

R.N.I No - UPENG/2010/34153; Registration no: UP/GBD-136/2017-19
Publication: 10th of every month | Posting: 15th / 20th of every month

GEOSPATIAL WORLD



Price: INR 150 / US\$ 15 Subscriber's copy Not for Sale

JAN-FEB 2019 » VOLUME 09 » ISSUE 05 | ISSN 2277-3134

www.geospatialworld.net

The **BURNING** Issue

The ongoing Digital Revolution has unleashed a flurry of technology advances which is transforming everything. As disruption gets to be the new normal, is the Geospatial Industry ready to take on the challenge of operating in a world where change will only escalate?

SPECIAL LEADERS' OUTLOOK EDITION



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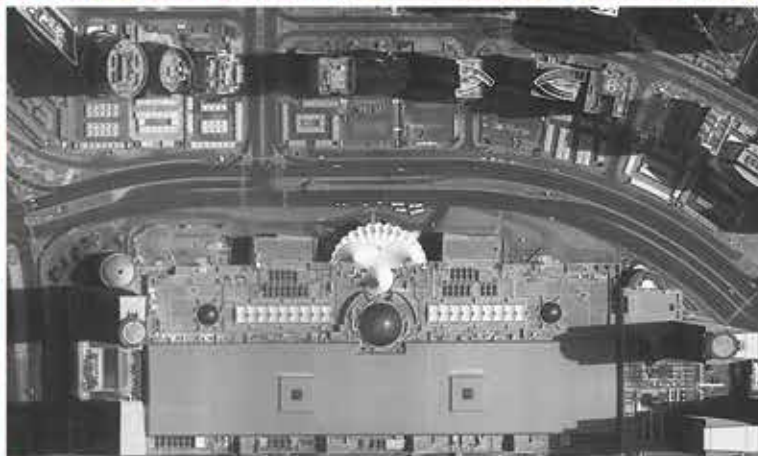
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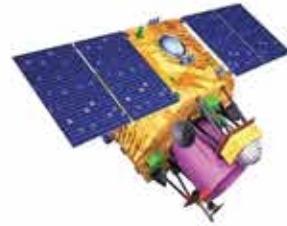
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Content

In the Fourth Industrial Revolution, geospatial is not just about location; it is more about an information revolution that is set to drastically transform humankind and its surrounding environment. From smartphones to self-driving cars to machines that think, the sheer level of ubiquity is subsuming geospatial systems into our everyday processes.

As geospatial becomes by-default in our daily lives, the industry is excited about new technologies like Big Data, artificial intelligence, machine learning and Internet of Things.

Geospatial World Leaders' Outlook 2019 seeks insights from the who's who of the industry in an effort to capture the changing business dynamics and technology trends.

We reached out to 200+ industry leaders from across the world, covering all seven continents, for this exercise. Our endeavor was also to reach out to a mix of companies, in terms of technologies and revenues. The leaders were given a detailed questionnaire to fill – both in multiple choice and elaborative format – and we acknowledge the time and patience showed by them while approaching the task. We are glad to feature the thoughts of 57 select leaders in this edition.

We also ran a survey on Geospatial World website calling on industry professionals to give their inputs on a wide variety of questions. We received responses from over 1,500 geospatial professionals. We are thankful to our readers for their valuable insights.

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Owner, Publisher & Printer: Sanjay Kumar
Printed at Rama Offset Printers
A 43, Sector 10, Noida - 201 301
Gautam Budh Nagar (UP) India

Publication Address
A - 92, Sector - 52, Noida - 201 301 India.
The edition contains 92 pages including cover.

Geospatial World Geospatial Media
and Communications Pvt. Ltd.

A - 145, Sector - 63, Noida, India

Tel + 91-120-4612500

Fax +91-120-4612555/666

Price: INR 150/US\$15



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The Geospatial Way!

Recently, while watching a documentary about life of an English agent operating in France during the Second World War, I came to know how Germans were able to circle her position by tracking her wireless device. Though, she was told that it was safe to operate the device for up to 15 minutes continuously and she used it from different locations, but she knew that it wouldn't be possible to hide her location for more than six weeks.

Moving forward a few decades, the end of The Cold War in 1990s brought about a revolutionary shift in the overall outlook of the geospatial industry, opening its frontiers for commercial exploitation. End of selective availability of GPS and granting of the first commercial license for earth observation satellite brought the power of location into the hands of the common man. Soon, the world began to witness the emergence of innovative companies, creating new markets and simultaneously embedding spatial dimensions in engineering, businesses, infrastructure, and consumer industries.

Today, what excites me is the fact that location offers the much needed fourth pillar (along with AI, IoT and Big Data) to the Fourth Industrial Revolution, enabling disruptive innovations and driving smart solutions for the future generations who are facing challenges of growing consumerism and depleting resources. All this makes it all the more important to observe, monitor and manage our Planet Earth in almost real time.

Innovations in technology and delivery platforms like the NewSpace revolution, duly augmented by drones, miniature sensors, Cloud platforms, and artificial intelligence has made geospatial data and its capabilities a commodity to such an extent that it has become "by default" in our work and personal lives.

The 'Geospatial Way' is the future and probably the most efficient and effective way to collect, process and utilize information in the overall global development agenda. It helps to identify, understand and contextualize challenges the world is facing today. Integrated geospatial information framework and readiness have direct co-relation with human development and quality of life. The Geospatial Readiness Index has clearly indicated that countries which have better geospatial institutional infrastructure and policies, have also adopted its benefits across almost every walk of socio-economic activities, furthering their programs of sustainable development.

However, digital divide is increasing and the geospatial divide may make it even worse for some countries to catch up. It's the right time to invest in developing a positive and collaborative approach towards building global geospatial infrastructure and policy frameworks. While, recognizing that the world economy runs on location-based services and data is the new oil, it is equally important to develop partnership models towards adoption of geospatial knowledge in making the Sustainable Development Goals a reality. In our quest to leave no one behind, it is pre-requisite to work with everyone with an approach of mutual trust, respect and gains.

Sanjay Kumar

Geospatial 4.0: Time to focus on social equity and sustainability

Another year dawns with many promises to realize and many pitfalls to avoid. Last year it was all about the Fourth Industrial Revolution, or as the geeky nerds put it IR 4.0. Will there be an IR 4.1 or even 4.01? Only time will tell. This year the World Economic Forum meeting at Davos seems to have caught the same fever and spoke about Globalization 4.0. I seem to have missed the 1.0, 2.0 and 3.0 but anyway what is it all about?

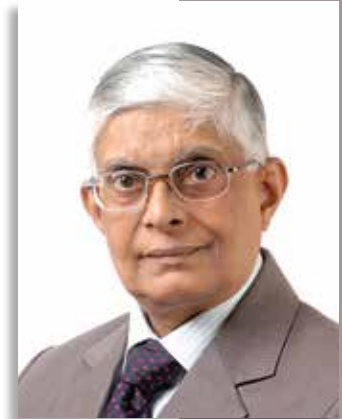
Simply put, it is an economic structure to realize the benefits of IR 4.0 in a more equitable manner. In keeping with this ideal Globalization 4.0 lists the following under Technology for the Common Good: Fourth Industrial Revolution, Future of Economic Progress, Artificial Intelligence and Robotics, Justice and Legal Infrastructure, Workforce and Employment, Education and Skills, Internet Governance, Social Media and Blockchain. Clearly, technology for technology's sake has run its course and in the new order of things there is a need to moderate technology use for better governance and economic progress within the ambit of an equitable and legally viable social environment. So where does it leave geospatial systems?

IR 4.0 is usually defined in terms of technologies like artificial intelligence, quantum computing, 3D printing and the Internet of Things. The burgeoning 5G, AI and IoT efforts are leading to a revolution in automation. While analysts feel that smartphones have reached their saturation point, their use in geospatial systems is still growing and will continue to grow with the IR 4.0 technologies mentioned above to create smart solutions in field operations.

Blockchain is another technology that will play an important part. In a publication prepared by UN FAO and ITU, the advantages of Blockchain in sustainable agriculture and rural development has been cogently presented. The involvement of ITU and FAO is in line with the application of ICT for betterment of the human condition. Thus, we are not looking at technology alone but its collaborative usage over many fields and disciplines. Earlier we talked of convergence of technology, now IR 4.0 and Globalization 4.0 extends this convergence to socioeconomic systems.


Geospatially we have to move beyond just maps and mapping. We need to integrate into the global system, looking at the overarching goal of social equity and sustainability and factoring in imminent dangers like climate change and cybercrimes. Geospatial needs to move out of the comfort zone of governmental nourishment and begin to play a role in industry and society. There are encouraging signs that this is happening, but there is a need to ramp up and accelerate the efforts.

Everybody talks of analytics but do we have a workforce capable of multidisciplinary analytics? This perhaps is the first step. As geospatial becomes citizen oriented, the dangers of deliberate or unintended invasion of privacy and the spread of cybercrime against individuals has to be tackled through government regulations and self-regulation by industry players. This century is the century of South and Southeast Asia and Globalization 4.0 will play out significantly in China, India and Indonesia. A huge market is nascent in terms of sustainable development and tackling climate change. Those who will lead the efforts are going to come from this region. May be it is time to look at and formulate the contours of Geospatial 4.0.



Prof. Arup Dasgupta

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THE TIME IS NOW

In an age of disruptions, much of what will happen in times to come is unpredictable. What is impossible today will become mainstream tomorrow, and only those companies who can accept the challenge to transform themselves will remain relevant in this new era.

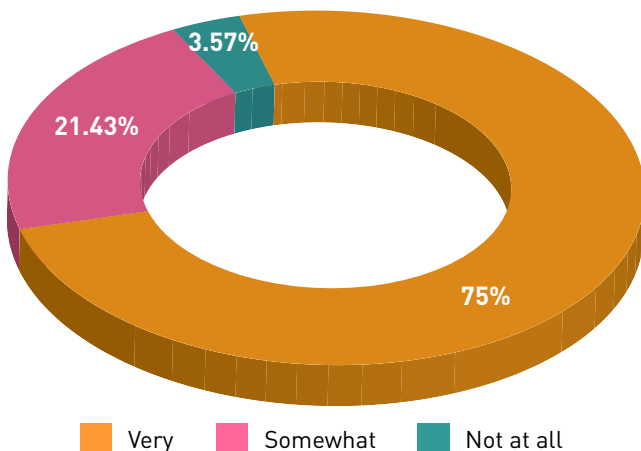
By Anusuya Datta

The Fourth Industrial Revolution ushers in the era of Big Data, artificial intelligence, machine learning and Internet of Things. The speed of disruption will be drastic as the advance of machine learning and robotics drive forward changes more quickly than we humans could ever achieve. While disruption gets to be the new normal, geospatial is becoming ubiquitous, pervasive, and 'by-default' in our daily lives. From smartphones to self-driving cars to machines that think, the sheer level of ubiquity is subsuming geospatial systems into common everyday processes. In the Fourth Industrial Revolution, geospatial is not just about location. It is more about how the information revolution will affect humankind and the surrounding environment.

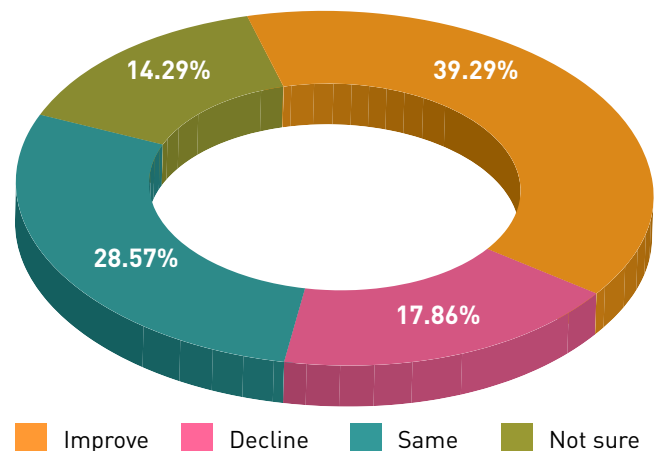
In 2018, we found the geospatial industry excited about the future, as they viewed the disruptions as an opportunity to further evolve. That optimism continues in 2019 — an overwhelming majority of business leaders (75%) are confident about their near-term prospects (Graph 1) in a somewhat rosy global economic scenario (Graph 2)— 39% believe it will improve while 28.5% believe it will remain the same.

However, this optimism is tempered with a sharp dose of realism — that while technological disruptions have/impacted the industry, they need to seize the opportunities unleashed therein, and continue with pathbreaking innovations. There is a sense of determination to this optimism, as if they were conveying the message “now or never”.

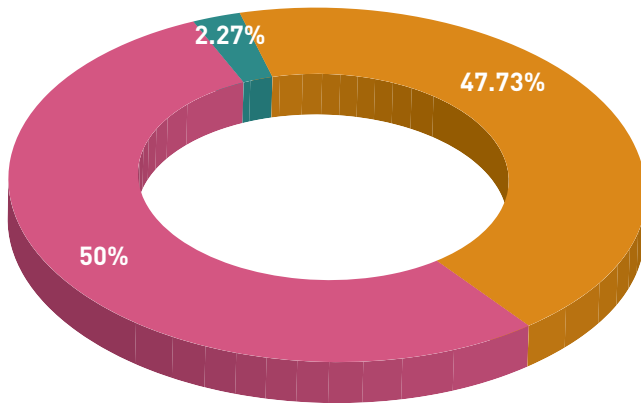
Graph 1: How confident are you about your company's revenue growth over the next 3 years?



Graph 2: What kind of change do you foresee in the global economic scenario over the next 12 months?



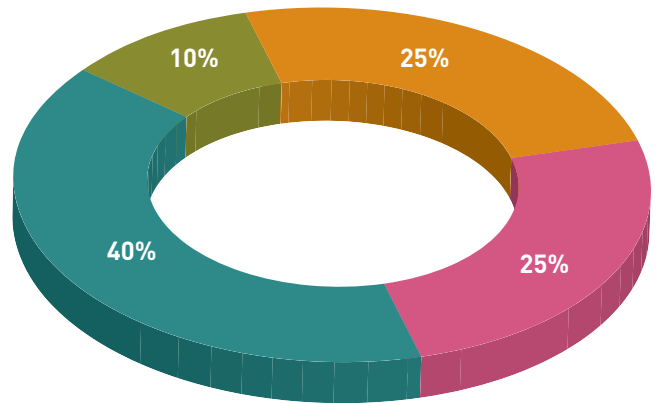
Graph 3: How technology has changed competition in the geospatial industry in the past 20 years?



- Completely Reshaped
- Significant Impact
- Moderate Impact

The “never” in the message may sound too dramatic. But if we look at how the industry has been reshaped/impacted by technology disruptions (See Graph 3) and how a majority of the disruptions in the geospatial domain have come from outside the industry (In 2018, 65% of the leaders felt so), the underlying message seems to be you need to innovate to stay in the game. The start-up community has fostered a rapid pace of innovation, and the Location Analytics and Space 2.0 communities in particular have completely challenged the incumbent business models and cost structure.

Graph 4: What is the next big thing for the geospatial industry?



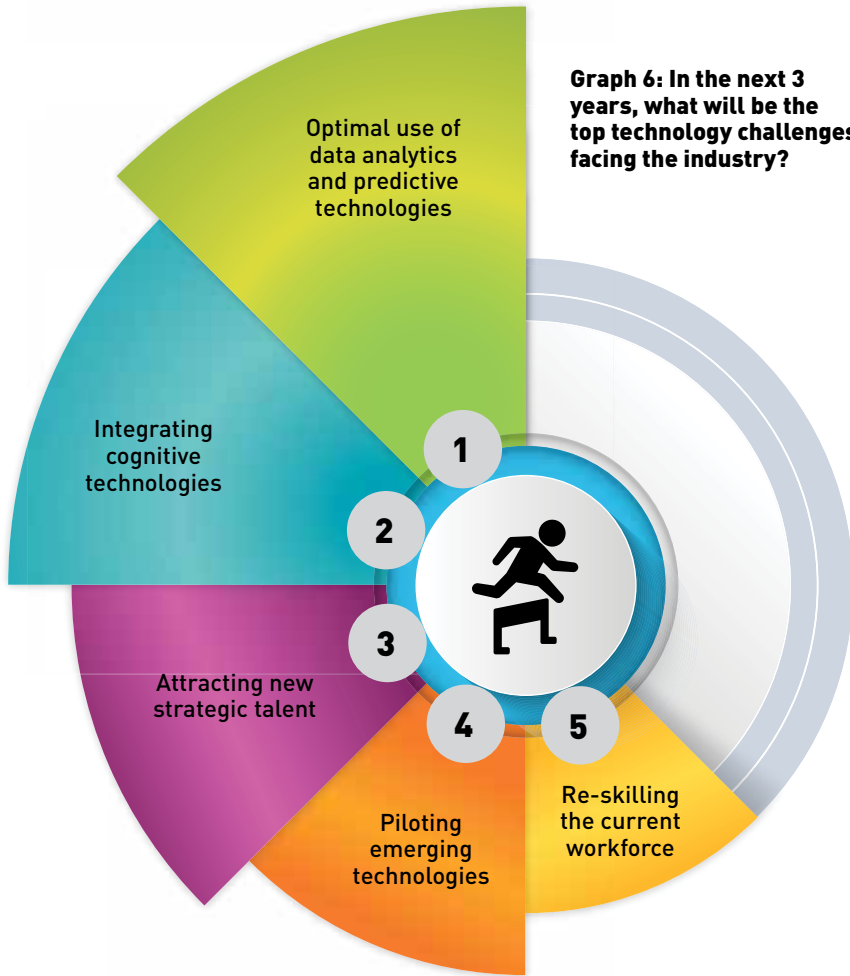
- Miniaturization of sensors
- Integrating AI, ML, Big Data
- Accelerating mobility
- Something new

Like all technology domains, drivers such as artificial intelligence, automation, Cloud, Internet of Things and miniaturization of sensors are adding to the momentum. As indicated by Graph 4, business leaders see Integration of artificial intelligence, machine learning and Big Data with geospatial as the next big thing for the geospatial industry.

The business leaders are also struggling with a spectrum of challenges grappling the industry and they acknowledge a growing list of concerns (Graph 5) — from changing customer loyalty, to restrictive regulations, to availability of skilled workforce. There are also a

Graph 5: What is your topmost area of concern?





number of additional critical issues that have emerged recently, ranging from rapid pace of technology, to data privacy issues.

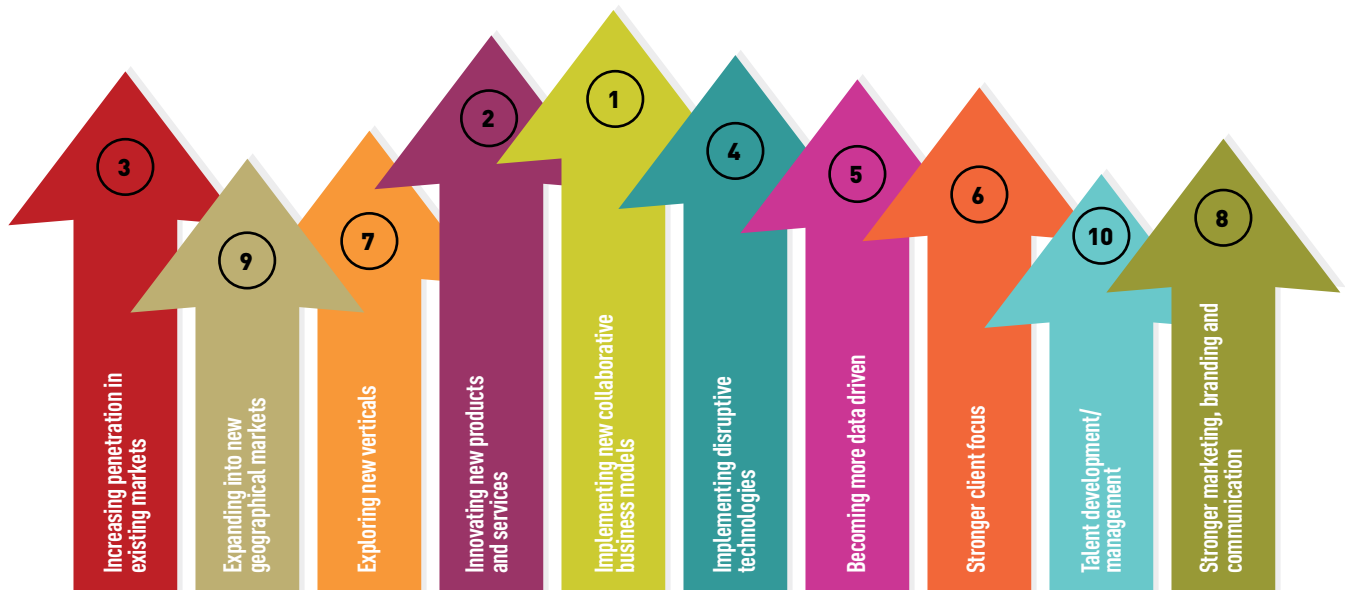
Majority of leaders identify the need for optimal use of data analytics and predictive technologies to be the top most technology challenge facing the industry (Graph 6).

To keep going on in this rapidly transforming landscape, companies are reviewing their business strategies. As per our 2019 leader's survey, the top five strategic priorities for the CEOs include implementing collaborative business models, innovating new products and services, adopting more disruptive technologies, increasing penetration in existing markets and becoming more data driven (Graph 7).

Collaborate, not compete

With the processes of geospatial data capture and maintenance getting dramatically reshaped — thanks to open data movements and advances in Cloud technologies — the lines separating industries, companies and technologies are fast disappearing. The proliferation of location-based technologies has raised awareness and accelerated the development of applications for user-based needs. Today, location technology is going into chipsets, cars, drones, enterprise software, traffic management systems, and no

Graph 7: What will be your topmost strategic priority in the coming times?





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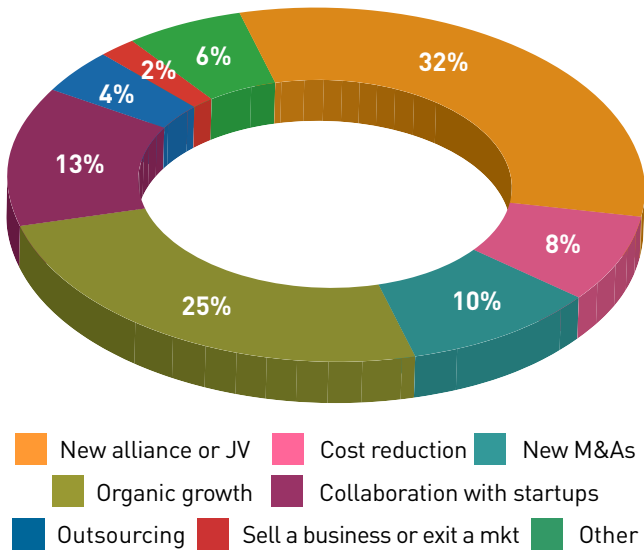


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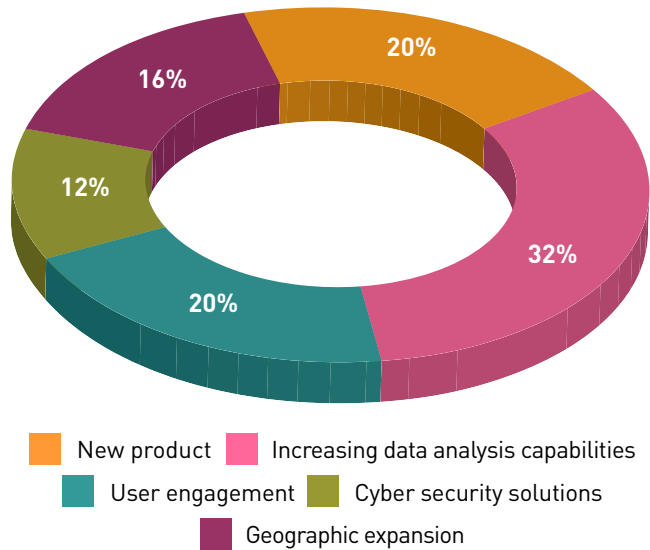


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Graph 8: To drive growth, which of the following activities are you planning in the coming 12 months?



Graph 9: Over the next 3 years, what will be your top areas of investment?



one CEO or company can have all of these things at the same time across the whole spectrum.

Consequently, the past decade saw a growing number of M&As within the industry. Even though the consolidation process still continues, an increasingly larger number of companies in the geospatial domain are now interested in entering into partnerships to deliver better shareholder value, customized solutions to their customers or enter new markets.

As Graph 8 shows, strategic alliance or joint venture emerged as the most preferred plan of action (32%) for the industry leaders to drive growth. This was followed by organic growth (25%); and collaboration with startups (13%). This is in sync with the 2018 survey, where an overwhelming 85% of the leaders said geospatial companies should go for collaborations within and outside the industry. M&As continued to be fourth on the list of priorities (10%) — in sharp contrast to the 2018 survey when 45% of the CEOs saw acquiring new businesses/technology to be their biggest investment in the three years.

This change in mindset is largely because of the realization that the speed of technological transformation demands faster turnaround times, and in such an environment, collaboration is a viable and alternative to buying and building/customizing from scratch. We have seen companies forming partnerships and alliances with competitors, startups and even universities and customers, making everyone in the ecosystem part of the innovation process.

Analytics the way to go

It is a given that in a highly digitalized world, every business must become more analytics driven to sharpen its competitive edge. This is not easy for an industry which traditionally has been product-oriented, with the end consumer either developing in-house capacity or

hiring consultants or system integrators to help with its implementation, operations and maintenance. While large companies suffered from legacy issues, this is a gap area that the start-up community were able to quickly fill up in the past few years. These startups — mostly backed by VCs and quick-thinking on their feet — realized early that analytics is the way to go.

While the large geospatial companies typically started off on unique technology platforms, even they have understood that data analytics is integral to survival, let alone grow. Naturally, majority of the business leaders see increasing data analytical capabilities as one of their top areas for investment over the next three years (Graph 9).

New business models

With frequent innovations and disruptions cutting down gestation periods and shortening product/solution lifespans, businesses are adopting new models to manage profit vulnerabilities. Further, there is also a realization that users today want complete workflow solutions rather than piecemeal approach. Most of the business leaders we interacted with stressed on the need for delivering services to customers rather than a standalone product-centric approach.

With the gradual realization of the consumer preferences/limitations and increasing market competition, it would be safe to conclude that X-as-a-Service is fast emerging as the most preferred business model. And, it is expected to gain further momentum with technologies expanding their applicability and reach to new user segments.

This is in contrast to the 2018 survey, where CEOs were seen to be gung-ho about a subscription-based business model, which was gaining traction for the past few years because of a smaller upfront investment and low upgrade cost. It, however, continued to remain the second preferred model for doing business this year too (Graph 11).

