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P06

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Josef Aschbacher
Director of EO Programs,
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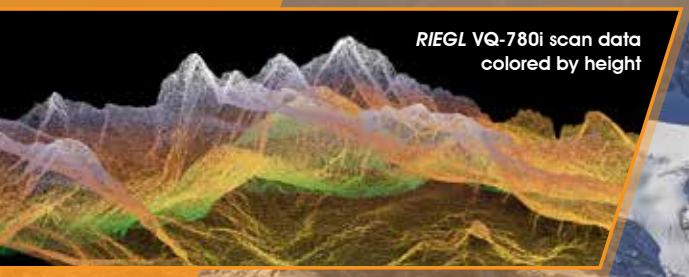

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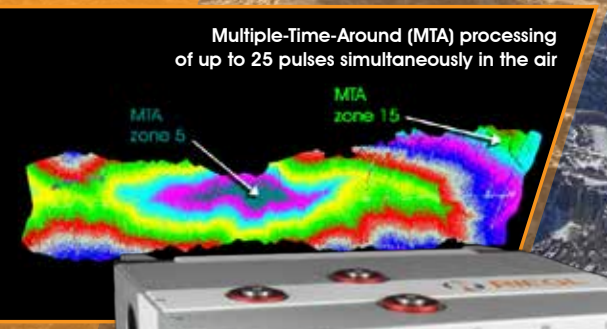

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Digital transformation and disruptions therein

Prof. Arup Dasgupta
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Digital technology has made and is making inroads into society since the early 1970s. However, with the advances in computation technology and science, communications and sensor technologies, the pace of digital transformation has accelerated and is creating a disruption in society. Industrial Revolution 4.0 is a better term to explain this phenomenon. 4IR has many elements which include Artificial Intelligence, Big Data Analytics, Internet of Things, Cloud Computing, Robotics, 3D printing, Augmented Reality, Virtual Reality and much more. Disruption carries a social cost, all the more so when it seeks to blur the cyber human divide. Ultimately, we will no longer use devices, we will become the device.

A frightening thought, perhaps but a real possibility. With the advent of 5G, video conferencing can become 3D and immersive. This is not a dream but a reality demonstrated by Microsoft in a system called Holoportation. Smartphones will soon be replaced by wearable technology which will integrate more closely with human systems. Therefore, 4IR will impact society more than industry because by automating complex tasks it will empower people. Thus it should result in better socio-economic benefits and improved governance. It follows that industry too will be impacted favorably provided it recognizes the human aspects of the change they wish to bring in.

The 4IR can cover digitization and integration value chains, digitization of service and product offerings and improvement of digital business models and customer experience. This will require a trans-disciplinary approach which should be agile, adaptable and empathetic towards its end users. While 4IR tends to promote a horizontal expansion of IT into all industries it can succeed only if it also gets institutionalized at all levels. This calls for innovation at the IT, technology, marketing and institutional levels.

For example IoT is expected to revolutionize the way industrial production is intelligently automated and citizens' lives are made comfortable through IoT based Smart Cities. However, if the requisite communications infrastructure is weak or missing these very benefits will turn into liabilities. IoT requires that all other infrastructure like communications systems, fail-safe sensors and strong cyber security are put in place simultaneously.

There are many cases where technology fixes have ultimately failed. Take the example of the 'One laptop per child' initiative which was spearheaded by Nicholas Negroponte of MIT Media Labs. It started with great fanfare as a means of educating children by unshackling computers from the classroom and giving it to a child to discover its powers thus enabling the child to learn while playing. Today that program is not heard of anymore though the OLPC Foundation exists. Why did it fail? Mainly because it did not take into account local conditions and social structures and values. What works in America need not work in Nigeria.

Therefore there is a need not to proceed at breakneck speed to be first off the block with a new service or product, but to see that there are simultaneous development of infrastructure and that there is a proper sensitization of the users who will use that service or product. We may have a fancy automated traffic control system but that will be useless if the roads are poorly maintained which will slow the traffic in spite of the traffic control system. The tendency will be to blame the system and not look at the original causative factor. In sum the citizens will be unhappy and the exchequer will be looking at an infectious expenditure.

A holistic approach is needed for 4IR to succeed.

Data at the scale, frequency, and quality available with Copernicus via free and open data policy constitutes a fundamental paradigm change in earth observation, thinks **Josef Aschbacher, Director of EO Programs, European Space Agency**

COPERNICUS A GAMECHANGER

Which are the top three trends that are impacting the earth observation sector?

First and foremost, there is a need to continue building high-precision satellites. There will always be need for them even with the proliferation of small satellite constellations. Secondly, the combination of big and small satellites for me is a major potential which has not yet been tapped. We either use big satellites or small satellites but very rarely a combination or an integrated dataset. There is a lot to be done in this sphere and this is something I would like to work on.

Third, technologies like artificial intelligence (AI), blockchain, machine learning and deep learning are deeply disrupting the IT world and earth observation will benefit from it. With the humongous volume of data being generated by satellites today, we would need even more automated processes like AI and machine learning to extract information and intelligence in a timely manner.

I see these three factors shaping the earth observation sector in the next five to ten years.

ESA for years has continued its commitment to realize cutting-edge satellite missions to advance scientific understanding of our planet. Can you briefly take us through the various earth observation programs of the agency?

ESA's earth observation programs have mainly three lines of activities. The first one is the science missions, called Earth Explorers. The second one is the Copernicus program, where the European Space Agency builds the Sentinel missions for the European Commission with European Union funding. The third one is meteorological, wherein the space agency develops polar-orbiting and geostationary meteorological satellites.

While the Earth Explorer satellites are geared up to address some of the intriguing science questions deploying best technologies, with the Copernicus, ESA is building the largest earth observation satellite system in the world — six families of Sentinels are being defined, developed and put into orbit. In the first round, 20 Sentinels are in the process of being launched.

ESA is also working with European Commission to advise on new policy requirements for issues such as Climate Change, CO2 monitoring, concerns around Arctic melting, food security in Africa and so on.

In addition to the meteorological segment, ESA is also striving to continuously improve the quality of weather forecasts. So in total, we have 14 satellites in orbit and 28 in development, which is quite a large portfolio. In fact, it is the largest portfolio that ESA has ever had.

Copernicus is said to be a gamechanger in the earth observation industry. Could you elaborate on this?

Copernicus is indeed a gamechanger. Data availability at this scale, frequency, and quality constitutes a fundamental paradigm change in earth observation. Today, we are producing 15 terabytes of data every day and on an average every product is downloaded about 10 times. Therefore, 150 terabytes per data are delivered to users from the central data hub. In addition we have other distributors of data who are consuming data from different bureau sites.

Also, since Copernicus data is free and open for everyone; it really disrupts and brings data to every single citizen in the world.

Landsat has been there for a long time and is an extremely important data source. How would you rate the two?

We cannot replace Landsat with Copernicus. In fact the programs complement each other. The world has been benefitting from Landsat data for the past 40 years now. It is really a unique and extremely valuable data source that has provided knowledge and understanding of the planet.

The Sentinel 2 satellites within Copernicus is similar to Landsat in accordance to sensors, with some variations like different numbers of channels and the resolutions. With the Sentinels 2 twins in orbit, we can increase the coverage provided by Landsat, and further with 13 channels increase the accuracy of the measurements taken with a 10-meter resolution in the best channels.

So, while Landsat has built up a long history and provides data globally for many applications, Sentinel is going to massively cover the planet regularly every six days. The combination of both will prove to be an extremely good application. In fact, I am working very closely with NASA and USGS in cross-calibrating Sentinel 2 data with Landsat data so that users can use either of them, whichever satellite just happens to fly over.

All of ESA's data is freely available. Where is your business case in it?

ESA is a public entity and the activities are funded by governments, which is the taxpayers' money. Our job is to develop new technologies and satellites. In case of Copernicus, we do it together with the European Union through public funding.

The goal is not to make money by selling data. Since we are not a commercial company, we do not need to create income. Our aim is to provide a data source which people can use in order to create more businesses afterwards.

“ESA is a public entity and our activities are funded by governments, which is the taxpayers' money. Our job is to develop new technologies and satellites and not to make money by selling data.”

This will also ensure that various ministers and politicians will find this system useful and give us money for continuation and development of new capacities.

However, there is a lot of economic value or economic benefit that can be derived from use of satellite data. For example, investment in Copernicus is multiplied by a

Copernicus Open Access Hub

The Copernicus Open Access Hub provides complete free and open access to Sentinel 1, Sentinel 2 and Sentinel 3 user products, starting from the In-Orbit Commissioning Review (IDCR).

Source: Copernicus

factor of between 10 and 20 in terms of feedback or return to the European economy. Therefore, I think it is a good investment.

ESA is known for its engagement with start-ups and incubation. Have you done any kind of research or study into data given versus jobs created?

NewSpace, as the name suggests, is a new phenomena. At the moment it has a very diverse landscape and ecosystem. It is difficult to see how this develops and what are the potential advantages and disadvantages. Hence it is difficult to predict its future right now.

However, what is certain is that it is a strong emerging domain and major IT companies outside the space domain. For instance, SAP and Amazon are engaging themselves by investing their own private money into getting access to Sentinel data and creating information out of it. Therefore this is not a space agency finding other space partners. I think it is the best proof that the concept is interesting from a commercial point of view.

The NewSpace sector has already developed in the US, while it is still developing in Europe. What are the lessons that EU needs to take from US on this?

The US progressed very fast in the NewSpace domain, and this was triggered by the companies in the Silicon Valley. There are two factors—one is speed and another is access to money, which is characterizing these NewSpace companies in Silicon Valley.

On our part, I want to give European companies a chance to develop themselves in the NewSpace domain. As one of the initiatives towards this, I have established a laboratory where new companies can try out innovation and disruptive activities.

However, we also don't want to disturb the commercial market too much, but rather support them within our mandate and capabilities. We certainly want to put programs on their feet to help these NewSpace companies to grow in Europe.

There is an ongoing tension between the UK and the European Union over Galileo following Brexit. Does this also impact ESA's earth observation program?

Firstly, even after Brexit the UK remains a member of ESA. Second, there is a small difference between Copernicus and Galileo. In Copernicus, the space component is co-funded by ESA member states (including UK) and European Union, while in Galileo the majority funding came from the European Union. Therefore, UK as an important member will hopefully continue to support Copernicus in the ESA context.

We hope that UK is joining the EU part of the Copernicus program and therefore continues to fund or co-fund the Copernicus program also through the Brussels' element. If that does not happen then we have contingencies which we are already have been discussing.

However, I think a big issue is also the security aspect in Galileo, which complicates the discussions. In Copernicus you do not have security issues because it is not considered a security restricted program. Therefore, the issue of the UK participation is an issue of industrial procurement and industrial participation. I am confident that we can find a good solution on this.

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POWERING DIGITAL TRANSFORMATION

History is replete with disruptions, some catastrophic, others beneficial in the long run. Will geospatial DNA of digital transformation ensure a better world?

By Prof. Arup Dasgupta

The digital transformation of the world is moving apace as digital devices become ubiquitous. Today, every object from the car you drive to the smartphone in your pocket has an element of digitization inbuilt. While a self-driving car is the ultimate in digitization, even the humble family jalopy has digital electronics monitoring various engine parameters and even your driving. Similarly, that smartphone in your pocket is not just a telephone but does more than your average desktop. A spinoff of this is the growth of electronic networks, particularly the Internet. Combined with the smartphone this enables an experience, which was in yester years, was available only on *Dan Dare* comics. Smart devices and the internet connect humans and machines together in a dynamic fabric.

The dynamic nature depends to a large extent on location. Take the example of the self-driving cars. This is an excellent example of a machine interacting with other machines, and humans in a dynamic environment in which location plays a crucial role. In smart farms we have an example of interaction between machines, human and other living objects which cover precision farming and animal tracking using RFID to name a few. The success of the Internet of Things is closely dependent on location. Thus the larger field of ICT needs geospatial systems to provide the all important location information. Unique digital solutions for dynamic solutions need unique applications of geospatial systems.

In life, the uniqueness of living systems is decided by their DNA. Like the DNA double helix strands, which have four connectors, cytosine, guanine, adenine and thymine in millions of combinations, we may consider the geospatial DNA to have four 'connectors' namely Platform, Data, Storage and Software, which can be combined in many ways to deliver unique solutions.

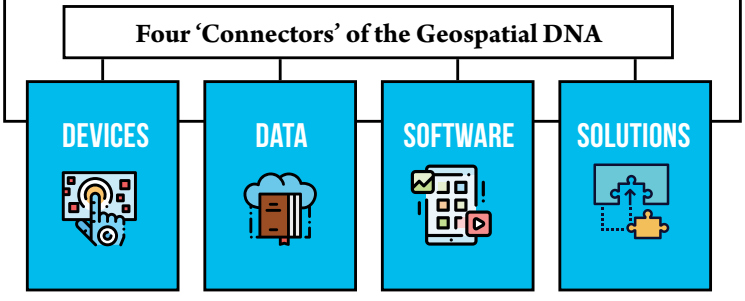
Platform and data

Data acquisition systems have grown rapidly thanks to innovative use of miniaturized hardware. Today EOS small satellite swarms provide hourly global coverage. With resolution in the range of a few meters, these satellites provide detailed imagery and video of each and every part of the globe. For example, recently a Chinese video satellite Jilin-1 orbiting at around 535 km above Earth live recorded the launch of the OS-X1 rocket as it lifted off from Jiuquan at 12:10 local time live, demonstrating the power of remote sensing far beyond what we have been used to. Such power is being used for many dynamic applications like tracking of ships and vehicles and monitoring of Earth events like storms, accidents and unusually large gathering of people which have a direct impact on safety and security.

Closer to Earth, remotely piloted aircraft systems, familiarly referred to as drones, are gaining acceptance as country after country are issuing regulations for their use. Drones can carry payloads ranging from digital precision still

CONNECTING THE DOTS

Digital transformation has become ubiquitous. Humans and machines are knit together by devices and networks and geospatial is an integral part of this network.



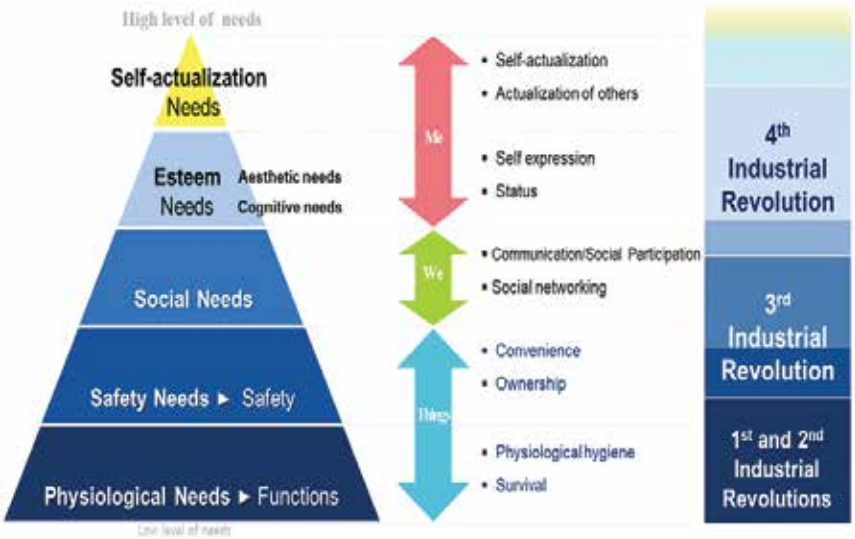
cameras to video cameras to SAR and LiDAR, all thanks to miniaturized electronics. Such drones are being used to provide 3D scans of buildings and other structures that can be integrated with BIM and GIS to provide near real-time data on dynamic activities. Drones provide that extra service, which is needed when cloud cover obstructs satellite imaging sensors or when high-resolution data is needed or when real-time data is needed.

Another advance in sensor technology are in situ sensors and implantable sensors. In situ sensors, for example, we monitor the Earth's crustal movements and automatically feed the data to a central computer for further analysis and possibly, earthquake early warning. GPS-enabled sensors with transmitters are used to monitor wildlife and research on their activity. Richard Attenborough's *Blue Planet II* used this technology to unravel many secrets like the spawning ground of Blue whales. *A National Geographic* investigation used this technology to track illegal trade routes of ivory using GPS tracker and transmitter implanted in a fake tusk. RFID sensor implants are used to track livestock, certify the authenticity of medicines, detect stolen cars. Self-driven cars use an array of sensors, which help to navigate public roads and highways. Finally the Internet of Things is driven by sensors of various types which enable smart homes, smart cities, smart manufacturing and smart healthcare to name a few.

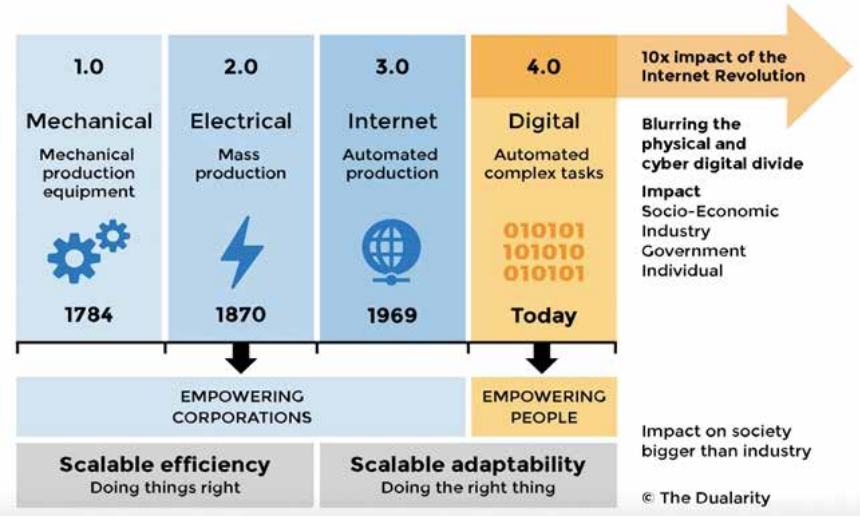
The users are spoilt for data. Considering the number of national and commercial satellite systems producing terabytes of data, the rising popularity of drones and the proliferation of sensors, enough and more data is now available not only for traditional use in monitoring and management of natural resources but for many commercial applications. Though the use is presently dominated by national governments, by 2025 it is expected that the demand from commercial users will equal and then perhaps exceed the governmental demand.

Drones can carry payloads ranging from digital precision still cameras to video cameras to SAR and LiDAR, all thanks to miniaturized electronics

Other moves that have accelerated data use are GEO initiative, Radiant. Earth, government institutions and some commercial initiatives. The Group on Earth Observations champions the move to Open Data. Its Founder Chair, Barbara Ryan had earlier made Landsat data freely downloadable when she was with the US Government. GEO encourages satellite operators to make their data available for free to stimulate data usage particularly for humanitarian activities. ESA has made Sentinel data freely downloadable right from the start of the program thus encouraging, both academic, government and commercial users.



Graph 1: Dynamic new combinations between technology, market, and society through open innovation.
Source: Journal of Open Innovation, Technology, Market, and Complexity, 2018, Vol 4



Graph 2: The supply (digital) and demand (consumer, demographics) trends and impact on our society, industry (Industrial Revolution 4.0) and the future of work.
Source: The Dualarity

The Radiant Earth Foundation is a not-for-profit initiative following the GEO initiative by creating a database of Open Data. Other data resources including drone data is accessible provided the user has the relevant license. The database is made available for analysis using tools provided by Radiant.Earth or by the users. This is a classic case of Data as a Service, and Applications as a Service. Similar initiatives are ISRO's Bhuvan and NASA's WorldWind, which are completely free. Esri's ArcGIS Online is an initiative in the commercial world based on a subscription model.

