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IT'S MORE THAN JUST A MAP

Innovations in location technology would fundamentally redefine human-machine interactions and create a new paradigm wherein location would be at the heart of automation. P 20

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Founder &
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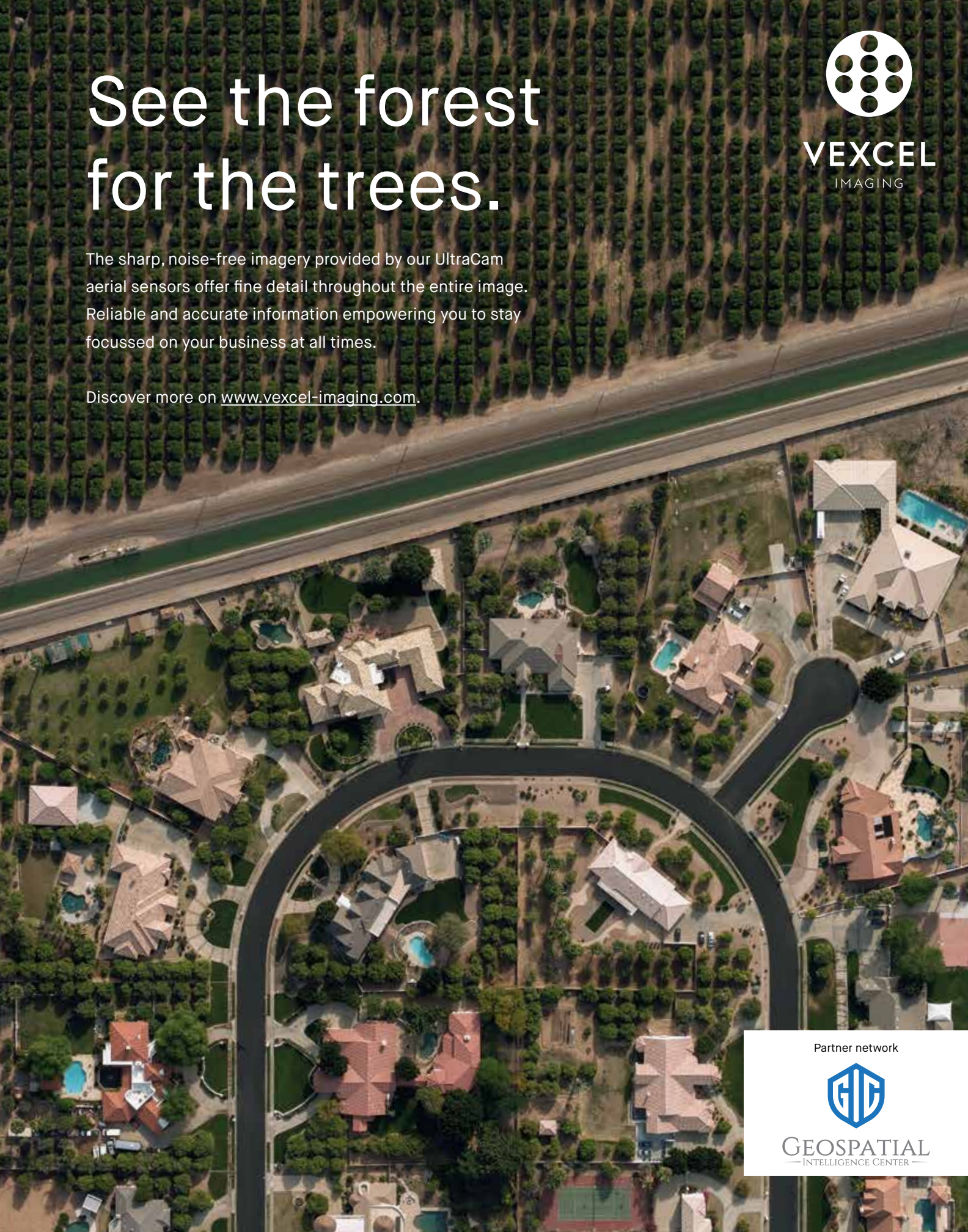
CARTO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Spatial Modeling will Become Fundamental to Business Decisions

Javier De La Torre
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LASER TECHNOLOGY INC

We Need Humans at the Center of Emerging Technologies

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

It is all about fabric, and not about textiles. The fabric here is invisible, but it ties together most of us, our possessions, our very lives. Early on, people referred to it as that formless, undetectable, immeasurable entity that brought light from distant celestial objects to us on Earth. Today, we call it electromagnetic waves, mathematically proved by James Maxwell, demonstrated in the laboratory by Jagadish Bose and practically demonstrated to the world by Guglielmo Marconi. What was a wonder in the early part of the 20th Century continues to amaze us in the 21st Century as well. Such is the power of electromagnetic waves and the ingenuity of humankind.

From that tragic day on board the Titanic, as its operator clicked out SOS on his wireless apparatus, to the 'Help Me' app on the smartphone of a lady in distress, electromagnetic waves have wrought wonders. Samuel Morse was prescient when he clicked out "What hath God wrought" on the first demonstration of his invention, the Telegraph. Alexander Graham Bell was more practical with his telephone when he said, "Mr Watson, Come here. I need you".

That 'here' has become the driving force of the marriage of wireless communications and geospatial systems. The offsprings of this marriage, among others, are location and Internet of Things. Today, we cannot think of 'where' and 'here' of geospatial without the connectivity provided by wireless communication systems. It all started with wired LANS and MANs, before graduating to wireless WANS. And then came the Internet, GRID and Cloud and cellular networks. The name of the game is bandwidth. From simple voice telephony of 1G, we rapidly moved through the numbers and are now at 5G, with 6G peeping over the horizon. Geospatial is all about graphics and graphics need bandwidth. Therefore, it is not surprising that location and IoT have taken to cellular like a duck to water.

Both applications need mobile, reliable and always-on connectivity. Location has moved much beyond finding POI. Indoor location is making waves and targeted advertisement based on individuals' location and preferences is one of the less desirable outcomes. Location borders dangerously on invasion of privacy and worse. IoT, location and real-time sensing are 'driving' cars into uncharted areas. While it is great to sit back in your car and relax while machines and AI do their job, it is that occasion, when they fail, that worries the prospective owner. Whose liability is it, the owners, the manufactures or the software developers? This dilemma is perhaps best illustrated by the Boeing 737 MAX MCAS system where it was just software automation, not artificial intelligence, that overrode human control with disastrous results.

So can we blindly put our trust on artificial intelligence and automation to do things while we are busy doing what computers and automation cannot do? The answer is a qualified no. Going back to the self-driving cars, is there an answer to the oft-quoted dilemma, whom to hit in an unavoidable accident situation: a senior citizen or a mother and child? There are ethical issues that go well beyond just hardware and software, beyond IoT and geospatial. Can a human ever be replaced in such situations? Have we ever heard of ethical robots?

As technology gallops on, there is a need to sit back and consider such issues. Perhaps that is why smart cities have put "the citizen" at the center of their efforts. Even here, the danger is that the technology developer might think and design on the basis of an imagined perception of citizen needs. Putting the citizen at the center should mean that he/she becomes an active member of the design and not just a "passive beneficiary". This is not a radical new concept. Social workers have been using participatory methods since long, and in the realm of geospatial, Public Participatory GIS is a reality. Maybe one should turn smart cities to PP-SC to stress on the point that the citizen has to be at the center of things.

There are other issues too, beyond location and IoT, beyond self-driving cars and targeted advertisement. 5G has resulted in unexpected fallouts. It is interfering with weather satellites, which are trying to estimate water vapor content in the atmosphere. In Europe, tests of 5G were halted after an unusual number of bird fatalities in the test area. The fragility of our only home is under threat from climate change and global warming, and from "unbridled development". A recent UN study shows that 1 million species are under threat of extinction and the window is closing to safeguard biodiversity and a healthy planet. To what extent are modern geospatial technologies gearing up to deliver solutions to such problems? A study shows that the very areas where the danger is high are also the ones where geospatial readiness is low. This is an indicator of where the industry and governments must focus and bring to bear all the tricks and tools of the trade, be it AI, Cloud, IoT, ore location.

Mohandas Karamchand Gandhi, popularly referred to as Mahatma Gandhi, once said, "The world has enough for everyone's need, but not enough for everyone's greed." Can geospatial provide information to help us address this sentiment and sift need from greed?

People Should not do Things Technology can

People have an innate fear of things they don't understand. Artificial intelligence is just another tool that can have negative implications if not used properly, or is used with inherent biases, believes **Alexis Hannah Smith,** Founder and CEO, IMGeospatial

How did you conceive IMGeospatial and what was your vision when you set it up?

I conceived IMGeospatial like any good business, out of solving a problem. A water utility company in the UK, Anglian Water, needed a way of understanding the pluvial hazard of its infrastructure and asked me to look at it. In doing this, I realized there was a gap in the market in surveying large areas of the world and understanding change when it had occurred, cost-effectively. That's where it all began.

My vision at the time, and now, is to enable organizations and enterprises to solve problems via intelligent use of data, across a multitude of sectors, not just water, but insurance, automotive, NGOs and more, with a focus on creating positive societal change.

Tell us a bit about how IMGeospatial came into being, its initial years and current business models.

IMGeospatial came about following the initial project with the water utility company in the U.K., Anglian Water, where we enabled them to understand the pluvial hazard of their infrastructure, cost effectively.