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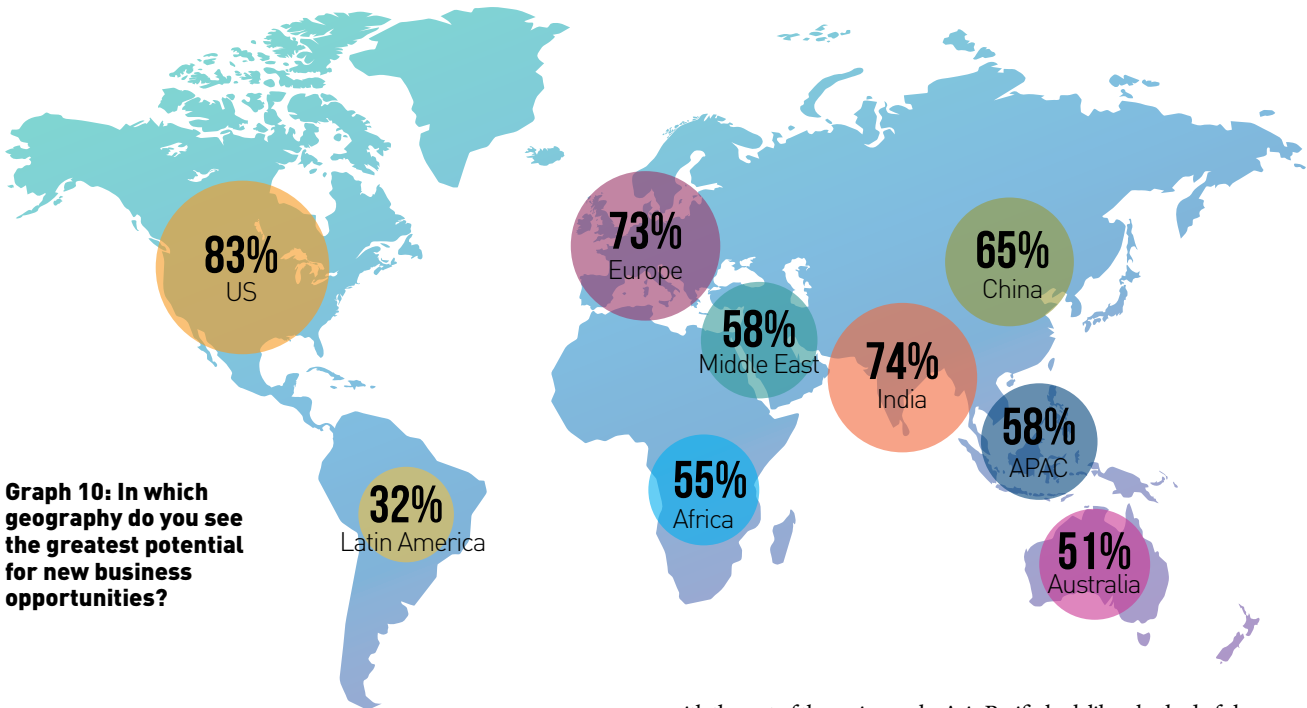
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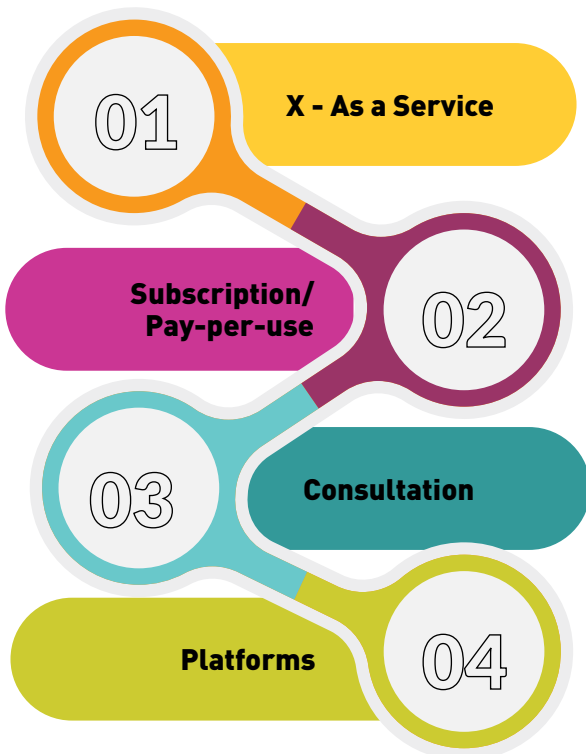
shaping smart change





Graph 10: In which geography do you see the greatest potential for new business opportunities?

Graph 11: What will be your preferred business model?



Geography — where is the market

While US continues to be the preferred market for business, the Indian growth story here is interesting. It emerged as the second most preferred market, even overtaking Europe, and leaving China lagging far behind in fourth position (Graph 10). India and China when taken together along

with the rest of the region make Asia Pacific look like a hotbed of change with an interesting combination of new entrants and technology companies constantly making new markets with new business models leveraging disruptive technologies. Industry leaders see the demand for geospatial data and services in these regions to be driven by sharp expansion of the user base — aided by numerous initiatives being taken by the governments in these regions to bridge the prevailing digital divide. They also see a sharp uptake of technology in Africa and Middle East but due to the very low base, the real value of business growth will be comparatively low.

Not innovating is not an option

It is amid such shifting realities that CEOs are setting their short and long-term strategies and executing them. They are anxious and at the same time excited about all the disruption coming their way. These business leaders — many of them young and restless — also realize sitting in the corner office will not make a successful CEO; instead they need to be on their feet thinking, innovating and adapting. A significant majority of CEOs recognize the importance of the need to foster a culture of innovation, respond quickly to technological opportunities and invest in new processes. They also recognize the need for skilling new workforces and re-skilling existing ones.

Mainstreaming of geospatial, smart devices and miniaturization of sensors has led to ever-increasing amount of spatially located information where maps have become like a toothbrush.

Much of what will happen in times to come is unpredictable. What is impossible today will become mainstream tomorrow, and only those companies who can accept the challenge to transform themselves will be more relevant in this new era. 🌐

Anusuya Datta, Executive Editor
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Workforce is one of the strongest pillars of any industry. Ideas can get implemented and bring the desired outcomes only if skilled workforce is available to drive the vision. Is the geospatial industry equipped enough?

By Shimonti Paul

The geospatial industry is on the cusp of a revolution, getting largely disrupted by the emergence and convergence of a gamut of technologies. This was the most prominent sentiment when we interacted with the leaders of the industry last year. This year too the CEOs and the geospatial industry business leaders are unequivocal that new technologies are making the industry take a new shape altogether.

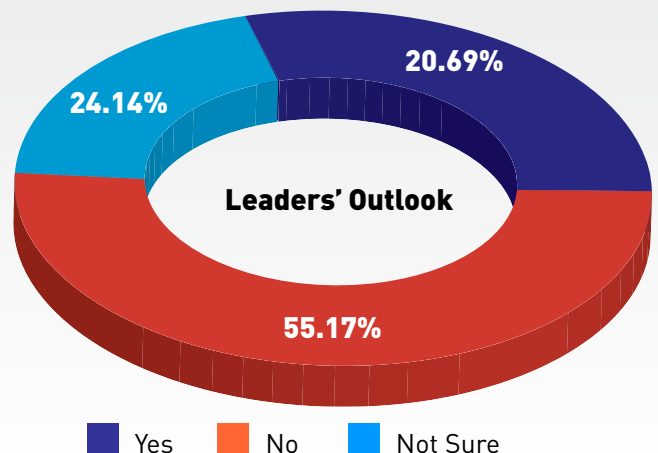
In a fast-transforming technology environment while businesses are struggling to keep pace with new developments, one thing the industry leaders unanimously agree is that there is a constant need to innovate to stay relevant, and capable workforce is a necessary requirement to continue the pace of this innovation.

Workforce is the basic foundation of any industry. Ideas can get implemented and bring the desired outcomes only if skilled workforce is available to drive the vision. Geospatial is a niche domain and has traditionally been underprivileged when it comes to having the

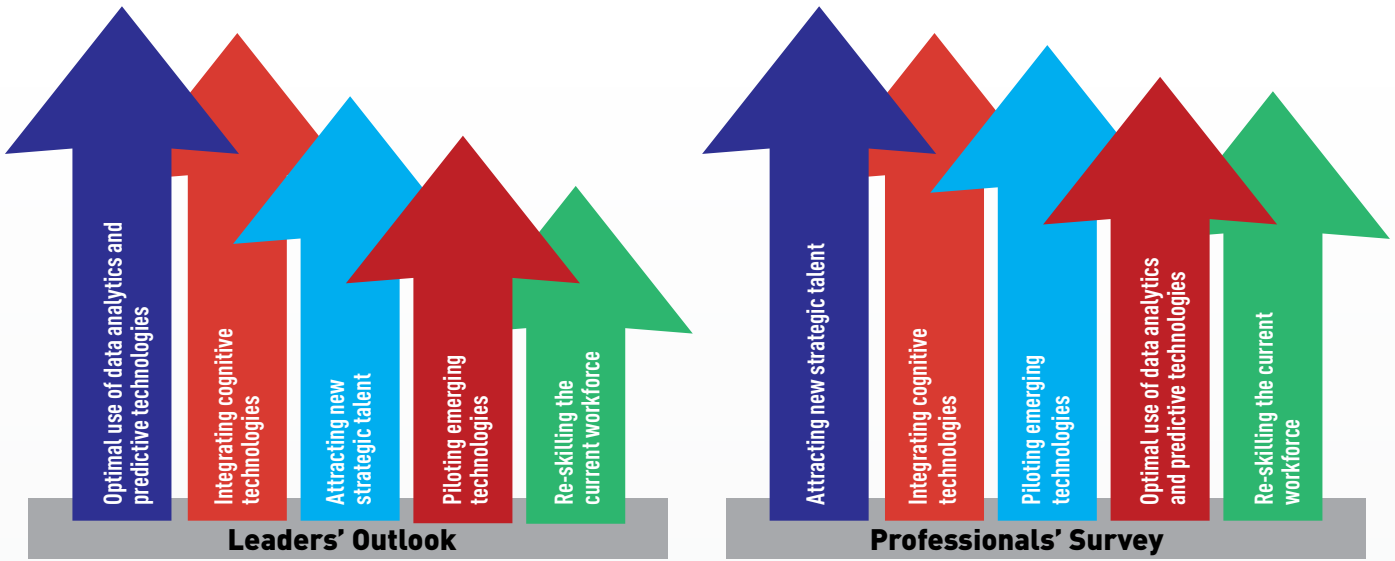
support of a trained workforce. The concern becomes more acute with further technological advancements. As technologies get integrated, the challenge of finding the workforce with the right skillset is becoming a stronger concern by the day. For instance, as Graph 1 shows, majority of industry leaders (55%) feel the existing workforce is not skilled in handling emerging technologies.

In the 2018 survey, an overwhelming 52% of industry leaders said they thought talent acquisition was a key HR challenge while 16% felt re-skilling the existing ones was a problem. The sentiment

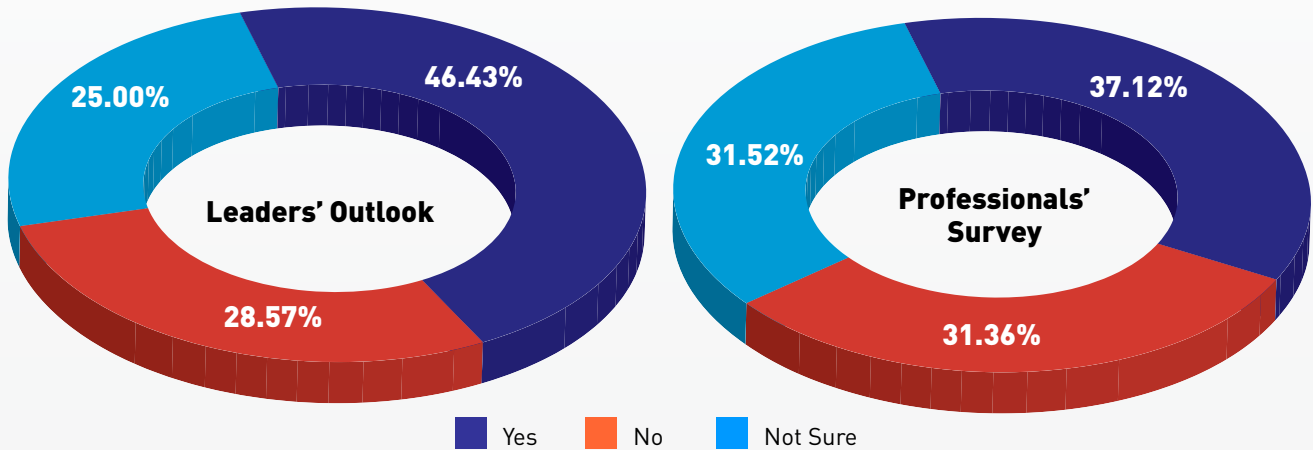
Graph 1: Is the workforce equipped enough to manage emerging technologies like AI/ML etc?



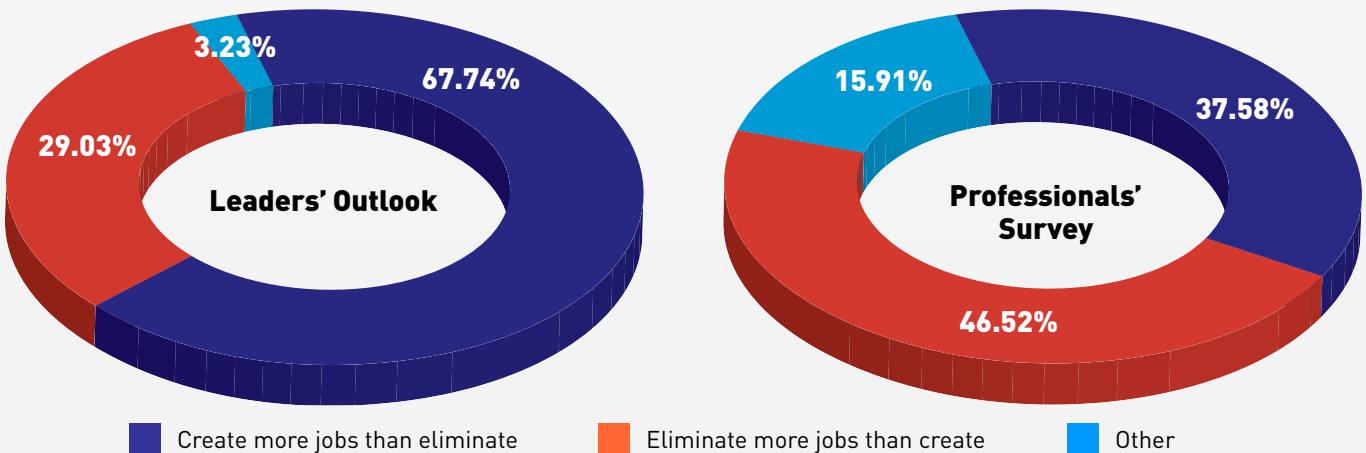
Graph 2a and 2b: What are the top technology challenges over the next 3 years?



Graph 3a and 3b: Is the workforce equipped to understand the technology platforms they are currently delivering service on?



Graph 4a and 4b: What will AI and robots do?



continues in the 2019 survey as well. As Graph 2a shows “attracting new strategic talent” emerged as the third most important challenge hindering the uptake of geospatial technology over the next three years.

In the *Geospatial World* Readers’ Survey of 1,500-plus professionals, “attracting new strategic talent” emerged as the foremost of the challenges for the industry (Graph 2b).

Technological advancements outsmarting skill development

Mainstreaming of geospatial has also ushered in an era of disruption where geospatial data and technologies are getting into every business, governance and daily lives. On one hand technological advancements are making the industry leapfrog into new domains rapidly, on the other, the sheer speed of this transformation is leaving the workforce gasping for breath. Before they are able to adapt to a new technology, another one makes its way in.

For instance, GIS or remote sensing professionals maybe handling their work efficiently, but when it comes to integrating these platforms with mainstream IT or using advanced technologies like artificial intelligence or machine learning they are found to be ill-equipped. Similarly, in the Architecture, Engineering and Construction (AEC) industry, the landscape is changing so drastically that an engineer or architect, who first has to take training to work in a GIS-BIM environment, now suddenly has stuff like real-time 3D modeling to deal with. Real-time data streaming and constant feeds only make it all the more complex for the workforce to keep pace.

As indicated by Graph 3a and Graph 3b, industry leaders and the geospatial professionals both agree that the existing workforce is able to understand the technology platforms they are currently delivering services on, but not equipped to handle new technologies. About 46% of CEOs agree that the current workforce is equipped only to understand the currently used technologies, and 37% of geospatial professionals feel the same.

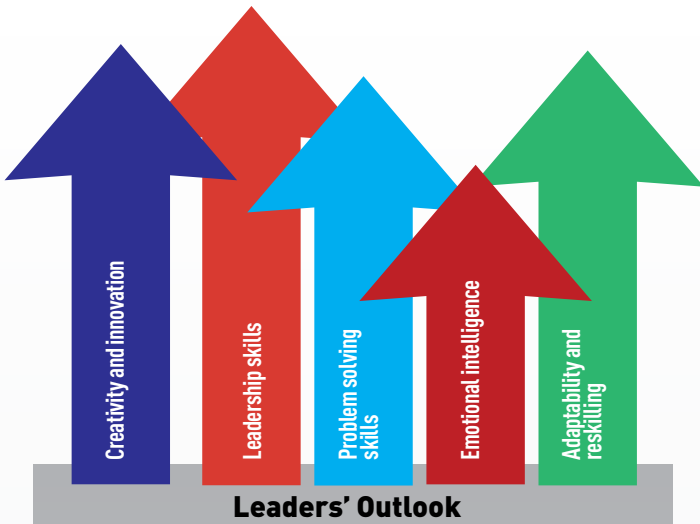


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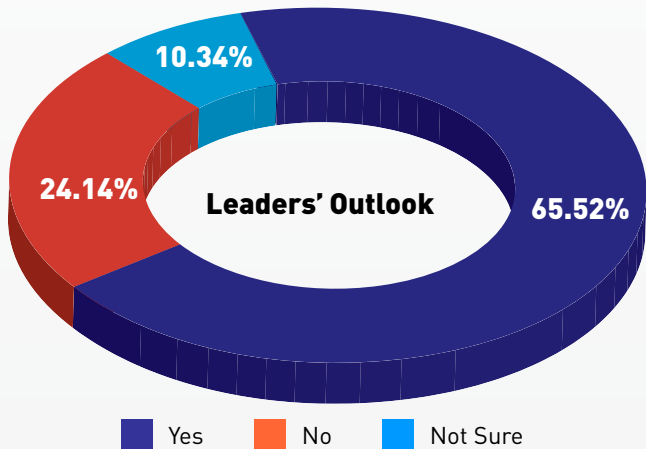


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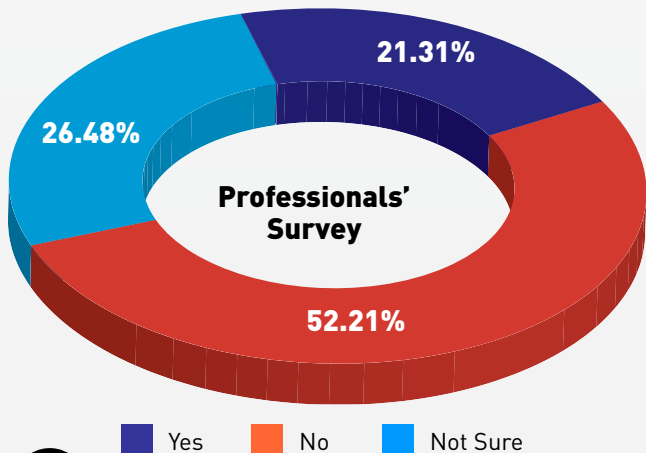
Graph 5: Which talent is most difficult to find in today's workforce?



Graph 6: Is fast-changing technology adding complexity to hiring strategies?



Graph 7: Are business leaders arming workforce for a new 'machine age' of AI and automation?



The rise of the robots

The rise of automation and robots has led to one of the primary concerns in recent times — will they take away jobs? It is inevitable that AI will replace some jobs. But then one must understand that machines have for ages now replaced humans — this trend is older than even the First Industrial Revolution — but that didn't lead to mass unemployment. There is a continuous shift in the way we use technology to automate previously manual tasks. In that sense they will both take away as well as create jobs.

Graph 4 represents how the two sides view AI and robots. While over 67% of industry leaders are confident that automation will create more jobs than eliminate (Graph 4a), about 46% of the geospatial professional feel they will take away jobs (Graph 4b).

Clearly there are a set of manual tasks that computers and machines will do better than humans – especially the lowest level menial jobs that are done by hand. In fact, in many obvious cases we already employ machines to do a lot of jobs that used to get done by human beings earlier. What will happen, and what the business leaders emphasize on, is that automation and robotics will create newer jobs. They will open new industries and new avenues, which will need new workforce. Therefore those jobs will be in new areas needing new skillset.

This is where the issue of reskilling comes up. "Adaptability and reskilling" came up as the second most difficult talent to find among today's workforce (Graph 5). Most of the industry leaders consider both upskilling and reskilling as arduous goals to achieve. Unwillingness to learn often comes as a challenge with seasoned professionals, and not everyone possesses the ability to acquire new technical know-how, and more so implement and effectively use them.

Further, while most CEOs worldwide agree that effective management of the recent technological advancements require not only technical competence, but also strategic thinking and leadership skills, they also believe that "leadership skill" is another talent hard to find. Along with that, they believe that today's workforce also lacks critical talents such as "creativity and innovation", problem-solving skills and "emotional intelligence".

Additionally, a large chunk of the industry leaders (65%) feel that fast-changing technology is adding a lot of complexity to hiring strategies (Graph 6), making things more difficult. The sombre mood continues in the professional side as well. As indicated by Graph 7, majority of geospatial professionals (52%) feel the industry is not providing them with ample opportunities for training and skill upgrade to strike it out in a new "machine age" of AI and automation.

All in all, the situation is not so favorable and the skill gap continues to stretch.

Lessons to learn

For efficient outcomes, it is necessary to mitigate the skill gap, and it can be mitigated only through efforts from multiple stakeholders. Key leaders within an organization must be able to identify the knowledge, skills and abilities required to accomplish daily work. They need to know what employees need to know and able to do. A competency-based approach could be used to define required skills.



The pace of development within the industry and academia must match. It has been observed that while the industry is developing at a fast pace, the academic world is lagging behind. This was highlighted in our 2018 survey where 49% of the industry leaders said they didn't think academic institutions were churning out industry-ready professionals.

Considering the evolving nature of the industry and changes in the labor market, it has become imperative to ascertain how best the academic curriculum can address various requirements and demands of the dynamic industry. There is also a need for geospatial professionals to learn data science as a subject.

It is also essential that education in geospatial technologies begins right from the school days. GIS leaders like Esri are already taking concrete steps in this direction. K-12 initiatives like the GIS for Schools program, the GeoMentor Program etc. are making the students more geospatial ready.

Companies also need to intensify their academic interventions in order to tackle the shortage. Employers should come forward and work with the academicians to develop a shared model for jobs and curriculum that ensures benefits for every stakeholder — that the graduating students are able to transition into industry roles more smoothly, employers are able to hire skilled and job-ready people, and academic institutions are able to place their students with reputed firms immediately after completion of the course.

