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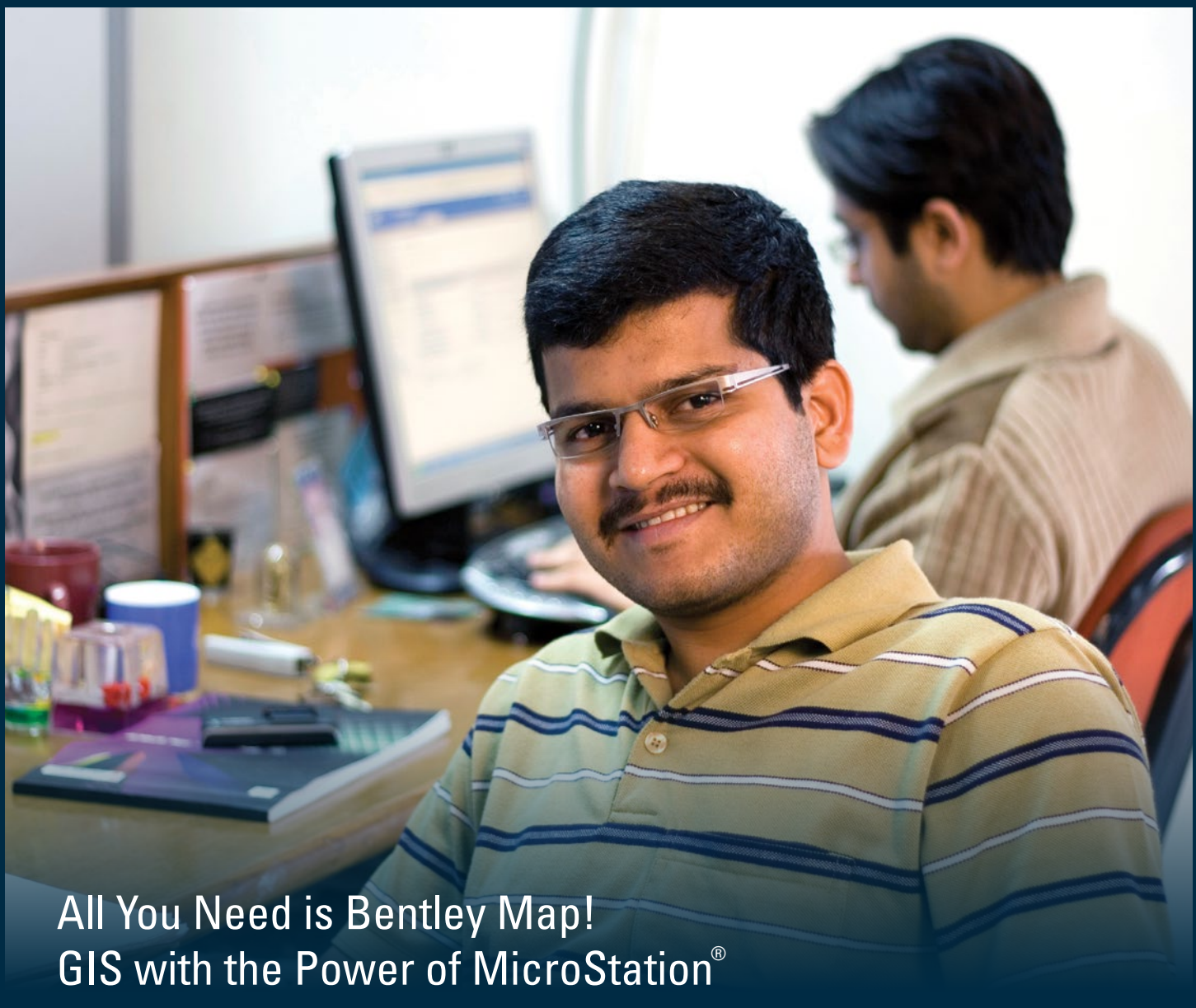

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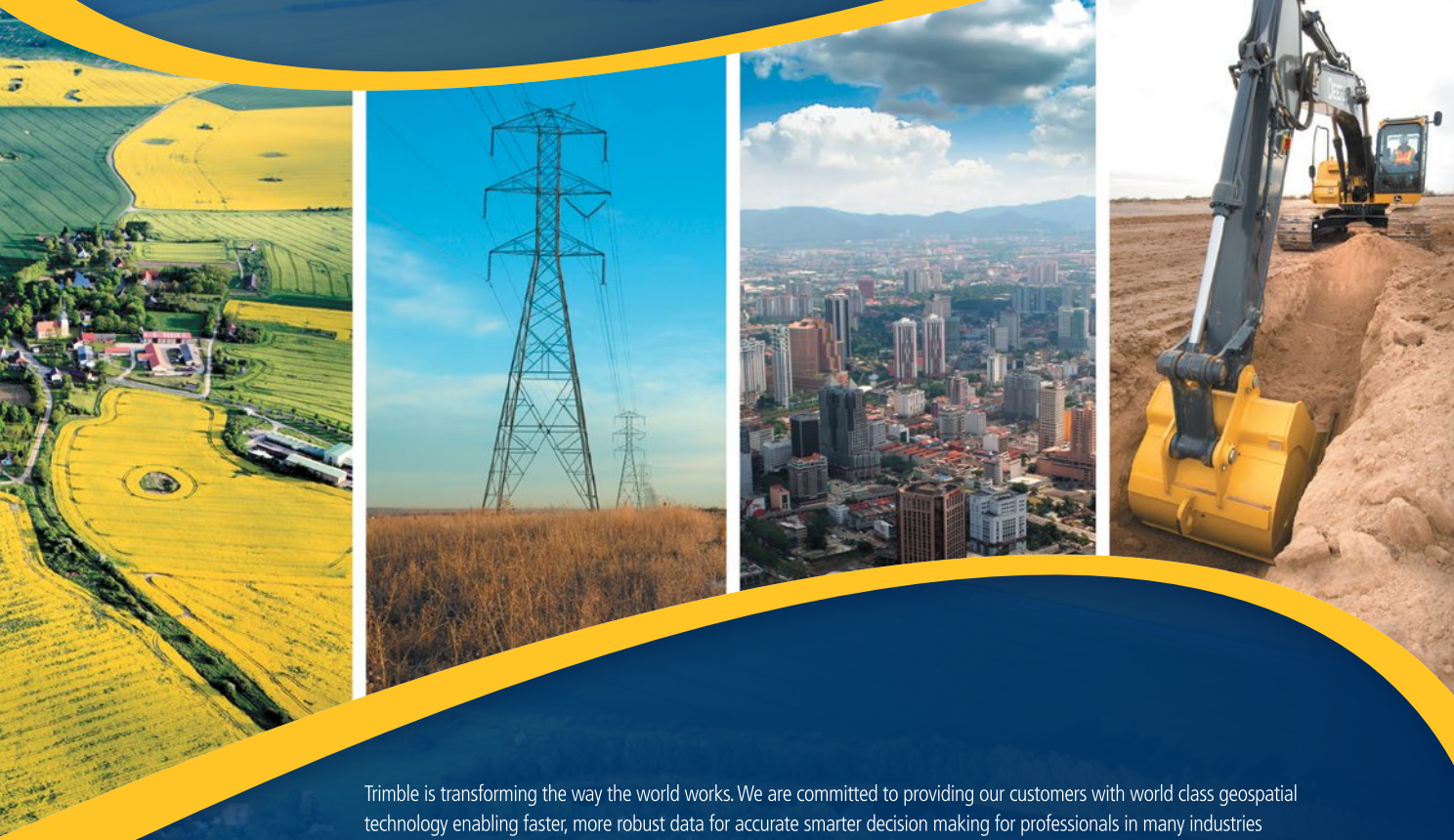

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TECHNOLOGY TRENDS

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Geospatial Vision for a Sustainable Future

Prof Arup Dasgupta
Managing Editor
arup@geospatialmedia.net

In the year 2014, Data became Big, Cities became Smart, Things jumped on to the Internet and even a staid organisation like the UN decided to look at Geospatial Globally for Information Management. These technologies are needed to improve the human situation at a very basic level through more food, shelter and protection from the vagaries of nature and the consequences of thoughtless anthropogenic activities. However, humankind is more aspirational, moving beyond mere existence to self-actuation through personal growth, knowledge, and fulfilment. Therefore, our ultimate goal is to realise a sustainable future and a better quality of life for ourselves. A key to this is better spatially referenced information which can be used with other data in the context of activities like better agriculture, efficient infrastructure, energy efficient buildings, and better citizen services at lower cost, to name a few. As David Schell, Chairman Emeritus of OGC, puts it, "It is not a question of which domain or how a domain is helped or developed with geospatial technologies — all will be helped eventually."

The key to technology usage is summed up by Dr. Anne Kemp, Chairperson of AGI, as "whole life business outcomes," which need projects to "start with the end in mind." This holistic approach requires that big data, internet of things, BIM, UAVs, and all the other tools in our tool chest need to be orchestrated with other toolboxes to address real life issues. Thus far, these have existed as discrete entities.

Big data, for example, has been in use in climate research, only it wasn't known as 'big data' till big businesses cottoned onto the utility of transactional data to serve customers (and themselves) better. Remote sensing experts fondly refer to high resolution imagery as big data, forgetting that it is the unstructured data streams like farmer reports, weather station data and even social media chatter which constitute a major part of big data and which can move image analysis to another level. Unfortunately, most big data training ends up with trivial non-geospatial applications. Similarly, the example of a refrigerator ordering milk from the department store and paying for it with one's credit card has been quoted *ad nauseam* as an example of internet of things. But real examples are prominent by their absence.

Technology integration has been addressed at length in this issue, and progress on this front is perhaps what we can look forward to in 2015. Further, as Schell commented, we may look forward to many more domains being addressed other than the ones mentioned in this issue.

As technology progresses and gets applied, laws and regulations can become impediments. This need not be so. It is necessary for industry to be proactive and work with regulatory authorities to smoothen the path of technology acceptance at the regulatory level. Administrators need to be tech savvy and have an open mind when considering disruptive technologies. An example is the role of UAVs — at the technology and applications levels the utility of UAVs is well understood and appreciated but there are open questions about their impact on safety and security which cannot be wished away. The solution to this conundrum has to come from the technology professionals and administrators jointly.

Geospatial companies will continue to create a fusion of solutions and fission of new ideas, products, and services, therefore national regulatory authorities need to apply their minds to evolve a set of rules which will allow the use of new geospatial technologies without jeopardising security. I believe, we need to bring technology and its applications closer to the regulatory environment. This should be one of the targets for 2015.

Looking Beyond Geospatial

As we look to extend the use of information about our changing earth to a billion plus people, we need to move beyond GIS and mapping…to explore how the fusion of several ingredients can help simplify the process of deriving information about our changing earth so everyone can make sense of change

Ola Rollen

President and CEO
Hexagon

I think policymakers are lagging behind when it comes to technology advancements, often putting constraints on development

Hexagon has found success in combining geospatial technologies with other technologies and introducing these innovative synergies into the operations of our customers. Take the mining industry for example — mines are so large that you need maps to navigate them. But you need more than a map to improve productivity. However, you can use that same map to assess your progress. You can produce what you intended simply by updating the map through the use of scanners and sensors, then include geospatial software that displays and visualises your mine. And we're looking beyond just mapping in mine operations — with an accurate and precise map you can move towards implementing autonomous vehicles.

We are also integrating GIS into industrial workflows. We introduced GIS to industry at a time when this technology wasn't considered a part of the industrial process. Other industries that benefit from this approach include wind and solar power, city planning and more. Having only a geospatial mindset is like climbing a tower and making great maps based on what you see. It should also be about coming down to the ground floor and using that information in operations where it will actually benefit society beyond creating nice maps.

Integrating geospatial data and workflow processes

In 2014, we acquired MineSight, a US-based company specialising in software for mine productivity. In simple terms, MineSight makes GIS for mines and the key parts of their planning process. Mine planners use MineSight software to determine the location of the iron ore and where to excavate; they then give the production plans to operations. But there is no feedback. The planners really don't know what has taken place in the mine since they initially submitted the production plan, so what will they do when they send out surveyors to measure the mine again to obtain new data to feed their software? By bringing together MineSight, Devex, Leica Geosystems Mining, and SAFEmine under the umbrella of Hexagon Mining, we can now integrate and align the machines that are operating in the mine with this GIS software. As they excavate, we can capture and feed data into the model of the mine, keeping it accurate and up-to-date.

The technology is packaged so it can be implemented as a solution. That is part of our value proposition. The critical time it takes to implement and train users can also be handled by partners, which is why it makes sense to have agreements with several system integrators or consulting companies.

Integrating vertical solutions

We are definitely moving towards vertical solutions. We believe that unless you target a particular customer group, you can't really address issues. Let's say you want to document the engineering aspects of an oil rig. In this case, we can provide reverse engineering of the rig feeding into a CAD model. We scan the structure using laser scanners and feed the information to our Smart Fusion software. So we now have a seamless connection between our scanners and Smart Fusion and we can very quickly capture all the data about this asset. And it doesn't have to be an oil rig; it can be a building or even a city. Then we have systems in which you can pin tags onto various pieces of infrastructure. Take a valve on an oil rig, for example — once scanned and tagged, you can click on it and read who manufactured it, where you can order a spare part, how often it should be replaced and more. This kind of information never existed in this format in the past; instead of the company maintaining the information, it was retained by engineers and often lost when they left the company. I think combining sensors and software to display your asset — this is really what it is all about. It could be a skyscraper in Hong Kong, it could be anything where nature and the environment change the face of your asset and you need constant updates with fresh information to stay a step ahead when it comes to best utilising that asset.

Targets for 2015

We have several geospatial businesses focused on driving revenue. One of our newer businesses, Hexagon Geospatial, is focused on refining our core software assets, while Intergraph SG&I and another more recently established business, Hexagon Solutions are both geared toward creating products and solutions based on those assets.

Hexagon Solutions will bring in a lot of added sales in the next few years. But we need to remember that it takes time to sell solutions and establish success. Hexagon Solutions is going to be a bigger contributor to our sales growth.

We have targeted 25% EBIT by 2016. That's more difficult to express in numbers. What we are seeing across the world is that technology needs to be much easier to use. That's our challenge for the future.

Rather than deploying thick applications with unnecessary features, the future will be more focused on delivering information subscriptions combined with unique dashboards

Role of policymakers

I think policymakers are lagging behind when it comes to technology advancements, often putting constraints on their development. But they should be aware of discussions taking place about key technologies such as robotics and automation and how businesses are incorporating them into their operations. In a mine or on a farm, it is probably safer to automate tractors and harvesters rather than rely on human operation. We need to look closely at the early adopters of this technology and prepare ourselves for a society in which we will see more and more automation.

Targeting user organisations

As a rule, we do not target user organisations because they are not our customers. We believe in finding a good customer who is willing to put resources behind his mission and develop it with our help. Having dedicated customers who can provide insight into their business and decision-making processes helps guide us in developing innovative solutions that enable them to work smarter and faster. Accenture is a good example — they wanted to sell more services to the oil and gas companies of the world. Through their partnership with Hexagon, they can offer implementation services around engineering software. In addition, they can undertake the complete reverse engineering of an existing plant using Smart Fusion and sensors.

One of the key game-changing trends we are starting to see is the fusion of geospatial analytics with content derived from multiple sources

The need for standards

Standards provide a common operating language for Hexagon to help customers connect sensors with software to provide solutions. In general, standards are theoretical, but their application ensures interoperability to provide a successful customer system. Industry standards such as the Open Geospatial Consortium and International Organization for Standardization provide a framework that can be followed, implemented and deployed. Without a common language, you cannot deploy solutions that can be scaled and easily replicated. Just as different parts of the world have different languages and accents that can be translated and understood, standards equip users to communicate through products they use on a daily basis.

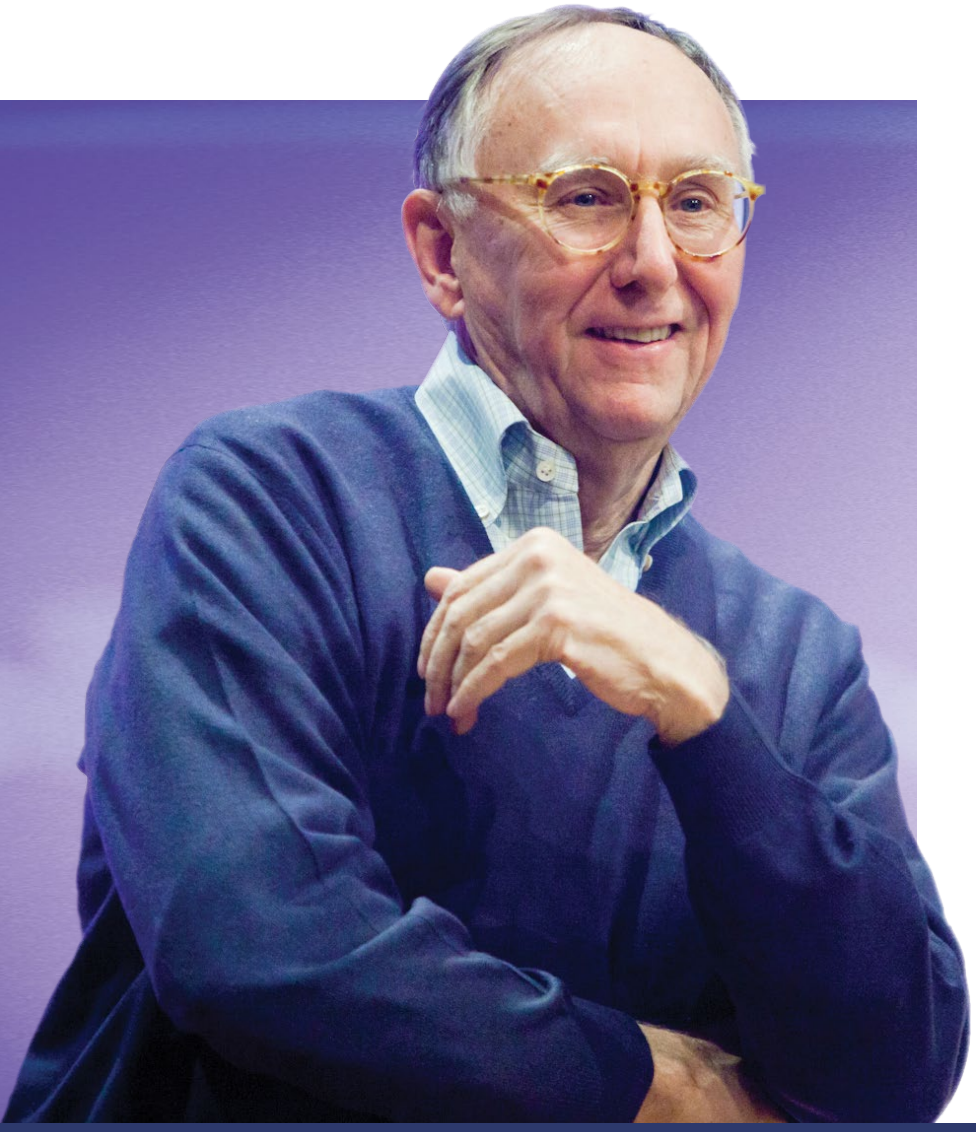
At Hexagon, we are not facing challenges due to the lack of standards. Hexagon provides the ingredients required to locally design, build and deploy solutions that can be scaled to meet local customer needs. Where standards don't exist, we work to create a customer standard. Hexagon has developed an interface that can communicate with most standards in the market, which makes standardisation less of an issue.

Game-changing trends

One of the game-changing trends we are starting to see is the fusion of geospatial analytics with content derived from multiple sources. This integrated technology is often wrapped around a lightweight application that is scalable, portable and dynamic, allowing it to be deployed in web browsers, mobile devices and rich desktop platforms. With this innovation, desktop systems will continue to be used by technically skilled geospatial professionals required to perform production workflows and map production.

As we look to extend the use of information about our changing earth to a billion plus people, we need to move beyond status quo, beyond GIS and beyond mapping. We need to explore how the fusion of all these ingredients can help simplify the process of deriving information about our changing earth so everyone can make sense of change.

Rather than deploying thick applications with unnecessary features and functionality, the future will be more focused on delivering information subscriptions combined with unique dashboards. The map itself will be only one of several components of that dashboard, with a broader scope of information conveyed.



Modern GIS is transitioning into a platform that integrates all types of geospatial technologies and data types into a system for supporting geocentric workflows, as well as people who want to make simple maps. It is also open for developers who provide complete application solutions to customers

Jack Dangermond
President, Esri

GIS – A Platform for Every Industry

There are many compelling reasons why GIS is being embraced by organisations. The three big ones are: maps, communication and spatial analysis. GIS is powerful and the technology is advancing and becoming easier and more accessible. The geospatial industry consists of a whole range of technologies, including measurement, data management, visualisation, spatial analysis, mapping, etc.

These are all parts of a kind of abstract system, which is systematically abstracting and leveraging geographic information to help us understand and make decisions.

Geographic information is unique because location is the common key for integration of all types of data. This ultimately means that data from integrating all of the different scientific disciplines as well as divisions of

GIS is cross-cutting and the information that is abstracted winds up supporting multiple industries at the same time. It is becoming a kind of language

an organisation can be brought together. This integrative capability, together with spatial analytics, is the essential component that makes GIS so valuable today.

Maps are becoming pervasive

Geospatial technology is now becoming a platform for just about every industry. For example, in utilities they are mission critical for asset management, analysing outages, and allocating/assigning work orders. For transportation companies they are becoming essential for routing and scheduling. In disaster management they are the foundation for predicting, managing and recovering from these events. Finally, in academia, they are essential for analysing relationships and patterns, and thereby unlocking our understanding of how geography works in physical and cultural settings.

Our experience is that about every human activity is now embedding and leveraging geographic knowledge in some way. Maps are becoming pervasive ways for everyone — from citizens to decision makers, from planners and engineers to managers — to understand what is happening. In this respect, GIS is cross-cutting and the information that is abstracted winds up supporting multiple industries at the same time. It is becoming a kind of language.

Integrating technologies

Modern GIS is transitioning into a platform that integrates all types of geospatial technologies and data types into a system for supporting geocentric workflows. It is also open for developers who provide complete application solutions to customers. What the platform means is that on the measurement side as well as on the app side, industry partners are embracing a common platform and becoming part of a broader geospatial ecosystem that provides integrated solutions. This represents an opportunity for more system integration at the COTS level and interoperability between the whole family of technology providers in the geospatial industry.

Industry and academia are partners in the mission

Fundamentally, industry and academia are partners providing education and ongoing research into emerging methods and tools. While the traditional role of the academic is at times one of being disruptive and contentious, it is also a rich place for industry collaboration and joint efforts in the mission of education and research.

Policy direction

The history of GIS has been one of applying tools to specific applications and projects. Over the years there has been a vision for organising these individual efforts into a common geospatial infrastructure with common data and shared information. This has been difficult as it requires a common technology platform (now everywhere) as well as collaboration and sharing of information across traditional barriers of science and bureaucracy.

Nevertheless, I see emergence and development of shared geospatial services that can be leveraged by individuals, workgroups and across organisations. This requires leadership as well as policies that facilitate this kind of collaboration. We are well on the way to this with open data policies across government and while this is not a new thing for GIS users, it seems to be picking up at the highest levels of policy direction. In North America, we have enjoyed this because of our constitution that mandates open access of all government records. This is referenced by our Freedom of Information Act which makes it clear that all citizens have a right to access public information. These policies are largely being implemented by many governments in EU, India and occasionally other locations in the world.

A new motivation here involves the belief that data shared by government can stimulate the private sector, allowing industry to build new types of apps on government data. There have been many studies that illustrate, with a few exceptions, that innovation developed, evolved and supported in the private sector is far cheaper than that developed under government. The evidence of this is clear, not just in the geospatial industry but also across almost every other software and hardware innovation in the IT world.

This is not to say that government should not fund fundamental research into the development of advanced innovations, but it should not be in the business of actually trying to either adopt these as enterprise systems or turn them into products in the traditional bureaucratic setting.

The way forward

Fundamentally, Esri will continue to deliver COTS software solutions and an online platform that supports the users. We will also continue to seek out business partners who create solutions with our technology. Increasingly, we see our platform emerging in ways that integrate many of our traditional competitors. This is creating a kind of geospatial ecosystem of solutions. In this evolution, we will continue to develop open platform technologies as well as facilitate business partnerships that are powerful for the community.

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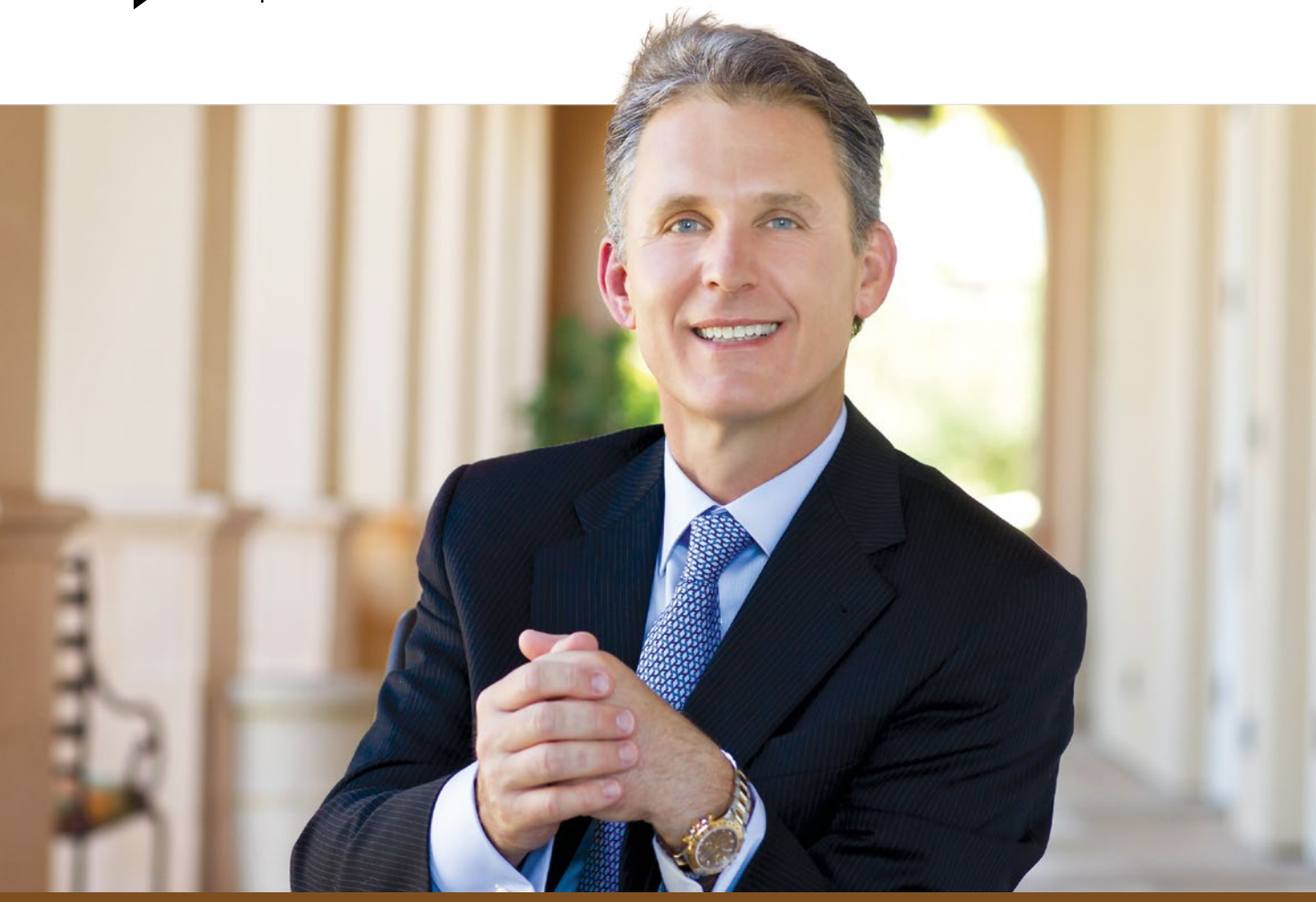


A Time of Innovative

As the availability of real time data has become a critical need for businesses, industries across geographies are required to become more productive and innovative in meeting the current and future demands of the user

Ray O'Connor
President and CEO
Topcon Positioning Systems

There is an old but very accurate saying, "You can't manage what you can't measure." Today, in all forms of geopositioning, that adage is more appropriately edited to say, "You can't manage in real time what you can't measure in real time." This is a major change across every industry that our technology touches. We are going from the inefficiencies of post-processing to the agility of real-time data.

Just like it has become a second nature for us to manage our personal information and schedules via mobile devices from anywhere on the planet, our products connect with our solutions via the cloud to enable our customers to manage their critical measurement data — and more — in real time.

An extraordinary shift is taking place in our industry right now that is melding

Coalescence

the productive forces of vast information, innovative machine control and measurement systems — and the power to manage it all from one place or many places, then deliver it to exactly where it is needed at any time. It is a rare period of innovative coalescence that is reorganising the way the world works. At Topcon, we use the phrase 'continuous representation of reality' to describe this integration of technologies that is propelling the real time management and productivity of our customers.

Closing the construction and agriculture gap

The population of our planet in 2012 was seven billion and it is said that by 2030-2040 it will increase to nine billion. So, how are we going to meet the infrastructure needs of all these people and how are we going to feed them? If we look at the agriculture industry, the arable land is growing at a very slow pace, with much of the existing productive land being consumed by commercial development. In 1950, the productivity of an average US farmer fed six people. Today, an average US farmer is feeding 200 people. To meet the future population's demands, an average farmer will have to feed 400 people using the same arable land. Although agriculture productivity has grown tremendously, it must begin to increase exponentially.

The same basic scenario exists for infrastructure. A few years ago, Standard and Poor's revealed a chart which depicted that by 2030 the demand value for infrastructure worldwide will be $60 trillion while the available funds through taxes and private investment are projected to be only $24 trillion. So, how do we bridge this gap? We must create and employ solutions that are much more efficient, productive, and sustainable. This is the biggest challenge and opportunity for our industry. And it will take all of us — customer, competitor, educator, and government — to ensure the technology is in the hands of trained users to meet it.