When we first started out, IMGeospatial was at the forefront of extracting features and has developed and grown from there. Over a few years, the technology and our understanding of what we can achieve has evolved along with the data that goes into flood modelling and all types of data that's now tied together with geospatial; digesting, distilling and disseminating the data pipeline for automated business intelligence.

Currently, we sell a variety of different data products which are outputted from clever tech to solve problems. For a water utility this might be around leakage, finding loss within a water system; for an insurance company it might be about understanding the under insurance problem within their customer portfolio; and for NGOs geospatial data can enable them to understand change efficiently and effectively – not change as in a time series of earth observation data, but change on the ground; ensuring there's no bias, that change with open data is understood and correctly adopted when it needs to be, and if there is malicious change that data is not adopted. Our work with the World Bank in Tanzania, understanding population density over scale, enables planners and people on the ground to do their jobs in a better and faster manner.

What is your leadership style?

My leadership style is empowering, I give people around me the power to make decisions. As Steve Jobs famously said, it doesn't make sense to hire smart people and tell them what to do. My skill is getting the right people in the room and empowering them, which enables us to collectively achieve what we need to.

My leadership style is also rooted in how I approach solving problems. In some cases data that's one hundred percent accurate may lead to the best academic solution but not necessarily the best business solution, they're very different things.

IMGeospatial calls itself an automated business intelligence provider. Business intelligence relies on a slew of emerging technologies like artificial intelligence and machine learning. How do you differentiate between business intelligence and automated business intelligence?

The difference between business intelligence and automated business intelligence is the latter enables data to be processed with

Photo Courtesy: www.imgeospatial.com

zero human intervention. The knock-on effect of this is significant savings in time and cost for our clients and their customers, which we're hugely excited to be leading the way with.

IMGeospatial's automated business intelligence is a completely automated data pipeline that can digest, distil and disseminate data without any human intervention.

With AI and machine learning, you often have a lot of people drawing boxes around polygons or doing certain things within the pipeline. These people may be looking at, for instance, earth observation data, sourcing data and manually loading it into a system, the system will then process it for people to manually take that data and do something with it.

Now, people might be scared thinking that the human resources element of our industry will disappear. But that shouldn't be a concern because the amount of data that will be needed to create a digital twin is overwhelming. If you are trying to digest all the data for the entire world every day, you would need a huge amount of people to carry out quality assurance of that data.

You use data from a wide array of sources. Do you encounter any difficulties while collecting and analysing these datasets?

We make computers develop an automated data pipeline with datasets, which means structuring data in a way that computers can use it and of course that's not easy. A good example is earth observation data. You need Cloud-free data that is normalised in a way that you can interact with certain places. Data needs to be used within a certain time period, it must be the right data in the right resolution and getting a computer to understand that is incredibly hard.

The cleverness in what we do is not in the processing bit. The cleverness is in finding ways to solve problems that generally humans face, like how to decide which parts of images to use and which not to, or how to decide when you need data and when you don't. How do you get computers to decide all these kinds of things without human intervention? Now that's clever.

How do you ensure cost effectiveness while using artificial intelligence, machine learning and algorithms at this stage?

Like geospatial, artificial intelligence is a sector and there are so many technologies that we use within geospatial, it's the same with AI. We do a variety of different things in smarter ways to ensure that we don't have huge overheads. What we can do is create our own datasets using our technology to help solve problems. It's important how you structure data or input and how you show data on the output.

So, in the way we think and approach things, we can go up against, or at least stand next to some of the bigger players in our industry without the £75 million ($98.4 million) investment, by just looking at the problem in a slightly different way and tackling it in an automated manner.

Would the use of AI in drones boost accuracy of analytics and increase the role of drones in capturing data?

Absolutely, using AI in drones can definitely boost accuracy of analytics and increase the role of drones in data capture; there are people already doing things in this area. It's important to consider how to structure the data that the drone is capturing, ensure it is used with the right control points and then ingested.

When we did a program with the World Bank in Zanzibar, we found the issue was not about what we can do with data, but how the data was captured. There was a problem in the standardisation of data, its interoperability and output. In situations likes these, IMGeospatial comes into the picture because we are very good at understanding what is really happening and forecasting what is going to happen.

What is the main deterrent to mass adoption of AI-based models and business intelligence?

People have an inherent fear of machines. When trains were invented, people were scared to ride them. It's the same with AI, people have an innate fear of things they don't understand. AI is just another tool, like a train or a plane; it can have negative implications if it's not used properly or used with inherent biases. If you don't have a diverse group of people with different gender, background, sexuality and ethnicity involved in the design, building and implementation of AI, then it will be biased. Businesses supporting diversity and collaboration, involving everybody and not being insular, is incredibly important for the long-term and the success of AI in general.

How do you ensure seamless delivery of high precision data analytics in your land use classification tools that are primarily built for the insurance sector?

A lot of hard work goes in to ensuring a seamless delivery of high precision data analytics across all of our products. We are constantly monitoring our performance, identifying areas for improvement and applying learnings as we move forward. A good example of this was a project where we had to identify leakage within the water system for a company and our automated system appeared to be confusing how the data was being digested. It occurred because we were picking data from irrigation networks that the water company wanted to know anyway, which was a scenario that we learned from.

What are the opportunities and challenges facing the business intelligence sector?

There are huge opportunities within the business intelligence sector. What's really exciting is people from different sectors being involved which casts a fresh perspective on our outputs. We have a diverse group of people at IMGeospatial with different backgrounds from different geographical locations working in a collaborative way, together and with many other businesses.

I had some very interesting conversations at the Geospatial World Forum 2019 about how we can use our intelligence with a Trimble device or Esri software. Instead of working against each other, if we start working together and trust each other a bit more, we might be able to deliver and solve some of the biggest problems in the world. That is what excites and motivates us at IMGeospatial.

There is a huge mismatch between the pace of profusion of data and the pace at which data analytics capability is getting refined. Then there are soaring customer expectations. What is the way around and the way forward?

We are doing well in our ability to digest, distil, disseminate and use the data; the issue, really, is people not fully understanding how all of this can be used. In the same way, like we have had a digital transformation in the past 20 years wherein people started to use computers and integrate things, they should be doing the same from a geo-transformation point of view; that is, looking to benefit industry at large, across multiple business sectors, rather than for solving one problem. This would result in a massive increase in business efficiency and lead to huge cost savings. Now, whether it is a standard GIS system or something more disruptive like what we are doing, or perhaps a collaboration of these things, remains to be seen.

To find out more about IMGeospatial
visit www.imgeospatial.com


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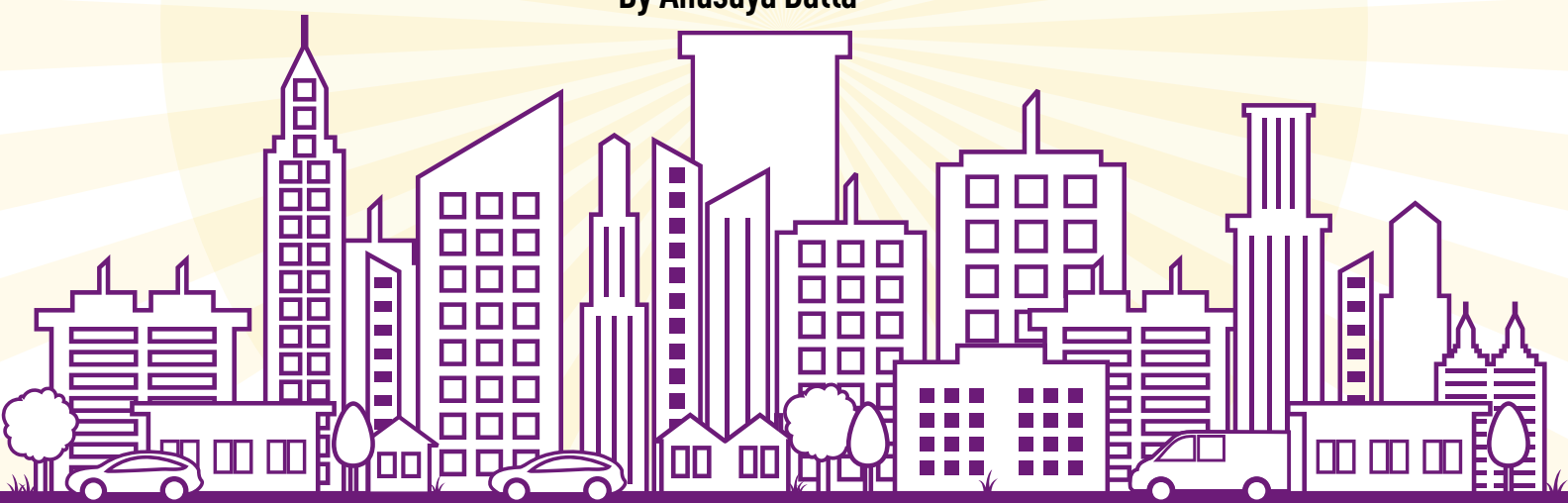
5G POWERING FUTURE CITIES

As the world gets smarter and more connected, 5G and geospatial will together be powering cities of the future.

By Anusuya Datta



Multiple Sensors Connected

High Speed on-the go Connectivity

Prioritization, Enhanced Reliability

Extremely Low Power Consumption

Half of the world's population lives in cities, a proportion that is expected to increase to 68% by 2050. As our urban ecosystems grow ever larger, technology has the potential to dramatically improve the lives of those living in them. With the onset of digitalization and the Fourth Industrial Revolution radically changing how we live work and interact, the biggest impact will be felt on our cities. As challenges like population pressure, deforestation, traffic congestion, deteriorating infrastructure, crime and resource crunch impact cities the world over, smart city innovations couldn't have come at a better time. Smart cities may save the world as much as $22 trillion by 2050, according to the Global Commission on Economy & Climate.