Industry-academia partnerships like the Constructioneering Academy, Bentley Academy are significant steps towards bridging the skill gap, but a lot more needs to be done to bestow the geospatial industry with an adept workforce that can take it to new heights. As geospatial gets subsumed in more and more workflows, the days of standalone technologies and skillsets are over. 🌐

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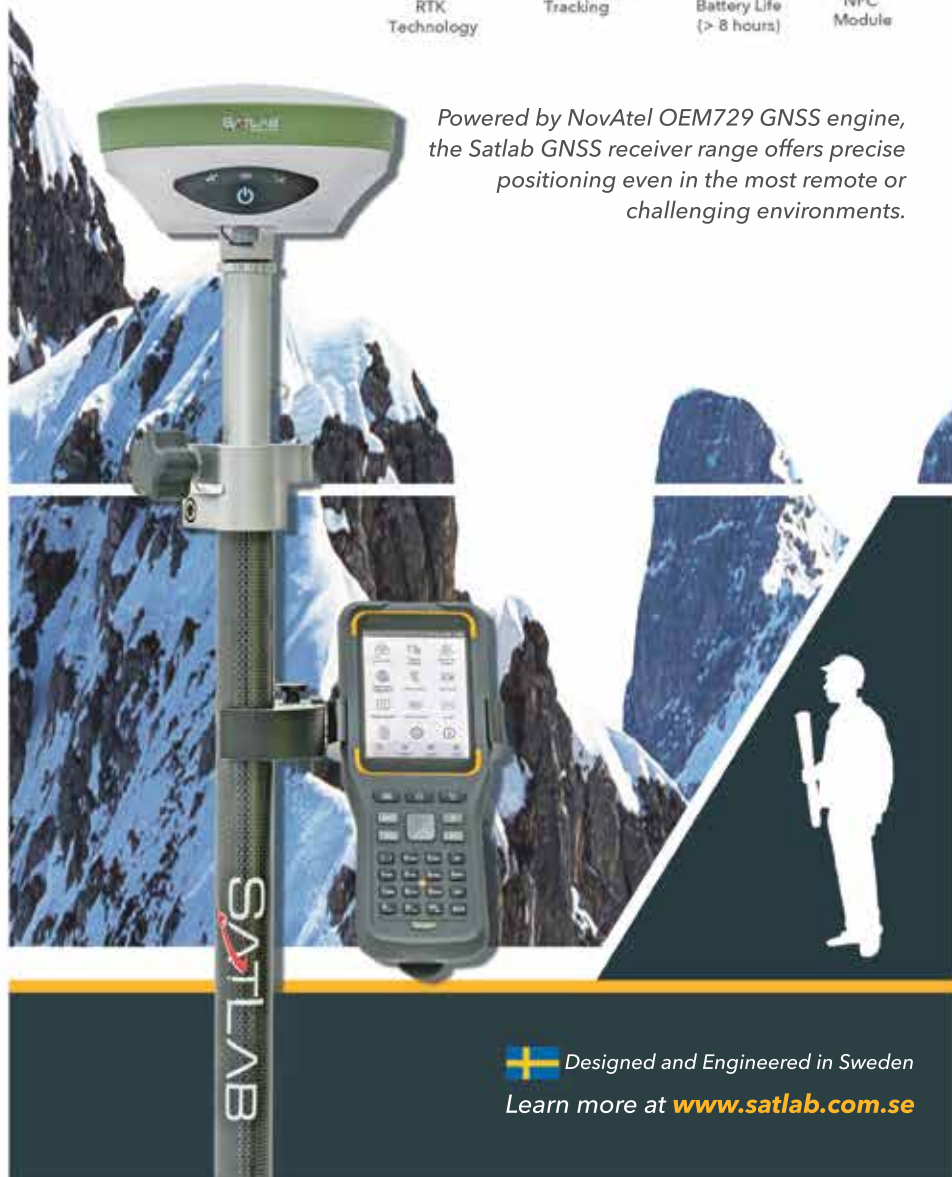
Multi-Constellation
Tracking



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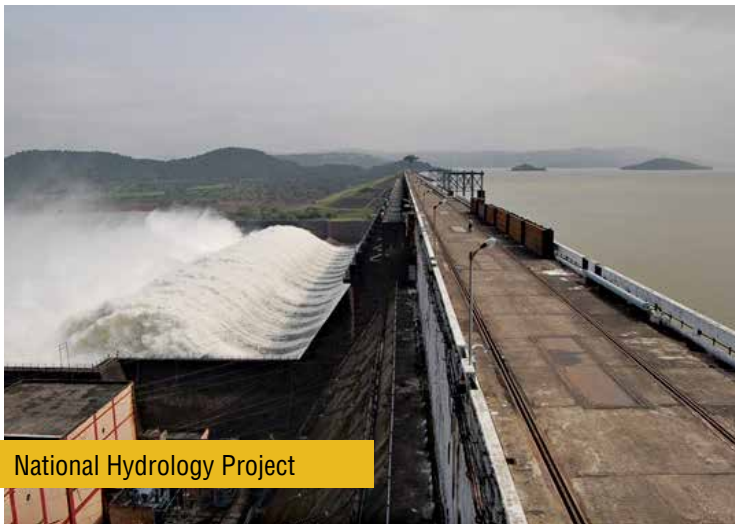


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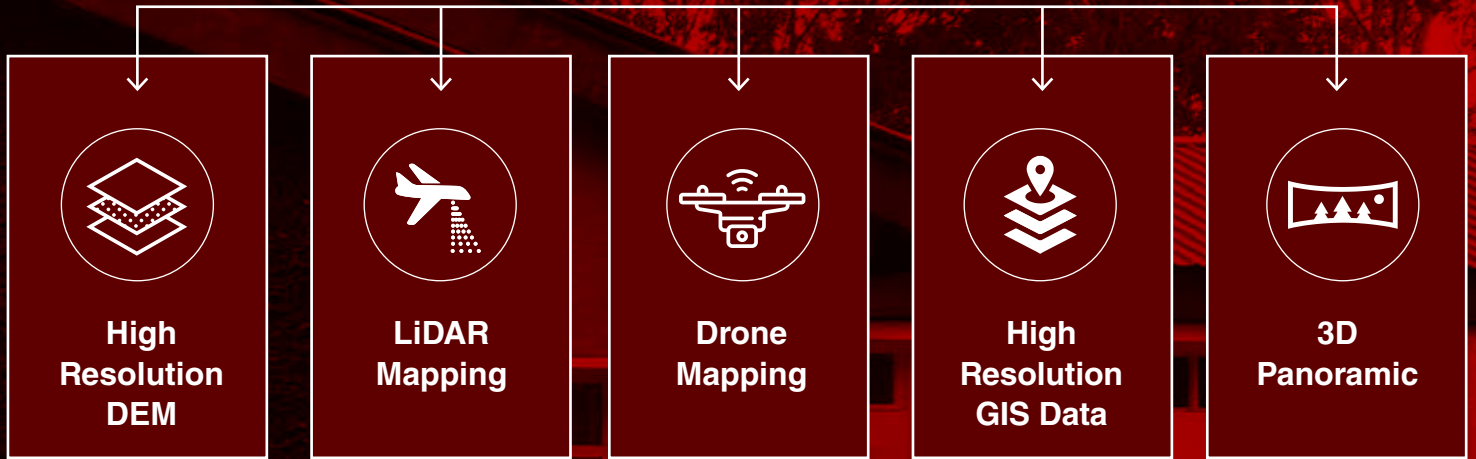
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MAPS

are becoming a

COMMON LANGUAGE

ACROSS ORGANIZATIONS

Organizations are increasingly transforming their operations by inter-connecting and integrating their corporate information systems. Geospatial information is beginning to play a role in this transformation and is being seen as one of the fundamental keys for enabling this digital integration. Enterprises are already — consciously or unconsciously — collecting and managing massive amounts of location data about their assets, personnel, and business activities. While this data is often used for wwspecific workflows, it is also rapidly becoming part of corporate information systems.

At the same time, GIS software, long known for its powerful mapping, visualization and analytics capabilities, has emerged as a powerful IT platform for helping organizations integrate and leverage their location data. When implemented as an IT platform, GIS uses location data to organize and explicitly define new relationships in data across an organization. These cross-cutting associations can also help coordinate disparate workflows and enable whole new forms of collaboration. They can also reveal deep insights.

The result is what many are calling “location intelligence” and can be used to understand patterns and

JACK DANGERMOND

FOUNDER & PRESIDENT, ESRI

relationships between all types of data. Maps have a particularly valuable role to play here because they facilitate communication of basic information and are becoming a kind of language across organizations.

An effective enabler

Location and GIS concepts are already becoming a part of most leading IT organizations; and they will eventually become pervasive. The three drivers influencing this are the increasing volume of geospatial data, the growing awareness of its value, and the dramatic advances in the technology itself.

We see many IT shops in both the private and public sectors implementing location capabilities, and setting up GIS systems side by side with other major enterprise systems. These systems immediately provide their users with the capabilities to visualize and analyze their data spatially. Some are integrating multiple systems and using the power of GIS web services to enable location intelligence and improve collaboration and communication.

In the local government sector, for instance, thousands of cities use it as one of their fundamental systems and recent usability improvements are opening up GIS and mapping as a community engagement platform, enabling a broad range of geospatial focused policy initiatives connecting decision makers with their constituents.

Towards a sustainable future

The big vision is that geospatial knowledge will provide better understanding and ultimately affect human behavior on many fronts. I see all geospatial technologies as part of an interconnected system of systems that will be continuously improving and contributing. They include better geospatial data collection, powerful analytics and predictive modeling tools, and advanced visualization and storytelling tools to provide awareness about our changing neighborhoods and planet. Of particular importance will be tools that integrate geospatial knowledge into the planning, engineering, and geospatial decision-making processes. With the emergence of the

geospatial Cloud, location services will become increasingly pervasive, informing, educating, and enabling many different kinds of applications. The mobile/app revolution will expand and extend these capabilities and empower almost everyone on the planet to act more responsibly.

Today geospatial data from countless organizations is already being brought together virtually using web services. This is resulting in a comprehensive platform and community of GIS users for the planet. The result is that geography and maps are enabling all kinds of conversations and creating relationships both inside and outside of our organizations. This notion that nearly everyone can take location intelligence capabilities with them wherever they go on their tablets and smartphones, has opened up the technology to be applied to a wide range of social initiatives and community projects.

The big vision is that geospatial knowledge will provide better understanding and ultimately affect human behavior on many fronts

Future is in integration

The future lies in integration of many kinds of technologies and types of information. We see our GIS offerings as increasingly being recognized as a fundamental IT system creating location intelligence. This new acknowledgment will raise the profile of GIS as a valuable cross-cutting platform introducing new capabilities of spatial data science and statistical tools for machine learning, integrating IoT, spatial BI and Big Data. It will also help bring GIS to life in new operational areas such as field mobility, logistics, dashboards for operations management, and even augmented reality. Finally, new integration capabilities between AEC, BIM, and related technical engineering offerings are rapidly becoming relevant in geospatial settings.

While this is still only early days, AI is already in use in Esri's Geospatial Cloud and becoming more effective and resilient with each passing week. Our users are making effective use of these capabili-

ties with both imagery and vector datasets. We are actively advancing the integration of GIS and deep learning tools. For example, AI is being used combined with location intelligence to enable retailers to predict customer behavior. It is creating maps and information about the ways that consumers in a particular area have behaved over time in order to make better-informed decisions about how to stock inventory in different locations.

Innovation is definitely one of the keys to our success, but certainly not the only one. At Esri, our goals have been to focus on the changing needs and aspirations of our users. We are also a strong business with a stable financial foundation for supporting the work we do. Having said that, we do invest heavily in building and enabling GIS software that advances the field. Each year we invest about one-third of our

revenues into advancing our fundamental technologies. We see our mission and goals as aligned with those of our customers who are also continuously advancing their use of GIS in thousands of specific workflows and applications. It's in our company's DNA to identify, integrate, and leverage new trends before they go mainstream so we can give our users the best possible products and services when the next big technology or trend emerges. The result is that our platform is itself continuously evolving with new innovations in data, computing, and science methods.

We have been very fortunate in our history to achieve a stable economic footing which has allowed us to maintain a consistently high level of R&D investment in developing strong location intelligence technology. While today our products are used in virtually every field of human activity in both the public and private sectors, we don't take that for granted and continue pushing to create What's Next. 🌍

THE NEXT EVOLUTION WILL BE FROM AUTOMATION TO AUTONOMY

Location data is a critical enabler for the technology powering the Fourth Industrial Revolution. Autonomous X (automobiles, industrial vehicles, public transportation, UAVs, marine); edge computing; advanced analytics (AI, machine learning, advanced algorithms), and visualization technologies all rely heavily on geospatial data and the insights we can derive from it.

Today's geospatial technology is digital-first in

nature. Geospatial data allows us to create digital versions of the physical world via sensor technology for reality capture opening up world of possibilities. And we can all see how amazing the potential is in front of us. However, there is an equal risk with that reward if we are unable to create actionable insights from the data we have created. The gap between what technology can do and what people are able to do with it

continues to grow, and that starts with data. Geospatial technology is merely interesting if we are not able to gain actionable insights that allow us to increase efficiency and productivity.

Digital transformation

AI and IoT are only buzzwords when they have empty promises behind them. The ability to track, measure and create autonomous feedback loops provides infinite opportunities to set better targets and achieve precise goals based on these targets. For instance, 5D maps for Smart Cities support utilities planning, resource management, emergency services, and disaster response and recovery. The availability of data and the power

of AI-supported data analysis will create substantial opportunities for a more sustainable future not fathomable today.

Digital transformation is not just about buying new technology. For example, if you switched from a Rolex to an Apple Watch but only used the latter to tell time, one might argue that you downgraded your time-keeping device. However, if you view a "watch" not only as a device that connects you to the external world through a single function (i.e. keeping time) but also as a feedback loop monitoring your internal well-being in real-time relative to multiple external inputs, the perspective changes. This is digital transformation — in this case from a single-function, analog device to a multi-function digital solution.

In a geospatial context, outfitting your operation with new sensors or upgrading your software is an important step, but it's only the first step. Companies have infinite potential to leverage more useful information from those solutions. Similar to the watch example, there's nothing wrong with a good, old-fashioned map to get from point A to point B, just as there's nothing wrong with using a watch to tell you if you are late. However, maps can be used for so much more than directions. Combining data from reality capture sensors and overlaying it on a digital map to see what's happening in real time tells us so much more about the world.

Ultimately, "digital transformation" is not a destination. Companies should think of their transformations in the context of digital maturation and where they are on that scale, which will continue to change as new technology continues to develop.

Industry 4.0

Industry 4.0 hinges on seamless integrations. This means not only smart adoption of new technology — i.e. choosing the right digital solutions for your business and ensuring they all work together — but also interoper-

'Digital transformation' is not a destination. Companies should think of their transformations in the context of digital maturation and where they are on that scale. This will continue to change as new technology continues to develop

**OLA ROLLÉN**

PRESIDENT & CEO, HEXAGON

ability of legacy systems with the latest innovations. It's not feasible for a company to flip a switch and be "digitally transformed" — again, that's why it's important to view transformation as a maturation process, not a final destination. As technology companies, we need to provide a vision and a path to digital maturity.

So what does that mean? Beneath the technical language is a very simple concept: digital solutions can't operate efficiently on their own; that's not what they were created to do. They need to be connected, integrated and accessible everywhere, from the source of the data (edge) to where it's stored (increasingly, the Cloud). That's where mobility and visualization come in — to access and interpret data.

Finally, and most critically, it's not humanly possible to keep up with the amount of information being created by these digital "things." So, artificial intelligence is necessary to analyze the exponential amounts of data being generated and package it in a way so that it's digestible and actionable.

Converging the physical and digital worlds

The next evolution will be from automation to autonomy. Right now, we are creating systems that can operate without humans, but an automated machine is only as good as the information we can get about its performance and efficiency. If we create more automated machines without intelligence built into them, we will only contribute to the exponentially expanding data gap. As we move from automation to autonomy, those machines will be able to process data faster and with greater accuracy, and they will be able to communicate with each other and self-correct to maximize productivity and efficiency.

This is what Hexagon does. We search for the greatest potential in technology and create solutions to connect what is to what can be and should be. We create solutions that converge the physical and digital worlds. For instance, Xalt is a new technology framework from Hexagon that supports interoperability to accelerate digital transformation. Xalt uses artificial intelligence, Cloud orchestration, data visualization, edge computing, enterprise integration and mobility solutions to create autonomous connected ecosystems, which we abbreviate as "ACE." ACEs are digital-first, infinitely connected and innately intelligent states where the physical and digital worlds converge, and intelligence is built in to all processes.

We intend to lead in the industries we serve through investment in R&D, and we continue to pursue strategic acquisitions that create synergies supporting autonomous connected ecosystems.

Our R&D efforts, in conjunction with our acquisition strategy, have focused on investing in technologies that will bring about the digital transformation of vital industries and governments, empowering them to see the 'complete picture' and to develop enabling platforms.

At Hexagon, we call this approach SMART X — whether it is mining, manufacturing, oil and gas, defense, construction, agriculture or smart cities. SMART X solutions are a bold approach aimed at solving the most challenging problems of the 21st century — how to make our cities safe; how to sustainably farm and feed a fast-growing population; how to make refineries more efficient; how to mine responsibly and manufacture products faster, with less waste and higher quality. 🌱

GEOSPATIAL TECHNOLOGY FOUNDATIONAL FOR ALL INDUSTRIES

Geospatial technology has always been the backbone of society. The sextant and the stars were used by Columbus and Cook to circumnavigate the globe.

Theodolites, distance measuring devices, total stations and satellite systems enabled the creation of paper maps as the common source for navigate even into this century. Today, machine learning, precise positioning satellites, Big Data, computing power and analytics are all used to create digital maps for everything from asset management to autonomy. The difference today versus a decade ago or longer is that data acquisition has become fairly easy with new and innovative tools that are available. The challenge is merging and interpreting data from many different sources — whether it is collected by professionals or crowdsourced — and discerning its viability and accuracy for a specific application.

Geospatial Quotient (GQ) or Geospatial Intelligence (GI) requires the geospatial industry to think of itself as more than an enabler; it should instead be looked at as a foundational component for all industries. Where we are, where we are going, how reliable is the data, and how we are getting there are core questions of any industry and only the geospatial industry can provide this information. There would be no precision agriculture, construction automation, autonomous cars or digital cities without geospatial data and its derived products and services. This was true in the past (space program, etc.) and is true today. The difference is that data is easier to collect and consequently it is easier for it to be misused and interpreted by untrained professionals. Our challenge going forward

A portrait of Steven W. Berglund, a middle-aged man with grey hair, wearing glasses, a dark suit, a white shirt, and a patterned tie. He is looking directly at the camera with a neutral expression.

STEVEN W. BERGLUND
PRESIDENT & CEO, TRIMBLE

will not be collecting the data, but rather determining and ensuring the integrity of that data for our specific-industry or application.

No one technology serves all needs

Integrating technologies has been a focus area for the geospatial industry since the first total station in the late 1970s. There is no one technology that serves all the needs of the customers. Do you have a smart phone today? Or do you use a separate mobile device for music, video, voice calls, email, text or social media? Integration of various positioning, imaging, and connectivity technologies is essential to fulfill customer needs. This hasn't changed nor is it a new focus area. We have been focused on integrated construction and surveying for the last 25 years and this integration has provided our customers significant improvements in productivity and quality.

Artificial intelligence, deep learning, Internet of Things are the buzzwords today. But buzzwords are common in any industry and make for good dialog over coffee or in written publications. Seldom does a buzzword solve a problem. Success in this industry is defining our customer's problems and then using all technologies available to assist in solving those problems. Some of those technologies you may organically develop while others you may integrate or partner with others to create a combined solution. We continue to strive at improving our customer intimacy. Through this intimacy, innovations such as RTK, 3D machine control, mixed reality and imaging have been realized. Our founder used the term "GPS: the Next Utility." In a nutshell, this was the Internet of Things (IoT) even before the term was coined.

The key going forward for the geospatial industry is to not only focus on collection and analysis, but also on market or industry verticalization. It is essential to know how the information will be used, where it is needed, and who is using it. If not, today's geospatial professionals risk becoming the slide rule, T-square or Rapidograph pens of the future.

Innovation goes together with customer intimacy

Innovation, customer intimacy and go-to-market strategy are the keys to staying relevant. However, innovation alone does not ensure relevancy. We also focus on customer intimacy where we work painstakingly to understand their challenges and develop or adapt technology solutions to help them solve those problems. In addition, we have a formidable go-to-market strategy that couples a worldwide distribution network along with an industry-specific direct sales organization that can serve the far reaches of the world 24/7.

Trimble has provided tools for over 40 years that collect, process and analyze geospatial data for many industries. In addition, analytics platforms such as eCognition image processing software have enabled our customers to also extract industry specific value from that data. If you look at Trimble's industry-based businesses of agriculture, transportation and logistics, and construction, all

of these businesses were born from our geospatial group.

Successful companies are always innovating and investing in R&D. Today, we subdivide R&D into pure research, which is looking at new technologies or the integration of technologies to solve existing and new problems for our customers. Development is where that research is then transitioned to a product for a specific industry or market. For example, mixed reality and imaging that were research areas a few years ago are now either standalone products or integrated with other technologies. The third component of R&D is sustaining engineering where there is ongoing maintenance or improvement of existing products. All three components are needed and require investment to have a successful R&D program. A failure to deliver in any of the three components of R&D can impact your brand and your long-term viability.

The key for the geospatial industry is to not only focus on collection and analysis, but also on market or industry verticalization. It is essential to know how the information will be used, where it is needed and who is using it

Sustainability is a human mindset

A single technology or innovation will not alone impact sustainability. Sustainability is a human mindset and philosophy that you must embrace. Technology can accelerate sustainability but it alone cannot change the world. Today, we have solutions that improve agriculture yield, reduce fuel consumption and costs, enable previously unskilled workers to compete for high paid jobs, subdivide land for development, create green structures, and manage our utilities to improve productivity and reduce waste. All of these solutions have positively impacted the world. However, it's up to all of us to employ and promote them not only to improve the productivity of our work, but also to sustain and ensure the long-term health of our planet and societies.

Sustainability is an outcome of all of our solutions and much like diversity plays a key part of our DNA. From our very first solutions nearly 40 years ago we have looked at how we improve productivity and reduce waste in the industries we serve. Sustainability and diversity will continue to be key components of our culture.

What doesn't work today might be the new breakthrough tomorrow. So don't give up, but at the same time be willing to move on if an idea doesn't have merit or is before its time. This balance is essential. Companies that survived The Great Recession of 2008 have a new-found definition for resilience. They understand that you must be diversified in technology, workforce, culture, geography, go-to-market strategy, and markets or industries. Diversity equals strength and only diverse companies can survive. 🌍

Bring on the Analytics; it's Awesome!

There are a number of trends — both in technology as well as marketplace — that are converging and affecting our industry. One key trend is miniaturization and pervasiveness of sensors which has drastically decreased the cost to deploy these sensors into space. Naturally, we now have more near real-time data about the world than we've ever had before.

Another trend is proliferation of data — geospatial as well as non-geospatial — which has led to the commoditization of computing infrastructure. Just 10 years ago it would have been impossible to think about productizing the deluge of remote sensing data if there wasn't a modern-day Cloud computing service. These advancements in geospatial data and Cloud computing combined with tools like machine learning and analytics are powering smarter, data-driven decisions about our world.

From data to analytics

The first thing I would say is bring it on, it's awesome! That is the community and the platform that we need in our sector to really bring geospatial advantage to the enterprises, because there is a need for industry-specific applications driven by spatial information that solves customers problems.

That is where we want to be. At Planet, we are keen to go into every single vertical and come up with intelligent solutions in addition to the best data available. We want more industries and companies to embrace these new products

ROBBIE SCHINGLER

CO-FOUNDER & CHIEF STRATEGY OFFICER
PLANET

driven by spatial information feeds, and give us their feedback so we can incorporate it into our core offerings. It is important to be a full-stack company that effectively enables other businesses to go further up the value chain. We would like to play a critical role in building this ecosystem that enables entrepreneurs to translate the science of remote sensing into real business needs.

Future of EO is in space infrastructure

Planet is a great example of an agile company that takes off-the-shelf consumer electronics and adapts them to work in space. Today, we have very high-performing yet very low-cost compact satellites and sensors in space. This started the new trend of small, cost-effective satellites, and this is going to continue. Aggregation and diversification of sensor networks in space for enhanced resiliency will further pick up pace. We will see a lot of that in the next ten years as the US government, in particular, begins to rethink their overhead architecture.

There is really a massive opportunity that the geospatial industry is right now facing as we climb up the rung from being something like a small cottage industry to being a specialty industry

When we started Planet seven years ago we didn't know this would be the obvious trend and there weren't a lot of companies in the commercial start-up space. So, we ended up having to build the entire infrastructure ourselves and it took us five years to do that.

Today, there is so much already available in the market as a service for entrepreneurs who are just starting a business, that one can get a differentiating product in the market much easier than we did. Now, you have ground station networks, mission control services, and Cloud computing infrastructure already available. For instance, Amazon's initiative to launch ground station as a service is really all about its Cloud computing capability. It really is a smart move because ground stations are expensive and this also allows resiliency across the national border in case Internet services are disrupted.

Endless possibilities

There is really a massive opportunity that the geospatial industry right now faces as we climb from being something like a small cottage industry to being a specialty industry requiring people to know everything about satellites and remote sensing science.

Think about how the Internet completely changed how businesses worked 20 years ago. The same will be the case with geospatial intelligence driven by machine learning technologies. It will become an enabling infrastructure that makes businesses and individuals more productive and more effective. 🌍

Location Data is Today a Pure Necessity

Location data is today a pure necessity for majority of the applications and a basic “information infrastructure” on which crucial applications in many market segments are based upon. It’s all about location data collected from an ever-increasing volume of sensors, which over time will also become more powerful and accurate. Artificial intelligence and deep learning are essential parts of this process to extract value (information) out of all the data which is collected from hundreds of millions of devices and sensors. This allows for more robotics applications based on location data (e.g. self-driving cars).

Cohesiveness is the key

Major improvements of quality of life across the world are made possible by the increasing amount of location data available to make essential decisions, both in everyday life and long-term planning. However, we need more cohesiveness within the geospatial industry to grasp vast opportunities unveiled by the ongoing digital revolution.

Geospatial is very much a part and parcel of the global focus on sustainable development, but it’s not a single geospatial technology that is the driver but rather the whole gamut of technologies that will enable applications which improve the quality of life.

As such Advanced Driver Assistance data as well as HD maps for a world of self-driving cars are clear examples of technologies that enable a world with less traffic casualties, less congestion, less negative impact on the

Increasing amount of location data is enabling faster decision making. However, we need more cohesiveness within the geospatial industry to grasp vast opportunities unveiled by the digital revolution



ALAIN DE TAEVE

MEMBER MANAGEMENT BOARD

TOMTOM

environment as well as more comfort for the users. We are fully engaged in mastering the essential technology to realize such applications.

Both short-term and long-term

TomTom is all about location data and helping the world moving (forward). Our products enable a better mobility (navigation, Advanced driver-assistance systems, self-driving cars) now and in the future. Also, we make development of applications using location data easier and more accessible to all through our MAPS-APIs.

The geospatial industry is going through massive transformation and we plan to remain

relevant in this disruptive environment with our focus on the future of mobility and the fact that we have developed and further develop key technologies crucial to the evolution of this mobility.

We have both short-term as well as long-term objectives and a clear mission to focus on delivering technologies that are crucial for today’s and tomorrow’s mobility applications. Constant feedback from the market and customers keeps us agile and we have a clear vision which includes an evolution of technology to which we will contribute. As such our whole organization is aware of the enabling role we play and works on the realization of such technology. 🌍



FRANÇOIS LOMBARD
SENIOR VICE PRESIDENT
HEAD, INTELLIGENCE BUSINESS
AIRBUS DEFENCE AND SPACE

Customer-Centric Digitalization is the Future

Customers are changing the way they work, and it is important to prepare accordingly to accompany them in this transformation. Today, clients base their decisions on ever larger and more disparate sets of data. As the ecosystem is becoming more complex and blurred — customers' needs are becoming more mature (e.g. SLA's). They have progressively higher expectations/i.e. more data source agnostic/multi-source solutions are needed to entice a long-tail new customer.

It is, therefore, our duty to make them easily accessible and make sense out of it, which means providing easy tools and world-class competencies, to analyze data and extract the information they are looking for, such as change detection and temporal analysis, statistics, or object detection.

Satellite operators like Airbus are striving to get geospatial embedded into business functions and this is leading to significant investment in technologies for the derivation of business insight and digital services.

Furthermore, we are also observing a growing demand for an open environment where entrepreneurs and companies can play with different geospatial components to build or complement their own services. The ambition in the short term is to offer this platform-as-a-service offer to a large community of geo and non-geo experts alike. We need to be more and more relevant within a growing marketplace.

AI and ML: Not buzzwords but concrete tools

Artificial intelligence and machine learning need to be part of a larger solution, as they don't solve everything by themselves. With more data, scalable computing power and analytical capabilities, the time has come to make the best out of these capabilities. They are not buzzwords anymore, but concrete tools that really can change the game and play a key role in making geospatial more relevant. Today, the industry has a lot of skill to leverage on to tackle this by focusing on integration technologies and capabilities.

Also, Cloud-based solutions will continue to drive major investments to improve all facets of the geospatial business. We are embracing multi-source data, including non-geospatial datasets and advanced analytical processes. We aim to be responsible in two main ways: firstly, by pushing ourselves and leveraging the considerable resources.

Secondly, by having an open philosophy where we can embrace the creative energy from across our ecosystem. For instance, Airbus designed the One Atlas platform with the customers and for the customers for providing easier access to constantly updated premium imagery and 3D layers across the world, performing large-scale image processing and extracting industry-specific insights.