Challenging traditional models

At Topcon, our traditional focus has been to serve the three major verticals: surveying, construction and agriculture. Surveying and construction go together in many aspects. For example, a typical construction cycle begins with surveying to collect data to assist the design. The completed design moves into action as the layout work begins, no matter if the project is building, roadway, utility, or other infrastructure. Traditionally, inspection of the work is done at predetermined intervals.

But the innovation required to meet future needs challenges the traditional model and reshapes it from vertical crafts working in a linear fashion to multi-dimensional businesses working from real time information driven models. A goal of Topcon from the beginning was to provide technology and solutions to help surveying companies expand their expertise into all dimensions of the construction cycle. This is a critical component to ensure information-based productivity. Today, we provide complete solutions that provide this integration from before the project starts until after it is completed.

> **An extraordinary shift is taking place in our industry right now that is melding the productive forces of vast information, innovative machine control and measurement systems**

We are very holistic in providing measurement, mapping and machine control solutions. But we also take pride in partnering with other leaders within our industry. To help advance innovative positioning into the BIM space, we work closely with Autodesk. To help bring the most efficient machine control to the vast earthmoving industry, we partner with several manufacturers and have helped create a fully integrated dozer and excavator control systems.

Advancing automation

We realise that increasing productivity 'vertically' is important, but we cannot fill the construction and agriculture gap without reshaping the entire workflow. That begins with taking full advantage of the technology that surrounds us in order to not only manage but also automate the largest manufacturing industries in the world — construction and agriculture.

It has been a goal in the making for decades, but with the combined forces of the geopositioning and data industries, it is now within our grasp.

Everybody is looking for 'spatially enabled' analytics. Whatever you do at the end of the day, you have to analyse the data

KK Singh
Chairman & MD
Rolta India

GIS is No More a Niche Technology

Geospatial technology is playing a critical role in decision-making across a wide spectrum of human endeavour — from the micro perspective of an individual's needs, like navigating in an unfamiliar neighbourhood, to the macro perspective of broad government policies, like pursuing the world's most wanted terrorist. In fact, in today's world, geospatial technologies are being seen to significantly enhance the quality of decision support systems resulting in more effective business and public governance processes. Businesses and government agencies are able to get far deeper insights from their business intelligence and analytics applications when these incorporate location intelligence.

There is, therefore, no doubt that the world economy will make significant investments in not only geospatial solutions, but also in creating

One of the most significant developments in the recent past has been geospatial convergence. Technologies, which were considered discrete and disconnected up until a few years ago, are now more connected and well integrated

comprehensive spatial data repositories suitable for integration with business systems. There is evidence that such investments are already underway.

3D mapping is a game changer

Today, three market trends are quite conspicuous. Firstly, around two-thirds of the world has not yet been mapped. This is both a challenge and a huge opportunity. Even in the remaining one-third part of the world which has been mapped, there is a shift from 2D to 3D mapping. 3D mapping is becoming a necessity because the kind of information and data it creates can be a game changer for any organisation. However, 3D mapping requires specialised competencies and technologies.

Second, GIS is no more a niche technology. Almost 80% of data that is generated has a context attached to it. However, for contextualising and visualising it, integration of geospatial and IT data is important. What is more important is that different technologies should be able to seamlessly integrate geospatial data. And lastly, everybody is looking for 'spatially enabled' analytics. Whatever you do at the end of the day, you have to analyse the data. Rolta has created a technology that enables us to integrate disparate data, analyse, add context, and give almost real-time information to the user. That is what differentiates us from our competitors.

From ubiquity to necessity

I cannot think of any major industrial activity that will not benefit from geospatial technologies. The convergence of geospatial technologies with industry-specific information systems has enabled the harnessing of true potential of geospatial information and technology for improving the productivity and efficiency of enterprises across different industry domains. The best way to appreciate the widespread use of spatial content in diverse areas is to consider a real-life example with which I am personally familiar.

An example of a state-of-the-art geospatial technology being deployed is the recent award of a $25 million plus project to Rolta for creating an intelligent 3D city for an emirate in the Middle East. This is an extremely ambitious project. Data collected from disparate sources is being integrated into a 'CityGML' data warehouse that can be accessed via the Web by users based on security access privileges of each. To overcome the challenge of standardisation, transformation and conversion of huge 3D datasets from disparate data sources and formats, Rolta developed an automated solution. As a result of this, 3D datasets can be rapidly converted with high accuracy and reduction of effort.

This project has raised the bar for municipal management by adopting such an approach for analysis and simulation for sophisticated applications like city planning, simulation of disasters, emergency response planning, critical asset surveillance and protection, etc.

Visualising data is more intuitive

One of the most significant developments in the past few years has been geospatial convergence. Technologies that include GIS, remote sensing and other earth observations, location based services and navigation systems, which were considered discrete and disconnected up until a few years ago, are now more connected and well integrated. Visualising data on a map not only significantly enhances the user experience but is also more intuitive. Studies have shown that representing the data visually creates a more compelling user experience by representing critical data through different colours, heat maps, pins and markers, proximity, etc. Geospatially tagging data enhances location-specific intelligence which enables organisations to gain new insights and make faster decisions.

Such convergence of geospatial technologies with other mainstream technologies is enabling the harnessing of true potential of geospatial information. Spatial information is being increasingly exploited by the common man, with the assistance of location based services and smart mobile devices, to get information

Spatial info is exploited by the common man, with the help of location based services and smartphone devices, to get information that is more relevant to the 'where' aspect, 'orientation' and 'when' parameters

It is generally agreed that in India the geospatial data policy requires urgent review, since it is overly restrictive with respect to dissemination of information and is based on archaic considerations

that is more relevant to not only the 'where' aspect, but also the 'orientation' and 'when' parameters. It is, therefore, evident that convergence of technologies will present unprecedented levels of business intelligence in a manner that will change the way even routine tasks are conducted.

Standards are critical

Standards are extremely important for wide adoption of technologies. Without standards, development of solutions and their continuous evolution would entail prohibitive costs and timelines. Since geospatial information is now being used as part of diverse mainstream business applications, it is critical that standard data formats and storage structures be established for interoperability, and for avoidance of dependence on any specific vendors. When one considers the fact that geospatial technologies are at the heart of many mission-critical solutions for businesses and governments, standards assume great importance for business continuity.

Rolta has been involved in assisting various organisations to establish their spatial data infrastructure standards. Companies like Rolta will, and must, participate in wider industry initiatives to define standards.

Workflow is a critical aspect

Rolta has been at the forefront of developing intellectual property (IP) that integrates spatial and non-spatial data from disparate sources. Our effort has been to build industry-specific solutions that combine vertical domain knowledge with geospatial and IT expertise. These are 'productised' solutions that can be readily adapted for diverse vertical segments, thereby providing a cost-effective approach.

For example, the Rolta Geospatial Fusion framework has enabled the company to deliver several replicable solutions, such as economic development, enterprise asset management, transportation assets management, utilities management, the issue of 'No Objection Certificates' for construction and digging, and SmartCity — intelligent 3D city modelling to name a few. Geospatial workflow is a critical aspect for all these solutions. More and more organisations are geo-enabling their workflows.

Need to strike a balance in policy framing

While spatially-enabled business applications are now becoming quite prevalent, the government sector at local and national levels is by far the larger beneficiary of geospatial technologies. It is, therefore, a given that governments will play a key role in shaping geospatial technology and its uses.

Since geospatial information can be of a sensitive nature, government policy will have to strike a delicate balance between making content available widely, and addressing public safety concerns. It is generally agreed that in India the policy in this regard requires urgent review, since it is overly restrictive with respect to dissemination of information and is based on archaic considerations. As mentioned earlier, there is overwhelming evidence that integration of geospatial systems into mainstream business and e-governance processes leads to enhanced effectiveness, and is even essential for national development.

The road ahead

Rolta has developed a repository of very sophisticated IP that integrates geospatial and mainstream IT. This IP is at the heart of numerous solutions for BI, big data and analytics tailored to suit the needs of a variety of vertical segments. Rolta will continue to invest in enriching its portfolio of IP-based solutions and expanding the scope of applications in each of the vertical segments it addresses.

Rolta encounters competition from providers of point solutions, but that is now a decreasing threat because customers see value in integrated solution platforms, such as Rolta Geospatial Fusion and Rolta OneView. In fact, Rolta's IP-based solution platforms enable it to compete and win against even the big consulting firms for enterprise-level solutions.

Our approach has been to develop platform-agnostic solutions. Like Rolta OneView has been designed to work with both SAP and Oracle technologies, allowing customers to protect their investments in technology. This also enables Rolta to work cooperatively with providers of core IT platforms, including SAP, Oracle, Microsoft, IBM, Esri, and Intergraph. This has resulted in extending Rolta's reach in the global marketplace.

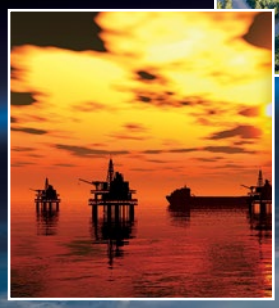
MDA DELIVERS A WORLD OF GEOSPATIAL INFORMATION IN NEAR REAL-TIME

Global Maritime Domain Awareness

Urban Infrastructure Monitoring

Natural Resources and Agriculture

Disaster Assessment and Response



Oil and Gas Operations and Environmental Compliance

MDA is a leading provider of geospatial information products and services. We support users around the world with the complex information products they need for:

- Near real-time maritime domain awareness
- InSAR for urban infrastructures
- Flexible multi-resolution imaging options for natural resource and agriculture monitoring
- Rapid assessment and response services for disaster events
- Innovative solutions to enhance field operations and safety in the oil and gas sector

MDA operates RADARSAT-2, the high-volume, high-resolution synthetic aperture radar satellite and distributes its radar image data and derived products worldwide, along with the world's highest-resolution optical satellite imagery to North American customers.

MDA manages a network of RADARSAT-2 ground stations that provide near real-time access to geospatial data over the world's landmass and oceans. Our growing suite of value-added products and cost-effective services are critical components of efficient operations and informed decision making processes.

www.mdacorporation.com

NGA: Working with Communities

The centerpiece of NGA's focus will be an effort called 'Map of the World' — an interface for all our customers, whether they are in WHO, in the military or in the State Department

Robert Cardillo
Director, National Geospatial Intelligence Agency, USA

The National Geospatial Intelligence Agency (NGA) of the United States is moving in the right direction with the right objectives. However, I intend to work on changing our speed and focus. I think we need to accelerate in a few areas and also focus our efforts on fewer things and do them better.

Map of the World

The centerpiece of that focus will be an effort we call 'Map of the World.' This will be an interface for all of our customers — be it the customers in the World Health Organisation (WHO) or officers in the military or in the State Department. We want to give them an easy and faster way to digest all our information. It sounds simple, but in order to achieve that, we have to create standards for all our data and they have to be metadata tagged in the same way. It is not the exciting work we usually get involved in, but if we don't do this baseline work, we won't be able to give an effective experience to those customers through Map of the World. So, from products we are moving to providing dynamic proactive persistent intelligence; and Map of the World is at the heart of that.

We are increasingly working with first responders in communities in the United States and around the world

Organisational priorities

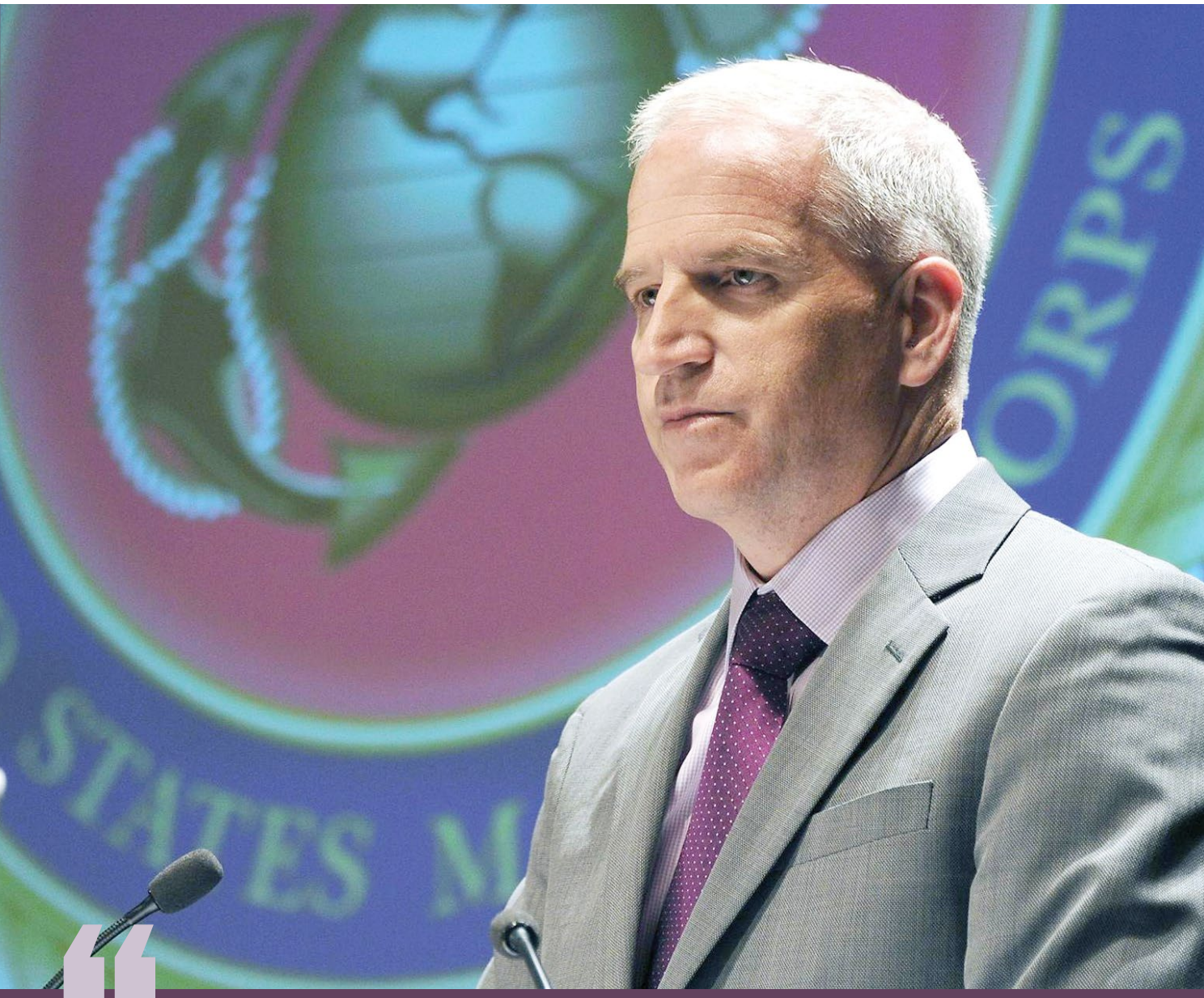
We are a member of the United States intelligence community — we work against the priorities that are set by our customers. Those customers are in the White House, the State Department, the Defense Department — and of course the deployed forces around the world. We are increasingly working with first responders in communities in the United States and around the world who need help in cases such as a hurricane or a tornado. In addition, because the world is so different now and because of the explosion in technology, another priority for us has to be 'how do we accommodate all of these new technologies?.' Twenty five years ago, the world was simpler because the inputs were few. So you could take your time and be careful and rigid in your processes. That won't work in today's scenario. It is a priority of mine that we have an architecture that is open to non-traditional sources and we accept outside data as well as develop our own.

NGA's role in international intelligence operations

NGA is playing a key role. For example, whether it was the tsunami (Asian) a couple of years ago or the typhoon that struck the Philippines a few months ago, NGA, in response to the US deployment of assistance, relief and recovery efforts, sent analysts, geographers, and computer specialists to provide assistance. They would support not just the US relief workers and the combat forces going in to provide supplies and materials, but also support the local governments whose ability to know where the damage is and how to deploy their resources to the areas was most affected. We have been doing this for years now and have been busy of late because of all the disasters happening. However, one can't know exactly where and when the next disaster will happen. So, we are currently working on creating a flexible capability which we can employ wherever and whenever it is needed. The Map of the World is the key conduit vehicle to provide that.

Scope of geointelligence

Water scarcity, energy security, the movement of refugees — all these



Water scarcity, energy security, the movement of refugees, all these things have a geographic connotation to them. NGA looks to provide a framework, platform and the data for the bigger conversations that need to happen on these issues

things have a geographic connotation to them and form part of the non-traditional part of our business. We have been able to employ our capabilities in concert with traditional providers of worldwide energy outlook or the UN's efforts to ensure water security or food security going forward. We may not be experts on food security, but we will provide a framework to understand both the threat and risk, and also the solution. We can provide a venue where people will see how best to address these problems. So essentially, we look to provide a framework, a platform and the data (wherever we can) for the bigger conversations that need to happen.

The confluence of technologies is creating magic for the construction industry. Now it is just natural for people at construction sites to use technology

Bhupinder Singh
Senior Vice President
Bentley Systems

Construction-Driven Design is

I believe the construction segment of design-build-operate has been one that historically lagged from a technology implementation standpoint. Today, the availability of cheap mobile devices like smartphones and tablets, the availability of Internet connectivity and the availability of all the devices on the construction site itself — a combination of this flexibility has served as an inflection point. We are seeing that construction profes-

Translating the digital world and putting it into the physical world at the actual construction site is a challenge

sionals and construction businesses are very open to rapid decisions and so the sales' cycle is getting shorter.

The interesting thing is that it is a cross-all industry. For example, if you take construction in oil and gas sector with multibillion dollar plants, every single day the plant is not completed is lost money. So they have been willing to build the 3D models and create all the other information together and then utilise technology in construction that can help them accelerate their plant design. Bentley has solutions for the oil and gas industry, which are quite mature.

When one designs, one typically designs system after system — say, electrical system, HVAC system, structural system — and brings them together. But actual construction is done by area. One then has to break it apart by areas and that is usually a problem. Usually, one would give drawings and collect everything that has been done. But all of this is now happening electronically, so one has to create work packages for an area, which starts decomposing the system-based design. So, construction-driven design is a big trend now. Another trend is the industrialisation of modularisation, where one can significantly accelerate the construction by bringing the pre-fabricated components together.

Translating the digital world and putting it into the physical world at the actual construction site is a challenge. For example, a drawing may show a plate to be laid 5-feet from the centre of a column. But the column is yet to be built. People on the construction site spend a lot of time trying to get such positions on the site. So, Bentley is working with construction equipment companies like Trimble, where we can identify discreet points on the design, called layout points. Using the layout point, devices now know where one needs to drill/or put a particular column/plate, etc. So, the next five years will see a huge change in productivity in construction. It is an exciting time for this industry.

The G Power

When one designs a building, typically one never designs specific to the actual location where it would be built. There's a virtual reference point and everything in the design is relative to that reference point. It is only now perhaps that there is a need to fix this infrastructure piece to a 'location' on the planet as people want to perform drainage analysis, seismic analysis, solar analysis, etc. This is a relativly a new aspect of our industry, where geospatial technology components have become very critical. It is only four-five years since the geospatial technology aspect has become an intrinsic part of the construction sector. Apart from modularisation, geospatial technology is fundamental in every other area of construction. The physical world and the digital world meet with geospatial technology.

When you look at any of the projects there are hundreds and thousands of people working on it across geographical boundaries, organisational boundaries, and functional boundaries; the only way to make all of them work together is to connect them through a common framework. So, it doesn't matter if you are a planner or an engineer or an operator. Our common environment has many dimensions for different projects;

One can't have just one tool that's going to give BIM. Information has to go from that one tool to the next tool and then get added to the third tool. That information mobility is at the heart of BIM

a Big Trend Now

be it for modelling, deliverables, creators or for performance. For the past couple of years we have been working on this common environment that enables one to connect personnel in the field with people sitting inside an office. You can also connect the owners with the contractors.

From a hardware standpoint, things are getting cheap and ubiquitous and they need to partner with people like us to make their data actionable. So, for the sensor data to be actionable you not only have to collect it, but also put it into context with working models. If you need to go from data to information you need to tie it to some kind of model and that whole fusion is where the magic happens. You get the model, you get the data and then you can look at how the two react. An engineer can look, react and manipulate the model to reflect what the results are showing and can make really effective decisions. So making these better decisions is what is enabled by the marriage of sensors and information.

It does not matter if you are a planner or an engineer or an operator. Our common environment has many dimensions for different projects; be it for modelling, deliverables, creators or for performance

Towards a solution-centric industry

If you visited a construction site 10 years ago, you would not have seen any Internet facility or mobile devices. But now the confluence of so many things has happened that there is a sudden inflection and that is kind of magic for us. When you take three to four things together like consumerisation, Internet, radio, hardware, cloud — you can get something magical happening in the construction industry. Now it is just natural for people at construction sites to use technology.

Leveraging BIM

BIM has two connotations. One is within the design axis, trying to get richer and more detailed models. The other is its use across the infrastructure lifecycle. The fundamental way through which this happens is what we call information mobility. One can't have just one tool that's going to give BIM. Information has to go from that one tool to the next tool and then get added to the third tool. That information mobility is the heart of BIM.

So, the whole information mobility story would be — now that you got your design, you create your construction work packages. Every construction work package has design artifacts in it. At Bentley, there is ProjectWise for design and construction and there's AssetWise for the owner, a handover system through which the owner starts getting information. ProjectWise and AssetWise start having a BIM conversation. We have AssetWise solutions for transportation and utilities, and we are extending AssetWise solutions for oil and gas. The flow from construction to operation and from design and construction to operation is not a one-time event, because if you look at any plant there's always maintenance. Typically, design and construction was one set of activities with capital expense, maintenance is an operation expense. So capex and opex — I think closing the loop is going to be Bentley's mission for the next decade.

In fact, governments across the world are increasingly mandating the use of BIM and civil building codes. The UK government is one of the few governments that is defining BIM with level 1, level 2, level 3 with increasing degrees of sophistication on both the axes. So level 1 BIM might just be using 2D drawings for design, but level 2 BIM is using model with simulation during construction. There's a level 3 BIM definition that the UK government has adopted. Bentley has set up a BIM Academy, a construction academy, in our London office, where we get the industry leaders, construction companies and owners to come and learn from each others' experiences. The Government too is learning about what sort of mandates it can make so that the industry doesn't complain and can move forward incrementally.

Standards and interoperability

Over the years, we have worked with many different standards bodies, though our engagement is with only a few of them. OGC is doing a lot of work that has geo-context and we are participating in it. Especially in construction industry in the UK, this is the only initiative and we are looking at the confluence of both of them with regard to our construction solutions. So we are looking at where we can learn. We would like to see OGC take a leadership position in terms of strictly spatial origins and also look into the broader context of how all things fit into the spatial context.

Bernhard Brenner
Head of Geo-Intelligence
Airbus Defence and Space

The Real Intelligence is Hidden in the Imagery

The earth observation business is not all about resolution and accuracy but about how soon you can provide the images and what intelligence you can extract from the data

It is pretty clear that the earth observation (EO) industry will move towards higher resolution, but this business is not all about resolution and accuracy. It is mainly about activities — in what timeframe you can provide the images and how flexible you are with your services. Imagery may be available for free — but is it up-to-date and of the required resolution? Airbus has two satellites that are pretty new — Pléiades1A and1B — and they still have a long life. Most customers like the kind of images we are selling and appreciate our responsiveness.

We also have location-based services after we reached an agreement with Google last year. There are many others in the market who could be interested in our business. We also have traditional customers in the civil institutional market. The way forward is to go more into solutions-based approach, but we will continue to work with our resellers and address some verticals directly.

A solutions-based approach

There are various satellite imagery types available on the market. The Sentinel satellites, part of the EU and ESA's Copernicus programme, will provide imagery that is free at the point of use. However,

The way forward is a solutions-based approach, but we will continue to work with our resellers and address some verticals directly

the real intelligence is hidden in the imagery and one needs to extract that. We want to continue to grow in our business solution service, part of which includes mapping and data streaming. Last year, Airbus's value-added services contributed 30% of its total turnover. If you compare us with our competitors, this is not too bad, though I think we can grow further still.

Solution business means that one needs to have the capabilities and the knowhow in the area they are dealing with, be it agriculture or any other field. As a part of the Airbus Group, if we look at the defence or aviation business, we do have a deep knowledge of these sectors inside our group, so we do not pay for such insight. I think this makes us an attractive supplier compared to our competitors who need to purchase such kind of information. As we work closely with our colleagues e.g. from Airbus Helicopters, we can get the required information on this business segment first-hand and free of charge.

The solution business is something that we are expanding into, but we are focusing ourselves on specific areas such as defence, oil and gas, maritime business and other programmes in CIS business. We treat our resellers as partners and have always felt they add value to our products. We want to grow directly in the vertical segments and create solutions. Last year, we held successful Channel Partner Conferences in the US, Europe and Asia, and this year we are doing the same.

Airbus offers various solutions for handling data cubes. In particular we manage hundreds of geospatial layers on behalf of government agencies in the UK and disseminate the data to thousands of users. We also offer a data management solution called DataDoors, which is ideally suited for handling large complex data archives. In addition, we supply bulk data processing tools like our Pixel Factory, which can also integrate data from UAVs. In addition, we have a strong heritage in interpretation and analysis, and today perform these both automatically and — where needed — visually through one of our experts.

In the geo-intelligence arena, we do have different business models — the Pléiades satellite model, which is associated with the French government, a PPP model with the German government for TerraSAR-X and TanDEM-X, and the AstroTerraprogramme, which covers Spot 6 and 7, financed solely by our company. So, we already do have different business models and maybe we can be more creative with this in the future, to find the right business model. Even on the customer side the things are moving. This kind of creativity is partly given by companies like Skybox. They give a different answer to this heavy CAPEX industry. But then again, we have huge opportunities.

Access to data matters

Data streaming and making it available is a key element, because that is where even established customer groups have issues. So this is a very important part here, i.e. making the data available, giving access, streaming it and even formatting it. This is an area that we are increasingly seeing as being key to our business and we are keen to promote it as a core competence. There are other major players in this area, for instance Esri, and I do not think we will move into the business segment as a software provider. We might overlap here and there, but that is about it. In one word I would describe these technologies as enablers.

Airbus is very active in the area of GIS. We are a leading player in the integration of various datasets for analysis either as a data provider or as a system integrator. We are active in the area of land administration and public safety where geospatial data is one input. Some of our activities are purely GIS, for example, the recently awarded contract for the mapping of offenders in the UK for the Ministry of Justice. A core competence of our business is in data management solutions. We are technology agnostic when it comes to partnering with companies. The more we are able to feed data to different systems, the better for us. We will not focus on just one solution but feed our data into various systems. Another area that needs attention is 'analytics' — interpreting the data, driving the conclusion out of the data and combining it with other sensors — which I think is very crucial.

Maturity of market

We also take all the new competition seriously and as a sign of maturity of the market. We have already started working with some of them, including Skybox, and are interested in working with others, too. We also have to see whether they are capable of satisfying the customer on the concept of low cost and higher revisit constellation. I think the market will be pretty interesting in the years to come.

The market will become mature and people will tackle this market in a more progressive manner. It is a pretty dynamic environment, which is the reason why so many private investors and venture capitalists are putting their money into it.

Innovative sensors

The major question is: how can we make our products faster, cheaper, better, and more accurate? As a sensor provider, we will be looking at completely different ways of creating geospatial information

Donald Carswell
CEO, Optech

The biggest trend for the coming times, based on popularity and interest, is unmanned aerial vehicles (UAVs). I think they are going to end up being game changers in ways we are not anticipating right now since regulations and capability expectations vary between countries. For instance, UAVs may go on to generate so much interest in geospatial information that they create fresh demand for, say, conventional ways of acquiring it, whether it is satellite, aerial or mobile mapping.

The second one, I think, is just the increased appreciation for geospatial information that has been generated by the Google Earths and Bings of the world by putting that information in front of an average consumer. For example, there are more and more expectations from smartphones. You want to not only get information on where you are going, but also obtain visually appealing spatial information about it. You do not want to just see a map to the store you want to see, but what the store looks like. You might ideally want to actually look inside the store and learn more! So it is things like this that drive how we respond as manufacturers.

Two-pronged focus

At Optech, we are looking at two major thrusts. One is that we want to keep on making our conventional products, like the aerial terrain mapping LiDAR systems, as efficient as possible. This is because it is all about the cost of carrying out a survey or a remote sensing campaign. We are always upgrading our products so that it is easier for a client to undertake a survey. For example, in our new Galaxy aerial product, we do not talk about the field of view in terms of degrees, but in terms of the on-the-ground density and the swath width you want. The magic of the sensor is that it adjusts the field of view as you fly to always maintain that density and swath width over varying terrain.

The other thing we are doing is looking at brand new areas — new technologies or applications for a technology that can solve problems that exist today. Of course, there is a great deal of innovation in the industry around micro sensors, and how to intelligently apply them to UAVs. This will also generate new markets and new types of information that will make their way into our smartphones, expanding their use to a broad base of consumers.

We are focussing on potential innovations in airborne and mobile sensors. When you are trying to come up with something new, you need to be a little cautious and ensure you shape the future product in a way that serves the existing and developing markets better. The major question is how can we make our products faster, cheaper, better, and more accurate. As a sensor provider, we will be looking at completely different ways of creating geospatial information. An important point we keep in mind is that there is no point in offering a sensor with amazing capability if it is not solving the client's problem.

There are three new products that are already attracting a great deal of interest. One is our new airborne LiDAR system called the Galaxy, and the second is a new version of our LMS processing software. The third is the world's first multispectral LiDAR system, which is actually ushering in a new era in active sensing and information extraction.

Our main focus is on easier-to-implement and more efficient aerial mapping with LiDAR and integrated cameras. We have been in the mobile mapping and static laser scanning markets for many years, though we will also be entering non-traditional markets. These new markets depend more on software algorithms, where the product is not so much a physical thing as the intellectual property implemented inside software, including the algorithms and workflows that make it easier to do something that you already do. There has been significant technology innovation in the industry, such as dense point matching, which creates points from photos, and there have been advances in how you process GPS information. That is more of the direction that we are looking at in the coming years.