Storage and software

The flood of data creates new problems of data storage and analysis. NASA, Radiant.Earth, ArcGIS Online and many other spatial data providers like Pitney Bowes Software & Data Marketplace and Planet use the Cloud to store data and provide access to data and analytics through APIs. However, this presupposes that the user has a stable, reliable and 'always on' connectivity to the Internet. Unfortunately, this is not the case in countries where such data is required the most. Thus, Bhuvan uses a distributed server model and allows download of data as per Indian security regulations and analytics support based on OGC Web Map Services.

Apart from spatial data there are several other data sources, which have an implicit spatial content like transactions, social media and socioeconomic parameters. Solutions for real-life issues need to use a variety of data sets in an analytic environment that goes beyond just image processing and GIS. Data science is a new branch of research that has come into focus. Big Data Analytics is one of the branches of data science, which enables insights culled from the data streams. Other techniques, which have emerged are artificial intelligence, machine learning and deep learning. These are not independent modules but are interrelated. AI can be considered as the mother technology that has spawned machine learning. Deep learning is a subset of machine learning, which uses BDA insights to train a deep neural network to do predictive analysis.

Other techniques relate to visualization of the analysis and spatially oriented smart contracts. Two important elements of visualization are augmented reality and virtual reality, which can create virtual worlds which can be viewed from the outside (Augmented Reality) or in an immersive environment (Virtual Reality). Blockchain is a new technology, which can tie up spatial analytics with smart contracts to enable reliable and assured transactions in the geospatial space.

Solutions using geospatial building blocks

Real-life issues like sustainable development, environmental management, climate change, infrastructure management, city management, business management, defense and security are all potential beneficiaries of digital transformation. Extending the DNA analogy we can consider solutions as composed of unique combinations of basic geospatial connectors with image processing, GIS, location on one side and subject specific software like Business Intelligence, Building Information Management, power distribution, land records management and process management on the other.

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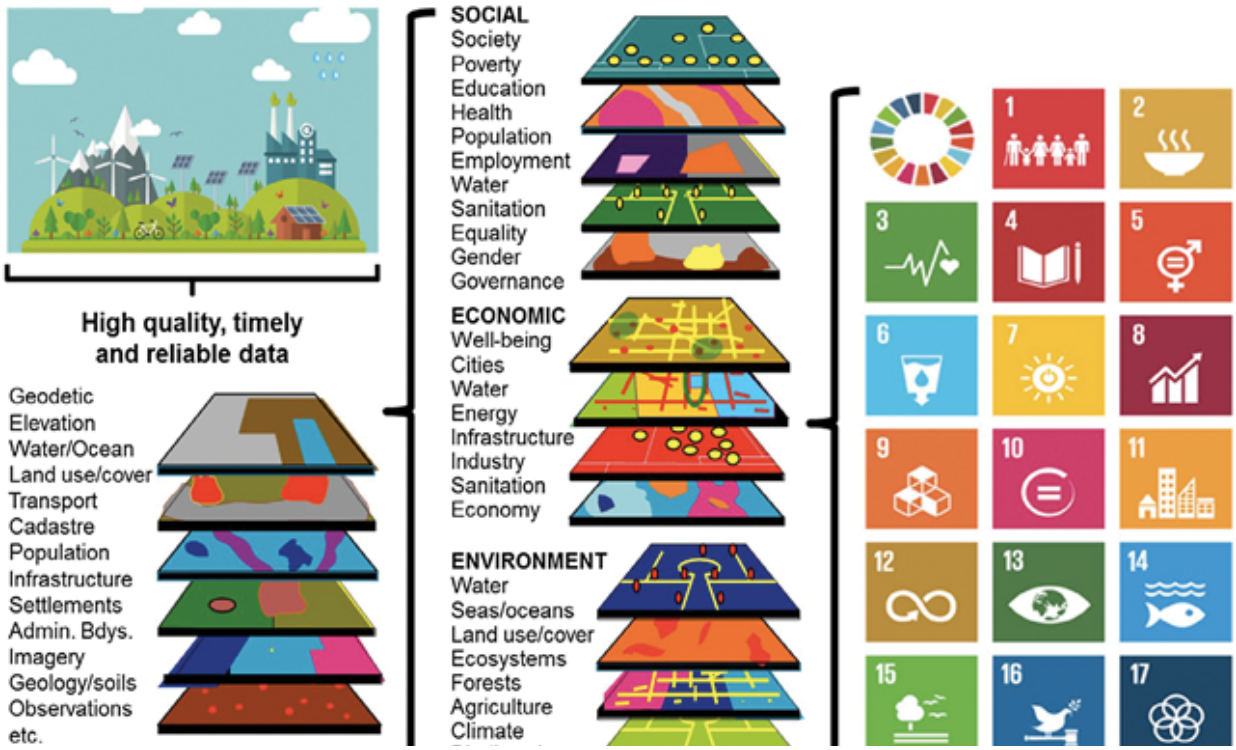

Graph 3: Extending national fundamental data themes to the SDGs and targets by means of the global indicator framework.
Source: Scott and Rajabifard: Geo-spatial Information Science, 2017 VOL. 20, NO . 2, 59–76

The continuum of digital transformation has traversed through several industrial revolutions and currently the hype is all about Industrial Revolution 4.0 which seeks "dynamic new combinations between technology, market, and society through open Innovation" (*Journal of Open Innovation, Technology, Market, and Complexity, 2018*, Vol 4, page 21). The key factor is society. 4IR seeks to bring about a merger of cyber and physical worlds to serve society and individuals. Though termed as 'Industrial' the socio- economic impact will be felt by society, government, industry and individuals in that order *(See Graph 1 and Graph 2 earlier)*.

A glance at the sustainable development goals shows that these have a significant geographical context and the requisite analysis, modeling and mapping can provide valuable inputs to the overall management and monitoring of resources *(See Graph 3)*.

PwC in a study on "Fourth Industrial Revolution for the Earth Harnessing Artificial Intelligence for the Earth" have listed the major areas of applications as climate change, biodiversity and conservation, healthy oceans, water security, clean air and weather and disaster resilience. Each of these areas has a strong geospatial content which when combined with other data and techniques can provide meaningful solutions. The study identifies the game changers, which can impact the Earth and humanity as a whole. These are autonomous and connected electric vehicles, distributed energy grids, smart agriculture, weather forecasting and climate modeling, community disaster response data and analytics platform, decentralized water systems, AI-designed intelligent, connected and livable cities, oceans data platform and Earth Bank of Codes for traditional information.

Dangers and pitfalls

As in any system, there are dangers and risks, which must be kept in mind. Such risks may include poor performance, security breaches at individual and collective levels, ethical risks, rogue operations, widening the have and have-not gap and economic risks. In a comment in Nature, Joshua Blumenstock outlines the possibility of Big Data ignoring the people for whom the analytics is intended. He writes, "algorithmic transparency, fairness and accountability are off the radar of most companies operating in developing countries" which can lead to invasion of privacy. There is a need to validate and customize data and collaborate with local entities. In his view "the successful use of Big Data in development requires a version of data science that is considerably more humble than the one that has captured the popular imagination."

Digital transformation is gaining momentum. The benefits of going digital are numerous, however, just like any new terrain, we need to traverse it carefully. The digital technologies have huge potential for facilitating more informed decisions, but preparedness is necessary for effective adoption.

Prof. Arup Dasgupta , Managing Editor
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While the prospects sound promising and ambitious, there is a lurking threat that is prodding many to view IoT with cynicism.

By Aditya Chaturvedi

SECURITY A PRIME CONCERN IN IOT

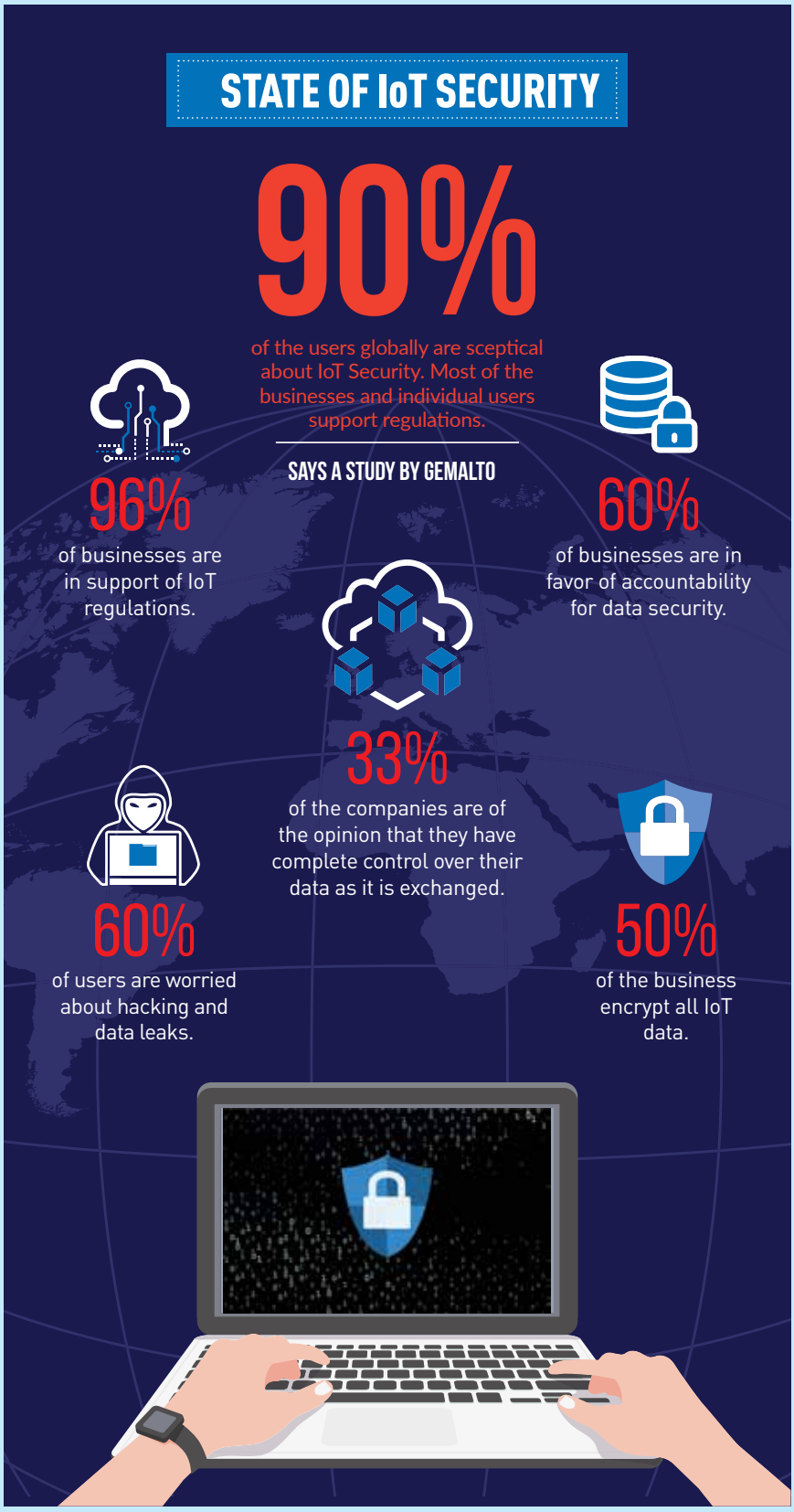
- *Hacking and spoofing leads to an estimated loss of whopping 300 billion dollars annually. And this is not all! Other than the financial loss, companies often lose confidential information and thus their image is dented or their quality of services is compromised. From hacking financial transactions to stealing classified info and creating a virtual profile, hackers manage to do it all despite cybersecurity measures and the abundance of anti-phishing and anti-virus, malware software.*
- *Last year cybercriminals gained access to the servers of Equifax, which is one of the world's largest credit bureaus, and stole personal data of 145 million people. This hack is among the most lethal security breaches of all time because of the sheer volume of information that was compromised, stolen and exposed. Equifax took two months to recover from the hack.*

The above scenario and the looming risk of cyber hacking and assorted malicious acts look ominous, right?

Now imagine what would happen if this risk increases exponentially with the existing or modified security frameworks that cannot keep pace with the massive interconnected networks when almost everything would be connected to the internet.

Sounds like an unmitigated disaster or a modern version of Orwellian dystopia. But this is not an unfounded fear.

Visualize for a second what would the consequence of security breach when all of our devices, smart homes, public transport systems, heavy machinery, and autonomous cars would be connected to the internet? This would lead to something fatal and not only financial loss or identity theft.



The security risks associated with Internet of Things (IoT) are quite alarming and we cannot imagine the havoc that would be unleashed if millions of devices stop functioning or worse are programmed for devastation. For Instance, high voltage in IoT connected electricity networks, or sensors in smart homes.

Nonetheless, breakthroughs in Internet of Things (IoT) would have a seminal influence on multiple sectors and would lead to the dawn of an unprecedented era of automation when billions of devices would be connected to the internet and would be able to share information. This would undoubtedly provide a boost to technological innovations and foster path breaking developments. It is estimated that by 2020, over 24 billion devices connected to the internet would be installed.

The number of IoT devices used in households is predicted to increase from 9 devices per household currently, to 500 by 2022, as per the research house Gartner.

While the prospects sound promising and ambitious, there is also a lurking threat that is ringing alarm bells and prodding a lot of people to view IoT with cynicism. And we cannot afford to overlook this huge risk.

Associated risks

Mounting concerns about data privacy and security breach has also lead to questions being raised about the security preparedness for IoT, considering the scenario that billions of people would be vulnerable.

Professor Chris Hankin, Imperial College London, believes that, "the major security risk associated with the IoT comes from interactions with physical processes. With manufacturers making devices to different standards, problems could include a lack of device interoperability, devices interacting unintentionally and even representing a risk to user safety, devices constructed from cheap or inferior hardware posing a cybersecurity risk by containing malware, etc."

Spoofing is a major risk as smart electricity meters that are used in Spain were hacked so that they would under-report energy consumption. A massive denial-of-service (DDOS) attack on Dyn's servers took down many companies including PayPal, Twitter and

Spotify. These incidents demonstrate that a lot needs to be done for protecting IoT devices.

A report by Vodafone stated that "18% of businesses said that concern about security breaches is a potential barrier to wider adoption of IoT in their organization. 30% said they were changing or restricting the scope of IoT projects to limit security risks. And more than half of businesses to said they're more concerned about IoT security risks than they were in the past."

Assessing data collection mechanism of IoT devices is an important process in determining the safety of data storage and is among the main security concerns.

Challenges and obstructions

Software security is also at the core of IoT. With IoT, companies would not only have to update their servers and systems, but also everything that is connected. Be it a security camera or a home device. Security patches would also have to be updated on a regular basis. In standalone devices, this is often condoned. But in IoT devices it could lead to the possibility of a severe cyberattack. Lack of interoperability is also a barrier in security

Intrusive surveillance is another a security risk associated with IoT. Organizations would have to be extra cautious to ensure that importation of new data in the system is not possible and the encryption is safe.

64% of those using IoT devices have encountered issues with it, as per data by software intelligence company DynaTrace. This doesn't present a good picture and highlights the need to enhance security and performance related issues in IoT devices.

This highlights the need for organizations to conceive meticulous IoT strategies keeping in mind security and performance.

Cisco Systems recognizes the risks but is also sure that we would be able to increase security. It said in a report that there is a need for IoT security requires programming cybersecurity and physical security solutions to work in tandem. This would make correlating information easier from multiple security systems and offer a more detailed view. There is also a need for a direct interaction between the security systems to save response time.

Security system should be smartly designed to follow different approaches in different cases.

Strengthening system security

Lack of a broad consensus on implementation of security in IoT is one of the major challenge before the industry. Divergent thoughts would enrich the debate on IoT security but a consensus around key areas is urgently needed.

According to the *International Journal of Advanced Computer Science and Applications*, IoT security requires a multi-faceted strategy and a durable system.

For increased security an IoT system should be able to auto-recover in case it accidentally crashes while transmitting data. Furthermore, the system should have the capability to protect itself from malicious programs that could be externally inserted. IoT devices also require an authentication framework that would permit data transfer exclusively between authenticated devices.

Authentication of devices should go hand-in-hand with authorization to strengthen IoT security. Access controls cannot be arbitrarily assigned and personal data access should be limited so that no random authenticated user can avail the information.

IoT would generate copious data that would have to be processed and stored. This would also mean a spurt in high-speed internet connectivity. So in adverse cases, if a hacker gains access to the system, he can do irreparable damage. For this companies need to devise an alternative security contingency plan.

What further exacerbates the risk in IoT security is that hackers use IoT devices not as ultimate ends but as launch pads for future attacks, while device owners remain oblivious that the security of their devices has been breached. Unprotected IoT devices in a network can be converted into bots by attackers, and then used to attack third-party systems and fetch data from communication channels. Case in point: 2016 Mirai attack used IoT devices for attacking internet infrastructure, leading to shutdowns across Europe and North America and causing a loss of more than 100 million US dollars.

Lack of a broad consensus on implementation of security in IoT is another major challenge before the industry

Most IoT devices function outside organizational firewalls but connect directly to companies' internal networks and applications, which substantially increase the vulnerability by extending the attack surface, points out a report by IT firm cognizant.

Cognizant recommends performing threat modeling at each security layer, including devices and connected cloud; gathering insights and then performing a test to gauge the vulnerability to attack. Attack routes, which could be physical access points, communication channels or other interfaces, should be detailed properly.

IoT companies should also focus on resilience of assets and making communication protocols more robust. Also, a strategy is needed regarding what could be done with a compromised device.

Need of cutting-edge IoT infrastructure

The latest McKinsey report reaffirms what we have been saying all along about the feebleness of the existing infrastructure and that it is not sophisticated enough and lacks many things. The report further underscores the confusion in providing end-to-end security solutions for IoT as it is yet not clear whether component suppliers and OEMs are positioned for this task, as the IoT network would feature diverse set of devices.

IoT also doesn't have well-formulated security standards that could describe the technology interaction. Different organizations use their own solutions and many segments still rely only on large players. Lack of a uniform standardization is a big impediment in IoT security and even stalls innovation as companies are unsure about regulatory guidelines.

IoT sensor companies also face another difficulty. As per the McKinsey report, increasing security features might not be profitable for sensor manufacturers because of the widespread perception that providing security is mainly the job of software providers, who are supposed to have expertise in the field.

The way around could be semiconductor firms developing a toolkit of security offerings that permits product customization, based on the degree of security that is required. They should also come up with unique solutions.

Mitigating risk smartly

To mitigate the security threat and the make the devices less vulnerable, security testing is a must. IoT device testers should pay heed to the device's password policy, ensuring that minimum password requirements are by default in-built, and that they are unfailingly enforced. A recommended practice for devices could be mandatory password change upon first access, and this should be taken into consideration when developing automated tests.

A report by Deloitte emphasizes on the fact that by focusing on some of the defining features of IoT deployments, we can begin to see how the reinforcing principles of security, vigilance, and resilience can assist companies in protecting the underlying value created by them.

The report also states that IoT sensors are most susceptible to counterfeiting (fake products embedded with malware or malicious code); data exfiltration (extracting sensitive data from a device via hacking); identity spoofing (an unauthorized source gaining access to a device using the correct credentials); and malicious modification of components (replacement of components with parts modified to generate incorrect results or allow unauthorized access).

Strong data regulations and a coherent policy around IoT are also needed to provide legal redressal in case of privacy breach along with concerted efforts by all.