Artificial intelligence and machine learning need to be part of larger solutions. With more data, scalable computing power and analytical capabilities, the time has come to make the best out of these capabilities

Heavy investments to fuel growth

In terms of funding models, the earth observation sector is undergoing significant changes from being a government-driven market to one with increasing private sector sponsorship aligned to expand towards more diverse use-cases. We need to be more and more relevant within a growing marketplace. In this regard, heavy investments are required into new space and ground assets, Cloud-based processing and solutions to provide new capabilities and improve the daily operations of customers. In this respect, benefitting from the financial support of Airbus and a pool of geospatial and aerospace expertise is a real advantage.

Additionally, partnerships and co-operations are at the core of our growth plan, and our recent experience with Planet and Orbital Insights comforts us in our willingness to use them to satisfy larger customer needs.

In recent times, technical innovation is also driving the compression of timelines, moving geospatial capabilities to embrace both strategic and operational (platform)/tactical (weapon/real-time business insight) applications. We aim to play an important role here by way of spending significant capital on bringing continuity assets to market. These activities are closely embedded with our R&D efforts that are essential to reinforce our technical leadership on key topics for the future. 🌐

THE BEST FORM OF DEFENCE IS INTELLIGENCE.



FLY
WE MAKE IT

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

Insight. We make it fly.

Everyone has a love-hate relationship with location. Everyone sees it as widely important and critical — be it in industrial automation, 3D Printing or analytics. As everything has become digital, location has become something that is embedded in digital assets.

However, at the same time everybody faces problems in the accuracy of location

the industry is not quite living up to that promise.

Setting standards is crucial

The geospatial industry continues to provide classic maps and imagery. We have talked about standards for a long time, but I am not sure whether they really have defined the standards that are required to easily incorporate geo-data into other datasets.

dous value in cooperation, mostly because no single company has all the information. We know that success in this space is going to be driven by end-users who are using geospatial data and technologies outside the traditional geospatial industry.

The other important enabler that is going to be super important going forward is the ability to handle real-time event flow — receiving real-time data streams from a variety of sources, sensors, IoT devices — and to be able to operate on those streams in real time, take action, deliver events to other systems. Today, as in many cases, merging multiple streams together in order to recognize information or recognize patterns is of utmost importance. In some sense, the integration of multiple partners and providers will happen not just at the physical data level but also at the advanced stream level.

Another dimension that is going to be critical is focusing on very fast delivery, very fast information processing, and very fast

The expectations of the user community when it comes to accuracy are growing faster than our technology to keep up with. People expect it to happen instantaneously and be 100% accurate all the time

information action as opposed to traditional long-term processing of information. The world is becoming a lot more real time. Cloudification of geo is a continuing trend. What is also emerging right now is that people are learning how to develop really good machine learning models that are stable and can be reused. The other key trends that I think are important are: democratization of analytics, which includes the ability to take huge datasets, use standard sequel to manipulate those datasets, and visualize and maintain those large datasets. 🌐

There is a Lot of Promise, but are We Living Up to it?

— the ability to use that location reliably, whether it is in automated map making, to day-to-day end user applications. The merging of data from different sources, from multiple geospatial sources is still very difficult. We don't have good universal point standards for mapping information or merging information together for using the same featured language across multiple sources.

There is a lot of promise, but at the same time there is also a lot of concern that

The expectations of the user community when it comes to accuracy are growing faster than our technology to keep up. People expect it to happen instantaneously and be 100% accurate all the time. Customer expectations are increasing faster than the technology is. Here again, standards play a crucial role since that would help us integrate geo-data with non spatial data to deliver better accuracy.

Further, standards among geo sources enable a set of patterns, tools, capabilities for merging the data sources together. Therefore, the question is does a customer have to go to five different vendors, get their data and figure out how to use it together, or can the industry actually support patterns and collaboration among different suppliers to deliver what is needed.

Cooperation is necessary

The ongoing digital transformation is leading to everything becoming a digital asset. Given this, the general pattern for a successful company in the IT and geospatial space has to be rapid innovation and built around integration.

The industry has realized that there is tremen-

SANDEEP SINGHAL

DIRECTOR CLOUD STORAGE, GOOGLE

GIS + BIM to Drive Digitalization in AEC Industry

There is a growing recognition in the collective AEC industry that geography provides a common language for collaborating on projects. This is significant as geography allows us to better understand how infrastructure such as buildings, roads, bridges, and utilities that need to be built or rehabilitated are connected to each other, as well as the conditions of the space in which they exist.

Bringing GIS technologies and BIM processes together provides a broader and deeper understanding of infrastructure in the larger context of the built and natural environments by integrating information and content. A solution enabled by this integration allows transportation planners and designers to use real-world data to perform traffic simulations and analysis in order to redesign the most unsafe roads in their cities. This integration can also take advantage of data to gain more insight into natural conditions impacting a site, such as understanding the flood sensitivity of an area-impacting decisions about an infrastructure's location, orientation and construction materials.

A case in point is how one of our customers (Mott MacDonald) is integrating BIM and GIS data and technologies in their work to rehabilitate the lower Catskill Aqueduct in New York resulting in an innovative approach to bringing in existing data, integrating new captured data to produce information that can be easily indexed and retrieved, supporting a more successful delivery of the project.

Technology integration is the future

Investments are being made heavily around the applications of manufacturing techniques in construction, incorporating AR/VR into planning, design building and operations as well as the introduction of machine learning and AI. All of these technological advancements collectively will help transform the AEC industry, a sector which hasn't seen major productivity increases for well over 20 years.

It is inevitable that AI and Big Data will be what powers innovations in AEC processes and workflows. GIS and BIM data brought together to create a "digital twin" of a project and its environment will allow for better designs and make both construction and operation much more efficient. Analyzing all this data will help professionals detect patterns about the sites existing environment. As this information gets richer, new insights can be derived to improve the efficiency of individual assets (one intersection) or an entire system of assets (road network

Technological advancements collectively will help transform the AEC industry, a sector which hasn't seen major productivity increases for well over 20 years.



NICOLAS MANGON

VICE PRESIDENT, AEC, BUSINESS STRATEGY
& MARKETING, AUTODESK

in a city).

Autodesk is contributing by providing AEC professionals with a more streamlined process to leverage geospatial information to create better context models, thus enabling better designs and more operationally efficient assets. As a result, we have been driving new partnerships in many areas of innovation to achieve this. Autodesk is bringing that knowledge from manufacturing to AEC and our Esri partnership allows us to improve the way we create spatially accurate digital representations of the physical. Our current plan is to expand the integration further into our detailed design applications like Civil 3D but also connect GIS data into our cloud BIM platform.

'What', 'where' and 'why' of sustainable infrastructure

The understanding of infrastructure assets within the larger contextual environment enables better-informed and smarter decision-making, improved stakeholder engagement, accelerated project timelines and reduced costs. The ability to fully take advantage of geospatial intelligence in design and build processes will ultimately be a key driver for innovations such as generative design, optimization routines and AI. These will enable the AEC industry to meet the growing needs of our cities through better planning, efficient use of resources, and improved understanding of *what* needs to be built, *where* and *why*.

We want to be part of this evolution and will continue to focus on building solutions that will enable our customers to imagine, design and create a better world. 🌍

We Need to Change and that too Fast

Today, geospatial is central part of the digital transformation process. We have more and more information delivered through geospatial services and applications. Combination of EO data, non EO data and all kind of data coming from a wide variety of in-situ sensors, our iphones/ipads and so on, is a fundamental and important part of the whole digitalization process. We will see more and more impact of IT technologies, advanced algorithms, machine learning, deep learning and AI to generate information flows for a wider range of final user communities in the coming years. Advanced algorithms and AI-based algorithms will help to achieve maximum.

Ability to combine and process space data, EO and non-EO data, and in-situ data is one of the most important elements for success in the coming years

The geospatial industry, for sure, realizes that we need to change and we need to change fast. Those changes need actions on a number of different layers; evolution and acquisition of new skills, new and much more interconnected multi-disciplinary partnership models and new business paradigms. So it's a kind of 360-degree fast evolution. The geospatial industry must prove that it is ready to take the challenge. It's a kind of continuous evolution that we will see in the coming years.

Partner to evolve

Integration of different technologies is the key. The first element is to know in detail what those emerging technologies can bring to our applications. Second, to know the key actors and players who know and work on the progress of those technologies and having the best infor-

mation and cooperation framework with the technology providers in a global ecosystem functional to the innovation process.

We can derive huge amount of valuable information from in-situ sensors and from the fusion with space and aerial data. This is true for a number of domains, agriculture, infrastructure monitoring, emergency management just to mention some of them. If the data is the new oil, the process to extract information from the entire spectrum of data set is a fundamental challenge to provide timely the right information to the final user. This is true for well-established user communities as well as for new ones like as example the financial and economic community. The ability to combine and to process space data, EO and non EO data and in-situ data is one of the elements for success in the coming years.

e-geos' strategy in this aspect is quite clear. We start from longstanding legacy of high valuable radar data. Starting from this very strong, solid foundation, we now have our application platforms covering all vertical domains — Maritime Domain Awareness, Image Intelligence, Agriculture and emergency — taking benefit of multi sensors multi platforms data fusion. Through this data fusion, through the combination of optical and radar, hyperspectral and other data, coming from other platforms, such as HAPs (High Altitude Platforms), we are getting ready for the future.

Enterprises must be ready to do partnerships, including partnerships among competitors. So far we have had traditional distinction between space companies, space technologies and IT companies. In near future, there will be more and more combination of different industries,

space companies, large scale integrators and “new space” companies must partner with IT companies and gain momentum in terms of speed and capability to evolve in the business paradigms.

e-geos is taking an active role in the digital transformation by embracing the latest IT technologies, evolving the skills, having a massive learning program and enlarging the base of key partnerships. We have partnered with all the main players in data analytics as well as enabling platform technologies. I believe this way we are going to play a more important role in the future. 🌐

MASSIMO CLAUDIO COMPARINI

CEO, E-GEOS





love
planet
earth

FROM PIXEL TO ACTIONABLE REPORTS

e-geos

AN ASI / TELESPAZIO COMPANY



DR. JAMES CRAWFORD

CEO & FOUNDER, ORBITAL INSIGHT

As Geospatial Data Grows, so will Our Analytical Abilities

As geospatial analytics capabilities advance, so does the number of applications of the technology. We are continually exploring new applications for our products, which has led us to expand into a variety of sectors, such as logistics and manufacturing.

With more and more satellites getting launched, and new data sources, such as high-altitude balloons, becoming increasingly available, the amount of geospatial data we have to work with will grow. The more data we have available to analyze, the more accurate and precise our analysis becomes. Continuing the exploration of these new data sources and how they can best be leveraged to provide actionable intelligence for a variety of industries and use cases is exciting for the industry.

Artificial intelligence, deep learning, IoT et al are all factors to the geospatial landscape today. It is important for us to specifically leverage deep learning (a subset of artificial intelligence) to analyze geospatial datasets and generate actionable information for our customers. We are working to push the boundaries of what AI can accomplish when applied to geospatial. IoT is also an interesting area of development for the industry. In general, the more data sources you can apply to answer a specific question, the better, so it offers an exciting way to expand the industry's reach.

Sustainable innovation

One important component of the shift from innovation to sustainable innovation is the ability to know that our products are sustainably sourced, and more closely tracking supply chains (an area where

geospatial analytics can be very useful). Imagine knowing what field the oil palm plant used to make your processed food was grown in and being able to know for certain that no natural forest was destroyed to make way for that field. With better supply chain visibility and traceability will come better accountability, and geospatial analytics can be a source of knowledge powering this shift.

Orbital Insight currently partners with the World Resources Institute to investigate how geospatial analytics can be applied to the problem of deforestation. We are working to automate the analysis of satellite imagery to understand not only where tree cover is being reduced, but whether or not it is natural or planted forest that's being cut down. This, in turn, will help better monitoring of forests and sustainable supply chains in a global, scalable way.

Demand for geospatial intelligence

There is a strong appetite for geospatial intelligence from numerous sectors, and we don't foresee that changing any time soon. At Orbital Insight, we plan to continue to serve this demand in the areas where they exist, and to explore new ways to use geospatial analytics to create value for additional industries and enterprises. Our strong technical foundation and solid relationships with many data providers equip us to continue leading the geospatial analytics space. We are especially excited that our three biggest product differentiators in the marketplace have resonated so well with current and prospective customers. To add some color, we address three specific issues that energy traders and financial analysts face every day in their job:

- Data bias that exists in self-reported data. Energy traders rely on gathering intel about a country's oil storage from reports by the government, as opposed to a neutral third party.
- Latency and speed. These oil reports are released at a 2-3 month lag, so traders never have up-to-date information.
- Data normalization. We spend a lot of time at Orbital Insight normalizing our data sources, so we always present an apples-to-apples comparison. This means our data takes into account things like seasonality.

With new types of geospatial data becoming available — such as multispectral imagery — we are working to develop the algorithms needed to analyze and extract information from these new sources.

The ceiling is very high for the geospatial industry, and we are constantly discovering new applications and use cases for our technology. We are actively exploring new opportunities as they become available, and are well-positioned to take advantage of them. As new types of data become available and computing power continues to increase, we will see even more opportunities for the industry. 🌍

It is important to specifically leverage deep learning to analyze geospatial datasets and generate actionable information for customers

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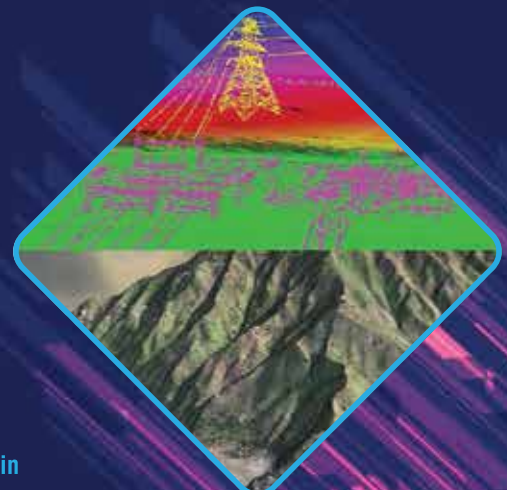
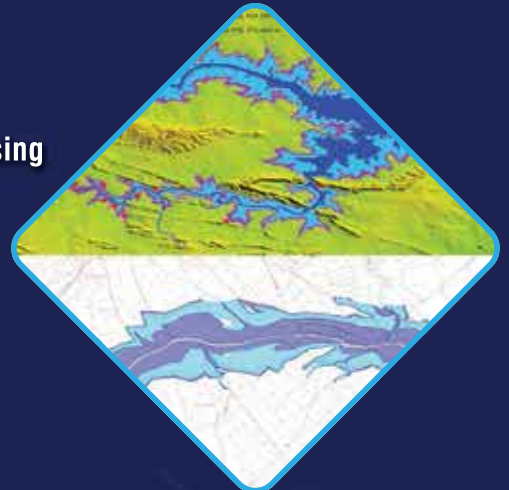
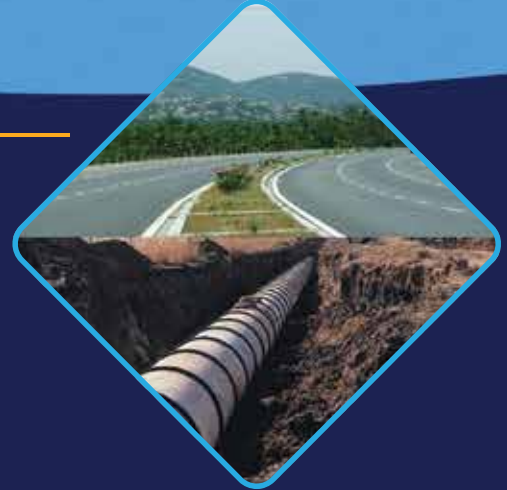
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- Geospatial World Excellence Award 2018
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Real Potential of Location Intelligence Yet to be Tapped

Location and geospatial technology have become essential to the modern life. Whether you are scheduling a pick up from a ride-sharing service, checking the weather for a vacation, or ordering your dinner after a long day, location is at the center of making sure those transactions are successful. Location has a huge potential to offer effective marketing solutions for brands and retailers. Many of the buyers in these segments are beginning to realize the potential of visitation-based performance.

However, a lot more work needs to go into building mature solutions. We strongly believe in the potential of location marketing, and as a result, we continue to invest in all aspects of our platform, so they we can drive better performance for our clients. The use of location to drive business performance is still in its early stages; 90%

of transactions still happen offline, making location a strong signal for intent. However, like any other tech, mining that intent requires innovation.

Consumer at the forefront

As customers become savvier and more familiar with location as a convenient addition to the technology they already use every day, we believe the possibilities for its use expand exponentially. At the same time, as location technology becomes more sophisticated, the

convenience and accuracy it provides to consumers will only increase. It will be the duty of the industry overall to ensure that data privacy is being protected and that the consumer is kept at the forefront.

The next phase of growth for the industry where it will see mainstreaming, will require ‘impact validation’ of using location intelligence. Customers would require us to clearly show how this technology is being effective and is influencing their businesses in quantitative terms, for example, increased store visits. It will require intra-industry partnerships as well as organic innovation to establish the value proposition of location technologies for the customers.

Make location accessible to everyone

GroundTruth has been focused on data quality, boundary data, protecting sensitive information, and using AI to predict behavior to drive performance. We are focused on building products and technology that drive real-world performance for our clients (i.e. visits and sales). We view our Cost Per Visit buying model, in which you can pay for an ad that results in a store visit, as a new KPI for marketers — much like what CPC did for search.

Over the last couple of years, we have also tweaked our platform to optimize media buys for the lowest effective Cost Per Visit. Additionally, we want to make location more accessible to marketers and advertisers, and we have a variety of different solutions that we believe are going to help push the location industry into the future.

The next phase of growth for the geospatial industry where it will see mainstreaming, will require ‘impact validation’ of using location intelligence. Customers would need to know how this technology is being effective for their businesses

Our self-serve platform called Ads Manager, which was launched in early 2018, gives smaller businesses and agencies direct access to our location technology—allowing them to optimize and transact on brick-and-mortar visits. This is a big deal since location marketing has historically been reserved for big brands and agencies who had the resources to pay for managed services.

We are also exploring other opportunities such as partnerships and new platform offerings that allow us to reach a variety of stakeholders. Our vision is to make location easily accessible to everyone.

Location intelligence technologies also have an important role to play in achieving environmental sustainability. It is already helping those who need it the most. We are very proud of our “Location for Good” initiative which highlights the accuracy and large-scale application of location technology in engaging audiences for a social cause. Since 2015, we have helped several non-profit and other for good causes by running pro-bono mobile advertising campaigns on our platform. 🌍



SUNIL KUMAR

FOUNDER & CEO, GROUNDTRUTH

Location, a De-facto in Modern Life

Foursquare was born, nearly a decade ago, because of our founders' desires to connect the physical world with the digital one. Now that future is here. Location Technology has become an integral part of services that are today de-facto parts of modern life — photo organization, ride-sharing, and even dating are all made better with location technology. As we look to the start of 2019, we can't wait to see what the future holds for geospatial and location technology.

The key requirement that we see emerging which will help the industry reach the next level of growth is mainly focused on one major area — digital media, inclusive of advertising, that is being consumed by all users. However, the importance of location in digital media remain largely understated since a lot of consumer decisions can't be measured in current e-commerce structures.

Mobiles open up a new world of opportunities

While mobile penetration may be close to saturation, at least in the developed world, we are just scratching the surface of possibilities that exist. We see more and more technology players such as Samsung, Uber, Tinder, Twitter, Microsoft etc. building new features with location in mind for enhanced experiences, notifications and personalized content.

At Foursquare we are focused on leveraging location data available from mobiles to give businesses the opportunity to understand their customers and engage with them in smart, contextual and personalized ways. What is exciting to us is how much progress we have been able to make in developing a more accurate view of where devices move from place to place so we can begin to bridge the gap between the mobile and physical world.

While mobile penetration may be close to saturation, we are just scratching the surface of possibilities that exist in the developed world at least

Our work under the 'For Good' banner showcases how location technology and location awareness can improve the world in ways big and small. In September last year, we launched a competition for nonprofit organizations asking them how they would use our location technology platform to create a better world. The winner, Objective Zero, is a mobile app and 501(C)(3) nonprofit that anonymously connects veterans to suicide prevention resources and a community of veterans, counselors, and concerned citizens.

Machine learning and location

Artificial Intelligence, deep learning, IoT all require access to Big



JEFF GLUECK
CEO, FOURSQUARE

Data. Foursquare has a powerful and complex dataset made up of visits and check-ins to over 105 million venues worldwide; and we observe over 7 billion monthly place visits from our own apps and from a selection of the 150,000 developer partners that have leveraged our technology. Naturally, to ensure the highest degree of precision and relevance at this massive scale, we need machine learning.

Our Pilgrim technology, which understands how people move through the world, was built from the ground up on the foundation of machine learning. We have harnessed the power state-of-the-art machine learning techniques, combined with our training data, to build an engine for understanding complex human movement and visitation. Our entire platform, which includes tools for marketers, analysts, developers and consumers, benefits from the precision of Pilgrim SDK.

To ensure reliable data, a big theme that marketers need to demand is "true stops" — to differentiate a true consumer who is actually interested in your product/services and not just driving or walking nearby the venue. At Foursquare, we are working on finding the frequency of a particular location attendance by analyzing multi-sensor data. Only multi-sensor can handle instances when a consumer is in a mall or multi-story building, or a dense urban shopping area where GPS is distorted by tall buildings. Since we use a lot of crowdsourced data for this, machine learning is important.

Privacy an important issue

With the recent discussions around data breach and regulations, privacy has become an important aspect for any location intelligence company. Data scientists need to earn the trust of the consumer and work with the interest of the consumer. Foursquare is in favor of smart regulations with more clear disclosure on how data can be used.

We must refine and deeply connect our products, allowing marketers and developers to build location functionality into apps, marketing campaigns and CRM platforms. In future, the Foursquare suite of products will be highly integrated, allowing a customer to easily segue between media, measurement, analytics and other location-based insights. 🍷

MARK HEINE
CEO, FUGRO

Unlocking Insights from Geo-Data for a Safe and Liveable World

Global trends are driving demand for more energy and infrastructure. Population growth and rapid urbanization are driving the enormous demand for modern and effective infrastructure.

Technology is changing faster than ever with digitalization and artificial intelligence increasingly getting embedded in everything we do, driving efficiencies while disrupting almost every industry in every country.

Climate change and related issues such as sea level rise and extreme weather patterns (storms, droughts, floods) are expected to change the way we protect ourselves and build safe environments.

But, the future cannot only be about more, it must also be about better. We believe in sustainable development as a

Many Infra projects run into budget overruns due to a lack of understanding of critical Geospatial-data

driver to help create a safe and liveable world, aligning with the UN sustainable development goals in what we do and how we do it, through our values, people and technology.

Understanding of geo-data is critical

Our planet is a much more complex object than many realise. Attaching any structure to the surface of the Earth – determining where and how to build safely and sustainably – is a very complex matter. We must first understand the geodynamics, geotechnics, geophysics, geochemistry, among other variables. Without that critical information we cannot attach any structure to the planet's surface without being exposed to enormous risks that can have disastrous consequences. Many infrastructure projects run into delays and budget overruns due to a lack of understanding of critical Geo-data.

Fugro's core expertise on data about the Earth's surface, the subsurface and built structures – what we call Geo-data – is essential for building infrastructure in a responsible and efficient manner.

Making a difference by digitally transforming

Digitalisation is a strategic priority for our clients, so developing differentiating digital solutions and changing the way we work is an important part of our vision and growth strategy.

To enable a mutually beneficial relationship with our clients and to improve the efficiency and capabilities of Fugro internally, we have embarked on a programme to digitally transform the company. This transformation will enable us to provide significant reduction in risks and costs, as well as accelerated project execution, while moving to a more sustainable way of doing business. It is focused on key “building blocks”, including remote operations, robotics, autonomous systems, advanced analytics, connected data and client interfaces.

To complement Fugro's internal digital transformation, we are changing how we interact with our clients by introducing the Fugro Digital Foundation. This concept provides a deep understanding of our clients' sites and their infrastructure assets.

Whether it be on land or under water, for yet-to-be-built assets or those that are decades old, Fugro's clients are starting their own digitalisation journey with a blank slate. By sequentially acquiring Geo-data about the sub-surface, the above-ground built structures and the surrounding environment, Fugro's Digital Foundation provides a spatial framework that is the contextual starting point for their asset management digitalisation journey.

All of this accurate, real-time data together with relevant client data, or third party data, is integrated into the Fugro Geo-data lake. Key information and real value can then be derived from this expanding dataset — individually and collectively — using data analytics powered by cloud-based machine learning and AI tools for fast and efficient processing. Ultimately, this allows our clients to make more informed decisions in real time, on the design, construction and maintenance of built structures, such as bridges, tunnels, roads, railways, airports, oil rigs and so on. This in turn greatly reduces risk and cost while improving the long-term resilience of these structures that play such an important role in people's everyday lives. 📍

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- SBAS: WAAS, EGNOS , GAGAN, MSAS, SDCM
- IRNSS



www.labsat.co.uk

Growing Need of Location Intelligence

Location data is a critical component of the strategic decision's companies make each day. Location is powering smarter digital products, digital marketing and online and offline business decisions. Our world is now mobile, computing is everywhere, and the power of location is changing everything — the way we get around, the way we interact with brands, the way we solve problems and the way we discover new services and access information. Location data is changing the way we experience the world.

The need for location data will only grow, and we are constantly testing and developing new applications for our data that will help businesses improve and optimize. Beyond licensing out our data, we are also helping our customers look inward at their own data, enriching it with additional points and making sense of who their customers are, where they go, and how they can build products, solutions and experiences tailored to key stakeholders.

Reimagining the real world

Nearly every industry is being re-imagined for a world in which every person and point on the globe is connected. Re-imagining the world means re-imagining the data that the world is centered around. More data means better information, and better real-world understanding. Factual exists to make this information available to those that need it — to build better products and experiences, to improve infrastructure, to impact global health and more.

Factual is providing the real-world intelligence needed to power the future through two core datasets — Global Places, Factual's high-quality, proprietary data asset comprising more than 130 million POIs around the globe; and Observation Graph, Factual's dataset that combines more than 300 million mobile device signals with Global Places data to index the real-world behavior of mobile users. Together this data helps product and engineering teams, data analysts, business intelligence professionals, marketers and more to make better, smarter business decisions.

We are highly focused on the quality of our data and the power of our location intelligence technologies and expect that we will be seen as a great partner.

Innovation for capacity building

New innovation often results in new horizontal layers of technology offered through emerging platforms or services which are then

In the end, all industries stand to benefit from comprehensive location data and intelligence, and there are many fruitful partnerships that will be built

integrated across end-user software and solutions. At Factual, we have thought carefully about how to build and offer our capabilities through a platform so that our partners can leverage our deep investments in location. We have also chosen a partner-friendly operating structure that avoids misalignment and channel conflicts — we don't compete with our partners' customers.