> **Some of the biggest changes in our industry are not going to come from our technology; they will come from individuals' desires for certain capabilities and how we are going to balance those with regulation and privacy to allow them to exist**

for new markets

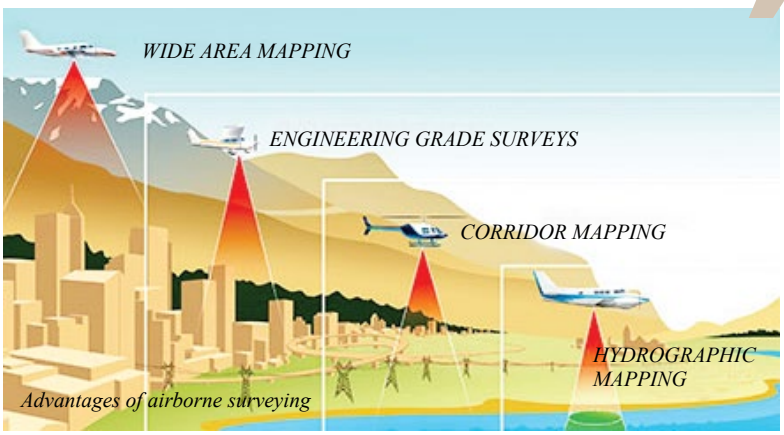
Need for greater accuracy and precision

Optech is already at the forefront in precision and accuracy. In the United States, USGS is a big driver of accuracy and standards, and currently our airborne Pegasus sensor can fully meet and actually exceed the USGS specification for accuracy even when operating from 3 km AGL. At that altitude, I would say we can collect 4 points sq/m with an overall accuracy of far better than ±8 cm. So, as new standards come along or the accuracy demands increase, we are of course ready to push further. We are already in a good position in the aerial and terrestrial scanning industry when it comes to these specifications, whether mobile or tripod based. The typical range accuracy on our long-range scanners is still sub-centimetre, even over distances of 1-2 km.

There is no point in having terabytes of geospatial information if you do not have intelligence to draw the information from them. I have always looked at it the other way — the bigger and faster computers get, the more they are going to create

There is no point in having terabytes of geospatial data if you do not have intelligence to derive the information from them. With adequate IT capability, geospatial will go on to fill the vacuum and put terabytes of information onto desktops and the cloud

demand for geospatial information. Nobody is going to ask for centimetre-level resolution from a kilometre away if they do not have a way to store, manipulate and extract the high volume of information from it. This means the IT capability has to be there. With adequate IT capability, geospatial will go on to fill the vacuum and put terabytes of information onto desktops and the cloud.



Advantages of airborne surveying

Balancing act between regulation and privacy

I actually think some of the biggest changes in our industry are not going to come from our technology; they are going to come from individuals' desires for certain capabilities and how we are going to balance that with regulation and privacy to allow those capabilities to exist.

If you look at what happens every time a new smartphone model comes out, there is a new capability that almost always requires geospatial information. Even with something as simple as tagging photos, or as complicated as a 3D visualiser on the phone, the changes in our geospatial industry are just phenomenal, particularly when you get into the ability to use the information you are gathering without even knowing it. The changes have been dramatic and we can assume they will continue to be so.

UAVs are going to end up being game changers in ways we are not anticipating right now since regulations and capability expectations vary between countries

The position of every cellphone in this building is known… but what do we do with that? Do we want to do anything with that data? Is that going to violate the privacy of an individual? Does the right to privacy change as you move that cellphone from country to country?

Consumer market vs professional market

To me, the consumer market is just a continuation of the professional market. For instance, the imagery that any of our professional clients gathers could be for a very specific engineering purpose — to build a bridge or road — but it could be that the same image is going to wind its way into a library that is going to make it a part of Google Maps. So I think the professional market has similar challenges because of the rules, approaches and expectations that are being established in the broad consumer market.

I see the trend in the larger geospatial industry to complement each other's technologies and marketplaces instead of compete with each other as a natural thing. Companies have to be brave enough to do it, even though when you do link up and partner with another company, you know you are exposing your secrets, clients, approaches and interests to that other company. In many cases this takes a leap of faith. So, although the practice has been around in the industry for many, many years, it is definitely picking up steam now. This has partially been driven by the cost of trying to be experts in everything, since that is simply too expensive.

Optech

GALAXY™

With PulseTRAK™ technology — No more compromises!

Power, Precision & Productivity

Galaxy packs tremendous density performance into a compact form factor for un-matched application and platform flexibility. Survey wide areas with the same point density and collection efficiency as that of much larger dual-beam sensors; map mountainous environments seamlessly and with consistent point distribution; and deliver double the vertical density of other sensors for improved complex target resolution.

- High-performance, fully-programmable scanner for superior point density
- Continuous operating envelope eliminates multipulse transition zones and maintains point density
- Dynamic scan FOV that automatically adjusts to terrain variation for consistent point distribution
- Up to 8 discrete returns for maximum vertical density
- Realtime XYZI for true-coverage verification and target detectability

Please join us at: ILMF 2015 • February 23-25 • Denver, CO • Booth #26

www.optech.com

Known for its IFSAR data, Intermap has repositioned itself as a 3D business intelligence (3DBI) software solutions provider, opening up new thinking and newer markets

Todd Oseth
President and CEO
Intermap

Location is Key to Next-Gen Geospatial Platform

The aspects and opportunities of 3D business intelligence applications are endless, but they are all anchored by fulfilling the promise of location-based answers. For instance, when a tsunami hits the islands of Indonesia, where do you send people if the storm hits the coast? When you are at Walmart and 5 inches of rain falls, how do you route your truck fleet to avoid the water? These are just a few examples of 3D business intelligence (3DBI) applications and there are infinite verticals that can be addressed. Our Orion Platform can provide answers for the oil & gas industry, the insurance industry, the advertising industry, the telecommunications industry, and several others.

Data is important

In 100% of the cases, multiple datasets are needed to deliver a location-based answer. One of the challenges is that there are so many data and file formats in the geospatial market that it is not possible to perform analytics on these different sets. Many people take these formats and put them into a single GIS format. While that might work for some applications, one must worry about data integrity, security and user authentication. Many of these features are changed when they are brought into a GIS application. We, at Intermap, took an approach to maintain the dataset formats and metadata so when we make computations, we do not alter the rights or integrity of the data. We are then able to distribute the disparate datasets in a unified manner to many different users. This unified dataset

When you add our data services to our software infrastructure and applications, we are delivering systems to Asia that are better than most spatial data systems in the world

can then be formatted to be distributed by standard web protocols.

GeoPro can stand alone and help people distribute their geospatial data. It also becomes a single repository for an organisation to have one place for all geospatial content. GeoPro is not a GIS; it's an enterprise service bus.

Data is the foundation of our software products. It is here to stay because you need data to provide an answer. We also happily provide data layers within our software from other vendors. We do believe that our radar technology (IFSAR) is a clear advantage in the industry and in our software. We will continue to offer this data acquisition service for large areas, especially in cloud covered areas. Much of Southeast Asia is under cloud cover, 360 days a year, so it is hard to use any type of optical technology. Our image resolution is sub-50cm and it produces a radar image that looks like a picture. It is very easy to classify features with this dataset and to answer questions. We will expand our use of third party radar sensors as they become economical. In addition, we will be acquiring and fusing LiDAR data as the applications demand. Of course, we have teamed with all of the large satellite vendors for imagery. The bottom line to our data strategy is that it is designed to help customers find answers to their questions by using our data or incorporating somebody else's.

Tapping different markets

Over 70% of our sales are outside the US. Most of our business is in Asia. Our World 30 data is distributed worldwide. We have a 5 metre database that contains all of the United States, most of Western Europe, lots of Southeast Asia, and a little bit of South America and the Middle East. When you add our data services to our software infrastructure and applications we are delivering systems to Asia that are better than most spatial data systems in the world.

We are a worldwide provider of location-based answers via the Orion platform. We sell everywhere and we aggressively pursue areas of the world that do not have an updated spatial data infrastructure (SDI). These areas include the Middle East, Africa, Asia, and South America.

Market forces and customer needs do not allow MDA to be primarily an imagery provider anymore — there is a shift towards extracted information services

David Belton
General Manager, Geospatial Services
MacDonald Dettwiler and Associates

A Continual Shift in Business

In the late 80s and early 90s, Canada was beginning to plan where it wanted to invest in space. One of the pressing demands the country faced was to have a better understanding of what was happening in the north (Arctic region). There were really few technologies at the time that were capable of addressing that area. One particularly suited technology was space-based radar systems, so Canada made a decision to strategically invest in that area. This gave birth to the RADARSAT programme. Since then, maritime surveillance has

The future for the RADARSAT programme is the RADARSAT Constellation Mission, which is now a fully-funded programme

become a huge and pressing issue for Canada, and ultimately this became the RADARSAT-1 mission.

RADARSAT-1 was launched in 1995. It had a five year design life but actually ran all the way to 2013, which is over 17 years of operational service. RADARSAT-2 was launched in 2007 and it has a design life of 7¼ years. The satellite is in an incredible health today, and with tons of fuel onboard, is expected to function for perhaps a decade or more. The future for the RADARSAT programme is the RADARSAT Constellation Mission (RCM), which is now a fully-funded programme. The Canadian Government entered into a contract with MDA for the build phase of the mission in early 2013, so it is in midstream construction. The parts are coming together now with a scheduled launch date in 2018 and a design life of 7-plus years for that mission as well. With the launch of RCM in 2018, data continuity for existing users of RADARSAT data would continue.

A public private partnership

Through the RADARSAT-1 and RADARSAT-2 eras, the success of the RADARSAT programme was based on some investment by the Government of Canada in the infrastructure. In the RADARSAT-2 era, this came in the form of an effectively prepaid purchase of imagery to MDA. Then, through the course of the mission, MDA delivered on the prepaid purchase commitment. MDA also made significant investments in the construction and operation of the mission, so the public private partnership has taken the form of a government pre-purchase of data and MDA investment in manufacturing and operations.

In the new RCM (RADARSAT Constellation Mission) era, things are back to a traditional model — where MDA is manufacturing and constructing a Government-funded mission and the company is also in discussions with the Government to commercialise the data.

MDA has a particular market focus in its business: defense and security, particularly maritime surveillance, are the top market verticals and the company spends a lot of its time and energy in developing that market. The second focus is the oil and gas industry, and within that industry MDA provides a range of services. Perhaps the most robust and mature is offshore oil spill detection and monitoring, which MDA does for commercial oil and gas operators and government regulators. MDA also does onshore subsidence monitoring, using a technique called INSAR that measures very small changes in surface elevation over active reservoirs where oil and gas extraction is happening. This is done for the purpose of safety and to help the industry understand the impact their activities are having on the environment over those reservoirs. The third focus is the natural resources sector — MDA has a range of services, particularly in the areas of ice monitoring and detection of illegal fishing.

Value-added services

MDA's business is going more and more in the direction of extracted information services as opposed to imagery. Because of market forces and customer needs MDA cannot primarily be an imagery provider — it needs to deliver more information and value to its customers.

For MDA and its customers to be successful, the company has to help the customers extract the information for radar imagery. For example, when we talk about surface subsidence and deformation services, what MDA is providing its customers is not imagery but deformation maps describing vertical motion. When we talk about maritime surveillance, while imagery might be a component of that service, these maps are often deliverable as a text information product with ship location, heading, speed, etc. There is a continual shift in business, more and more towards these value added services. This doesn't mean MDA does not sell imagery — that is still at the core of the business. It is a service as well as a product model — there is a range of subscription-based services. For example, in maritime surveillance, the way service is provided is that a customer who wants monitoring of a certain area signs up for it. In other cases, there is a product delivery model whereby MDA delivers products to customers in response to an emergency event, or they are bought and sold on the basis of a customer order. It varies depending on the customer and the level of service he wants.

Catering to emerging markets

The overall MDA strategy is to become a multinational company. In order to address that strategy the company is looking to find ways to become more of a local presence in emerging markets and geographies like Brazil and India. Natural resources are driving a lot of geospatial activities in these economies and the company has a particular focus on building local partnerships with organisations that are operating in these domains and locations. Places like Brazil, where mining is a major endeavor and deforestation is a major issue, are well suited for some of MDA's technologies.

> **In addition to exploring new markets we also believe that we are responsible for knowledge transfer. We are now leveraging ADCC Academy and training locally and in overseas markets to develop local knowledge base**

Total Solution is the Keyword

As the world demands faster and faster solutions, all technologies will come under one roof for providing end-to-end solutions and services to mankind

Amit Somani
Jt. Managing Director
ADCC Infocad

As GIS industry's approach changes from being a mere service provider to a solution provider, I think total system integrator would be a crucial aspect in the coming times. Till date, most of the work was focused on creating base maps, databases, and project consultancy. The focus now is to be an end-to-end solution provider. Our solutions will work at solving the entire equation; starting from the GIS data (spatial and non-spatial) creation, integration, analysis, implementation and maintenance. In terms of technologies, I believe LiDAR and low-altitude aircraft/drones will play a crucial role in the future.

In the coming time, all the technologies will come under one roof for providing better services to mankind. If you look at the current

projects in the Indian scenario, you will find this happening quite often. In power reform projects, a common sight is geospatial technology converging with engineering solution for integrating business analytics/CRM for electricity domain. On the same lines, survey and mapping have already converged with mobile technology for projects in land information system.

Similarly, when we analyse solutions from various geospatial companies like Esri, Intergraph, Autodesk and Bentley. We find that they are also moving in the same direction. I think the time is not far when customers will use a combination of geospatial technologies as per their strengths to service their needs.

Smartness is the mantra

At ADCC, we are working towards smart city solutions. With rising demand for resources and space, especially in a country like India, where population exceeds the resources available, we need 'smart' solutions. As a rising world power, India needs its systems to be social, mobile, available, reliable, and technology driven.

We are banking on smart city solutions as the one unique selling solution for the coming year. A smart city uses location-based information to enhance performance and well being, to reduce costs and resource consumption, and to also engage more effectively and actively with its citizens. Key 'smart' sectors include transportation, energy, health care, water and waste.

The focus next year would also be on exploring solutions for land, energy and water. In the land domain, we will be focusing on agriculture. Though India is primarily an agrarian economy, our production efficiency is less than that of countries like the Netherlands. Better land use and production management systems are the only solutions towards a more efficient output. With GIS and remote sensing solutions, the food producers will gain the ability to frequently monitor their crops at increasing resolutions, enabling them to introduce a more direct correlation between their actions, yield, and gain. Farmers can then decide the best production plan and prepare better for forthcoming seasons. We plan to explore various GIS services to cater to the agriculture industry.

The modern fast-moving world expects dynamic smart services, and service providers, utility companies and civil authorities can utilise location-based services to cater to this demand. Such solutions have a direct impact on the lives of the population and upgrade the living conditions drastically, while also aligning with our vision of providing services that optimise customer investments.

High on India and Africa

Investments from governments, demand for setting up National Spatial Data Infrastructure (NSDI) in developing countries in the African continent and general demand for geospatial services are important drivers of our business strategy.

India is looking to invest about $101.96 billion for development of roadways connecting cities and villages. Another $92.41 billion will be invested in urban housing projects and government has also allotted $11.15 billion for smart city projects, in which they have targeted about 100 cities. GIS and remote sensing technology will provide the ground work for setting up these countrywide projects initiated by the union government. We plan to collaborate with various government agencies in order to deploy these schemes and enrich the resources with latest technologies like LiDAR.

In our overseas ventures, countries like Zambia, Uganda, and Tanzania are being helped by the World Bank funding to set up NSDI and we plan to bid for these projects and expand our presence in these regions.

We are banking on smart city solutions as the one unique selling solution for the coming year. The focus next year would also be on exploring solutions for land, energy and water

New markets and geographies

Other than India, we are already well rooted in Kenya, from where we serve the markets of Uganda, Tanzania and Rwanda, while our Ghana unit serves Nigeria, Liberia and Senegal. We have also set up base in Zambia and Namibia to serve countries like Botswana and Mozambique. We are also planning to increase our presence in Central and South America by foraying into markets in Peru, Chile, Colombia and the Caribbean Islands. ADCC already has an office in Mexico and is exploring emerging markets like location-based services and business intelligence, agriculture insurance, electricity and water distribution.

In addition, we also believe that we are responsible for knowledge transfer. We are now leveraging ADCC Academy and training locally and in overseas markets to develop local knowledge base.

For BIM implementation, we will be focusing on Far East Asia and the Middle East. Although we do not have immediate plans to enter Europe, US and Australia, we may explore opportunities and partnerships 2018 onwards.

Do More with Less

In these demanding times of limited growth and changing market opportunities, companies should focus on integration of various technologies to provide customers with higher performing instruments and improved workflows

Dr. Johannes Riegl

Founder & CEO
RIEGL Laser Measurement Systems

We have one of the most diverse LiDAR portfolios in the marketplace, which has proven to deliver according to the slogan 'Innovation in 3D' and served the international markets with cutting-edge solutions

The broad array of products that RIEGL has developed over the last several years reflects the diversity of the geospatial ecosystem — stationary and terrestrial solutions, mobile and airborne solutions and now the exciting small UAS field. Within each of these categories, RIEGL offers systems designed to meet the demands of specific niches within the segments. RIEGL, which undoubtedly has one of the most diverse LiDAR portfolios in the marketplace, has proven to deliver according to the slogan 'Innovation in 3D' many times over the last decade, and served the international markets with cutting-edge solutions.

Small UAS is the way to go

We have been monitoring the field of sUAS for quite some time, and in 2014 began to address the requirements of the exciting new emerging sUAS trends. Year 2015 will provide us with an opportunity to meet with customers and to implement and train on the remarkable technologies on board the RiCOPTER.

The introduction of RiCOPTER at InterGEO in Berlin 2014 reflects our overall strategy and product development philosophy for the markets we serve. RiCOPTER is an innovative multi-sensor solution for the sUAS requirements; it is a completely integrated mapping solution that demonstrates superb integration of multiple geospatial technologies. The speed and movement of the aircraft reflect the determined purpose of a mapping mission. The flight characteristics and the sensors on board provide users with a dramatic leap forward for a 3D scanning platform. I used to call it "The Flying Laser Scanner". The unique performance of the RiCOPTER enables the user to custom tailor the density of the data collection to the requirements of the project.

The logical step following this was the development of the RiCOPTER to offer a complete turnkey solution. The integration of multiple sensors on this unique platform is the continuation of the broader strategic initiative of multi-sensor integrated platforms such as the VMX mobile mapping system, the recently introduced hybrid scanning system VMZ, the LMS-Q1560 turnkey airborne laser scanning system, and the brand new VQ-880-G for combined topo-bathymetric/ shallow water surveying.

Complementing each other's technologies

There is a trend in the geospatial industry towards complementing each other's technologies and this is to be seen in the ever-expanding solutions from RIEGL that incorporate multi-sensor approaches to the mapping requirements. In these demanding times of limited growth and changing market opportunities, we believe in providing our customers with higher performing instruments and improved workflows to increase their profitability by reducing acquisition and processing time to a minimum for the desired deliverables. Integration of various technologies provides our customers with the ability to do more with less.

A wide variety of technologies like LiDAR, GNSS, camera, and imaging sensors are all being carefully integrated and calibrated to enhance productivity and the completeness of our customers' activities. This is not only with our well-known sensors but also with the equally powerful software complements for these high-productivity solutions.

For instance, RiCOPTER is the first multi-copter developed by a LiDAR manufacturer, fully integrated with the VUX-1 LiDAR sensor specifically developed for UAV-based aerial missions. The VUX-1 delivers detailed LiDAR datasets, and in combination with the RiCOPTER, provides an efficient solution for a variety of applications such as corridor mapping, powerline mapping, and pipeline inspection has become available.

A wide variety of technologies like LiDAR, GNSS, camera, and imaging sensors are being integrated to enhance the productivity of our customers' activities

Policy makers do not understand technical jargon and one of the big emphases for UN-GGIM is to take on this challenge. The geospatial community has to talk about outcomes and outputs, and change and impact; that's when the decision makers start listening

Stefan Schweinfest
Director, UN Statistical Division
& UN-GGIM Secretariat

UN-GGIM: In Pursuit of a Common 'Geospatial' Language

What always surprises me is the reaction of people when I mention the word 'geospatial'. When I tell my friends at the dinner table that I have just attended a meeting on Global Geospatial Information Management (GGIM), they look at me as if I am saying something alien and strange. But surprisingly, each and everyone in that room would have used geospatial information via their smartphones, even to get to that particular restaurant. Increasingly, with all the new technologies, geospatial information management has become a part of what everybody does every day, but they are unaware of it. If you ask a person on the street, "Are you a geospatial information manager?", they would say, "God! No." On the other hand, if I rephrase my question and ask, "Do you use the mapping application/app on your phone?", they would say, "Of course I do, I just used it to find the closest Citibank office." This disconnect is experienced by many people, from policymakers to even some United Nations leaders.

The United Nations Global Geospatial Information Management (UN-GGIM) Committee of Experts is working to bridge this divide by highlighting the value of geospatial information, by facilitating the building of successful spatial data infrastructures (SDIs) at the national, regional and global levels.

Value proposition of SDI

Some important factors for a successful SDI revolve around standards, interoperability, sharing of information, using appropriate tools and technology, and making SDIs more agile and inclusive, so that they can harness and consume information from anywhere and deliver information to anyone at any time for a multiplicity of purposes. It's work is more about facilitating a framework, having dialogues with ministers and decision makers who are asking questions about the value proposition of SDI.

Stesalit announces the launch of the SXtreo series of GNSS/GPS devices with complete mobile mapping capabilities at an affordable price point

Designed and Conceptualized in India, SXtreo Range of Rugged Handhelds are Ideal for Field Survey, Field Work and Industries Combined with GIS Mobility Apps from Stesalit

Enterprise GIS now has an affordable companion. The missing link from enterprise GIS to mobile GIS is now addressed by the series of product launches from Stesalit under the SXtreo family. SXtreo addresses the need for GPS accuracy through its high sensitivity GPS receivers and includes the mobile mapping capabilities to all of the models at an affordable price point.

Built through years of research and development by the Stesalit R&D team, SXtreo has integrated the GAGAN capability and supports post processing, enabling a highly accurate GPS output through its multi constellation approach. Interestingly, Stesalit is the first GNSS devices manufacturer which allows the user to choose the GPS receiver of choice, through its modular hardware design.

Environmental stability and durability is a hallmark of rugged design and Stesalit is proud to announce that SXtreo has been certified for IP 68 standards by

ERTL-India, one of the highest levels of certification for durability, ensuring complete protection from dust and water.

The multifunctional device approach from Stesalit ensures that SXtreo exceeds the capability of a GNSS device and allows the user to choose and load general features of a smart phone and additionally a slew of sensors, biometric readers, RFID scanners, printers and other accessories as add-ons.

Built on open source architecture, SXtreo comes in Linux and Android variants with an inbuilt mobile mapping interface while incorporating all mobile mapping features with easy sync to all enterprise GIS installations.

Introducing SXtreo™ Smartly Rugged

Stesalit Unveils Android Based Mobile Mapping Software with Cloud GIS Architecture for Enterprise GIS Mobility

SXgeoCloud

SXgeoCloud is the First Android Based Mobile Mapping Application Software Introduced in India for Affordable GIS Data Collection, available on Cloud Architecture as Pay-per-use Rental Subscription Model.

The Android based mobile mapping system of SXgeoCloud supports over 50 OGC compliant formats and background raster Web Mapping Services. It allows users to acquire geospatial data including points, lines and polygons, along with their attributes with the advantage of creating new objects in the field. It supports all editing features and is flexible for users to work on offline and online basis with active sync to the SXgeoClould Server.

Stesalit announces the launch of Android Based OFFLINE Mobile Mapping Software for Enterprise GIS Mobility

SXgeoV

SXgeoV is an interesting product in the mobile mapping space that allows the user to enjoy all the features of a complete mapping interface on the rich GUI experience of Andriod through the SXtreo Android GNSS devices.

All of SXgeo mobile mapping systems support the following features:

- ❒ Manage survey operations, take GPS coordinates, waypoints, tracks and routes
- ❒ Capture geo-tagged photos
- ❒ Take notes, attributes or data in customizable forms
- ❒ Create hand sketches (Single line drawing)
- ❒ Export the data instantly through GPRS in .gdb .shp, .kml, and other OGC formats
- ❒ Creation of the output data in SXgeo from field gets populated in real-time
- ❒ Background Maps – Maps of choice for the AOI in the devices
- ❒ Create customized data models per feature type (networks / roads / assets etc)

For more information please visit www.sxtreo.com or email info@sxtreo.com

Stesalit

The biggest challenge perhaps for UN-GGIM is connecting geospatial information management to policymaking at all levels – mostly at the national level and also at the global level

At UN-GGIM, we have brought diverse groups of the geospatial community together, to talk and address the challenges facing the statistical as well as geospatial information communities, and to find their niche and offer their products and services. The interaction between the groups/communities requires a change in thinking. Data providers always think in terms of the production of data. They need to think more in terms of how their data can actually be used for various purposes. And that is where I think a dialogue, which is not so easy, between policymakers, users of data and the producers, is very important. Policymakers do not understand technical language and one of the big emphases for UN-GGIM is to take on this policy challenge. One has to focus on outcomes and outputs, and change and impact; that's when the decision makers start listening.

I think the biggest challenge perhaps for UN-GGIM is connecting geospatial information management to policymaking at all levels — mostly at the national level and also at the global level. Many of the challenges we are facing today are global in nature. For example, a disaster doesn't stop at a political border. Climate change is not something any single government in the world can solve alone. We need a collective approach to tackle these challenges.

We have a great opportunity in that respect with the post-2015 development agenda. The United Nations is reflecting on a new development agenda under the heading of sustainable development, which in its current proposed version prescribes 17 goals and 169 targets. This creates an information need that is enormous. UN-GGIM is working with other divisions in the United Nations Systems to infuse the use of geospatial information into the overall development agenda.

Supporting developing countries

UN-GGIM offers different degrees of cooperation in different regions. For instance, Latin America already has an agreement regarding its geospatial data infrastructure and they have developed a common language for cooperation. However, this is not the case with Africa. In this region, UN-GGIM has initiated efforts to strengthen the position of national institutions, by helping them engage in a dialogue with their governments and rallying around these countries to establish spatial data infrastructures by bringing various expertise and data together at a national level, which are otherwise fragmented.

UN-GGIM recognises the need to provide technical support at the operational level to assist countries to realise their SDIs. The current financial and technical resources available make it impossible to provide this level of direct support. We therefore facilitate tripartite arrangements, wherein we find a donor (World Bank, African Development Bank, etc.) who can actually help these countries set up their SDIs. I strongly believe that a dialogue can bring this to the fore at the global and regional levels, where we have strong infrastructure. Making it happen at the country level is yet another step.

Creating a global geospatial community

One can define achievements at various levels. A very tangible outcome is that UN-GGIM has been able to create a global professional community, which is reflected in the number and the spectrum of people represented at our events. That is no small feat, considering that the professionals from various geospatial sectors, from different parts of the world do not speak the same language. The initial fragmentation of the geospatial community is in fact one of the main drivers for initiating UN-GGIM.

Another achievement is the resolution on a Global Geodetic Reference Frame (GGRF) for Sustainable Development that is just walking up its way through the UN levels. It was adopted in August 2014 by the Committee of Experts and was adopted by the Economic and Social Council (ECOSOC) in November 2014. The final destination now is the General Assembly (GA) and given ECOSOC's unanimous support, the endorsement of the resolution by the full GA in early 2015 is very likely.

In no area that the United Nations touches here in New York can it help or be operational on the ground without a structure that is regional, sub-regional or even national. With respect to geospatial, the good news is that there is a lot of infrastructure that exists already. I am pleased to share that by the time we hit the five year review mark in 2016, we would have created five regional pillars — UN-GGIM Europe, Asia Pacific, Arab States, Africa, and Americas. This really covers the whole world. Once the work of the regional bodies gets going, we don't have to even lead it from New York, as the technical work is much better done at the regional level. At that time, I would be happy to focus more intently on the issues of global standards, guidance and developing linkages with policy processes.

Leading the way to a

SMARTER FUTURE

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Hemant Khemka
CEO, Stesalit Systems

We Believe in 'Make in India'

We are working to take this 'Make in India' initiative in a big way to penetrate the markets in other countries too

As a company, we have been investing heavily for the past few years into research and development to address the gap in the market for Indian-made rugged field computing and GNSS handhelds. We have ourselves used and have seen our customers using GNSS handhelds from manufacturers abroad; they are priced high and often beyond the budgets of many agencies, both government and private.

At Stesalit, we have competence in four diverse areas — geospatial technology, embedded engineering, high-end software development, and rugged mechanical design. This unique combination of diverse capabilities has given us confidence to design and manufacture our own brand — SXtreo rugged industrial handhelds — as GNSS devices in India, for the first time. We believe this would fill the void and make surveys, mapping and geomatics affordable in India.

New trends and technologies

Increasingly, there is a need for enterprises to take their enterprise

Financial inclusion is getting a very major thrust in India and elsewhere in developing countries. As a result, digital identification and its management are becoming major drivers

applications to the field. The field mobility segment in India has started growing fast, with geospatial technology as its backbone. Location Intelligence is becoming pervasive in all spheres of our lives. Intelligent devices and systems are in place now to capture location data in real time. In addition, big data analytics, cloud computing at a personal level, on-demand services with pay-as-you-get service, and wearable devices are becoming big trends in the technology domain.

Financial inclusion is getting a major thrust in India and elsewhere in developing countries. As a result, digital identification and its management are becoming major drivers. Smart Cities is another focus area for the Indian government — this too needs a lot of technology intervention.

We have competence in four diverse areas – geospatial technology, embedded engineering, high-end software development, and rugged mechanical design

Focus areas

We believe in the 'Make in India' initiative of the Indian Government. At the same time, the market for rugged field computing and handheld GPS and GNSS devices is growing tremendously. Right now our focus is to create an affordable solution for the Indian and Asian markets. We are working to take this 'Make in India' initiative in a big way to penetrate the markets in other countries too.

We are also developing and implementing Smart City projects, especially in the areas of intelligent transport systems and solid waste disposal systems. The verticals that we are focusing on are agriculture, transport, utilities, smart city, e-governance, and defence. Our focus continues to remain in these areas to build solutions that improve the process, and make it more efficient and affordable.

