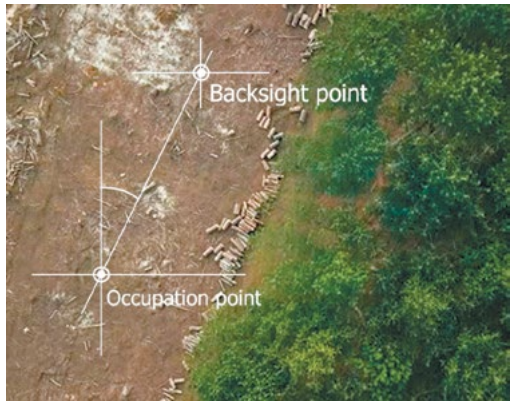
Why follow a workflow designed for yesterday's equipment?

J-Mate features a **camera** that can also find targets automatically, and a **laser module** for accurate distance measurements. It scans and examines the area around the intended target to ensure reliable identification. Two **precision encoders** measure vertical and horizontal angles to the target. Three **precision vials** allow a visual check on levelness of the instrument.

Backsight icon

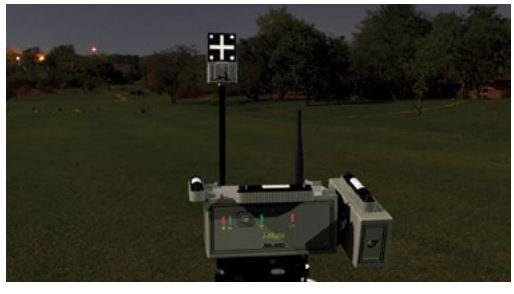
If GNSS signals are available at the job site, click the J-Mate Backsight icon.





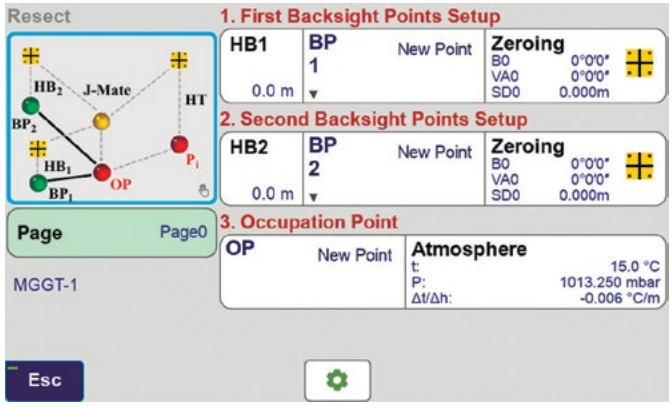
This screen appears which guides you to determine the accurate positions of the Occupation Point and the Backsight Point, to establish an azimuth and calibrate the J-Mate angular encoders.

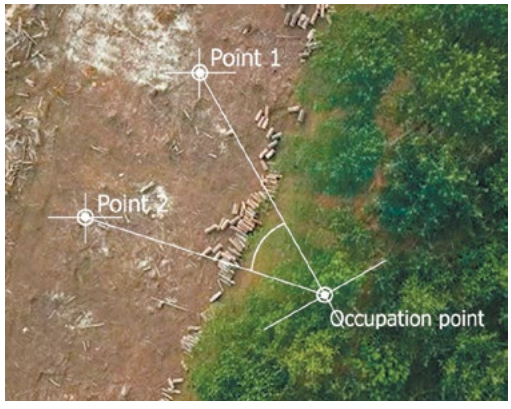
- The tripod is setup at the "Occupation Point" (OP).
- The J-Mate is secured on the tripod.
- Next, TRIUMPH-LS is placed on top of the J-Mate with its legs registered to the matching features on the J-Mate.
- Next, Use the RTK Survey feature of the TRIUMPH-LS to quickly determine the accurate location of the Occupation Point. You can use your own base station or any public RTN.
- Next, slide the Plus sign target on top of the TRIUMPH-LS, lift it from the J-Mate and move to the "Backsight Point" (BP). The camera of the J-Mate will robotically follow the plus sign target. The camera's view is visible from the TRIUMPH-LS screen, which mostly focuses on the plus sign. When at the Backsight Point, its accurate position is determined by the TRIUMPH-LS, and the Azimuth from the Occupation Point to the Backsight Point is established, and the J-Mate is calibrated and ready to shoot other points.
- After this calibration is complete, if the tripod is disturbed, the red LED on the front of the J-Mate will blink to show that re-calibration is required.
- We can now replace the TRIUMPH-LS on top of the J-Mate at the Occupation Point and proceed to shoot as many "Target Points" as the job requires. From now on the TRIUMPH-LS is used as a controller and you can hold in your hand too, but it is more convenient to put it on its place on top of the TRIUMPH-LS to have free hands.



Resect icon

If GNSS signals are not available at the Occupation Point, click the “J-Mate-Resect” icon



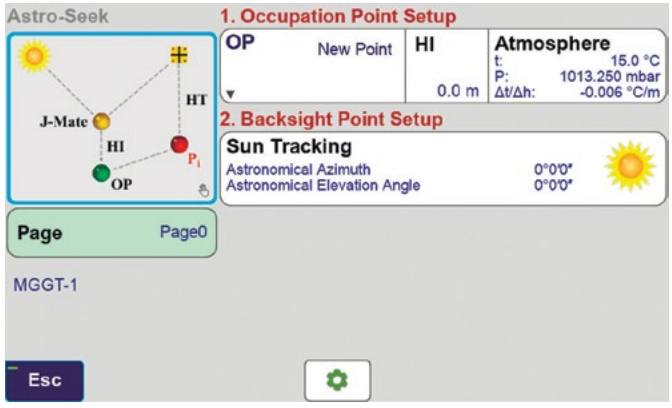


Shoot two or more known points to establish an accurate position and calibrate the encoders. Then continue to shoot the unknown points.

The “J-Mate Resect” automatically finds the plus sign “+” that you carry to two, or more, known points, and shoots them to determine the accurate position of the J-Mate and the azimuth to calibrate the encoders of the J-Mate and then you can proceed to shoot other points.

Astro-Seek icon

And now our new feature!



We have added a new innovative feature to the J-Mate that it can automatically calibrate itself via its automatic Sun or other astronomical objects-Seeking feature.

If doing a sun-shot, attach the Sun filter to the J-Mate

Click the “J-Mate-Astro-Seek” icon

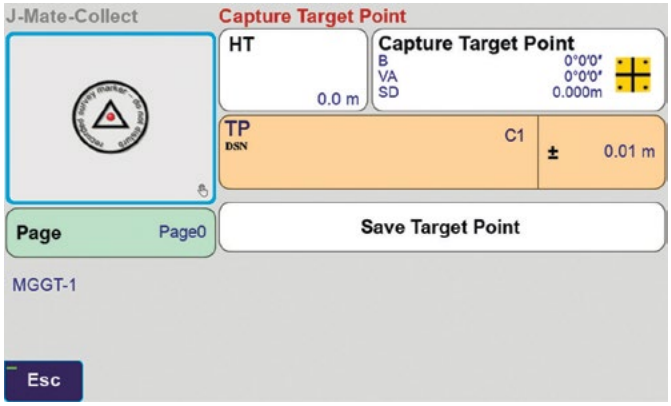
Then click the “Sun” icon in the screen which appears

J-Mate will automatically find the Sun, and use its position to calibrate the angular encoders automatically.

LIVE video at www.javad.com

J-Mate-Collect

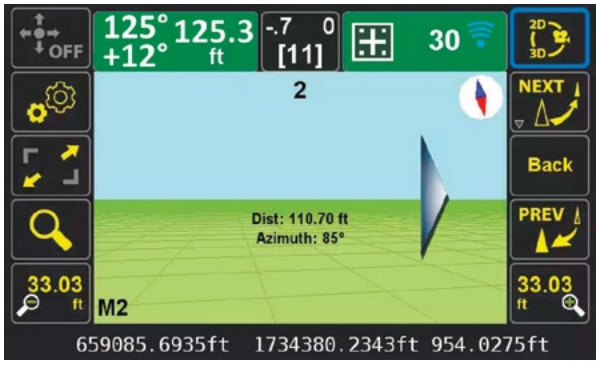
After calibration is performed, click the J-Mate Collect icon to shoot the unknown points.

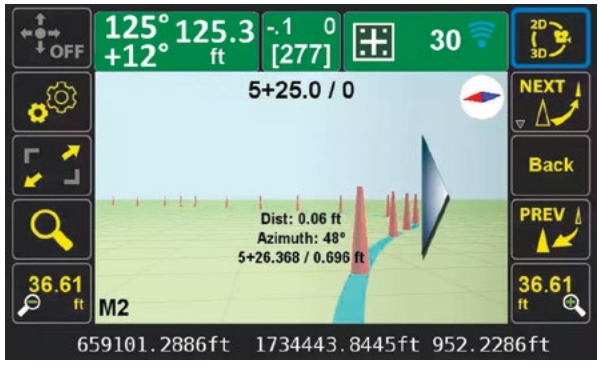


J-Mate-Stake

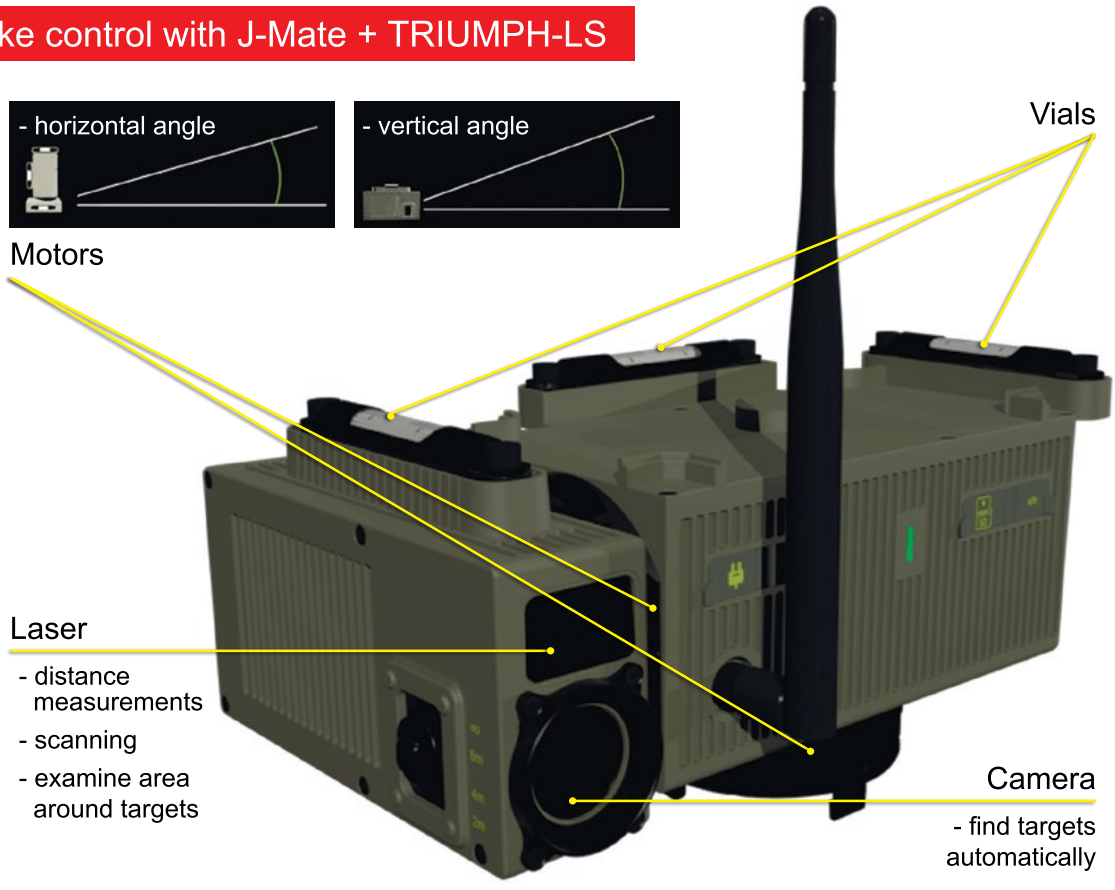
Click the J-Mate Stake icon to use the J-Mate for stakeout.