Accurate geospatial information helps governments design better cities, improve public services and engage with citizens. Urbanization of the future will be driven by geospatial data and location would be a crucial component in digitalization of cities. And as cities get smarter, much of this location data has to be in real time. This is where geospatial and 5G converge. 5G and geospatial will together be powering cities of the future.

"5G will act as the connective tissue of tomorrow's digital economy, linking everything from smartphones to wireless sensors to industrial robots and self-driving cars," says **Malcolm Johnson, Deputy Secretary General, International Telecommunication Union (ITU)**. Together they

are the critical link for a smart, interconnected world, bringing the next level of connectivity to industries and society that helps in shaping digital cities.

Besides powering data at unbelievably fast rates, the coverage density of 5G is a hundred times greater than current standards. 5G can connect up to 1 million devices per sq km; its low latency and incredible speed and bandwidth will bring in the ubiquitous connectivity required by the smart city ecosystem.

What is 5G?

5G is the short form for 'fifth generation mobile network', and is quite unlike any of the previous generations in a way that it is unlikely to be defined by any single technology. Often referred to as "the network of networks" because of the way it will bind together multiple existing and future standards, including the current LTE 4G networks, 5G will be way more fast and reliable with greater carrying capacity.

5G will accelerate the move towards digital as a transformative ecosystem that combines Big Data and Cloud, virtualization and augmentation, automation and intelligent machines, distributed computing and artificial intelligence, to derive insights from data that is generated by billions of connected devices.

Of course, 5G doesn't exist alone and will be majorly driven by the ongoing sensor revolution and the move towards a connected world. According to **Jeff Glueck, CEO, Foursquare**, "For 5G we need a multi-sensor approach. It is important to add the human element on the physical element for innovation."

As sensors get smaller, they are getting more and more ubiquitous. From smartphones to cameras, wearable devices to platforms like social media, crowd sensing technologies are increasing at an incredible pace. The number of connected devices worldwide is forecast to grow to almost 31 billion by 2020, according to Statista. The total installed base of Internet of Things (IoT) connected devices is projected to amount to 75.44 billion worldwide by 2025, a fivefold increase in 10 years.

"Multiple sensors are adding to more dynamic data coming from all quarters, drowning the whole world in a pool of data. You need more dynamic technologies to handle this data," underlines **Christopher De Preter, Chief Sales Officer, Hexagon Geospatial**.

"5G will make networks several times faster, increase network capacity, open possibilities to cover not only dense built-up territories in cities but suburbs and villages, and will really unlock the potential of IoT and smart cities development, connecting all people and all things," says **Dr. Volodymyr Kolinko, CEO, Visicom**, a Ukraine-based geodata provider company.

5G and smart cities

The expansion of 5G technology is one of the keys to smart city development. 5G will help make smart sustainable cities a reality, underlines Johnson.

An Accenture study had earlier estimated that modernizing rules around 5G small cells could unlock additional $100 billion in US economy. The connectivity and computing capacity unleashed by these high-speed wireless networks will bring the power of smart city solutions even to municipalities, transforming local economies. Smart city solutions applied to management of vehicle traffic and electrical grids could produce $160 billion in benefits and savings through reductions in energy usage, traffic congestion and fuel costs. These 5G attributes will enable cities to reduce commute time, improve public safety and generate significant smart grid efficiencies.

"In the nearest future, a huge amount of various devices will be available online, providing multimedia services, alternate/augmented realities and IoT solutions. Such innovations are already featured in many aspects of human activities; further they will become part of our ordinary life: transport, energetics, healthcare, manufacturing, business, public safety etc," adds Dr Kolinko.

As artificial intelligence and machine learning capabilities become common, data analytics will have perhaps the most significant impact on 5G/smart city development. There are some incredible usages of AI-enabled solutions that are already in use. One perfect example is how the New York City Fire Department does predictive analytics to mine Big Data flowing in 7,500 nodal points across 17 different data streams. The department then assigns fire risk scores to over 1 million buildings across the city. The aim is to prevent frequent fire mishaps in the city.

Geospatial and 5G

"Geospatial insight is key to planning for 5G network for unprecedented speed. It will expedite the process of site selection, design and asset management, providing immersive, overlay and point cloud view for decision making," explains **Frank Paulie, CEO, Cyclomedia.**

5G's higher frequencies — which is needed to carry huge amounts of data — have a very short range which can be impacted by smallest of the obstructions. The signal is so sensitive that it can be blocked by the palm of your hand, or even a raindrop. 5G will also require denser telecom network — more towers placed selectively and strategically. Therefore, accurate, authoritative geospatial data is fundamental here to plan network towers.

Further, because of the sensitivity of radio waves, it is necessary to have detailed maps — buildings with roof features, pipes, air conditioners, spires, sloping roofs, and even vegetation which also can affect signal propagation.

5G wireless promises higher capacity, more reliability, lower latency and improved coverage, thus bringing greater accuracy in positioning services, since telecom-based positioning technologies require telecom towers to be synchronized to nanoseconds relative to each other.

5G will also usher in new technology trends that will significantly impact the overall mobile network architecture, thus influencing the traditional positioning concepts as well. With location becoming fundamental to governance and all business process, the value of location-based services for industries such as advertising and marketing, transportation, retail, will only increase, since the 5G rollout and its subsequent expansion will enable more mobile interaction opportunities.

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WHICH IS THE MOST GEOSPATIAL READY COUNTRY IN THE WORLD?

While developed nations like the US and UK reap the benefits of adopting geospatial technology, their developing counterparts need to cover a lot of ground, shows the latest edition of Countries Geospatial Readiness Index. **By Dr Satarupa Bhattacharjee Kapoor & Ananya Narain**

The United States of America and the United Kingdom have retained their position as the top two geospatial-ready countries, followed by Germany in the third edition of the Countries Geospatial Readiness Index (CGRI 2019). While countries like the Netherlands, Canada and Denmark have improved their rankings in the last two years, China, Singapore and Switzerland have slipped to lower positions.

Countries Geospatial Readiness Index (CGRI) 2019

As we move towards the Fourth Industrial Revolution, which will be powered by several new technologies, the significance of geospatial technology will only grow. It is, therefore, important for countries to adopt geospatial tools in this digital era. With the growing need for a combination of niche technologies (artificial intelligence, Internet of Things, Big Data, machine learning and geospatial technology), both developing and developed countries must assess their level of preparedness in adopting geospatial technology. A nation's position on Geospatial Readiness Index is based on a comprehensive study of parameters that are crucial for policymakers to take informed decisions.

In the latest edition of CGRI, the scope of the study has been expanded to 75 countries (+25 from CGRI 2018). The study evaluates the geospatial preparedness of these 75 nations based on five parameters: data infrastructure, policy framework (geospatial and enabling), institutional capacity (education), user adoption and geospatial industry fabric (innovation, incubation and accelerators, and capacity).

The top ten rankings indicate that the Global North is leading, while countries in Asia-Pacific lag behind — only Singapore and China feature in the top ten. The other three regions, Middle East & Central Asia, Africa & South America, and Caribbean, are still "aspiring" to improve their tally.

Country	Rank 2019	Rank 2018
United States of America	1	1
United Kingdom	2	2
Germany	3	3
The Netherlands	4	5
Canada	5	7
Denmark	6	8
China	7	6
Singapore	8	4
Belgium	9	11
Switzerland	10	9

Green indicates improvement in raking, red shows fall, and yellow highlights no change

Regional Overview

As is evident, the **United States of America** retains its top spot for the third consecutive year, making it the most geospatial-ready country since 2017. From a regional perspective, owing to USA's 1st position and Canada's 5th position (up two places from CGRI-18), the North America region continues to dominate the regional geospatial readiness for third straight year. Even though Mexico and Costa Rica rank relatively low globally, these countries are taking several initiatives to become geospatial-ready.

USA has a rich heritage of having highest scale thematic layers (1:200-1:1,250) such as cadastral, topography, utility network, transport network, among others, with almost a monthly update. Additionally, the country is a leader in earth observation (EO) and has its own satellite-based positioning system, GPS, which is still unmatched by the rest of the world. While Canada closely follows USA, Mexico and Costa Rica, the two emerging markets, have been able to successfully begin their National Spatial Data Infrastructure (NSDI) journey in recent years. Further, to build up their EO data capabilities, these countries are signing cooperation agreements with space agencies across the globe (ISRO, CNES, NASA), highlighting the willingness to enhance their geospatial readiness.

The European region continues to occupy the second position in the regional assessment of geospatial readiness. Supported by integrated policy frameworks and mechanisms such as the INSPIRE Directive and the European Space Strategy, European countries continue to occupy 25 slots on the index.

The European Union's healthy approach towards the digital agenda is evident by its adoption of BIM (Building Information Modeling), a task group to transform the construction sector, National Research and Innovation Strategy 2020, and the Horizon 2020 Strategy. These initiatives contribute to the region's geospatial readiness and serve as the infrastructural backbone for geospatial advancement.