Expanding markets

Though our current focus is India and Asia, we have clients from all over the world. We are exploring opportunities in the Middle East too and have seen a lot of enthusiasm in USA and Europe about our newly launched SXtreo rugged handheld devices.

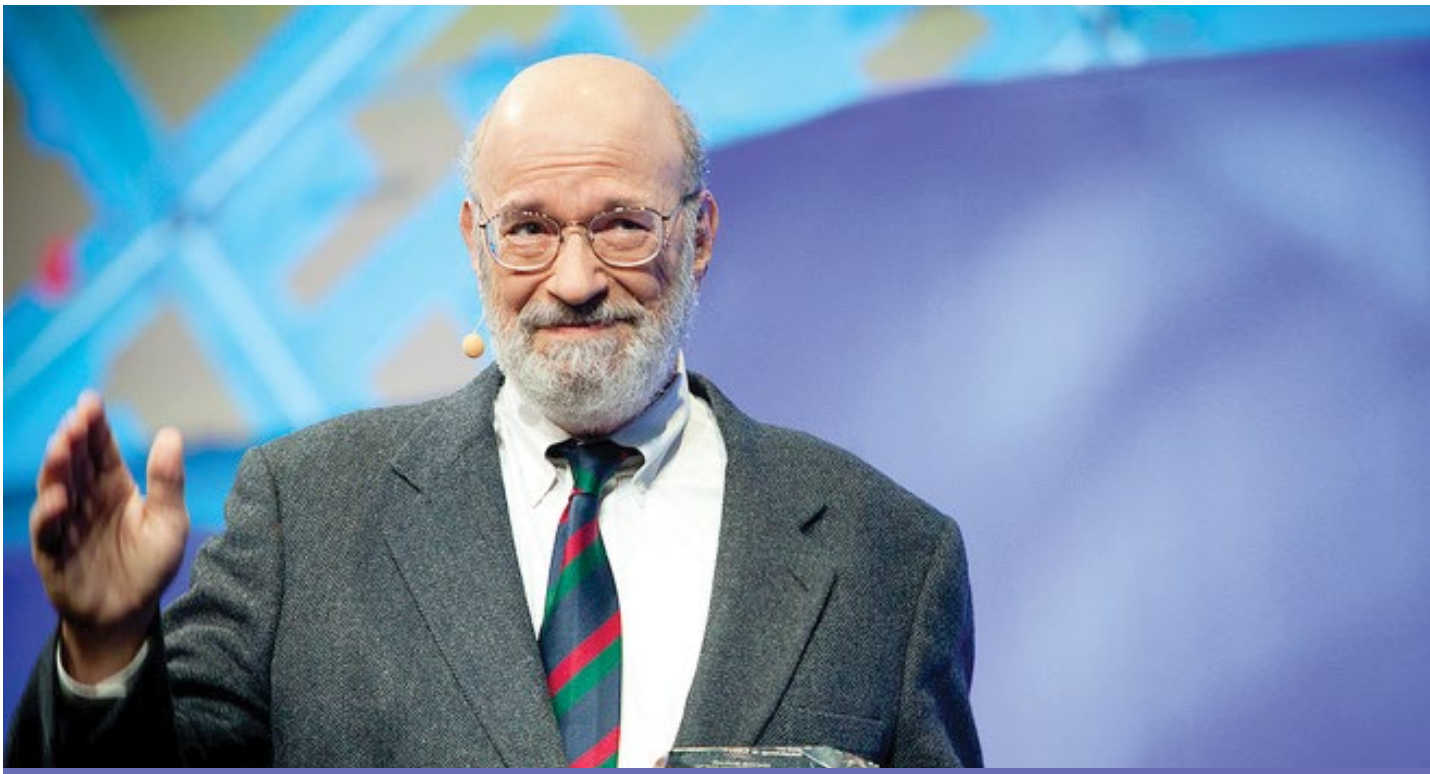
We are also exploring the market of financial inclusion, as the SXtreo rugged handhelds are ideally suited to the needs of last mile connectivity and secured banking in the field. In the agriculture domain, we are adding more features to our SXagro agriculture decision support system.

Complement, not compete

There is a trend in the larger geospatial industry towards complementing each other's technologies and marketplaces instead of competing with each other. We have been seeing this trend. We are talking to many of our peers to see the synergy we have and how we can complement each other. We believe in partnerships and collaborations and have had several collaborations in different technology domains.

Worldwide, a massive integration of geospatial information across government and business processes and enterprises is underway to improve situational awareness and decision making. Big data and cloud computing technologies have permeated into almost every other technology domain, including geospatial technology. Disruptive changes in these are bringing down the costs of operations in many of the scenarios.

With the increase and fast adoption in location intelligence technology, the availability of tracking data of everyday objects such as animals, vehicles, and people, we have a huge geographic data mining approach to detect generic aggregation patterns such as flocking behaviour and convergence in geospatial lifeline data. The entire domain of location intelligence is becoming the centre point of disruption and new technologies, as this now forms part of our everyday life.



Assimilating Geospatial & Interoperability Science

It is not a question of which or how a domain is helped or developed with geospatial technologies — all will be helped eventually

David Schell
Chairman Emeritus
Open Geospatial Consortium Board

The unique value of geospatial technology to both commercial and government organisations, is the simplification of increasingly complex global phenomena, markets and logistics. Working in the business environment of the future requires the ability to visualise and comprehend global issues and model innovative operational strategies based on integration of the multiple technologies through 'interoperability science'. Social networking, particularly Facebook and Google, provide some useful information resources to the public and generate a lot of random and linkable data to feed commercial and intelligence analysts for use in advertising, profit or for geopolitical advantage, but they don't immediately address the hard scientific problems involving the interaction of location variables, production requirements and international financial conditions.

Such data will have the immediate effect of driving cloud usage, which is just another form of a 'service bureau,' or IBM's concept of the 'compute utility', and will participate in the current marketing excitement of the cloud. However, considering innovations in processor technologies, network architecture efficiencies and

Standards and interoperability are ways in which organisations can save cost, time, effort and, in some cases, assets and lives

inevitable regulation based on security and privacy requirements, especially the unrestrained reselling of both personal and commercial data, I see a movement away from lightweight user devices like dumb terminals, desktops, and mobile devices, etc. This is similar to the growth of the 'super micro' industry of the 80s in the context of that decade's concept of the cloud called cluster computing, and the re-emergence of real-time distributed database applications, only now they travel on super-fast networks.

Who benefits?

Deployed and distributed industrial operations, in particular the increasing numbers of multinational concerns with just-in-time requirements, will be under growing pressure to optimise routing, assigning the greatest importance to organisational and logistical planning.

This is addressable only in application environments designed from the bottom up to address spatial and temporal variables as integral components of corporate process infrastructure. Such systems place process infrastructure at the centre of corporate business planning, where profitability depends on the efficient distribution of commodities and manufactured goods or the delivery of financial information across a network routing architecture. Examples of domains ripe to benefit from geospatial technology include energy and utilities, public safety and security, insurance, retail and consumer aids like indoor location and augmented reality, city management which includes integration of geospatial, built infrastructure and sensors of all kinds to improve city services, etc.

But, most importantly, it is not a question of which domain is helped by geospatial technologies and how, because all will be helped eventually! Rather, it is how efficiently high volume data in any domain is able to use the network. I envision the 'after cloud' markets of the future will be driven not just by transmission speeds, high capacity and router topologies, but instead by AI-based, smart network configurations incorporating geoprocessing and caching of location intelligence similar to those used by the major financial institutions for competitive micro-second level trading. Combined with miniaturised super-high-performance, high capacity sensor-driven personal devices of the future, we will find that the network will evolve to replace the vast, expensive and cumbersome data-centre and cloud configurations of the present day.

The evolution of geospatial workflow

Given the unpredictable, even chaotic, application landscape facilitated by universal access to web-based development resources, I can think of only two issues substantively relating to the future workflow profile of network computing. The first is the restructuring of the commercial environment for geoprocessing through the merging and consolidation of the major players in the field, and assimilation of the majority of geospatial technology and marketing resources by a few major IT and communications conglomerates. The second, a consequence of the first, is the evolution of IT architecture to accommodate increasing volumes of geospatial activity in the mainstream processing environment of the web.

It is evident already that a major consolidation of commercial geospatial enterprises is underway. The fast paced acquisition of closely related technology companies by Trimble Navigation, driven by an integral set of workflow objectives and technology affinities is one approach. Another approach is the more heterogeneous, investment-driven evolution of Hexagon, through an effort to embrace the entirety of the geospatial market by linking together under a corporate umbrella a collection of successful but far less coordinated and often competitive component companies. This is far more consistent with 'buy out' ambitions rather than with the close coupling of an enhanced technology product. Consolidation has also been evident in the extensive, conglomerate-like, partnership-driven growth and diversification of Esri, whose resources have enabled it to converge multiple geospatial market sectors through its own product development. But, like Hexagon, it is limited by its inability to control the broader space of web-based communications and IT architecture.

As this development continues, my sense is that the major IT suppliers, almost all of whom are already working on alternative foundation technologies with integrated spatial

Governments provide the data development resources and regulations needed to grow civilised and socially useful markets

Working in the business environment of the future requires the ability to visualise and comprehend global issues and model innovative operational strategies based on integration of the multiple technologies comprising 'interoperability science'

capabilities, will, within 5-10 years, execute the next step in the geospatial market consolidation process by either overwhelming or buying out these present market leaders and assimilating their capabilities into comprehensive proprietary solutions, much as the 80s saw the absorption of Artificial Intelligence by the likes of IBM and Digital Equipment Corporation (DEC), and office automation by Microsoft.

It is inevitable that geospatial technology will be assimilated into the most basic workflow architecture at every level of the IT stack — at chip, system design, network, and application interoperability levels. Web transmission speeds will increasingly become a function of hardware layout and the real-time spatial optimisation of network components. Workflow involving unprecedented data volumes and an 'internet-of-things' driven by virtually infinite sensor and mobile communication inputs will depend on micro-second timing algorithms based on spatial measurement.

The role of standards

Standards and interoperability are making a significant difference in public safety, climate change assessment and forecasting, defence and intelligence, energy and utilities by providing frameworks in which organisations can save cost, time, effort, and in some cases assets and lives. They will stimulate seamless integration of key workflows for agriculture through sensors, precision machinery and help advance the semantic web, where data can be spatially enabled, and the meaning of this data can be aligned with the user's training, profession and understanding of the world. The key to market advancement and keeping competitive edge is the ability to rapidly mobilise new capabilities into the hands of decision makers.

Compete and complement

There is incredible value in the integration, fusion and analysis of data from multiple sensors like aerial multispectral imagery, SAR and LiDAR, to achieve results that no single sensor can provide. Cloud and big data analytics will change the face of geodata capturing, processing, managing and delivery. Web processing and mobile delivery will continue to eclipse computer based processing. For commercial data providers 'open data' will continue to be a challenge as well as an opportunity to value add from the increasing variety of public information. Privacy will continue to influence all of this, and a focused effort to educate the regulators and politicians will be critical.

Role of governments and policy makers

Government institutions play a pivotal role in shaping the global geospatial industry of the future. Direct financing and the requirements of government contracting are sufficient to cite in this regard. But more than that, governments provide the data development resources and regulations needed to grow civilised and socially useful markets.

Governments, if they are motivated and civilised enough, are positioned to create policies that serve public needs and curb many of the abuses of geospatial information gathering and analytics. Without the guidance of government policy, individual privacy will soon be completely shredded and insidious political practices that limit the democratic process will be impossible to curb.

OGC's relevance

OGC's mandate is not just to serve present geospatial company and institutional requirements for interoperation, but to morph its concept of interoperability with the evolving logic and structure of domain markets and the technologies which serve them. OGC's Interoperability Program maintains its currency by constantly addressing platform innovations that define the current and evolving requirements of geospatial technologies from the most fundamental research in geodesy to the nuances of human communication. Like ISO's solid placement at the foundations of enterprise IT and guiding influence on the development of de jure global standards for information processing, OGC functions uniquely as the bedrock of standards for open geoprocessing, balancing the requirements of society at all levels with the geopolitical realities of a rapidly changing world.

With ties to ISO and all other major standards organisations dependent on its leadership in development of advanced standards for geoprocessing, OGC's consensus processes and broad-based membership have institutionalised it and positioned OGC to evolve successfully with the decade's transitional technologies and business models.

Pitney Bowes believes it is at a very interesting crossroad — one where it can harness the strengths of physical and digital technologies to enable commerce

Roger Pilc

Executive Vice President and
Chief Innovative Officer, Pitney Bowes

Putting 'Context' to the 'Where' Factor

Innovation is one of the three core pillars for Pitney Bowes. At Pitney Bowes, we believe that at the end of the day it is about solutions, services and business outcomes; it is not about technology. Our vision is to harness the strengths of physical and digital technologies, including location intelligence and geospatial services, to enable commerce.

Location is fast becoming one of the most important sources of data in the market today. A case in point is a recent study conducted by eBay and PayPal which found that a consumer was 60% more likely to respond to a mobile offer if the offer is informed by his/her location.

Pitney Bowes has always believed and stressed that geospatial location is important. Many forward thinking organisations are demonstrating that

Finding, analysing and putting context to location data is one of the best predictors of responsiveness to marketing campaigns

they believe in location as well. For example, Alibaba recently bought one of the leading Chinese mapping software companies. In a world that is going through a mobile transformation, separate technologies are now converging and location is becoming central to not just marketing communications but e-commerce. Finding, analysing and putting context to location data is one of the best predictors of responsiveness to marketing campaigns or communications.

Breaking away from silos

Telecommunications is one of the most exciting verticals we serve, and it illustrates the shift from GIS operating in silos to infused business intelligence. Insurance is another such vertical. These two verticals have been undergoing a transformational change. Both verticals are moving away from the traditional GIS use cases, such as determining the most suitable location to put up a cell tower or retail store, to utilising location data for making effective marketing, sales and inventory decisions. Telenor, one of the leading players of the telecommunications industry, has taken our location intelligence solution and integrated it with its SAP objectives to drive its marketing and sales decisions.

Over the same period, sources of data have become more varied and plentiful. All of a sudden you have geo-behavioural mobile data which can be used for better decision making. This paradigm is getting applied to many verticals at the same time. We are sourcing knowledge from different domains, combining it, analysing it and then handing it over to our clients to drive better business outcomes. One of the biggest challenges is collecting and managing big data. The bigger problem, however, with data science is the application of data to a business problem. That is the real magic, and that is where we excel.

Perfecting geocoding

Geocoding and reverse geocoding have been two of the most competitive products we have in our company. With time, we built our expertise in reverse geocoding. We have global reverse geocoding coverage of more than 240 territories at street level, and about 50 at a rooftop level. There are only two companies in the world which can do that. Our reverse geocoding algorithm differentiates us from our competitors.

We consider geocoding and reverse geocoding as part of our overall location intelligence business. We have taken these core capabilities and applied them to exciting new areas. For instance, we helped INRIX, one of the mobile traffic app companies, create a more location-intelligent mobile app. Using our geocoding and reverse geocoding technology, the app is being enhanced with a'geo-complete' feature. This means that if a user searches for a coffee shop on the app, the app would provide details of the ten closest venues meeting the user's criteria. So we have not only worked on strengthening our geocoding and reverse geocoding mechanisms but also applied them to other data to provide a service or a solution that a customer would value. We are also working on geocoding indoor locations.

Working towards a comprehensive solution

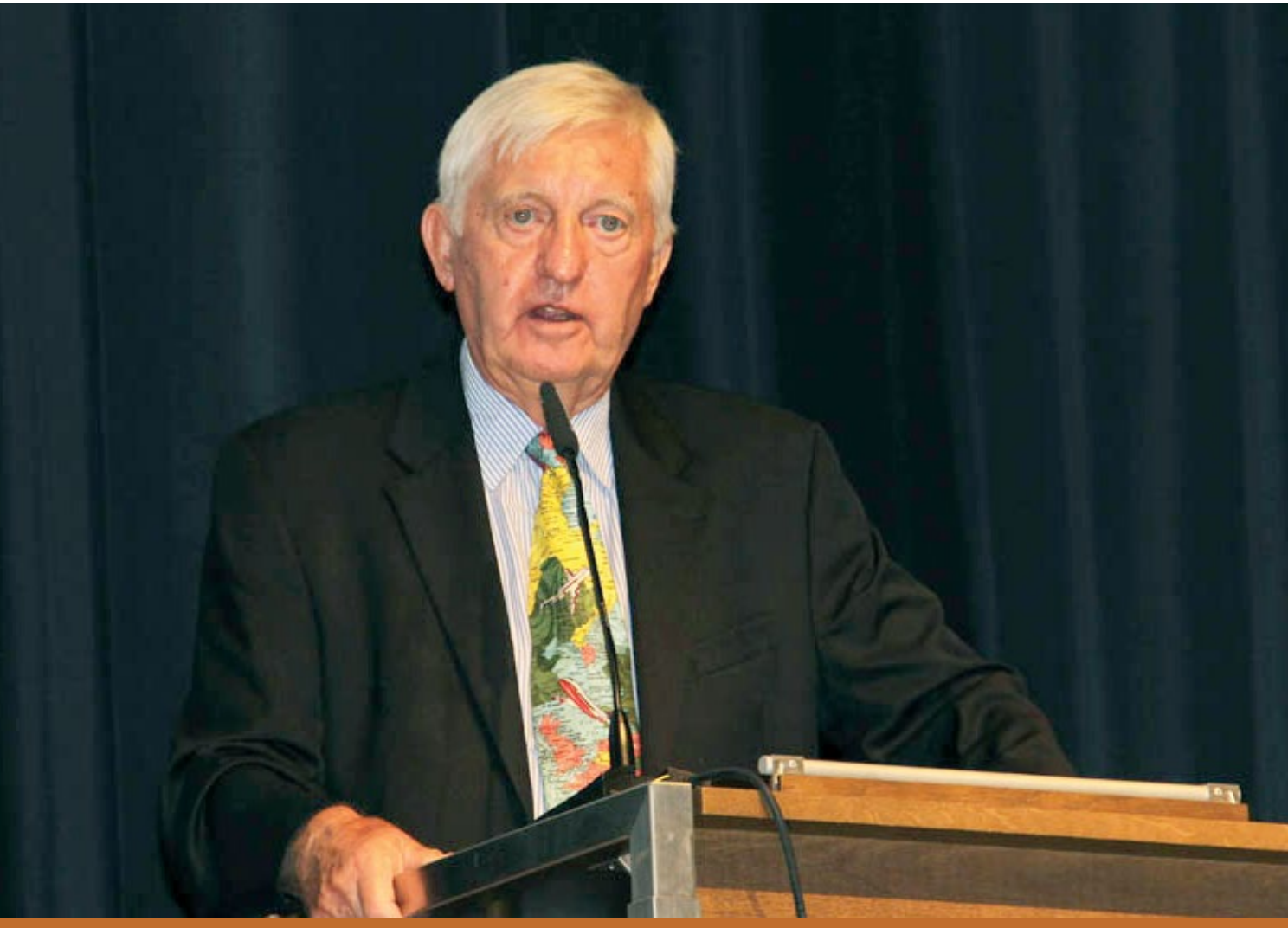
Pitney Bowes has been working with several other partners like IBM, SAP and TCS to further its vision of innovation. We think of partners as a means of accelerating our innovation as well as giving us knowledge of the technology or vertical domain. For instance, TCS is an important partner of ours, and they have a very large practice in insurance. We took their solutions for underwriters that also included business process workflows, and integrated them with our inherent geospatial and data capabilities to provide a more comprehensive solution.

The next logical step

We are investing more in innovative products. In the last few years, we have substantially increased our investment in research and development. We have increased our focus on the user experience. Building on our strengths, we have created the easiest of GIS tools now available in the marketplace by incorporating user feedback and taking care of user experience. Ultimately we believe we have succeeded in the consumerisation of GIS.

We believe our timing is just right. The abundance of additional data sources, including geo-behavioural information, will potentially make location intelligence even more valuable for our clients. To build on that, Pitney Bowes will continue to advance its capabilities in big data technologies. We are also working to make our products more accessible for developers, and easier to integrate into enterprise system.

We have very good technology vision and we are listening carefully to clients and, at the same time, we are focused on execution of these ideas to benefit the client. We are creating more innovation in a shorter time so that we achieve our goals more quickly than our competitors.



Academia is Stuck in a GIS Time Warp

The education and training that academia is providing is geared to the perceived needs of traditional geospatial industries and is overwhelmingly technical in nature

Prof. Fraser Taylor

Director, Geomatics and Cartographic Research Centre, Carleton University, Canada

> **Breaking down the silos between and among the custodians of government data is important to help release the full power of location**

Geospatial is not special anymore. Locational information on a wide variety of topics not usually associated with the traditional geospatial market is now ubiquitous and growing very rapidly. Almost all businesses, regardless of sector, can benefit from this opportunity — from the organisation of their own enterprise wide data management system to the sale of their products. This is especially true of the increasing market for location based services.

I believe that those industries which provide location based services are best placed to benefit first but this will spread to other industries. There is also evidence to suggest that if an industry reorganises its data management system using location as a key, there are considerable cost and efficiency savings in the longer run although the initial investment cost can be high.

The geospatial workflow will increasingly become an integral and possibly central part of the workflow in general, not a separate entity as is too often the case at present.

OGC participation is key

Access to, and linkage of, disparate datasets is crucial to all sectors of the economy. OGC is far ahead in terms of interoperability standards and specifications as indeed is the geospatial industry in general. Although developed specifically for geospatial data, I believe that these have much wider potential and applicability.

Many sectors could benefit from the work of OGC, not just the geospatial. But if the full potential of location based information is to be realised, then all geospatial players should be members of OGC.

Future Potential

There will be a continuing market for the core sectors of the geospatial industry, but in my view the real potential lies in increasing involvement in new fields and expanding the use of geospatial into new sectors with location as a key concept.

The role of academia

Academia has much to offer, especially in the development of new approaches to geospatial data management. Academia, as currently structured, is often like the French generals in the Second World War with the Maginot Line — perfectly prepared for the last war! They are too often stuck in a GIS time warp.

The education and training they are providing is geared to the perceived needs of traditional geospatial industries and is overwhelmingly technical in nature. This is of course necessary but by no means sufficient, and is one of the reasons that surveying schools (despite changes in name) are not recruiting students.

New opportunities demand new approaches. Academia is not agile but changes could be made within existing course and degree structures. How many, for example, are teaching the importance of standards and specifications?

It takes time to change academic programmes and industry is not prepared to wait for years for change to take place. In the short term, industry could fund training courses to meet more specific user driven demands. It is interesting to note that other disciplines, such as schools of business and management, are increasingly discovering the power of location. Perhaps more interdisciplinary interactions would be useful and industry could encourage this.

Governments have an important role to play

Governments have an important role to play in establishing the policies and structures which will enable location based approaches to grow. Open government and access to government data at no or low cost is critically important. It is encouraging to see many governments moving in this direction.

Breaking down the silos between and among the custodians of government data is also important to helping release the full power of location. Here, interoperability standards are important and many national governments, such as Canada and UK, are playing an important role in OGC.

It takes time to change academic programmes, and industry is not prepared to wait for years for change to take place

Access to Data is the Key

Users are not interested in new technologies; they want products and services that provide real, measurable value

Ryan Johnson
CEO, BlackBridge

There is a big push for new technology in the industry, but without clear end user needs in mind. There isn't so much one 'killer technology' that is changing the market, but rather the ability to leverage many smaller technologies to provide better solutions for customers. We have found that balanced investments across the entire value chain are what work best.

BlackBridge is a very customer-centric company. We are constantly on the lookout for new technologies to support our end users. A big trend we are noticing is that our customer base is changing and broadening to include a more diverse group of end users. These users are not interested in our 'technology', but in our solutions. They want products and services that provide real, measurable value.

Easy access and subscription access to data are definitely the biggest trends shaping our strategies. As always, our ever-widening group of professional customers drives our business strategies.

Almost all of our invoices are from commercial companies, but if you look at who is driving our demand it is almost always government programmes

The nano trend is catching up

There has been a lot of traction in the earth observation industry with a host of nano and microsatellites entering the market. Our RapidEye constellation is actually the grandfather of the microsatellite market and has proved itself to be an incredibly well-conceived strategy to provide content. It works very well at low cost.

But I think there is still some time before the industry moves entirely towards nanosatellites. The new developments in this sector are interesting and everybody is looking forward to them. New technology is driving cost savings for us in terms of our next constellation, RapidEye+. As more and more of these microsatellite systems become mature technology, we can leverage these technological advances because we are not a satellite company.

BlackBridge is a content company. We don't sell satellites; we use satellites to deliver content. So, if somebody has a nanosatellite that is cheap and fulfills all our requirements, we will use it. Currently, however, I do not think our requirements can be met with these small satellites. The technology landscape is changing very fast though, and it is something that we are watching very closely and are excited about.

The 'local' driving factor

We focus on creating horizontal applications that are beneficial to many users. But again, it comes down to the three L's — local knowledge, local relationships, and local investment. What we are doing in each region is a little bit different, based on the user need. One area that we have focused our energy on is our monitoring programmes for agriculture. We have partnered with regional players to distribute large quantities of data to subscribers. For example, for our monitoring programme in the United States, we are imaging around 3.5 million sq km each month on an ongoing basis. That is a big commitment and we are very pleased with the progress of the programme thus far. We are currently in the process of rolling this out to other markets around the world, including Europe and Asia.

One of our core business drivers is environmental issues. Our strategy is to build a system best suited to this application. We understand our customer base very well, as we regularly take feedback from them. BlackBridge is not so much about the technology itself but in the new things that people can do with that technology.

As far as new markets go, access to data is key. We have leveraged our investments into the geocloud and launched our new monitoring services that allow our customers unprecedented access to imagery.

It is interesting to see such exciting innovation coming from different parts of the world, too. Look at the activity happening in places like Brazil, for instance. Brazil's use of geospatial technology is growing incredibly fast. It is one of the biggest growth markets for us right now, and our partner Santiago & Cintra Consultoria has done a tremendous job of positioning products and solutions across a wide swath of customers there. We are glad that we are a part of what is happening in Brazil and we see the same thing happening in different markets around the world.

Europe and North America are also growing markets for us. For example, we have been working on a large monitoring programme, using RapidEye data, in the US agriculture sector. The programme has been very successful for the past few seasons and is continuing to grow.

Global concerns driving our business

In terms of the balance between commercial and government clients, one has to look at it in two ways. We sell through a commercial network. Almost all of our invoices are from commercial companies, but if you look at who is driving our demand, it is almost always government programmes. Governments around the world take responsibility for the environment and energy sectors. The demand in these cases is generally government driven, and we sell to them through a commercial network of partners. It is the big global concerns that are driving our business.

Populations are growing faster than ever and we need to have another green revolution. We have an ecosystem that is taking pressure everywhere that you look, we have shrinking biospheres, and we have species decline. The efforts that are going into protecting those resources are huge and that is really the work that we are focused on. The money spent on those issues is only going to increase over the coming decade, so it is really up to our company to take up a leadership role in environmental applications around the world. Our next generation of satellites, RapidEye+, is really designed to position us as the leader in these industries.

KEEP CALM AND BROWSE ON

www.geospatialworld.net

Sanjay Kumar
CEO, Geospatial Media & Communications

Value-Centric Market

Technology innovations and increasing access to geospatial information have triggered tremendous business opportunities leading to the industrialisation and mainstreaming of geospatial technology, while compelling businesses to align, re-align and consolidate

Forging Geospatial Alliances

Having had the privilege of meeting many of you round the year on multiple occasions and deliberating on the past, present and future fabric of the geospatial industry, I herewith pen down my own learnings and perspectives.

The year 2014 has brought in a watershed change in the geospatial industry, paving the way for an innovative, mature, meaningful, and value-based business direction. The year has seen leading players going on a quest to find a common playing field, with specialised expertise coming together to enhance winning combinations, expand horizons, and explore opportunities in an ever-growing but more competitive and complex market driven society.

Leaving behind misconstrued and narrow individual impressions, C-level executives of traditionally competing companies got courteous and exchanged business cards, designing a blueprint for converging and leveraging their respective capabilities. Being a believer of greater interaction and a facilitator of opportunities for industry leaders to shake hands, I foresee immense value in a co-competitive approach. I made the first of such efforts by inviting industry leaders for a breakfast brainstorming session in Amsterdam on 24th April 2012, and have subsequently been advocating the expanding scope of converging workflows involving companies having competing legacies. I must admit that C-level executives do see value in converging strengths and are driven more by a futuristic view of business. Encouraged by the need to bring together major stakeholders questing for geospatial *arth* (Sanskrit for value, purpose) under one umbrella, we have endeavoured to organise an exclusive executive session at 'GeoQuest', to be held in Goa this February.

Though the transformation towards this convergence may appear to be sudden, the determinants of change have been germinating for the last one decade. In fact, the term 'geospatial' itself could be considered a binding force for the integration and convergence of several independent yet interdependent technologies like imaging, surveying, scanning, GIS and 3D modelling.

Disruptive Change

The year 2005/06 saw a disruptive wave, when Google and Microsoft jumped into the geospatial ocean, extending its shores and making spatial information available at an affordable bandwidth and computing infrastructure, encouraging 'people' to play and communicate in geospatial language. Decades of effort by OGC to develop international standards and interoperability science came in very handy to facilitate the 'mashing up' of geospatial language with those of several industries like design, construction, banking, insurance, energy, water and transportation. Very soon, the geospatial community began two-way communication, wherein a consumer of information became a contributor as well through web and mobile platforms and especially in times of emergency situations, allowing geospatial platforms to become live and dynamic so as to provide spatial perspective and analytics to save lives and manage disasters.

The expanding user base brought in tremendous opportunities for innovation in terms of convergence and integration of geospatial technology with several mainstream disciplines of engineering, information technology, telecommunication, and data analytics. Several players, who until that time were just observers, suddenly found an opportunity to enter the geospatial industry, bringing along domain knowledge, financial capital, business leadership, and extensive outreach, initiating the process of industrialisation and mainstreaming of geospatial technology.