The functions and features of the J-Mate stakeout are very similar to our conventional GNSS stakeout: RTK solutions guide you to the stake points. But with the J-Mate the camera follows the “+” sign that you carry and then the encoders and laser measurements (shown on screenshots) provide guidance to the stakeout features. This is similar to Visual Stakeout and other useful and innovative features of our TRIUMPH-LS GNSS RTK stakeout.





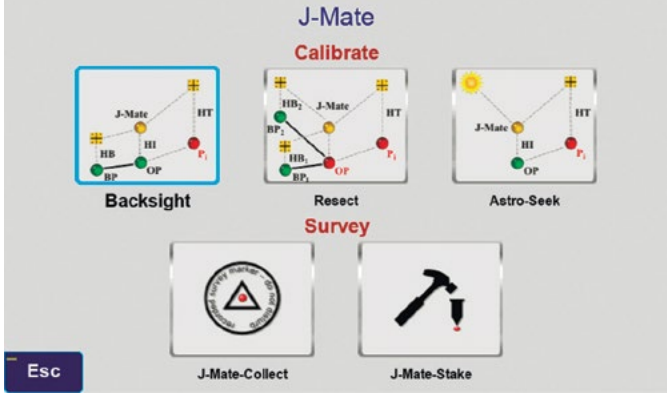
Take control with J-Mate + TRIUMPH-LS



Similar to using conventional total stations, to use the J-Mate you need first to establish its accurate position and calibrate its vertical and horizontal encoders. Then proceed to shoot the unknown points. This is similar to using any total station, but we have improved and automated the process.

With J-Mate you can establish your occupied position via three different ways: 1) Backsight; 2) Resection; or 3) our new Astro-Seek (more of that later).

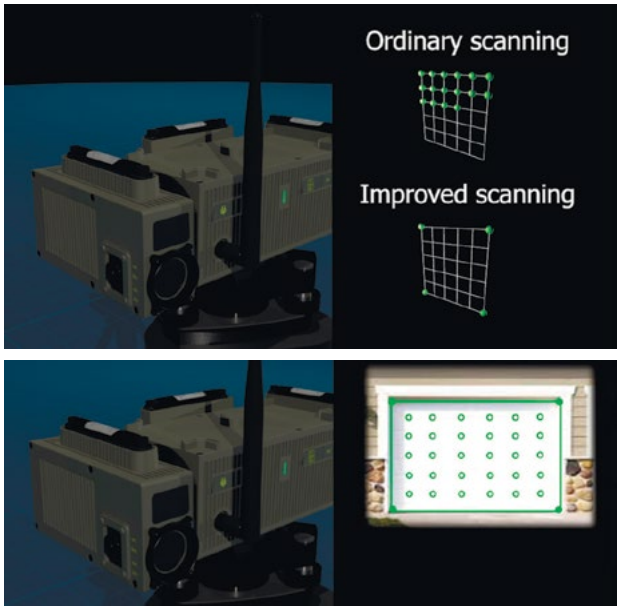
After the J-Mate is calibrated, you can proceed with your work as normal via the Collect or Stake icon.



*We plan to ship by **September 2018**.*

Smart laser scanner

J-Mate is also a camera-aided, smart laser scanner. The camera identifies redundant points that do not need to be scanned, but instead can be copied or interpolated from other readings without loss of information. That is, if the camera identifies a completely uniform flat area, it only scans the four corners of that area and interpolates in between. This feature can increase the effective speed of the scanner to much higher than its native 10-points-per-second speed.

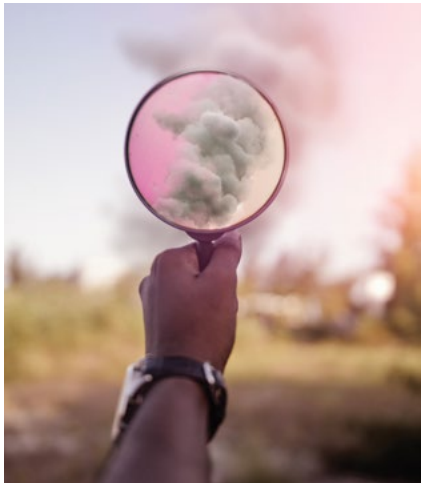


The scanning feature can also be used to find items like wires and poles and "closest-in-view" items and shoot them automatically.

Seize the day with J-Mate + TRIUMPH-LS

And all components fit in this small carrying case.

So we have a "**Total GNSS**" with a "**Robotic Total Station**" and a "**Smart Laser Scanner**". We call it our **"Total Solution"** and it can be operated by one person to perform jobs.



CAN SATELLITES LINK HAPPY CIVIL SERVANTS TO CITIZEN CONFIDENCE?

With over 12 terabytes of earth observation data generated daily, Copernicus is indisputably recognized as the third largest data provider in the world. The role of the public sector in unlocking the full potential of Copernicus uptake has been widely disputed, discussed and established. **By Ilaria d'Auria**

As Copernicus is increasingly portrayed as a game changer in different policy domains and economic sectors, many civil servants working in public administrations across Europe are still unaware that Copernicus exists. With over 12 terabytes of Earth Observation data generated daily, Copernicus is indisputably recognised as the third largest data provider in the world. This does not necessarily lead to the processing of this data into useful, usable, and used the information; let alone is this information necessarily transformed into knowledge for shaping evidence-based policies.

The so-called "Copernicus user uptake", an expression widely used by those operating in the European space sector, should not be considered as self-explanatory. There are a series of underlying assumptions in the common understanding of this expression, such as:

- We all relate Copernicus to Europe's constellation of Earth Observation satellites and dedicated Services (rather than to Nicolaus Copernicus, the Renaissance-era mathematician and astronomer who revolutionized the understanding of the universe by formulating a model that placed the Sun, rather than the Earth, at the centre of the universe);
- We assimilate users to specific categories of people that could make use of Copernicus-based products and services in their daily work and/or life (think of "ideal types" or "user personas", and increase the resolution)
- We associate the notion of uptake to a set of activities that range from awareness raising to the actual transformation/use of Copernicus data and services by the users.

Much ink has been spilt on the topic of the obstacles to the full deployment of Copernicus uptake. The panorama of roadblocks commonly mentioned in the different studies and reports range from policy barriers to market constraints, governance difficulties, technical issues and, to a lesser extent, lack of skills.

Which skills? Whose skills? Skills, for which purpose?

The role of the public sector in unlocking the full potential of Copernicus uptake has been widely disputed, discussed and established. The public sector—at European, national and regional level—impacts on both ends of the space value chain: the fact that civil servants are key players of this process is undeniable, as public administrations act both as procurers, data providers and users of Copernicus-based products and services. Their importance in driving the full deployment of Copernicus in different application domains is directly related to the mission of the public administration, responsible for policy formulation and its implementation in different fields related to territorial management for which Copernicus has been designed.

Although the lack of skills and awareness is recognised as an effective barrier to Copernicus user uptake, this shortage does not have the same impact when it takes place in the private sector rather than the public one. In the first case, new commercial users who do not have the competences and experience to manage the raw data and services made available by the Copernicus programme could be facilitated by the different measures that address the issue of data access (i.e. DIAS, Sentinel Hub, etc.) as well as those dedicated to the private sector (Copernicus Relays, Hackathons, Accelerators, Incubators.

When it comes to the public users, the skills shortage within the administration—understood as a key user group—is doubled with the systemic resistance to change. The issue of Copernicus user uptake should be addressed as an issue related to public sector innovation as a whole, and approached similarly as issues related to the digitization (although in the latter it is about converting information into bits,

while when it comes to raw Copernicus data it means transforming this data into useful and usable information). Obstacles to the systematic use of new technologies, such as satellite imagery, should not only be related to skills shortage but seen as part of a broader issue of change management. Provided that we agree on the fact that territorial management and decision-making as a whole would greatly benefit by the systematic use of Copernicus data and related services by public administrations across Europe, the concerns on which obstacles are slowing down this process should be mainstreamed by broadening the perspective.

Roadblocks to Copernicus user uptake in the public administration should be related to those affecting the innovation of the public sector. The role of the public sector in shaping the space value chain has been broadly recognised. Can we say the same about the impact of space-enabled technologies on the public service value chain?

The Expert Group on Public Sector Innovation (PSI), established by the European Commission in 2013 and chaired by Mindlab, published a final report titled "Powering European Public Sector Innovation: Towards A New Architecture". It gives inspiring insights on where we stand, shapes a new innovation paradigm and design principles, and suggests three cross-cutting recommendations for a new public sector innovation in Europe.

Three-fold set of objectives

▶ Policies and initiatives with an internal focus on enhancing public sector efficiency (policy design with an internal focus, aiming at administrative or organisational innovation).

▶ Policies and initiatives with an external focus on improving services and outcomes for citizens and businesses and policies (service delivery with an external focus, aiming at tackling differently other public policy domains).

▶ Initiatives with a focus on promoting innovation in other sectors (pro-actively driving the innovation in, i.e. the private sector by "taking on risk that the private sector fears").

This framework helps us to better shape the debate on Copernicus user uptake by public administrations, as we can already use this first distinction on innovation happening IN the public sector (the first two points) and THROUGH the public sector (the last point).

Evidence suggests that public sector innovation today mostly happens through uncoordinated initiatives rather than as a result of deliberate, strategic efforts.

When looking back at the skills shortage as a barrier to the full deployment of Copernicus, and to the differences between the impact in the private and public sectors, it is interesting to learn that a survey conducted by Eurisy on the use of satellite-based applications in the public administration, shows that in-house expertise is not a pre-condition for their use, but when it exists it does lead to more proactivity in considering them.

However, is it only a question of lacking in-house expertise and/or technical and scientific skills shortage?

Three examples come to my mind, taken from my experience in working for a European regional network aiming at raising awareness on the benefits of using space technologies within local and regional administrations.

The first example comes from Wallonia: a group of motivated people working for the Scientific Institute of Public Service as well as Skywin (the Belgian aerospace cluster) got together to better understand how to integrate the emerging products based on Copernicus data into the decision-making processes of the local and regional authorities. Since 2015, they set up a Working Group on Earth Observation, with the objective of strengthening the exchanges between the private sector, universities and the public sector. In 2017, a second working group called "Common Working Group within Walloon Government services for Earth Observation" was initiated by the Service Public de Wallonie specifically targeting local and regional bodies with the aims of facilitating the use of remote sensing and its derived products within the administrations, coordinating the initiatives internally and externally, adding value to existing experiences and contributing to the awareness about these techniques.

How does this play out in numbers?

As many as 16 Working Group meetings have been organized in different policy domains, each of which had between 25 and 50 participants. One survey gathered about 50 topics of interest from 52 respondents mainly from the regional services, although its diffusion to 70 communes identified an interest also at local level. Initially self-financed, the activities have now received a support by the European Commission and new reflections and actions have been planned for 2018:

> How can we set-up peer learning mechanisms (training, pre-processing of data, specific services…).
> What is the role of the Public Service as a facilitator of the public actors concerned?
> How does the public service meet the

A survey conducted by Eurisy on the use of satellite-based applications in the public administration, shows that in-house expertise is not a pre-condition for their use.

expectations of private and academic partners in terms of dissemination and information?

After three years, a joint initiative emerged aiming at drafting a joint position paper detailing the strategic vision of the Walloon Earth Observation stakeholders. This position paper will be sent to the government authorities to address the future opportunities and challenges.

Another example comes from Veneto region, where Silvano works for the Strategic Territorial Planning and Cartography Organizational Unit heard about the Copernicus Research and User Support Service Portal (also known as Copernicus RUS) shortly after it went public, in September 2017. The first contact email led to an intense correspondence to tailor the service (duration, number of support hours, number of virtual machines, etc.) to his needs. The first virtual machine led to the request of 15 more (for a more limited time) in order to train 20 young colleagues internally.

What is the result of this proactive attitude? Today, more people within the regional administration understand the potentialities and criticalities of Copernicus, and a interdepartmental working group has now been set up and will look into the specific needs of the different departments within the regional administration.