Only innovation can meet new challenges

Cities are growing and more successful hubs of innovation and commerce are emerging. But as cities grow, only innovation can meet the new challenges. Uneven distribution results in rising epidemics of homelessness and poverty. Under-investment and under-education within many under-represented communities limit future potential. Traffic gets worse and the average cost of living grows, which has a huge impact on quality of life. There are many issues to solve, and geospatial technology can provide critical efficiencies to city planners, saving time and money while offering a broad view of the data they need to drive strategic decisions.

The geospatial industry will see well-established vendors come together with newer startups to focus on emerging categories and use cases. In the end, all industries stand to benefit from comprehensive location data and intelligence, and there are many fruitful partnerships that will be built. 🍷



GIL ELBAZ

FOUNDER & CEO, FACTUAL

J-Mate updated



**Built-in
0.001 degree
inclinometer
to level,
monitor
and correct.**

**We delayed introduction of
the J-Mate to January 2019 to
replace the vials with built in
accurate electronic inclinometer
to level and continuously
monitor and correct.**

TRIUMPH-3

All the features of the TRIUMPH-1M, a new TRIUMPH chip, in a solid magnesium alloy metal box.

Top part exactly like TRIUMPH-LS

Half the height of TRIUMPH-LS



Ideal as a base station

LIVE at www.javad.com



G'day, Mate!

Redefining Total Stations
and GNSS workflow.

The **“Total Solution”**

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

Why follow a workflow designed for yesterday's equipment?

This is J-Mate

J-Mate features a **camera** that can also find targets automatically, and a **laser module** for accurate distance measurements. It scans and examines the area around the intended target to ensure reliable identification. Two **precision encoders** measure vertical and horizontal angles to the target. Built-in **precision electronic inclinometer to level and monitor and correct continuously**.



Take control with J-Mate + TRIUMPH-LS

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



Motors

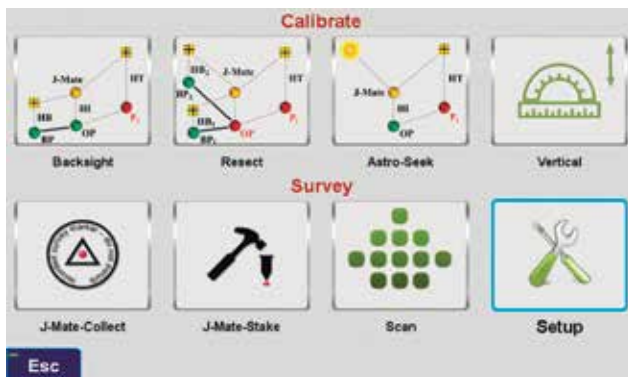
Laser

- scanning
- distance measurements
- examine area around targets



Camera

- find targets automatically



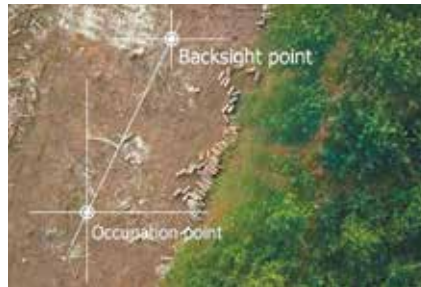
With J-Mate you can establish your occupied position via three different ways: 1) Backsight; 2) Resection; or 3) our new Astro-Seek (more of that later).

When you click the Setup icon of the J-Mate screen you get access to parameters that tunes J-Mate to your desire.

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

Backsight icon

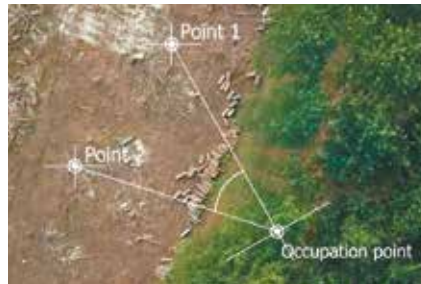
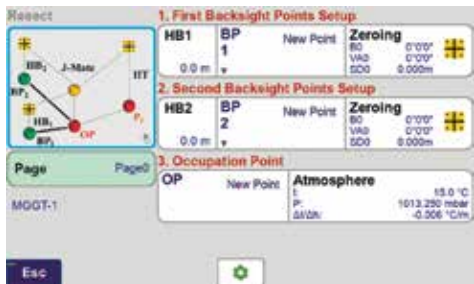
If GNSS signals are available at the job site, click the J-Mate Backsight icon.



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

Resect icon

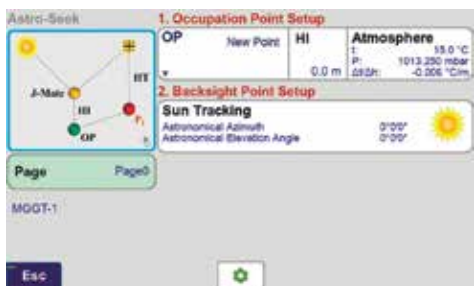
If GNSS signals are not available at the Occupation Point, click the “J-Mate-Resect” icon



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

Astro-Seek icon

And now our new feature!

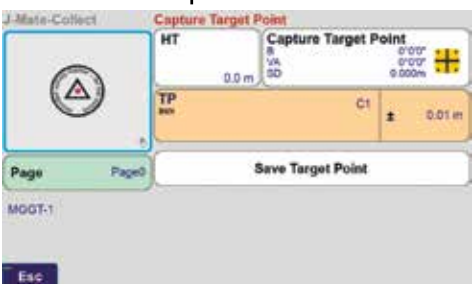


We have added a new innovative

feature to the J-Mate that it can automatically calibrate itself via its automatic Sun or other astronomical objects-Seeking feature.

J-Mate-Collect

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



J-Mate-Stake

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

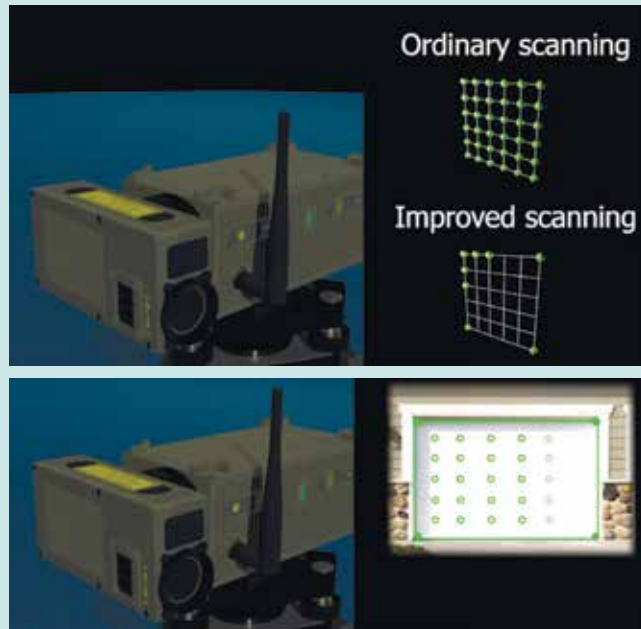


The functions and features of the J-Mate stakeout are very similar to our conventional GNSS stakeout: RTK solutions guide you to the stake

points. But with the J-Mate the camera follows the TRIUMPH-LS and then the encoders and laser measurements (shown on screenshots) provide guidance to the stakeout features. This is similar to Visual Stakeout and other useful and innovative features of our TRIUMPH-LS GNSS RTK stakeout.

Smart laser scanner

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



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

Seize the day with J-Mate + TRIUMPH-LS



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

TRIUMPH-1M

Based on our new 864 channel chip, equipped with the internal 4G/LTE/3G card, easy accessible microSD and microSIM cards, includes “Lift & Tilt” technology.



TRIUMPH-1M



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

TRIUMPH-2



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

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

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

And all this with competitive prices!

HPT435BT/HPT135BT/HPT225BT*



35 W UHF/VHF Transceiver

HPT404BT/HPT104BT/HPT204BT*



4 W UHF/VHF Transceiver

HPT401BT/HPT101BT/HPT201BT*



1 W UHF/VHF with internal battery

L-Band/Beacon*



Receivers for multiple applications

JLink LTE BAT*



Web-interface Wi-Fi, Ethernet, 4G/LTE, UHF/VHF/FH915, internal battery

OEM Solutions



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

*Power, data cables and antenna are included.

Needed: Fit-for Purpose Solutions

The explosion of data and the geospatial enrichment of that data has added value in business.

Today, we are seeing a steady march of adoption towards utilizing more fit for purpose software solutions such as for financial crimes and compliance and property evaluation of risk. Specifically, Big Data solutions for processes are fulfilling the goal of embedding geospatial capabilities into compute-intensive environments, which many companies are adapting today.

The industry is also undergoing significant impact from the amount of location-based data that is being collected by mobile devices and sensors. In this regard, the industry must take a leading position to solve the challenges of organizing, enriching (geo-enrichment) and analysing these data. Data management, data quality and integration are critical to deriving these solutions. Without a deep understanding of the myriad data sources necessary for complete location analytics (both land-based and remote sensors) and the ability to organize and geo-enrich these data, achieving even sustainable living will not be possible.

Increasing investments in APIs and SaaS

To be at the forefront of providing value to customers, it is imperative

to constantly talk to customers and analysts and investigating market trends something that is embedded in every-day workflow of Pitney Bowes. Simultaneously, it is necessary to continually educate clients as to where the most effective use of location intelligence can be implemented.

Investments are necessary in developing APIs that expose both our data and software technology so that it can be easily deployed with today's IT infrastructure.

Services-oriented architecture approach

We should aim to make our software platform fully technologically integrated so as to take a services-oriented architecture (SOA) approach to product development. Pitney Bowes has already taken a step in this direction. Through complete workflow solutions, from mobile apps to field force scheduling and cost analysis, Pitney Bowes supports a holistic approach toward managing the environment and infrastructure. 🌐



GREG VAN DEN HEUVEL
CHIEF OPERATIONS OFFICER
PITNEY BOWES SOFTWARE AND DATA

Geospatial: A Unifying Language

With the changing technology trends for the last 30 years, geospatial information has become an increasingly common and unifying language in every industry across the globe, bringing geospatial technologies closer to broader IT and ICT. Technologies driving the Fourth Industrial Revolution — Big Data, Cloud, artificial intelligence (AI), Internet of Things (IoT), Augmented and Virtual Reality (AR/VR), and Automation — are going to have a far-reaching impact on the geospatial industry and vice versa. What has changed considerably is the speed at which this integration can be completed

and the democratization of the technology, such that it is now accessible to non-geospatial professionals in ways that was simply not the case in the past.

The growing role of ICT has increased the significance of geospatial technologies,

with digital transformation ensuring it is an indispensable part of our lives. Geospatial data and related technologies have become enablers across various sub-systems and is integrated in every walk of life today, right from the way energy efficiency is monitored, through transportation planning and public safety to environmental monitoring. The industry definitely has grasped the opportunity on offer. Today, it would be extremely difficult to find a successful business or idea that does not embed some sort of geospatial technology, from booking a taxi or finding a hotel, to capturing a Pokémon!

Integrated solutions is the future

Geospatial technology is enabling various functions to integrate, visualize and exploit enormous amounts of spatial or location data for better decision making. Geospatial, perhaps more than ever, is an enabling technology that underpins many of the complex decisions being made by across multiple industry segments. As a result, organizations such as Cyient are increasingly considering Geospatial services to be a horizontal capability, while at the same time providing targeted and bespoke solutions to each customer. Our customers are seeking faster and more cost-effective methods to access the power of geospatial, and we will enable this by providing end-to-end solutions that solve the problems. 🌐



JOHN RENARD
PRESIDENT
UTILITIES & GEOSPATIAL BU, EMEA
CYIENT

Harnessing the Power of Geospatial Data in a Digitized World

With growing digitalization across the world, an ever-increasing list of datasets is getting geotagged. In order to take full advantage of these geospatial data streams, organizations need techniques and tools that make it easier to harness the power and potential of such data.

At Senzing, when we started conceiving our entity resolution software in 2009, we knew for sure it needed to be geospatially aware. After much work, we implemented something called space-time-boxes to make it easier to process and compare entities for similarity and relationships.

While a wide range of geospatial capabilities are being developed, it still seems to me that the geospatial opportunities exceed current

offerings. I think this holds especially true in the area of multi-source fusion; for instance, fusing geospatial data sets with non-geospatial data sets — which as a by-product labels location-less data with location. This type of auto-labeling is essential to machine learning. Another area where I feel much more work needs to be done is privacy by design (PbD) engineering. Without a lot of forethought into privacy, systems are less sustainable i.e., apt to be discovered and shut down.

Privacy by design (PbD) was one of our core design objectives when we started designing and building our software in 2009. One of our more unique PbD features is something called selective field hashing. When this hashing is combined with our space time boxes, our customers discover a very unique and powerful way to compare geospatial coordinates between systems for closeness without exchanging actual latitudes and longitudes. This is discovery without disclosure.

Remaining relevant in a disruptive environment

If artificial intelligence means “systems that act smart” — then geospatially tagged data is going to play a key role; because the “where” factor plays a big role in all decision making.

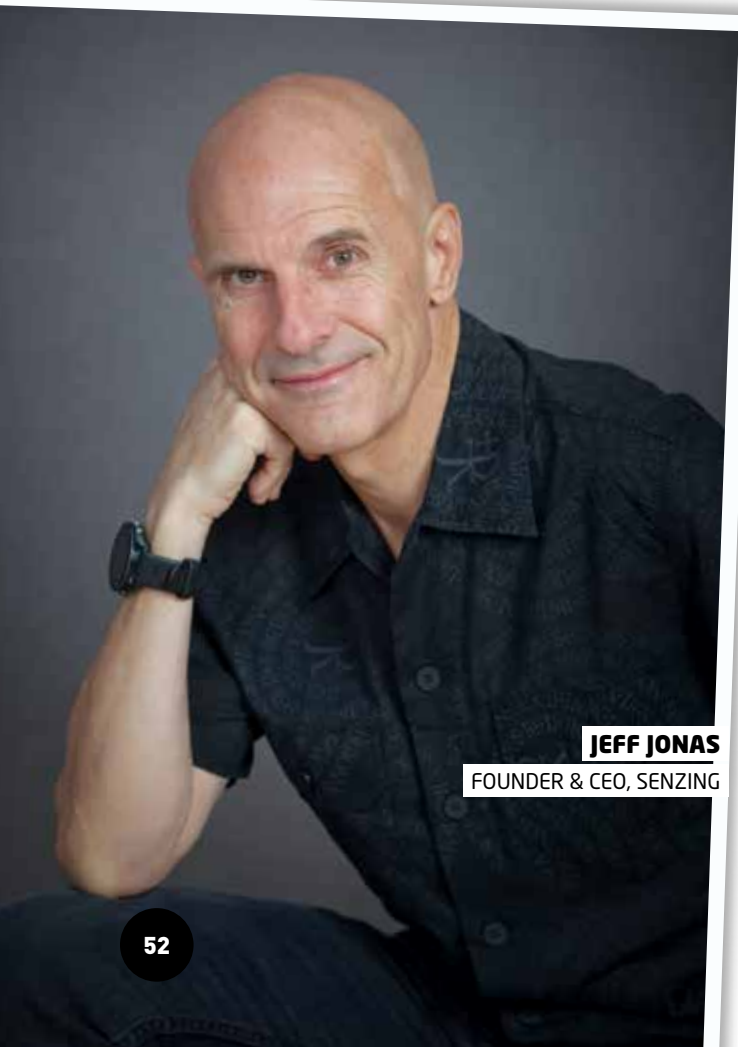
The geospatial industry is undergoing a great disruption. One way of staying relevant is factoring agility and resilience into our

While a wide range of geospatial capabilities are being developed, it still seems to me that the geospatial opportunities exceed current offerings. I think this holds especially true in the area of multi-source fusion

growth strategy. I believe agility comes from underlying foundations and structures, and we are prepared for this. Continuous innovation is another aspect we need to focus on. As the primary innovative work is done and ahead of its time, a large chunk of our investment is geared towards boosting customer demand. I also think instead of standalone technologies, the future lies in integration of various technologies, and hence the focus on open source integrations.

As our technology enables real-time, multi-source entity-centric data fusion, with geospatial-awareness, and more importantly privacy by design — we feel well positioned for what’s coming in the geospatial industry. Furthermore, as a library for programmers, we hope the companies building geospatial systems will find us. We would love to demonstrate to such organizations just how easy and affordable it is to now embed our advanced analytics inside of their technology — helping them leapfrog their competition in terms of capability — as well as performance and cost.

As we are on the cusp of The Fourth Industrial Revolution, it becomes imperative for the industry to reorient itself with an emphasis on privacy concerns and policy. 🌐



JEFF JONAS

FOUNDER & CEO, SENZING

Geospatial – Bringing New Insight, New Meaning, New Data to the C Suite

Technology is touching everything now. Sensors are integrated in to all our devices. All these devices are producing data, and spatial information can be unlocked to produce incredible insight. The themes we see driving this are: faster decision making by leaders, better consumer experience and more accurate predictions.

The solutions available now provide comprehensive functionality. Consumers of geospatial information ask about technological possibilities, and the response typically confirms that the right combination of solutions makes it possible today. With the right combination of data and tools, use cases that will redefine the geospatial industry are already possible.

There is a lot of opportunity in processing of spatial imagery coming from satellites, drones, stationary cameras

At SAP, we are working closely with our customers to understand what business enablement is important to them. We are leveraging internal development and external partnerships to provide a comprehensive solution to the challenges and opportunities that our customers face now and in the future. In addition, SAP has a visionary approach to produce solutions, which make our customers more competitive and agile in their decision-making processes. We look forward to developing a technology platform, which can unify systems and data sources, provide governance, and remove the limitation created by silos of data.

Integration is necessary

The geospatial industry is providing new insight, new meaning and new data to the C suite. It is helping them to make better decisions than ever before. SAP is currently leveraging partnerships and internal development teams to quickly respond to customer needs. As the business software organization that processes the majority of the world's financial transactions, SAP is in a unique position to create just in time functionality that is innovative.

A digital copy of the ever-changing world is becoming the source for new decision-making and geolocation intelligence. SAP customers that are embracing the next wave of geospatial functionality



MATTHEW ZENUS

GLOBAL VICE PRESIDENT

DATABASE & DATA MANAGEMENT, SAP

are clearly achieving next level competitive positions. They use additional insight to pull ahead and define next generation best practices. The top global companies trust SAP for guidance to navigate a technology avalanche.

Future lies in AI and machine learning

AI and machine learning have the potential to change industries. For instance, HANA spatial services is a geospatial processing technology that leverages Machine Learning to produce insight directly related to business or industry models.

There is a lot of opportunity in the processing of spatial imagery, coming from satellites, drones, even stationary cameras. Machine Learning can be used to identify objects and detect anomalies in these images. Combined with artificial intelligence, thousands of decisions and predictions can be made from images taken at different points of time.

SAP is a provider of many cutting-edge technologies that enhance current geospatial solutions. 0-20% of its development time is focused on enabling innovation and research projects to extend geospatial functionality. Some examples of our focus topics are Geo-ML, Graph-ML, Advanced Analytics, Drones, and multi-dimensional data analysis as well as scaling, partition and compression.

The next big thing for the geospatial industry is to use the technologies more effectively for achieving sustainable development. Earth observation technologies, which can provide automatic analysis of the changing environments can be pivotal for sustainable living. Smarter farming, agribusiness practices, and production of food sources as well as environmental impacts of industrial production can all be viewed real time, using such technologies. HANA spatial services is a solution that can provide insight on this topic today. It can be used to analyze changes on the earth and thus minimize impact. 🌍

Geospatial Silos are Unacceptable

Over the last two decades, there has been an increasing trend to incorporate and enable spatial data, visualization, analysis in the context of the applications, development tools, services, UI, and analytics. Today, the focus is on including native spatial capabilities across platform technologies, applications, and cloud services. Applications and SaaS services use spatial visualization and analysis to provide context and information relevant to the applications; our technology stack — database,

In a geospatial context, it is the time to embrace, extend and innovate keeping up with the major trends in technology field – autonomous services, self-service and low code interactions, Cloud-native capabilities and implicit mobility

development tools, platform services — incorporates spatial analysis, understands spatial datatypes, and supports spatial services including 2D/3D vector data, point clouds, topology, raster and remote sensing, and networks, thus fully embracing the essential role geospatial plays in all modern applications and services.

Digital Technologies: Shaping the future

In a geospatial context, it is the time to embrace, extend, and innovate keeping up with the major trends in the technology field — autonomous services, self-service and low code interactions, Cloud-native capabilities and implicit mobility. Today, everything is based and offered on new and emerging Cloud and autonomous architectures as well as embracing ML and AI technologies. But, so do players outside the traditional geospatial industry who have entered as disrupters or from a different perspective. This creates a dynamic where more established geospatial industry players can be followers because while we understand the opportunity, we may not be as focused or agile as non-traditional entrants.

The industry plays a crucial role in this changing approach from a number of perspectives. First, the Internet of Things and predictive data from artificial intelligence and machine learning allows us to provide more relevant and contextually appropriate spatial analysis or location-enabled information. Second, the “signal” that is generated from spatial analysis can feed ML and analytics to provide more relevant results. Taking all this into consideration, Oracle develops applications, technology and services that use AI, ML and IoT technologies with geospatial from both of these dimensions.

Service-based offerings

What the geospatial industry can do differently is to offer more data, more “service-based” offerings, and more VR/AR and hybrid reality offerings. Companies like ours should continue to invest significantly in R&D and new product development and focus on geospatially-enabled self-service/autonomous services and real-time sensor based advanced analytic capabilities based on Internet of Things (IoT) and machine learning technologies.

The future lies in integrating technologies. Geospatial silos are increasingly unacceptable in modern technology architectures. Oracle presents data through industry-standard APIs (not only geospatial standards) and formats. We also enable access to analysis and results sets in application context; our approach is not to depend on users and applications to learn geospatial concept, but to deliver geospatial information and analysis as consumable services in the context of the user or application. 🤖



STEVEN HAGAN

VICE PRESIDENT, SERVER TECHNOLOGIES

ORACLE

Geographic information systems (GIS) have been used successfully for a long time to extract insights from static, geo-coded “vector” information such as points, lines, and polygons. However, traditional GIS is hitting scalability limits as a result of the emergence of “mega” Big Data in the form of geo-coded imagery from drones and satellites and time-series Internet of Things (IoT) data. We expect to see a major shift in 2019 to address this issue, driven by the confluence of massive geospatial-temporal data together with advances in Cloud computing, advanced machine learning, and artificial intelligence (AI). New innovations are helping businesses in different industries as diverse as energy and utilities, finance, insurance, and governments capture the full value of this ever-growing, ubiquitous, and vitally-important class of information.

Seeing the larger picture

Today, geospatial-temporal data remains relatively “dark” compared to other kinds of data, in large part due to its size. Consider the fact that some data sets now grow by tens or even hundreds of terabytes per day, making traditional approaches of downloading information and working with geo-coded imagery on a “file-based” level, a daunting

Cloud, AI Key to Unlocking Insights from Geospatial Temporal Data

quest for obtaining timely insights for geospatial-temporal use cases.

Beyond its complexity and the enormous size of this data, the level of “indexing” for geo-coded imagery from drones and satellites is insufficient. For example, the data from the World Wide Web has been indexed such that we can search or query billions of Web pages within a fraction of a second using a few search criteria or keywords. In contrast, until recently it has not been possible to query petabytes of satellite information rapidly given a few search criteria.

To address these issues, over the past several years a team at IBM Research invented a new technology called IBM Physical Analytics Integrated Data Repository & Services, known as IBM PAIRS Geoscope. PAIRS is a Cloud service that provides a ready-made catalog of carefully indexed, diverse, and continuously-updated geospatial-temporal information, enabling scalable access to complex queries and machine learning-based analytics and AI without the need for downloading data.

PAIRS provides four Cloud-based core services. Data or information services provides access to petabytes of up-to-date, AI-ready curated data, such as historical precipitation data and passenger traffic information for all airports in southeast Asia. Data curation services enables clients or content



KATHRYN GUARINI
VICE PRESIDENT, INDUSTRY RESEARCH, IBM

Traditional GIS is hitting scalability limits due to emergence of ‘mega’ Big Data. We expect to see a major shift in 2019 to address this issue

providers to integrate their own data into the PAIRS platform thereby allowing them to exploit, analyze, or monetize their data along with the petabytes of already-curated data. Search or query services enable rapid search given a few specific criteria (e.g., show me all places in the United States where next week’s average forecasted temperature is lower than 40F and the population density is larger than 4,000 people per square mile). Finally, PAIRS provides complete analytics platform services that enable clients to run their own custom analytics without downloading the raw information.

Examples of very challenging questions that can now be answered with PAIRS include everything from “how can we predict the corn yields in a specific region this harvest?” to “where are the most vulnerable places or biggest problems during an earthquake in a specific region?” to “where is the best place to build a wind or solar farm?” to “how can we track the spread of a wildfire?” These queries require advanced analytics, and PAIRS leverages machine learning and AI techniques to make predictions based on a complex mix of parameters, models, and historical data.

2019 will be a defining year for geospatial-temporal data as we finally see the tools needed to exploit this frontier of Big Data come to market. 🌐

Big Data Analytics is Becoming an Industry Standard

Due to digital transformation and advancements in technology today, geospatial data is used by everybody in some form whether it is mobile, wearables, Augmented Reality, IoT, etc. Geospatial technology is completely embedded into our daily lives. The best example is the GPS capability included in almost every mobile device. On the enterprise level, the abundance of sensor-derived geospatial data combined with modern Cloud infrastructure has made Big Data analytics applications available for everyone, making SaaS an industry standard for companies who want to stay competitive.

While technology has been enabling the geospatial industry, it is also enabling new computing technologies such as virtual reality & augmented reality making everything autonomous. As a baseline, geospatial technology have become a commodity, embedded into every location-enabled service. This separates core geospatial technology developers from the developers of location-specific services, and require very different skillsets.

Business models to become more service oriented

Geospatial data is difficult to process and use, and applying geospatial data to various industries and businesses is a new experience for most. One of the critical drivers will be the ease of access to publicly

available data for people to build simple tools. For example, by having robust programmatic access to large scale weather datasets, Planet OS enables people and heavy industries to use environmental data in their everyday lives. The fusion of weather, consumer and business data will allow new insights, which will help drive policies and business decisions going forward.

Further commoditization will drive consolidation across companies and make them choose whether they want to be in the core geospatial industry or service industry. Device manufacturers will also need to work around their business models, either becoming fully vertically integrated, or just providing access to data as a service without selling devices, or using their proprietary analytics to provide just the answers to the questions their customers have.