Aditya Chaturvedi, Correspondent
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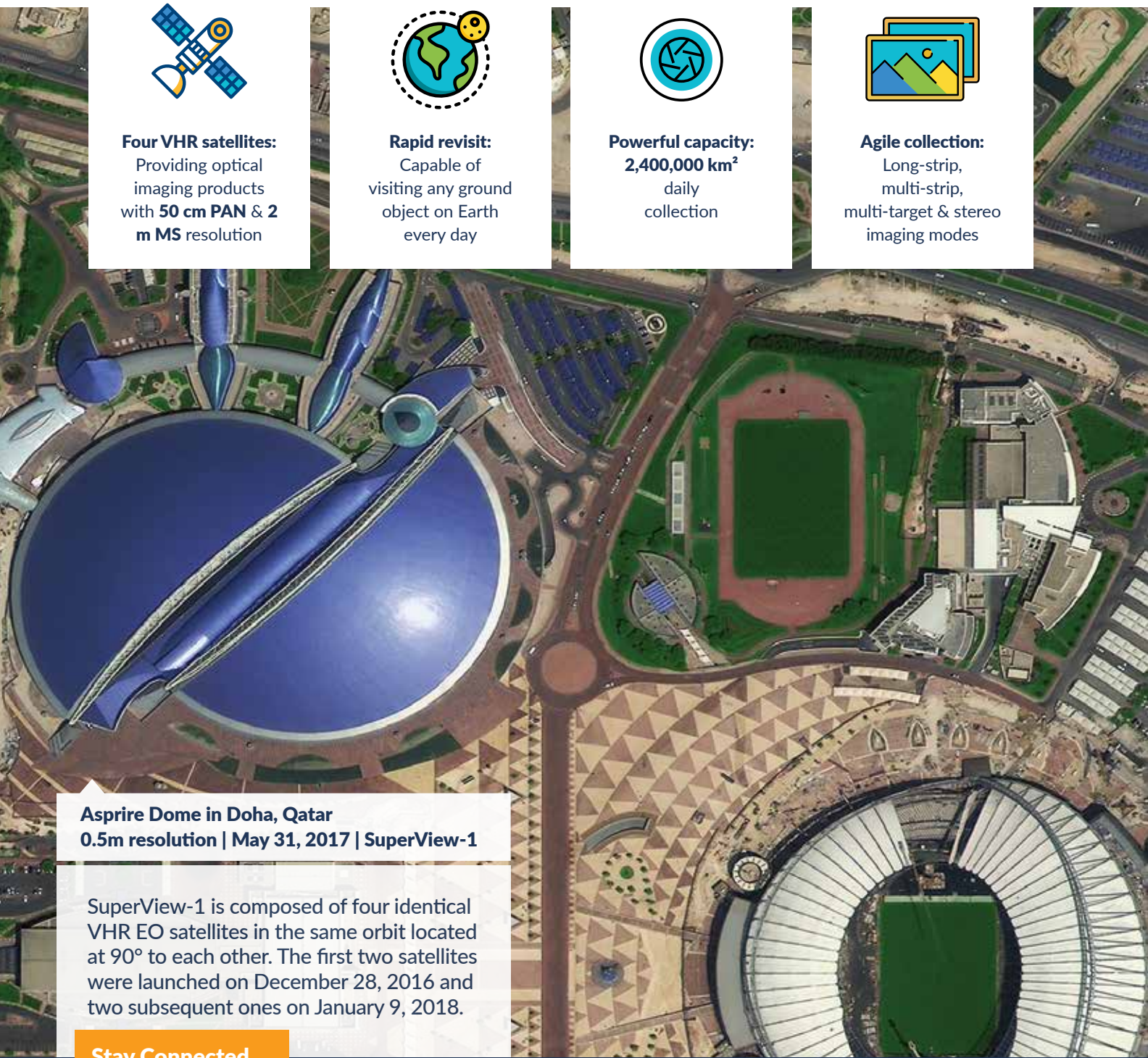

Asprire Dome in Doha, Qatar
0.5m resolution | May 31, 2017 | SuperView-1

SuperView-1 is composed of four identical VHR EO satellites in the same orbit located at 90° to each other. The first two satellites were launched on December 28, 2016 and two subsequent ones on January 9, 2018.

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The depth and breadth of the data that Ordnance Survey produces and manages is one of the best examples of its kind, anywhere in the world. This data is so big, yet granular and accurate.

By Keegan Wilson

The interest in the geospatial industry has never been so great, reinforcing the global recognition of the value of location data. Today the geospatial industry is thriving and supporting economic growth and development, delivering value to millions of citizens across the world.

With the emergence of technologies that have the potential to transform our world and the way we live and do business, Ordnance Survey (OS) believes the geospatial industry is on the verge of something special: a data driven world where place is the common factor, which is going to be core to getting value from data.

The focus for OS today is making geospatial data even more detailed and current, and by offering data as a service it has transformed its business model. Last year, the company generated revenues of over £400m, with roughly 90% of that coming from data-based projects.

The depth and breadth of the data that OS produces and manages is one of the best examples of its kind, anywhere in the world. This data is so big, yet simultaneously so granular and so accurate that the location of every fixed physical object in Great Britain, from the ground upwards, is mapped and

GEOSPATIAL

Case study

A recent example of the vital role geospatial has to play in maximizing the potential of new and emerging technologies can be seen in an ambitious UK Government project to develop the world's first Artificial Intelligence-based simulation model for testing autonomous car safety.

OmniCAV will be a simulation environment featuring a 32km circuit of roads in Oxfordshire, covering rural, urban, main roads and intersections. It will be used to create and run different scenarios for the safe testing of Connected and Autonomous Vehicles (CAVs), and will support certification bodies, insurers and manufacturers.

On the project, OS will lead the capture, processing and serving of geospatial high-resolution mapping data. This will include 3D geometry and detailed information about the roadside assets and their characteristics, so that data standards and requirements can be developed for the eventual real-world deployment and operation of CAVs.

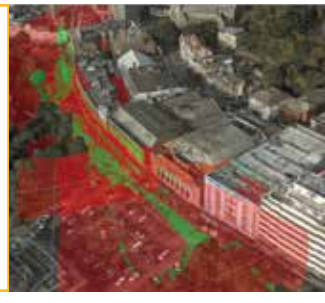
OS used similar data capture techniques in projects such as CityVerve, the UK's IoT demonstrator, and in resort town Bournemouth, which OS used as a test case to produce a 5G planning and rollout tool.

Miranda Sharp, Head of Innovation at Ordnance Survey, says: "This project is one of a number of UK government-sponsored projects that supports the position of the UK as the best place in the world for autonomous vehicle testing. Building on the unique strengths of OS capability and data, the aim is to help accelerate the safe deployment of autonomous vehicles on UK roads by permitting testing in linked versions of the real-world environment and a digital one. To achieve the CAV ambition, geospatial data is key. Not just to the creation of a realistic simulation environment to test in, but also to the eventual deployment of a new infrastructure to enable improved connectivity and mobility."

registered to within 1cm accuracy. OS draws information from its ground-based surveying team and aerial photography produced by its flying unit. When you consider the scope of maintaining this across England, Scotland and Wales, and the constant change that goes on, especially in areas of constant redevelopment and transformation such as London or other major cities, you realise what a mammoth task it is to keep that information up-to-date and accurate. It literally is a never-ending job.

Last year the number of unique geospatial features in Great Britain exceeded the 500 million mark and each day the database is tweaked, on average, around 20,000 times. Each geographical structure is also assigned a 16-digit code, to which information can be added: ownership, power supply, crime data or sale values.

DATA FUEL FOR THE DIGITAL ECONOMY



"We've changed from a company that sells paper maps to one that sells the ability to use data," says Caroline Bellamy, Chief Data Officer, OS.

"We need to treasure and protect our data. It's a tremendous asset. We live in an economy where data needs to be accessible and available.

"We work with every government department, all local councils and have about 300 partners which include the world's biggest data users. People come to us because we can deliver authoritative data – our credibility is our USP."

How did it all begun?

Ordnance Survey was the first national mapping agency to digitize its database, giving Great Britain's government agencies and businesses 'one true digital source' for all the nation's geospatial information. The aim was to improve infrastructure planning and building through reducing the margin for error and increasing efficiency by having everyone working off the same picture.

The digitization process was started by OS in 1971. Computers were already being used to simplify the process for updating maps, but as the 1960s became the 1970s, digital mapping was introduced to large-scale map production. A year later, the first Outdoor Leisure Map – *The Dark Peak* – was published, while 1973 saw the production of the first large-scale digital map of Great Britain. This was described by the Director General of the time, B St G Irwin, as "An event of the greatest possible importance in mapping."

It was a painstaking effort to transfer its paper data to digital, and some twenty odd years later, in 1995 it was complete as OS launched its website and digitised the last of about 230,000 maps. Computers further transformed OS's map-making by enabling electronic data to become routinely available to customers within 24-hours of sites being surveyed.

Today, if you say, "Ordnance Survey" to the person on the street, the chances are they'll think "paper maps". That's no surprise, as for over 200 years those paper maps were the organisation's main business, and so they're deeply engrained in the nation's culture. But OS's iconic paper maps account for a small percentage of its annual revenue.

Most of its income comes from its giant digital database known as OS MasterMap, which shows every building, garden, statue, pavement and property boundary in the country. Launched at the start of the century, OS MasterMap has transformed the way people work with geospatial data and use this data to underpin their decision making.

The digitization process has meant that things can happen in Great Britain a lot faster, and with greater confidence and competence. A consequence of this is how geospatial data use has increased, and in turn this has unlocked a hunger for more detailed micro geography, which in turn should act as fuel for the digital economy, helping the geospatial industry to grow and continue developing.

The importance of geospatial data has been acknowledged at the highest level of UK Government. In June this year, Prime Minister Theresa May announced that OS would open parts of its OS MasterMap dataset for free. This move demonstrated how central geospatial data is to the government's plans and policies – and how it is needed for the future growth of the nation.

Keegan Wilson, Senior Press Officer, Ordnance Survey; *keegan.wilson@os.uk*

Is IoT data taking geospatial analytics to the next level?

On its own, sensor data is one dimensional. When combined with geospatial analytics, business data, and operational data, the data reveals hidden patterns and relationships for more effective outcomes. **By Matthew Zenus**

IoT connected devices surround us both at home and work. We encounter IoT connected devices every day but their reach extends even further into businesses. By 2020, 200 billion devices are expected to be connected to the IoT.

Interestingly, the biggest portion, (70.5%) of IoT connected devices will be in business/manufacturing and healthcare. Within these and other market sectors, connected devices with fixed and moving sensors will be the source of vast amounts of real-time and near real-time data. On its own, the sensor data tells an interesting story, but it's one dimensional. When combined with geospatial analytics, business data, and operational data, the data can reveal hidden patterns and relationships that deliver better business outcomes.

Companies within the insurance, travel, agriculture, and construction industries are enriching data from IoT sensors with business applications and geographic data from GIS. They are overlaying business data, device location information, customer locations and more with detailed geographic information, like topography and satellite imagery. Rich graphics, such as heat maps and charts help users visualize business activities, relationships, and patterns.

IoT in the field

In commercial agriculture, farmers are overlaying maps of their fields with historical data and sensor data to produce crops more efficiently. Through an app, they can take a virtual walk-though of any sector and understand exactly what is happening with their crop.

Sensors in the soil measure moisture, pH, and more to show farmers the state of their soil. A crop history shows past planting schedules and harvests. From a dropdown list, scheduled and unscheduled tasks display irrigation, fertilization, planting, spraying, and harvesting timelines. Farmers can schedule these tasks and assign a contractor to complete them.

When a crop needs irrigating, for example, the farmer first tests the land's moisture. The sensors can tell him the exact percentage of moisture in the land at 6 am, 1pm and 5pm. He can look at records from last year at this same time, and he can run a quick analysis to see what the moisture should be three days, two days and one day before planting a crop of wheat. If rain is in the forecast, the farmer can cancel the contractor and avoid an unnecessary expense.

IoT in the sky

Likewise, in the travel industry, geolocation apps and IoT data can be the ticket for cost savings and improved operations. With the right geospatial analytics solution an airline could track global flight operations more closely and accurately with spatial capabilities by monitoring airport, meteorological, and fleet data in real time to improve its flight planning solution and optimize fuel and staff costs. Thousands of flights can be tracked each day on a 3D mapping interface that displays spatial and temporal coordinates. Flight delays based on hurricanes, volcano eruptions, or other major travel inhibitors can be rerouted based on the data's projections.

IoT assesses risk

In another interesting example one of the world's largest reinsurance companies uses spatial data processing, predictive analytics, and

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Indian Space Research Organisation

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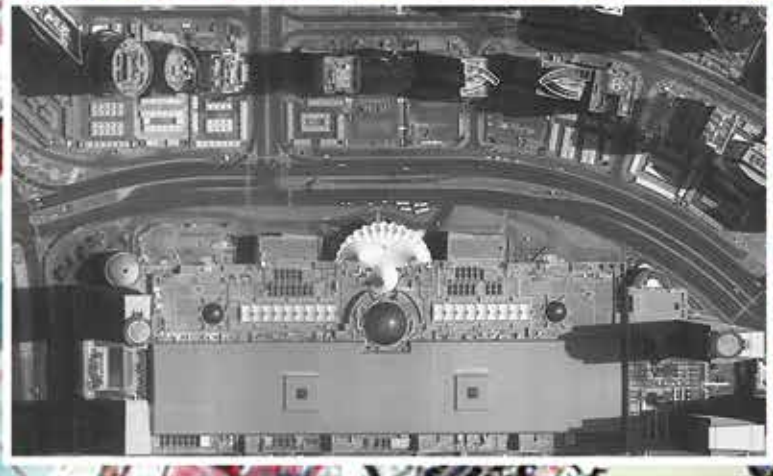
Smart Way to address Geospatial Quest



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simulation capabilities to assess risk based on hurricanes, wildfires, tornadoes, and other weather-related events. The company is tapping into a cloud-based earth observation analysis service to analyze natural disaster data with its customer data to make more informed decisions about insurance risks. The company looks at topography, occupancy, climate rainfall, vegetation, and more to better calculate risks and costs. Its customers benefit as the company pushes down costs based on accurate, timely, historical and real-time information.

IoT and remote asset monitoring

Within construction, a global industrial machinery company has equipped its drills and heavy equipment with sensors connected to the Iot. The company is embedding SIMs into its popular line of drill products, as well as other heavy equipment that customers use on their construction sites. When customers purchase or lease the equipment, the machinery company begins capturing a range of data about the equipment, such as usage time, vibration, speed, and temperature.

When the equipment moves from a site in Belgium to a site in Austria, the company continues to track usage and collect data without interruption. The company is easily able to not only track the location of its equipment, but also monitor and maintain it remotely. It can provide maintenance recommendations and upgrades before the equipment becomes faulty.

One platform for all data types

Geospatial analysis of IoT and other data types has arrived, but we have only just begun to realize its potential. With both volume and variety of data growing, companies choosing to harness the power of various forms of spatial data can outpace competitors by tapping into new methodologies to analyze existing data. Geospatial analysis can lead to improved decision making, better results, new revenue opportunities, and overall a better view of the company's data, thus opening up new areas for growth.

Based on these examples, companies are pushing ahead in their digital strategies and leaving many of their peers behind. What they all have in common and gives them a clear advantage is that they standardized on a single platform that supports their needs of managing their data regardless of its format, source, or location. Other companies that are still supporting multiple platforms are experiencing increased costs to support multiple technologies, increased effort from management staff, as well as insights latency and data availability concerns.

These findings were recently reported in a Forrester Consulting Opportunity Snapshot[1], commissioned by SAP. Additional findings revealed that the most compelling use cases and initiatives rely on multiple data formats.

Analyze data from a central platform that handles structured and unstructured data in a variety of formats

In fact, organizations regularly process several types of structured and unstructured data for high priority use cases. On average firms deal with four different data types, and they work with these different data types on four to eight of their initiatives.

"This means that not only are firms losing productivity and investing more time and money than they'd budgeted, but they're still not getting the results they want from the data," according to the study.

Other challenges are increasing time to value and inefficient data management. The bottom line is that when organizations can't combine business, operational, IoT and geospatial information, they can't fully unlock the value of their data.

To overcome these challenges, successful early adopters are recommending these best practices:

- Analyze data from a central platform that handles structured and unstructured data in a variety of formats
- Be prepared to collect and analyze data from multiple sources
- Enable real-time and near real-time analytics
- Support massive amounts of data with in-memory processing
- Leverage reports that visualize business insights for both data scientists and anyone who works regularly with data

We are not so far away from 2020 or the 200 billion IoT connected devices. Preparing to manage those devices and their data is possible for those ready to undertake the challenge now and begin defining a strategy for combining and realizing the power of analyzing their business, operational, IoT and geospatial data.

[1]*Do More With Data Through Multimodel Capabilities, Forrester Consulting Opportunity Snapshot: A Custom Study Commissioned By SAP HANA, August 2018*

***Matthew Zenus**, Global Vice President, Database & Data Management Solution Go-To-Market, SAP*

HOW LASER SCANNING is used for perfect flooring

New insights are helping in compressing workflow with minimal floor inspection disruptions and costly remedial action after issues are discovered 'too late'

Is it level? Is it flat?

For concrete construction contractors, finishing foremen, superintendents, flooring inspectors, and structural engineers, they are the central questions to any large concrete pour.

Extreme concrete floor flatness (FF) and floor levelness (FL) are requirements for any environment housing sensitive, finely calibrated equipment. Modern warehouse and distribution centers also require concrete floors of exceptional levelness and flatness. Flat, smooth surfaces support safe lift truck operation. Level concrete floors ensure vertical storage shelving of up to 40 feet and higher can support electronic picking systems. There has never been more demand on general contractors and their subcontractors to deliver extremely level, flat concrete floors.

Floor profilers

In the 1970s electronic floor profilers were introduced, providing builders with a dramatically more reliable and comprehensive way to meet concrete floor flatness and, finally, levelness requirements. These operator-guided wheeled devices generated measurement values that required a new way to understand the results. This new floor measurement language, called F-Numbers, grew in time as the basis for industry standards. Today the American Society for Testing and Materials (ASTM) recognizes F-Numbers as the basis for Floor Flatness (FF) and Floor Levelness (FL) standards with ASTM E1155 Test Method for Determining Floor Flatness and Floor Levelness Numbers.

With the F-Number system, concrete construction professionals finally had a common, standardized way to understand floor flatness and levelness. Even so, wide industry acceptance was not immediate. Other pour concrete floor finishing enhancements, such as the laser screed and ride-on power trowel, also contributed to rapidly evolving concrete floor flatness and levelness standards.

FF/FL revolution

Running concurrent to that revolution was another: laser scanning. Laser scanning includes a vast array of everyday applications, from bar code readers and DVD players to 3D printers. Laser scanning at the construction jobsite can also serve varied purposes, including reality capture, the science of digitally capturing the precise shape of an object—say the surface topography of fresh concrete pour—by creating point clouds of data that present the object in a highly accurate 3D digital form.

This point cloud representation is analyzed by software that can visualize deviations, say with a colored heat map. These deviations can include floor flatness and levelness.

Today a growing number of general contractors (GCs), concrete contractors, and inspection services perform highly detailed analysis of just-poured concrete floors for levelness and flatness with a laser scanner.

What advantages do laser scanners and supporting software offer? How does the new measurement technology transform workflows, improve pour outcomes, and simplify measurement.

This case study briefly examines the opportunities and challenges now before construction professionals.

Shifting Standards

Floor profiling devices have served as the gold standard for FF/FL measurement for more than 40 years. For a fast-growing group of GCs, concrete construction contractors, and floor inspectors, that hold is giving way to the accuracy, speed, convenience, versatility, and payback of laser scanning measurement. Wet-Pour Quality Control Compressing Workflow in Concrete Slab Pour Flatness and Levelness Measurement

Standards-setting bodies have taken note as well, with laser scanning applications now

recognized as compliant with ASTM, AISC, ADA, and ACI guidelines.