Last but not least, an example from the Azores regional administration and its Mission Structure for Space. Approximately three years ago, Francisco is appointed there as the regional contact point for space matters. He has a background in marine biology, and has little knowledge of this field. Space is a complex issue when you lack the scientific and technical background, but it becomes very concrete when looked upon from the user's point of view, in terms of applications, products, and services. Francisco rapidly learns about the achievements of the local space community, and grows passionate about the opportunities offered at European level to regional ecosystems who have interests in this field. By looking into the timely information he receives, making the best of networking events, and monitoring calls for tenders, he contributes to shifting the positioning of the Azores.

The benefits of using Copernicus are presented in terms of cost efficiency, transparency, accountability, openness, productivity, timeliness, — etc. important, crucial indicators when it comes to the evaluation of public administrations

The impacts are diverse: the visibility of the local space community is increased, the European dimension of regional events is strengthened, the regional administration and local university are branded with the Copernicus Relay and Academy logo, and his department becomes part of the only consortia that is selected for implementing the first pre-commercial procurement in the Earth Observation sector.

These stories do certainly not exhaust the meaning of Copernicus uptake by public users. These civil servants are probably just doing the job. This is what is expected from them, this is what their mission implies. But while working with them, while listening to their stories, it is hard not to feel that there is something that goes beyond the job description.

Need to look at innovation in the public sector through the magnifying glass

Institutions are made of people, by people. They are the ones embodying public sector innovation, they are the ones that add passion to their work and find the motivation within them to change their working habits, grasp opportunities, learn more, train their peers.

More than looking at the skills, knowledge and abilities, which can always be acquired in time, should we not consider the motivational dimension behind resistance and effective change?

Can motivated, satisfied and fulfilled civil servants lead to an increase in trust and confidence towards the public institutions? This is what the public service value chain is about. What happens when this question is translated in terms of "Copernicus user uptake"?

As the institutional communication says, Copernicus produces a wealth of data and enable services that support "improved decision-making and long-term planning". The benefits of using Copernicus is presented in terms of cost-efficiency, transparency, accountability, openness, productivity, timeliness, etc. Important, crucial indicators when it comes to the evaluation of public administrations.

Yet, God lies in the details. We are hungry for stories. About women and men waking up in the morning, coping with their personal lives and at the same time doing something more than what is expected from them, or doing it with a sparkle in their eyes that makes the difference. Space is magic because of its inspirational power. The achievements of the European Union in the space sector would not have been the same if each Member State had acted alone. Now that Copernicus and EGNOS/Galileo, the two European space flagship programs are becoming operational, today that the European Commission has presented its proposal for the next EU space budget, we should insist even more on the importance of space for our well-being here on Earth.

The story of Copernicus user uptake should (also) be told in terms of space systems linking happy staff to citizen confidence, highlighting the importance of inspiration, collaboration, open standards and motivation in public service value chain. In times of growing disaffection towards Europe and the establishment, the inspiring power of space should not underestimated in telling a different story on those who shape our world.

Ilaria d'Auria, Network of European Regions Using Space Technology
idauria.nereus@euroinbox.com

A Game Changing Solution for GIS Professionals

New EOS Platform lets you run image processing tasks in browser.
By Earth Observing System

Most of your image analysis tasks that required ENVI or Erdas Imagine software are now available online thanks to **EOS Platform.** This new game-changing Cloud service launched by EOS Data Analytics provides GIS professionals with a one-stop solution for search, analysis, storing, and visualization of large amounts of geospatial data.

With EOS Platform you get access to an ecosystem of four mutually integrated EOS products, which together provide a powerful toolset for geospatial analysts. Image data is stored in Cloud-based **EOS Storage** and is available for image processing or remote sensing analysis at any time; this can be a raw user file, an imagery obtained from **LandViewer** or an output file from **EOS Processing**.

There are at least two reasons why image processing is the platform's major asset: the processing of large data amounts runs online and offers as many as 16 workflows with even more coming soon. On top of that, users can get the best cartographic features of **EOS Vision** for vector data visualization and, as announced for the future, its analysis.

Data agnostic platform

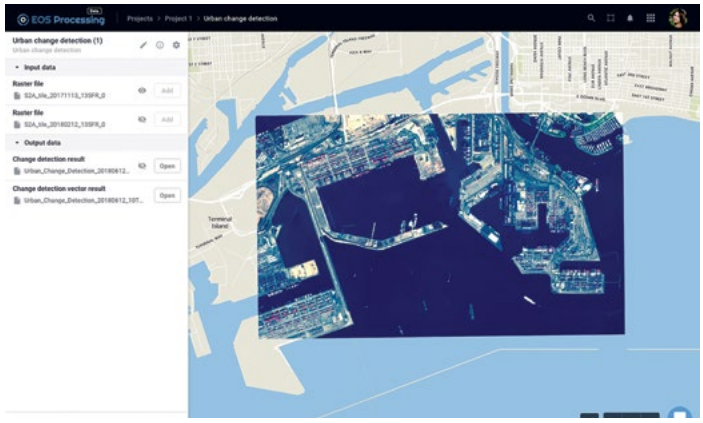
When it comes to raster data, you can work with a variety of satellite and airborne datasets in LandViewer, EOS Processing, and EOS Storage. Users can also upload their own GeoTiff, JPEG, JPEG 2000 files and apply GIS data processing algorithms via API or from the web interface. EOS Vision is your tool for vector data operations with multiple formats support (ESRI Shapefile, GeoJSON, KML, KMZ).

The whole package for image processing

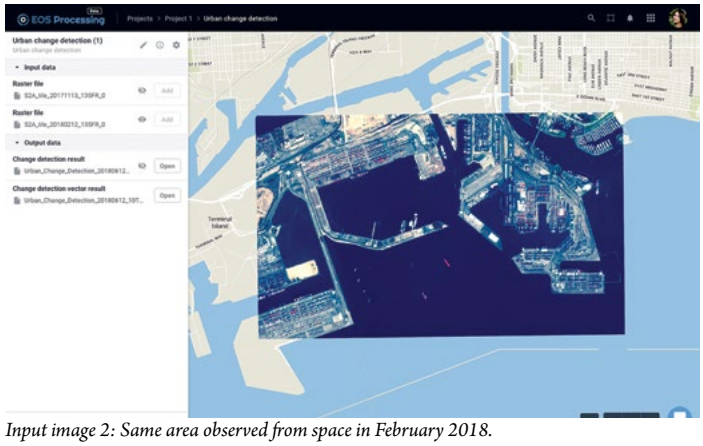
EOS Processing offers a great experience with its sixteen processing workflows, including the popular raster tools (merge, reprojection, pansharpening), remote sensing analytics, photogrammetry, and proprietary feature extraction algorithms that can't be found anywhere else. Get your data ready for the upcoming LiDAR analysis and 3D modeling as they'll become available soon.

Such pre-processing tasks as Cloud detection or radiometric calibration help you refine raw data for further analysis: you can correct images for atmospheric effects and obtain the real ground radiance or reflectance values.

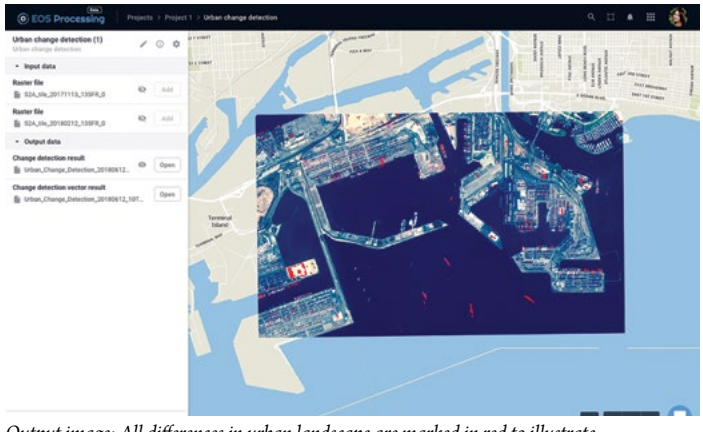
Urban change detection results obtained with EOS Platform from Sentinel-2 imagery.



Input image 1: Sentinel-2 image of Long Beach taken in November 2017.



Input image 2: Same area observed from space in February 2018.



Output image: All differences in urban landscape are marked in red to illustrate how Long Beach seaside has changed within a few months.

Object detection, change detection, and classification

The convolutional neural networks, pre-trained by EOS Data Analytics to extract features from imagery, let you apply state-of-art methods to detect objects and track changes from space.

- Having only a set of multi-temporal images and change detection workflow, you can track how illegal deforestation progresses over time.
- Edge detection can show the exact boundaries of your agricultural lands down to the last pixel.
- It is possible to estimate the parking lot traffic of largest shopping centers with car detection algorithm.

The best of spectral analysis

Products within EOS Platform support almost all remote sensor types and the user can choose from a long list of spectral indices to calculate on the fly. Aside from the complete set of vegetation indices (NDVI, ReCI, ARVI, SAVI, AVI, etc.), there are also indices to outline landscape features (water, snow and ice – NDWI, NDSI) and burned areas (NBR). The greatest thing is that here you get the freedom of experimenting with spectral bands and can create custom band combinations that best fit your purposes.

Agriculture, forestry, oil and gas, and more industries

A tandem of EOS products offers a much-needed solution for individuals, businesses, and organizations across numerous industries.

With vegetation indices and crop classification feature, agronomists can continuously monitor crop conditions to detect plant diseases, pests, droughts. Forestry specialists can assess fire damages, monitor forest health, track and enforce logging restrictions.

EOS Platform is a great choice for regional and urban planning, helping users identify land cover classes to generate a vegetation map. It can also make a complete list of urban features like buildings, roads, and other major features in the region.

The platform can tackle disaster management by measuring flood extent and finding fire boundaries. When it comes to oil and gas, it is capable of identifying oil rigs and assessing the environmental impact.

Build your own business on top

EOS provides a lot of opportunities not only for users, but also for businesses. Satellite imaging companies can expand the reselling business with EOS Platform by placing their data to LandViewer where thousands of users will find and purchase them daily. Partner companies are using EOS White-Label solutions to provide platform-based services for their own customers. There's also a way advanced GIS experts can leverage the power of EOS Platform: they get tools to build their own image processing algorithms and make them available to users all over the world.

Unlock the full potential of Earth observation data with EOS Platform, directly in your browser: https://eos.com/platform

HOW THE WORLD IS IMBIBING ADVANCEMENTS IN SPACE POLICIES AND ACTIONS

The capacity to look at the Earth every single day impacts a lot of businesses. To enable the space industry become a better contributor, the major players world over are working towards creating stronger policies, and the not so big players are eagerly joining the bandwagon.

By Shimonti Paul

Space technologies, data and services have become an indispensable part of our daily lives. The overall international space context is changing fast: competition is increasing; new entrants are bringing challenges and new ambitions in space; space activities are becoming increasingly commercial with greater private sector involvement; and major technological shifts are disrupting traditional industrial and business models in the sector, reducing the cost of accessing and using space. To keep pace in this changing scenario and excel in new space ventures, countries world over are modifying their space policies and strategies; the goal remains more or less same for all: to be a leader in Space.

The American space policy — Always ready for change

The Trump administration has been taking significant steps to reorient the American space policy. On June 30, 2017, US President Donald Trump revived the National Space Council for the first time in 24 years. Then on December 11, 2017, he signed the Space Policy Directive – 1, which calls on NASA to focus on human exploration of Mars and other parts of the solar system.

The policy aims to more effectively organize government, private industry, and international efforts toward human exploration of Mars.

However, the administration has totally shifted its focus from earth observation. Donald Trump's proposed 2018 budget intends to cut four NASA Earth science missions. These include the Plankton,

Courtesy: NASA/Bill Ingalls

President Trump signs the NASA Transition Authorization Act of 2017.

Aerosol, Cloud, ocean Ecosystem (PACE) satellite; the Orbiting Carbon Observatory-3 (OCO-3) experiment, the Climate Absolute Radiance and Refractivity Observatory (CLARREO) Pathfinder and the Deep Space Climate Observatory (DSCOVR).