Industrialisation forcing consolidation

This industrialisation led to the evolution of geospatial workflows and their embedment to create solutions for government and business enterprises. While this has enlarged the scope of geospatial technology, it has compelled businesses to re-align and consolidate. The past five years witnessed four different and successful strategies for consolidation (Figure 1).

The first level of consolidation has been followed by geospatial players by restructuring geoprocessing through acquisition, merger, and assimilation of majority of geospatial and market resources. The Hexagon group (with limited

Autodesk and Topcon have been dating each other for some time; however, their bond can be strengthened further if Esri and DigitalGlobe join the alliance

affinity to core geospatial) first followed a strategy of acquiring major technology companies like Leica, Novatel, and Intergraph. It further acquired domain specific companies to integrate restructured geospatial workflows. However, Trimble followed a slightly different strategy of acquiring closely connected technology companies driven by an integral set of workflow objectives and technology affinities.

The second level of consolidation was driven by IT majors who included geospatial capabilities within the larger IT architecture, offering seamless web-based user interface although with different business drivers and objectives. Under this, the first category of IT majors includes Google and Microsoft and their motivation to add and offer geospatial content to their respective business offerings, creating geospatial content-driven IT platforms. The second category includes Oracle and SAP, whose prime motive was spatial enablement of databases. IBM, and to some extent Esri (along with its partners), falls in the third category, which was driven by Data Analytics and Business Process Platforms.

A phase of (ad)venturing into business-oriented but cautious partnerships through a combination of the above two models is an alternative consolidation model. The alliance of Autodesk with Topcon, FARO and Pitney Bowes, along with an open approach towards IT majors, is one such example. Similarly, Esri is entering into partnerships

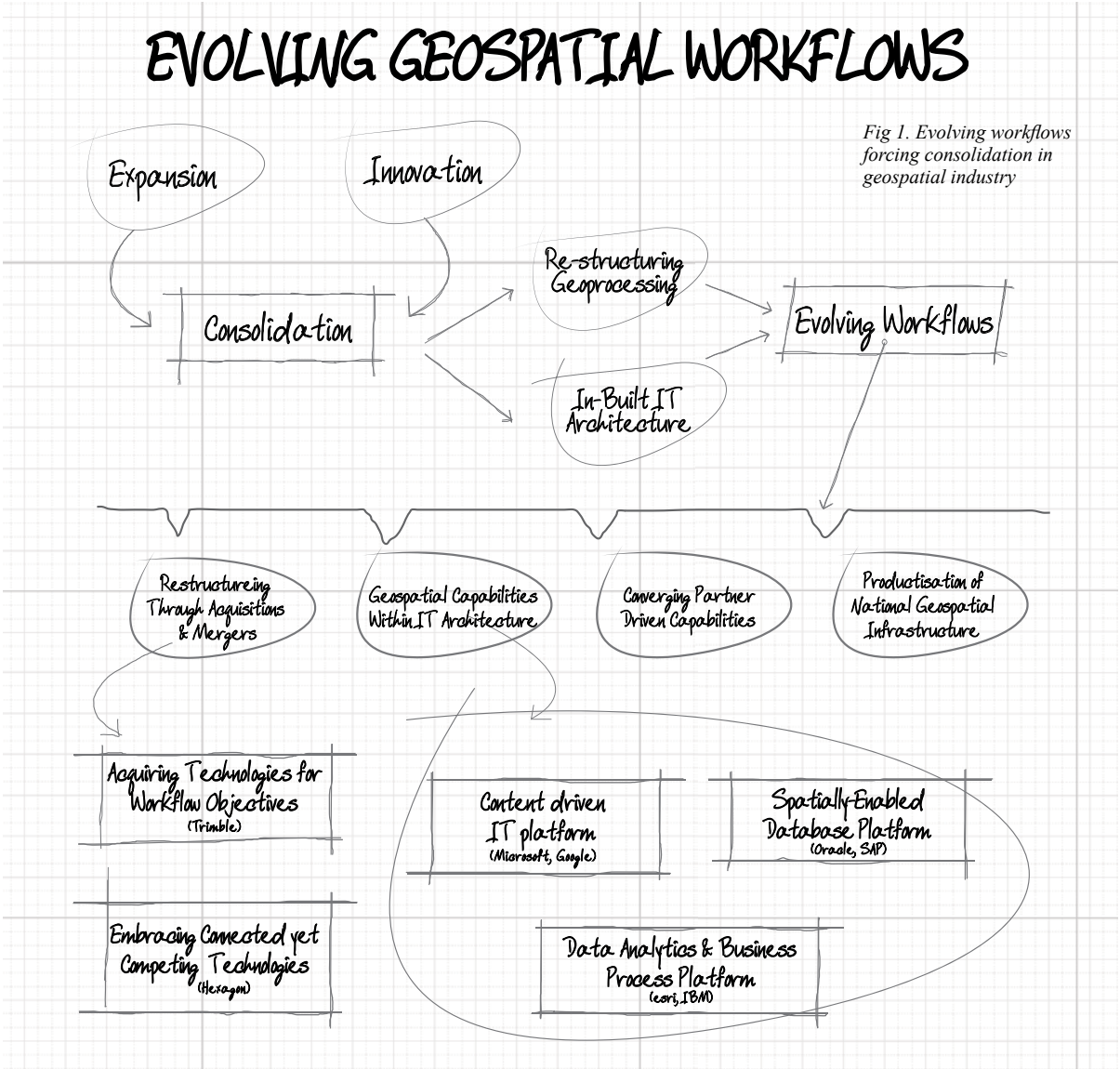


Fig 1. Evolving workflows forcing consolidation in geospatial industry

with SAP, IBM, and a host of content and hardware companies to provide better solutions to its user base.

The fourth level of consolidation primarily concerns the public sector stakeholders who are responsible for and mandated to provide authoritative and quality geospatial information to governments and citizens. The increasing use and need for high quality, updated and authoritative geospatial content is putting enormous pressure and greater responsibility on national geospatial information agencies to transform themselves.

In this context, the productisation of national geospatial information infrastructure is seen as an emerging model at national, regional and global levels. Initiatives such as United Nations Global Geospatial Information Management (UN-GGIM), European INSPIRE, and National Spatial Data Infrastructures are going through the test of time. Fostering alliances with fellow thematic geospatial data agencies and private sector data producing agencies like Google, Microsoft, Navteq and TomTom are the key instruments for the successful realisation of national geospatial platforms. Understanding the requirements of public and industry user domains and restructuring geospatial data, along with open policies and open standards, is an important part of this productisation.

Solution-centric approach defining partnerships

What has been driving the constant evolution of workflows? While there could be multiple reasons, I believe that it is the overall process of industrialisation and productisation that is triggering constant alignment and re-alignment. The geospatial industry is moving up the value chain by moving away from a product-centric approach and embracing a solution-centric approach and demonstrating higher returns on investments for the users.

A comprehensive view of the geospatial technology fabric, as shown in Figure 2, organises companies according to their strengths and offerings. The figure does not rate the companies but indicates technology offerings and coverage of the companies. For example, surveying is primarily driven by hardware tools, but there is a role for software companies to complement these tools through software offerings. Trimble, Topcon and Hexagon offer the entire range of surveying solutions while Autodesk, Esri and Bentley provide software solutions. This creates scope for partnerships.

Market perceives Hexagon and Esri as hardcore competitors; however, in my opinion, Hexagon competes with Esri only for 5% of its market share. Hexagon's geospatial software business can be estimated between USD 100 to 150 million, as against its projected annual turnover of USD 3.5 billion for 2014 (around 5%). Given the fact that Esri's revenue ranges between USD 1.2 billion and USD 1.5 billion, there clearly lies an opportunity for both Hexagon and Esri to leverage each other's market outreach beyond the collective USD 5 billion, while offering value-based geospatial solutions workflows and letting Hexagon Geospatial compete for its own market share. Ola Rollen, CEO of Hexagon, took a bold and forward-looking step

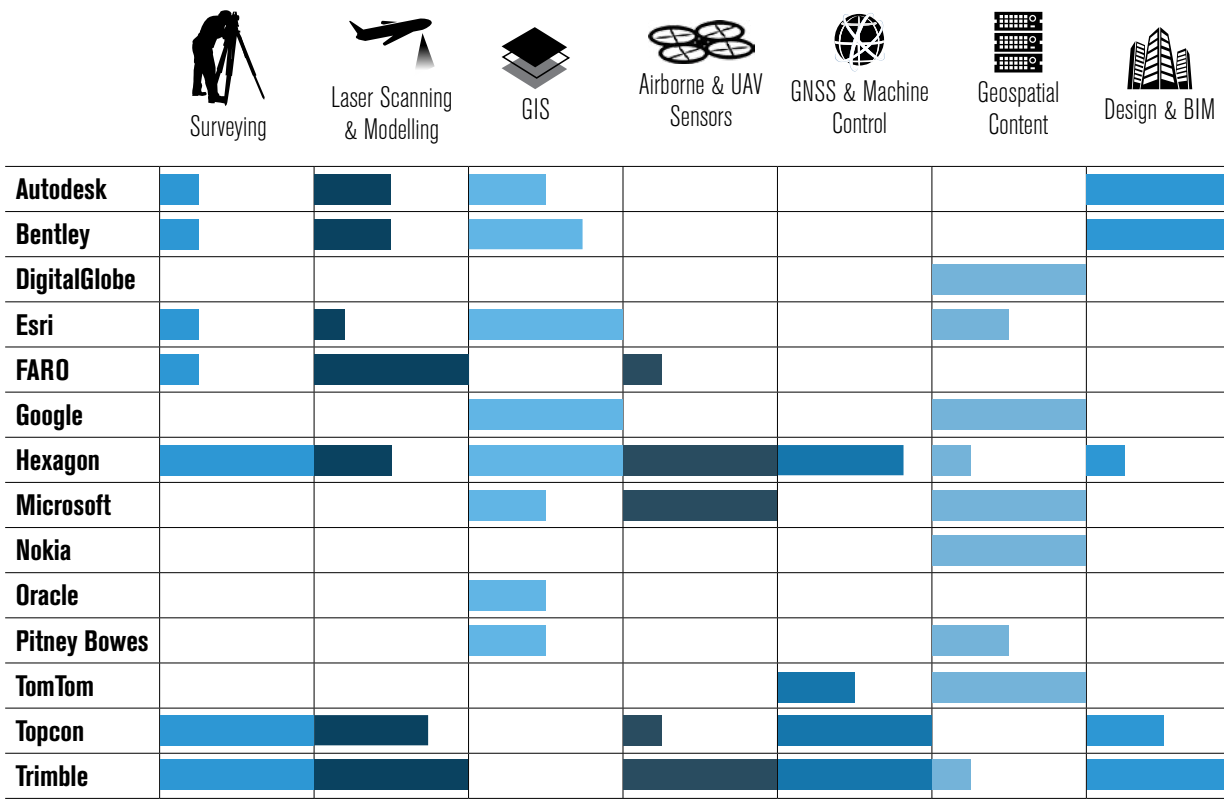


Fig 2: Technology fabric of major geospatial players

last June when he first separated the software and solutions groups and subsequently allowed the Intergraph solutions division to use any available competing software (including Esri) while delivering solutions to users.

Autodesk and Topcon have been dating each other for some time; however, their bond can be strengthened further if Esri and DigitalGlobe join the alliance. Though both Autodesk and Esri are in the software business and compete for their 5% of market share, Esri's strength in urban planning and GIS could be very valuably harnessed by Autodesk's offerings in design and building information modelling, supplemented by Topcon's solutions in scanning, GNSS and machine control, and finally supplemented by the monitoring capability of DigitalGlobe for large infrastructure projects. Several such combinations and alliances could help leverage a larger market outreach while offering rich geospatial value and utility to customers.

Content bottleneck

However, all this still misses out a key component — qualitative, authentic, current, high resolution and dynamic 'geospatial content' that would make the entire ecosystem functional, relevant and useful. Despite several global and national initiatives, both in the private and public domains, geospatial content remains a big bottleneck in the overall maturity of this industry. On the one hand, there is a flood of content for general consumers but, on the other hand, there is a definite paucity of geospatial content for professionals and businesses, often resulting in technology failure.

Geospatial companies like Esri, Hexagon, Trimble, and Pitney Bowes have been investing in content development and working towards offering content as part of their technology offerings. On the other hand, Google and Microsoft have volumes of content and are offering their technology along with content platforms. National, regional, and global geospatial infrastructures are mandated to serve quality geospatial data to governments, businesses and citizens and also evolve policies and regulations to facilitate conduct of the industries' organised geospatial data business. Most government agencies are heavily challenged by an ever growing data demand and complex regulatory constraints, making it tougher to live up to market expectations. This is leaving more responsibility on the private sector to build and collaborate for content platforms to appropriately harness the overall momentum and opportunities offered by the market.

TECHNOLOGY TRENDS

Geospatial technology is changing rapidly and finding use in virtually every economic sector. As 2015 rings in new horizons, and invites new challenges, experts take a look at the game-changing technology trends and application directions of geospatial industry.

Bryn Fosburgh
Vice President,
Construction Technologies, Trimble

The Rise of Connected Construction Environments

Despite the many challenges facing construction projects today, the outlook is bright. A new generation of connected construction environments and platforms is changing the landscape of collaborative construction

Collaboration, transparency and efficiency are among the greatest challenges facing the global construction industry today — an industry whose projects and teams are increasingly dispersed geographically, with architects, engineers, contractors and field teams often operating in different time zones or even continents. It takes a small army to design, build and then operate any structure, and the amount of coordination and communication needed is immense.

By some estimates, 80% of civil projects are delivered late and/or over budget. In building construction, nearly 90% of projects are late with approximately 40% coming in over budget. While it might not be surprising to many, it still leaves one wondering…Why?

Measurement, connectivity and data

At a high level, the biggest challenge is maintaining a seamless flow of data across work processes that span a mix of often incompatible or poorly integrated technologies. As a result, data silos develop among/within stakeholders, data isn't shared and aggregated as projects progress, and there is no single source of truth for master data.

Three key elements are central to the efficient and accurate construction and management of infrastructure: measurement, connectivity and information. Enabling construction professionals to make better decisions by providing improved access to key operational information is a vital ingredient in successful construction projects.

At the core, a big challenge is turning 2D plans into 3D constructible reality, because operations are often disconnected from plans. This is where constructible models come into play, with the potential to be a 'centre of gravity' — a place where building data resides and can be both pulled from and pushed to key stakeholders from planning and design, to surveying and site preparation, and onto construction and operation.

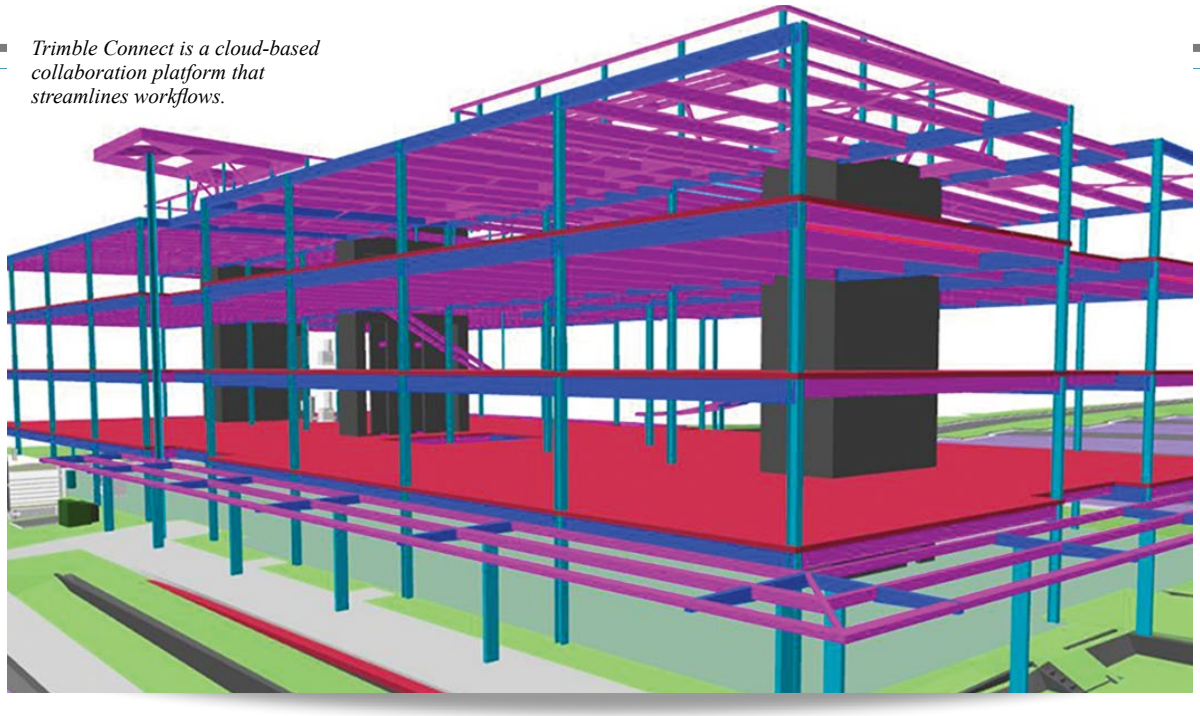
But to streamline the flow of data based on those constructible models requires connected communications and technology platforms, which strengthen links between distributed teams and facilitate collaboration across all phases of complex projects. The combination of constructible models accessed across connected platforms is the big trend that will make it easier for all parties involved in the lifecycle of infrastructure and buildings to access key operational information for more precise and higher quality results.

Linking heavy civil projects

It has been said that the minute that first bucket of dirt gets moved, all plans go out of the window. But the Internet is changing the way the construction business is done at almost every level. Connected environments for heavy civil construction projects should sync up data between the office, site workers, and machines.

When linking data between the office and the site, crews avoid standing around waiting for hand-delivered updates. Instead, they can instantly learn when plans change and stay on the same page. A grade checker can obtain the design file, create new measurements and check results with the office, knowing immediately if they're good to go. When designs change, the office can share them with the machine controller in real time. The foreman doesn't have to stop everything and wait for someone from the home office to arrive with the latest information. Everyone keeps working. Productivity goes up. Schedules are met. And the bottom line stays green.

Trimble Connect is a cloud-based collaboration platform that streamlines workflows.



By ensuring that machines are connected to the office, connected platforms let project managers know where their machines are located, and whether they are being appropriately maintained. Our research has shown that these capabilities can cut fuel costs by as much as 43%.

In addition, data from the site allows office teams to understand if the asphalt temperature is too low at rolling time, or if spots are being missed, while the office can instantly send detailed 3D construction models to the site. Real-time communications create a two-way virtuous cycle of improved accuracy and efficiency in heavy civil projects. We have seen customers realise 30% improvements in machine productivity, 50% reductions in survey engineer time, and 30% overall improvements in project efficiency and time.

Building bridges between teams

The challenges are much the same with building construction projects, where the majority of difficulties arise from incomplete coordination and collaboration throughout the design and construction process.

An effective connected platform enables communities to collaborate across and within disciplines, integrate data from a range of applications and devices to reduce the barriers between teams and tasks, while allowing teams to access, analyse and share project data from anywhere at any time. By serving as a technology hub, a cloud-based platform streamlines the process of combining 2D, 3D and data-rich BIM models via the Web, improving coordination between dispersed offices and teams, and reducing costs for software and training.

Equally important is a platform's ability to store and archive project documentation in the cloud, so that team leaders may keep track of their staff's progress remotely. By centralising all digital assets across a project portfolio, the platform allows project managers and building owners to audit and report on all past and present project data and activity. And since construction sites don't always have the best internet connectivity, synchronisation capability is very important — enabling team members to store critical project data on their mobile devices for later uploading and sharing.

But data must flow smoothly in all directions. In the diverse, dispersed environment of building construction, collaboration works best when it doesn't require everyone to adopt the same tool. That means liberating the data, not locking it up. Each stakeholder — architect, engineer, fabricator, general contractor — should be able to easily access the information required for their job and contribute additional details back into the aggregated hub of information. Connected construction platforms should support the use of many BIM tools in the same project with a high level of interoperability, so that project members can choose solutions optimised to do the job they need. Combining models created in any modelling tool into one common coordination view also eliminates tedious file conversions and expensive proprietary software.

A brighter future

Despite the challenges facing construction projects today, the outlook is bright. A new generation of connected construction environments and platforms is changing the landscape of collaborative construction. This is leading us toward a future of higher quality, more accurate, more innovative, and more cost effective, buildings and infrastructure.

Dr Kumar Navulur
Senior Director of
Strategic Business Development
DigitalGlobe

IN SHARP FOCUS

The advent of very high resolution commercial satellite imaging has introduced a new era in information about our changing planet

Technological advancements in the last decade are enabling commercial remote sensing companies to collect over five million square kilometres of very high resolution imagery per day, or cover the equivalent of the entire land mass of earth, eight times per year.

The commercial satellite imaging industry is growing at an unprecedented pace, with more potential launches of small satellites as well as satellites planned by various international governments than ever before. The current and planned satellites across the industry have varying capabilities of spatial resolution, ranging from 5 metres to 30cm, which can capture the finer details of both land as well as water. These satellites can now capture images over any given spot on the earth as well as capture imagery multiple times a day.

The need for speed

The last decade also saw imagery become ubiquitous through the increasing popularity of various online mapping platforms. Information about the planet is now commonly available through platforms such as Google Earth, Bing Maps, etc. Today, the commercial remote sensing industry boasts access to over two billion users who use imagery for a variety of applications, from navigation to browsing the globe. This increased awareness of the public has created a demand for speed and easy access to imagery. In response, commercial companies have created broad networks of global infrastructure that allow near real time access to satellites for collecting new imagery for time-sensitive applications, including monitoring and disaster response. Further, robust ground infrastructure also allows delivery of the information to end users within minutes of imagery acquisition, through cloud platforms and mobile devices.

What else can we do with imagery?

People have used imagery to make maps, extract information layers such as roads and other transportation features, iden-

WorldView-3 satellite image of Bayan Obo Mine in China

tify water bodies or points of interest, create land registry systems, assess and analyse post-disaster damage, and estimate population density, among many other applications. Imagery has become foundational information for some of the most common location-based questions people ask, such as, where are all the Starbucks coffee shops, bus stops, train stations, etc. The latest advancements in technology include cloud computing, high performance computing, crowd sourcing, and other technologies that enable the creation of geospatial big data, a living digital inventory of the changing planet. These technologies have enabled the creation of detailed maps at scales that were not possible before, and at speeds that were unimaginable just a few years ago.

By exposing this imagery to online crowds, also known as 'crowd sourcing,' we can develop robust information layers in a matter of weeks. Open source data initiatives, such as Open Street Map, are leveraging the power of the crowd to digitize various map features such as roads, structures, land use and points of interest, and other micro details from very high resolution satellite imagery.

Quality of data

For customers faced with a myriad options for imagery, it is necessary to establish a quality framework that allows users to make educated decisions about imagery and it's fit for a given application. This should cover four critical components: accuracy, currency, completeness, and consistency.

Some of the commercial satellite companies are embracing the concept of creating video from space; this will provide consumers with a unique view of changes happening on the ground

Accuracy is paramount to various mapping applications such as navigational maps, land tenure maps, planimetric maps, etc. The second critical component of the satellite imagery quality framework is the currency of the data. The currency required from imagery depends on the end application, with mapping applications able to use historic imagery, while disaster response scenarios demand the latest imagery to understand current conditions on the ground.

Completeness refers to the comprehensive nature of imagery, whether it is the spatial resolution or the spectral bands required. Consistency of data is also important — DigitalGlobe pioneered an automated image consistency technique that ensures the consistency of image quality over time, as well as over changing atmospheric conditions.

The future of remote sensing industry

One thousand satellites are planned for launch in the next 5-10 years. Some of the commercial satellite companies are embracing the concept of creating video from space. The industry is embracing new computing concepts, cloud technologies, and other technological advancements to make data easily accessible not only to consumers, but also for developers and businesses. The geospatial services industry, which includes commercial satellite imagery, drives USD 1.6 trillion in revenues for the U.S. economy alone.

Dr. Bernd Becker
Chief Technology Strategist
and Evangelist, FARO

Platform Integration

Key for Business Solutions

The ubiquitous use of 3D LiDAR data is closer than we might think and integration of new platforms will drive the success of point clouds to extremes we hardly can dream of today

Terrestrial Laser Scanning (TLS) technology has become one of the most interesting topics in geomatics in the last few years. Fifteen years ago there were very few companies working with the early versions of TLS. Nevertheless, they showed that the historic dimension of human activities could be easily captured in 3D-reality as a scaled, measurable image.

Now, thousands of professionals and graphics artists employ advanced technologies but at prices of several tens of thousands of dollars. These adopters are still a small group compared to the millions of consumers of products like Kinect from companies like Prime Sense, Microsoft and others.

While low cost consumer tools costing around a few hundred dollars can create impressive results, they are not designed for serious professional use which requires longer range, very low noise, high accuracy and especially integration with other platforms to provide reliable results in the most efficient and safe manner. In the last few years, a multitude of new integration options for laser scanners have been successfully developed and new ones are emerging daily.

New integration options for laser scanners

To make the capture process more efficient and versatile, TLS is now integrated to terrestrial, marine and aerial platforms. Mobile scanning is popular because it can be up to 100 times faster than stationary devices. Integration with UAVs enables versatility but is the hardest to achieve. High performance multi-core computers, together with IMU, GPS and other sensors, enable high quality results at lower costs. But regulations hamper the use of UAVs even on private areas like open pit mines, large factories, etc., where they could be used freely.

Automation helps to conduct scanning jobs safely. In 2013, FARO showed a prototype of a 'ScanBot,' an autonomous vehicle that moves to scan-positions and scans all by itself. This enables safe scan operation in hazardous environments like mines and nuclear plants, and better efficiency if, for example, an area like a factory has to be scanned repeatedly. This can be done over a weekend when the factory is shut down.

> **3D representations in virtual space will soon be common, with every software dealing with 3D-reality data enabling simple and direct use of LiDAR data**

Platform integration involves multi-sensor approaches that overlay other sensor data like thermal, radiation and others over the 3D scan. In this way, new business solutions are created — such as designing insulation systems by measuring thermal dissipation from buildings or machinery. The radiation example is most fascinating since piles of radioactive dust can be visualised in the FARO 3D SCENE software.

Processing scan data is a necessary and time consuming task which is better automated. This forms the core of all software development at FARO. However, it never is 100% correct

all the time. As long as vendors achieve automation level above 95%, the customer can be confident of scheduling the next job immediately after the current one, since only one in twenty scan jobs needs manual work.

Automated processing for different environments requires intelligent 'software-behaviour' through the development of algorithms which analyse the scan data, apply statistical methods and combine them with expert knowledge to emulate the cognitive abilities of human operators. In the case of processing 3D laser scans, compute power limits the use of huge data volumes. The need for massive computing power necessitates running the processing of scan data on the cloud, which provides almost infinite power at low cost. Typically, for USD 0.25 one can either run one computer for 1000 seconds or run 1000 computers on the cloud for only 1 second.

In many applications, the scan data is not the final product but a foundation for analysis by subject matter experts. Therefore, the integration of laser scan data into proven workflows and other software platforms is essential. For most users this requires the direct export of scan data to CAD software. Autodesk ReCap and Bentley Pointools are leading examples. To make the use of laser scan data ubiquitous, it is important that more industrial CAD packages follow, like Siemens NX and Dassault Catia, as well as specific trade CAD tools. New standards like the ASTM E57 file format for vendor independent exchange of point cloud data will help smaller software companies to create integrated products based on a future-proof, open data format. FARO has identified early on this need of third party software in accessing its 3D laser scan data by developing tools for software developers which provide direct and fast access to the original point cloud information.

As the user community desires a quicker ramp up of point cloud capabilities in specific application software, FARO has now put in place the 3D-App-Center. Here, partner apps are made available to the global user community over the Web, as a way to a broader coverage via simple apps that are focused on specific uses and at the same time are lower in cost and do not require training.

As the point cloud quality improves and scan cost goes down, many more uses will emerge. Animation and simulation performed directly inside point clouds, as we see in Law Enforcement software like CAD-Zone, ARAS 360, etc., lead the way here with very impressive results. Integration with 3D-Studio Max and similar software will improve applications for marketing, gaming, etc.

At the other end of the range of possibilities are a number of applications where direct access and easy-to-learn use of the point cloud data opens new business opportunities or enhances communication processes. Web-based viewers like FARO's SCENE WebShare Cloud allow easy view of scan projects, measurements and insertion of comments and hyperlinks to additional information. By allowing external software to interface with this cloud service it can also be used as a platform for application specific solutions.

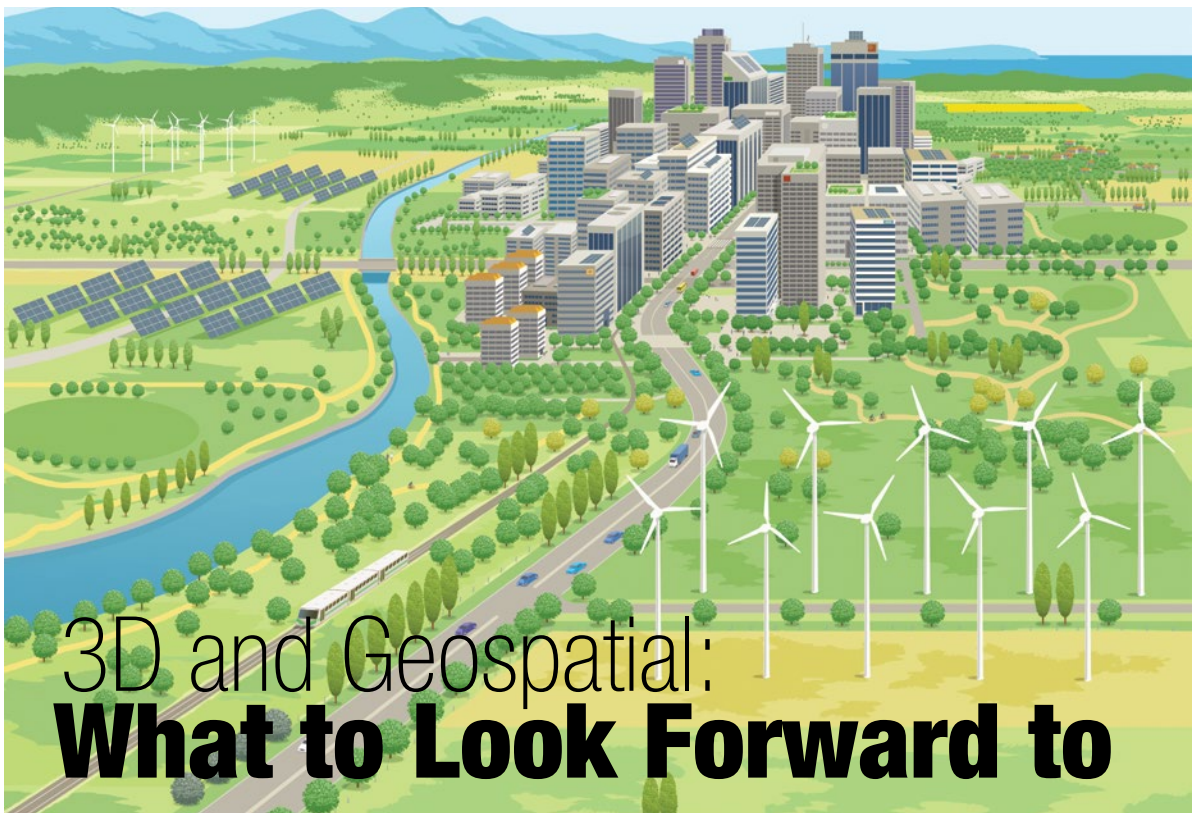
FARO Scanbot

As the point cloud quality improves and scan cost goes down, many more uses will emerge

Overall, the integration of LiDAR with new hardware and software platforms is well underway. The cost reduction for laser scanning and the need for accurate and simple to capture 3D reality drives specific solutions for the professional and the pro-sumer.