Key to growing industry acceptance is side-by-side testing of the competing measuring systems. Laser scanning has demonstrated time after time it "delivers the goods" at F-Number levels that meet or exceed traditional floor profile analysis.

Philip Lorenzo, a software developer for Rithm, a maker of FARO laser scanning Apps for construction workflow management, is an active observer. For example, his firm now serves a growing constellation of mid- and large-size GCs nationwide, including:

- DPR
- Largo Concrete, Inc.
- McCarthy
- Morley Builders
- Pankow

What intrigues many GCs is the idea that FF/ FL measurement can be transformed beyond a "gotcha" process where floor issues are discovered far too late in the finishing process. "With laser scanning, problems can be detected while the concrete is still workable. There's no need for a floor profiler operator to walk on the concrete, or even touch it," explains Josh DeStefano, DPR Technology Innovation Manager. DPR is a California-based general contractor and the nation's number-one builder of health care centers.

Thomas Rogers, VDC field Manager of McCarthy Construction, a self-performing general contractor, says their California teams have made this QC step part of their pour workflow. "At first there was some skepticism about wetscanning the pour. I would bring our finishers over to show them all of the defects highlighted live on the computer screen, when they were in a position to fix them," Rogers says. "Fortunately, I've saved them enough floors by using this method that they now trust the process."

Minimum Viable Workflow

That's just one of the many attributes that is leading trade pros to reconsider traditional measurement methods. Other workflow friendly benefits of laser scanning include:

Single Registration: There's no need to laser scan from multiple positions to capture an authoritative point cloud data set. Single position scanning for wet concrete analysis eliminates the need for stitching together multiple scans to render a full view.

Speed: A single operator can capture up to a 70-foot by 70-foot area usually within 3 minutes, and 4 minutes for the computer to calculate a thorough analysis of the floor. Faster verification means the finishing team has time to address potential issues before curing, minimizing the need to grind, cut, float, or perform other costly corrective measures.

Tablet-friendly: Trips back and forth to the trailer to analyze F-Numbers can be reduced or eliminated. Finishing foremen and superintendents can use handheld tablets right at the jobsite to quickly observe results and rapidly direct next steps.

F-Number Familiarity. Software presents laser scanned results in conventional ASTM E1155 values, speeding on-site interpretation and understanding.

One big reason: A new generation of easy-to-use software that vastly simplifies laser-scanned FF/FL measurement and analysis.

Laser scanning has demonstrated time after time it 'delivers the goods' at F-Number levels that meet or exceed traditional floor profile analysis

FARO with Rithm Inspector

Leading the software breakthrough is Rithm. Their Rithm Inspector software application offers GCs, concrete contractors, and inspection companies the ability to:

- Perform FF/FL according to ASTM E1155, simulating a device that measures elevations at every one-foot interval
- Create reports and generate overall FF/FL based on multiple test runs (Repeatabilit)
- Automate routines for inspecting stair riser heights to check compliance with International Building Codes (IBC)
- Automate routines for inspecting ramp slopes and cross slopes for compliance with the Americans with Disabilities Act (ADA) requirements

Lorenzo says Rithm Inspector is designed to be easy-to-use, very field-and-tablet-friendly. "There isn't a lot of background knowledge you need to use it for wet concrete scanning," observes Lorenzo. Rithm Inspector is built on top of robust, highly versatile SCENE Software from FARO Technologies. The SCENE platform is a comprehensive 3D point cloud processing and managing software platform specially designed to view, administer, and work with 3D scanned data from the FARO Focus3D X and S series Laser Scanners. The FARO Focus3D Laser Scanners offer operators industry-leading portability, capability, and battery life.

"Superintendents and project engineers without highly technical backgrounds in building information modeling (BIM) can quickly become productive with the Inspector App being relatively simple," Lorenzo says.

User experience verifies that. "People hear 'laser scanning' and they think that it's a big, complicated thing. Collecting data isn't complicated," DeStefano observes, an Inspector user.

Laser scanning supported by next-gen applications

Proven laser scanning technology supported by next-gen software applications is helping empower GCs, concrete construction contractors, and floor inspectors with unprecedented real-time build environment insight and analysis.

As user experience shows, the new insight will help compress workflow with minimal floor inspection disruptions and costly remedial action after issues are discovered "too late." Also, the risks associated with litigation for not meeting FF/FL standards will gradually dissolve, as pour outcomes are promptly verified with repeatable certainty and irrefutable confidence.

Courtesy: FARO Technologies

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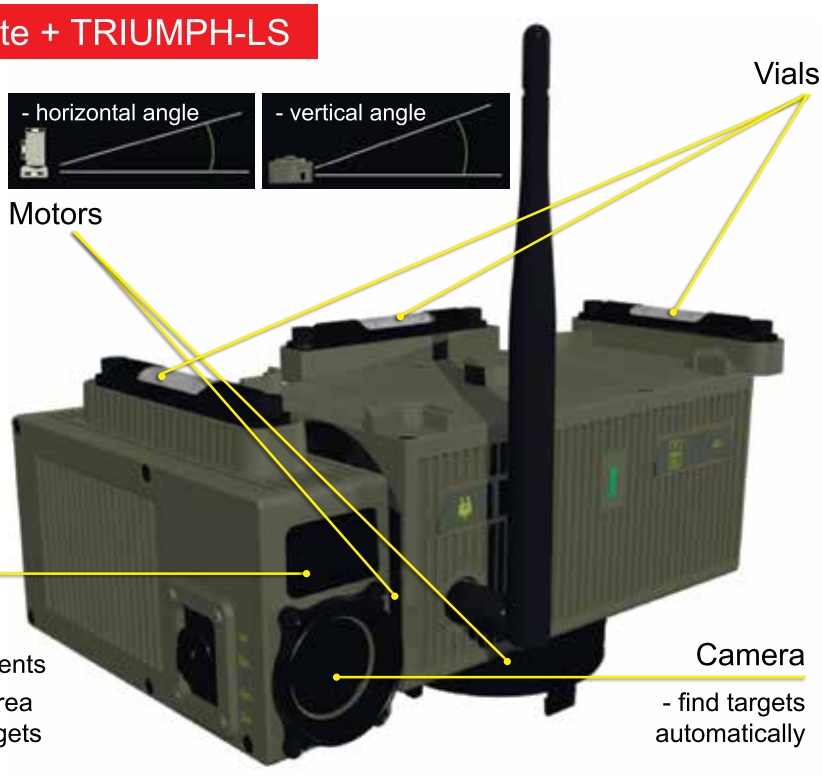

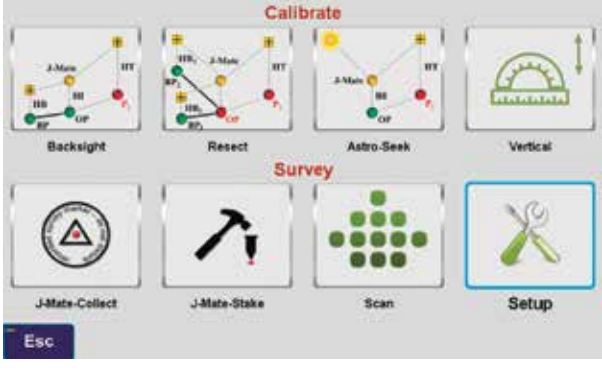

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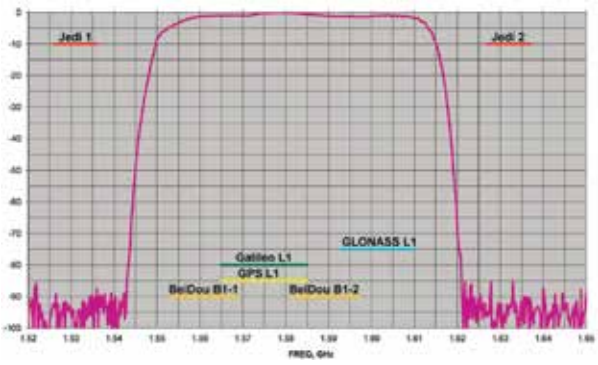
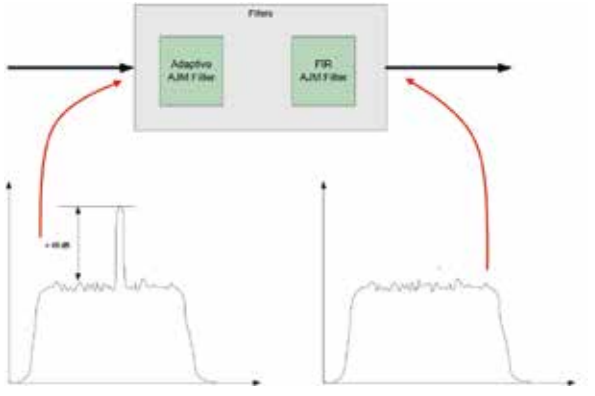
and Near Band Interference

J-Shield is a robust filter in our antennas that blocks out-of-band interference. In particular signals that are near the GNSS bands like the LightSquared signals. The graph on the right shows the protection characteristics of our J-Shield filters. It has a sharp 10dB/KHz skirt which provides up to 100 dB of protection. It makes the precious near band spectrums available for other usages and protects GNSS bands now and in the future.



FIR (Digital Filter)
and In-Band Interference

Our In-Band protection digital filter protects against in-band interference like harmonics of TV and radio stations when you get close to them, or against illegitimate in-band transmissions. Our in-band interference protection is based on the 16 adaptive 80th-order filters. AJM-filters can be combined in pairs for complex signal processing. This filter can simultaneously suppress several interference signals.

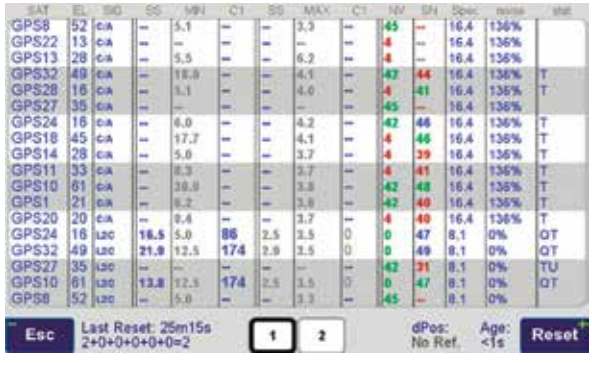


The 16 FIR AJM-filters can be combined in any number in chain. Each filter is a 255 order FIR-filter. It can be used to suppress the stationary interference signal in programmable (in compare with adaptive AJM-filter) area or for spectrum shaping. To have more suppressing areas or more aggressive suppressing one can combine FIR_AJM serial.

In-Band noise
Measurement

This figure-of-merit number shows the level of interference as percentage of noise above the normal condition. The first row of the first screenshot shows the condition in a clean environment. 8 GPS satellites were visible (according to the almanac). 8 C/A, 6 P1, 6 P2, 6 L2c and 2 L5 GPS signals were tracked. The noise level is 2% on C/A and L5, and 0% on P1,P2,and L2C. The screenshot below that, shows 290% noise in GPS C/A and %121 on Galileo E1. Only one of 8 GPS C/A code and none of 5 Galileo E1 signals were tracked.

This typical screenshot shows details of each signal. In the last column (T) indicates the signal was tracked by the main channels, (Q) by the Fast Acquisition Channels and (U) signal was used in position calculations. The SN color coded column shows the signal-to-noise ratio of tracked signals. Blue is perfect, green is 3 dB down, and red is 6 or more dB down. Percentage numbers show the percentage of interference above the normal level. We explain other columns later.

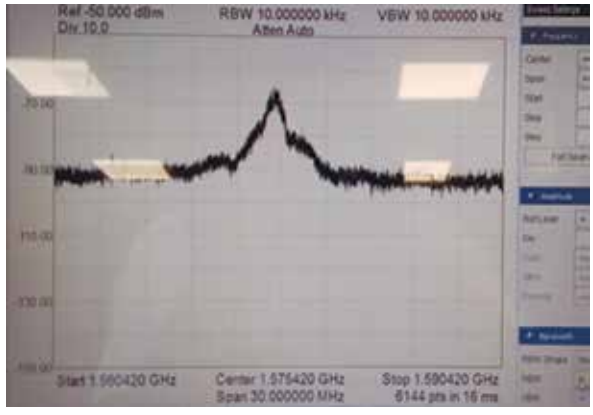


No jammer can escape our figure-of-merit test.

Spectrum Shape

We have a very powerful spectrum analyzer within our GNSS TRIUMPH chip. Each spectrum shows the power and the shape of the interfering signals and jammers. This is more powerful and more efficient than having a $30,000 commercial spectrum analyzer to evaluate the environment. The screenshot on the right shows the shape of the GPS L1 band spectrum when the band is not jammed. The GPS C/A code peak at the 2-MHz center of the L1 band is visible.
The height of the spectrum is 11.2 dB.

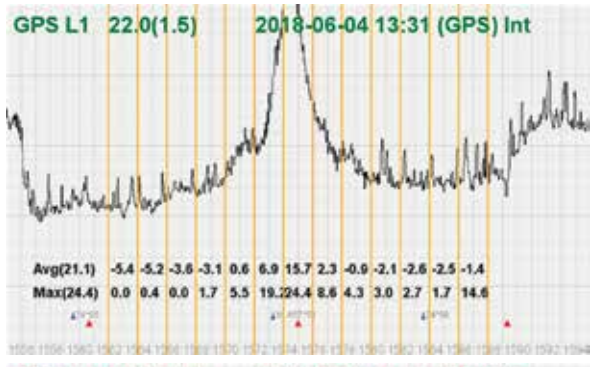
This is an example of GPS L1 spectrum with a commercial $30,000 spectrum analyzer.



Our integrated spectrum analyzer has the advantage that it monitors the spectrum inside the chip where it matters. It has effective bandwidth of 1 KHz.

Our embedded spectrum analyzer also has the advantage that it can be programmed to automatically record the spectrum (and other information) periodically or according to the set conditions, and monitor the environment continuously.

This is the spectrum example of a GPS L1 band when it is jammed. There is a huge peak in the center where the C/A code is. The number on the bottom left is the height of the peak.



The height of the spectrum is 21.1 dB, which compared to the calm 11.2 dB, indicates about 10dB of jammer.

Although we label the bands as three GPS and 3 GLONASS bands, but they represent all bands of all GNSS signals, because bands are shared by all GNSS signals.

AGC
Automatic Gain Control

In addition to the spectrum, we also keep record of Automatic Gain Control which is another indicator of external signals.

The AGC monitors the environment and adjusts the gain to keep the voltage at a certain level. The change in AGC is an indicator of interference existence.

The narrow orange line in the middle of the band in this screenshot shows a quiet AGC.

AGC in this screenshot shows there are activities in this band which our AGC was able to defend against it.

We believe it could be harmonics of GSM cellular phone near our site.

Our AGC mitigates the effect of such interference completely.

Spoofers & 2 Peaks

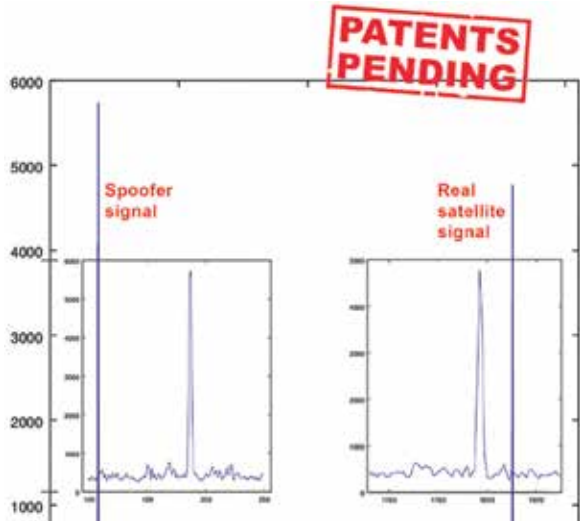
Spoofers are quite different from jammers. They don't disturb the environment and the spectrum shape. They broadcast a GNSS-like signal to fool the GNSS receivers to calculate wrong positions.

In the top screenshot 10 GPS satellites were visible (according to the Almanac). 6 of the 9 GPS satellites that we tracked were spoofed, as indicated by the red number, while the noise level was 0% in the GPS C/A band.

In the second screenshot, 5 of the 6 GPS C/A signals were spoofed while the noise in the band was only 2%.

We detect spoofers by digital signal processing. With 864 channels and about 130,000 Quick Acquisition Channels in our TRIUMPH chip, we have resources to assign more than one channel to each satellite to find ALL signals that are transmitted with that GNSS PRN code.

If we detect more than one reasonable and consistent correlation peak for any PRN code, we know that we are being spoofed and can identify the spoofer signals. Figure on the right is an example of two peaks. We isolate and ignore the wrong peak.



The screenshot on the right shows details of each signal. The first six lines in this screenshot show the spoofed signals that we detected as soon as they appeared (numbers "1" in those line). The two section columns represents the characteristics of each peak. Second SS column show if the second peak is a consistent signal.

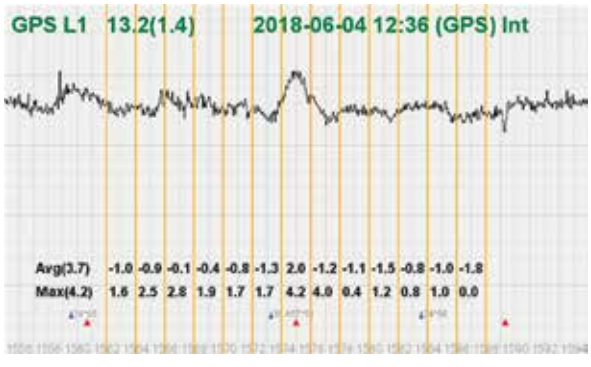
While six satellites were spoofed, there was no indication on the noise level (0%) and no indication on the spectrum shape and level as shown on the screenshot on the right below the chart.

If the spoofer strategy is to cover the real satellite signal and then put the fake signal on top of it to produce only one peak, we notice that by more that 200% of noise level that it has to introduce.

We reject infected signals and then among all the available GPS, GLONASS, Galileo, BeiDou, IRNSS and QZSS multiple signals we use the healthy ones.

Usually there are over 100 signals available at any given time, and we need only four good signals to compute position. In rare cases that all signals are affected, we inform the user and guide them to use compass and altimeter to get out of the Jammed area.

There is absolutely no way that we can be spoofed without our knowledge. We will immediately recognize and take corrective action.

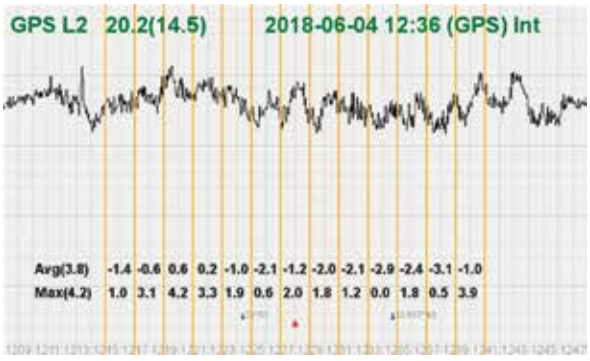


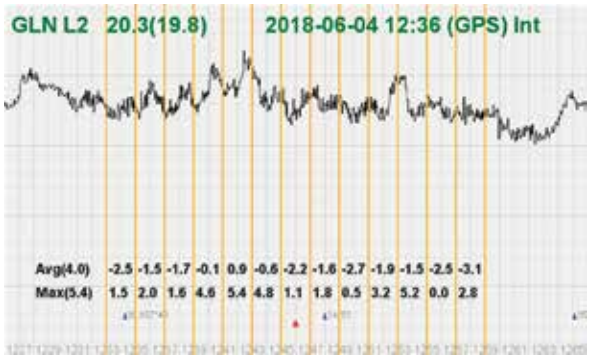
Jamming and Spoofing protection option is available in all of our products and OEM Boards.