Interoperable data governance key requirement

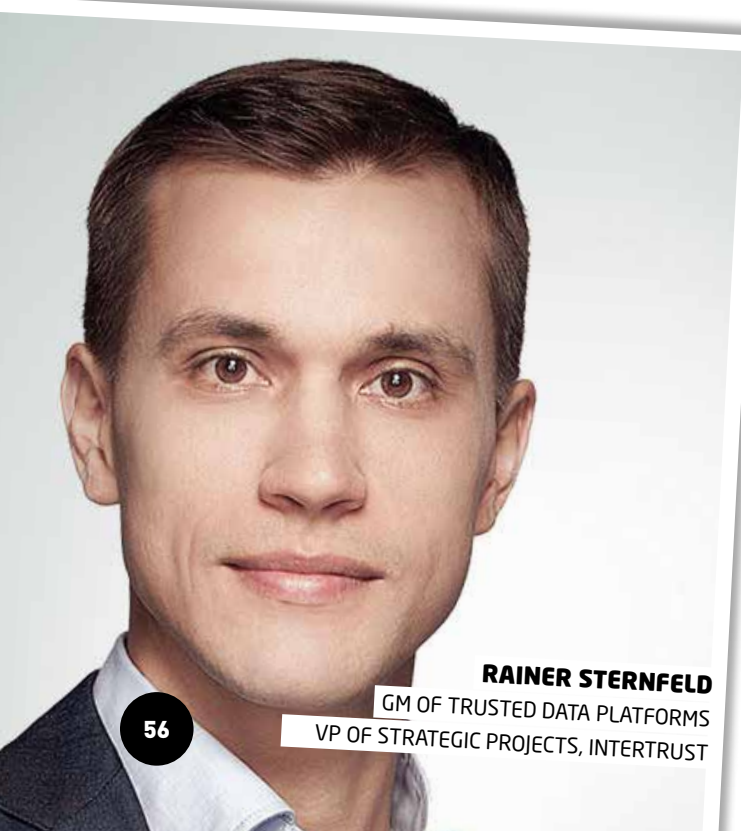
When data becomes property, it needs to be managed. Today, asset data is one of the most valuable properties a company owns. After having been locked out of their own data by variety of stakeholders — from OEMs to analytics companies, companies with asset-level data in the field are learning this the hard way. As data privacy

In building data-driven services, knowing how organizations' data and devices are protected and used will be critical

laws such as the GDPR come into effect and we are witnessing an increase in security concerns, companies are now faced with a new challenge. Secure, interoperable data governance is becoming a key aspect for virtually any internet-connected device that has location-based technology attached to it.

Our mission at Intertrust is to put the right technology in place to ensure trusted data exchanges between entities and their partners. We provide companies peace of mind on how their data and devices are protected and used. We do this by enabling multi-sided secure data exchanges/services, app stores, etc.

In 2018, we built the Modulus data rights management platform to allow users to securely virtualize their increasingly growing volumes of data across various Clouds without moving the data around, all while providing controls to manage the rights of the underlying data. The system is designed to enable businesses to build multi-party marketplaces, with privacy and commerce functions built into the platform. A unique advantage of Modulus is the capability to easily combine proprietary data with a wide variety of geospatial industrial IoT, and business data. It allows one to securely share data within an organization, with partners, and even work with competitors without being compromised. Whether executing a two-sided data exchange or building a multi-sided marketplace for smart services, organizations want to be sure their information will be safe and used only as intended. And geospatial data is right in the middle of all this. 🌍



RAINER STERNFELD

GM OF TRUSTED DATA PLATFORMS

VP OF STRATEGIC PROJECTS, INTERTRUST

The freedom to use data exactly how you intended.

Introducing Intertrust Modulus.

It's your data. Break free from vendor-specific data silos and build data-driven policies without compromising the integrity of your data or any third-party interests.

With Modulus, you're unlocking real value by bridging diverse interests. It's opening up new possibilities that happen when you freely exchange information. Set yourself up for success and make the most of every location-enabled opportunity.

The Modulus Data Rights Management Platform

- Never get locked out of your data
- Unify access protocols across diverse data sources
- Securely share data within organization, with partners, and even with competitors
- Develop advanced analytics applications and data exchange partnerships

Features

- Cross-cloud interoperability for ease of doing business
- Work with multi-format data: tabular, time-series, grids and nd-arrays
- Fine-grained data rights management
- Secure analytics environment for trusted data exchanges
- Comply with privacy regulations and protect customer data

Rapidly Changing Tech Landscape Demands Dynamism

It goes without saying that we have been living in the digital age for quite some time now. Having a paper map on file that was surveyed 20 years ago really has no true value in today's world. The location and condition of facilities and assets change constantly, and therefore GIS professionals need to be continuously auditing the landscape. To enable efficient decision making, the software platforms are making it easier to collect and report reliable geospatial data and more and more private and public entities are embracing what geospatial technologies have to offer. With the rapidly changing technical environment in the geospatial market, we do not foresee the luxury of standing pat when it comes to new product development.

On the other side, the ongoing focus for the geospatial industry should be to continue to embrace new technologies while improving workflow efficiency and the overall operator acceptance. Improvements in data mining capabilities, field data collection efficiency and equipment affordability would all lend themselves to supporting sustainable living. Whether it is working to locate clean water sources for

the developing world, identifying traffic flow challenges to improve transportation efficiency and safety or making sure that new infrastructure is properly overlaid on the old, improvements in geospatial technology will play a key role going forward.

Embedding intelligence in hardware and software

Leveraging new technology saves time and money while improving final output results. Smartphones and tablets are becoming more useful in the geospatial marketplace, providing easy access to high powered computing platforms. In addition, they are improving the "ease of use" to operators which helps to eliminate the fears of new technology adaptation. The focus should be to improve measurement accuracy, operator efficiency and product affordability to provide more precise feature locations and increased field data collection capability to more users across the globe.

The ongoing focus for the geospatial industry should be to embrace new technologies while improving workflow efficiency and overall operator acceptance

GIS/GPS/GNSS hardware and software solutions are continuously evolving and LTI lasers and software apps are no different. We have created a simplified laser-based mapping software that runs on the Android platform and allows integration with third party GPS/GNSS devices. We are leveraging these concepts in our current and future products by embedding more intelligence in the internal hardware and software. This allows for more sophisticated data processing and measurement algorithms that produce improved results but is fully transparent to the operator.

Future lies in partnerships

Integrating with third party GIS technologies is very important for growth of future businesses. Building and maintaining strategic partnerships with other market leaders to combine forces to improve our response time to trending technologies is also critical. Also, it is important to continually seek system integration opportunities and work closely with other business partners to create mapping packages that offer the utmost precision at an affordable price, combined with ease of use.

At LaserTech, we have also been partnering with start-ups, small businesses as well as major players in the geospatial marketplace by providing a laser development kit that makes the integration of our laser data much quicker and easier. We are trying to quickly adapt to new technologies and changes in field workflow requirements.

Our ability at LaserTech to keep up with the changing times is not easy, but it is something we most certainly work on day in and day out. We will continue to do what we have been focused on for the last 30 years — making highly efficient and reliable laser measurement technology that is accessible to everyone. ☺



ERIC A. MILLER

PRESIDENT & COO, LASER TECHNOLOGY

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Real Revolution is Democratization of Mapping with Affordable Devices

The idea that the geospatial industry is undergoing a massive transformation is only partly true. There will always be space for highly accurate geospatial equipment. But the real revolution is the democratization of mapping with affordable devices. Today's consumer mobile devices have the potential to obtain geospatial information, and they are everywhere. But obviously, these affordable sensors cannot digitalize without the help of automatic software that converts this data into meaningful and accurate information. That's where Pix4D comes into play. Pix4D has been a powerful driver in showing that even with your phone or with a cheap drone camera, you can create accurate 3D models and maps and reconstruct reality. This is not yet a very competitive industry landscape, but once consumers have the power of 3D in their hands, we will definitely see other players enter the market.



CHRISTOPH STRECHA
CEO, PIX4D

More possibilities with AI

Analyzing how humans behave, how they live, work and eat will require a good knowledge of the 3D world around us, in order to improve human interactions. Artificial intelligence and machine learning can bring a lot of value to this field by automating the analysis, allowing larger datasets and faster results.

Industries are creating a lot of expectations around AI, machine learning and deep learning. The technology is getting better, but it's not quite there yet. It is very difficult today to acquire the right training data to teach a machine to be smart enough to solve specific problems. This is evolving and AI will undoubtedly play an important role in this automation process, reducing the need for human interference in the processes of inspection, asset management, and also in 3D modeling.

The future lies in integrating technologies driven by end-customer needs. What is important for end-customers is not photogrammetry or machine learning — what really matters is solving problems. This means the value proposition needs to be simplified. Partnering and integration with other companies is essential. Connecting all the automatic data coming out of digitalization process with the customer asset databases is an important workflow, where integration plays a key role.

Partnering and integration with other companies is essential. Connecting all the automatic data coming out of digitalization process with the customer asset databases is where integration plays a key role

Creating solutions for a better world

We are continuously thinking about the industries, the customers and where we should invest next, and when it's the right time to build new applications for end-users. In near future, we intend to increase our investment in technology, especially in our platform, Pix4Dengine, which is used by large clients who build their own applications around our photogrammetry and machine learning expertise. We also aim to grow our dedicated inspection R&D unit in Madrid, while continuously investing in Construction. We are always investigating if the timing is right to spin off more and different verticals, which can benefit from our platform, and we will continue to do so and innovate.

We are creating technology that can help humans live safer lives with less danger, doing less repetitive tasks and be more productive and happier, reducing stress levels and having more data to make better decisions more quickly. Digitalization is a huge opportunity for the whole geospatial industry. Knowledge is part of our DNA and makes us well prepared to tackle the challenges of each industry with photogrammetry and machine learning. 🌐

Location Data is Critical for Big Data Analytics



On the basis that everything happens somewhere, location data is fast becoming a critical variable in Big Data analytics, and the move to data-driven decision making, in both industries and governments worldwide. The geospatial industry has, therefore, a crucial role to play in providing accurate, timely and reliable streams of location or spatial data to underpin those data-driven decision-making processes and strategies. In addition, the challenge is to ensure that such data is easily integrated with many other types of data, and the geospatial industry is

RICHARD BLAIN
FOUNDER & CEO, EARTH-I

itself a leader in the application of machine learning and AI techniques required to make big data analytics meaningful.

Integration in the future

The future is about integration of a wide range of data sets and types to answer a complex problem or drive new insights into industries, supply chains and environments. The application of new and powerful geospatial technologies, such as very high spatial and temporal resolution sensors, from space, provides the critical location-based data that give data analytics and insights the context of time and space. Without that context many data analytics outcomes lack actionability. The application of data science, using machine learning and artificial intelligence, drives deep analytics and reveals insights that enable decision-makers in these sectors to make better decisions and policies.

The industry must both lead on the development of new geospatial technologies and solutions, and adapt quickly to the demands of integration with a myriad of other data sets and wider data science technologies. Earth-i intends to be at the forefront of both.

Earth-i is pioneering the integration of very high resolution satellite imagery and video to a range of applications in data analytics and insights. We are developing and deploying analytical capabilities that integrate other datasets and technologies with satellite imagery and video in fields as diverse as copper mining, coffee farming in Africa, maritime monitoring and defense and security. 🌐



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We are Entering a New Age of Geospatial Big Data

Geospatial technology is permeating in the digital landscape very rapidly and eventually driving the digitalization process that the world is undergoing. The accelerating transformation of the industry is opening up new opportunities to serve the needs of consumers, professionals, enterprises and organizations. In order to grasp these opportunities, the geospatial industry needs to modify its project lifecycle models and fast-track latest technology adoptions to traverse the digital ecosystem and realize the value-creation potential that geospatial promises. Further, it also needs to synchronize with constantly changing business processes.

We are entering a new age of geospatial Big Data due to significant increase in the demand for geospatial information. However, we must acknowledge that the big shift is not coming from the geospatial industry, but from outside. Growth in drones and the data they

produce will be of focus in coming years. Further, integration of artificial intelligence and machine learning with geospatial will play a significant role here.

Location intelligence is going to be integral

Location intelligence is bringing new analytical capabilities. Artificial intelligence and deep learning technologies are harnessing the availability of high-performance computing and high-resolution geographic data to empower the geospatial ecosystem by facilitating seamless augmented real-time perception, geospatial intelligence, predictive analytics and visualization. AI and IoT devices can be combined to analyze spatio-temporal data at the point of origin and embed geospatial intelligence into devices. With the integration of AI, deep learning and IoT with geospatial, location intelligence is going to be integral to new business models, turning insights into actionable intelligence and informed decisions.

We have successfully employed IoT sensor technology, smart grid, smart meters and automation to help utility clients to comprehensively capture data, minimize cost, drive top-line growth, and improve consumer perception.

Geospatial Industry needs to modify its project lifecycle models and fast-track latest technology adoptions to traverse the digital ecosystem and synchronize with changing business processes

In sync with new innovations

In the past five years geospatial industry has immensely evolved and as trend shows this is going to be the pattern for years to come. At Ceinsys, we constantly pursue and evaluate new innovations. Our plan is to become a disruptor ourselves and challenge this disruptive environment rather than being a temporary solution provider.

Ceinsys positions itself as a system integrator in the geospatial market by integrating numerous technologies and providing end-to-end solutions. We are involved in every phase of project lifecycle, and have vast expertise and capacity in data acquisition, data processing, analysis and software development. To keep up with the pace of technological advancements, we have adopted new emerging technologies in timely manner, maximized customer service level, and developed strategic alliances with OEMs. Recently we invested heavily in training and capacity building and overhauled business and organizational process areas to enable ourselves to soak in the digitalization wave.

Other than this, we are focusing our resources on specific domains like transport, energy, utilities and defense, in addition to aligning innovation and new product development plans with our business strategic objectives. In future, a large chunk of our R&D budget will be spent on 3D data acquisition technology, customized software development and geospatial analytics. 🌐



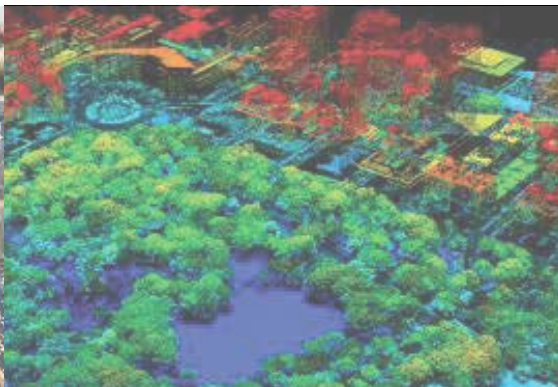
DR. ABHAY KIMMATKAR

JOINT MANAGING DIRECTOR, CEINSYS

Ceinsys Tech Limited (formerly ADCC Infocad Limited) is a CMMI SVC Level 3 and a BSE Listed company. A part of the large conglomerate Meghe Group, we have a core focus on providing Geospatial, Engineering & IT solutions. Incorporated in 1998, Ceinsys has built up a reputation as one of the premier Technology solution providers in the country. Over the past few years, Ceinsys has taken its capability and vast experience to a global level and now has two dedicated offices overseas. With a team of 1400+ employees spread across different locations, Ceinsys is in a position to deliver high volume turnkey solutions to clients.



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Geospatial Demand for Smart Cities will Increase Manifold

The adoption of geospatial technologies is necessary to understand and adapt the aging infrastructure in continuously growing cities. Today, smart-cities, connected devices, telematics and autonomous vehicles are dependent upon the availability of accurate up-to-date geospatial data and analysis of such massive quantity of information to make them useful.

Technologies are allowing the creation of a world from a 3D digital or virtual model to the physical world, then from the physical world to application specific as-built models to come full circle. The geospatial demand for 'smart cities' is expected to double every three to four years, bringing real-time information to local governmental entities for them to adapt their investment policy to rapid changes (traffic management, road maintenance, utilities etc.).

Moving towards connected solutions

As a positioning and navigation technology-oriented company, CHC Navigation is enabling the digitalization process by merging technologies, from millimeter accuracy GNSS sensors to long range high

The geospatial industry is keeping pace with the technology challenges represented by the necessary combination of mass data and local detailed and specialized information

precision scanners, from underwater bathymetric survey to drone photogrammetry, from optical survey to high resolution 360-degree images, from local to large area data capture and maintenance.

Technology integration for CHC Navigation means going beyond survey instruments and developing 'geospatial tools' that will provide effective decision-making solutions to the geospatial community. CHC is a global provider of integrated solutions, from ground to airborne survey, from traditional GNSS survey to mass data collection with 3D mobile mapping solution such as our recently introduced Alpha3D, machine control and agriculture auto-steering, all that within real time infrastructure from network RTK solution to advanced bridge monitoring systems.

Finally, the geospatial mobile workforce tends to look for connected solutions which are able to run on their own devices, requiring light portable browser-based applications backed up by resources hosted in the cloud.

Technology should remain affordable

The geospatial industry is keeping pace with the technology challenges represented by the necessary combination of mass data and local detailed and specialized information. This process is taking place in a fast-evolving environment, high demographic pressure and expanding cities, reshaping the requirement for balanced and wise urban planning.

From its foundation in 2003, CHC has always been aiming at developing technology with high-standards but always keeping in mind two major factors — the initial investment cost and cost-of-ownership for our users. Technology should remain affordable. CHC is a technology enabler for a growing number of geospatial professionals, in many countries. The final geospatial users are more and more coming from diverse educational background. It requires us to massively invest in the simplification of the data acquisition workflow processes with carefully designed man-to-machine interfaces.

We are rapidly expanding in geographically thought bespoke business and marketing centers. The proximity to our customer is a key factor to maintain a clear understanding of geospatial customer requirements in an extremely fast changing environment. In most case accuracy is not anymore purely related to a set of XYZ coordinates. As a matter of fact, more dimensions are of equal importance namely, data completeness and the rapid obsolescence of the information.

Fundamental research in technologies is also making larger contribution in our plans, including advanced tightly integrated positioning algorithms, IoT and cloud-based solutions. We are working towards achieving more agility by building market alliances and technology partnerships worldwide. 🌐

GEORGE ZHAO
CEO, CHC NAVIGATION



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Make your work more efficient

Understanding Human Mobility

Grasping the opportunities provided by the merging of location and the geospatial industry is elusive, but is slowly becoming approachable. To accomplish this, the industry needs to continue to focus on what use cases and business challenges geospatial data can answer.

Our industry is growing fast, but we have just seen the beginning. It has become necessary to understand human mobility and accurately predict how people move around on our planet. This is where our focus lies now, and companies need to get this very right before talking about other enhancing technologies.

A lot of major technological leaps like, Artificial Intelligence, Deep Learning, Internet of Things etc. have become buzzwords today but the base knowledge they provide the population of clients signal their future importance.

Right data for the right use case

At Unacast we are trying to understand human mobility, to empower other companies to build better products and make better decision with our data sets. We listen to our clients, who are spread across multiple verticals, to ensure we help them use our human mobility data sets for the right use cases.

We are also fortunate to have a group of great investors who also are long term and see that the value Unacast provide multiple clients in verticals such as transportation, city planning, research and real estate will compound over time.

R&D remains an important focus of our business and all our efforts are centered around R&D. We have an envious amount of knowledge and insight in our data, and our goal has grown to make this data easily accessible to clients with varying demands.

We really like the idea about using human mobility to make cities more aware of how environmentally friendly they are or aren't. This knowledge will improve how we and the next generations will live and create a wider scope for business opportunities and expansions in areas that are most in demand right now. 🌍



THOMAS WALLE
CEO & CO-FOUNDER, UNACAST

Technology Integration is the Key

Location information on (or above) the surface of the Earth continues to make our lives safer, comfortable and more convenient. As the real-time knowledge of position is extended to include better information about what is happening around us, the benefits to the society grows at an exponential rate. Even basic information on disasters (earthquakes, fires, floods, tsunamis, etc.), weather, and traffic improves dramatically with the integration of geospatial data. Further, even entertainment is altered forever with the integration of geospatial data.

Today, by dramatically reducing the cost of delivering geospatial

datasets, satellite operators are able to retrieve more data from their satellites than ever before. In the past, a satellite operator discarded most of the data collection potential of their satellites

due to the cost of data transmission and processing — typically only downlinking high priority data previously ordered and paid for by customers. Through innovations of today, satellite operators are now able to salvage more of the data collecting potential of their satellites to build up a data archive, providing greater “depth of archive” for geospatial data sets. These “data archives” will grow increasingly valuable in the future as applications for AI increase, and training data sets will be needed.

Geospatial data transformation is future

Technology integration is an important factor in continuing the accelerating pace of development. Advancements in technologies both inside and outside of the traditional geospatial industry, such as, advancements in 5G communication, autonomous vehicles, materials science, and quantum computing, will continue to have significant impact on the geospatial industry in the coming years.

We are sitting at leading edge of geospatial data transformation and are pushing for further disruption by pursuing R&D efforts in areas such as edge computing, software defined radios, laser communication, and electronically steered array antenna technology 🌍



CHRISTOPHER RICHINS
FOUNDER & CEO, RBC SIGNALS

We are Moving to an Autonomous, Connected World

Geospatial or location information is integral to way forward. We are moving from human intelligence to machine intelligence world, wherein everything is connected and becoming autonomous. This world, for making decisions has to rely on reliable information, and location is one of the key pieces of information that is required to be reliable for a car to drive down a freeway or a drone to fly or a mobile phone to interact with the world around. Location industry is going to be one of the key pillars on which the future of the autonomous world is built on, so it is a vital part of the connected, autonomous world.

We haven't figured out what are the boundaries of information. Right now, it's very fragmented and siloed and everybody is very protective of it. This is probably one of the big areas in the near term that needs to be addressed

More collaboration going forward

For end users to have good experience, be it human beings or machines, many things have to come together. They must have good location information about their surroundings and they should be able to navigate. They also need to understand where they need to go and the context. All of that cannot be done by a single entity. It absolutely requires collaboration and cooperation among the technical people, the mapping people and the building information people. All of them have to also collaborate with the city and urban planning people to address the need of that particular application which could be a car wanting to drive down a certain street or a robot going inside a building or a human being walking around. There will be a lot more collaboration happening going forward. Right now we have a very simplistic approach to it, a basic outdoor map data, with a point of interest and navigation as our best use case. This is going to get more complex as we get into new areas of indoors and urban scenarios.

We need to work towards stitching all the pieces of information together to build a cohesive and rich map of information set that works across cities or indoor areas, for instance. That's going to take some time. Unlike outdoors where nobody had issues with information sharing and privacy, the minute you start getting into urban areas and indoors, you also get into privacy issues. We, as a society, haven't quite figured out what the boundaries of that information are. Right now, it's very fragmented and siloed and everybody is very protective



GANESH PATTABIRAMAN
CO-FOUNDER & CEO, NEXTNAV

of it. This is probably one of the big areas in the near term that needs to be addressed, and this is what Nextnav is focusing towards.

Building the next generation of GPS

Nextnav makes use of machine learning and AI quite extensively. Just by the given statistical nature of location, you have to use those techniques to reliably determine where you are and what you do with that. For instance, we get a lot of information from devices saying where they are. From that we can determine many other things, including which floor of a building you are in. But the information is noisy, so we need to be able to filter that to understand this actually belongs to this level, and this belongs to a level below. So we build a lot of techniques to support that kind of information management. Those are integral to what we do

We have all grown up in a world where GPS has been the end to all. But now Nextnav is starting to push the boundaries of going beyond where GPS works. We are building the next generation of GPS. Fundamentally, we are a service provider/ technology developer that solves the problem of the high precision reliable 3D geo location in places where GPS doesn't work. This broadly is indoors, urban areas. We essentially hope to be the GPS for those kinds of places, in the sense that we are the reliable blue dot that you can count on and know this is exactly where you are, that's useful for people and their context, for machines to know where their context is or for autonomous systems. We are working with mobile phone operators to more recently with NASA, who is currently using our systems to fly drones, which gives you a breadth of understanding of how we play, which is across the entire gamut of indoors and outdoors. We are very excited by the future because we think we are an integral part of it and we can enable a lot of those capabilities that otherwise are hard to get to. 🌐

Towards Geospatial Machine Maps

Geospatial mapping has become more important now than ever before; driven by the unstoppable growth of automated decision making. From self-driving vehicles that can navigate a specified route to a drone that can fly over a construction site, autonomous decision making requires a next level of digitalization. Each aspect of the physical world requires layers of digital signatures to be embedded within a virtual representation of the necessary space. The level of information that's required for the representation is ever increasing and each enable new use cases. Digitization is not just on a growth curve, but on a hockey stick growth curve, moving at a rapid pace and introducing new autonomous use cases.

The future is machine networking

Mapper's core capabilities enable self-driving vehicles and machines of different autonomous levels to navigate set routes by providing

Making maps visually pleasing and readable for people has always been the main priority. However, machines do not need a positive user experience, but rather require high precision and up-to-date accuracy. The requirement for no-frills technology to help an autonomous machine navigate lends itself to a new kind of a technology

layers of up-to-date information in a machine-readable map. Mapper has created a globally scalable ecosystem for on-demand creation, validation and maintenance of centimeter-accurate maps. Mapper's cutting edge technology allows customers to request a map based on their unique geographic needs — think entire cities for robotaxi fleets, sections of highways for truck drivers, shipping container lots for autonomous machinery.

As more and more innovative autonomous technology gets developed, automakers will begin collecting high fidelity data themselves. So at that point, the question becomes who is going to be the aggregator of that data, and that is where Mapper will play a key role. What Mapper is trying to enable is a network effect wherein in the future, autonomous mapping data can be automatically converted into meaningful information for various use cases.

Until recent autonomous vehicle developments, geospatial mapping has been focused on consumer use cases, such as Google Maps or Apple Maps. Making maps visually pleasing and readable for people has always been the main priority. However, machines do not need a positive user experience, but rather require high precision and up-to-date accuracy. A machine doesn't care to explore the world

through a map, but needs programmed direction to take it from point A to point B and complete the task at hand. The requirement for no-frills technology to help an autonomous machine navigate lends itself to a new kind of a technology that Mapper is developing. Mapper hopes to grow the company as the industry matures and as automation becomes a part of daily life.

Making mapping relevant

The technology that Mapper is developing takes raw data from the streets and converts it into a map without human intervention – just data in and maps out. That is the core machine learning AI capability that Mapper built in-house. In any given city where no map exists, or a city where a map has been built and hasn't been updated for a very long time, Mapper can automatically convert data capture to map creation and automate it. What these geospatial machine maps will enable in the future is automation in the form of autonomous driving, driver assistance capability, drone capabilities and beyond, because maps are a fundamental piece of the environment meeting a machine. 🤖



NIKHIL NAIKAL
CEO, MAPPER

Convergence of Mobile, Cloud and Low-Cost 3D Sensors

Enabled by low-cost LiDAR scanners, drones with longer mission times and payloads, advances in photogrammetry and simultaneous localization and mapping (SLAM), geospatial has already seen an incredible transformation in just a few years. At the same time, the convergence of mobile, Cloud and low-cost 3D sensors and 3D engines has propelled the industry forward. The world of immersive 3D technology has been around for approximately 30 years, but users, who were lacking a deep technical understanding of creating these models and the extensive budgets to support it, were not able to properly utilize the technology.