On April 16, 2018 Vice President Mike Pence also announced a new space traffic management that gave the Commerce Department, and not the FAA, the responsibility for providing space situational awareness data to satellite operators.

This new policy directs the Department of Commerce to provide a basic level of space situational awareness for public and private use. The Senate Appropriations Committee has approved an increased budget to the Federal Aviation Administration office that licenses commercial launches. For the FAA's Office of Commercial Space Transportation or AST the Bill provides $24.981 million. That is an increase of nearly $2.4 million over what AST received in fiscal year 2018, and $3.4 million above the administration's request. The House offered $24.917 million for AST in a bill approved by the House Appropriations Committee May 23.

Taking things further, the Trump administration is all set to unveil the new National Space Strategy. On March 23, 2018, the administration released a brief of the same. The new strategy prioritizes American interests first and foremost. As per the strategy, the United States will partner with the commercial sector to ensure that American companies remain world leaders in space technology.

Also the House Science, Space and Technology Committee has adopted Chairman Lamar Smith's American Space SAFE Management Act , which would transfer key responsibilities for space traffic management from the Pentagon to the Commerce Department.

Donald Trump has also recently directed the Pentagon to create a special 'Space Force' as an independent branch of the US military to ensure the safety of US spacecraft and astronauts. The concern is that such a step could ignite an arms race in outer space.

How is EU coping up?

In October 2016, the European Union's executive commission unveiled a new space strategy, the focus of which is to use public investment to stimulate the creation of space start-ups. The U.K. plans to become a haven for space start-ups from all over the world as it aims to grow its space industry to control 10% of the global market by 2030.

Space in EU primarily means Galileo and Copernicus. Galileo is the European Union's Global Satellite Navigation System (GNSS), sometimes called the 'European GPS'. *Copernicus* is the European Union's Earth Observation Programme, looking at our planet and its environment for the ultimate benefit of all European citizens.

The European Commission aims to build a sustainable space economy. The new strategy specifically mentions the Investment Plan for Europe and an upcoming vehicle called

the Venture Capital Fund of Funds as sources of financial support for space ventures. The major beneficiaries of the commission's space budget of 12 billion euros ($13.5 billion) between 2014 and 2020 will be the 30 satellites that the EU plans to launch in the coming decade for the Galileo navigation and Copernicus environment-monitoring programs.

Additionally, the NewSpace strategy aims to develop a comprehensive EU Space Situational Awareness Service to protect critical space infrastructure from space debris, space weather and cyberattacks.

The Commission has also restated its support for a GovSatCom program that in principle would collate the military satellite telecommunications requirements of EU nations.

The new space strategy clearly indicates Europe's eagerness to excel in new space ventures. Many member countries of the EU have their own space agencies with France and Germany being the two biggest players.

In October 2016, the EU's executive commission unveiled a new space strategy, the focus of which is to use public investment to stimulate the creation of space start-ups

UK — All geared up to embrace developments

Brexit pushes UK to strengthen its own standing in space. Consequently, the UK government is seen to be making more efforts to create a regulatory framework for the expansion of commercial space activities and the development of a UK space port. It has now drafted The Space Industry Bill, which intends to cover both orbital and sub-orbital activities, and horizontal and vertical launches carried out in the UK.

The Space Industry Bill is aimed to enable the first commercial space launch from UK soil. The passing of the Bill indicates that British businesses will soon be able to compete in the commercial space race using UK spaceports. UK is already a global hub for satellite manufacturing, operation and application development.

With one in four of all telecom satellites substantially built in Britain and UK businesses at the forefront of hypersonic flight technology, through its Industrial Strategy, the government is working with the industry to increase its global share of the space sector from 6.5% to 10% by 2030.

If UK can build its own spaceports, it will also be able to tap into the rapidly expanding launch market — worth an estimated £10 billion over the next decade. Satellite services already support more than £250 billion of GDP in the wider UK economy as well as products and services we all rely on.

Currently UK firms rely on a limited supply of launches in other countries which leaves them vulnerable to launch delays. The Space Industry Bill will help to increase the supply of launch services closer to home, and capture a share of growing global launch demand. This will open up the UK to new frontiers, transforming the way they live, and establishing than as a space flight leader.

Mission Control Room of ESA at the European Space Operations Centre (ESOC) in Darmstadt, Germany.

Courtesy: ESA

Russia takes the leap through its 10-year space strategy

Though it is still a far cry from its glorious past, Russia's intent to create a mark in new space ventures is clear from its approval of the 10-year space program worth 1.406 trillion rubles ($20.5 billion). The space strategy is known as the Federal Space Program 2016-2025.

As per the new strategy, Roskosmos has streamlined its large and disparate fleet of launch vehicles from eight to just two families: Soyuz and Angara. Only six variations of these two types of rockets will remain instead of current 12. Also, the Russian orbital assets will grow from the current 49 operational spacecraft to 73 by the end of the projected period in 2025.

The first priority for the program is communications and broadcasting satellites. According to the head of Roskosmos Igor Komarov, the Russian constellation of communications satellites will grow from 32 to 41 under the projected funding. The bandwidth of the communications channels carried through space was promised to increase 1.3 times and broadcasting capabilities would grow 3.3 times. In the meantime, Russia's "eyes in the sky" and other remote-sensing satellites will multiply from eight to 23 during the same period.

In the field of human space flight, the Kremlin still promises to complete the assembly of the Russian segment of the International Space Station, which has remained unfinished since the turn of this century. Also, according to the approved strategy, Moscow still remains committed to shifting human space launches from Baikonur in Kazakhstan, to the new spaceport in Vostochny in the Russian Far East. Such a move would require a new launch pad for the human-rated version of the Angara rocket. The new facility is promised to be ready in 2021.

Komarov promised to launch the unscrewed prototype of the Soyuz replacement in 2021 and to send the first crew to the ISS aboard the new ship in 2023. The Moon landing still remains the strategic goal of the Russian human space flight but with a tentative launch date in 2030, or five years beyond FKP-2025.

Still, Roskosmos pledged to go ahead with its robotic lunar probes, which include progressively more complex orbiting and landing missions. A pair of astrophysics research satellites also made it into the program. The Spektr-RG X-ray observatory and the Spektr-UF ultraviolet telescope are scheduled for launch in 2017 and 2021, respectively.

In case the Russian economy improves in the years to come, the space budget will grow accordingly. Banking on the better days ahead, FKP-2025 reserved an entitlement for an additional 115 billion rubles after 2022.

China is in no mood to lag behind

The Chinese government takes the space industry as an important part of the nation's overall development strategy, and adheres to the principle of exploration and utilization of outer space for peaceful purposes. Over the past 60 years of remarkable development since its space industry was established in 1956, China has made great achievements in this sphere, including the development of atomic and hydrogen bombs, missiles, man-made satellites, manned spaceflight and lunar probe. It has opened up a path of self-reliance and independent innovation, and has created the spirit of China's space industry. It has opened up a path of self-reliance and independent innovation, and has created the spirit of China's space industry.

Keeping in view the advancements in space technology, in December 2016, China released a white paper, titled "China's Space Activities in 2016, detailing its plans to expand the "strength and size" of its space program. The nation plans to increase the estimated $6 billion per year it currently invests in space activities, in order to fund numerous proposed initiatives. The plan outlines a robotic lunar program made up of several missions.

In addition, China's BeiDou navigation system is on course to provide global coverage using 35 satellites by 2020. The navigation system will complement the marine and land trade routes initiative of the Chinese government's 'One Belt, One Road', covering most of the globe with heavy investment on the routes and associated industries. Most member countries of the route, and developing economies, will easily adapt to the BeiDou system and other Chinese space initiatives. The whitepaper mentions in 'Key areas for future cooperation'; 'Construction of the Belt and Road Initiative Space Information Corridor, including earth observation, communications and broadcasting, navigation and positioning, and other types of satellite-related development; ground and application system construction; and application product development'.

The 'Space Information Corridor' is a broad term for a bouquet of potential multidimensional services of variable magnitudes.

China is also looking towards the establishment of a permanent manned space station by 2022.

China also intends to have its own Space Law in 2020. China encourages and supports Chinese enterprises to participate in international commercial activities in the space field. It has exported satellites and made in-orbit delivery of Nigeria's communications satellite, Venezuela's remote-sensing satellite-1, Bolivia's communications satellite, Laos' communications satellite-1 and Belarus' communications satellite-1. In addition, it provided commercial launch service for Turkey's Gokturk-2 earth observation satellite, and when launching its own satellites took on small satellites for Ecuador, Argentina, Poland, Luxembourg and other countries. It has also provided business services concerning space information. In the next five years China will, with a more active and open attitude, conduct extensive international exchanges and cooperation.

Is India ready to adopt a broader approach?

In case of India, everything related to space is governed by ISRO. Be it the Satcom policy, 1997 or the Remote sensing policy, 2011. The fundamental aim of the Satcom Policy Framework for Satellite Communications in India approved by the Cabinet is to develop a healthy and thriving communications satellite and ground equipment industry as well as satellite communications service industry

Though it is still a far cry from its glorious past, Russia's intent to create a mark in new space ventures is clear from its approval of the 10-year space program worth 1.406 trillion rubles ($20.5 billion). The space strategy is known as the Federal Space Program 2016-2025

ISRO successfully launched 104 satellites in a single launch in January 2017

in India. Also, use and further development of the capabilities built in India in the area of satellites, launch vehicles and ground equipment design and sustaining these capabilities is an equally important aim. Encouraging the private sector investment in the space industry in India and attracting foreign investments in this area are other specific goals.

Recognizing that Remote Sensing data provides much essential and critical information, which is an input for developmental activities at different levels, and is also of benefit to society, the government has adopted the Remote Sensing Data Policy (RSDP) -2011 containing modalities for managing and/ or permitting the acquisition / dissemination of remote sensing data in support of developmental activities.

To make effective use of the advancements in space technology for citizens' benefit, the country needs to encourage both the public and private sectors to participate in the space program. With this aim, India is drafting a new Space bill. The new Bill encourages the participation of non-governmental/private sector agencies in space activities in India under the guidance and authorization of the government through the Department of Space.

The main aim of the draft is to open up the space for participation from other sectors. It may help to break the monopoly of ISRO in Space activities in India.

Space development in Japan — governed by security concerns

On April 1, 2016, the Office of National Space Policy (ONSP) released the fourth Basic Plan (Basic Plan 4), which for the first time has made space policy an important part of Japanese security planning. Basic Plan 4 explicitly supports the goal of advancing operational integration of space technologies and programs in service of US-Japan security alliance. The Plan recognizes space as a strategic domain for national security.

Basic Plan 4 also represents Japan's first implementation policy that openly states that Japan must actively develop a national security space program with the military use of space in tune with the new National Security Strategy (NSS). In terms of core security components, the plan focuses on key space-based programs. Primarily these include: doubling the number of satellites in Japan's information-gathering satellite (IGS) reconnaissance satellite constellation, developing a space-based maritime domain awareness capability, enhancing space situational awareness capabilities and linking Japan's space assets in the service of US security strategy to support the allies' deterrence capabilities.

NOT SO BIG PLAYERS ARE ALSO GAINING MOMENTUM

UAE — GAINING MOMENTUM

In 2016, UAE launched its national space policy. The Policy focuses towards expanding the utilization of space to protect and support vital sectors. It aims to achieve this by identifying the capabilities and competencies needed to support the space sector. The Policy seeks to promote space-related scientific programs and projects. This includes the planning and execution of both sole and cooperative space missions; the procurement and development of capabilities for space exploration and earth observation; the encouragement of scientific research and development of programs, which will strengthen and utilize the UAE's space capabilities and technology. Along with providing national organizations guidance specific to their role and contribution to the space sector, the National Space Policy identifies fundamental success factors required for the policy's successful execution.

The Basic Plan 4 is a welcoming change as Japan's space policy has for long, almost 40 years stayed away from any involvement in national security. The new policy is designed to achieve a stronger alliance with US.