And Examples of when the world is peaceful.

Jamming and Spoofing protection option is available in all of our products and OEM Boards.

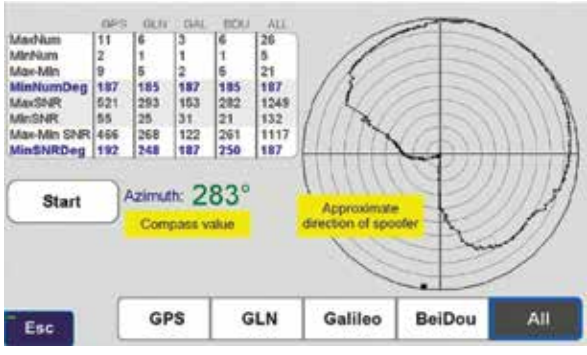
All screenshots are from our TRIUMPH-LS Receiver.





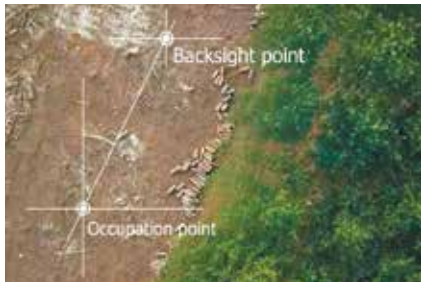
When you detect that spoofers exist, you can also try to find the direction that the spoofing signals are coming from. For this, hold your receiver antenna (e.g. TRIUMPH-LS) horizontally and rotate it slowly (one rotation about 30 seconds) as shown in the picture and find the direction that the satellite energies become minimum. This is the orientation that the spoofer is behind the null point of the antenna reception pattern.

After one or more full rotations observe the resulting graph that shows approximate orientation of the spoofer as shown in figure below.



Backsight icon

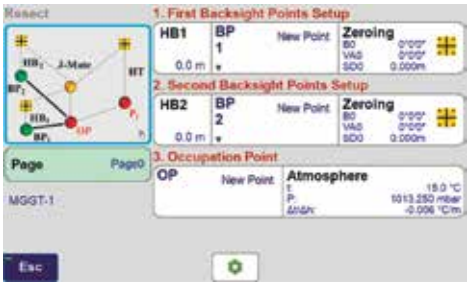
If GNSS signals are available at the job site, click the J-Mate Backsight icon.

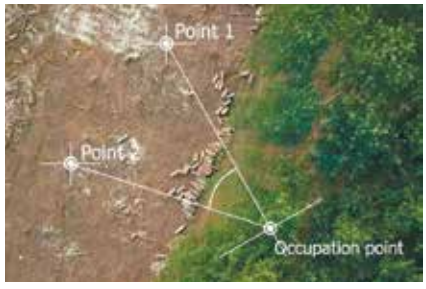


This screen appears which guides you to determine the accurate positions of the Occupation Point and the Backsight Point, to establish an azimuth and calibrate the J-Mate angular encoders.

Resect icon

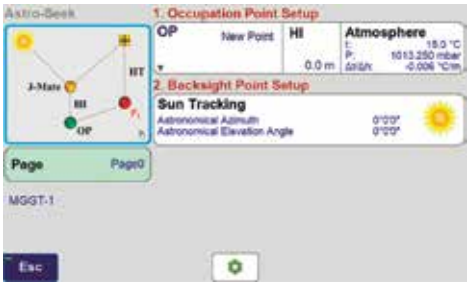
If GNSS signals are not available at the Occupation Point, click the “J-Mate-Resect” icon





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

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.

J-Mate-Collect

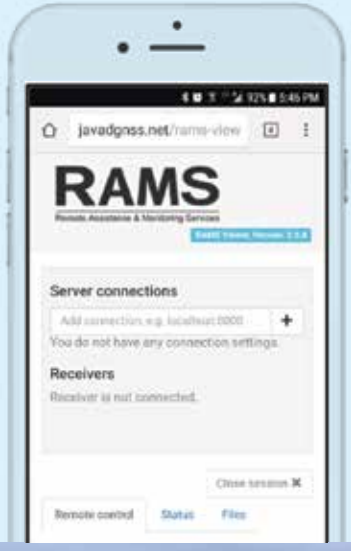
After calibration is performed, click the J-Mate-Collect icon to shoot the unknown points.

J-Mate-Stake

Click the J-Mate-Stake icon to use 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.

Remote Assistance & Monitoring Services (RAMS)



Every function of J-Field that is available to the operator of the Triumph-LS that's in the field, is available to the remote viewer!

Push and Pull Files Wirelessly

From the office to the field in case a file was forgotten.

Live support by the PLS

Support Team directly to Javad customers in the field, structural monitoring, training and other educational opportunities presented to large audiences in real time.

Rich is a surveyor in Massachusetts who is demoing a Triumph-LS with the MaCORS RTN network (no base).

Here are his comments:

Had our first real world experience today, and we are blown away! I should've taken pictures, and I'm sure you've heard it all before, but WOW! We were looking for a pin on an existing job that we'd already done most of the work for, and which was tied in to MaCORS. Plugged in the coords while in the field, and were directed by the LS to proceed west through a "wall of green" 50' high! 15' in to said wall of green was the pin in question. We were now completely canopied in, no big holes, mostly just green, very little sunlight getting in. Set the LS up over the pin and start the waiting game: a click here and a click there, when suddenly, rapid fire clicks and we're under a tenth from our first shot (Precise Topo mode), all in less than 20 minutes. We did this 3 more times on this mile long, 150 acre site, and it was amazing!

We're sold! We started this job today as a test, comparing the iG8 to the LS. The test lasted about 10 minutes, the amount of time it took the iG8 to get its first fix, when the LS was already fixed and collecting data for 5 minutes. No comparison at all.

Rich

AUTODESK

InfraWorks

Civil infrastructure gets effectively planned and designed in the context of the real-world with Autodesk InfraWorks software. InfraWorks enables users to take advantage of large amounts of existing data such as GIS information and aerial photography to quickly create a model of a project's existing environment. Roads, bridges, and other design features can be added to this base model, building more detailed design elements into the InfraWorks model.

The intelligent InfraWorks model enables users to quickly evaluate design alternatives, simulate and analyze scenarios, and deliver compelling visualizations—improving decision making, empowering team collaboration, and accelerating project stakeholder buy-in. Design models can also be moved downstream to AutoCAD Civil 3D for detailed design and construction documentation with minimal loss of critical information.

And now the new Autodesk Connector for ArcGIS makes the InfraWorks model even more robust and accurate. This tool connects InfraWorks to GIS data from Esri's ArcGIS Online or ArcGIS Enterprise. BIM workflows are improved by linking directly to GIS data instead of importing static data (with no ability to refresh if the GIS data is updated).

KEY FEATURES

- Enables users to take advantage of large amounts of existing data.
- Provides more detailed design element.
- Can be directly linked to GIS data.

AIRBUS DEFENCE AND SPACE

AirSense

Airbus Defence and Space has launched AirSense, an advanced analytics solution enabled by multi-source surveillance data, based on global Automatic Dependent Surveillance-Broadcast (ADS-B) data. AirSense is based on data feeds of various aircraft positions.

A strategic partnership between Airbus and Aireon, (the provider of global, space-based ADS-B data) is enabling AirSense to accurately track any aircraft in real-time and identify flight-related events around the globe.

With the upcoming International Civil Aviation Organization (ICAO) requirements and growing volumes of air traffic, aviation stakeholders increasingly require real-time situational awareness on a global scale – supporting effective decision-making.

AirSense now combines Aireon's global, space-based ADS-B data with unique Airbus assets and domain expertise to offer advanced analytics leading to further enhance the aircraft situational awareness, optimize flight routes, increase airport capacity, optimize airspace utilization and improve the overall travel experience.

The collaboration also paves the way to further develop applications for improved industry operations delivered through the various Airbus service offerings.

KEY FEATURES

- Enables development of aggregated, live and predictive analytics.
- Based on data feeds of various aircraft positions.
- Enhances aircraft situational awareness, optimizes flight routes and increases airport capacity.

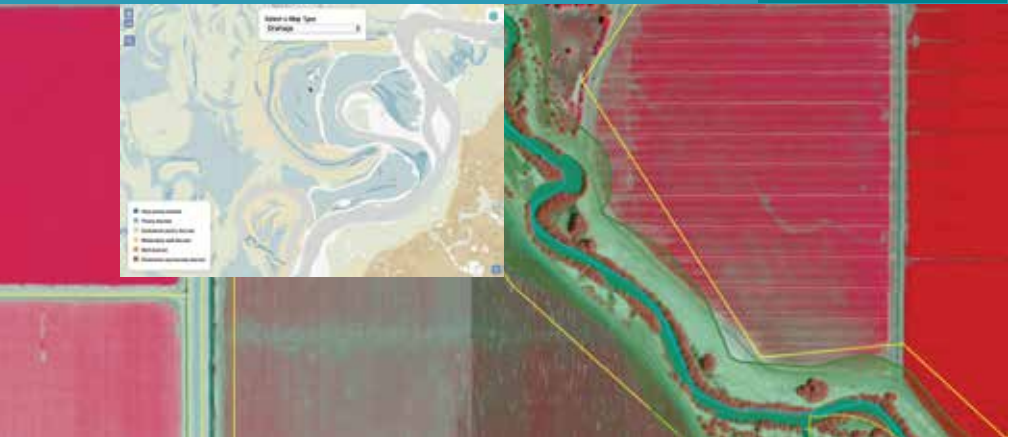
BOUNDLESS

Boundless Server Enterprise

Boundless Server Enterprise is the first cloud-native geospatial server designed to maximize the value of geospatial data in elastic and cloud environments. It enables the organization's GIS deployment to scale quickly and efficiently to respond to changing demand, without complex licensing limitations or restrictive named user logs. It helps in extending access across the organization, to anyone who needs it. By matching resource curve to load curve, it aids the organization to move closer to perfect efficiency, and get the lowest operational cost to meet its specific business needs. There's simply no faster way to get an organization's GIS in the cloud.

KEY FEATURES

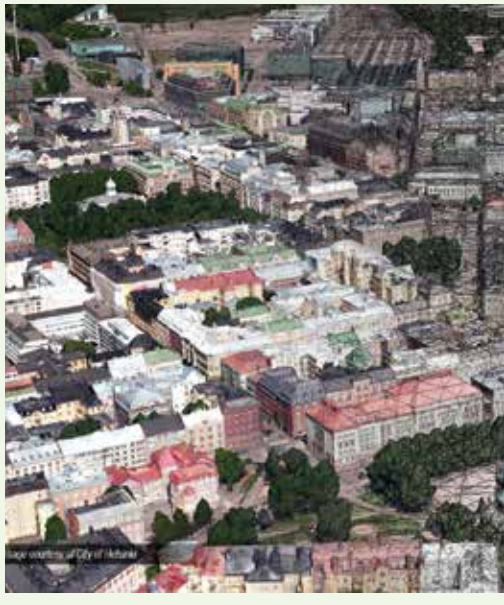
- First cloud-native geospatial server.
- Helps in extending access across the organization.
- Brings in perfect efficiency by matching resource curve to load curve.



BENTLEY SYSTEMS

ContextCapture

ContextCapture is Bentley's reality modeling software that can quickly produce 3D models of existing conditions for infrastructure projects of all types, derived from simple photographs



CYIENT

Road Health Analytics solution

By leveraging over 25 years of geospatial experience, Cyient has developed an integrated Cloud-based mobile solution that enables real-time road condition mapping and analytics.

Cyient's Road Health Analytics solution provides a predictive and innovative mechanism for local governments, municipalities, smart city councils, or private companies to improve their decision-making capability and their bottom line. It provides actionable data and insights for road repairs, infrastructure upgrades and monitoring, powered by machine learning algorithms. By fostering a shift from reactive to predictive road repair, it helps in optimizing and prioritizing workload. It also facilitates measurement of repair work quality by contractors, thus leading to timely improvements.

Provided "as-a-service", the solution improves drivability and safety of roads, reduces traffic congestion and pollution hotspots, thus improves the experience of citizens and businesses. It enforces performance guarantees, and consequently, contributes to robust cost savings on annual road repair and maintenance by optimizing costs and improving quality.

KEY FEATURES

- Reduces annual road repair costs by up to 20%.
- Optimizes workload through predictive road repair.
- Increases productivity by improving time-to-destination.

and/or point cloud. Without the need for expensive or specialized equipment, it enables users to quickly create and use these highly detailed 3D engineering-ready reality meshes to provide precise real-world context for design, construction, and operations decisions throughout the lifecycle of projects. Project teams can easily and consistently share reality modeling information, consumable and accessible, on desktop and mobile devices, in many formats, including native use within MicroStation for use in any engineering, operations, maintenance, or GIS workflow. ContextCapture offers the full reality modeling workflow from acquisition through to consumption.

KEY FEATURES

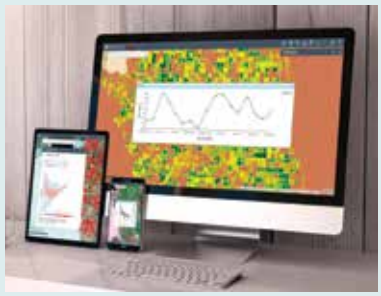
- ContextCapture is available as an on-premises and Cloud-processing service solution.
- High-performance Cloud service enables faster processing and reconstruction of 3D models using parallel processing with multiple engines.
- Scalable mesh technology allows multi-resolution inputs with 3MX, 3SM, and Cesium 3D Tiles formats.
- Thermal imagery support enables the detection of leaks or abnormalities of critical assets.

DEIMOS IMAGING

Kanvas Origin

Kanvas Origin, Deimos's imagery service powered by ESRI technology, is an easy-to-integrate and ready-to-use solution. It ienables all users to access timely, reliable and quality-assured imagery, directly into their apps and ArcGIS desktops. Hosted in Amazon Web Services using ArcGIS technology, users can utilize the multi-temporal imagery service and start building valuable apps for monitoring, change detection and more.

You just need to define your Area of Interest (your application (or resolution) and your frequency needs to trigger the imagery service and get actionable information for dependable decision making. Deimos virtual constellation formed by over 40 multi-resolution sensors increases significantly revisit capabilities and allows covering any area in the world.



KEY FEATURES

- Users can access timely, reliable and quality-assured imagery, directly into their apps and ArcGIS desktops.
- Users can utilize the multi-temporal imagery service and start building valuable apps for monitoring, change detection and more.

DESCARTES LABS

Descartes Labs platform

The Descartes Labs platform extracts data and imagery from its Cloud-based data refinery, cleans up the data, and preps it for analysis. The platform was built to equip decision-makers with the actionable insights that are required to drive business growth and make broader impacts across industries.

As part of the Descartes Labs' platform, there is 'Viewer', which is a tool that allows users to navigate their own imagery datasets, as well as sets from the extensive Descartes Labs data refinery — including a new weather dataset and Airbus's global OneAtlas Basemap.

Through Viewer, users can interact with imagery and datasets on a Web-based map by moving through time-lapsed imagery, selecting different spectral bands, and categorizing reference data. The Descartes Labs platform runs on Google Cloud Platform, which allows users to deploy thousands of CPUs and process quadrillions of pixels. Viewer also lets users load datasets into discrete layers, easily manipulate vector data and tailor the data to their specific requirements for analysis.

The technology speeds up the standard time it takes to process images by automatically correcting for clouds and other barriers, which allows the platform to massive, real-time analysis at scale. The Descartes Labs platform allows decision-makers to solve problems, get answers, and make smarter business decisions, efficiently and accurately.

KEY FEATURES

- Extracts data from cloud-based data refinery, cleans and preps it for analysis.
- Runs on Google Cloud Platform allowing users to process quadrillions of pixels.
- Allows massive, real-time analysis at scale.

DIGITALGLOBE

EarthWatch

DigitalGlobe's EarthWatch is the most comprehensive way to interact with the world's best geospatial content and apply analytics to derive meaningful geospatial information. For the first time, customers have access to all of DigitalGlobe's premium imagery through a single usage-based subscription.

DigitalGlobe adds about three million sq km of new imagery every day. EarthWatch provides the highest resolution, most accurate and current satellite imagery and derivatives, with no restrictions on geography or area of interest. Users can stream or download DigitalGlobe's industry-leading native 30 cm resolution imagery, access highly aesthetic image mosaics, and assess change over time with 18-year imagery library. EarthWatch is a key component for geospatial workflows and essential for mapping, monitoring, detecting change and responding to activities on the ground.

KEY FEATURES

- **Premium Content:** Stream or download the highest resolution satellite imagery and derivative content.
- **No geographical restrictions:** EarthWatch can be accessed anywhere on the globe, anytime, with no user restrictions, so organizations have a common operating picture.
- **Usage-based subscription:** Organizations need to pay only for the amount of imagery streamed and downloaded.

EAGLEVIEW

Reveal Imagery

Ultra-high-resolution Reveal imagery is the latest innovation from EagleView, offering the finest, sharpest, and highest resolution available to uncover incredible property details within each image. Reveal imagery changes the way private-sector businesses and government organizations view the world.

Reveal imagery includes oblique and orthogonal images that display an unprecedented level of detail, enabling the identification of property features not visible from other imagery sources. In addition, Reveal imagery delivers the clarity necessary to assess grade and condition of residential and commercial properties, infrastructure, and ground elements right from the desk. This ultra-high-resolution imagery delivers critical accuracy of structural dimensions and clarity so fine that property features and condition can be identified quickly and easily.

Captured with precise, custom-designed, next-generation camera systems, the patented technologies behind Reveal imagery enable efficient acquisition with faster delivery times. With its wide-area view, Reveal imagery enables users to pan through images and zoom in or out without a change in perspective. EagleView's library of high-resolution aerial images will provide more detail and answers than ever before with the addition of Reveal imagery.

KEY FEATURES

- Includes oblique and orthogonal images, displaying high level of detail.
- Ultra-high-resolution imagery delivers critical accuracy of structural dimensions.
- Precise, high-end technology enables efficient acquisition with faster delivery times.

EOS

EOS Platform

EOS Platform is a Cloud-based GIS that provides users with both geospatial data and tools for its management, analysis and processing. It comprises four mutually integrated products, designed as a single workspace, where one can find, store, analyze and process satellite images.

It provides:

- Access to a wide range of satellite data
- Remote sensing data analysis
- Image processing in browser

KEY FEATURES

- The intuitive EOS LandViewer web interface provides easy access to multiple global satellite imagery collections.
- Satellite sensor data carries valuable information about vegetation, land, air, water bodies, glaciers, volcanoes, etc.
- EOS Processing offers over 20 algorithms for imagery pre-processing and advanced analysis.

ESRI

ArcGIS Hub

ArcGIS Hub is a bridge between the government departments and the community it serves. It makes a smart community even smarter, giving context and purpose to data. It organizes people, processes, and technology to meet the needs of citizens and governments.

With data-driven citizenship as a top priority, ArcGIS Hub engages governments and communities around policy initiatives to tackle pressing issues. It extends the organization's enterprise GIS and brings data-driven policy to life. The framework combines data, visualization, analytics, and collaboration technology. It helps in unlocking the potential of open data.