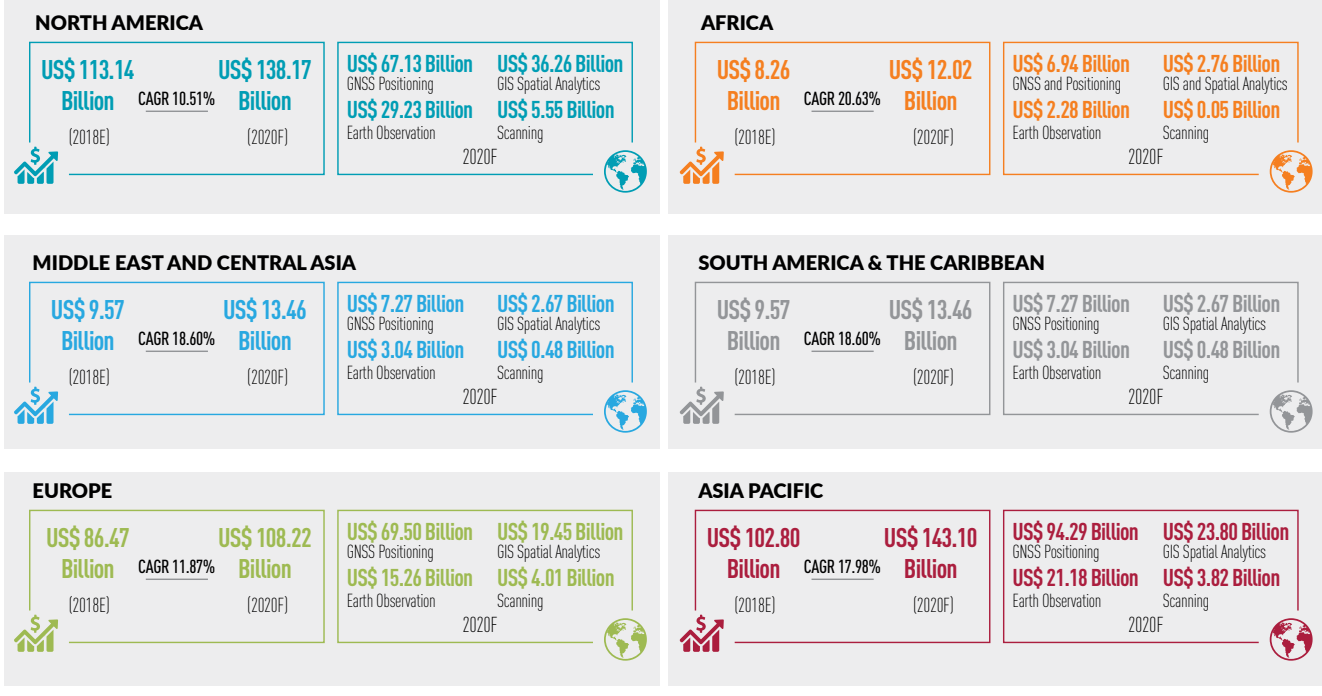
Further, the European Commission is focused on encouraging public-private partnerships as a new business model to remain competitive in the international market. The Commission's SME initiative, European Space Agency's (ESA) industrial policy and its business incubation centers are aimed at acknowledging the critical role of the private sector and the need for building a local industry.

The Asia-Pacific region is called "the engine" of the global economy as it continues to outdo its western peers with an above average GDP growth rate of 3% (and more!). As several Asian economies are working towards becoming the next "Silicon Valley", some of these countries have done exceptionally well in CGRI 2019. Of the total 16 countries assessed, seven, namely China, Singapore, Japan, South Korea, Australia, New Zealand and India, are among the top 25 on the index.

Almost all Asia-Pacific countries have been working with an intention to strengthen and improve their geospatial readiness through dedicated policy efforts. Indonesia was the first country in the world to pass the Geospatial Information Act in 2011 to create NSDI and promote spatial data sharing between government agencies.

In terms of EO capabilities, China and India are progressing fast in space research, having carried out memorable missions in space over the past two-three years. Many countries lack EO capabilities of their own, and hence collaborate with international space agencies such as JAXA, ISRO, ESA and NASA to acquire and disseminate data to businesses and citizens.

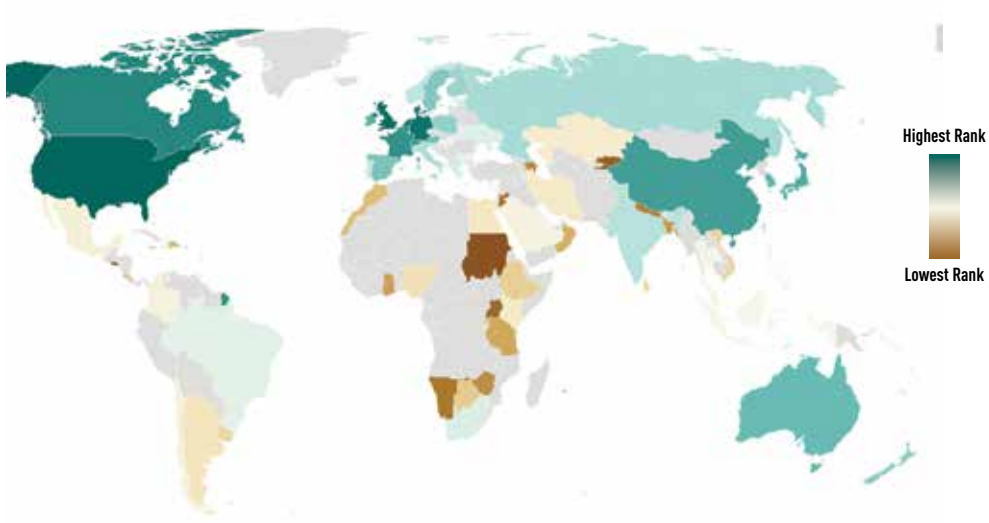
The technological advantage of the Asian economies is valuable due to the large number of courses being offered by institutes of these countries to develop geospatial-related capabilities. Almost 30% of institutes



Growth prospect of geospatial industry in different regions *Source: GeoBuiz 2019 Report*

LEADERS

Rank 2019	Country	CGRI- 2019 Score (0-100)
1	USA	100.00
2	United Kingdom	62.16
3	Germany	49.51
4	The Netherlands	47.03
5	Canada	44.45
6	Denmark	44.06
7	China	41.19
8	Singapore	41.16
9	Belgium	41.11
10	Switzerland	40.94



CHALLENGERS

Rank 2019	Country	CGRI- 2019 Score (0-100)
11	France	40.11
12	Japan	39.03
13	South Korea	38.70
14	Ireland	38.60
15	Australia	38.10
16	Austria	37.54
17	Sweden	37.14
18	Norway	36.82
19	Spain	36.79
20	New Zealand	35.77
21	Finland	35.54
22	Russia	35.27
23	Poland	35.18
24	Italy	34.12
25	India	31.91
26	Portugal	31.71

ASPIRERS

Rank 2019	Country	CGRI- 2019 Score (0-100)
27	Israel	26.90
28	UAE	26.50
29	Greece	26.20
30	Estonia	25.25
31	South Africa	24.42
32	Ukraine	23.62
33	Brazil	23.56

Rank 2019	Country	CGRI- 2019 Score (0-100)
34	Bulgaria	23.23
35	Hungary	22.68
36	Thailand	21.82
37	Philippines	20.17
38	Indonesia	19.94
39	Malaysia	19.66
40	Bahrain	18.65
41	Saudi Arabia	18.20
42	Colombia	16.84
43	Chile	16.32
44	Mexico	15.69
45	Brunei	15.47
46	Qatar	15.43
47	Kazakhstan	15.40
48	Kenya	15.09
49	Iran	14.98
50	Argentina	14.57
51	Egypt	14.43
52	Nigeria	14.21
53	Uruguay	13.53
54	Sri Lanka	13.46
55	Vietnam	13.32
56	Botswana	11.94
57	Ethiopia	11.89
58	Costa Rica	11.04
59	Rwanda	10.68
60	Morocco	10.53
61	Jamaica	10.38

assessed for the Geospatial Readiness Index are located in the Asia-Pacific region.

Meanwhile, the **African region** continues to hold the fourth position in terms of regional geospatial readiness. Barring South Africa, all other countries have performed rather poorly. While even South Africa has failed to make it to the top 30, Namibia, Uganda and Sudan feature at the bottom of the index at 70, 72 and 75, respectively. The scope for improvement for the Africa region in geospatial readiness is extremely high, though it is impossible to determine how long will these nations take to be fully geospatial-ready.

Under the African Union, the region has a defined common approach to NSDI, i.e. the African Regional Spatial Data Infrastructure (ARSDI) paradigm. However, not much is known about the initiative and its implementation structure. While South Africa, under the Spatial Data Infrastructure Act 2003, has set up its NSDI (SASDI), even after implementation, it figures somewhere between Stage I and II. The law is old, and the implementation guidelines do not conform to recent technology innovations. Further, the region also does not foster easy private sector participation, which is seen as one of the major challenges for these countries.

For the CGRI-19 Policy Framework, the African Space Policy and the African Space Strategy, by and for the African Union

countries, have been taken into account. Seen as an initiative by the region to construct a more efficient space infrastructure, the policy is well received from a geospatial readiness perspective. At present, South Africa, Egypt, Ghana and Nigeria are the major space players in the region.

An assessment of institutional capability of the African region reveals that the focus of universities in these countries is to offer diploma and short-term certificate programs in GIS and remote sensing that enable the workforce to be geospatial-ready quickly.

The **Middle East and Central Asia** region is among the most prolific users of geospatial solutions. However, as far as its readiness is concerned, it is still an aspirer on CGRI 2019. With the exception of Israel and UAE, all other countries in this region have so far underperformed.