Very low cost tools from the consumer industry additionally create millions of new 3D users. 3D representations in virtual space will soon be common, with every software dealing with 3D reality data enabling simple and direct use of LiDAR data. The ubiquitous use of 3D LiDAR data is closer than we might think and integration of new platforms will drive the success of point clouds to extremes we hardly can dream of today!

Geoff Zeiss
Editor, Building and Energy
Geospatial Media & Communications



Courtesy: www.dgem.nl

3D and Geospatial: What to Look Forward to

Cities around the world are realising the power that comes from the convergence of modern information technology, including 3D models, geospatial/GIS, intelligent network models for electric power, telecommunications, water and wastewater, transportation, and other infrastructure

The world's construction industry, including buildings, electric power, water and wastewater, roads, rail, seaports and airports, contributes about $7 trillion annually or 10% of the world GDP. Productivity in the construction sector has stagnated over the last few decades in the world's advanced economies. There is an accelerating drive to increase productivity in the construction sector to improve returns on investment.

About a third of the world's electric power goes to buildings. Environmental concerns are changing how we design and build buildings and infrastructure. This trend is driven by aggressive building codes, customer driven certification such as LEED, financial incentives from local governments and power utilities, and measures mandating 'zero energy buildings' (ZEB) that have been introduced in EU, US, and Japan. Navigant Research projects that global ZEB revenue is expected to grow from $629.3 million in 2014 to $1.4 trillion by 2035.

The electric power industry is undergoing an unprecedented transformation motivated by smart grid and distributed renewable power that is changing every aspect of the utility industry. As a result of these changes, geospatial is poised to become a foundation technology for the smart

grid. A recent report forecasts that the global utility GIS market will grow at a CAGR of 9.27% from 2014-2018.

Convergence of construction and GIS

A major milestone for the development of standards as a foundation for the convergence of building and civil engineering design and geospatial technology occurred in 2012 when the Open Geospatial Consortium (OGC), buildingSMART International (bSI), ISO TC 211, and ISOTC 59/SC 13 began discussing ways of harmonising standards. This collaboration is creating the foundation for modelling urban environments such as integrating CityGML and Industry Foundation Classes (IFC), Augmented Reality Markup Language (ARML), InfraGML/LandGML for transportation modelling, and Indoor Geographic Markup Language (IndoorGML). A critical initiative for the future of geospatial-BIM convergence is the development of a common conceptual model of road alignments that will be used as a basis for both OGC (geospatial) and buildingSMART (architecture/engineering) standards for roads, railways, tunnels and bridges.

Indoor location is getting a lot of attention, primarily because of the commercial opportunities it enables. Indoor navigation must necessarily be 3D. OGC has already released the first version of IndoorGML, a standard for modelling indoor spaces in 3D. In the realm of electric power, John McDonald, Chair of the Smart Grid Interoperability Panel (SGIP), who has been a firm believer for a long time that geospatial information is part of the foundational platform for smart grid, recently signed a MoU with OGC with the objective to further integrate geospatial standards into smart grid standards.

Reality capture transforming construction

The global LiDAR market is projected to grow by more than 15% annually over the next five years, reaching $551.3 million in 2018. LiDAR is increasingly being used during construction for monitoring design compliance and LiDAR scans are being delivered during construction as well as with as-builts at the end of a project. Recent research forecasts that low-cost LiDAR systems could revolutionise the surveying industry in the next five years. Already, lightweight UAV-mounted platforms weighing less than 10kg, which combine LiDAR and GNSS technology, are available. For existing buildings, 'scan to BIM' is being used by companies such as Mollenhauer to create BIM models that provide the key elements required for building renovation, indoor navigation, or energy performance analyses.

New underground remote-sensing technologies such as GPR and electromagnetic induction are helping utilities create accurate 3D models of underground infrastructure

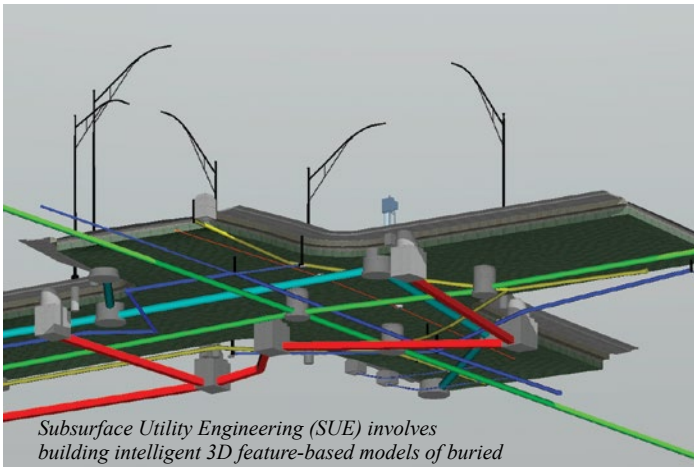
New underground remote-sensing technologies such as ground penetrating radar (GPR) and electromagnetic induction (EMI) are helping municipalities and utilities create accurate 3D models of underground infrastructure. A pilot conducted by the Region of Lombardy (Milan) reported an ROI of €16 for every €1 invested in improving the accuracy of geolocation of underground utilities.

Handheld 3D scanners have been trialed by major engineering firms who have reported using them successfully on real world engineering projects. For example, DotProduct offers a professional device intended for engineers in the construction industry; it weighs less than a kilogram and is accurate for engineering purposes at distances up to 3.3 metres. Engineers who have used this device on engineering projects have reported very favourably and have predicted publicly that 3D handheld scanners could revolutionise construction.

Adoption of BIM and BIM for infrastructure

Government agencies in Norway (2007), Finland (2007), and Denmark (2007), the Netherlands (2012), and the US (2007) have already mandated BIM strategies for public procurement. The top three economic players (Germany, France, and the UK) in Europe are in the process of launching BIM strategies in 2016/2017. The combined economic weight of Germany, France, and UK means that most public procurement in EU will require BIM, beginning in 2017. In Asia, the Singapore government will require BIM e-submissions for all building projects greater than 5,000 square meters starting in 2015.

A recent McGraw-Hill SmartMarket report suggests that the use of BIM for infrastructure (horizontal BIM) is about three years behind its use on vertical projects, but that adoption in the horizontal market is occurring at a faster rate than it occurred in the vertical market. At SPAR International 2013, Kevin Gilson described how his firm Parsons Brinckerhoff



Subsurface Utility Engineering (SUE) involves building intelligent 3D feature-based models of buried construction zones

(PB) integrates GIS, LiDAR, BIM and construction project management data together in large integrated 3D datasets that enable the project team to concurrently support visualisation, stakeholder communication, design, construction planning, and site logistics.

BIM – transforming construction

3D geospatially-aware engineering design is poised to "turn the construction process on its head" in the words of Ron Singh, Chief Surveyor at the Oregon Department of Transportation (DoT). In Singh's view, maintaining accurate, up-to-date intelligent 3D highway models will require a fundamental change in how highways projects are managed. New projects will be designed based on 3D geospatially-aware engineering archives, and during- and post-construction surveys using LiDAR scans will ensure that what goes into the 3D engineering data archive including underground utilities is accurate and up-to-date.

The cost of maintaining and operating a building over 20 years can be up to 30 times the original construction cost, so it is clear why the UK Government foresees "the largest prize for BIM lies in the operational stages of the project life-cycle." During the operations and maintenance phase of building 3D models, GIS data and a common geospatial coordinate system enables a comprehensive operational view of all infrastructure, including internal and external structures. Convergence of 3D and geospatial also enables automated design optimisation based on defined design goals such as minimising energy requirements or water consumption.

Integrated BIM for data-driven utilities

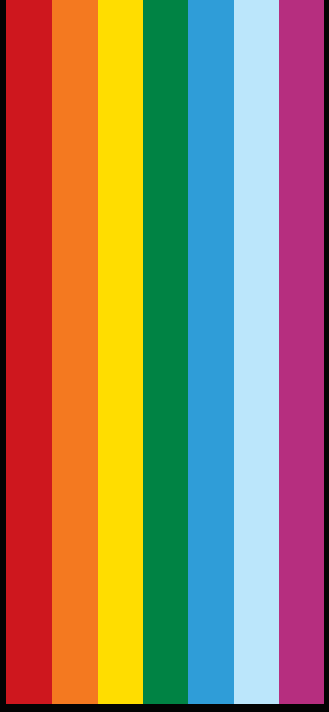
Integrated geospatial and engineering design (BIM for Infrastructure) is becoming increasingly important for data-driven utilities. Spatial analytics is predicted to be one of the keys to success for electric utility operations in the smart grid era. Identifying patterns in different land, weather, terrain, assets, social media and other types of geospatial and operational data will be increasingly important for utilities. In the future, integrated engineering and geospatial will enable location-aware predictive analytics, where an integrated location aware system will be able to estimate threat potential and forecast where and what type of outages are expected during a storm and what type of equipment will be required to deal with the outages.

One of the biggest challenges that utilities are experiencing is increasing volumes of structured and unstructured data, most with location, that are overwhelming traditional enterprise systems. Smart meters, intelligent electronic devices, and unstructured data from social networks including Twitter, Google, and Facebook and other social applications will enable crowdsourcing of all sorts of real time information about electric power networks.

Convergence of BIM, 3D, geospatial and big spatial data management

Cities around the world are realising the power that comes from the convergence of modern information technology including 3D models, geospatial/GIS, intelligent network models for electric power, telecommunications, water and wastewater, transportation, and other infrastructure. The Delhi Mumbai Industrial Corridor, Songdo IDB in Korea Fujisawa in Japan, 36 smart cities in development in China, Singapore, Iskandar in Malaysia, King Abdullah Economic City (KAEC), and Masdar City in Abu Dhabi are a few of the new cities planned globally. All of these projects involve developing a 3D representation of the planned city. 3D visualisation technology and simplified ways of interacting with the design enable all the stakeholders, including non-technical folks, to actively participate in the design process. The goals are improved productivity, reduced risk and greater predictability, which in turn improve the ROI for large infrastructure projects.

3D and geospatial technologies are experiencing significant investment by the $7 trillion construction industry for both buildings and infrastructure. The integration of sensors, new reality capture techniques, geospatial technologies, 3D visualisation and simulation, and the development of cross-disciplinary standards for interoperability are enabling the modelling of entire urban environments. With these smart urban models, the rapidly developing fields of 'big spatial data' management and spatial analytics are beginning to make possible simulation of aspects of urban environments, including population dynamics, transportation flows, electric power and other utility loads, and emergency planning.



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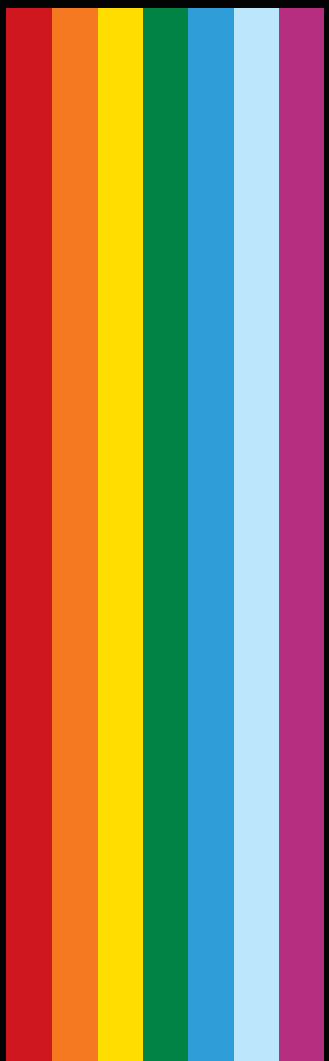
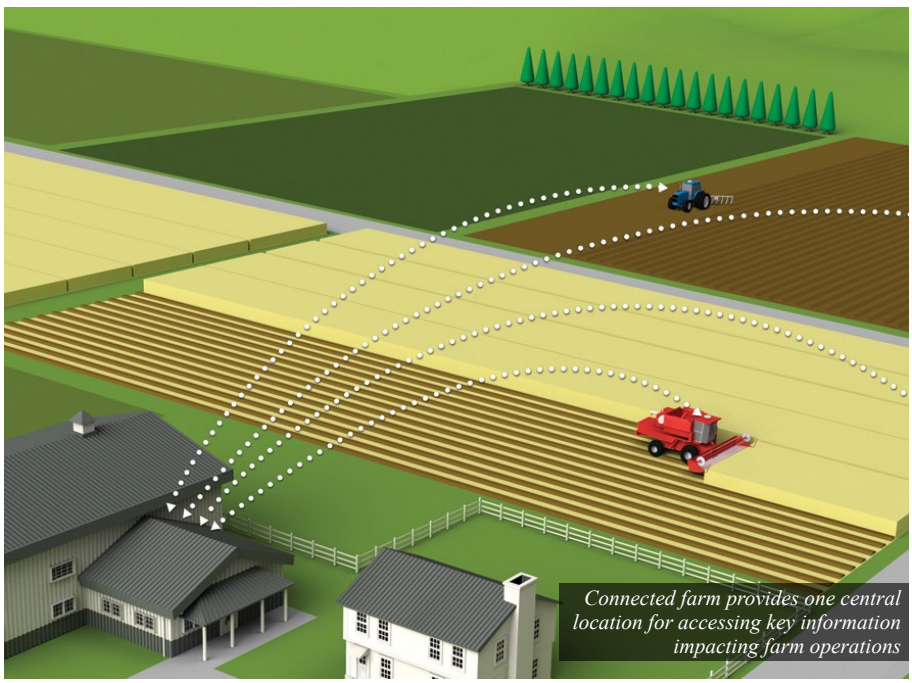


Albert Zahalka
President
Topcon Precision Agriculture

The Cloud Isn't Just for Rain Anymore



Connected farm provides one central location for accessing key information impacting farm operations

Precision agriculture has been a key enabling technology to achieve higher yields with lower cost and less environmental impact, while keeping the cost of food fairly stable

Has global agricultural productivity increased or decreased in the last 25 years? It has, in fact, more than doubled since 1985. Next to advances in seed genetics, precision agriculture has been a key enabling technology to achieve higher yields with lower cost and less environmental impact, while also limiting the cost of food so that it has remained relatively stable in fixed dollars.

Agriculture, the largest industry in the world, is an example of putting automation and innovation to work with established standards that support adoption and growth. In fact, if agriculture can do it, then so can construction and the diverse disciplines that make up the global geospatial community.

Expanding the use of precision agriculture

However, if productivity has doubled in 25 years then why is there concern about it continuing to increase and meet the needs of earth's escalating population?

First, the regions of the world that have experienced the highest rates of productivity are exactly where agricultural land is being lost at the highest rate. According to the United States Department of Agriculture's research services, more than 2000 acres of existing or potential farmland are being lost every day in North America and Western Europe due to development. Coincidentally, these nations also have the highest utilisation of precision agriculture technology.

Second, the amount of food wasted is climbing. According to a report by the United Nations Environment Programme,

at least 30% of all crops are wasted because of simple logistics issues. Just as Building Information Modeling (BIM) is being used to eliminate waste and create buildings and infrastructure that can be maintained more efficiently, the scope of precision agriculture has now expanded to include systems that help ensure the crop is delivered with low loss to store shelves, fuel production facilities, and the many other destinations that rely on it as the key ingredient of the food, fuel and fiber supply chain.

Often referred to as 'farm-to-fork' traceability, cloud-based systems within precision agriculture platforms enable the monitoring and analysis of virtually every plant from its planting, to harvest, to the dinner table. As this vast amount of data grows, so does the industry's ability to fine-tune all aspects of the crop and distribution cycle. This not only helps ensure that demands are met but also quickly pinpoints areas of safety concern — whether they be possible contamination by salmonella or the need to quarantine specific harvests that may have been improperly treated with pesticides or other chemicals.

The third issue that needs to be looked at is that of expansion. How can the benefits of precision agriculture be advanced to countries where arable land is in abundance but inefficient farming methods are limiting the crop output such that farmers are barely able to meet their own needs?

The Precision Agriculture Institute was founded in 2006 with this question and advancing the technology within the industry in mind. Most manufacturers of precision agriculture equipment, including OEMs who develop their own platforms, belong to this group which provides educational resources and outreach to farmers and governments that are new to the technology.

Looking back at the amazing contributions of precision agriculture over the many years past, one realises that the technology is yet only in its infancy. The exponential growth in technology, communication, analysis, and navigation present exciting opportunities for precision agriculture to expand its benefits very quickly and in ways that we couldn't even imagine earlier.

Addressing agricultural challenges

Major technology companies such as Hitachi and IBM and well known agribusinesses such as Monsanto are focused upon ways to gain greater precision of the single most impactful element on growing — weather forecasting — not just for a region, but for a specific field. For example, the 'Deep Thunder' IBM weather analytics research programme has been adapted for use in creating 'micro forecasts' that offer farmers weather outlooks specifically catered to their fields up to 36 hours in advance with 90% accuracy. This system uses sensors that are in the fields along with mobile devices and cloud-enabled data services to ensure best practice timing for planting and inputs application scheduling.

The widespread reach of smartphones can also play a major role in the future of precision agriculture, especially for small farmers or in areas without robust technology resources. The Norwegian-based agrichemical company, Yara, has introduced several apps designed to improve crop nutrition. The Yara ImageIT app is designed to measure nitrogen uptake and generate a nitrogen recommendation based on photographs of the crop. The uploaded photos undergo a comprehensive pixel based image analysis of leaf colour. If the field is in an area lacking cellular coverage, the images will be batch uploaded from a cellular or Wi-Fi hotspot. It is not exact science in real time, but is a tremendous leap to take advantage of expertise when it is needed, no matter where the farm or expert is located.

Unmanned Aerial Systems (UAS) are also creating a vibrant buzz in agriculture where they are forecast to provide immediate benefits. Agribusinesses and farmer service providers could use data supplied by them to create very fast reporting of improper application, forecasting of crop yields, and providing in-season crop scouting — just to list a few of the more obvious benefits. Though the concept of lower cost methods for acquiring data over large land areas is significant, today the UAS industry is facing regulatory challenges in some countries, while the value proposition continues to be sorted out in others.

All that is needed is for companies who contribute to UAS technology to apply similar remote operations for farm machinery, and one can truly farm from the office

Could autonomous vehicle operation happen in agriculture? It is quite possible that autonomous equipment operation will be adopted in agriculture before most other industries. Auto-steering is already a pillar of precision farming; there are added efficiencies to be gained through coordinated machine operation and leader-follower systems. All that is needed is for companies who contribute to UAS technology to apply similar remote operations for farm machinery, and one can truly farm from the office.

Kevin Pomfret
Executive Director
Centre for Spatial Law and Policy

A 'GEO-DIVIDED' WORLD

There will be a clear divide between 'winning' and 'losing' nations with respect to the adoption of geospatial technology

A healthy geospatial ecosystem needs consistent and transparent laws and policies that support the collection, use, storage, distribution, analysis and display of spatially-enabled data from both public and private sectors. Such a legal and policy framework must be broad based, cutting across both technology platforms and legal disciplines because of the variety of ways geospatial information is collected and used. Such a framework does not necessarily mean creating a new set of laws and policies; in many instances it simply means applying or amending outdated laws, policies and regulations in a timely manner in ways that are applicable to the new capabilities and challenges associated with advancements in geospatial technology.

Confusion and uncertainty

In recent years, there was a great deal of uncertainty in many countries with regards to the collection, use and distribution of geospatial data due to inconsistent and conflicting laws and policies and governing structures that don't evolve to keep up with technological developments. Since legal and policy communities in many nations were still coming to grips with the power of geospatial technology and the unique aspects of geospatial information, there was confusion as to how to apply existing laws and policies on matters such as privacy, licensing, national security, open data, liability, and intellectual property rights to geospatial information. As a result, businesses and government agencies struggled with what geospatial information they could collect, how to use this information and the potential legal risks associated with offering products or services that use geospatial information.

Even today, governments around the world are struggling with the existing laws and policies in the backdrop of disruption caused by geospatial technology and the widespread availability of geospatial information. For example, many nations have concerns over the proliferation of unmanned aerial vehicles (UAVs, commonly known as drones). UAVs have the capability to collect high quality geospatial information at much lower prices than other platforms. However, the U.S. Federal Aviation Agency (FAA) is struggling with the issue of safely integrating the UAVs into the national airspace. The privacy implications associated with the numerous UAVs operated by government agencies, commercial businesses and individuals collecting data on cities, neighbourhoods and individuals is another concern. In response, several states have passed laws that limit how government agencies and private citizens can collect and use data collected from UAVs. As a result, commercial use of UAVs in the U.S. is for all practical purposes still prohibited. Moreover, countries with more liberal policies with respect to UAVs are considering imposing more restrictions.

The global response to the ride hosting company Uber is another example of such challenges. Uber's use of geospatial information to connect drivers and passengers is a direct challenge to government authorities that currently regulate the taxi industry. As a result, a number of countries have attempted to ban Uber. In fact, one government has considered regulating Uber's use of geoinformation in its popular app. Uber is also faced with increased concerns over location privacy. Recently, there have been a number of media reports on the potential for Uber to misuse the data they collect. Some of these concerns are based upon the reported actions of Uber's employees while others are primarily speculative in nature.

Privacy concerns

Not surprisingly, the potential privacy/personal data protection risks associated with various types of geospatial information have caused the greatest confusion to date. For example, courts in the United States differ as to whether the concept of a 'reasonable expectation of privacy' in a public place should be redefined due to the proliferation of sensors that can monitor an individual's movements over long periods of time. European courts differ as to what level of protection to give to the location associated with an IP address. The growth in data collected from LiDAR and radar sensors and indoor location technologies — and the associated products and services — will only increase this confusion. Such confusion causes uncertainty for businesses and government agencies that collect, use or share geoinformation. There are numerous examples of businesses that have pulled back products and services due to the public backlash over privacy concerns, even though no law was violated.

Governments around the world are struggling with the existing laws and policies in the backdrop of the disruption caused by geospatial technology

Long term implications – 'Geo-divide'

Fortunately, as with all disruptive technologies, the legal and policy communities will catch up. However, the result will be a clear divide between 'winning' and 'losing' nations with respect to the adoption of geospatial technology.

The winners will have developed legal and policy frameworks that support the creation of a 'location-enabled' society. These nations will have strong economies, fueled in part by jobs created from the many new products and services that can be offered based upon the efficient and safe use of vast amounts of geospatial information. For example, new companies will be built to provide products and services for location-enabled industries such as the smart grid, intelligent transportation systems and precision agriculture. Citizens in these societies will live in safer 'smart cities' and have governments that are more open and transparent. The contour of the relationship between governments and their citizens will change as government agencies use geospatial technology to deliver more efficient and timely services while still protecting their citizens from unwarranted government intrusion. Effective use of geospatial technology will also provide increased public safety and allow such nations to better prepare for and respond to natural disasters. 'Location-enabled' societies will be the leaders globally on transnational issues, such as protecting natural resources, understanding climate change, addressing poverty and preventing the spread of infectious disease.

The 'losers' will be those nations with overly burdensome laws and policies concerning the collection, use and transfer of geospatial information. Such restrictions might arise due to the concerns over privacy, national security or liability or in an effort to protect local industry. As a result, government officials in one agency will be afraid of sharing data with other government agencies and collection of many types of geospatial data by private businesses will be limited. Some governments may also use geospatial technology to monitor or restrict citizen movements and personal interactions. As a result, many individuals will be unwilling to adopt new applications involving their location. Over time, businesses will pull operations from these countries due to increased costs and public pressure not to support repressive regimes.

Hopefully, governments are beginning to see the value of location-enabled society and will begin to take steps to develop the appropriate legal and policy frameworks. Moreover, if a geo-divide does occur, hopefully there will be many more winners than losers.

Paul McRoberts
Vice President, Infrastructure Modelling
Product Line Group, Autodesk

Design Trends for Future Cities

How dollars are prioritised for infrastructure investment is a reflection of a community's social, economic and environmental values

Cities are the driving force behind the global economy. According to research firm McKinsey& Company, just 600 cities are responsible for 60% of the global GDP — and the number of people living in cities is expected to increase from 3.6 billion in 2010 to 6.3 billion in 2050.

What strategies can cities adopt to plan, build and maintain themselves as centres of innovation and economic growth?

Invest for future economic and environmental vitality

Before discussing investment strategies, it's worth considering why cities have been growing for the last 5,000 years. In short, it is because they have proven to be an incredibly durable and productive economic model. The shift to urban living is helping to increase the incomes and purchasing power for millions around the world.

Infrastructure plays a critical role in a city's success, providing the energy, water, transportation, waste management, and access to food and manufactured goods. Vital to a city's well-being, infrastructure supports more than basic needs; it encourages the ability to interact, communicate with ease and share ideas — the fundamental basics of innovation and future economic growth.

Today, people move to cities for many reasons, including access to jobs, schools, services and culture. What will the city of the future look like? Quality of life is likely to be even more important in years to come, and factors like sustainability, resiliency, energy-efficiency, quality housing and schools, safety, and even happiness will be requirements. Cities will be adaptive, collaborative, walkable, and everyone will have access to public services and public transportation.

> **Infrastructure supports more than basic needs — it encourages the ability to interact, communicate with ease and share ideas**

Design trends point to more greenery for buildings, with rooftop gardens and vertical farming. Urban planning is moving toward mixed-use zoning that will provide office and shared space ideal for collaboration. Social and entrepreneurial connectivity is becoming ubiquitous, supporting a rise in mobility and self-employment. A thriving city has ease of movement and adaptable transportation making it possible to move people from one point to another quickly and with minimal energy. Cities are championing 'access through proximity' over 'access through mobility' as a way of reaping huge economic and environmental benefits — including higher tax revenues, healthier residents, better use of existing infrastructure, and reduced demand for fossil fuels.

Investment for urban vitality

In reality, the city of the future depends on the decisions we make today. How dollars are prioritised for infrastructure investment is a reflection of a community's social, economic and environmental values. The question for city planners is how to foster economic activity in a way that maximises benefits to the community.

Technology can help cities to investigate how different design options can contribute to a more sustainable city, with an economic advantage and a better quality of life. To achieve these goals, four key areas for technology-aided infrastructure investment are:

- **Buildings:** Buildings constructed decades ago will still be standing because they are made of steel, but with contemporary advances in computing power it is now possible to rapidly evaluate the building systems and prioritise energy-efficient retrofits for the greatest impact.
- **Water:** Adding parks and green

corridors in cities can help with storm water management, reduce maintenance costs for ground-level and below-ground infrastructure, and create a healthier, better looking environment. Sensors in the pipes can track usage and more importantly leakage so they can be quickly corrected. Coastal cities in particular need to deliver resiliency strategies in light of rising sea levels, increasing storms, earthquakes, or just the weight of increasing urbanisation pressure. Simulation enabled through powerful cloud computing is helping planners and designers explore innovative and less costly alternatives and view those approaches into the future through time based simulation.

- **Transportation:** Transportation authorities are also taking advantage of virtually infinite computing and modern design tools to quickly explore a number of transit options. These are expected to reduce travel time and congestion and decrease carbon emissions, as well as encourage the aforementioned 'access through proximity' as a development strategy.
- **Energy:** Aside from reduced greenhouse gas emissions and more stable energy costs, generation within the city from renewable sources such as solar and wind can also reduce dependency on imported energy, and help improve urban resiliency in the face of fluctuating commodity prices and natural disasters.

Leveraging GIS, CAD and BIM

The biggest challenge is defining what we want our future to be; only with clear objectives can we achieve our goals. Information matters because when it comes time to rationalise spending finite resources, we need to be able to do this on social and environmental — as well as economic — factors.

Advanced technology for simulation, visualisation and analysis is already in wide use today in the manufacturing sector and is growing rapidly in the infrastructure and construction industries to better plan and understand projects. These tools use GIS, CAD, and a variety of land use, parcel, and census data to create intelligent 3D models to visualise and analyse the existing urban environment. Furthermore, they enable planners to quickly evaluate multiple design options and help predict the physical and functional performance of the finished projects under a variety of conditions. Known as BIM (Building Information Modelling) by planners, engineers, architects, contractors, and owners, the process is also valuable in helping achieve significant productivity improvements.

Another key technological advancement is the availability of big data coming from sensors that can include everything from environmental to traffic data — the Internet of Things. Turning data from the Internet of Things into information can inform the planning process like never before, providing planners with a deeper understanding of current infrastructure issues and limitations, and leveraging that information to plan future investments.