Ready-to-use initiative includes content and apps designed to inform and engage the community on the chosen issue. Each initiative comes with maps designed to help the community members understand data related to current policy issues. It provides attractive default layouts that automatically inherit the look and feel of the organization's brand, thus saving time and money. Users can also create their own custom initiative with the initiative builder tool.

With ArcGIS Hub, users can keep a 24/7 eye on their initiatives to identify successes and share results using story maps, dashboards, and infographic reports.

KEY FEATURES

- Engages governments and communities around policy initiatives.
- Makes open data work for organizations.
- Allows organizations to keep a 24/7 eye on their initiatives.

FARO

FARO SCENE 2018

The FARO SCENE 2018 is a tightly integrated software platform specifically designed for the FARO Focus Laser Scanner product family. This new offering represents a substantial leap forward for 3D reality data capture and the FARO-driven concept known as Traceable Construction, which optimizes the entire AEC construction lifecycle.

An all new feature in SCENE 2018 is the Laser-HDR, which improves on conventional multi-exposure HDR techniques by intelligently combining a laser scan image and a photograph through a proprietary FARO process. This results in a laser enhanced HDR image is breathtaking color and detail, in even the most challenging environments. This advanced feature is fully compatible with all generations of FARO Focus Laser Scanner products.

With SCENE 2018, FARO FocusS 150 and FocusS 350 Laser Scanners now offer additional time savings on-site, performing at least 1.5 times faster than when it was required to perform high-resolution scans continuously. Selected areas can also now be rescanned at a higher resolution for more accurate target detection. Furthermore, since the registration workflow is now fully automated, in-field and in-office productivity is improved substantially.

KEY FEATURES

- Laser-HDR improves on conventional multi-exposure HDR techniques.
- Fully compatible with all generations of FARO Focus Laser Scanner products.
- Can begin to evaluate and process data immediately, create 3D visualizations, or export to various point cloud and CAD formats.

GEOSPOCK

LIaaS Product Showcase

GeoSpock's LIaaS Product Showcase is intended to give clients the opportunity to experience analytics in action and demonstrates a variety of real-world scenarios, enabling companies to try real-time data evaluation and application for themselves. Businesses can therefore harness these insights to make smarter decisions across multiple disciplines – including advertising spend, supply chain efficiency, and point-of-sale utilization.

KEY FEATURES

- **Audience profiling around supermarket store locations:** targeting relevant product offers in a cost-effective way.
- **New York taxi passenger drop-off and pick-ups:** discovering the powerful combination of geospatial and temporal data.
- **Analysis of flights arriving and departing from airports:** understanding the smart city implications of population move.

GROUNDTRUTH

Blueprints

Blueprints is the proprietary mapping technology GroundTruth uses to define a physical place and is the only mapping platform built for the specific purpose of location-based marketing. The company launched Blueprints in 2015 and since then has been expanding and improving the technology and points of interest mapped. Today, more than five million business and points of interest across 21 countries are Blueprinted. While a majority of GroundTruth's Blueprints are auto-generated, all of the Blueprints are then evaluated, enhanced, or improved through their global team of Blueprinters.

This technology differs from other location technology because of its levels of precision. Areas are Blueprinted in three different layers, so you can tell whether someone is actually in a store, in the parking lot, or in the general retail block area – making it perfectly built for marketers.

KEY FEATURES

- Only mapping platform built for location-based marketing.
- Areas are blueprinted in three different layers.
- Offers high-level of precision.

GEOSPOC

GEOQI

Geospoc's flagship product, GEOQI is a geospatial big data visualization engine, with the ability to connect with multiple types of datasets. With a linkage to a big data 'lake' architecture, this tool is capable of handling extremely large geospatial datasets.

The tools included in the platform include AI based image processing tools to enable fast feature extraction, a spatial query system to

perform fast spatial searches, and an intuitive reporting system to derive intelligence at the click of a button.

It also includes specialized tools and data for certain regions to enable easier entry into geospatial tools for new users:

Geocoding in India – In India, addresses are unstructured and have very little hierarchy, making geocoding a very difficult task. The tool provided in this platform allows users to geocode unstructured Indian addresses

Data – Geospatial analysis depends on good quality spatial data. An extensive list of data is also available through this platform

With close integration with Esri tools, this also allows enterprises to take advantage of their investment in Esri technology.

Current users of the system come from a variety of industries, including Banking, Insurance, Retail, FMCG and Agriculture.

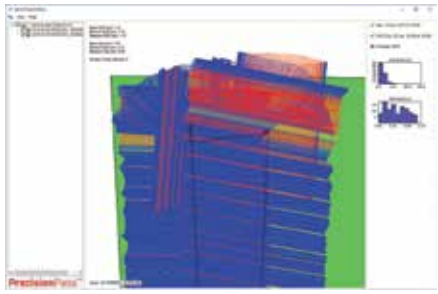
KEY FEATURES

- Able to manage extremely large geospatial datasets.
- Includes AI-based image processing tools.
- Provides specialized tools and data for certain regions.

HARRIS GEOSPATIAL SOLUTION

PrecisionPass

Harris Corporation, developers of the leading image analysis software, ENVI®, has created PrecisionPass to assess UAV data collects in the field. This toolkit lets pilots quickly determine if a data collection meets the required criteria or if it needs to be collected again. This immediate feedback reduces the risk of failures during the analysis stage, all but eliminating the need to re-fly a mission, so customer needs are met in a timely and cost-efficient manner.



KEY FEATURES

- **Review required metadata:** Perform a metadata review to ensure all required metadata are present and are within the specified criteria for the capture.
- **Evaluate coverage:** Review the spacing along and between flight lines to ensure that there is proper overlap and sidelap for stitching and analysis purposes.
- **Assess image resolution:** Determine the minimum, maximum, and average ground sample distance (GSD) for each pixel, which ensures that the spatial resolution required for analysis will be met.

HERE TECHNOLOGIES

HERE OTA Connect

HERE Technologies is offering automakers a valuable over-the-air (OTA) solution that reduces costs and opens new revenue streams. HERE OTA Connect is a highly secure, open OTA software management solution, designed specifically for the automotive industry to transfer data, software and firmware in a cost effective and scalable manner. HERE OTA Connect optimizes map updates through secure, incremental data transfers. This reduces costs and downtime for the vehicle. It provides flexibility that is critical in leveraging the full potential of connected and autonomous vehicles. This technology enables software-based vehicle updates and upgrades that can reduce costly recalls, introduce new on-demand functionality for user satisfaction and pave the way for new revenue opportunities inside of the vehicle.

KEY FEATURES

- **Highly secure:** To defend against threats, HERE OTA Connect utilizes Uptane, one of the first comprehensive automotive security frameworks available.
- **Openly flexible:** Modular, expandable and built on open standards and open source to ensure businesses have unlimited freedom to integrate and migrate data as they see fit.

HI-TARGET

INTERGEO 2018, the world's largest trade fair in the field of geodesy, spatial data and land management, is coming!

As always, Hi-Target International Group Limited will present at INTERGEO 2018 with excellent products and cutting-edge technology. Hi-Target will share application cases on "INTERAERIAL SOLUTIONS" and the full range of solutions will be on display, such as Survey & Mapping, GIS, Lidar and Laser Scanning, Unmanned Ariel Vehicle and Solutions, Hydrographic and Oceanology.

City: Frankfurt, Germany
Date: 16-18 Oct. 2018
Booth No.: 12.1C.086

Spotlight

Various live demos of the latest and cutting-edge products and technologies will be shared and experts from Hi-Target team will provide you with solutions.

Live demo Guidelines

Tuesday, 16th Oct. 2018
1. SATLAB UAV mapping solutions
2. Supergeo Mobile GIS solution 1
3. Hi-Target UAV mapping solution
4. Archikart GIS solution introduction

Wednesday, 17th Oct. 2018
1. SATLAB mobile mapping solution
2. Hi-Target swift hydrographic survey solution
3. Supergeo Mobile GIS solution 2
4. SATLAB multi-purpose GNSS receiver

Details of live demos at INTERGEO will be updated on Hi-Target Facebook and twitter, please follow us to learn more!

Join Hi-Target at INTERGEO 2018 – Let's Achieve Mutual Success!

Unraveling the mysteries of WATER WITH USVs

Brooks might contain shallow *shoals or dams from the upper or lower streams. While surveying these, surveyors are likely to face safety, accuracy and efficiency issues. With that in mind, Hi-Target has come up with several innovative solutions for hydrographic surveying.*

By Adin Li

In the world there are many unreachable, dangerous or inconvenient places that need to be surveyed such as the tailing ponds, narrow channels, ultra-shallow water ponds and lakes with barriers and so on. How to survey these areas with safety and efficiency is the question that Unmanned surface vehicles (USV) is going to answer.

Traditional marine hydrographic survey

Water is one of the most basic needs for all living creatures, civilizations built their towns around water sources such as rivers, brooks and wells. Our planet Earth is covered with vast amounts of water that we have not yet discovered. This amazing resource is filled with mystery. Due to the rapid development of urbanization, our interaction with water has also increased exponentially. With the need to explore and map out these unchartered territories, new hydrographic surveying solutions have evolved.

These innovative solutions such as multi-beam echo sounder, side sonar, sub-bottom profiler and even LiDar for topographic and hydrographic purposes, greatly contribute to the workflows for public authorities and private sectors all over the world.

In order to increase safety measures during fieldwork to collect data, more flexible solutions are required. However, the picture is not all rosy. There might be encounters on brooks which might contain shallow shoals or dams from the upper or lower streams, in which surveyors may face safety, accuracy and efficiency issues. With that purpose in mind, Hi-Target has innovated and come up with several solutions for hydrographic surveying.

USV iBoat BM1

The iBoat BM1 is an USV that can work for more than 12 hours continuously. It has an auto pilot function that provides precision survey with a gap between each surveying lane, which is implemented (within 10 cm offset). On top of that, the boat can be easily sailed back automatically when the signal is lost or there is insufficient battery to return to its original station that is pre-set. The real-time camera data transmission assists surveyors in monitoring the boat from the bank.

This advanced and autonomous system consists of the vessel body, excellent echo sounding module and positioning module, along with a data communications system and a controlling system.

Heavy traffic channel surveying

Since 1979, Pearl River Delta has been the most important economic engine and industrial area in China due to its availability for raw materials.

More than 30% of Chinese goods are produced or assembled there and exported to the rest of the world. The water network has hundreds of harbors which plays an important role in the export of goods and import of raw materials. There are plans to build more pipelines for electricity, gas and municipal water through some channels.

However, before laying these pipelines, the contractor must survey the channels to collect the latest data of the water bed situation to draft the plans. One of the main Channels that the pipelines are going to cross is called the Modao Gate Channel, which runs 89.5 KM long.

Modao Gate Channel has more than 30 ports, thousands of factories, 45 million cargo volume and 70,000 dockings. More than 800 vessels travel through these waters daily, which can be quite difficult and challenging for surveyors.

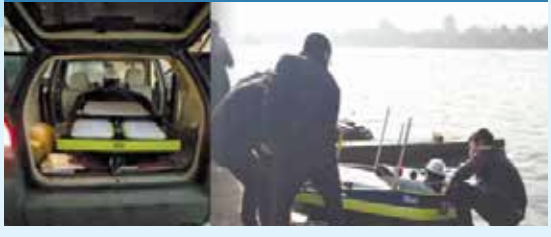
The initial stage encompasses designing the survey lanes using online Google satellite images on the USV pilot software. The interval and length of each cross section lane can be easily implemented. Therefore, the USV is an ideal solution for the surveyors to finish the work on time without risks on safety.

Task goals

- To finish a hydrographic survey within 20 cm accuracy
- 5 channels where the pipelines are going to cross

Challenges

- Cross section survey is easy to disrupt the traffic flow with a possibility of causing accidents takes too long during busy traffic with a possibility of accidents
- Impossible to survey the shallow area
- High cost for periodically channel survey



When the USV is operated, it will sail either automatically or manually, with the capability of switching its work modes in real-time. During the surveying task, the USV avoided the heavy ships easily as soon as the controller sent the interception command into manual mode. Due to its flexibility and swift performance, this lightweight boat provides safety and efficiency for surveyors.

The data is transmitted from the boat to the laptop software where users can easily monitor the position, heading, depth and control the parameter setting for the sounding system from the safe bank area.

Once the surveying job is completed, the data is processed with results showing the contour of the riverbed, trajectory and project background map that can be overlaid together for further use as an important reference.

Adin Li, Product Manager, Hi-Target
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HEXAGON GEOSPATIAL

Hexagon Smart Census

Hexagon Smart Census is a client-server software platform developed primarily for census completion. It combines traditional GIS functionality with a powerful workflow and workforce management tool to provide a total solution for each stage of the census cycle: Pre-enumeration mapping, digital enumeration, and post-enumeration dynamic mapping.

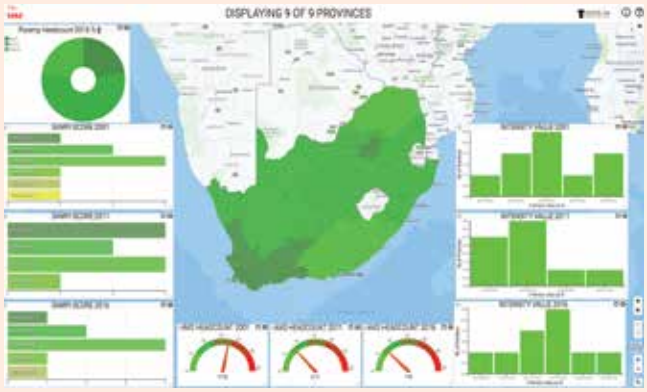
Pre-enumeration mapping module combines imagery base maps and GIS functionality with a powerful workflow and workforce manager to enable the creation or maintenance of census enumeration areas (EAs). EAs are the land areas each enumerator, or census information collector, represents.

The digital enumeration module facilitates the planning and execution of census enumeration. Each enumerator can use a mobile device to conduct interviews, as well as for navigation and progress updates.

The post-enumeration dynamic mapping module enables users to create Hexagon Smart M.Apps to display census data. Census data can be viewed in graphs, charts, and on a map simultaneously, and customers can allow their user community to access the resultant Smart M.Apps online using either desktop or mobile capabilities.

KEY FEATURES

- **Modular system** – can be implemented for one, two, or all three phases of a census.
- **GIS platform agnostic** – integrate with and complement any existing GIS platform.
- Configurable to meet the exact needs/requirements of each unique census project.
- Real-time automated progress reporting.



HEXAGON GEOSYSTEMS

Leica Pegasus: Two Ultimate

The new Leica Pegasus: Two Ultimate is the updated version of the Pegasus: Two, the trusted mobile mapping platform from Leica. It removes the need for six camera stitching by incorporating back to back cameras creating a 24 MP 360-degree image calibrated to the LiDAR profiler, enabling digital reality capture from car, train or boat. To enable faster processing at the office, a removable SSD allows the user to easily access the data. The new Leica Pegasus: Two Ultimate allows seamless 360-degree image calibrated to the point cloud. It is the best solution for smart city digitization. It reduces operation cost and increases RoI.

KEY FEATURES

- **Improves flexibility:** Increases working capacity of the user by allowing capture in a variety of lighting conditions and vehicle speed. It improves image quality and productivity at a faster speed.
- **City digitization:** The backbone of a smart city is the city infrastructure. Thus digitization of the infrastructure is required, which can be easily achieved with the help of Leica Pegasus: Two Ultimate.
- **Error free:** Due to very less human intervention, the chances of errors are negligible.

THE BEST FORM OF DEFENCE IS INTELLIGENCE.

WE MAKE IT FLY

At Airbus, we employ an unrivalled team of intelligence experts to deliver insights from a variety of sources including satellite imagery. By pairing state-of-the-art technology with in-depth analysis, we ensure you are fully equipped to counter credible threats.

Insight. We make it fly.

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AIRBUS

IBM

Cloud Private for Data

IBM's Cloud Private for Data is an integrated data science, engineering and development platform designed to help companies gain insights from data sources such IoT, online commerce, and mobile data.

Cloud Private for Data builds on IBM Cloud Private, a private Cloud platform IBM introduced in November 2017 that brought Kubernetes into the data center. Cloud Private for Data expands on that greatly, adding IBM Streams for data ingestion, IBM Data Science Experience, Information Analyzer, Information Governance Catalogue, Data Stage, Db2, and Db2 Warehouse. All run on the Kubernetes platform, allowing services to be deployed "in minutes," IBM claimed, and to scale up or down automatically as needed.

The solution is meant to provide a data infrastructure layer for AI behind firewalls. In the future, the Cloud Private for Data will run on all Clouds, as well as be available in industry-specific solutions for financial services, healthcare, manufacturing, and others.

KEY FEATURES

- Collect, organize and analyze data to scale insights on demand.
- Power advanced analytics in the cloud with data behind your firewall.
- Identify new sources of revenue and develop new business models.

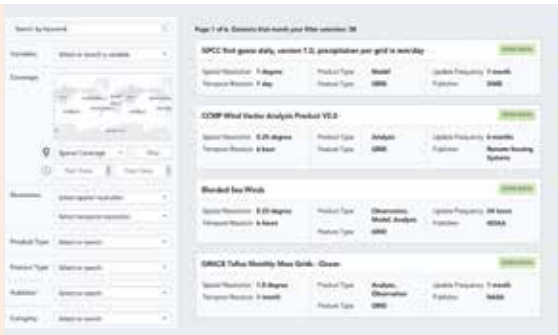
INTERTRUST

Modulus

Intertrust Technologies recently announced Modulus, a secure data rights management platform for Cloud-based datasets that allows the users to virtualize their data across Clouds and customize the framework to their preferred analytics algorithms for analyzing driving behavior, system performance, etc. The unique advantage of Modulus is the capability to easily combine proprietary data with a wide variety of geospatial and environmental data sources. Applications running on Modulus allow securely sharing data within organization, with partners, and even with competitors. Data is persistently protected in a secure container, even when shared over the Internet or an open platform. Modulus supports the most complicated enterprise policy and privacy regimes and is compliant with privacy regulations.

KEY FEATURES

- Data is organized as a virtual database with all the data consistently secured and governed.
- Scalable and elastic compression keeps data storage costs low.



MICROSOFT

Azure DevOps

Microsoft has announced Azure DevOps which will replace Visual Studio Team Services (VSTS, formerly Visual Studio Online) and Azure DevOps Server which will replace Team Foundation Server (TFS).

The rebranding makes sense as VSTS is basically a Cloud service backed by Microsoft Azure and the company notes that its new services will "span the breadth of the development lifecycle to help developers ship software faster and with higher quality".

Both of Microsoft's Azure DevOps services are open, extendable and designed to work with any type of application no matter what framework, platform or Cloud it runs on. Both public and private Cloud configurations are also supported by the new services.

KEY FEATURES

- **Azure Pipelines:** Build, test and deploy with CI/CD that works with any language, platform and Cloud. Connect to GitHub or any other Git provider and deploy continuously.
- **Azure Boards:** Deliver value to your users with proven agile tools to plan, track and discuss work across teams.
- **Azure Repos:** Get unlimited, cloud-hosted private Git repos and collaborate to build better code with pull requests and advanced file management.

MDA

Pipeline system monitoring program

Pipeline systems span thousands of kilometers, often crossing rugged and remote terrain with a wide range of geology, soil, and climate conditions.

Understanding the dynamic forces with a potential to impact a pipeline system's right-of-way have to be considered. Once built, monitoring the integrity of pipeline systems is critical in ensuring effective and safe operations; identifying issues early is key to mitigating risks to the environment. An early warning of changes in risk areas provides information to better target other geotechnical resources to reduce costs and improve performance.