Israel, UAE, Bahrain, Saudi Arabia and Qatar are the only countries that have a functional NSDI in place to facilitate easy access to spatial information and data. In Bahrain, for the implementation of the Bahrain Spatial Data Infrastructure (BSDI), a National GIS Steering Committee (NGISSC) has been established which has also formulated a Data Exchange Policy for this purpose.

In terms of the institutional capability, it is found that many countries in the region such as Azerbaijan, Oman, Kyrgyz Republic and Jordan do not have research-oriented geospatial courses or labs. The number of postgraduate and graduate courses is comparatively low, and the main focus is on certificate and diploma programs.

In the **South American and the Caribbean region,** Brazil is the only country that continues to excel since last two years, while the rest of the countries are at a moderately lower level of geospatial readiness spectrum.

Brazil, Colombia, Chile and Argentina are a few countries that have a functional NSDI at Stage I with limited effectiveness, i.e. lacking user engagement and uptake of geospatial information. These countries are also backed by policy mechanisms.

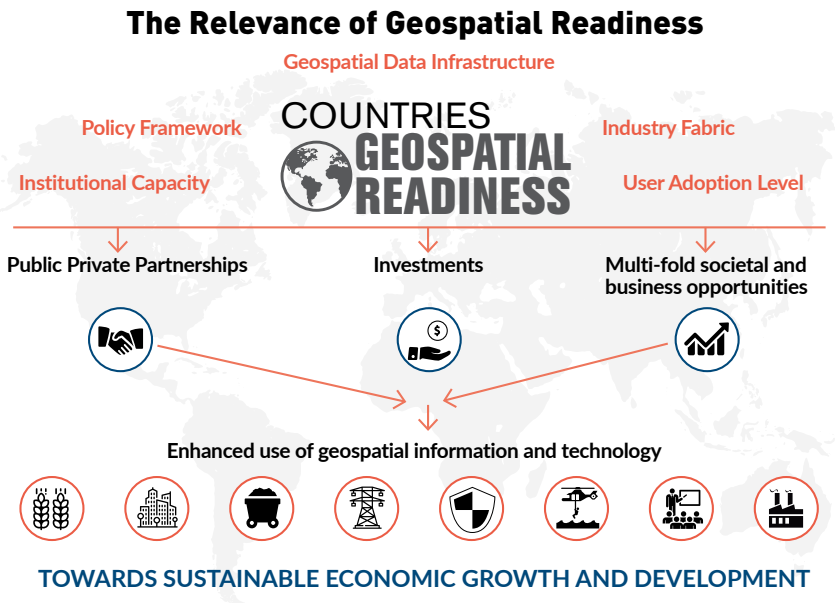
Jamaica, Dominican Republic and El Salvador rank extremely low on the Geospatial Readiness Index. While the El Salvador National Geographic Institute was one of the first to launch a Cloud-based map service, lack of data integration at high thematic layers reduces the country's overall score.

While universities in Brazil, Colombia, Chile and Argentina are focusing more on enhancing geospatial knowledge through postgraduate and graduate inter-disciplinary courses (more focused on GIS), the rest of the countries in the region are mostly offering certificate and diploma programs. These short-term courses are popular among students who want quick employment in the sector, but they do not enable innovation in the country, which in turn affects the growth of the local industry.

Further, the user adoption of geospatial solutions in the region is largely restricted to the public sector, which faces its own challenges.

Latin America has been witnessing steady economic growth, along with a growing understanding of the benefits of geospatial information and technology, which is attracting interests and investments from various multilateral organizations and core geospatial industry players.

The developed countries lead the Countries Geospatial Readiness Index (yet again!), consistently following an integrated approach on advancing geospatial technologies to priority economic sectors and delivering better geo-enabled services to citizens and/or consumers.



Conclusion

Many countries have started undertaking national geospatial readiness assessments to comprehend their strengths and weaknesses in the sector. Debates and discussions have already started at the national level to understand who shall take the leadership role — national geospatial organizations, policymakers, communities at the grassroots or local geospatial industry. Also, countries have begun to recognize the need for developing collaborative frameworks within the geospatial community to derive significant economic and other benefits.

Dr Satarupa Bhattacharjee Kapoor, Director, Market Research and Consultancy *satarupa@geospatialmedia.net*
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SPATIAL MODELING will become fundamental to BUSINESS DECISIONS

Understanding business in relation to space, understanding where things happen, why they happen there, and where and how they will happen in the future, will become an essential tool for planning in future, says **Javier De La Torre, Founder & Chief Strategy officer, CARTO**

Tell us about your journey from being a conservation scientist to a pioneer in location intelligence. How have the years been, starting from Vizzuality to CARTO, and why did you step aside as the CEO to take up the role of Chief Strategy Officer?

Mine isn't such a rare case; many colleagues in the geospatial industry come from the natural resources industry, especially from the research segment. I use to be a scientist working on biodiversity. We did a lot of spatial analysis and modeling. We had to work on large databases from many organizations. And working with spatial data over and over again was really hard.

The technology was just too complicated and you had to do a lot of work around it to analyze and visualize location data. I felt that was limiting the possibilities for awareness, so I decided to start Vizzuality to provide consulting services for conservation organizations. As we started working on deforestation — modeling endangered species and climate change — we ended up creating a lot of technology to serve different customers. One day we decided we had created enough to think about a product. That's how CARTO got started.

We knew the time was right with the availability of location data streams, new forms of analysis on machine learning and AI, and finally, a new audience that was requiring spatial analytics like never before. It turned out that modeling the location of species and that of retail customers wasn't too different, and there was a huge appetite by organizations to leverage the power that location intelligence could provide.

In January this year, after more than 10 years of functioning as the CEO of Vizzuality and then CARTO, I decided to step into the Chief Strategy Officer's role in order to prepare CARTO for its next phase of growth. We have had rapid progress in the past few years. In order to continue like this, it's important to bring in further expertise in scaling B2B SaaS companies, which Luis Sanz (our new CEO) has in abundance. The shift is also allowing me to focus on strategic partnerships, particularly in the technology and data streams field, which is proving to be a very exciting part of our strategy, with partnerships already in place with global players like Salesforce, Vodafone and Mastercard.

> We are heading towards a connected world where spatial models are running out of live feeds of data, testing new analysis, and informing us of a change on the space and our position

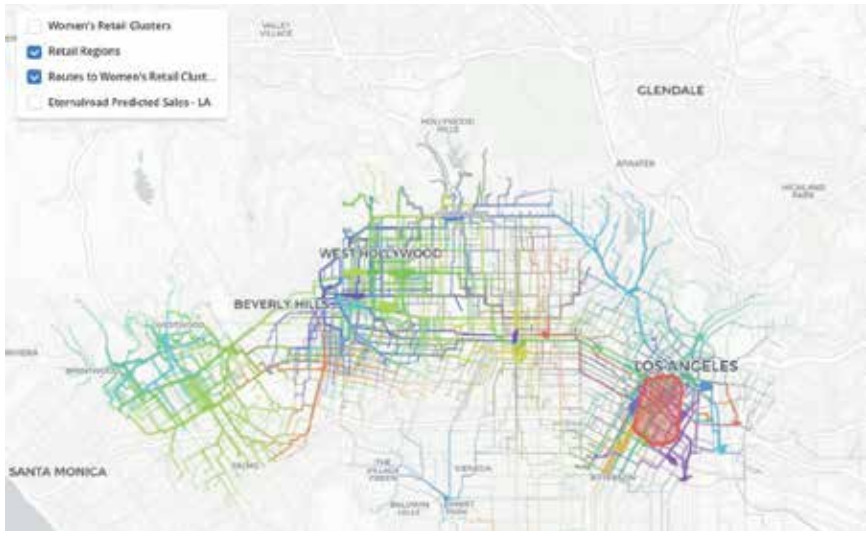
Location technology plays a big role in multiple fields. How do we ensure

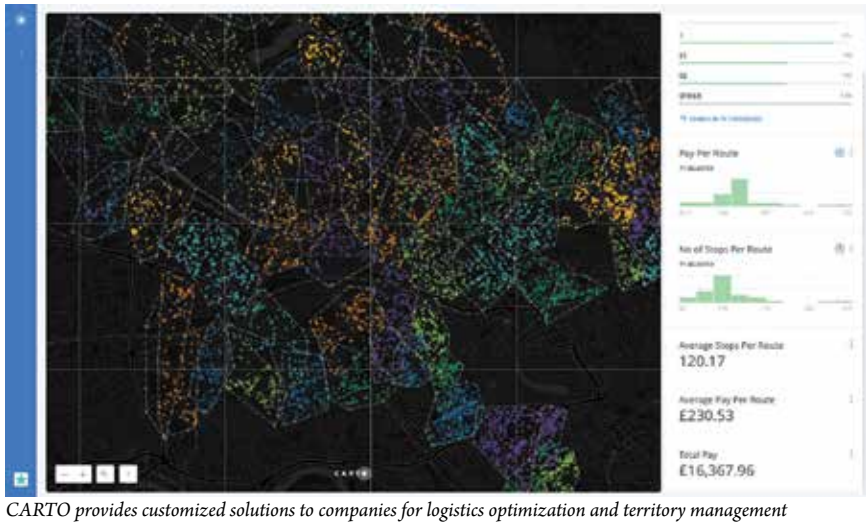
authentication of location data, and how do you foresee the future of location intelligence?

Location intelligence is going through evolution. There are three major disruptions going on in the industry: availability of new location data streams, new possibilities that machine learning and AI are bringing, and a strong demand from a new set of users. We are only starting to see the power of spatial analytics in this new era.