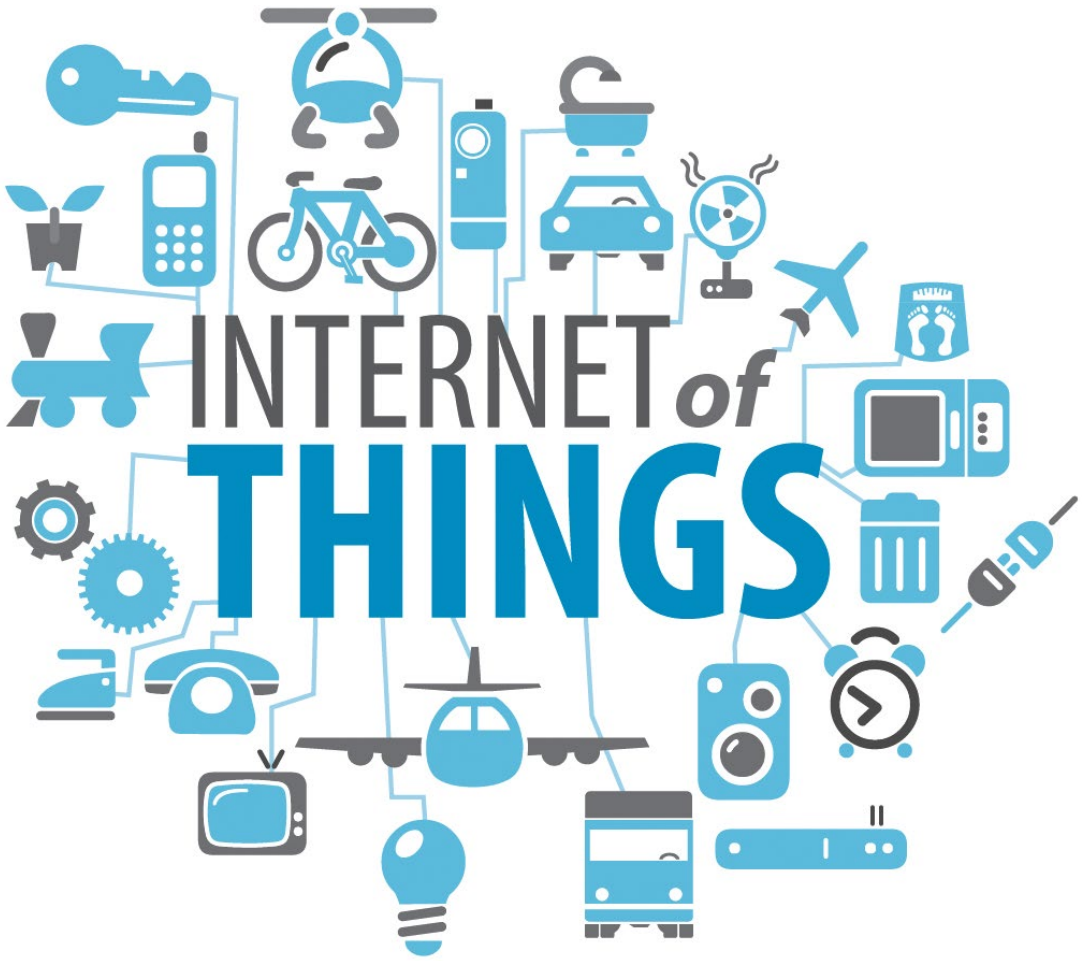
With the rise of big data and the availability of advanced modelling technology, it is now possible to plan and prioritise investments in urban development with greater foresight, better communicate potential outcomes, and yield measurably better results.

People make the city

However, it is people not technology that make a city. An informed public will be critical of any approvals for proposed new or rehabilitation projects to improve a city's economic competitiveness. Today's technology, along with social and mobile platforms, provides a means to engage all stakeholders — from citizens to professionals — earlier and throughout the process in a way that is easily understood. It allows cities and commercial firms to use data to create and present proposals for new designs shown within their existing surroundings or conduct analyses for population growth, weather impact and many other factors. Allowing people to plug into the data can help facilitate communications and smooth the approvals process.

Ultimately, it's those people who live and work in cities who matter. Big data and simulation technology can help people design and make the infrastructure investments their cities need for a future of renewed economic and environmental vitality.

Prof. Arup Dasgupta
Managing Editor
Geospatial Media & Communications



The idea behind the Internet of Things is to make things intelligent, programmable, and more capable of interaction with humans

According to Cisco, the number of devices connected to the Internet exceeded the total population of the world in 2008. Twenty quintillion (1018) bytes of data are being generated every day. According to various projections, by 2020 we will have 50 billion machines, each with their unique IP address, talking to each other. Humans will be downloading about a gigabyte of data every day. At the same time, the number of applications (apps, for the initiated) has become prolific but not persistent because the rapid progress of technology renders many of them obsolete. In short, not only people but things as well have become interconnected. Welcome to the world of the Internet of Things (IoT).

Connecting all things

According to J. Roberto Boisson de Marca, IEEE President and CEO, IoT envisions a complex, self-configuring, and adaptive system of networks of sensors and smart objects whose purpose is to connect all things, including commonplace and industrial objects. The idea is to make things intelligent, programmable, and more capable of interaction with humans. The key word is 'more'. Human machine interaction, like driving a car for instance, is not something new. A modern car with embedded computers

talks back, telling the driver about its status. Cars can now entertain, receive phone calls and provide route guidance through discrete, independent utilities. The car of the IoT world will integrate all these functions and take over repetitive human actions like driving and free the human to attend to phone calls, work on documents or just watch some programme. This is a technology oriented view of IoT.

Paul Teich, CTO & Senior Analyst at Moor Insights & Strategy has looked at IoT from the human angle through Maslow's model of human needs (Figure 1). The vertical axis is adapted from Maslow's conceptual model. At the bottom are the needs of existence while at the top we have the needs for self actuation. The horizontal axis represents the available input from industry on the left and those human inputs that are interactive on the right. The industrial inputs to IoT are those items which affect human existence but cannot be controlled interactively by them, for example, smart grids. On the other hand, the human inputs are those on which human beings have choice and control, for example, smart appliances.

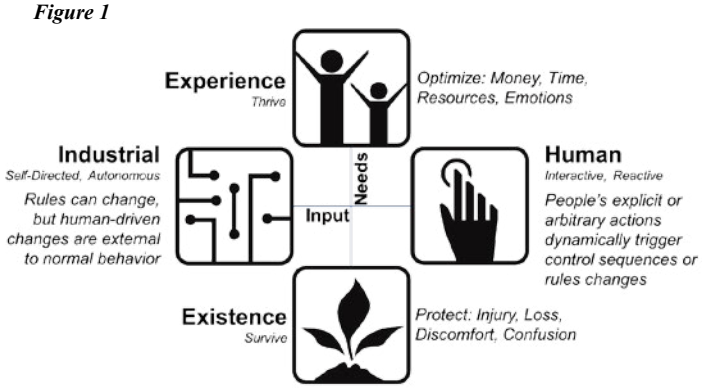
Adding value to information

This conceptual model can be extended to the geospatial world by considering those technologies that impact the industrial and human input groups. UN-GGIM, in its decadal vision on future trends in geospatial information management, declares that over the next five to ten years the vast amount of data being generated has to be understood and linked to other data, adding value to the information that already exists. Location will be an essential information to provide the underpinning framework that brings many datasets together.

Raw data, coming from a variety of sensors ranging from imaging devices to *in situ* sensors, VGI, citizens as sensors, will require the use of Big Data analytics, sensor networks and conventional image processing and IT techniques. Unstructured

IoT will allow a car to take over repetitive human actions like driving and free the human to attend to phone calls, work on documents or just watch some programme

Figure 1



Courtesy: Paul Teich, CTO & Senior Analyst, Moore Insights & Strategy

data from social media and from transactional data streams will require semantic analysis and knowledge extraction to create rich machine-processable descriptions of data.

A smart farm in Australia that uses environmental sensors, livestock monitoring technologies, and an ontology-enabled architecture for personal alerts and data sharing is an example of IoT (Figure2). Data from *in situ* sensors and RFID tags are pushed to a global sensor network stream management system. The summarised data is converted into a Rich Data format and stored in a Virtuoso Triple Store. Various algorithms, implemented in Java or R, are deployed to consume real-time sensor data and produce value-added streams. Semantic event descriptions are processed to generate alerts. The farmer can also personalise alerts based on the data from the sensors and local meteorological data.

Paul Teich terms industrial IoT as 'brownfield' because they apply to existing mechanical and digital systems ready to be connected to IoT. On the other hand, human IoT is termed as 'greenfield' "because these are emerging services and technologies that must build infrastructure as it grows. It requires fast moving prototyping driven by leaps of faith in user experience and device design."

Intregrating with other applications

Geospatially, human IoT encompasses pervasive and interactive emerging applications like location based services, wearables, health and fitness, indoor positioning, augmented reality, amongst others which heighten consumer engagement. Independent human to machine interactions will evolve and integrate with other applications through machine to machine interactions. An example of an intelligent refrigerator automatically ordering milk and paying for it through online credit card services is frequently quoted. Though trivial, this example does highlight the degree of integration that will be needed.

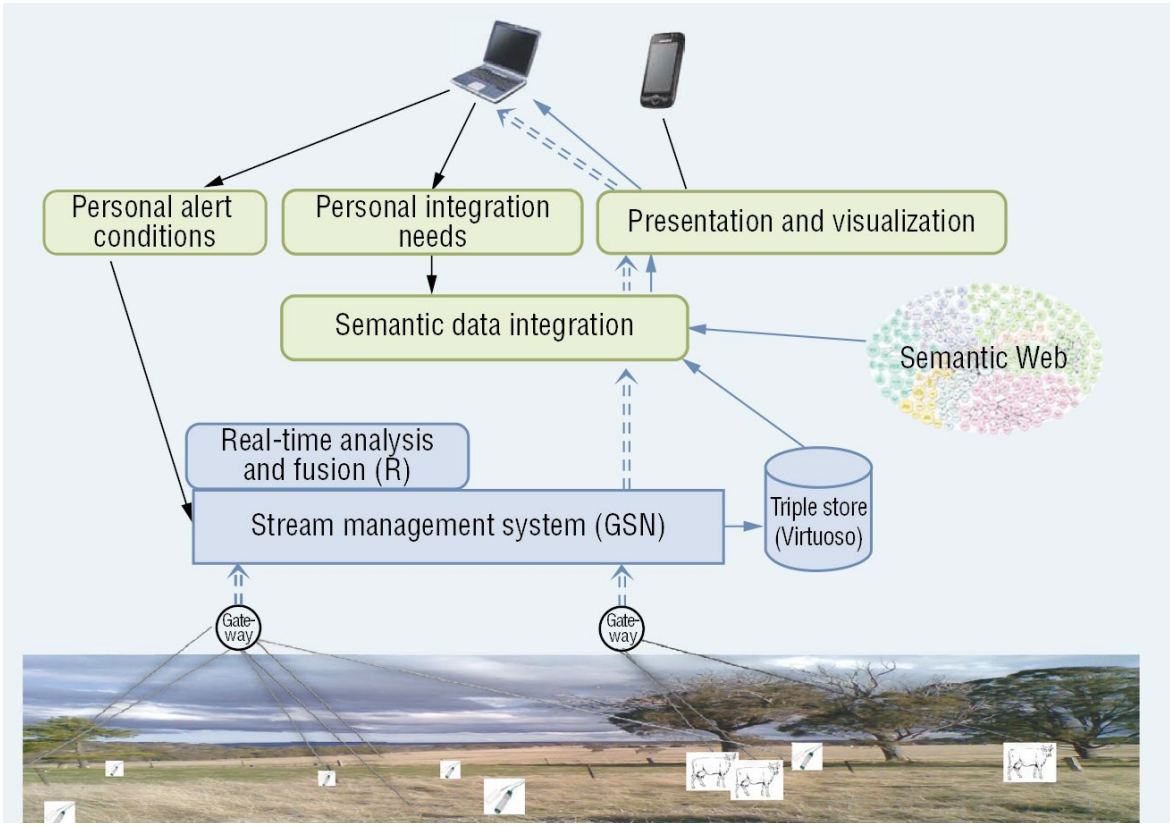


Figure 2. The architecture of the smart farm situation awareness and open data framework. Sensor data are data pushed to a stream management system that's extended with predefined analytic functions and dynamic alert conditions. Semantic Web technologies are used to define the alert conditions and to integrate and publish data. (Embedded Linking Open Data [LOD] cloud image courtesy of Richard Cyganiak and Anja Jentzsch.)

IoT will require end-to-end thinking for services which should integrate currently available technologies and be able to adapt to and adopt new technologies as they evolve. Such systems will have a consistent service interface, be Internet connected, be configured and monitored over the Internet, run user-mode applications, and be secured through encryption and authentication.

The need for standards

Building IoT will require standards, which have to evolve out of the existing ones, adding on the interconnectivity. For example, the European Union's Seventh Framework Programme has commissioned several studies on IoT architecture. One of the outcomes is the development of the IoT-aware Process Modelling Concept (IAPMC) seeking to lower the barrier for applying IoT technology like sensors and actuators to current and new business processes. OGC is developing a lightweight standard for Sensor Observation Systems.

Open data and open source seem to be the prerequisites for IoT because consumers want to use a large variety of devices in their ecosystem and don't want to be limited to using devices of one specific vendor. Vendors of IoT devices want to maximise the number of ecosystems for their devices, vendors of IoT platforms want to integrate more devices into their ecosystem, and application developers want to support a broad range of devices and minimise vendor specific code.

Some of the early starters in the drive to IoT are IBM with their Smarter Planet, Cisco and its Planetary Skin, and HP with their Central Nervous System for Earth. Other players are Microsoft Intelligent Systems, Google, GE Minds+Machines, ARM, Qualcomm and Intel Intelligent Systems Framework. Several groups have been formed, like EU's IOT-A for architecture, Internet Protocol for Smart Objects Alliance, and International M2M Council.

Speaking on privacy in an article in the IEEE Institute, Monica Rozenfeld says "Everything, including our homes and heartbeats, will be monitored to make our lives easier and healthier, (but) companies are planning to turn information about our every move into valuable market data." Welcome to yet another 'Brave New World'.

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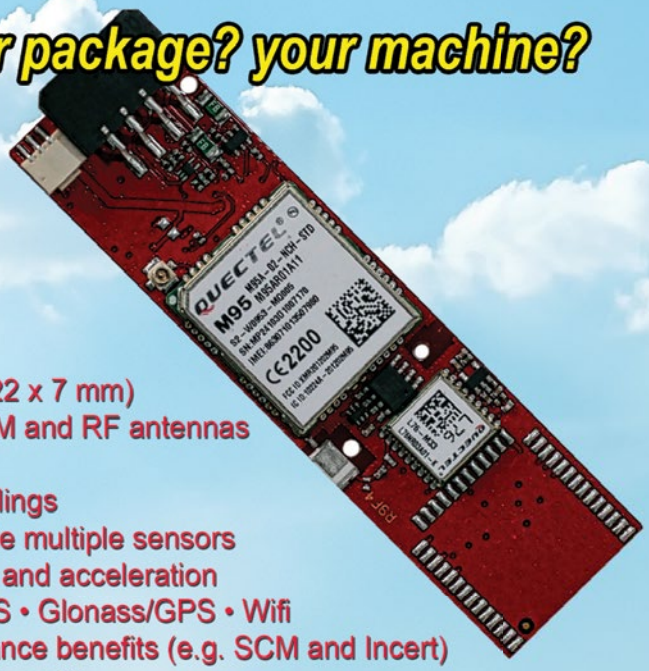

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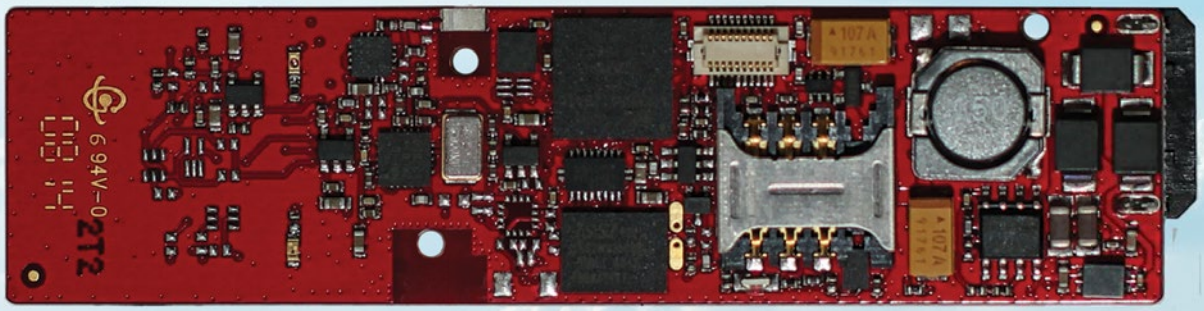

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Mark Reichardt
President and CEO
Open Geospatial Consortium (OGC)

Smart Cities and Sensor Webs

The convergence of sensor webs and geospatial technologies is a trend that is on track to become increasingly obvious and important in the near future

The term 'sensor web' refers generally to multiple connected sensors providing data for use by Internet-connected applications.

Sensors play a key role in Smart City applications and their importance will increase with the growth in the number of sensors that are connected to the Internet. Smoke detectors, weather data, traffic radar, surveillance cameras, gunshot detectors, and mechanical strain gauges on bridge structures are examples of sensors that make cities safer by supporting disaster and emergency prevention, response and management. Air, water and radiation pollution monitors, hospital asset location and patient monitoring systems, and 'healthy building' sensors help us maintain health. Apps using smartphones' accelerometers and GPS can give cities the locations of street potholes, and systems using traffic counters can help distribute traffic for efficient transportation. The improved granularity of this data is partly a result of the growing number and improved resolution of satellite-borne remote sensors and partly a result of the increasingly dense spatial distribution of sensors on or near the earth's surface.

Exponential growth in the number of Internet-connected sensors is due to overall miniaturisation and reduction in cost and power requirements of digital devices in general. Not only the number but also the variety of Internet-connected sensors is increasing at a phenomenal rate. Smartphones are highly distributed location-aware sensor platforms for camer-

as, gyroscopes, accelerometers, thermometers, microphones, light meters, GPS, compasses, and sensors that enable WiFi and cellular and near-field communications. Every sensor observation can include location with varying degrees of precision and every observation can be time-stamped with extraordinary precision. Smartphone apps using combinations of these provide many capabilities. Network-connected sensors are making their way into vehicles, buildings, pipes, ducts, bridges, stores, and factories. In addition, a global network of satellite-borne imaging sensors, ocean sensors, weather stations, seismic monitors, etc., provides a broader regional and global picture of weather, ground cover, land use, etc.

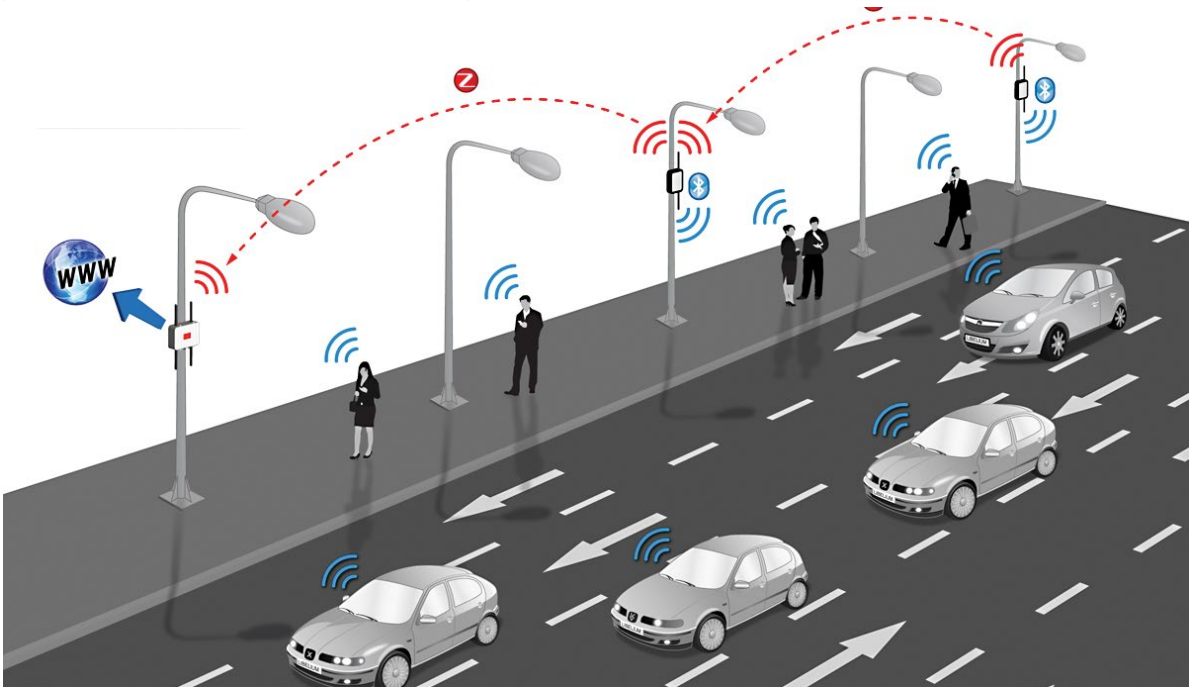
Silos of automation

Unfortunately, most sensor systems are limited by their technical isolation — also known as silos of automation — resulting from proprietary interfaces, APIs, and data encodings. Every sensor observation is collected in a particular place at a particular time by a device with particular technical characteristics, metadata, history, and ownership. This information is usually important and must be made available. Unfortunately, all too often, communication involves proprietary or custom-built encodings and interfaces that can't easily be discovered and exploited. Typical security monitor networks, building temperature control systems, subway tunnel flood monitoring systems, etc., are deployed for specific purposes by contractors who are usually not asked to make their systems conform to a master plan for interoperable systems. This is understandable because the sensor industry evolved without widespread connectivity and without a comprehensive set of open standards that enable interoperability. If such open standards had been available 15 or 20 years ago, we would already be realising the benefits of connecting sensor systems with each other and with geospatial systems. Fortunately, today those standards are available.

Future proofing sensor webs

Open standards for sensor web enablement, 3D urban models, geospatial processing systems, building information models, indoor location and other spatial technologies are now available from OGC, ISO and other standards organisations. These standards are mature to the point where comprehensive Smart Cities information system architectures enable integration of all of this information.

Urban information system experts are using these standards to connect sensor arrays to the Internet using open interfaces and data encodings that enable sensors and sensor data



Source: www.libelium.com

Vehicle Traffic Monitoring Platforms, such as one developed by IoT platform provider, Libelium, for its Smart Cities solution, is capable of sensing the flow of Bluetooth devices in a given street. Sensor data is then transferred by a multi-hop ZigBee radio, via an internet gateway, to a server. The traffic measurements can then be analysed to address congestion of either vehicle or pedestrian traffic.

collections to be described (along with location), catalogued (for searches), discovered, controlled, and read by diverse applications. Access control is often important, of course, but so are flexibility and 'future proofing'. The value of sensors and sensor data increases when multiple applications are able to combine information from different sensors — including spatial and temporal information — so that sensor data can be used in combination with other kinds of location data.

For instance, the OGC Sensor Web Enablement (SWE) standards are open standard interfaces and encodings that make it possible for sensors to be connected to the Web, located, described, read, and controlled remotely. SWE is part of the larger framework of widely adopted OGC standards, so integration with other kinds of spatial data can be accomplished without developing or adapting to special purpose spatial encodings or interfaces. OGC standards are closely aligned with and sometimes are the source of related ISO standards. A variety of ISO standards are the basis of the OGC Abstract Specification.

Convergence of sensor data with spatial data in smart cities advances along with convergence of indoor 'building-spatial' encodings and outdoor geospatial encodings. Urban sensor integration will benefit from all of these developments:

- The OGC Sensor Web Enablement (SWE) SensorThings API candidate standard for the Internet of Things builds on the OGC's SWE standards suite, but it is designed to be lightweight and easily implemented.
- buildingSMART International is working with OGC to harmonise the Industry Foundation Class Building Information Model (BIM) standards with OGC standards.
- The OGC CityGML standard allows users to share virtual 3D city and landscape models for analysis and display tasks.
- The candidate OGC IndoorGML Encoding standard specifies an abstract model and XML schema for indoor spatial information to support navigation.
- The candidate OGC Moving Feature Encoding standard defines an abstract model, an OGC Geography Markup Language (GML) application schema and also a simple CSV (comma-separated value) format for encoding moving feature data.
- The OGC LandInfra Standards Working Group is working on a standard to integrate land information contained in various CAD formats into the OGC standards framework.
- The OGC Urban Planning Domain Working Group (SWG) is defining the role for OGC standards and related activities within the Urban Planning discipline.

Implementation of these and related standards will enable integration of many different kinds of data and many-to-many communication among urban users of different kinds of information systems. Deployments specified with this kind of integration in mind are wise deployments that will deliver a much greater return on investment than choices that impose technical interoperability limitations.

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Prof. Josef Strobl
Chair, Department of Geoinformatics,
University of Salzburg, Austria

Time to open up

Open education, in particular open access to education, must be goals in every forward-looking society striving to have a future

As an academic programme director, I sometimes hear the question: "Why would anyone pay for education these days as ample knowledge today is freely available – Wikipedia, Open Access Journals and all …" A quick response is to point out the differences between a university and a publishing house, the social contexts for learning and the key mentoring role of a teacher, but clearly there are important recent developments influencing the educational domain.

This misconception of education has already been concisely described by the Greek historian and philosopher Plutarch through the famous quote: "Education is not the filling of a pail, but the lighting of a fire." Once the fire is lighted though, it needs to be nourished.

Availability of educational resources

We currently observe substantial changes across the resources available in support of teaching and learning. In the discipline of Geoinformatics, traditionally learning is based on instruction and experience gathered from being confronted with problem-oriented projects, where students analyse geospatial data with methods and algorithms coded in software. Their work is based on conceptual and applied knowledge documented in published papers and summarised in textbooks.

Availability of these educational resources, software, geodata, and publications at many places of learning has been posing (and partially still does) limitations to the educational process. Cost and access constraints mean that learners had limited access to professional technology, would work on the same 'demo datasets' over and over again, and could not fully leverage prior knowledge and experience reported in publications. Obviously, business models at many places have changed: (in particular) governmental datasets increasingly are subject to open data policies, and the same happens with research data. High quality software is becoming freely accessible as open source, challenging learners to explore and adapt algorithms, and to extend existing frameworks. Publishers change from reader-pays to author-pays, triggering all kinds of not only desirable dynamics, but overall making access to knowledge easier than ever.

The Internet drives some of these changes in a twofold way: by technically facilitating access, and by establishing a spirit of sharing across all kinds of boundaries. In practice, open access only works via the Internet as a basic framework and resource, and this already points at a limitation for open access wherever there are policy constraints or cost concerns to be considered. Unfortunately, these affect many of the disadvantaged countries of the planet, which would benefit most from open resources for education.

What are open educational resources?

Open Educational Resources (OER) are built from a combi-

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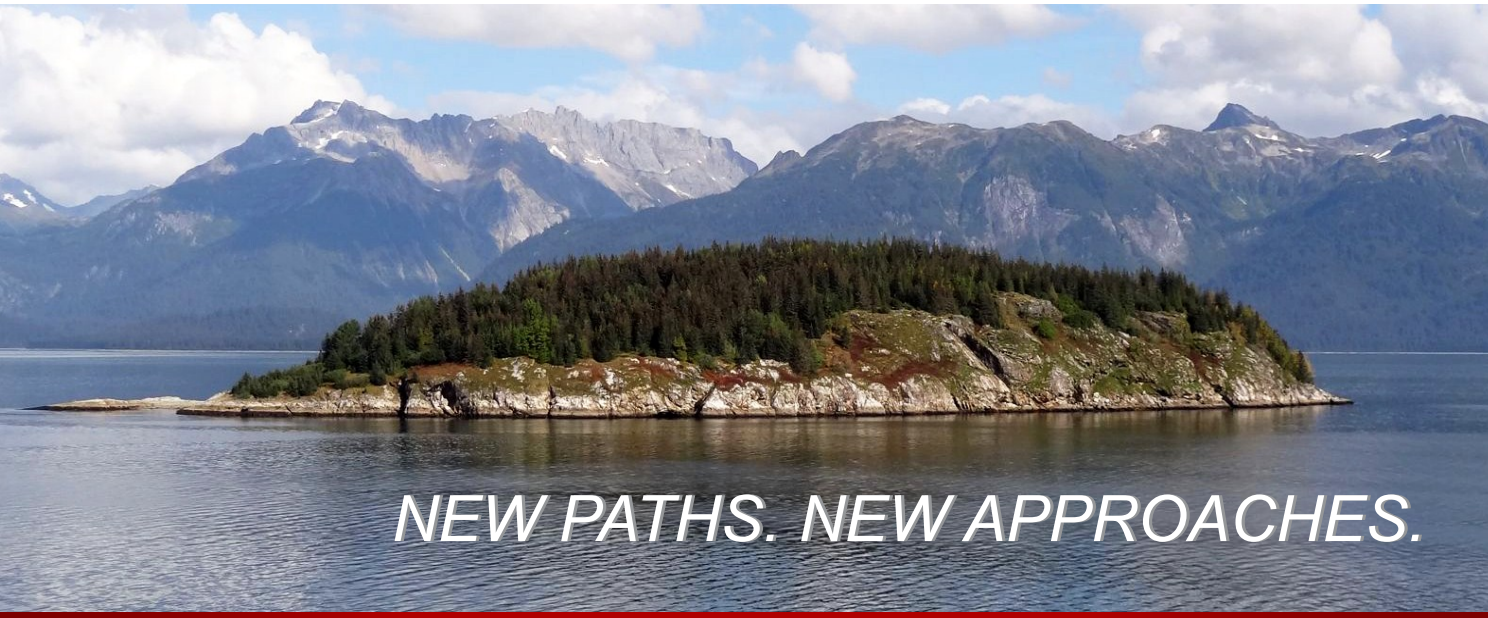

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nation of open (geo) data, open source software and open access publications. Some of the practical impacts in learning by each of these are:

- **Open Data,** including but not limited to Open Government Data (OGD), allow students to 'geospatially explore' their personal regions of interest. Teachers will aim at making each student's project an individual one, instead of everyone in class simply clicking through a standard exercise with all expected to get the same result. Even more importantly, with the obstacle of data acquisition out of the way, students focus much more on the what-and-why of their analysis. The former ratio in many projects of 80% database development and 20% analysis is flipped, with the result of learning more about the actual problem, with less focus on the technical format/projection/documentation/semantics/access problems encountered along the way.
- **Open Source software**, while too often simply perceived as free, opens up choices and insights. Choices, because limited affordability does not make graduates into 'single trick ponies' only exposed to and skilled in one technology environment. Insights, because black boxes of methods are opening up, can be changed and expanded, and students are being challenged to further develop their coding competences.
- **Open Access publications** are game changers in academia per se, but yet need to be fully leveraged in education. Since non-authoritative and non-peer-reviewed sources dominate the internet since its inception, teachers still are working hard to direct students toward original research and well documented application experience. Obstacles like 'it is not in our library' and 'I cannot afford to purchase it' still prevail in many learners' minds. Beyond publishers' business model change, the spirit of open knowledge development has not yet made it into publications like, for example, with open source software. Very little commenting, shared writing, 'forking' and open collaborative publishing is currently done.
- **Open education,** in particular open access to education, must be goals in every forward-looking society striving to have a future. This requires flexibility in learning environments, and in particular increased individualisation of learning. Access to Open Educational Resources facilitates the latter, lowers hurdles for institutions and individuals alike, and allows people to concentrate attention on real-world problems instead of only learning inside of severely limited sandboxes.