Matterport got its start among commercial and residential real estate brokers who adopted the technology as an end-to-end marketing solution for virtual property tours, high-quality 2D still images and Google Street View integration for businesses.

In the AEC industry, 3D service providers who utilize drones, total stations and laser scanners have recognized and implemented

the power of fast and cost-effective 3D scans before anyone else. From remote inspections and quality assurance, to scan-to-BIM services, these users are helping the industry reach a wider audience and improving its functionality.

Price, speed and ease of use

Combination of price, speed and ease of use is enabling organizations to acquire a brand-new category of professionals working in GIS, facilities management, architecture, engineering and construction. This has also allowed Matterport to expand our application areas to new industries that hadn't previously realized the advantages of remote sensing technology, including real estate, retail, insurance and hospitality. 🌐

R.J. PITTMAN
CEO, MATTERPORT



Geospatial will Disappear as a Subset

Data is becoming more critical to business success, and understanding the planet, supply chain, and organizations' operations is only possible with data that has the critical context of time and place. Satellites, drones, fixed cameras, weather, an organization's proprietary operational data — it's all geospatial. The supply chains that crisscross the planet — farms and mines, factories and production facilities, ocean, rail and road transportation — make up a dynamic living system. Organizations can now digitize their supply chain and predict probable outcomes of whatever they plan to do next.

Integration of data and technology

The geospatial industry will disappear as a subset to become a descriptor of everything related to data. The entire commerce and communication flow will be underpinned by a robust set of data that offers deep insights. All of this data will be inherently geospatial helping to redefine the term. Data is always more valuable in combination with more data. So the integration of data — and the technology that makes it most useful — will continue to be a focus. Our data refinery is a prime example of this.

The challenge we see is the ability to clean disparate data sources from many sensors and put it together in a normalized format for use in creating models. We at Descartes Labs, are building the world's largest and most

diverse data refinery so data from inside and outside of organizations can be gathered and made ready for use in model building in one place. These models will produce digital twins of an organization's processes, operations, supply chains, and markets. The digital twins will offer calculated predictions and observations based on real-time global data that's constantly streaming into the refinery.

The past four decades saw the rise of at least three major technological eras — the PC, Internet and mobile. Each started out as toys for nerds, but grew to impact the world. We are now on the cusp of a new era, fueled by data and run by machine intelligence. Geospatial data cannot be used to its maximum potential without AI and deep learning. We now have the ability for first time in human history to monitor and measure the impacts of entire supply chains. I believe that this transparency will drive the innovations needed to create a better world. 🌐

MARK JOHNSON
CO-FOUNDER & CEO, DESCARTES LABS



Real-Time Data Collection a Real Game Changer

GIS software is a powerful engine and, as computing power has increased exponentially over the years, GIS software has become exponentially more powerful as well. GIS software needs fuel. Data is fuel for GIS. One of the most prolific GIS data generators is GNSS technology. Whereas in the past it would take tens of minutes using expensive GPS receivers, specialized software, and a specialized operator to generate centimeter-accurate GIS data, today's modern GNSS receivers, along with off-the-shelf software on any personal mobile device, enable almost anyone to collect centimeter-accurate locations in just a few seconds. On top of that, this can be done in real-time. From a practical perspective, an operator can navigate precisely to a buried water valve, for instance, to turn off service to a broken water main pipe. Once the valve is turned off, its location is instantly sent to a GIS server, where a public-facing map is updated instantly to show which street addresses will be without water service during the repair. Not only does the utility save non-revenue water loss, but it also keeps its customers happier through transparency.

Information Technology and GIS technologies are converging and becoming tightly intertwined. Stakeholders are asking for more and more real-time data

This level of real-time precision enables all kinds of organizations to make accurate decisions very quickly and if they choose to, they can inform tens, hundreds, thousands, or millions of people in an instant.

Ease and simplicity of data collection

Like it or not, most people choose the path of least resistance. Today, billions of people interact with their iOS and Android devices every day to the point that mobile devices have become an extension of their minds. These devices help us communicate, stay organized, and navigate efficiently.

If an old computer, tens of thousands of times less powerful than an iPhone 8, was able to guide and control the Apollo spaceship to successfully land it on the moon 50 years ago, then certainly the mobile devices of today, being incredibly more powerful, would make perfect tools for collecting GIS data — and they do. Their large screens, fast processors, wireless communications, high-resolution cameras, and huge storage capacities make today's commercial smart devices ideal for collecting, accessing, displaying, storing, and analyzing

GIS data. They also can talk to the most accurate GNSS receivers in the world through Bluetooth.

Suffice to say that when I designed the first high-precision Bluetooth GPS receiver in 2002, I could not imagine the power of the mobile devices that, today, all of us carry in our pockets. No one except Steve Jobs could. But isn't it great that today's most perfect GIS data collection device also happens to be the path of least resistance?

The cost of collecting 3D, survey-grade data is falling drastically

We already carry powerful handheld GNSS/GIS data collection devices in our pockets, thanks to our smart phones. In addition, "survey-grade" GIS data collection software is easier and more affordable than it's ever been. Centimeter-accurate GNSS receivers cost less than ever before in history.

These three trends mean you can quickly grab a device and collect an astounding amount of survey-grade, three-dimensional data in one afternoon. Contrast that with the old days, when an organization would have to hire an engineering or surveying company, schedule the project, and wait for the final data to be delivered, which is a process that can take weeks or months. The old days are over. Today's organizations can collect such data themselves — in hours — at a fraction of the cost. Lower-cost data means organizations can afford to collect accurate data on projects that couldn't afford the cost of high-precision data previously. What was previously inconceivable yesterday has become a reality today.

Driving the future: The impact of high-accuracy data on IoT and Augmented Reality

Information Technology (IT) and GIS technologies are converging and becoming tightly intertwined. Stakeholders are asking for real-time data. Real-time data requires IT owners to join the data movement within their IT infrastructure and software systems. If we accept this is happening today, then as we look ahead to tomorrow, we'll see the Internet of Things (IoT) start to take off. The future is bright for a smarter world. And it may be starting one high-accuracy data collection point at a time. 🌐

JEAN-YVES LAUTURE

FOUNDER & CHIEF TECHNICAL OFFICER

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Geospatial Data has Become One Of the Core Enablers

Everything in the physical world can literally be located geospatially, and our consumption and production of data reflects this in almost everything we do. As activities, workflows and processes digitize, geospatial data becomes one of the core enablers in a world of location-based products and services.

Every company will soon need to incorporate geospatial data into their thinking both from a strategic and operational mindset. The future lies in integrating technologies but there is more of a cross-discipline fusion of technologies required here. Being able to identify and orchestrate the cross-functionality of the tools developed across imagery, Big Data, computer vision and SaaS development is critical and then being able to deploy them seamlessly through low friction and increased time to value is imperative for scalability and success. Through technology integration and in particular, deep learning integration, we can democratize the processing of geospatial information.

AI, deep learning and IoT allows for out-of-the box thinking. These technologies are radically changing how processes are done and how technologies are utilized across industries. We need to push towards the fusion of multiple geospatial datasets to evaluate predictive and change assessments.

Possibilities in sustainability are limitless with geospatial

We have barely scratched the surface as to what sustainability and scalability with geospatial technology can look like—the possibilities are endless. Identification and classification of properties and structures for their optimal use will be a driver for sustainable living. Through geospatial technologies, understanding how best to use the resources we have available will benefit us all. For example, identification of potential storm run-off issues as well as identification of ideal locations for roof top gardens in urban areas. All these aspects will improve the quality of life for both users and consumers of geospatial. 🌱



RISHI DAGA
CEO, EAGLEVIEW

Being as Accessible as Microsoft Excel

It's now much easier to talk to people about geospatial data, and people understand the importance of having an encompassing rather than a single (point) location view. In times to come, we expect the geospatial industry to no more remain as something separate. There's no reason why in future people shouldn't be able to use geospatial software in the same way they use Microsoft Excel.

about opening people's and hence their organization's eyes to the possibility of using data captured by satellites. This doesn't always mean satellites are the only solution. Often the cost of using this technology is falling alongside the data streams becoming more robust.

Understanding the data before applying is essential

We are always following technological advances and seeing where we could use them/ be involved in their development. Artificial intelligence, deep learning, IoT - these technologies have been overhyped regarding what they're currently capable of, but they are also useful when applied to the right situation. We use machine learning techniques in our work, but it's about understanding the data before applying them, so we understand the relationships they determine.

Geospatial technology is driving data storage and transfer that's accompanied by power and other resource usage, so we need to become less throw-away and more sustainable in our use of resources. To contribute, we are currently working on two UK Space Agency International Partnership Programme funded projects, in Colombia and Uganda, using space technology to improve sustainability within those countries. 🌱

It's about making the most of the technology and scientific developments so we can offer cutting-edge approach to clients. For us, it's



SAMANTHA LAVENDER
MANAGING DIRECTOR
PIXALYTICS

Drone Innovations: A Technological Shift for the Geo Industry

Geospatial industry is a relatively young industry which involves a variety of sensors. If we look at the growth of the geospatial industry from being introduced by satellite and now, with the inception of drones, it has taken a rocket flight. With lesser distance, more precise datasets can be captured in real time. This technological shift has shortened the data capturing distance and relatively increased the number of use-cases for various industries that was not possible via satellite. Now as data points are increasing, there is a need for accumulating, storing, visualizing and using this data.

The geospatial industry is bound to grow big with miniaturization in the sensors/hardware industry, and the market shift to drone innovation. Miniature technology will take it to a different level of success

Upcoming innovations in geospatial industry are playing a crucial role in providing engineering intelligence solutions. Many other heavy industries such as township development, infrastructure, and mining are in a dire need of such digital intervention. Geospatial is not only becoming a by-default for new trades but also for the established industries. For instance, in the infrastructure sector, it is providing alignment layouts for the construction of highways and railway tracks. In agriculture, we can collect critical datasets like pest affected crops by conducting a topography survey with the precision of 5 cm. Similarly, in areas like urban planning and VIP movement,

which demands precise data of higher resolution, we are playing an important role.

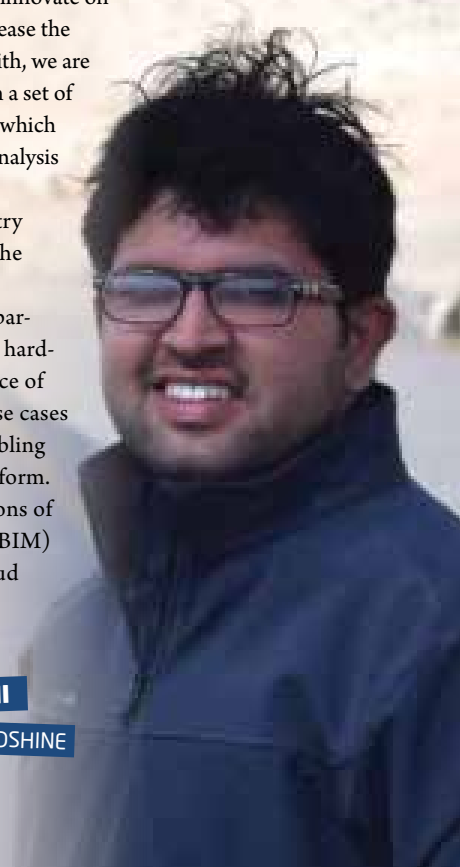
Miniaturization of sensors

The industry is bound to grow big with miniaturization in the sensors/hardware industry, and the market shift to drone innovation. Miniature technology will take it to a different level of success.

Our focus at Indshine is on providing insights and analytics for efficient planning, monitoring and inspection across various industries using drones, satellites and other sensors. With our collaborative web platform, users can harness the power of remote sensing and artificial intelligence. We seek to innovate on analytics on our platform to increase the utility of the dataset. To begin with, we are working on building a panel with a set of tools to maintain the repository, which can then be used for predictive analysis overtime.

The future geospatial industry will demand the utilization of the innovation in sensors and data points. Here, our services will partake the role by connecting the hardware/sensors which is the source of generating data points to the use cases in the industry and further enabling it through our AI analytics platform. We are also exploring integrations of Building Information Models (BIM) with geospatial data on our cloud platform. 🚀

SAKSHAM BHUTANI
CHIEF BUSINESS OFFICER, INDSHINE



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P.V. RAI

MANAGING DIRECTOR, PIXEL SOFTEK

disruptive technologies are delivering information that has never been possible before, creating entirely new avenues for geospatial data collection and processing while posing challenges for geospatial data storage, retrieval and analysis.

We at PIXEL SOFTEK, with over two-decades of industry experience, have worked with several prestigious state and central government agencies in digitalizing their assets data and strive to provide them the latest in geospatial technologies and solutions so they can optimize their processes and functions, thus saving costs and improving productivity. Niche technologies have always been the main stay of our customer centric solutions. We continue to innovate and acquire new technologies to remain relevant in this disruptive environment.

Over the last two decades we have transitioned from a purely services business model to one where we have a vast portfolio of our own products and solutions for industries ranging from Broadband to Agriculture to Infrastructure. These solutions have been developed by integrating GIS, IoT, Mobile and Web technolo-

Location Intelligence is the Mainstay of Disruptive Innovation in Digital Age

The geospatial industry has been an early adopter of the digitalization process. First, paper maps became digital maps. Then, Remote Sensing/GIS Technologies added more layers of information to the digital maps. Now it continues to advance with the advent of technologies like drones, LiDAR, web GIS and mobile GIS. These and many other technologies continue to enable the industry to build intelligent spatial data.

The importance of location intelligence is more than ever for businesses or individuals in this digital age. Utility companies need to know “where” their assets are to optimize upgrades and maintenance, ride-sharing apps need to know “where” their drivers are to assign them to the nearest customer and average consumers need to know “where” the nearest businesses are. Geospatial technologies are integral to answer the “where” question.

Location intelligence is the mainstay of several disruptive innovations of today and continues its key position in futuristic disruptive technologies such as Internet of Things (IoT), machine learning/deep learning, unmanned aerial vehicle, augmented reality, spatial augmented reality, virtual reality, autonomous vehicles, computer vision, etc.

Key differentiators to businesses

Ever-growing location intelligence-based innovations and platforms, coupled with cutting-edge technologies, are proving to be key differentiators to businesses to improve customer experience, drive revenue and increase operational efficiency. These

gies. We are now exploring in the realm of artificial intelligence and machine learning to further fortify our solutions.

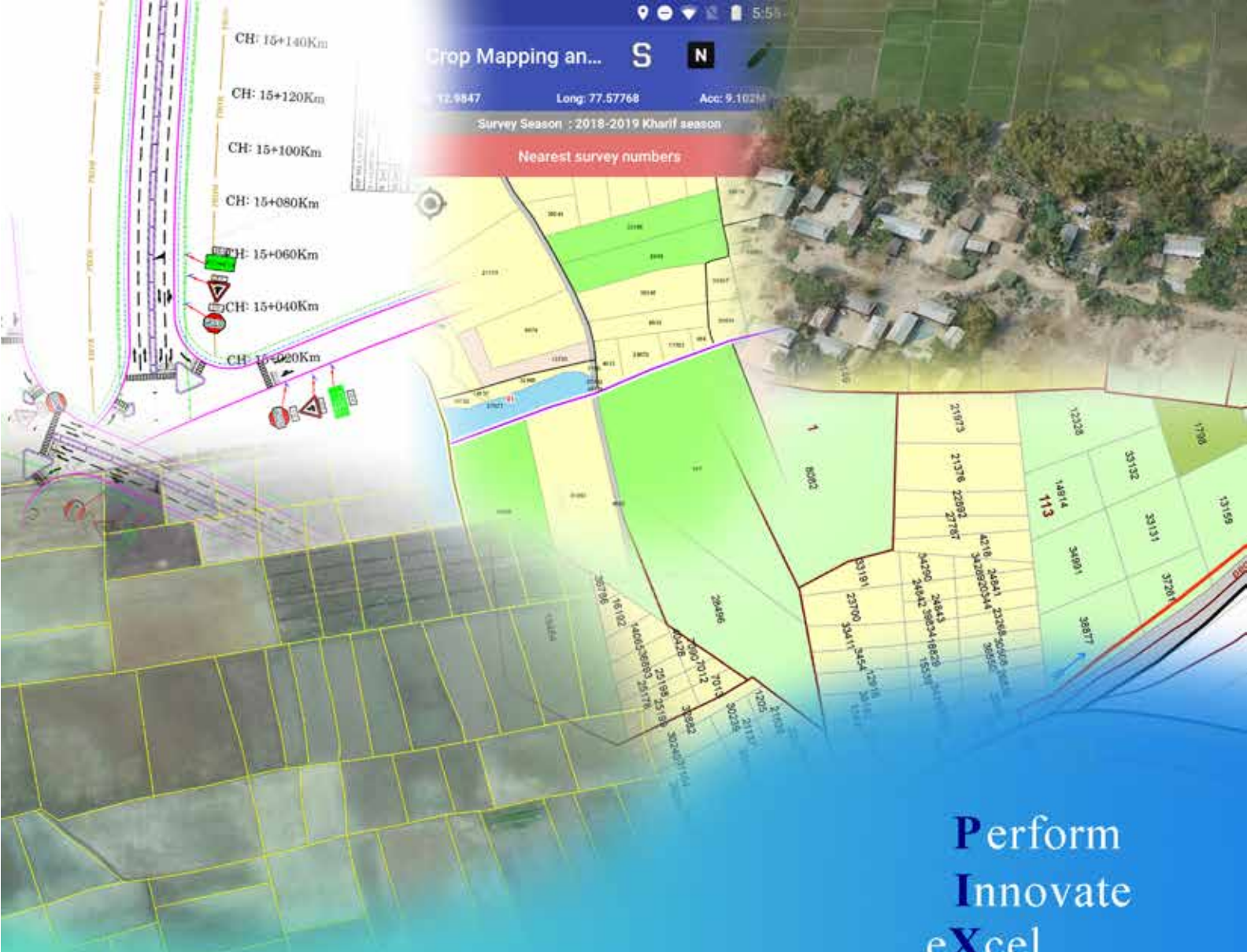
Integrating disruptive technologies into solutions

Constant innovation has been the key mantra to empower ourselves to be more responsive towards technological advancements. This is also reflected in our successful customer-centric implementations over our two-decade journey as a geospatial company. All our products and solutions are a blend of technologies like GIS, IoT, Mobile and Web technologies, but we continue to further their functions and capabilities through research and development in the arena of computer vision, machine learning and Augmented Reality.

We focus on integrating disruptive technologies into our solutions, wherever relevant, to provide the most value to the customer and end-user. Most of the issues and roadblocks towards sustainable living can be solved through geospatial data. Innovations in the domain of processing this data and identifying the answers that address the roadblocks to sustainability will be key in the future.

PIXEL SOFTEK is working in the agricultural and water resources domain to provide geospatial solutions that help optimize processes, reduce waste and increase productivity. Our grassroots approach in building the solution for our customers ensures that the benefits of these technologies reach the common man. 🌱

Importance of location intelligence is more than ever for businesses or individuals in this digital age



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MAX POLYAKOV
CEO, EOS DATA ANALYTICS

Most Global Processes Today have Become Geospatial Data-Driven

Geospatial technology, much like digitalization, has had its ups and downs, and is currently booming. Advances in cloud computing and mobile technology, its affordability and accessibility have provided a powerful computing resource. The Big Data revolution and bulks of invaluable geo-data going public have further scaled up the geospatial expansion across governments, public agencies and businesses. We are at a point where most global processes have become geospatial data-driven. GIS tech is leveraged

to entry in tech — we are likely to see a lot of such innovations coming in the near future.

Success lies in combining technologies

Technologies are a fine matter that requires balance, as there's always a risk of having technology for technology's sake. Artificial intelligence, deep learning, IoT — these are not buzzwords, but biz-words today. They push the geospatial industry forward, both through the use of single methods within the technology or by using the combination, i.e. data fusion. We believe that the combination

On the macro scale, we are considering a shift towards both vertical integration in the economic value chain and a horizontal integration in terms of strategic partnerships development and implementation of joint projects.

Real-time data analytics is going to be the key asset

In times to come, real-time data analytics is going to be the key asset in creating solutions for prevention of damage to the natural resources. The IoT industry will grow, enabling us to better understand the environment and effectively manage the non-renewable resources.

With more powerful future satellite sensors and increased imaging capacity, we'll be able to scan deep within the earth, beyond the 5-cm depth, and gain some literally in-depth insights. This goes in accord with EOS' motto: "we are listening to the pulse of the planet!"

One of digitalization's key enablers is fast and reliable decision-making. So is data accessibility, which propels technology growth and calls forth market demand. Even then, only 5% of imagery collected by Earth observation satellites is being utilized (despite open access). There are still barriers left to overcome in making remote sensing "a thing for everyone."

EOS is one of the companies set to drive this change as soon as possible. We are developing methods of analysis and simplify access to geospatial data, trying to shape a brand-new industry. 🌐

One of the key enablers of digitalization is fast and reliable decision-making. So is data accessibility, which propels technology growth and market demand

by businesses to generate more insights and drive more revenues; geospatial empowers the UNO and environmental organizations of any scale in achieving the overarching missions of fighting poverty, reducing the human impact on climate, protecting health. It is the public need that's pushing the development of geospatial towards digitalization.

The geospatial industry today is centered around two things: data generation and data analysis, which enable the creation of full-value products and services for end users. Product integrity and completeness are shaping the process of technology development, and considering the lowering barriers

of technologies is the key to creation of new successful products. Globally, there are two clearly visible trends: consolidation of market players and vertical integration, along with creation of a synergy by combining different types of data (optical, radar data, LiDAR, etc.) to increase the accuracy of provided solutions.

EOS Data Analytics company aims to hold focus on data processing and creation of relevant tools, and is already working on the combined analytical solutions, which will embrace data of various formats and from different sources. Additionally, mutual integration of services for processing, storing, visualizing and analyzing this data will allow us to create a synergy.

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analysis workflows



Build Time series with historical
imagery to see changes over time



Use Comparison tool, 3D view,
Contrast stretching and more

We are Moving into a Geo-Aware World



KANWAR CHADHA

EXECUTIVE CHAIRMAN, BINATONE GLOBAL & HUBBLE CONNECTED

FOUNDER SIRF & INOVI

Geospatial technologies are certainly becoming a default part of the digitalization process that the world is undergoing. As we move towards a future that is powered by smart homes, communities, cities, roads, autonomous mobility, etc. machine-readable geospatial information becomes an essential element of its ecosystem, and every element will become geospatially tagged. We are gradually becoming a more “geo-aware” world where geospatial technologies are combined with location technologies. This convergence is supported and accelerated by artificial intelligence, data science and analytics to provide real-time geoinformation. The “geo-aware world” of the future requires integration of multiple technology platforms. Geospatial companies that form collaborations based on open platforms will succeed in future.

The geospatial industry is going through a massive transformation and companies will have to link themselves to some of the core elements of these disruptions. Companies that can focus on developing solutions or elements of collaborative solutions for smart cities, autonomous vehicles, IoT connected enterprises, autonomous delivery, etc. will thrive. AI-driven data analytics, on-demand machine-readable geospatial information, accurate location awareness, ability to sort through massive amount of data generated by smart sensors in real time are some of the technologies that companies need to invest in.

How to be future-ready

The industry will have to adopt to the changing needs of the future. Many technologies and systems that sufficiently address the current requirements, may not be fit for future applications. For example, at present, many mass consumer-centric applications are empowered by visual maps which allow for easy human interpretation, while the same resolution of granularity of maps may not be useful for autonomous cars. The cars of the future will need HD and machine-readable maps. Companies need to be constantly aware of the upcoming changes in the ecosystem and ready themselves for them accordingly to make the best of such opportunities.

The application of location analytics for businesses and consumer applications has grown rapidly. Recently, it has received a lot of coverage, some of which has been negative, especially in terms of regulatory non-compliance and data privacy-related concerns. However, that is also typically the sign of a technology becoming popular and successful, since it is only once a technology has been accepted and is being used in our daily lives, do we seriously begin to assess its positives and negatives. We have to collectively figure out how to address these concerns and transform the negatives into positives.

Data privacy and protection

Since location is one of the most sensitive types of user data, its protection and anonymity is of utmost importance. Location technologies, just like any other line of technologies, offer values to its users along with some inherent challenges. With the recent episodes of location data misuse, there is a rising clamor among the public for tighter regulations for its access and distribution.

The industry is concerned that regulators may even go overboard in creating stringent regulations to pacify the concerned users, which may eventually suppress innovation in this sector. It is therefore imperative for the industry to clearly articulate the benefits of using location intelligence vis-à-vis the challenges that it poses, and take concrete action to address those challenges. It should diligently work with all major stakeholder such as user-groups, data providers, regulatory authorities, etc. to develop a conducive environment for its sustained delivery value to the users.

The geospatial industry is going through a massive transformation and companies will have to link themselves to some of the core elements of these disruptions

Geospatial technologies will play a crucial role in enabling sustainable living as well. However, it is not one technology, but a combination of technologies that will drive towards a more sustainable world. For example, autonomous vehicles will make driving more efficient and safer, they would require smart sensors, accurate location, geospatial information, and ability to process and analyze enormous amounts of data in real time. Artificial intelligence will enable us to generate geospatial information more efficiently and process the data generated by “geo-aware” smart sensors more efficiently. 🌐

Geospatial a Foundational Technology for our Data-Driven Future

One to two decades ago, geography was a arguably a craft, practised by a relatively few seasoned professionals with their roots in the physical world, serving similarly experienced users. The era of digitization marked the rise of new suppliers, users and use cases in the industry. However, it was still dominated by big and deep-pocketed players, both as buyers and suppliers. Government, military, construction, transportation, etc. were the major drivers of demand.

In the last 5-10 years, the barriers to entry and to experimentation have collapsed. As a result, we are seeing increased geospatial innovation and geo-applications reaching new industries. The level of aware-

We are likely to see the opportunity to attract more incubation support, venture capital and private equity into the industry – further fueling innovations

ness of the value of geospatial technologies has greatly improved, and geographical information has moved from being a niche interest to being a vital input to whole new industries, such as targeted and personalized marketing and advertising.

The rapid urbanization and technological advancements of the last few years, and the indications of change to come, have the potential to truly transform where and how we live, move, interact and transact, with geospatial technologies having a big role to play in this transformation. It is highly unlikely that these advances will mature without mining, milling and matching mass data. We are moving towards a data-driven world, data will drive value. The different datasets being generated from different sources, despite being disparate, will connect through a common thread of location. This common reference point of location is what makes geospatial such a foundational technology for our data-driven future.