A new Canadian space strategy is on the way

As per the Canadian Space Policy Framework 2014, the Canadian Government is committed to ensure that Canada is a sought-after partner in the international space exploration missions that serve Canada's national interests.

BRAZIL — PRIORITIZING SPACE

The 1994 Brazilian National Policy for the Development of Space Activities set as a strategic goal the development of national space technology capabilities. The main current policy instrument is the National Programme of Space Activities 2012-2021 (PNAE 2012-2021). It identifies priority actions, investments needs and international cooperation possibilities. It also foresees a calendar of space missions and describes a set of specific projects. Some of the projects mention cooperation with international partners. The 2004 Technological Innovation Law provided conditions to build a more favorable environment for partnerships between universities, technological institutes and industry. There is legal framework in Brazil that provides for the participation of the private sector in space activities in Brazil, particularly in space launch from the Brazilian territory. For that purpose, foreign private companies must register as enterprises in Brazil, in accordance with the Brazilian national law.

MALAYSIA — INCESSANT EFFORTS

Three arms in the Malaysian government deal with space technology- the National Space agency (ANGKASA), the Remote Sensing Agency (ARSM) and the Astronautics Technology Sdn Bhd (ATSB). On 14 July 2009, Malaysia launched RazakSAT, the first and only earth observation satellite on equatorial orbit. The RazakSAT was the second satellite into orbit joining its forerunner, the TiungSAT-1. RazakSat-2 Satellite Program is a continuation of the strategic satellite technology development in the aspect of infrastructure, human capital and industry's capabilities enhancement.

AUSTRALIA — CATCHING UP FAST

Australia's first space agency is set to begin operations in July 2018 after securing $26 million in budget funding. The agency is located within the Department of Industry, Innovation and Science and is expected to take the lead on civil space policy, including finding ways to use Australia's technology and advanced manufacturing skills to become a world-leading developer of space-based technologies. It will also facilitate international space engagement, both in policy and industry forums, to build the networks needed to develop Australia's space capability and ensure industry partners can access global supply chains. The space program has the potential to create a $12 billion space industry in Australia by 2030 and up to 20,000 jobs.

SOUTH KOREA — PROGRESSING AGGRESSIVELY

Korea now has a rapidly expanding space program with exploration aspirations. In order to develop it more efficiently the Korean government revised the Mid-and Long-Term National Space Development Basic Plan with a resolution of the National Science and Technology Council on 17 May 2005. Furthermore the Korean government established "a new 1st Space Development Promotion Plan (2007-2016)" on June 2007 and formulated annually "the Space Development and Implementation Plan (January 2010 ~ February 2011). The Korean National Science and Technology Council issued a plan for a National Space Program. Korean space policy is based on the national space program and the following three space. Acts. The Space Relationship Law of Korea is divided into three branches: (1) the Aerospace. Industry Development Promotion Act of 1987, (2) the Space Development Promotion Act of 2005 and the (3) Space Damage Compensation Act of 2007.

AFRICA — TWO BIG PLAYERS, OTHERS STROLLING CLOSE

Africa's space programs now look much more promising. Nigeria, South Africa, Ethiopia, Egypt and Algeria have taken renewed interests in their existing programs, and Kenya has joined the club and launched its own home-designed satellite, recently. Nigeria and South Africa have by far the most advanced space programs on the continent, and South Africa is set to host the world's biggest radio telescope, the Square Kilometre Array (SKA).

The policy framework clearly indicates that national sovereignty, security and prosperity are the key drivers of Canada's activities in space. I

The Government focuses on supporting the domestic space industry in the innovation required to bring to market cutting-edge technologies. The Government looks to continue partnerships with international partners to pool data for mutual benefit and obtain services and technologies that would otherwise be unavailable. At the same time, effective export control and regulatory measures will continue to protect Canadian technologies and data from theft or from falling into the hands of hostile interests.

Canada is soon going to have a new space strategy. The Canadian government has recently announced an investment of more than $26.7-million in space technology through the Space Technology Development Program (STDP). The funds allocated in this round of the STDP included $3.4 million for space research and development by small businesses.

The capacity to look at Earth every single day impacts a lot of businesses. The world is gaining understanding that the space industry is actually about life on Earth and businesses on Earth, and they can help in numerous ways. To enable the space industry become a better contributor, the major players world over are working towards creating stronger policies, and the not so big players are eagerly joining the bandwagon.

Shimonti Paul, Deputy Executive Editor
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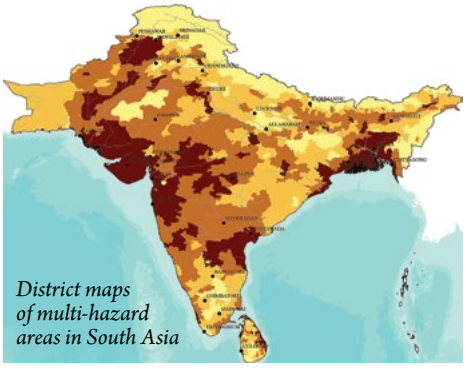


District maps of multi-hazard areas in South Asia

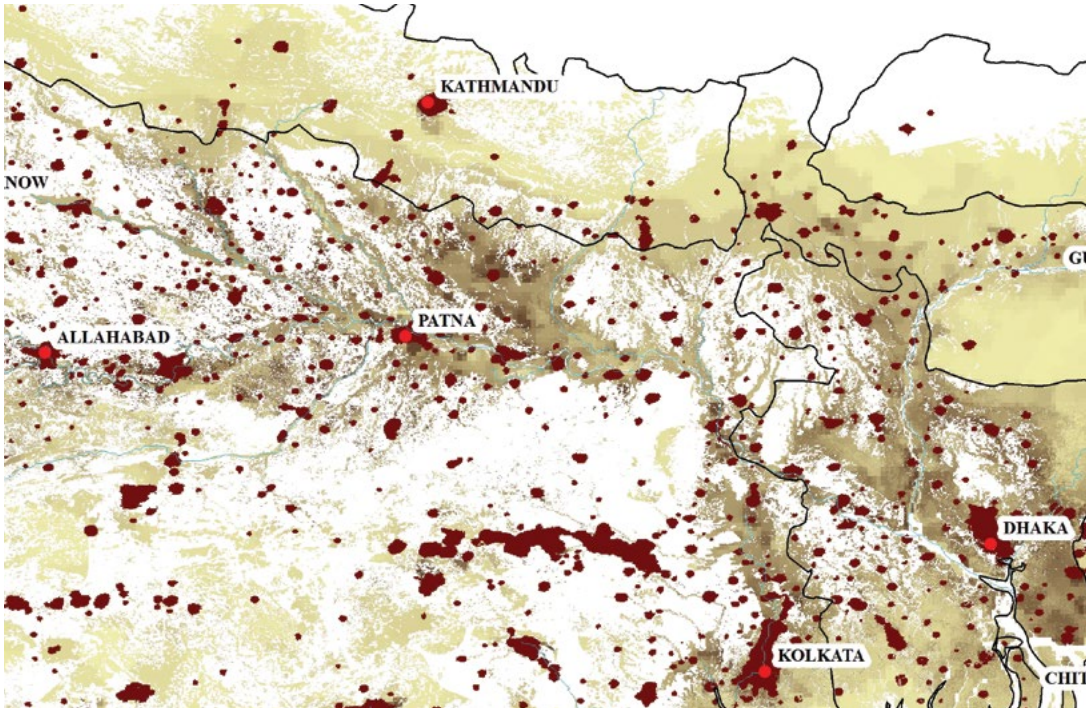
Using satellite and observational data to map risks on a regional scale ranging from floods, droughts, heat waves to sea-level rise can help locate high-risk areas and thus saving enormous lives. **By Giriraj Amarnath, Shehnab Sahin & Alok Sikka**

MAPPING THE VULNERABILITIES

The developmental discourse has made a paradigm shift with its emphasis on 'sustainable' growth. With the 2030 agenda of the United Nations' Sustainable Development Goals (SDG), there is a reaffirmation of the need to follow a growth pathway that reflects reduced risks of disasters which is instrumental in addressing vulnerability of millions of people. Specific agendas adopted, like the Sendai Framework for Disaster Risk Reduction in 2015, highlight the refurbished focus of the international community for reducing disaster related risks which is essential for achieving many of the goals stated in the SDGs.

Research in action

The International Water Management Institute (IWMI) with support from the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) is contributing towards these efforts through its research and expertise in the area and is garnering global attention for its report titled, 'Mapping Multiple Climate-related Hazards in South Asia'. The report presents methods for mapping primary risks and estimates their potential impacts on people in general and more specifically on agricultural systems.



False Color Composite (FCC) from Landsat satellite data taken on August 26, 2017 showing the extent of flooding along the Kosi river, India.

Researchers at IWMI used both historical and current satellite and observational data to map risks on a regional scale ranging from floods, droughts, heat waves to sea-level rise and coastal vulnerability due to the same. To illustrate, there is flood risk mapping for which rainfall patterns and recurrent flooded spots were examined using remote sensing and field data. This led to the development of algorithms that pointed out those mountainous areas where high rainfall would pose a potential risk of flood downstream. Spatial population and agricultural data were used to examine where high risks are, form both individual and multiple hazards.

The study undertaken reveals that approximately 750 million people, constituting over 45% of South Asia's entire population have been affected by climatic hazards for the period between 2000 and 2015. Out of this, nearly 72% were in India, 12% each in Pakistan and Bangladesh and 4% in Nepal, Bhutan and Sri Lanka. More specifically the study highlights that the critical vulnerability of agriculture to climate extremes such as extreme droughts and floods. More than 58% of the agricultural areas across the region has been projected to have suffered damage due to multiple hazards. The largest area i.e. 786,000 square kilometres has been affected by droughts, followed by extreme temperature, extreme rainfall, floods and sea-level rise.

Technology in aid of vulnerable population

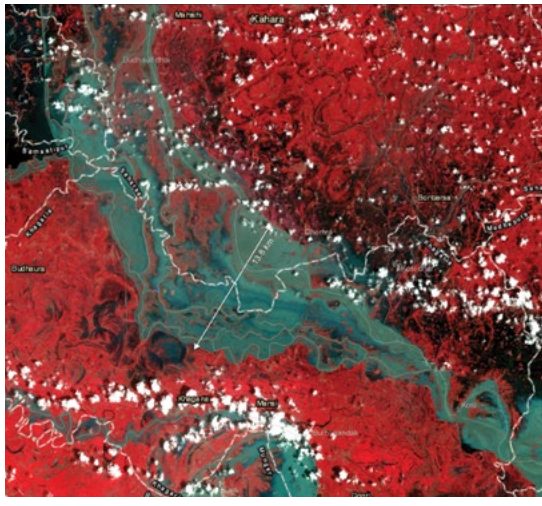
As a natural next step, those locations were identified that displayed the greatest vulnerability to hazards. The process included the overlaying of data from the Human Development Index (HDI) of the United Nations Development Program (UNDP). With details of indicators such as life expectancy, education, per capita income, derived from UNDP, vulnerability was assessed taking into account the risks from disasters. Based on these data, a comparative analysis could be drawn of countries at the sub-national level on the adaptation capability to vulnerability. For instance, it was deduced that countries such as Sri Lanka and Bhutan have a reasonably good capacity to cope with hazards, since they have higher HDI due to proper education, medical facilities and employment levels as compared to their neighbors. On the other hand, countries such as Bangladesh exhibit a low HDI which in-turn affects its adaptive capacity, seen to be reduced when affected by climatic events.

Making headway

The IWMI report has drawn immensely positive attention from different stakeholders, especially development banks such as the Asian Development Bank which seeks to deploy the mapping method prescribed in the report to investigate financial exposure. The organization plans to use IWMI's climate risk mapping data within its climate screening tool to identify climate change risks for assessing performance in the early stages of project development and incorporate adaptation measures in the design of projects at risk. Similarly, the World Bank has sought IWMI's collaboration for identifying hotspots of high risks for sea-level rise at the sub-national level in the coastal areas of South Asia.