In the future, I can see how spatial modeling will become a fundamental asset of every business. Understanding business in relation to space, understanding where things happen, why they happen there, and where and how they will happen in the future, will be a fundamental tool for planning. I can see organizations asking many more 'what if' questions based on location.

From a technical perspective, I think we are going to see a connected world where spatial models are continuously running out of live feeds of data, testing new analysis, rechecking our assumptions, informing us early of a change on the space and our position. And that spatially aware world through spatial modeling is really exciting to me. We need it not only to improve our businesses, but also to understand how our environment and society are being impacted. I cannot think of a better moment for geography than now.





CARTO provides customized solutions to companies for logistics optimization and territory management

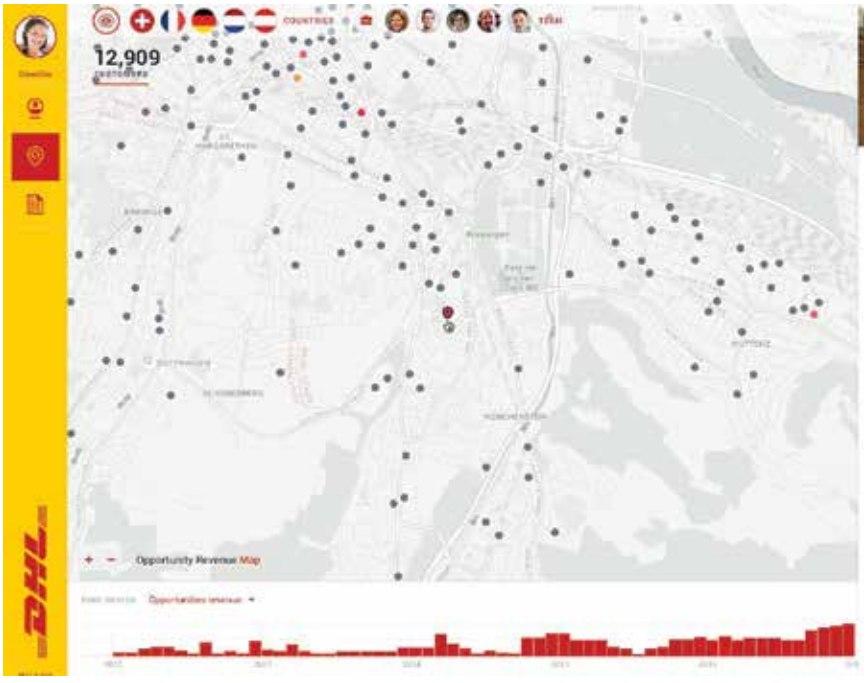
What's your take on the debate over data privacy?

There is a clear issue around privacy and access to personal data. I think that privacy and personal data need to be protected. But this issue is confusing a large part of our market. So many executives from different industries still think that location intelligence is synonymous to adtech targeting. Using demographic data, like government census or similar data obtained by other methods through aggregation and anonymization, is the key to help business and society. And we need to explain very well that the methods that we use while working with location data do not allow us to invade personal privacy. We will have to do that as an industry, with standards and education. From a business perspective, I don't think there is any way to create a successful business without caring about the issue of privacy. In CARTO, we don't offer, or process personal data to provide our service. Therefore, we do not support targeting use cases.

How does CARTO use location intelligence for smart logistics optimization and site planning?

Some of our largest clients use CARTO for logistics optimization and territory management. With e-commerce accelerating, these companies face big challenges when it comes to optimizing delivery networks, particularly in densely populated urban areas. DPD has used our solutions to test the spatial efficiency of new payment plans for drivers using historic delivery data, as well as analyzing new real estate opportunities to prioritize the rollout of a network of lockers around the UK.

When it comes to site planning, the problem is no longer about the expansion of strategies. The retailers who work with CARTO are focusing on new challenges concerning omnichannel and consolidation. In fact, two of our most innovative clients in the space actually started solely as e-commerce players. They have been leveraging their data alongside external data streams available through our platform (such as Mastercard's retail location insights) to drive decisions on where to open their very first store.



CARTO helps firms in mapping revenue opportunities through location analytics

How does CARTO ensure precise conversion of location data streams into actionable insights?

There are multiple answers to this question. First of all, we find that many organizations do not get insights from location data because it is just too hard to access. That's why we created CARTO Data Observatory — to make it super easy and convenient to find spatial data for analysis while working with our platform. It is incredible how many sources and intermediaries a company needs to work with to get access to data. It is even more amazing how much ETL (extract, transform and load) and pre-processing is needed to use it altogether. We simplify this a lot.

The second part is how we normalize, harmonize in scale and attach data to different topologies and geographies from multiple sources. This is a very tough job that requires a data scientist supervising the methodology and doing quality assessments when data gets added or updated.

What are the opportunities that can open up with seamless integration of business intelligence with AI and machine learning?

I believe the most interesting change we are seeing right now is continuously updating location data streams. This is enabling what we call "continuous modeling". Instead of running an analysis once a year, now, every time the underlying data changes, you can get notified about its impact to your model. This is game changing for me. In particular around AI and ML, we have seen already the potential for things like satellite imagery classifications, and therefore the new stream of feature datasets coming from space. In spatio-temporal datasets, we have seen entirely new ways of modeling. But one of the areas that is going to be even more disruptive is on the assistance to data scientist when creating models. Think of a GIS expert back in the day, working with 16 layers to create a spatial model. Now we can have thousands of layers available. We are going to see a lot of benefits on assisted advance analytics. In fact, we are already seeing them when using our own data observatory.

There are also challenges. With the explosion of usage and demand for spatial analytics, there is a risk of many "dumb" spatial models created automatically that are a black box or just do not perform. ML and AI can be of incredible help, but you have to use them with caution.

Big Data, AI and 5G would play a leading role in location analytics, and may even change the face of the location industry. Is the industry prepared for this disruption?

When it comes to Big Data, I think we are already in it — most product companies in the location industry are Big Data companies in a way. At the consumer level, the expectation is also clear that we all want smarter products and solutions. In the enterprise world, on the other hand, although huge investments have been made towards digital transformations, data-driven organizations are not as common as you would expect.

As far as 5G is concerned, it is hard to predict the impact. While we expect huge amounts of new data from the provision of services, we are already as an industry working with massive sources of data like those coming from cars. So I am not sure this will have such a great effect. What we know is that the deployment of 5G infrastructure will be a massive investment for telcos and that is a huge opportunity for us.

What should companies do to stay competitive and ensure commercial viability in a hyper-transforming location paradigm?

Interestingly, 80% of data now has a location component, but only 10% of it is actually being used. Smartphones, drones, connected cars, IoT, they are changing the game for a lot of industries. Companies that move fastest to recognize the power of location and adopt at the same pace as "location-first" companies like Amazon, Uber or Google, will reap the rewards.

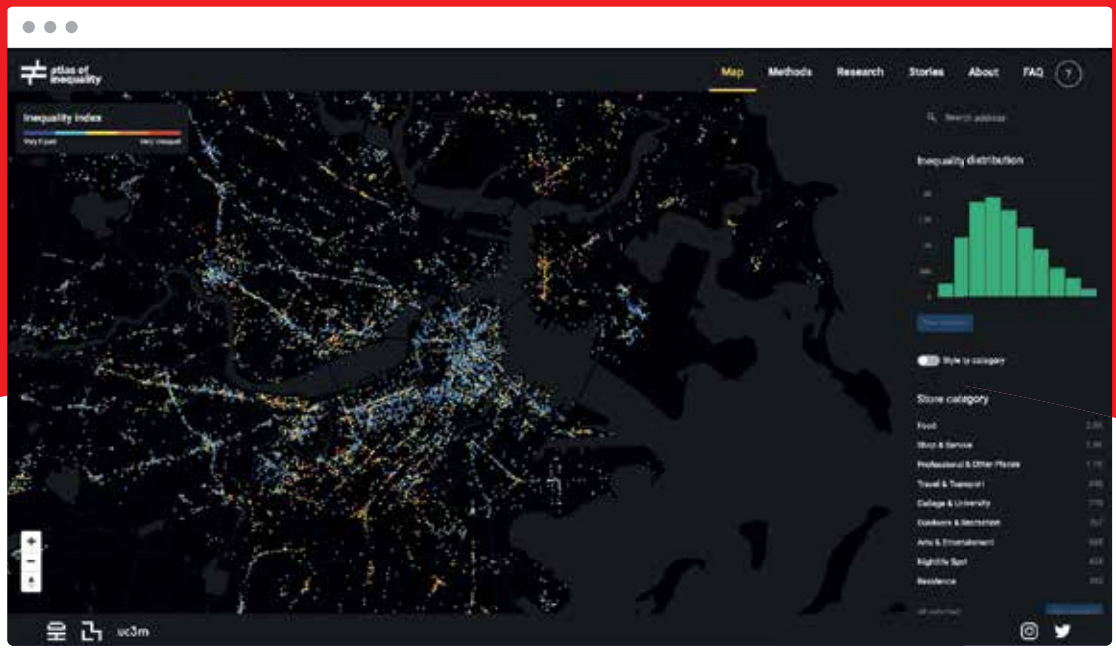
This means investing in location intelligence platforms, as well as hiring developers and data scientists who know how to deal with spatial data. If they can't do that, then they may need to find that capability externally. This is why many of our enterprise clients often require professional services to build their location.