MDA supports these challenges with its pipeline system monitoring program using Synthetic Aperture Radar (SAR) and high resolution optical satellites. Its space-based solutions provides users with a cost-effective method for accurately and routinely monitoring very large areas for initial screening of hazards, to detailed inspection based on this initial screening. SAR is a satellite sensor that is all-weather and light-independent. These unique capabilities enable us to reliably detect land cover/land use change events, as well as measure small amounts of surface movement that can indicate changes in key areas of geotechnical risk. MDA also have access to an extensive catalog of archive SAR data to provide maps of historical change analysis and ground movement.

KEY FEATURES

- Uses Synthetic Aperture Radar (SAR) and high resolution optical satellites.
- Apt for accurately and routinely monitoring very large areas.
- An early warning of changes in risk areas helps in improving performance.

MAPILLARY

Mapillary for Organizations

To support the workflows of GIS professionals, Mapillary recently introduced Mapillary for Organizations. This enables teams to share a workspace and contribute imagery on behalf of the organization. By defining "shapes", teams get an overview of the imagery and data available in their area of interest. There's no charge for using the organization's own imagery. It's also possible to licence Mapillary public imagery and automatically extracted data by getting a subscription for your area. You can then use the freshest imagery in integrations or download the latest data files throughout the whole subscription period — helping you ensure that your geospatial datasets are always up to date.

Mapillary is a platform for extracting geospatial data from street-level imagery. You can easily capture your own street-level imagery using the tools that suit your needs,

from smartphones to high-end camera rigs. You can host the imagery publicly on the platform for free and access it on the Mapillary platform or through integrations such as Mapillary for ArcGIS.

KEY FEATURES

- Enables teams to share a workspace and contribute imagery on behalf of the organization.
- By defining shapes, teams get an overview of the imagery and data available in their area of interest.

MAPBOX

Mapbox Vision SDK

Mapbox's Vision SDK to transform connected cameras into a second set of eyes for your car. With live imagery processed directly on your device, it brings visual context to Mapbox's live location platform and rethinking how machines and humans alike interact with the road.

For users, the Vision SDK unlocks augmented reality navigation, detection and segmentation of various road features, customizable safety alerts, and more. On the backend, the SDK feeds valuable road metadata back into the living map. Highly efficient neural networks run solely on the device, so network bandwidth needs are low.

Vision SDK identifies salient road features (such as signs, traffic lights, and lane information) and processes the data directly on-device. Changes to the driving environment are detected on the spot and uploaded to make low-latency, low-bandwidth updates to the living map.

Vision SDK is not just for mobile apps – it unleashes new functionality for embedded automotive systems as well.

KEY FEATURES

- Takes advantage of ARM's Project Trillium AI technology to provide recognition of vehicles, pedestrians, signs and crosswalks out of the box.
- Runs neural networks directly on mobile devices, which allows for recognition to occur in real time.

MATRIX GEO SOLUTIONS INDIA AND TOPODRONE RUSSIA

Revolutionary Aerial survey solution with DJI Phantom + PPK Kit

Topodrone Russia and Matrix Geo Solutions India are delighted to introduce a revolutionary product" Professional Aerial survey solution based on DJI Drone + Topodrone RTK/PPK upgrade Kit. The PPK drone delivers reliable ground accuracy that may be considered as a true alternative to ground control points.

It is a ready to fly and easy to use DJI drone with additionally installed GNSS receiver connected with modified and calibrated camera, everything you need to get high accuracy photogrammetry data up to 3cm accuracy in XYZ. Built in survey grade GPS/QZSS, GLONASS, BeiDou, Galileo, SBAS, with possibility to work in RTK and PPK mode turns your drone to a professional survey tool.

The result of composite study done by Institute of Photogrammetry & Geo-Informatics (IPGI), Matrix Geo Solutions along with Topodrone Russia concludes, that the upgraded DJI PHANTOM 4PRO PPK drone not only achieves an accuracy of 3-5cm RMSE consistently, but also has potential to achieve an accuracy up to 2cm RMSE, without the need of Ground Control Points.

Matrix Geo and Topodrone also offers all range of geospatial services and engineering consultancy in Railways, Road, Mining, Water and Power sector for Topography & Mapping.

KEY FEATURES

- The "Topodrone - RTK/PPK kit" can be installed on DJI MAVIC PRO, DJI PHANTOM 4 PRO, DJI MATRICE 200 or DJI MATRICE 600 PRO.
- Lower down your project cost by reducing ground control points and yet achieve the better accuracy.
- Does not require any additional power supply for PPK.
- Easy to use and with open source post processing software.
- Fast geotagging of correct coordinates.

1SPATIAL

1Integrate

New and enhanced technologies have automated and expedited the process of spatial data collection; allowing greater volumes and categories of data to be captured, at faster rates, more consistently and with more storage capacity available. 1Integrate is a rules-based data processing engine for automatically transforming data, particularly spatial data. Users can define intelligent rules using a user interface and then apply the rules to one or more sources of data.

The 1Integrate solution from 1Spatial applies intelligent rules to data in order to correct data errors, integrate data from multiple sources, infer new data or transform data to different form. This helps deliver smarter data for a smarter world.

KEY FEATURES

- Users can define intelligent rules using a user interface and then apply the rules to one or more sources of data.
- Corrects data errors, integrates data from multiple sources, infers new data or transforms data to different form.

ORACLE

Oracle Cloud Services

By incorporating spatial data management, analysis, visualization and development APIs, Oracle Cloud Services make location intelligence and advanced geospatial analysis part of every users' experience. Oracle Database Cloud Services include the world's most popular database management system and the platform for the most demanding GIS and land management systems, Oracle Database with Oracle Spatial and Graph. Oracle Big Data Cloud Service offers the first commercial Big Data geospatial features for Spark, Hadoop, and NoSQL – Oracle Big Data Spatial and Graph; and Oracle Analytics Cloud has the most comprehensive autonomous analytics in the cloud with automatic recommendations, location analytics, chart and map creation, single-click trending and forecasting, and drag-and-drop clustering and outliers.

Oracle also delivers leading location-enabled SaaS services for public safety, utilities, transportation and logistics, communications, and real estate and horizontal applications in financials, human capital management, CRM, ERP and customer experience.

KEY FEATURES

- Autonomous Cloud services – self-driving, self-securing, self-repairing – resulting in substantial savings in labor cost.
- Interactive map visualizations, JSON support for spatial data, REST APIs for modern application development.
- Integrated geocoding and routing .
- Performance and massive scalability features for enterprise deployments .

PITNEY BOWES

Software & Data Marketplace

Software and Data Marketplace by Pitney Bowes was built for data users who want to explore, visualize and sample the largest catalog of address-centric data available. It connects data with data users. The Software and Data Marketplace lets you be in control, to evaluate data products to see if they suit your needs, get access to more in-depth information on product offerings and use cases, and equip yourself with the knowledge needed to make the most educated business decisions; any time of day, from any device, in any location, at your own pace. It is a new way to experience data. Instead of spending time searching for what you need, access it all right here in one convenient marketplace.

KEY FEATURES

- Offers a convenient destination to discover, explore and access relevant data.
- Cloud-based access and single sign-on convenience allows users to be up and running in minutes.
- Uniform data specifications for global coverage across regions, interoperability and frequent refresh cycles come as standard.

PLANET

Planet Analytics

Planet has announced its vision to index physical change on Earth and make it searchable for all. The company's beta release of an exciting new solution called Planet Analytics will leverage machine learning to transform global, daily satellite imagery into information feeds that detect and classify objects, identify geographic features, and monitor change over time. These intelligent

information feeds integrate into existing workflows and give customers unprecedented insights about places they care about.

Planet Analytics gives access to actionable insights based on the most recent imagery available.

KEY FEATURES

- **Building Detection:** Identifies the creation of buildings in an area or creation of road networks in an AOI.
- **Aircraft Identification:** Monitor movement and volume of aircraft understand economic activity.
- **Maritime Vessel Identification:** Tracks vessels for law and policy enforcement..

UNITED NATIONS WORLD GEOSPATIAL INFORMATION CONGRESS

19-21 November 2018
Deqing International Convention Center, China

THE GEOSPATIAL WAY TO A BETTER WORLD

The **United Nations World Geospatial Information Congress (UNWGIC)** will provide a 'global geospatial stage' for multi-stakeholder and multi-industry participation by all actors to demonstrate capability, enhance communication, grow understanding, develop knowledge, and showcase the application of geospatial information management to address local, regional and global challenges.

With an overarching theme **'The Geospatial Way to a Better World'** the UNWGIC will be a truly global event bringing together all stakeholders at the highest level to address and ensure that geospatial information has its widest and fullest utility in service of social, economic and environmental development.

Organized by : The United Nations
Hosted by : Ministry of Natural Resources, China
The Government of Zhejiang Province, China
Guided by : The United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM)

As an important part of the UNWGIC, the
Geospatial Technology and Application Exhibition
will be organized from
19-23 November 2018
at the
Deqing International Exhibition Center.

It will showcase the state-of-the-art technologies, products and application solutions from world leading companies, academic and research institutions, as well as other related organizations from across the globe. The Geospatial Technology and Application Exhibition will cover four major themes.

Intelligent Equipment

- Satellite Remote Sensing Equipment
- Navigation and Positioning Equipment
- Measurement and Data Acquisition Equipment
- Aerial Photogrammetry and UAVs
- Data Processing and Analysis Platforms
- 3D Visualization Platforms
- Data Storage, Management and Big Data Service Platforms
- Data Display and Output Equipment

Smart Applications

- Natural Resources Survey & Registration
- Integrated Emergency Response
- Climate, Marine and Environmental Protection
- Energy and Public Utilities
- Tourism and Cultural Heritage Conservation
- E-Government
- Smart Cities

Location Based Services

- Autonomous Vehicles
- Smart Business
- Intelligent Transportation
- Integration of Spatial Data and AI, Big Data, Cloud, and the Internet of Things
- LBS, O2O, and Sharing Economy

Intelligent Equipment

- Intelligent Robots
- Intelligent Homes
- Smart Wearables
- Cultural Innovations
- AR, VR and Interactive Experience
- Commercial Aerospace
- Entrepreneurship Program Demonstrations

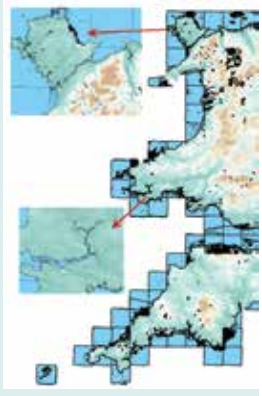
All interested enterprises, research institutions, and other organizations from China and abroad are cordially invited to join in the Geospatial Technology and Application Exhibition of the United Nations World Geospatial Information Congress.

UN-GGIM Secretariat
United Nations Statistics Division, Department of Economic and Social Affairs
Email: ggim@un.org
Exhibition details can be viewed at: *http://www.unwgic2018.org/exhibition.html*

PIXALYTICS

Pixalytics Water Extent Mapping product

Pixalytics Water Extent Mapping product provides an automated, cost-effective all-weather rapid solution for mapping areas of open water and saturated ground using Copernicus Sentinel-1 data. It is a cost-effective online solution for mapping water availability.



Pixalytics' Web-based interface reduces the need for specialist knowledge by providing clear information and graphical maps and delivers detailed outputs suitable for incorporation into mapping software.

The product uses Pixalytics' unique algorithm developed by its remote sensing experts and in conjunction with the latest scientific knowledge. The core product is for the United Kingdom and can be scaled up to run for other locations around the world, as required. The product can also be based on commercial data if a higher spatial resolution is required. Users can purchase one-off products, or a time series, via pre-defined 20 km square tiles.

KEY FEATURES

- Copernicus Sentinel-1 data provides systematic coverage for many parts of the world.
- An automated solution provides rapid processing and information outputs.
- Processing data over time indicates areas of increased flood risk, changes in the coastline and where water resources may be declining.

PIX4D

Pix4Dmapper

The mapping solutions company Pix4D launched Pix4Dmapper that automatically converts images taken by drone, by hand, or by plane and delivers highly precise, georeferenced 2D maps and 3D models. They are customizable, timely, and complement a wide range of applications and software.

The company develops a line of end-to-end mapping solutions which convert images into georeferenced maps and models. Using advanced algorithms based on computer vision and photogrammetry, Pix4D offers survey-grade accuracy, as well as a unique bundle of desktop and cloud processing.

KEY FEATURES

- **3D Point Cloud:** Laser scanner quality 3D points from a consumer-grade camera. Clean from moving objects, aerial perspective with limited occlusions, and low acquisition time..
- **Orthomosaics:** High-resolution aerial map with corrected perspective, putting you in control of geographic data generation.
- **3D Textured Model:** Full 3D triangle mesh with photorealistic texturing, perfect for sharing and online visualization.
- **Digital Surface Model:** Accurate, georeferenced elevation map, ready for your preferred GIS workflow.

PRECISIONHAWK

Beyond Visual Line of Sight

PrecisionHawk has launched the first Beyond Visual Line of Sight (BVLOS)-enabled, multi-rotor drone platform. The drone incorporates industry-leading technology to automatically identify all cooperative and non-cooperative aircraft within a 10km radius, ensuring airspace de-confliction well before potential confrontation. The platform was designed based on the findings and recommendations in the Federal Aviation Administration (FAA) Pathfinder Report, which serves as a blueprint for enterprises to conduct BVLOS drone operations.

Through the Pathfinder fieldwork, PrecisionHawk identified three pieces of technology that should be required for safe BVLOS operations.

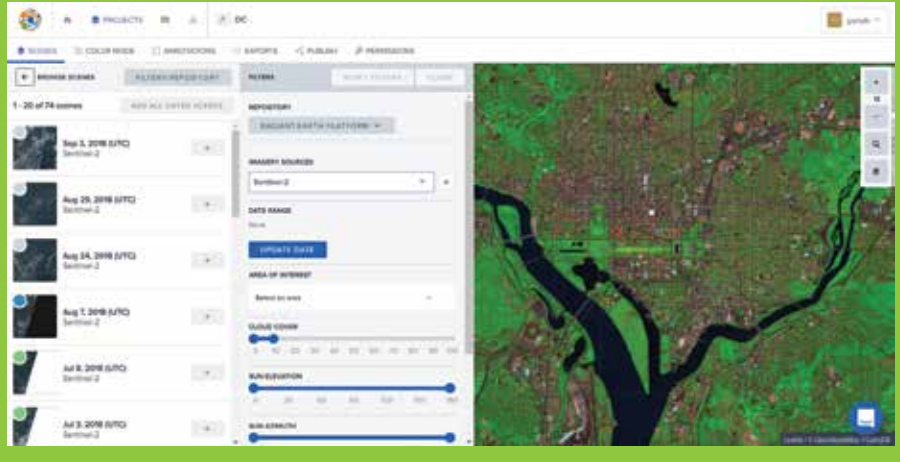
KEY FEATURES

- Equipped with GPS technology to broadcast location and trajectory of the drone at all times, making it visible to drones and other aircraft in its vicinity.
- Low altitude traffic and airspace safety (LATAS) technology, which provides access to real-time manned aircraft data.

RADIANT EARTH

Radiant Earth Foundation Platform

Radiant Earth Foundation's open Earth imagery platform is an innovative vehicle to help people search, discover, and analyze Earth observation data. Users may access a federated catalogue of satellite, aerial, and drone sources on the cloud–instantly, securely, and for free. With an intuitive interface, the platform allows users to upload data from local files, Amazon S3 buckets, and Dropbox. Users can also apply analytical and custom visualization tools in seconds, as well as extract features, adjust histograms, generate dynamic map tile sets, and more. Data sharing is simplified through the Radiant Earth Foundation API. The platform, valuable to users of all experience levels, is ideal for NGOs, multilateral organizations, government agencies interested in harnessing the power of geospatial data to understand and serve their communities.



KEY FEATURES

- Open Access—Secure self-sign-up for free.
- Diverse Data Sources—Satellite, aerial, and drone imagery archives.
- Multi-Organization Collaboration—Share data and analysis with virtual teams.
- Analytical Tools and Support—Training resources.

RIEGL

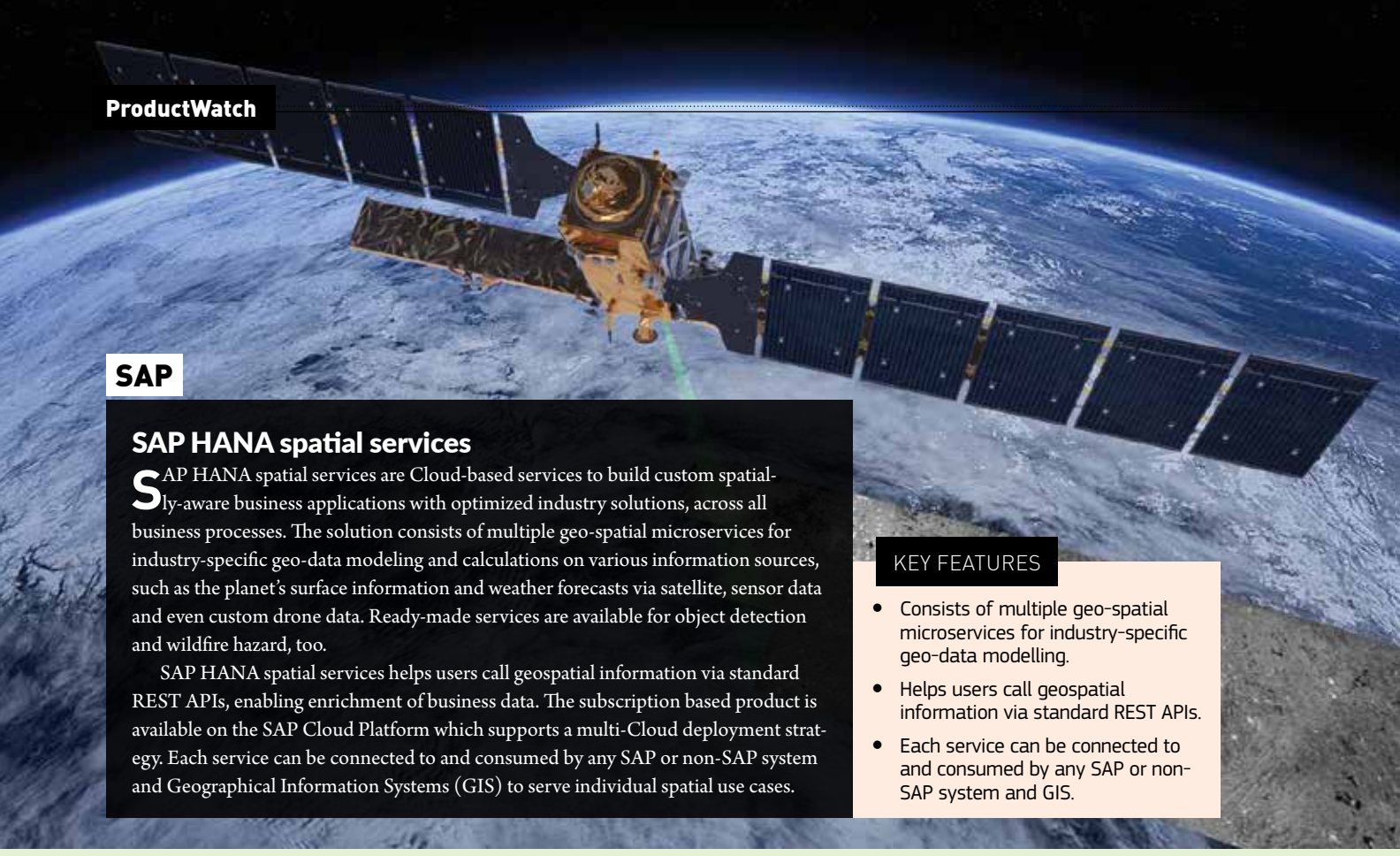
RIEGL Integration Kit 600

RIEGL has revolutionized the possibilities of UAV-based surveying with the development of the survey-grade miniVUX-1UAV LiDAR sensor. Extremely lightweight and compact, the sensor was especially designed for system integrations that have restricted pace or payload weight. RIEGL has also enhanced its product range by offering a complete unmanned miniaturized laser scanning system, the RIEGL miniVUX-SYS. This complete system of low weight and compact size was designed for flexible use in UAV-based surveying applications on a variety of UAVs and is made up of — in addition to the LiDAR sensor — an IMU/GNSS system and an optional RGB camera system.