Since its publication in September 2017, the report has been utilized to inform on field interventions such as in case of flood insurance in the East Indian State of Bihar. In Bihar, Index Based Flood Insurance (IBFI) that has been developed by IWMI, CCAFS and the CGIAR Research Program on Water, Land and Ecosystems, was successfully piloted in 2017 to provide insurance to hundreds of farmers against flood damaged crops.

IBFI enables insurers to provide compensation to flood-affected households quickly, particularly during localized and mid-season flooding events, ensuring timely access to finance for smallholder famers, which helps them utilize residual soil moisture to produce crops before the next crop season. IWMI's risk mapping aided the exercise as it allowed for the prioritization of areas where flood insurance could be implemented. Based on the success of the pilot in Bihar, the Ministry of Agriculture of the Government of India plans to discuss wider scaling of the scheme and support technological innovation to the Pradhan Mantri Fasal Bhima Yojana (PMFBY) crop insurance scheme.



Population exposure to multiple climate hazards in eastern India and Bangladesh.

Delving into details for the future

Based on the success of the multi hazard mapping exercise at the regional level, IWMI now plans to develop a village-level water risk mitigation tool, which will help in more accurately pinpointing vulnerable rural communities. This upcoming 'Water Risks and Disaster Mitigation Tool' will help identify climate change risks and vulnerability at a finer scale to that of the village level, to report levels of risks and suggest climate proofing measures. The information from remote sensing and climate models on the hazard, exposure and vulnerability from time-series socio-economic data will be used to develop scenarios of adaptation options for better disaster planning and sustainable development in the region. The tool will provide valuable information that can be used by the insurance industry, private sector, government and also taken up as for Corporate Social Responsibility programs.

Giriraj Amarnath, Research Group Leader: Water Risk and Disasters, International Water Management Institute (IWMI), Sri Lanka
Shehnab Sahin, Communications Specialist, CCAFS South Asia
Alok Sikka, IWMI India Representative, IWMI, India
Pramod Aggarwal, Regional Program Leader, CCAFS/BISA-CIMMYT South Asia

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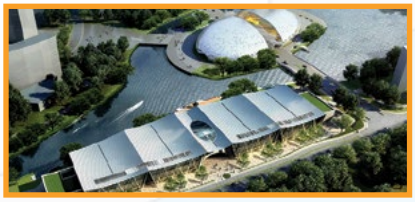
- Enhancing international cooperation among participants from Member States, including among the Belt and Road countries
- Reflecting the importance of geospatial information to support technological development
- Addressing development and strengthening of geospatial information management systems and capacities
- Demonstrating the importance of international coordination and cooperation for building a human data and geography community



PLENARY SESSIONS

MINISTERIAL DIALOGUE
Towards a more Sustainable World for All

PLENARY 1
Sharing The Digital Economy

PLENARY 2
Attaining Sustainable Development

PLENARY 3
Building Smart Societies

PLENARY 4
Growing International Cooperation

PARALLEL SESSIONS

Measuring and Monitoring the SDGs

Digital Economy, Location Analytics and Big Data

Smart, Resilient and Sustainable Societies

Growing Global Geospatial Capability and Capacity

Geospatial Innovation, Science and Technology

Digital Silk Road and International Partnerships

Sustainable Development in Action

UN-GGIM Secretariat
United Nations Statistics Division, Department of Economic and Social Affairs
Email: ggim@un.org

The sub themes of each parallel session can be viewed at:
http://ggim.un.org/meetings/2018-1st_Congress_Deqing/

SATELLITE AIS

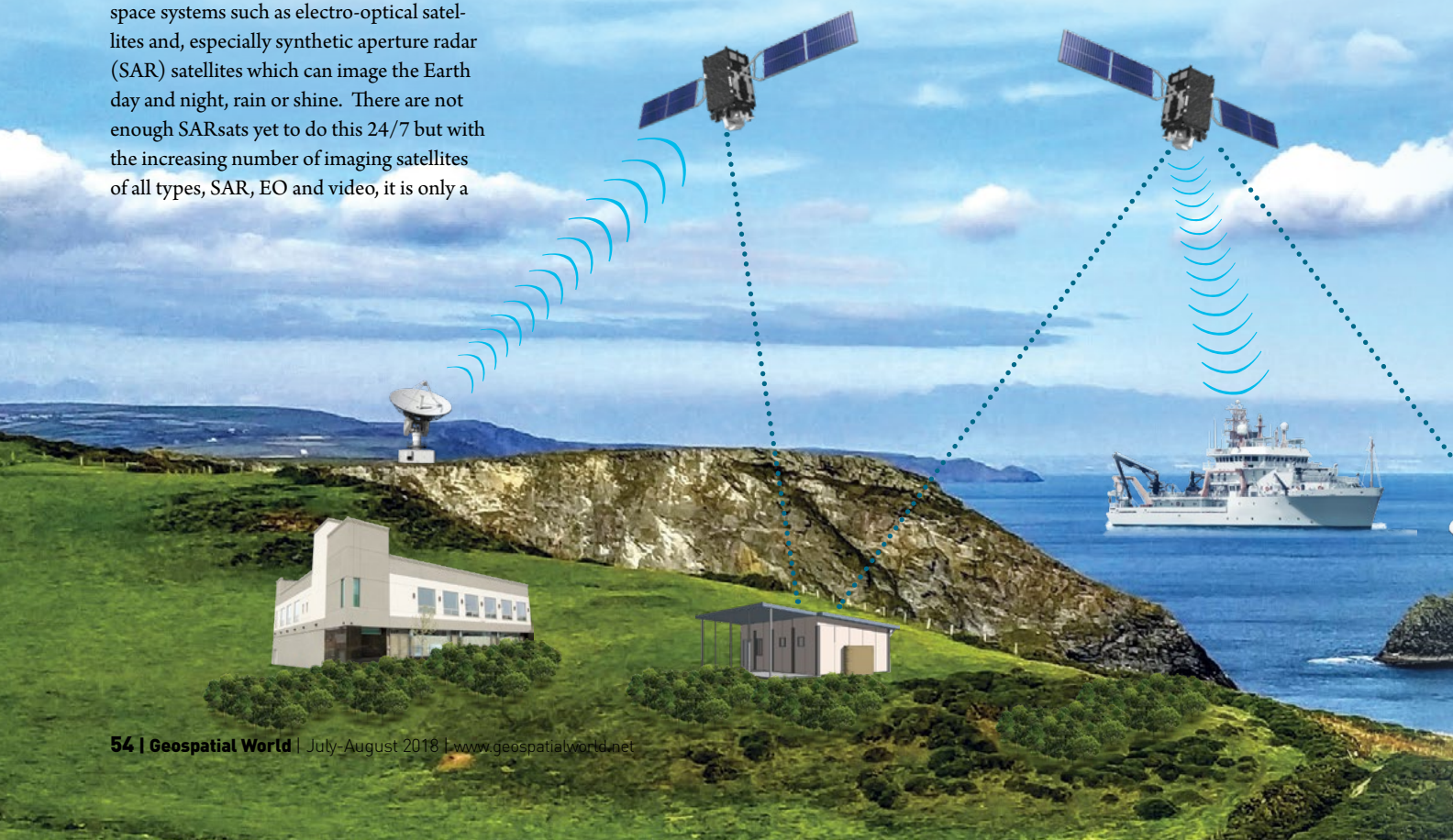
The Largest Paradigm Shift in 150+ Years

GPS is the only other system that even comes close to the impact of S-AIS in last 150 plus years, but while GPS allowed for mariners to navigate with more surety, it left the maritime world opaque. S-AIS is quickly making it much more transparent. **By Geo. Guy Thomas**

Satellite AIS (S-AIS) has created the largest paradigm shift in the maritime world since the steam engine and the screw propeller. (Yes, even larger than GPS!) The first six satellite constellation was launched by ORBCOMM for the US Coast Guard in 2008 to allow the United States to understand who was approaching its coasts and ports but has since become an ubiquitous tool for an ever-increasing array of maritime applications.

It is also routinely paired with imaging space systems such as electro-optical satellites and, especially synthetic aperture radar (SAR) satellites which can image the Earth day and night, rain or shine. There are not enough SARsats yet to do this 24/7 but with the increasing number of imaging satellites of all types, SAR, EO and video, it is only a matter of a very few years before nearly every place on Earth will be under near continuous observation/surveillance. With all three types of imaging satellites there is a natural synergism in the maritime world. S-AIS gives them the added ability to identify the ships imaged, and if they are not identifiable, the very lack of an identity, or the attempt to hide their identity via spoofing, which is actually counterproductive for the spoofers as they are actually calling attention to themselves by the very act of sending out false information, can lead to further examination by other terrestrial assets such as aircraft and military or law enforcement vessels.

Many have the mistaken impression that S-AIS is easy to spoof undetected. Since the very first ORBCOMM satellites with S-AIS as a secondary payload were launched in 2008 there has existed the capability to geo-locate all AIS emitters collected. That geo-location is compared with the reported position contained in the transmission itself and if it is more than a certain number of miles away the



report is flagged and that emitter is collected at every opportunity. Normally once a position is verified to be "true" all subsequent collection of that emitter by that satellite during that collection opportunity, is discarded. (A collection opportunity is defined by the time the AIS sensor on the satellite comes into view of the terrestrial transmitter, until it leaves that field of view.)

Also, there are now a number of software tools that process AIS data for a number of uses. This data includes the Maritime Mobile Service Identity (MMSI The MMSI is a unique 9 digit number that is assigned to each AIS unit. Some of these software tools contain data bases that strive to record the MMSI of every AIS signal detected anywhere, stretching back to early 2001. It is very easy for theses software tools to sort through the history of almost every MMSI ever broadcast in milliseconds and detect whether there is something amiss. Those transmitters are also flagged for special attention. False locations and false MMSI generates very special attention in some circles.

While GPS allowed for mariners to navigate with more surety, it left the maritime world opaque. S-AIS is quickly making it much more transparent. Like GPS, which was created to improve the accuracy of the US's submarine launched ballistic missiles, S-AIS is rapidly becoming ever more present in the marine world as more and more applications for its data are being discovered and developed. However, while GPS is now found in many applications for all three environments, sea, air and land, S-AIS's impact is focused on the marine world where it is causing a major change in its global operations. It is interesting to note that both satellite navigation and S-AIS were invented at Johns Hopkins University's Applied Physics Lab.

While S-AIS was created as a maritime security system its usage has expanded into a number of fields.

Commodities

The tracking of all the world's commodities location and the estimate of their time of arrival at destination is now down to a very few hours. This detailed information, derived from S-AIS and brokers' records, has allowed commodities traders to be dramatically more accurate in predicting daily prices in many ports of the world, thereby allowing the first few who developed and employed the analysis based on this information to reap huge rewards.

Marine maintenance

Determining when hull and machinery maintenance needs to be scheduled for maximum return on investment because S-AIS allows for very accurate record-keeping of hours of operation - at what loading/speed and in what type of marine environment at what average speed. These factors are critical to hull maintenance.

Illegal fishing

Determining when a ship which is bound for an area might pose a threat, such as illegal fishing, or having traversed an area known to contaminated with a sea life threatening biological problem such as a diseases. This allows for the concerned authorities to demand the diversion of the threat bearing vessel. Also, the pattern of the courses used by fishing boats while fishing are very distinct in many instances. Several software tools now automatically recognize these patterns.

Environmental

Using synthetic aperture radar satellites detecting illegal bilge dumping in controlled waters is now much more effective because the exact identification of the offending vessel and its next port of call can often be determined via S-AIS. When the offending vessel docks, the local authorities can demand to see both its bilges and its log. If the bilges are clean but there is no log entry as to when they were last pumped clean then a citation, often worth many thousands of dollars, is issued. The Italian Navy reports this has caused a dramatic reduction in the illegal dumping of bilge waste in the Mediterranean.

Search and rescue

S-AIS has also dramatically improved safety of life at sea by allowing for the location of all ships in an area to be known by all interested parties thereby permitting the speedy reaction to maritime disasters, large and small. Indeed, AIS transmitters are now being installed on life jackets to assist in recovery of crew in the water. S-AIS allows for the closest vessels to a maritime problem to be identified and vectored to the site as needed.