CARTO

carto.com

Solve spatial problems with the best data and analysis

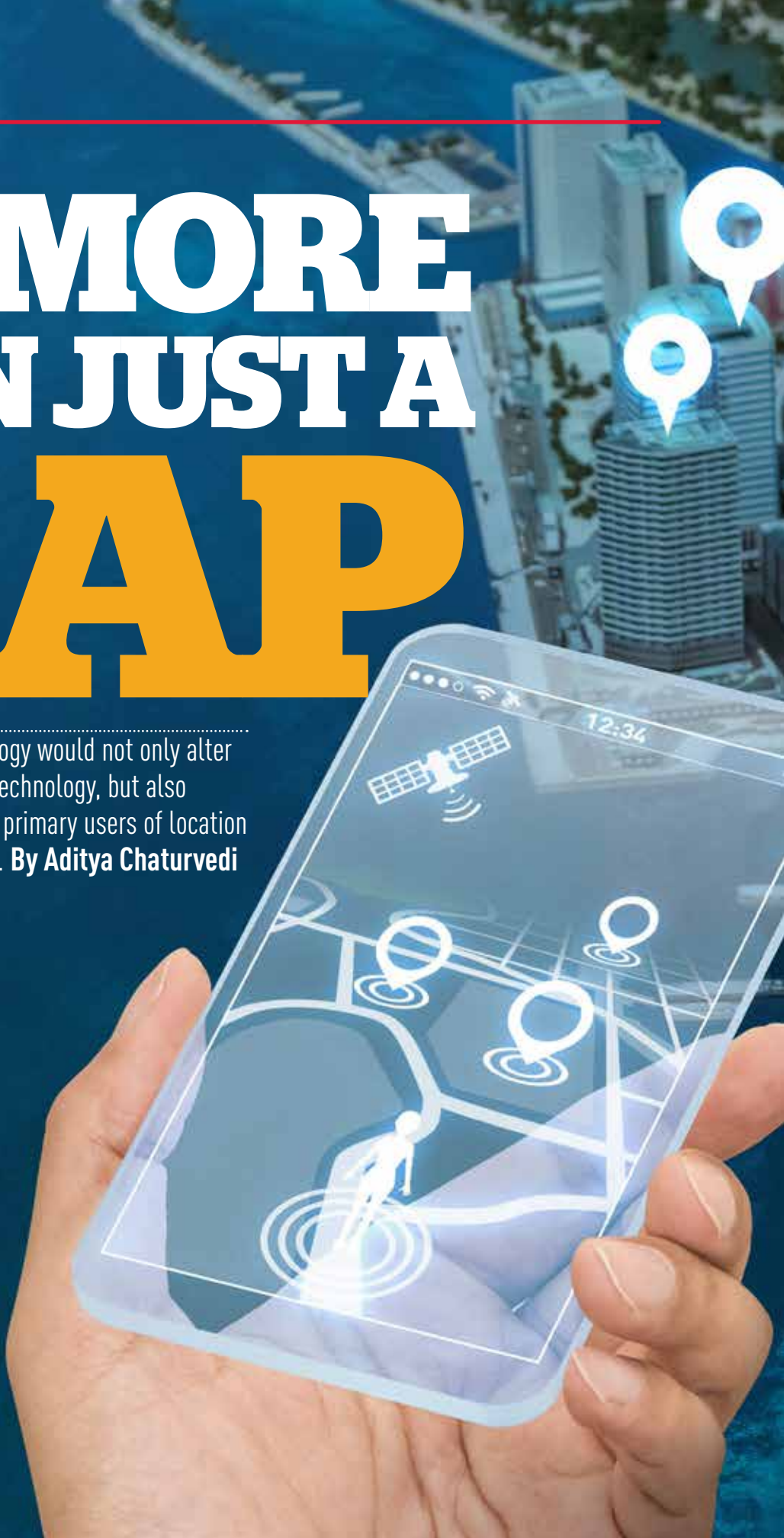
Whether it's more efficient delivery routes, strategic store placements or targeted geomarketing campaigns - CARTO makes geospatial simple.



DHL vodafone mastercard Bloomberg BCG Telefónica

IT'S MORE THAN JUST A MAP

Advancements in location technology would not only alter the way individuals interact with technology, but also create a new paradigm, where the primary users of location would be machines and platforms. **By Aditya Chaturvedi**



September 1, 1983: Korean Air Lines Flight 007 (KAL007), which was a scheduled flight from New York City to Seoul via Anchorage, Alaska, strayed into the Soviet airspace. What followed was profoundly tragic and led to escalation of tension between the two Cold War era superpowers. The plane was shot down by a Soviet Su-15 interceptor, killing all 269 passengers and crew-members on board.

For years, theories were floated around how the tragedy could have been averted. One wonders how things could have been a lot different if the pilot had access to GPS and location technology. Soon after the incident, then US President Ronald Reagan offered to let all civilian commercial aircraft use the GPS system once it was fully operational.

The availability of location and positioning can actually be a matter of life and death in certain situations. What we take for granted today was once a defense-purpose technology, with limited civilian applications. The mainstreaming of location and positioning not only ushered a technological revolution, but also paved the way for an interconnected world driven by digitalization and a confluence of technologies.

With smartphones in every hand leading to exponential growth in location data, we are fast heading towards a geo-aware world, which is the next step in the path of digitalization.

In a geo-aware world, location would underpin not only the new innovations, but would also be the golden thread interlinking new features. It would serve as an enabler, a pivot, as well as an interface. "A geo-aware world is one where instead of people, drones are doing the deliveries; where instead of consumers driving, they are sitting at the back, sleeping, and the cars are driving themselves. In short, it is a world where all sensors are geo-aware and where cities are aware of what's going on," explains ***Kanwar Chadha, Executive Chairman, Hubble Connect and Founder, SIRF & INOVI.***

> *A geo-aware world is one where instead of people, drones are doing the deliveries; where instead of consumers driving, they are sitting at the back, sleeping, and the cars are driving themselves*
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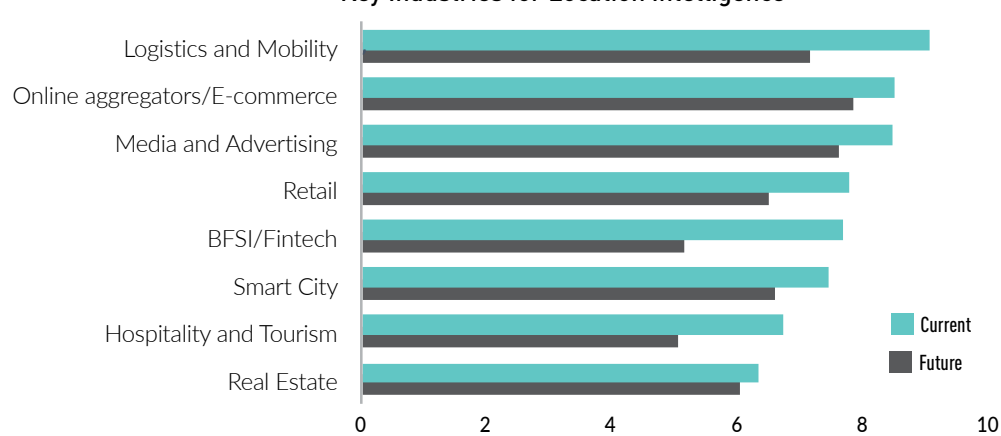
> Kanwar Chadha,
> Executive Chairman, Hubble Connect and Founder, SIRF & INOVI

Location Intelligence: Empowering Businesses

Location analytics is a means of combining location data with business data/processes in order to draw meaningful insights, discover relationships between various factors and identify trends. It has a wide range of application — from rendering basic features such as map-based visualization to enabling complex analytics for scenario analysis. Location analytics solutions and platforms are also being used to create services based on real-time movement of objects.

With the proliferation of mapping as an essential UI (user interface) and the ubiquity of location, the need for location intelligence (LI) is more than ever. It enables the integration of various data feeds to build better experiences and derive new insights for users. With the application of location intelligence, visualizations can be created that help convey the desired

Key Industries for Location Intelligence



Source: GeoBuiz 2019 Report

information in a lucid manner. After all, a picture speaks a thousand words.

The LI industry market has grown from nearly $9 billion in 2014 to around $22 billion in 2018, and is expected to nearly double by 2022, according to the *Location Industry Market Report* published by Geospatial Media and Communications in April.

Recently, Salesforce, one of the world's top CRM (customer relationship management) companies, acquired MapAnything, a pioneer in location-based intelligence software. The development was indicative of a bigger trend — incorporation of location intelligence in business processes.

"The addition of MapAnything to Salesforce will help the world's leading brands accurately plan: how many people they need, where to put them, how to make them as productive as possible, how to track what's being done in real time and what they can learn to improve going forward," according to ***Jon Stewart, CEO and Co-Founder, MapAnything***.

Location intelligence also provides users and organizations with a robust framework for analyzing and managing geospatial data. Analyzing disparate data sources, finding commonality between them and then seamlessly bringing them together through a common interface is possible only with the help of location intelligence.

Location-based Services: Facilities at Your Fingertips

Be it hiring a cab, searching for a good Italian restaurant in your city, ordering food through a smartphone app, or getting discount offers at the nearest mart, one is often left wondering how technology is progressing and making our lives easier and simpler. The above-mentioned services, which are now part of the daily lives of millions across the globe, are essentially location-based services.

According to ***Gil Elbaz, Founder and CEO, Factual,*** 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," he says.