Easy access and delivery of data

One of the key breakthroughs for mainstreaming of the geospatial industry is the easy access and delivery of data. Digitization of geospatial data and its easy access formats have been instrumental in transforming this industry and taking it to 'the masses'. As a result, we see an exponential increase in the supply and application of geospatial data, fuelling a plethora of 'location-based' or 'geo-aware' services.

The geospatial industry has to find ways to penetrate more and more applications that power the human world of the day, and simultaneously innovate to drive the machines of tomorrow. In order to become one of the rightful drivers of the fourth industrial revolution, we have to actively invest in R&D and collaborations to embrace emerging technologies such as big data, IoT, artificial intelligence, etc. Defining the standards for a 'connected world', continued development of 'digital twins', innovating with AI-driven services are some of the aspects that have huge importance.

Next phase of evolution

Although the awareness and acceptance of geospatial technologies has significantly improved, we need to prepare ourselves for the next phase of evolution and democratization of geospatial data. It will require us to establish better collaborations within the industry on standards and how to contribute and strengthen the digital economy of the future. Geospatial technologies can no longer function in a silo, we have to play the role of an enabler, a truly fundamental enabler.

At the same time, we must be mindful of the opportunities to assist the developing nations, apply our collective capabilities to help local economies and hasten delivery of the Sustainable Development Goals.

With all the growth the geospatial industry has witnessed and the realisation of its fundamental value, investors have started taking interest and are scouting for opportunities. We are therefore likely to see the opportunity to attract more incubation support, venture capital and private equity into the industry — further fuelling innovation and the expansion of our community. This is good news for us, and great news for downstream users, hungry for the geospatial data they now realise is a fundamental fuel for the new industrial wave. 🌐



NIGEL CLIFFORD
FORMER CEO, ORDNANCE SURVEY, UK

Significance of Place is Not Just Assumed Now, It's Expected

Geospatial information and technologies now underpin decision-making within businesses, governments, and society worldwide. The transformation of the geospatial industry over the past few decades has been dramatic with today's disruptive technology advancements further hastening the pace of change. The ubiquitous and near real-time generation and application of information from billions of location-aware devices operating in our digital society is rapidly making universal location context the norm. The ability of businesses, governments, citizens, and consumers to access and leverage the 'significance of place' is not just assumed — it's expected.

Ushering a disruptive change

Clearly, the momentum is building rapidly for government and business sectors to apply location to better understand their customers' needs and to drive mission efficiency. Major business sectors are embracing location information and technology as essential for mission success. The Insurance sector, for example, is leveraging

geospatial information to better understand and assess policy risk and to respond responsibly to policyholders when losses occur. Further, with the proliferation of web-accessible Earth Observation platforms overhead and in-situ, and mobile sensor and Internet-Of-Things (IoT) devices observing our environment, there is great potential for the insurance industry to further improve policy value and risk reduction by augmenting actuarial data with customized analytics relevant to the policyholder and their location.

Along with IoT, advancements in machine learning and artificial intelligence; augmented & virtual reality; modeling, forecasting & prediction; and connected & autonomous vehicles are all on the forefront of disruptive change. As these and other trends are addressed by the technology community and implemented for the benefit of businesses, governments, and citizens, we must also place equal emphasis on addressing key challenges, such as a lack of technology interoperability, concerns about data privacy and ownership, and cybersecurity risks, if we are to assure the quality and reliability of future products and services.

Open standards and effective policies

The advancement and availability of timely and effective open standards, along with effective policies that support their broad opera-

The ubiquitous and near real-time generation and application of information from billions of location-aware devices operating in our digital society is rapidly making universal location context the norm

tional use, will be major factors in assuring the ability to rapidly and efficiently mobilize and integrate new and emerging technologies, information sources, and workflows into systems and enterprises. Considering today's rapid pace of technological change, OGC is working closely with an expanding list of partner programs, associations, Consortia and Standards Development Organizations, such as the World Wide Web Consortium (W3C), the buildingSMART Alliance, and various technical committees within ISO, IEEE and ITU. These alliances enable OGC to assure that location is consistently represented throughout the IT standards stack, to affirm that standards work remains well coordinated, and to broaden our collective ability to help different user communities benefit from the standards and related best practices that OGC and its partners produce.

I am consistently impressed with the advancements that the geospatial industry achieves, and I am equally excited at the opportunities ahead for continued adoption of geospatial technologies across new industries and governments worldwide. With an understanding that much more work lies ahead, we as an industry should be proud of the contributions that our work is making to improve governance, business, and citizen value. 🌍



MARK E. REICHARDT

PRESIDENT & CEO

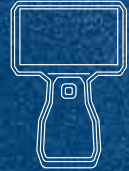
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DMITRY LOSKUTOV
DIRECTOR GENERAL, GLAVKOSMOS

Space Exploration Connected to Enhancing Quality of Life on Earth

Space exploration has always been concomitant with the goal of enhancing the quality of life on Earth and facilitating human development.

It is obvious that today any progress in space exploration or achievement of ambitious goals is hardly possible without international cooperation from both financial and technological point of view. Therefore, only by consolidating our efforts, we will be able to achieve goals no less ambitious than those that were confronted by the pioneers of cosmonautics.

The major task of Glavkosmos is to promote the achievements of the Russian space industry in the world market. We plan to expand the number of the countries we collaborate with in regions such as South-East Asia, Latin America, and Africa.

We have also entered into a cooperation that involves liaison between Russian space companies and the Emirates side in implementing the program on selection, training and space flight of the UAE's first astronaut to the International Space Station (ISS).

Human spaceflight mission

Human spaceflights are the most important part of the Russian Space Program, the significance of which became even greater in 2011 when the US closed the Space Shuttle Program. At present, human flights to the ISS are supported exclusively by Russian Soyuz space vehicles.

As for the upcoming NASA missions, we recognize the progress

of SpaceX and Boeing in development of manned space vehicles. Besides, China is rapidly working on its human spaceflight program as it is experienced in operating its own orbital station. India and other countries also have such plans for the coming years. We welcome such developments and healthy competition that encourage progress, just as any other peaceful activities in space for the benefit of humanity.

By the way, we have had very productive preparatory negotiations in Moscow recently between the ISRO delegation and the top management of Roscosmos, Glavkosmos, and NPO Energomash — manufacturer of the best rocket engines in the world. We hope that Russian-Indian cooperation in a number of areas will turn into a practical plane.

Further, the expected expansion of the Russian segment at the ISS (a Multipurpose Laboratory Module will be added in 2020 and a docking and power modules in 2022) will provide more free space inside to attract tourists and will allow to enlarge the areas and quantity of experiments held on the space station.

Creation of a new human spaceship, *Federation*, is underway. The ship is expected to be ready by the test campaign of the new Soyuz-5 launcher, the flight tests of which are scheduled for 2023.

Innovating to stay ahead

Despite the emerging reusable rockets and small launchers, the market still demands a safe and constant access to space.

Soyuz-2 launcher is one of the most reliable vehicles in the world. The Fregat upper stage enables complicated cluster missions with payload delivering to up to three different orbits within one launch. It gives the customers a competitive advantage in the launch price compared to super-light launchers due to the economy-of-scale effect:

It is obvious that today any progress in space exploration or achievement of ambitious goals is hardly possible without international cooperation from both financial and technological point of view

the average cost of orbiting one satellite in a cluster is significantly lower than the cost of a dedicated launch of the same. With its high performance, Soyuz is capable to deploy large constellations of small satellites within one launch.

Along with that, we continue efforts in Soyuz-2 improvements to make the launches more cost-efficient.

Future of space exploration

In the next 20 years there will appear some national stations on the lunar surface and they will be serviced mainly by robots. There will be national, and probably private, habitable stations in the lunar orbit, and next on Mars. The development trends will be focused on exploration of asteroids for mining natural resources, private space cargo transportation, space tourism, and space medicine. 🌍

Data is Turning into Commodity

For many years, earth observation and satellite data has been used primarily for research purposes or by the military for strategic missions. However, in the last few years, this has changed dramatically with commercial satellites being launched in constellations, giving assurance that a lucrative business case can be built upon a steady and assured supply of imagery.

Again, in the early days, imagery was made on film and expert photogrammetrists would inspect the images and interpret them for intelligence signals. Now, all imagery is digital and becomes much more accessible and importantly tractable by computers. Thus, earth observation has not only joined the digital world and but has also become an integral part of it.

Data is the king

Although we are already seeing better sensors and more open data beginning to come from governments, there is room for growth. Data is gradually turning into a commodity. No matter what the platform (satellite,

aircraft, drone, crowd, or in-situ measurements) data is the king. The digitalization imagery data was only the beginning of the story. The real transformation is being catalyzed by substantive improvements in storage and processing capabilities which have become cheaper and more performant. It is no longer necessary to move large volumes of data around all the time, or to make deep investments in analytics engines.

Artificial intelligence is helping make sense of the large volumes of data which we seek. This opens up new possibilities where more automated processing becomes possible and new business models spring up to cater for this new market. Companies must also prepare to adapt as the market moves towards on-line services and the previous consultancy model becomes a niche market for some experts to work in.

Policy and technology go hand-in-hand

EARSC is a trade association with the mission to foster the development of the European geospatial services business. We play the role of an enabler and do our best to follow technological trends but more important are the policy trends in Europe because we believe both go hand in hand. We engage with the EC and the European Parliament to understand priorities and to influence the shape of future legislation.

Artificial intelligence is helping to make sense of the large volumes of data which we seek. This opens up new possibilities where more automated processing becomes possible

As the trend towards on-line services accelerates, we are establishing a marketplace through which member companies can sell their services. It is a promotional tool called eoMALL where just like the physical shopping malls, companies can set-up their shops which sell services. It is like a very sophisticated store-guide which helps customers find the services which they are looking for, and at the same time allows sellers (service providers) to promote their offers in many different ways in order to attract and keep customers. eoMALL is just becoming operational and it will be very interesting to see over the next two years if this assertion is correct.

The next big theme for EARSC is to try to increase the success of research ideas being translated into business ventures. 🌐



GEOFF SAWYER

SECRETARY GENERAL

EUROPEAN ASSOCIATION OF REMOTE SENSING COMPANIES

Modern Maps are Providing Deeper Insights into the World Around Us

Maps have been a medium for people to communicate for many years. The information provided on maps was based on what was known (or sometimes unknown) at that point in time. Through the years, maps have evolved into a more powerful communication tool to help provide context and understanding.

With more information available than ever before, which can provide more context and refined understanding of the questions we ask, modern “maps” are providing deeper insights into the world around us. These maps are far from traditional maps that once described where topological features were in the world; these geospatial informational displays can connect people, deliver real-time information, and provide augmented experiences to help drive deeper understanding.

Cloud, open source and hybrid systems — key to future relevancy

With more and more data getting processed in modern IT architectures and third party Clouds, Cloud-native geospatial is key to the future relevancy of our domain. Next, most businesses and organizations are adopting open source as a foundational element of their IT/business missions. Loosely coupled architectures, joined together through open technology standards and APIs, are key to maximizing how best technologies can work together.

We have taken the best of open source and packaged and delivered it in a way that it is not only solving traditional geospatial problems, but modern IT problems of scalability and interoperability as well. Providing a modern platform to IT departments that can quickly enable their location information workflows is the sweet spot of our technology. We see a whole new horizon for these organizations to better understand and make more informed decisions by analyzing streams of information on the fly, building processes on top of that information in real-time, and making timely decisions to what the information is communicating to the organization. 🌐



ANDY DEARING

CEO, BOUNDLESS

Democratizing Access to Location Intelligence

It has become clear across every industry that the highest-growth companies out there put location first, and we are now entering an era where location intelligence is not only limited to early adopters in Silicon Valley (e.g. Google, Uber, Amazon), but also opening up to a much wider range of players (e.g. telecommunications, energy and utilities, financial services).

Today, however, only 10% of the data with location component is being used in business decision-making, which is definitely something we see in the digitalization process of the different enterprises we

work with. There is a big discrepancy between what the C-suite think about their use of geospatial analysis vs what the front-line analysts think. In many cases, geospatial is still seen as a niche category limited to a handful of GIS experts. In order to go beyond that and open up the power of spatial analysis to a wider range of business users (e.g. in marketing, finance, innovation, operations) geospatial software has to become more user-friendly. This means moving towards “lower-code” environments that make it simple to create and share location intelligence applications around an organization, bringing in always-on data streams in the Cloud.

Sustainability with location data

Location data is driving politics and policy and geospatial has a fundamental role to play in some of the world’s biggest challenges. This could be anything from measuring overpopulation with satellite imagery, to reducing traffic using mobile or GPS data or measuring the impact of climate change with climatological data. Geospatial is undoubtedly a key driver for driving innovation around data-driven policy making.

Location-aware AI and deep learning have the advantage of drawing on features at or near that location or a history of events there. IoT is providing countless measurements associated with locations. By combining these together with other relevant data sources, data scientists are helping cities, businesses, autonomous vehicles, and more to make better, more-informed decisions. 🌐



JAVIER DE LA TORRE

FOUNDER & CHIEF STRATEGY OFFICER

CARTO

Integration Key to Growth



Due to mobility based devices, as well as GPS mobile phones, instant geo-location is now available to most of us. This has created an environment to assemble large volumes of geospatial and location data that allows us to analyze data and trends more efficiently.

WILLY GOVENDER CEO, DATA WORLD

Integration of technologies is key to growth. We see the world of APIs being the future where anyone can use the APIs to derive accurate analysis quicker and easier.

It is necessary for organizations to keep in touch with technology trends and embrace the need to change and adapt new business models. 🌐

Partner with Innovators

It's crucial for any business to stay on top of technology trends and partner with innovators in the space to figure out how disruptive forces will impact it. This way it can get ahead of the curve. Understanding this, the infrastructure sector is largely adopting location as an important element of the process of digitalization. In the construction world, everything built and left behind as location is coordinating finished products beautifully.

For a brighter future, the company is putting a significant amount of money in AI, computer vision and predictive analytics. 🌐



MATT MAN CO-FOUNDER & CEO
CONSTRUCTION INTELLIGENCE SERVICE, INDUS.AI

Solving Complex Data



Geocoding is the means to connect all digital information of the world. Geospatial is the best way to make massive information, even literal or digital data, in good correlation, and driving the diversified information globally. With more and more technologies paving our

LILY XU
CEO, SPACEWILL

way, integration is the only way to growth.

In future, AI and deep learning will bring more efficiency to remote sensing applications. Satellite data will continue to be the upper stream resource of the industry, and Space-Will will keep the position as a main satellite data channel to serve the industry. 🌐

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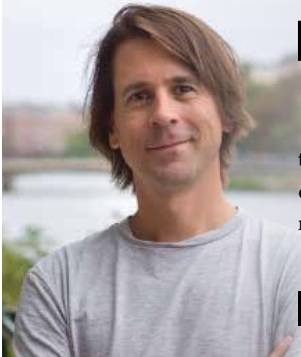
Data Access to Users Must

Many firms are creating geospatially driven apps. A majority of people use Google maps as a ground reference map. However, there is an entire world of additional geospatial databases online which have tremendous potential for application to important user issues, but are 100% unavailable to the common user.

The major barrier to practical use of geospatial data is the unavailability of the data to the common user. GeoG2 is a geospatial data company trying to transform the industry. We are a disruptive element breaking access barriers that will leave our imagery competitors (satellites, drones, etc.) by the wayside. 🌐

KEVIN SPRY FOUNDER, GEOG2 SOLUTIONS

Fixing Maps with Computer Vision



The world in itself is changing rapidly — streets are undergoing massive changes as a direct result of urbanization. This means that the pressure on geospatial tools to keep up has increased. Collecting geospatial data manually doesn't allow for the speed that is now needed, considering how fast cities and streets change.

Mapillary allows anyone to capture map data

at scale and have it automatically analyzed with artificial intelligence. Using simple tools like mobile phones or action cameras, anyone can capture images of the streets they need to access map data from, before having the imagery automatically analyzed with computer vision. This allows GIS professionals with quicker access to data, slashing costs significantly. 🌐

JAN ERIK SOLEM CO-FOUNDER AND CEO, MAPILLARY



Handling Real World Problems

The geospatial industry is creating opportunities through its products by giving widespread access to them.

We take these products and

craft geospatial solutions to real world problems. We can do this meaningfully because we understand that location plays an important role under many circumstances and we are able to demonstrate this by utilizing the powerful GIS products now available. Like others in this field, we constantly upgrade our skills and finetune our strategies as the market evolves. 🌐

DR MANOSI LAHIRI FOUNDER, ML INFOMAP

Drones: Cheap Data

The geospatial industry is set to undergo a paradigm shift in areas such as GIS, earth observation and, scanning with the advent of drone-based analytical solutions. The main beneficiaries of this shift are enterprises that have large assets and projects that are distributed across a wide territory.

Drones will drive down the cost of geospatial data and more enterprises will be able to tap into geospatial information about their assets on demand. As the cost of the hardware continues to decrease and new age solutions make drone-based data acquisition more scalable and smarter, there will come a time when geospatial intelligence will be a fraction of the cost compared to traditional geospatial tools of data collection. 🌐

MUGHLIAN THIRU SWAMY
CEO, SKYLARK DRONES



Invest More in Software



The world is undergoing a massive digitalization process and geospatial is accounting for about 75% of this transformation. New markets entrants and startups are currently at the forefront of digitalization process. Technological advancements are useless unless they solve a concrete customer problem. To stay relevant in this disruptive environment, the industry needs to focus on end-to-end solutions.

The geospatial industry is seeing an ongoing shift to cloud-based data processing (e.g. photogrammetric calculations), implementation of deep learning algorithms. With new technologies like AI, machine learning etc. gaining more relevance, we see ourselves playing an integrator role by implementing these technologies into our customers' workflows. 🌐

MARIAN MEIER-ANDRAE | CEO, MULTIROTOR

More Data for Analytics

More data to analyze can bring to smarter conclusions. This can make the world more sustainable. As a young start-up we are as agile and resilient as can be! We are contributing to the digitalization process by enabling the user to choose what to do with their data and to give them the tools to universally integrating that to their wishes, without forcing them to make use of certain data formats or software. The whole process is done by linking systems, companies, data and positions through a universal Cloud platform.

From professional-only use to everyday use of geospatial data for everyone, MarXact is ready for the future, ready to make everyone use geospatial data. 🌐



TOMMY VAN DER HEIJDEN | CEO, MARXACT

Be Open to Build Partnerships



Coordinates are the universal building blocks of our planet. In a digitized world, the only way to build a 'Digital Twin' is by using location. The geospatial industry has extensive knowledge of digital mapping and location intelligence.

From sensor to aerospace to IoT, people are collecting data, in terms of both rational and experience. We use AI and deep learning to improve the quality of information and have achieved fantastic results.

Acknowledging that our industry and our business is a small player in the digital world, we should be open to learn across domains, build partnerships to participate in the new arena where location is now part of main-stream IT. 🌐

WOUTER BROKX | PRESIDENT, IMAGEM



THIS IS WHY
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Opportunities for Geospatial Industries in the Age of Location

The year 2018 saw a rapid acceleration of the processes by which geospatial technologies and applications became increasingly central to societies all over the world. What has been called “The Age of Location” is now most firmly established. For some time it has become increasingly obvious that the geospatial industries are facing unprecedented changes. Traditional approaches are no longer adequate to deal with the new situation where location based data and information have become increasingly central to industries which have never considered themselves to be part of the geospatial family. Geospatial is not “special” anymore as it has become increasingly obvious over the last several years. Industry observers like David Schell and others have been drawing attention to this for some time but 2018 saw a rapid increase in the pace of change.

Geospatial industries exploding with new opportunities

For the geospatial industry, the increasing centrality of location to everyday life is both a challenge and an opportunity. If industries which have never seriously used geospatial technologies before now enter the market place, will this lead to a decline in the market share of what was a market in which the geospatial industries were previously dominant? My answer to this is a definite no. Geospatial industries are now more relevant than ever in a market that is exploding with new opportunities created by the central importance of location.

What is required, however, is an imaginative and agile response to these new opportunities including the development of new partnerships. Some years ago Sir Tim Berners Lee, a pioneer in the development of the World Wide Web was asked what the future of the Web might be. He responded that there were two major directions and challenges for the future. The first was the challenge of linking disparate data sets and the second was the creation of innovative display techniques by which the results of these linkages could be more effectively used and distributed. Both of these are areas where the geospatial industry has particular strengths and opportunities. This is especially the case with the geospatial services industry sector but opportunities exist for the industry as a whole.

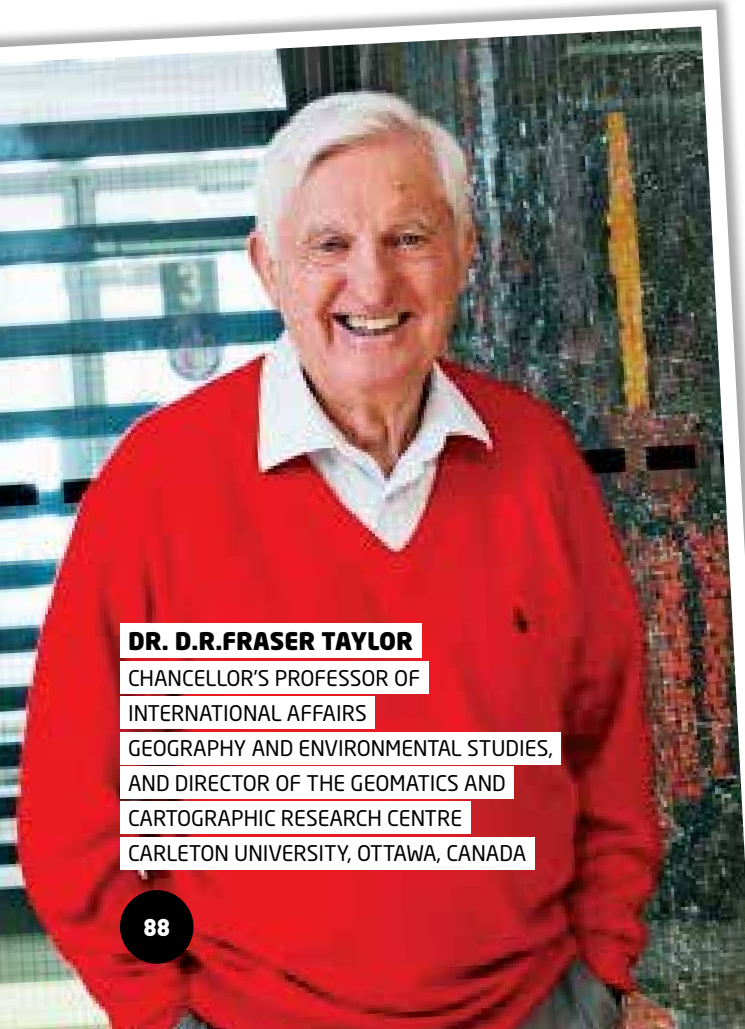
Interoperability is essential

Interoperability is now “the flavour of the month” and this involves much more than simply making different data sets easier to discover. There is a need to develop and model what has been called a “data ecosystem” which is seen as “... a complex system of international data resources, technology, funding, human and machine actors and other components” (Pulsifer 2018). New approaches are needed to transform data to meet the needs of different users, what Peter Pulsifer calls “mediating”.

Geospatial industry players are in an ideal position to play this role which is a vital one if data is to be shared to meet the demands of an increasing number of user communities at a variety of scales from the personnel needs of individual consumers to the needs of industrial enterprises and those of both regional and national governments and other societal organizations. The market opportunities are virtually limitless but effectively identifying and responding to these opportunities is challenging. Both the Sensor Web and the Semantic Web are emerging concepts and the geospatial industries have a key role to play in shaping their growing emergence.

Complex interoperability exercises need attention

The interoperability challenge and opportunity is one to which a growing number of geospatial industry players is already responding but the second challenge, that of making the results of creating useful and more usable knowledge from complex interoperability exercises has not received the same degree of attention.



DR. D.R. FRASER TAYLOR

CHANCELLOR'S PROFESSOR OF
INTERNATIONAL AFFAIRS

GEOGRAPHY AND ENVIRONMENTAL STUDIES,

AND DIRECTOR OF THE GEOMATICS AND

CARTOGRAPHIC RESEARCH CENTRE

CARLETON UNIVERSITY, OTTAWA, CANADA

Human and computer interaction is the future need

The map is an ideal storage and display mechanism for all forms of interoperable data but what is required here are new forms of maps and related visualizations. The tendency of maps to be personalized, on demand, products, is now well established. Such maps are now ubiquitous at the personal level but the consumer is going to demand even more locationally referenced information than simple way-finding information. Here an increasing number of thematic data sets will have to be made more interoperable.

Effective display of this information on small screens is challenging as is the development of better user interfaces. Multimedia and multi-sensory approaches hold promise in this respect but although the technologies to create them exist the challenges of effectively integrating senses such as sound, touch and eventually both smell and taste remain to be overcome, new partnerships with Human Computer Interaction specialists will be required. Too many technological “bells and whistles” may lead to information overload and lack of effective communication.

Demand driven approaches are, of course not confined to the individual consumer. Many National Mapping Agencies are having to alter their business models from the more traditional supply driven approaches to ones which directly meet the priority needs of both governments and societies. Private sector demands for interoperable information displayed in innovative formats also presents opportunities for geospatial industries. Here we need a visual equivalent of the “one page memo” approach that presents complex information in an accurate but readily understandable form to inform corporate decision-making.

Cybercartographic atlas — a metaphor for all information linked by location

A major difference from the past is that we are now dealing with location based information which is a much more expansive source of information than the traditional geospatial ones. Geospatial industries may find themselves dealing with data sets that are not geospatial in nature.

Interoperability is ‘the flavor of the month’. This involves much more than making different data sets easier to discover. There is a need to develop a ‘data ecosystem’

Concepts such as Cybercartography can be useful in this respect. I define Cybercartography as “...a complex, holistic, user-centred process which applies location-

based technologies to the analysis of topics of interest to society and the presentation of the results in innovative ways through cybercartographic atlases. A cybercartographic atlas is a metaphor for all kind of qualitative and quantitative information linked by location and displayed in innovative, interactive, multimodal and multi-sensory formats.” (Taylor 2019)

The map is only one of a whole variety of presentation modes including complex visualizations and even “rap videos” such as that created by the youth of the small community of Arctic Bay in Nunavut in northern Canada entitled “Don’t Call Me Eskimo”. This is part of the Cybercartographic Atlas of Arctic Bay (<http://arcticbayatlas.org>) which presents many of the social and economic problems facing youth in Canada’s north in an interesting way.

Some years ago the problem facing geospatial industries was the availability of data. Now the problem is often the availability of too much data and the need to present “Big Data” in meaningful and useful fashions.

For the geospatial industries the pressing need is not for better hardware and software although these are of course important but the need for more innovative “brain ware” to take advantage of emerging and exciting opportunities. 🧠



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