Disaster support

It is also a major tool in disaster recovery operations. In Hatti, S-AIS provided the knowledge of when needed supplies would arrive at ports which were severely damaged and thus had very limited offload capabilities. S-AIS allowed for the accurate planning of the landing of the most needed supplies in priority order. It has been used in a similar fashion in many disasters since, in several countries such as the Philippines, which has been hit several times recently with hurricanes, and in the Indian Ocean, Japan and Chile, where tsunamis have severally damaged ports and seacoasts.

Security and Surveillance

Finally, S-AIS is being used worldwide as a primary adjunct to maritime security operations by allowing for the study of normal "pattern of life" operations to determine when anomalous activity is happening. Thus, surveillance and intercept units can be dispatched with much improved chances of apprehending wrong doers, be smugglers of all types, or illegal fishers, or whatever. This saves wear and tear on equipment and personnel, as well as money by limiting operating time of scarce assets. It also raises crew moral because it knows they have a better chance for a productive operation.

And more

The list just keeps getting longer, but clearly, S-AIS is making a huge impact on the maritime world.

Geo. Guy Thomas, *Managing Director, C-SIGMA LLC*
Geo.Guy.Thomas@C-SIGMA.space

Transforming the previously unimaginable into a new normal – THE HEXAGON WAY

Hexagon has continually been shaping smart change with its innovative solutions, and the Indian arm of the conglomerate thinks no differently.

The dream of 'Digital India' is fast becoming a reality and the record allocation of INR 5,970 billion for infrastructure spending in India reinforces the grit. Meeting the expectations of the citizens and the economists, the government is placing huge emphasis on railways, roadways, defence and connectivity infrastructure. Additionally, the ambitious 'Smart City' mission has reached closer to its target of 100 smart cities with an allocation of INR 2,040 billion.

As Juergen Dold, President, Hexagon's Geosystems Division, puts it, "For India there are many possibilities. There is a huge opportunity because of the massive plans to build new infrastructure, new roads, and with the smart city initiatives, there are quite some opportunities to make cities more attractive for people to live in and also to make them safer."

Nevertheless, execution of such large scale projects is a mammoth task, while being a fantastic opportunity to create employment and bring in technologies that companies like Hexagon has to offer.

Hexagon India is excited to be a part of this positive transition as the words of Pramod Kaushik, President, Hexagon India, reinforce, "Hexagon India aspires to play a leading role in the efforts to solve the challenges faced by our nation by providing ground-breaking information technologies that make a positive and lasting impact."

Making a difference

Hexagon is committed to leveraging digital solutions to fundamentally change the way business is done. With the intent to create a connected ecosystem, Hexagon India has been incessantly widening its horizon, engaging with some of the top development projects in India. The major headways include:

Dam Safety and Monitoring: The dams in North East are part of run of the river. These concrete gravity and rock filled dams have been commissioned more than 20 years ago. As the concerned states are in the area of seismic activity, these dams pose threat to the civilization there. Moreover, when the spillway is opened, flow from some of these dams effects the downstream areas, like causing floods. Additionally, the geo-technical equipment installed during the erection of these dams are non-functional and no analysis information of structural characteristics of these dams are available.

To combat these issues, Hexagon developed a Dam Safety Monitoring System, a first of its kind in India. The system combined multiple technologies with geodetic tech-

Left: Hexagon successfully executed the Dial 100 project for Uttar Pradesh Police.
Below: Structural Monitoring of Neepco Ranganadi Dam

JUERGEN DOLD
PRESIDENT, HEXAGON GEOSYSTEMS

"There is a huge opportunity in India because of the massive plans to build new infrastructure, new roads, and with the smart city initiatives, there are quite some opportunities to make cities more attractive for people to live in and also to make them safer.

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nologies to become an effective monitoring application. Under the Government's DRIP (Dam Rehabilitation and Implementation Program), Hexagon became a front runner for a dynamic dam safety monitoring solution.

Land Records Management: This is done through Hexagon's Digital India Land Records Modernization program. Hexagon conducted PAN India training as a capacity building initiative of Department of Land Resources. It is closely associated with the Department for Land Records Management, Survey/Resurvey, Mapping & Updating Land Parcel and Management of Land Records.

Utility detection: Technological solution from Hexagon is enabling detection of underground utility facilities.

Mine management: Integrates planning, operations and safety solutions for the mining industry. The technology integrates the data processes from these solutions and the customer is better informed to make an intelligent decision. Currently, it is catering to 5 mines of Coal India.

Hydrography solution: Hexagon has provided a solution to the Survey of India, for mapping assets and resources for hydrography, both in 2D and 3D. This is done through Hexagon's IMAGINE Suite including photogrammetry module.

'Mahabhumi' project of Maharashtra Remote Sensing Application Centre: This project by Hexagon's Geospatial Division incorporates large scale mapping of the whole state.

Smart cities need a special mention

Hexagon's Safety and Infrastructure segment has an extensive portfolio of end to end solutions and domain expertise for orchestration of vital public services that are uniquely positioned to realize safe city strategies. Its Safe City Framework includes mission-critical, safe city-ready components that advance a city's capabilities; some of which are:

Data mining and analytics: Identifying and mitigating risks and improving resource management and operational efficiency.

Sensor and video intelligence: Improving operational capability to detect, assess, and respond to incidents.

Citizen reporting: Improving the ease and speed with which citizens can request assistance and provide information.

Next-gen call taking and dispatching: Managing communications from multi-media sources and coordinating and tracking resources and situations in real time.

Multi-agency resource management: Providing information and capabilities to optimize resources across services and jurisdictions.

Infrastructure management & operations: Gaining better understanding of the condition of network assets, minimizing service disruption, and expediting recovery.

Incident command: Collaborating for faster, efficient, and effective incident planning, response, recovery, and mitigation.

Mobile working: Empowering personnel and increase situational awareness, while enhancing efficiency and service delivery.

Digital records and evidence: Collecting and managing information about incidents and events to aid investigations and decision-making.

Dashboards and reporting: Making information accessible, interactive, and fact-based for greater insight, visibility, and engagement.

Kaushik shares, "We believe that for cities to be smart, they need to be essentially safe and digital. Safety in cities depends on multiple services working with singular purpose to achieve common objectives. We are participating in major projects in mining, road & highways, and smart cities by deploying technologies and building an autonomous ecosystem."

A successful tryst in public safety

"We are extremely proud to have successfully executed the Dial 100 project (popularly known as UP100) for Uttar Pradesh Police, in partnership with Mahindra Defence Systems This project is a centrally managed system to facilitate a quick response in emergency situations such as road accidents and crime-related incidents," shares Kaushik.

As part of the system, 250 call-takers, 150 dispatchers and thousands of field officers use I/CAD applications to respond to citizen needs. Before UP 100, the police received around 3,500 calls per day across the entire state. In the initial stages only, the event volume rose to about 15,000 per day and call volume is more than 100,000 per day, and the number keeps on rising as the system becomes more familiar to citizens.

PRAMOD KAUSHIK
PRESIDENT,
HEXAGON INDIA

> "For cities to be smart, they need to be essentially safe and digital. We are participating in major projects in mining, road and highways, and smart cities by deploying technologies and building an autonomous ecosystem.

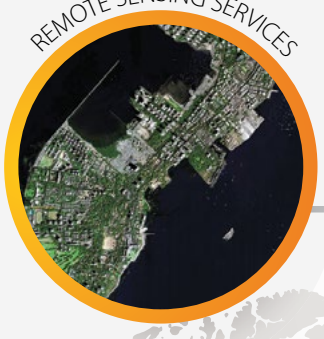
When Kaushik says, "We envision to replicate this success to other states of India and I believe that this is one initiative that can nationwide enhance the safety of the common man," the benefits of the solution get rightly reinforced.

'Leaders evolve through working for the greater good,' and Hexagon India, through its innovative accomplishments is proving the point. Hexagon is making investments in India to make it a strong facilitator of digital transformation. "We are investing in India to make all the technologies available that we have here. We have invested in our own organizations to help foster growth of different business models, whether that's our industrial division or our public safety division or the Geosystems division, to set them up here in the country to be there with local people and support the local developments," echoes Dold.

Steering Indian Space Excellence into Global Market

CREATING SPACE ECOSYSTEM

REMOTE SENSING SERVICES



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Working for the common good pushes me towards optimum delivery

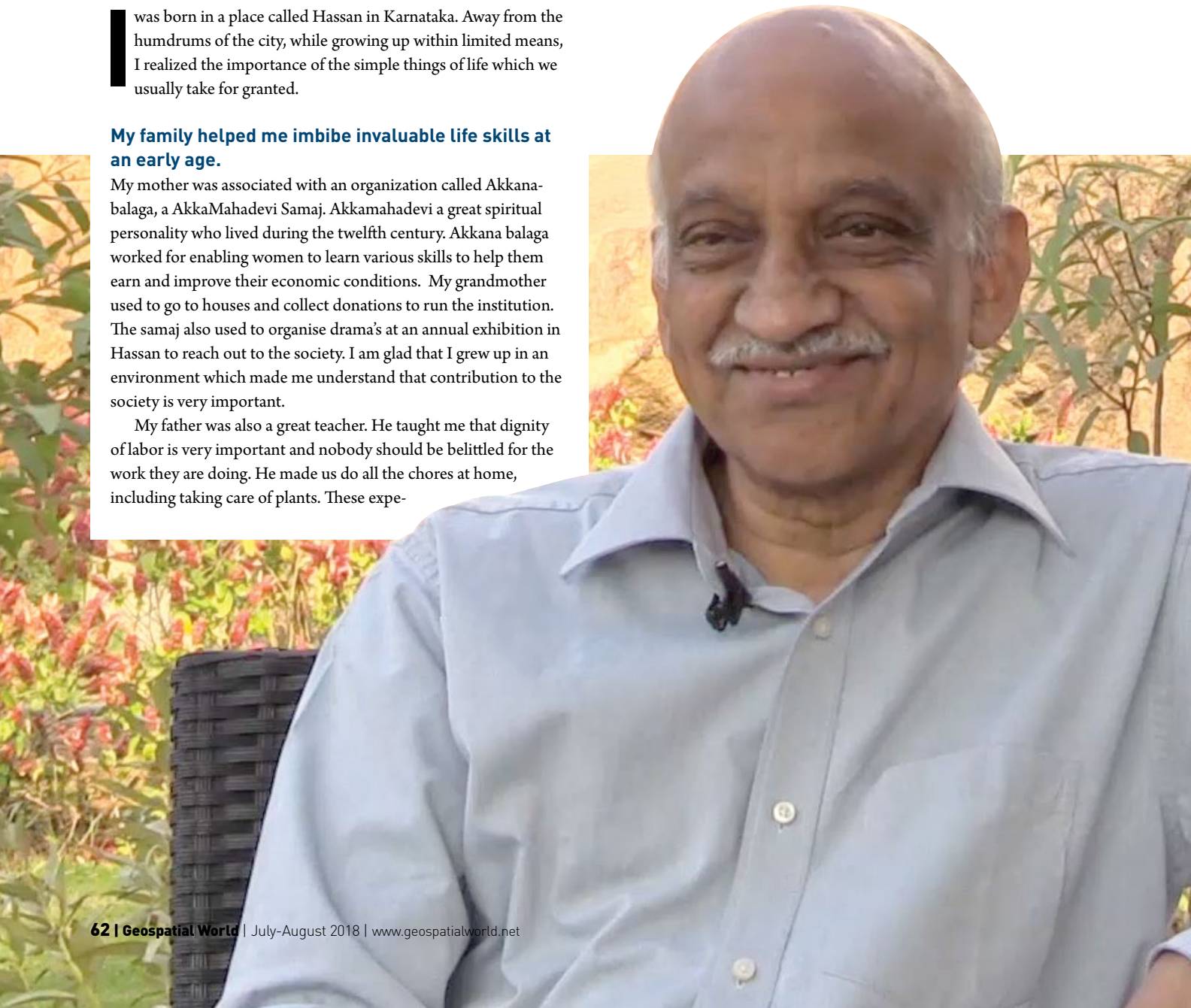
Growing up in a joint family made me develop interpersonal skills, interacting with people with varied mindsets made me more acceptable towards different points of views. Another important thing that helped me evolve was the freedom of choice I was given since childhood, shares **Kiran Kumar, Former ISRO Chairman**

I was born in a place called Hassan in Karnataka. Away from the humdrums of the city, while growing up within limited means, I realized the importance of the simple things of life which we usually take for granted.