Open Educational Resources are built from a combination of open geodata, open source software and open access publications

Drivers of OER

Fortunately several 'drivers' of OER have emerged recently in the geospatial domain. The International Cartographic Association (ICA) and the Open Source Geospatial Foundation (OSGeo) under the mission of 'Making geospatial education and opportunities accessible to all' have established the Geo-for-All labs initiative, recently joined by the International Society for Photogrammetry and Remote Sensing (ISPRS).

Outreach and open access to education is a priority for the International Society for Digital Earth, stimulating its membership through commissions, workshops and summit events to focus on geospatially oriented literacies, awareness and capacity building.

Several institutions are now leveraging the emergence of Massive Open Online Courses (MOOCs) for attracting learners into the field, and to lower the barriers for entry. While MOOCs are not necessarily based on an entirely 'open' concept, they nonetheless contribute valuable components to open learning environments.

Most importantly though, a majority of the leading technology companies in this field have accepted the challenge and are making significant contributions through the opening up of educational resources and easy access to technologies for learners and educational institutions.

Making a difference

Does all this make a difference already? Are our graduates more qualified, and are their numbers increasing? Is continuing education through lifelong learning facilities having the intended impact on the workforce and growth of individuals' professional capabilities and opportunities?

As educators, we now are facing the challenge to not only enjoy and reap the benefits of easier availability and access to educational resources, but in many ways to restructure and re-engineer approaches to capacity building and learning environments. As e-learning thought leader Wayne Hodgins put it at a Seattle conference many years ago: "The only sustainable competitive advantage is the ability to learn and apply the right stuff faster."A truth, both for learners and educators!

PRODUCT WATCH 2015

Innovation is the byword for geospatial industry. Here's a look at the software, hardware, data and services top technology companies are betting on in 2015!

AUTODESK

App for Collaborative Construction Management

To fuel construction layout activities on the job site, Autodesk has launched a new iOS app **Autodesk BIM 360 Layout**, as part of its fast-growing BIM 360 cloud service. The app uses the BIM 360 cloud service to provide general mechanical, electrical and plumbing contractors the ability to connect the coordinated building model to the construction layout process. The layout connects design intent from a digital model with the physical world by controlling a robotic instrument from Topcon Corp – a strategic partner to Autodesk.

Key Features:

- Replaces error-prone manual layout techniques with laser-guided precision. It improves field accuracy and productivity, resulting in faster construction.
- Users are able to connect the field point creation process within the coordinated model to the actual layout process, without the need to manually prepare and export point lists.
- Contractors can start with Autodesk Point Layout in connection with Autodesk AutoCAD, Autodesk Navisworks software or Autodesk Revit software, and then import their model with field points into the BIM 360 Glue web service, which can then be synced with the BIM 360 Layout app on the iPad.

BENTLEY

Information Mobility with Expanded Interoperability

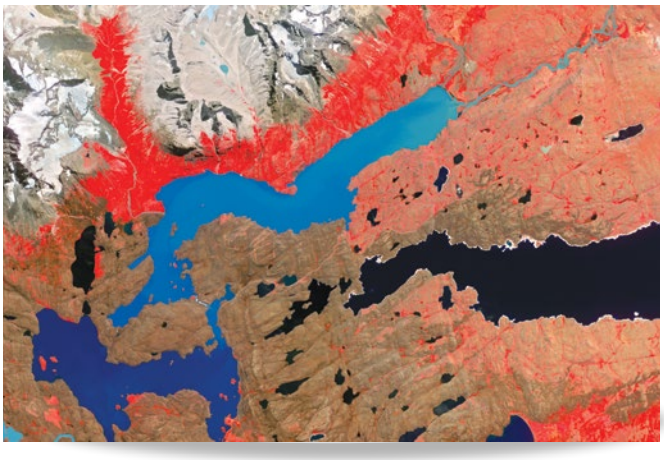
Bentley Map, a fully featured 3D GIS application, addresses the challenges of organisations that map, plan, design, build, and operate the world's infrastructure. It is a 2D/3D desktop GIS that provides infrastructure professionals with the right geospatial tools to create, maintain, analyse and share spatial information. The new release of Bentley Map SELECTseries 4 brings engineering and geospatial data closer together through improved interoperability with Esri File Geodatabase, Oracle 12c, CityGML, and hybrid point-cloud and vector workflow support. This expanded support for interoperability is extremely beneficial for the industry because more types of data can be leveraged throughout the entire project lifecycle. It eliminates redundant workflows and provides collaboration between geospatial and engineering standards to better support multi-discipline project teams.

Key Features:

- Support for leading spatial databases such as Oracle Spatial and Microsoft SQL Server Spatial databases that allow organisations to store and manage very large volumes of spatial data.
- Intelligent geospatial object creation that includes advanced 2D and 3D design productivity innovations to create and maintain engineering-quality spatial data.
- Spatial analysis including a full collection of spatial analysis and presentation capabilities using 2D and 3D data.

BLACKBRIDGE

A Cloud Approach to Imagery



Collections of satellite imagery are most valuable when they are easy to access and use. BlackBridge has developed the **GeoCloud Suite** with the goal of making the RapidEye archive one of the most valuable sources of information about the changing planet.

The GeoCloud Suite is a collection of web applications (EyeFind and EyeFind+) and web services that allow users to manage their archive of purchased RapidEye imagery and third party imagery within a web browser or within their own developed applications. With the tools in the GeoCloud Suite, users will be able to monitor their orders, search the archive, stream products, and run processes online.

Technology limitations, budgetary constraints, and staffing concerns are challenges for even the most established organisations. The GeoCloud Suite frees users from these constraints, allowing them to focus on getting rich information content out of their imagery without worrying about large expenditures for building or maintaining a similar system.

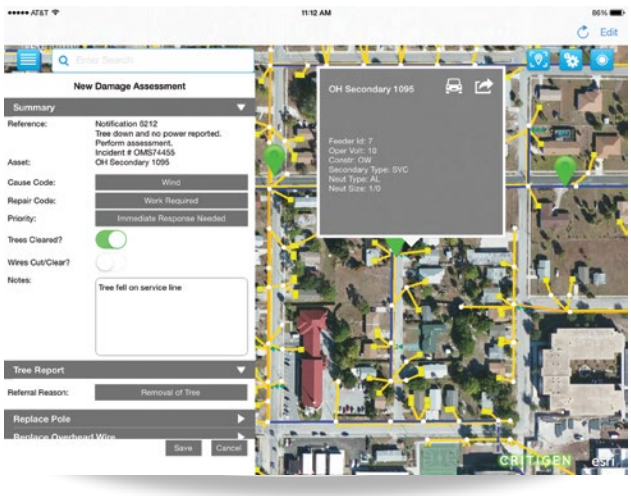
Recently, this model has been embraced by the precision farming industry. End users want to measure vegetation health,calculate biomass, forecast yields, and analyse trends of crops over time. The combination of RapidEye's high collection capability, combined with the GeoCloudSuite, made this possible.

In 2015, BlackBridge will make the enhanced capabilities of the GeoCloud Suite commercially available to all users to power their applications.

CRITIGEN

Creating Value by Integrating GIS with Mobile Applications

Much of the SAP Utilities customer base is looking for mobile field applications that are lightweight, provide flexibility, and give the field more tools and information to work with in order to provide faster service, better access impact areas, and determine priorities during critical events. In collaboration with SAP mobile engineering, Critigen addresses this challenge through a new set of functions available with the latest version of SAP mobile platform and SAP EAM Mobile Work Manager 6.1 and soon to be released 6.2. This new solution called **Open UI** integrates both environmental and engineering data in GIS and SAP EAM work management and field services in a single application for field services.



The SAP Solution:

- Critical GIS and environmental data need to support the field mission.
- Situational information employed to assist and back critical decisions when time is a major factor.
- Essential features in a single lightweight application to seamlessly integrate the back office and the field with a common operational picture.

DAT/EM

For Valuable 3D Information

Gain valuable 3D information from the UAS data with DAT/EM Systems International's **SUMMIT UAS**. An essential component to any UAS workflow, SUMMIT UAS provides a set of tools to analyse or compare UAS data by viewing, editing and defining features. It requires no training in photogrammetry and is tailored to resource-grade data analysis. It integrates with all DAT/EM software for those with survey-grade requirements. It will be available later this year.

Prospective industries and uses include:

- **Farming:** Determine crop yields; conduct fertility time analyses.
- **Forestry:** Analyse remote areas; determine best area for project or harvest; stand typing.
- **Mineral Extraction:** Measure stockpile volumes; assess and monitor mine conditions and environment.
- **Conservation:** Monitor and analyse remote and inaccessible regions.
- **Utilities:** Assess utility corridor infrastructure.

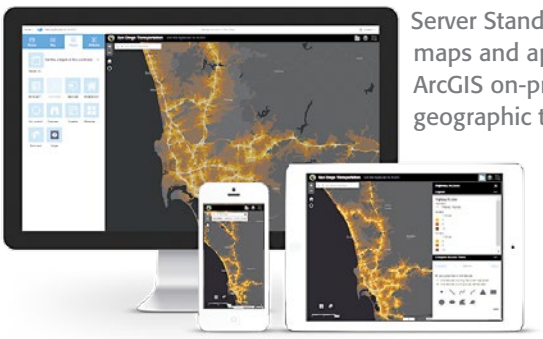
Key Features:

- **DAT/EM Drawing Tools:** Terrain following, simplified 3D vector editing.
- **Interconnectivity with the DAT/EM Photogrammetric Suite:** Compatible with the DAT/EM Photogrammetric Suite for advanced capabilities for expanding the use of UAS data.
- **Interface to CAD and GIS programmes:** DAT/EM software provides an interface with CAD and GIS software from other manufacturers. Currently product partnerships are in place with Esri for ArcGIS for Desktop line of products; AutoDesk for AutoCAD and AutoDesk Map; Bentley Systems for MicroStation and Bentley Map; and Blue Marble Geographics for Global Mapper.

ESRI

Map like a Pro, on Any Device, with ArcGIS 10.3

At version **10.3**, ArcGIS continues to innovate and push the science of geography and GIS. This release includes a series of new apps and enhancements that helps people discover, make, use, and share maps from any device, anywhere, at any time. ArcGIS Pro is a brand new app that revolutionises desktop GIS in the geospatial industry. ArcGIS Pro is 64-bit, multi-threaded desktop app that takes advantage of a new display engine to render and process data faster than ever before. With ArcGIS Pro, you can design and edit in 2D and 3D, and you can work with multiple displays and layouts, all from the same project.



Portal for ArcGIS: At version 10.3, portal for ArcGIS is now included with ArcGIS for Server Standard and Advanced. With Portal for ArcGIS, one can easily find and use maps and apps built on top of ArcGIS for Server. One can also deploy Portal for ArcGIS on-premises and behind the firewall to effectively create, store, and manage geographic tools and information products from a secured, central location.

Web Apps: One can use easy-to-configure Web Application Templates to create professional web apps with minimal effort. One can also build one's own custom web apps with the new Web AppBuilder for ArcGIS.

HEXAGON

Taking Your GIS Deeper into the Organisation

Hexagon's **GeoMedia Smart Client** is a flexible, web-based GIS that enables one to configure and use custom, map-based web applications in the office and in the field. At GeoMedia Smart Client's core is a powerful Workflow Manager that enables delivery of highly-optimised, task-specific processes focused on the creation, update and analysis of geospatial and attribute data. It is a GIS workflow management system that connects tasks and dependencies across different roles in a process and dynamically configures to reflect a user's role and specific workflow steps.

Key Features:

- **Custom, task-specific user processes:** Through a simple interface, GeoMedia Smart Client provides easy and highly efficient map-based tools that enable high-end, powerful GIS functionality.
- **Workflow Manager:** This product comes with GeoMedia Smart Client or can stand alone. A comprehensive toolset, this XML-based tool lets users construct highly focused processes that can be made available in the Java-based Smart Client or in the browser and public-facing websites.
- **Powerful GIS functionality:** Users have robust GIS functionality at their fingertips and in the field including digitising with snapping support, large format plotting, query, field updates, dimensioning and redlining.
- **Enterprise management and administration capabilities:** It provides sophisticated data and user management functionality that is essential for enterprise implementations.

For Easy and Cost-effective Large-format Printing

Print large-format drawings, satellite and aerial photos, maps, and plans in-house — and control costs effectively — with the **HP Designjet T3500** Production eMFP. Rated as one of the most productive large-format multifunction laser printers (MFPs) in the market today, this powerful multifunction device improves workflows with print, scan, and copy capabilities and enables easy and unattended printing. Furthermore, it keeps your documents confidential and secure. Ideal for geospatial professionals, the T3500 enables you to modify and print updated plans for immediate evaluation by team members and clients. Plus, you can always expect to see prints with excellent image and line quality, including outstanding colour consistency.

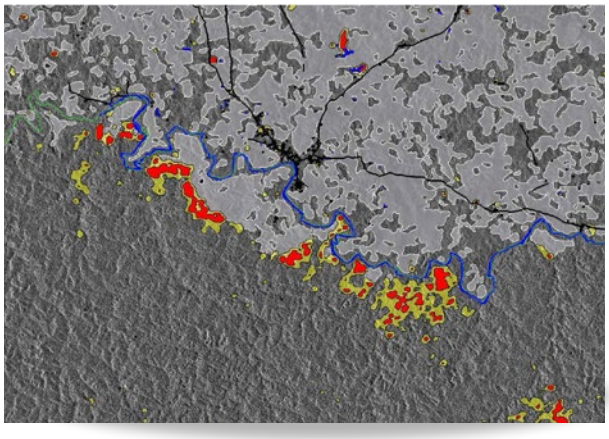
Key Features:

- Print D/A1-size pages in 21 seconds (in fast mode) with dark blacks, neutral grays, and vivid colours.
- Copy and scan quickly with advanced features — presets, batch scanning, multipage PDFs, and scan to email.
- Operate unattended thanks to two heavy rolls of up to 650 ft (200 m) and a total ink capacity of 1800 ml.
- Minimise device-management tasks and costs using the HP Designjet Universal Print Driver.

HP

MDA

Automating Forest Change Monitoring from Space



With forests covering one-third of the earth's landmass, effective monitoring of these vast regions has been a challenge. MDA's **Forest Monitoring Solution** detects changes in a forest environment through reliable coverage of an area of interest (AOI). MDA uses the RADARSAT-2 satellite to acquire imagery to build a temporal archive, creating a baseline view of the AOI.

Key Features:

- **Cost-effective broad area monitoring:** Routine monitoring (monthly, quarterly, annually) at the right frequency provides a cost effective way to respond to unexpected changes. Access to up-to-date change maps allows for better allocation of field resources.
- **Actionable information:** Change detection algorithms deliver up-to-date change reports on a routine, reliable schedule. High resolution imaging over large areas enables customers to send ground personnel to the areas where unexpected changes have occurred.
- **Know when change occurs:** Image acquisition, independent of clouds or darkness, delivers routine, reliable monitoring to identify changes to the forest canopy. Turnkey change reports deliver the information needed, without requiring SAR expertise.
- **Real-world solutions for UN REDD+ monitoring:** MDA provides proven solutions for the effective monitoring of large-scale forest change. Fully processed change detection reports provide a cost-effective addition to Monitoring Reporting Verification (MRV) efforts.

OPTECH

The Next Generation of Airborne LiDAR Sensor

The new **Optech Galaxy** is a significant leap forward for airborne LiDAR sensors, offering the performance and productivity typically associated with much larger dual-beam sensors in a compact form factor that provides maximum installation and application flexibility. Key to Galaxy's high productivity is PulseTRAK, a set of technology innovations that address common deficiencies found in lesser designs. PulseTRAK's foundation is a new scanner capable of much higher speeds over larger scan angles than ever before, resulting in improved point distribution, wider swaths, and the ability to 'dial up' point density on demand with narrower FOVs for maximum resolution.

Key Features:

- The swath tracking mode dynamically adjusts the scanner FOV to keep swath width and point density consistent in variable terrain.
- Up to 8 returns per pulse to provide greater vertical density for targets like transmission towers without requiring voluminous full-waveform capture.
- 550kHz effective 'on-the ground' sampling rate.
- Real-time XYZi point display for on-the-fly powerline detection confirmation, plus real-time LAS file generation for immediate deliverables and visualisation.
- Supports up to 6 imaging sensors and a waveform recorder in a gyro-stabilised, static or pod mount on fixed or rotary-wing aircraft and UAVs, giving it the power and flexibility to handle corridor, engineering and wide-area surveys.

PITNEY BOWES

A Premier Desktop GIS and Mapping Application

Originally thought to be a technology solely used by GIS professionals, business professionals across industries and technical backgrounds are relying upon location-driven insight and mapping technologies to glean greater insight into how their operations perform. To meet this ever-growing need of GIS professionals and business leaders, Pitney Bowes released **MapInfo Pro 64 bit**, a platform built on MapInfo technology, which enables businesses to create and analyse spatial data through map production. The release highlights the company's reinvestment in its location intelligence services that more than a billion people worldwide use today.

Key Features:

- **New User Interface:** Brand new ribbon UI, window management (tabbed, docking, Floating, multi-monitor support, mini-toolbar, workspace explorer, labeling styles and label preview.
- Layout Designer with live editing capabilities.
- Workspace Explorer to manage windows, database connections, layers and tables.
- Performance improvements for object editing: buffer, split, erase and erase outside.
- Hotkey and quick access toolbar customisation.
- Geomapping functionality.
- Multi-threading of selected object processing capabilities to use more or all of the available processors.

RIEGL

An Integrated LiDAR Unmanned Aerial Vehicle

The **RiCOPTER**, RIEGL's ready to fly remotely piloted airborne laser scanning system provides full mechanical and electrical integration of sensor system components into the aircraft. The robust and reliable platform includes the survey grade RIEGL VUX-1 LiDAR sensor, a high performance IMU/GNSS unit with antenna, the control unit, and up to four optional cameras. This fully integrated turnkey solution provides remarkable measuring characteristics: 230 degree field of view, 350,000 measurements/sec, and 10mm accuracy. The Class 1 unmanned aircraft system can be flown at a maximum operating altitude of 550 metres with a maximum take-off mass of up to 25 kg, a max payload of 16 kg, providing a long flight endurance of 30 minutes. RiCOPTER was designed to meet the growing need for a comprehensive and complete UAV LiDAR system for applications like precision agriculture, forestry, topography in open-pit mining, terrain and canyon mapping or archaeology and cultural heritage documentation.

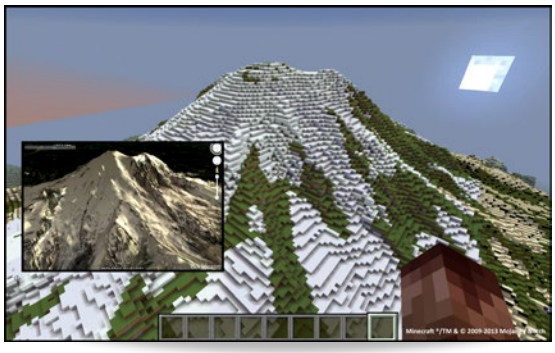
Key Features:

- High performance X-8 array foldable octocopter.
- Payload weight 16 kg (sensors and power supply).
- Maximum Take-off Mass (MTOM) <25 kg.
- Foldable propeller carrier arms, integrated carrying handle, and compact box for transportation.

SAFE SOFTWARE

Exchange, Transform and Gamify Geospatial Data

Keep up with a world of advancing technology without a hiccup in knowledge exchange. Enable data to automatically flow between 325+ systems including GIS, CAD, database, 2D, tabular, Web services, and more. **FME 2015** builds on the leading data transformation engine created by Safe Software, providing the ability to connect information between incompatible systems without requiring anyone to change their daily workflows or write code. Expanded system support offers sharpened tools for point cloud data (e.g. LiDAR), BIM, Microsoft Excel, Adobe PDF, and many others. New Mojang Minecraft support enables government agencies to leverage the gaming platform to increase citizen engagement in planning. Even more, coordinate systems can be expertly converted. Usability enhancements make it even easier to exchange, transform, and automate the flow of information using pre-built tools in a graphical user interface.



Key Features:

- Integrate location-aware information between 325+ otherwise incompatible systems.
- Transform data, models and coordinate systems in a graphical user interface.
- Automate the flow of data, removing the risk of human error and returning work-life balance to data managers.
- Remove the barriers to make critical information available when, how and where it's needed.

SOKKIA

Innovative 'Bullet': An Ergonomic GNSS Receiver

Nicknamed 'the bullet', the new **Sokkia GCX2 GNSS** receiver is a completely reimagined approach to receiver design that offers an ultra-lightweight and ergonomic solution at a low cost. It brings the power and convenience of GNSS positioning to new markets and regions where traditional designs have either been too costly or too intimidating. The multi-constellation and dual frequency receiver offers affordable high quality results for traditional surveying and construction fields – as well as unconventional applications such as in landscape architecture, GIS, BIM and forensic mapping. This is the smallest and lightest integrated receiver Sokkia has ever offered. The innovative POST (Precision Orbital Satellite Technology) antenna element allows for a form that is both ergonomic and extremely lightweight, which fully differentiates it from existing receivers in the market. The unique 'bullet' shape appears as a small extension of the range pole.

Key Features:

- Advanced satellite tracking technology featuring 226 channels; each one optimised to constantly track any currently available satellite signals.
- Radio-free RTK operation via interference-free data communication technology, which eliminates licensing issues.
- Can be used as a base station and can support up to three concurrent GCX2 rovers at a range of up to 300 metres. Each receiver may be used as a base or as a rover.

An Innovative Survey Solution for Reliable Field Use

The **Spectra Precision SP80 GNSS receiver** was introduced in early 2014 as a highly innovative survey solution combining GNSS technology and a unique combination of communication capabilities in a distinctive and ergonomic design. It responds not only to surveyors' lofty expectations, but also enables them to explore new modes of operation resulting in increased productivity and immediate returns on their investment. The SP80 introduced a unique anti-theft technology to safeguard the receiver by detecting if it has been disturbed while operating as a GNSS base in public or remote locations. Thanks to this anti-theft protection, the SP80 receiver informs the surveyor via SMS or e-mail if it is moved and can provide its position to facilitate recovery. When the UHF transmit radio module is used, its UHF antenna remains protected inside the rugged rod and extends the radio range performance.

Key Features:

- Exclusive Z-Blade GNSS-centric technology for improved performance and accuracy, including GLONASS-only or BeiDou-only operating modes.
- Next-generation 240-channel 6G chipset capable of fully utilising all 6 available GNSS systems (GPS, GLONASS, BeiDou, Galileo, QZSS, and SBAS).
- Built-in WiFi and 3.5G modem providing an Internet connection for RTK corrections or for sending e-mails (or text messages) with system alerts.

A Cloud-based Platform to Streamline Geospatial Workflows

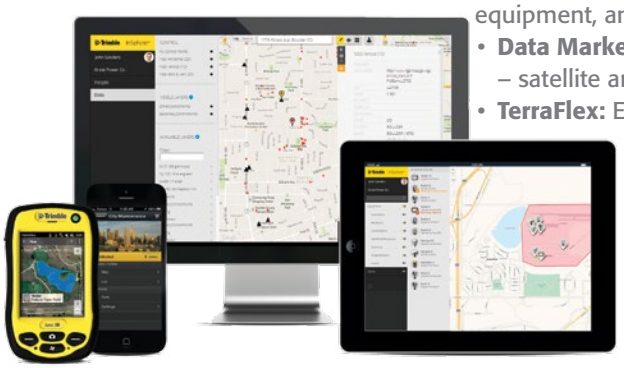
Trimble InSphere, a cloud-based platform of geospatial software, data and servcies, which helps geospatial enterprises streamline their workflows- from data collection through delivery of geospatial information.

Located in a centralised place to easily access information, Trimble InSphere is built from the ground up, and enables organisations to efficiently manage data, equipment, and overall workflows — placing team members and stakeholders firmly in control.

The InSphere platform is useful for sharing data between the office and the field, or sharing deliverables with a broader range of stakeholders. Managing equipment effectively also boosts efficiency. Quickly seeing details like the required updates, location and utilisation of equipment on a project is a great time saver.

Key Features:

- **Data Manager:** Securely search, access, visualize and share your organisation's geospatial information.
- **Equipment Manager:** Centrally manage your field devices – know the location and status, manage equipment, and receive alerts.
- **Data Marketplace:** Discover and access map data relevant to your projects – satellite and aerial imagery, elevation data, census data, etc.
- **TerraFlex:** Enable fast and efficient geospatial data collection and updating across a fleet of devices.
- **Access Services:** Wirelessly share surveying data files between field and office.



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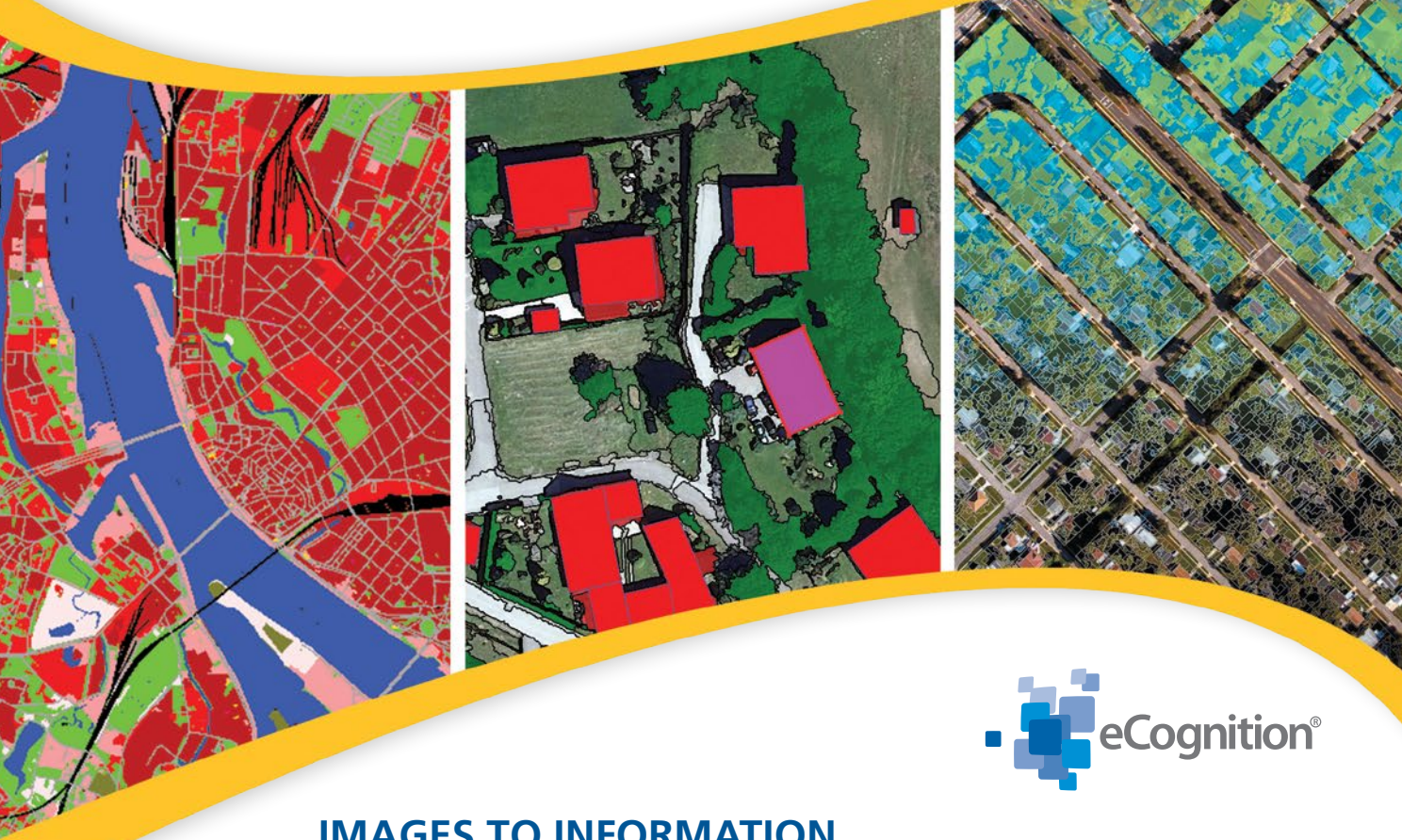

eCognition®

IMAGES TO INFORMATION

Digital photogrammetry, terrain modeling, change detection and feature extraction are transforming the way we understand and manage natural and man-made assets.

Trimble® eCognition®, an object based image analysis software, is designed to improve, accelerate and automate the interpretation of images and geospatial data for environmental monitoring, resource development, infrastructure management and global security. Trimble eCognition software is used to process, model and analyze geospatial data such as images, point clouds and GIS vectors fusing them together into a rich stack of geodata for analysis.

eCognition transforms geospatial data into information to increase productivity and improve decision-making within survey, engineering and GIS service companies, governments, utilities and transportation authorities.

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