For a quick, straightforward integration of the miniVUX-SYS to a multi-rotor UAV, RIEGL developed the RIEGL Integration Kit 600. This add-on to the miniVUX-1 LiDAR sensor comes with a shock-absorbing mounting kit, a power supply module, and cabling. It further simplifies the use of drones as an essential tool for surveying and mapping and will further promote the recent growth of using UAVs in this industry sector.

KEY FEATURES

- Add-on to the RIEGL miniVUX-SYS UAV-based laser scanning system.
- RIEGL miniVUX-1 LiDAR sensor with Applanix APX-15 UAV or APX-20 UAV IMU/GNSS unit fully integrated.
- Prepared for interfacing with optional RGB camera(s).



SAP

SAP HANA spatial services

SAP HANA spatial services are Cloud-based services to build custom spatially-aware business applications with optimized industry solutions, across all business processes. The solution consists of multiple geo-spatial microservices for industry-specific geo-data modeling and calculations on various information sources, such as the planet's surface information and weather forecasts via satellite, sensor data and even custom drone data. Ready-made services are available for object detection and wildfire hazard, too.

SAP HANA spatial services helps users call geospatial information via standard REST APIs, enabling enrichment of business data. The subscription based product is available on the SAP Cloud Platform which supports a multi-Cloud deployment strategy. Each service can be connected to and consumed by any SAP or non-SAP system and Geographical Information Systems (GIS) to serve individual spatial use cases.

KEY FEATURES

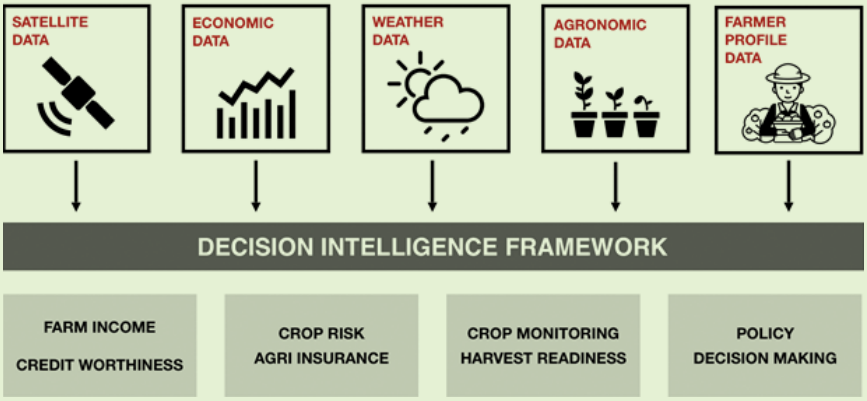
- Consists of multiple geo-spatial microservices for industry-specific geo-data modelling.
- Helps users call geospatial information via standard REST APIs.
- Each service can be connected to and consumed by any SAP or non-SAP system and GIS.

SATSURE

Agri Risk Management Solution

SatSure delves into agri risk management through innovative solutions. The company is improving financial inclusion of farmers in the developing world by employing technology that combines remote sensing, AgriIOT, and drone data alongside novel machine learning algorithms. Resultant decision making insights help create indices such as farmer income profiles, farmer credit rating, crop risk management, predictive crop modeling, harvest readiness and water-use efficiency. These insights are used by our customers in agri finance and governments to take data driven decisions to manage their risks better and for the betterment of farmers.

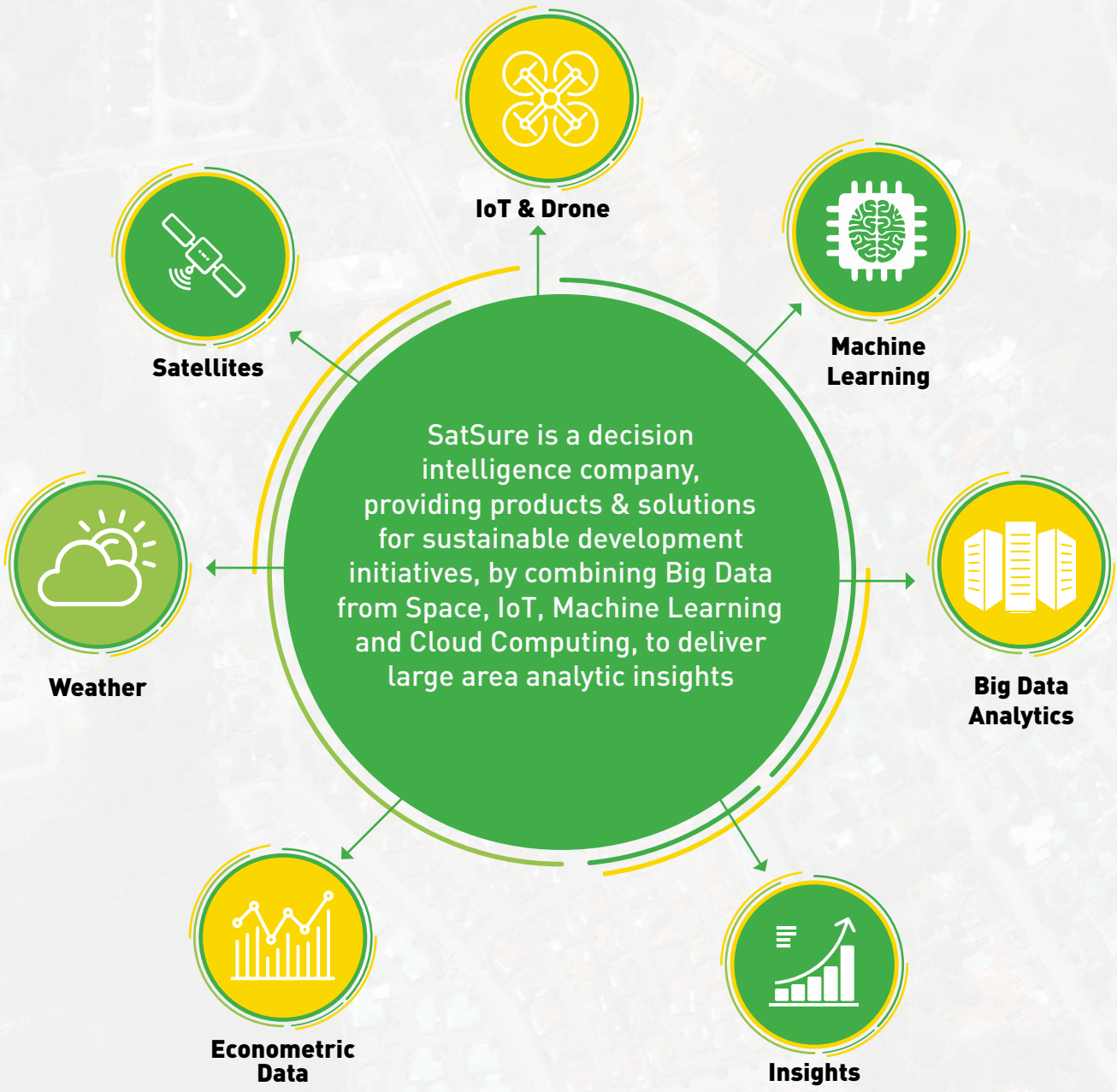
Some of the immediate challenges faced by the farmers in the developing world are depleting groundwater resources, climate change, an increase in the frequency of extreme events like droughts, floods, lack of fair and timely compensation for losses incurred, lack of transparency in fixing the fair price for the produce and difficulty in access to markets. The lack of a proper insurance market and an un-localised insurance index developed by insurance companies is also a major issue as fair insurance premiums are not triggered. These are compounded by existing problems like the farmers' debt burden, their lack of access to scientific agricultural practices, dwindling farm holding sizes, institutional apathy and access to markets.



KEY FEATURES

- Employs technology that combines remote sensing, AgriIOT, and drone data alongside novel machine learning algorithms.
- Resultant decision making insights help create indices such as farmer income profiles, farmer credit rating, crop risk management, predictive crop modeling, harvest readiness and water-use efficiency.

SatSure



Risk Management | Business Intelligence | Transparency

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Phone: +41 71 845 13 76, **Website:** www.satsure.co, **E-Mail:** info@satsure.co

SAFEGRAPH

SafeGraph Places

SafeGraph Places aims to be the source of truth about physical places in the world. In its current version (v 1.1), SafeGraph Places consists of almost every place in the US where one can spend money. The company is working on having every place in the US one can spend time (including office buildings, homes, parks, schools, etc.). And eventually wants to be able describe every place in the world.

SafeGraph ingests data from thousands of diverse sources that together represent billions of discrete pieces of information about places of interest. Its system programmatically ingests, compares, validates, merges data and draws precise polygons. It leverages unique, advanced truth data to continually improve the accuracy of Places, ultimately resulting in a map of Places of Interest that best represents truth.

KEY FEATURES

- 5MM+ points of interest (POI) covering all places someone can spend money .
- Accurate Polygons for every place.
- Additional critical information such as major brand names, hours of operation, street address, and category data.

TEXTRON SYSTEMS

RemoteView geospatial intelligence software

Textron Systems Geospatial Solutions' flagship product RemoteView provides proven analysis and exploitation capabilities to fit a variety of multi-industry needs. From imagery analysis to precision positioning and 3D visualization, RemoteView is a proven solution for situational understanding and interoperability. By harnessing the platform's newest abilities, users can simultaneously load imagery and elevation data to use Line of Sight, Helicopter Landing Zone, contour lines and flood plain analysis tools.

KEY FEATURES

- A proven solution for situational understanding and interoperability.
- Allows users to simultaneously load imagery and elevation data.
- Can gather data from any type of commercial satellite.

TERSUS GNSS

Tersus David

The Tersus David is a cost-efficient, palm-sized GNSS receiver designed for surveying UAVs, AGVs, and agricultural applications. David GNSS receiver supports GPS L1/L2, GLONASS L1/L2 and BeiDou B1/B2. With this GNSS receiver, users can take full advantages of common platforms such as smart phones, tablets or traditional handheld modules to collect data.

Working with an external GNSS antenna, the free Tersus Survey App and post-processing software, the David GNSS receiver is a low-cost solution for all survey applications, including real-time RTK positioning and data collection for PPK. A 4GB in-built memory makes it easy to save data for post processing. The compact size, IP67-rated enclosure and external Bluetooth module alleviates most of the inconveniences encountered in field work.

Nuwa, which is a free survey App developed by Tersus GNSS Inc, can help you manage the collected data more easily. Nuwa App provides various built-in survey tools along with graphical Interface for surveying and stakeout. With Nuwa you can connect David GNSS receiver via Bluetooth or USB that turns any Android devices into RTK base, rover or GIS data collector.

KEY FEATURES

- Supports GPS L1/L2, GLONASS L1/L2, and BeiDou B1/B2.
- Supports RTCM2.3/3.x, CMR, CMR+ corrections.
- Easy to connect an external powerful radio for long range.
- Solution update rate up to 10Hz.
- 20Hz raw measurement output for post processing.
- Carrier phase accuracy down to 1mm.

David GNSS RTK Receiver

The Tersus David is a cost-efficient, palm-sized GNSS receiver designed for surveying UAVs, AGVs, and agricultural applications.

Tersus will be at **InterGEO 2018**
Hall 12.0 Booth D.071

To learn more
Visit www.tersus-gnss.com
Sales inquiry: sales@tersus-gnss.com
Technical support: support@tersus-gnss.com

TRIMBLE

Spectra Precision SP20

Discover now the Spectra Precision SP20 handheld GNSS receiver for survey and GIS. The SP20 combines innovative, camera-enabled data collection workflow with a high level of performance in an ergonomic, scalable solution. Rugged and lightweight, the SP20 is easy-to-use and highly accurate. It is the optimal tool not only for cadastral, construction, or topo surveys, but also for a range of GIS projects, including data collection, inspection and maintenance. The 5.3-inch screen delivers vivid visuals of the workflow, which enables precise 2D handheld logging. And the system's high degree of accuracy can be enhanced with a monopole accessory to deliver solid, survey-grade 3D measurements. Its surveying equipment is an economical choice that utilizes technologies for optimal efficiency.

KEY FEATURES

- 5.3-inch screen delivers vivid visuals of the workflow.
- Enables precise 2D handheld logging.
- Monopole accessory to deliver solid, survey-grade 3D measurements increases accuracy.

Trimble Business Center

Trimble Business Center (TBC) is a field-to-finish survey CAD software that helps surveyors deliver high-accuracy GNSS data, create CAD deliverables, and leverage full data traceability throughout a project's lifecycle. TBC allows users to manage, process and create customer deliverables for all of their office survey tasks in one software package.

Trimble Business Center is part of a fleet of Trimble software that includes the flagship Trimble Access Field Software, featuring an all-new user interface that works with the TSC7 Controller, and Access Sync, which combined represent the industry's most robust all-in-one solution.

KEY FEATURES

- Survey CAD software for customizable template and automated plotting functionality.
- Surface modeling to design, create, process and deliver surface models.

VEXCEL IMAGING

Vexcel Data Program

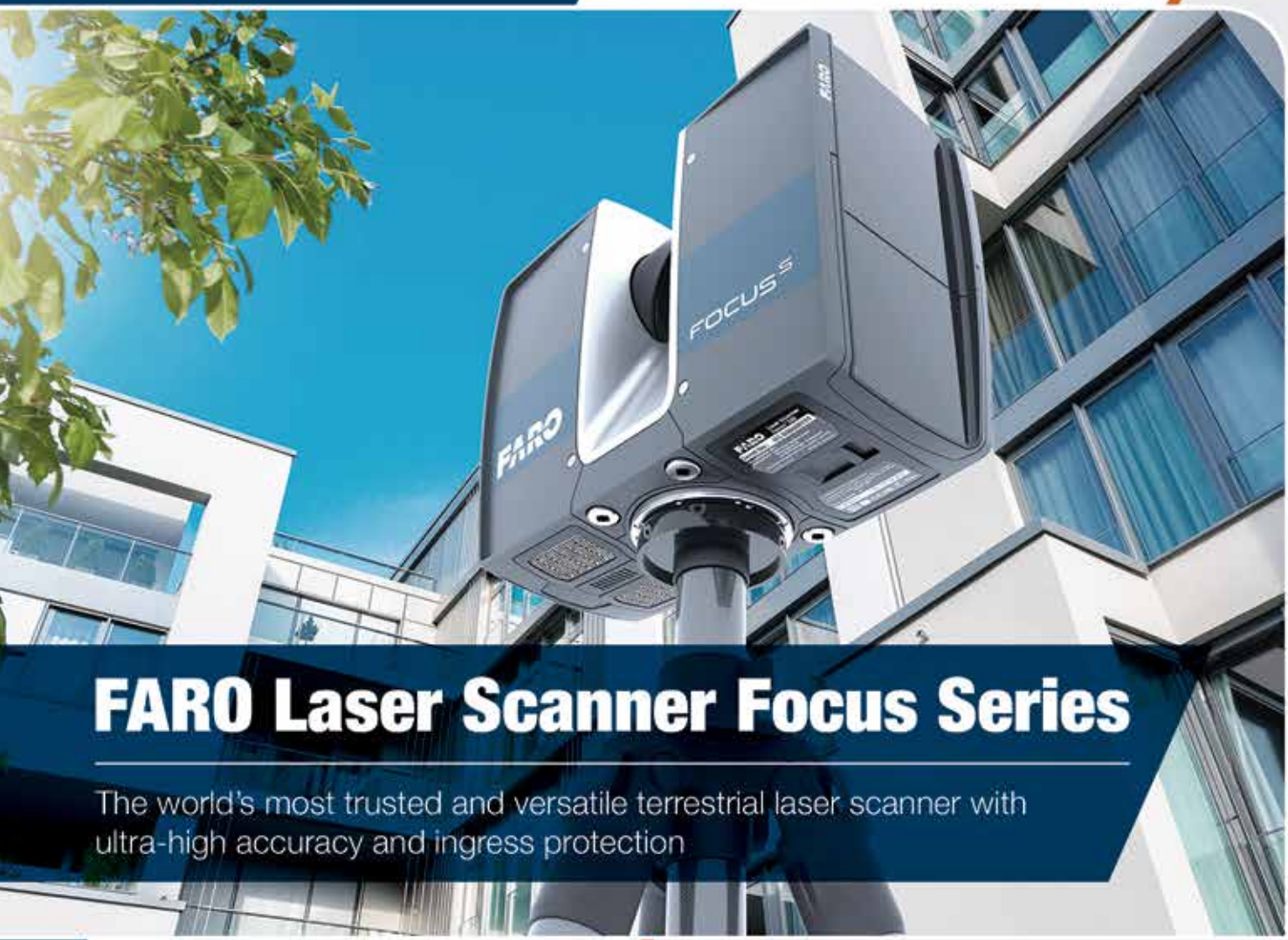
Vexcel Data Program (VDP) is an imagery service that leverages the company's advanced UltraCam aerial and terrestrial sensors and UltraMap software technologies. The VDP consists of a library of high-resolution vertical and oblique aerial imagery covering the US.

The VDP is already powering the Geospatial Intelligence Center (GIC). Easy access to up-to-date imagery, streamlines underwriting, claims and special investigation processes. In doing so, the GIC enables its members to better serve customers while reducing operating costs. All organizations may access the comprehensive coverage of the US via a Cloud-based service. The VDP calls for annual coverage of the entire nation with 20 cm GSD vertical imagery, and major metro areas at a higher resolution of 7.5 cm GSD vertical and oblique imagery.

KEY FEATURES

- Calls for annual coverage of the entire US with 20 cm GSD vertical imagery.
- Offers consistency by collecting data with same type of sensor at the same resolution using the same workflow every year.
- Enables better service to customers while reducing operating costs.

FARO



FARO Laser Scanner Focus Series

The world's most trusted and versatile terrestrial laser scanner with ultra-high accuracy and ingress protection

Accuracy
Reality-like scan data by increased distance accuracy and angular accuracy

IP Rating - Class 54
Scanning in rough environments while protection from dust, debris and water splashes

On-Site Compensation
With the on-site compensation functionality users can verify and adjust the Focus^S compensation immediately before scanning, ensuring high-quality scan data and traceable documentation

On-Site Registration
During on-site data capture, the laser scanner immediately transmits scan data wirelessly to FARO SCENE 2018 for real-time scan processing and registration, providing efficiency and time savings

FARO SCENE 2018
A virtual ready software, FARO Scene 2018 enables an immersive VR experience with integration of detailed photographic textures and rendering of 3D scan data so quickly that it appears to be generated in real time.

Architecture | Construction | Engineering | Energy | Civil Survey | Factory Management | Heritage

INFORMED LIFECYCLE

www.faro.com/LaserScanner/sg

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Works when you do

Zenith GNSS family

Your team to take up the challenge

GNSS users GeoMax has a complete GNSS portfolio to fulfill the needs of all users. Ensure ultimate reliability with GeoMax GNSS systems even in challenging environments. Providing true cost-effectiveness these systems are equipped with the latest GNSS technology in the field helping you increase your productivity and taking your performance to a new level.

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