My family helped me imbibe invaluable life skills at an early age.

My mother was associated with an organization called Akkana-balaga, a AkkaMahadevi Samaj. Akkamahadevi a great spiritual personality who lived during the twelfth century. Akkana balaga worked for enabling women to learn various skills to help them earn and improve their economic conditions. My grandmother used to go to houses and collect donations to run the institution. The samaj also used to organise drama's at an annual exhibition in Hassan to reach out to the society. I am glad that I grew up in an environment which made me understand that contribution to the society is very important.

My father was also a great teacher. He taught me that dignity of labor is very important and nobody should be belittled for the work they are doing. He made us do all the chores at home, including taking care of plants. These expe-



Bangalore University — a strong foundation laid.

riences helped me develop holistically. I learned what humility is.

Growing up in a joint family made me develop interpersonal skills, interacting with people with varied mindsets made me more acceptable towards different points of views. Another important thing that helped me evolve was the freedom of choice that I was given since childhood. There was no constant asking as to what I am doing, what I am not doing etc. Because there was no pressure, I could explore and learn and this freedom, I believe, sharpened my faculties.

Sport was also an intrinsic part of growing up. I enjoyed playing cricket, badminton, you name any game; I used to play it. These involvements helped me gain holistic development.

Encouraging teachers at school motivated me to work diligently.

Our school, being situated in a remote place, could not provide me exposure to lot many of things that I came across later. But what I learned at school was unprecedented. I learned to respect. As I observed my father paying huge respect to my teachers, I developed the similar ability. Moreover, the encouragement I got from my school teachers laid a strong foundation for my future accomplishments. The teachers used to have a lot of interest and pride in the way we used to perform. For instance, I still remember, in grade 10, before the Mathematics exam, my teacher told me, "You should get 100 out of 100." However, when I scored 98/100, he encouraged me immensely, motivating me to do better next time.

Technical education happened by chance.

After school, I had plans of pursuing medicine. After completing grade 10, I joined pre-university, and took up one year course including physics, chemistry and biology with the intention of doing medicine. Even though I scored the highest marks in the exam, I couldn't meet the minimum age criterion. So, I decided to pursue BSc for one year.

I always had the desire to study in the National College, Bangalore. Fortunately for me, that year, they re-introduced the course, Physics Honours after a gap of many years. While studying there, I came across Professor H. Narasimhaiah (principal and physics professor) who later became the vice-chancellor of the Bangalore University. His simplicity, positive approach to life and dedicated efforts for societal development highly influenced my thinking and made me interested in learning more and more. Physics Honours course actually gave me a different perspective.

Neil Armstrong made me a fan of space.

When in 1969 Neil Armstrong stepped on the moon, we were listening to the radio commentary of the event live in the college's hostel. The enthusiasm was contagious. At that moment space looked very promising future. After completing Physics Honours I pursued my MSc in Physics with specialization in Electronics and then had an opportunity to study in Indian Institute of Science on Physical Engineering. In April 1975, for the first time a satellite from India, Aryabhatta was launched. That also in a way contributed to my choice of going for space activity. Even before my final year project work was completed, I spotted a vacancy in ISRO's Space Application Centre, applied for it and got selected.

My journey at ISRO has been the most enriching part of my life so far.
Moving on from several techno-managerial positions at the Space Application Centre, I went on to function as the Principal Investigator of Terrain mapping camera and Hyper spectral camera payloads that flew in Chandrayaan-1 mission.

I became the Associate Director of Space Applications Centre in 2009 and later its Director in 2012. I am glad to get the opportunity to steer the design and development of several breakthrough areas in ISRO like — the space-borne electro optical imaging systems covering optical infra-red and microwave wavelengths, multi-band communication transponder system for GSAT-7 communication satellite for strategic applications, navigation payloads for Indian National Regional Navigation System etc.

Science and technology has the power to solve many problems; this is my biggest motivation in life.
I am inclined to use my knowledge and skills to develop solutions that can mitigate the difficulties of the people around us. Dr. Vikram Sarabhai inspires me immensely. He was a man with fantastic vision. Within 6 years of space technology being seen in the world, the first activities of launching rockets had started in India. He had also envisioned that this technology will give tremendous boost to the country's development, whether it's communication, remote sensing or navigation. He had conceived the idea of making technology accessible even from America. He went to America and expressed the desire to borrow their advanced technology satellite for one year, to give information to the entire rural community and to showcase to the government how technology can be harnessed for societal benefit. This passion of his to work for the common good drives me.

I feel happy that we have been able to fulfill the promise that the great visionary Vikram Sarabhai had made to the country. Success on a regular basis has kept us motivated

If you look at many of the activities that ISRO has undertaken, you will see that it has looked at whatever technology is accessible to it, and has modified it to bring down the cost and provide a solution specific to our country. For example, the 3-in-1 satellite and the 3-axis stabilized satellite, which nobody had ever built. Moreover, the three tier imaging system which we came up with was a unique way of generating information particularly given our small land holdings. We also had the highest spatial resolution imaging in the world in the civilian domain between 1995 and 1999.

Elated to send India's 100th satellite in Space. Kiran Kumar with current ISRO chief K. Sivan (Left)

I feel happy that we have been able to fulfill the promise that the great visionary Vikram Sarabhai had made to the country. Success on a regular basis has kept us motivated. Today for example, with NavIC and remote sensing data we are able to provide the fishermen community with critical information about fishing zones and alert them about weather in their local language. So the idea is- "whatever technology you have, make use of it and conceive a solution that can solve problems that are relevant to you." This motto is also a big motivator across the organization, because it brings perspective to your work and you are ready to ignore and forego many of the difficulties that you would have encountered in fulfilling them.

Nothing would have been possible without the support of my family.
It is not an easy task to work for the country and without enough support from the immediate family it can never be achieved. Without my wife Jyoti's support I don't think I would have done what I have done today. My family has gone through a lot of difficulties. My work made me move out of station very often and for long periods. My wife was at home taking care of the child and doing everything on her own. She was very supportive of the work we were doing. Her support motivated me to scale new heights. I really appreciate the contribution and I'm extremely grateful to her for being the biggest support of my life.

Spending quality time together
Whenever time permitted, we used to make travel plans within Gujarat and Rajasthan. We traveled a lot in my first car, a Maruti bought in 1986 that I was so proud of! Additionally, we would go for a weekend trip to any place within 500kms. Those trips created beautiful memories.

Courtesy: Deccan Chronicle

Lighter moments with daughter Suhasini

Books and sports have been my constant companions.

Since childhood, I have had the habit of savoring any book I can lay my hands on, anything from detective story to fiction, in Kannada language or English. Besides reading a lot, sport has always been a fascination. When I was a child, I used to play a variety of indoor and outdoor games. When I was in Ahmedabad, we used to conduct sports events across institutions. Ahmedabad had institutions like IIM, NID - National Institute of Design, CEPT (Centre for environment planning and technology), PRL (Physical Research laboratory, Space application Center). So we used to conduct tournaments for a Director's Cup in cricket, hockey, badminton and table tennis. This is how we kept ourselves engaged beyond work. With age, the only thing I could continue playing was Bridge, which I played once every week at our office canteen in Ahmedabad.

With every interaction with children in schools and colleges I keep visiting, I try and bring to their knowledge what space technology has done to the country and through that process I make them aware of the capability that the country has

The retired life gives me more time to reach out to the society, understand people from different strata and their problems, and work towards deriving better solutions. The objective continues to be – "to solve problems using technology." But now it's not restricted to space technology, it could be anything. I intend to focus on capacity building using schools and colleges throughout the country. I realize that there is a huge gap between capacity and the knowledge people need to deal effectively with technology. How can we enable them will also be one of the activities I will be actively engaging myself with. I will remain associated with ISRO, providing perspective to the problems the scientists face as and when necessary.

I am happy that I have been able to inspire a few

One person who has got highly motivated with my passion for the country, my intent to do things for the common good, is my nephew, Chandrakanth B. N. is my sister's son who is now the chairman of Pairee group of companies. He had gone to US to study his Masters in Industrial Management at Northern Illinois University, but eventually returned to India only because I had told him we need to do something for the country. In India, he became a serial entrepreneur and established several companies providing employment and generating true value for our nation. One of his start-ups called 'Theorem India', an IT Services company for which he established a campus in Mysore is now a huge facility with over 1200 people working there. He also runs an NGO in Mysore for empowering rural girls by providing soft skills training.

With every interaction with children in schools and colleges I keep visiting, I try and bring to their knowledge what space technology has done to the country and through that process I make them aware of the capability that the country has, and how they can also contribute in general. That's how I make use of all the opportunities to update children, even at religious places like *maths*, which run educational institutions for underprivileged kids. I am glad to be able to make a difference in my own little ways.

As told to Shimonti Paul, Deputy Executive Editor *shimonti@geospatialmedia.net*

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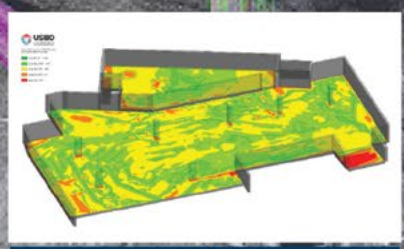


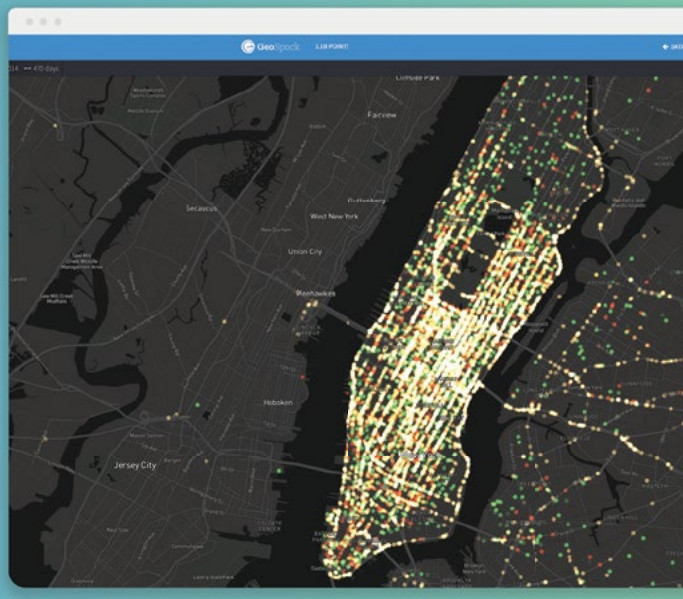
Surface Analysis -
As-Built for Autodesk® Revit®

Create perfect BIM from reality capture data

- Software for efficient evaluation of real-world building, infrastructure and plant data
- Most complete functions, most effective workflows, most innovative technology
- Available as Plug-in for AutoCAD® Software and Autodesk® Revit®
- Be flexible in data extraction through connectivity to different sensors, such as scanners, mobil mapping systems or total stations

GeoSpock® | Uncharted discoveries

Are you looking for contextual understanding to the everything-connected world?



Isn't it time you discovered GeoSpock's location intelligence engine, which provides the ability to unlock new insights from legacy data gathered over years of operation or extreme data from the hyper-connected world of sensors and portable assets.

Media

Gain dynamic 360 degree geoviews of customer behaviours and usage patterns agnostic to device, network or service.

Telco

Go beyond traditional network planning by measuring interactions of people and connected devices on the move.

Automotive

Visualise multi-modal transport networks and gain insights from predictive models that power new world services.

Infrastructure

Improve asset utilisation by gaining deep insights of usage, capacity, location and environmental factors, transforming to smart infrastructure.

Get in touch today to find out more and unlock your data potential

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