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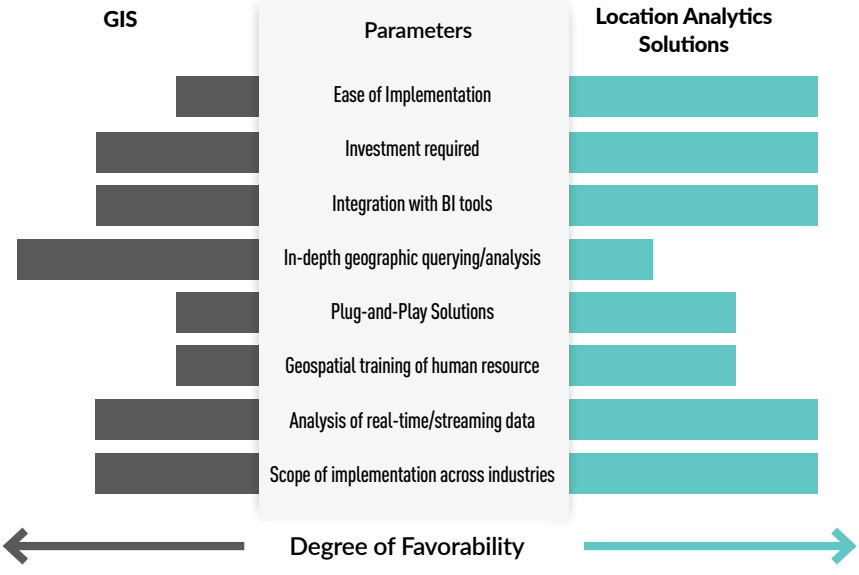
Gil Elbaz
Founder and CEO, Factual

With the advent of digitalization and companies relying on highly accurate data for delivering "best services", the utility of location in businesses has grown manifold and is expected to grow even further, leading to the age of automation. The location-based services (LBS) market is projected to reach $68.85 billion by 2023, at a compound annual growth rate (CAGR) of 25.4%.

GIS and Location Intelligence: The Twain Shall Meet

Geographic Information System (GIS) has been in use for several decades for delivering spatial analytics and geospatial data-based insights, while location intelligence is a comparatively new phenomenon. Despite their similarities and map-based usage spectrum, GIS and location intelligence

Difference Between GIS and Location Analytics



Source: GeoBuiz 2019 Report

industries have grown and stayed independent of each other. However, as their integration with business data deepens, and the industry players begin to focus on developing solutions, the convergence of GIS and location intelligence has started taking shape, according to the *Location Intelligence Market Report*.

Location analytics solutions usually are not designed for handling heavy spatial data. Their main focus is integrating business and location data with a map-based context. Most of the location analytics solutions offer a plug-and-play level to deliver visualization, analytics, resource and workflow management. Unlike GIS solutions, which have the ability to run in-depth queries on multiple geographic and non-geographic attributes, location analytics solutions are specifically meant for spatially referred analytics of regular business and operations data to derive intelligence on nearly real-time basis.

"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," says ***Alain De Taeye, Member, Management Board, TomTom***.

Drones, autonomous vehicles, Internet of Things, indoor positioning, digital twins, all collect or rely on location information. Geospatial data can be har-

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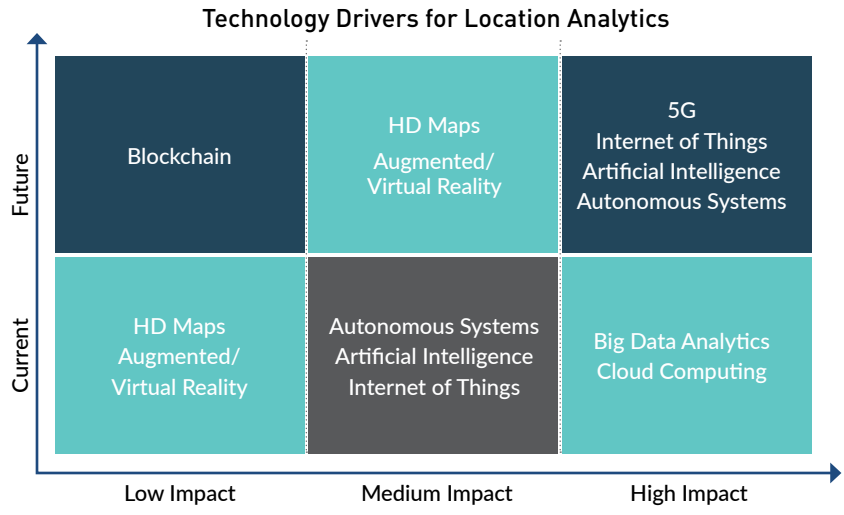

nessed for extracting valuable features that are required for creating and training new models. Location intelligence, in this case, provides a smart framework that helps understand input, output, roadmap, action plan and discrepancy, if any. Location intelligence also powers geospatial data in a Blockchain system to ensure fairness and transparency. Be it drones, IoT or Digital Twin, all of these require location intelligence.

"The next phase of growth for the geospatial industry, where it would see mainstreaming, would require 'impact validation' of using location intelligence. Customers would need to know how this technology is being effective for their businesses," says ***Sunil Kumar, CEO, GroundTruth.***

Elbaz also believes that location intelligence would lead to new innovations in geospatial industry and open new avenues for growth and diversification. "The geospatial industry would 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 would be built," he adds.

The Drivers: New Advancements and Emerging Technologies

The location intelligence industry is being driven not just by the growing demand from its users, but also by new advancements in other technologies that ultimately enable it to offer better propositions to its current and potential customers.

Emerging technologies like artificial intelligence, autonomous systems and IoT are expected to drastically transform location analytics. The arrival of 5G would be another game changer for location data and foster rapid innovations. This would enable not only an increase in location awareness, but also location becoming a pillar of most technological processes.

"Location-aware AI and deep learning have the advantage of drawing on features at or near that location or a history of events there," underlines ***Javier De La Torre, Founder and Chief Strategy Officer, CARTO***. Pointing out that IoT is providing countless measurements associated with location, he adds that by combining these with other relevant data sources, data scientists are helping cities, businesses and autonomous vehicles make better and more informed decisions.

Using advanced analytics methods and smart optimization for vastly improving anything from communication systems to logistics to the myriad applications of Blockchain and AI that will immensely benefit the consumers, location intelligence today has become a critical component in workflows.

Further advances in location technology would lead to storing and analysis of reams of data, new methodologies, more sophisticated predictive models and visualization tools. A combination of all of these would provide unprecedented insights and change the course of industries as well as societies.

The Future: Autonomous Mobility and Location

Location would be at the heart of the automotive industry, not just for ride-hailing services or navigation, but also for a number of other reasons. Autonomous vehicles would be requiring real-time mapping that is based on precise location.

Autonomous vehicles will depend on a data-driven mapping system that HERE calls a "self-heal system". The map would update real-time information and include the latest information about the surroundings based on the car's location. For instance, if there is an alert about a roadblock ahead, or about poor

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> *By combining location data with other relevant data sources, data scientists are helping cities, businesses and autonomous vehicles make better and more informed decisions*

Javier De La Torre
Founder and Chief Strategy Officer, CARTO

road condition in another part of the town, maps would update themselves real-time by gathering and analyzing information from a variety of crowdsourced updates

"If you think about a six ton car running at 60 miles per hour, you better have good communication with it and you better have good location for it. Otherwise it's a disaster waiting to happen," says Elbaz.

According to ***Ganesh Pattabiraman, CEO of NextNav***, "Location is one of the key pieces of information that is required to be reliable for a car to drive down a freeway, a drone to fly, or a mobile phone to interact with the world around. So, location industry is going to be one of the key pillars on which the future of autonomous world will be built." NextNav is developing something called Metropolitan Beacon System (MBS), a wide area location and timing technology designed to provide services in areas where GPS signals are not available.

The Challenges: Data Accuracy and Integration

In an automated world, where most processes would hinge on real-time availability of data, even a lag of a few nanoseconds could lead to big blunders or a colossal loss of revenue for an organization. Real-time geospatial information and visualization of location would be crucial for multiple reasons in the future.

"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 operating on those streams in real time to take action and deliver events to other systems," explains ***Sandeep Singhal, Director, Cloud Storage,*** Google. Today, in many cases, merging multiple streams together in order to recognize information or 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.

However, the demands and expectations of the consumers are fast outpacing the technological capability of the industry. The foremost problem is the accuracy of location data, the ability to use location reliably, whether it is in automated map-making, or day-to-day end user applications.

Mike Davie, CEO and Founder, Quadrant, paints a very realistic picture when he says that a city government may purchase location data surrounding the movement of its citizens and use that data to plan new bus routes, train stations, hospitals or emergency services. But if this data is wrong, then the result could be anything from wasted spending (and higher taxes) to worse crime, or slower economic growth. The problem is, data accuracy and quality are rarely questioned, and rather it is the end analysis and decision-making that usually bears the brunt of criticism when things go wrong.

One way to close this increasing gap is through real-time streaming that can be made possible by integration of geo-data with non-spatial data. However, merging data from different sources, particularly 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," adds Singhal.

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>
> Ganesh Pattabiraman
> CEO, NextNav

This again brings us to the original premise of standardization. Embedding geo-data and location element into other datasets requires standardization, and this is another area where the industry is lagging behind.

"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

HERE'S SELF-HEALING MAP: THE FOUR STAGE PROCESS

1. OBSERVE: DATA COLLECTION

2. AGGREGATE: FUSING DATA

3. CREATE: INTELLIGENT UPDATES

4. PUBLISH: UPDATING USERS

> *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*

Sandeep Singhal
Director, Cloud Storage, Google

> *The problem is, data accuracy and quality are rarely questioned, and rather it is the end analysis and decision-making that usually bears the brunt of criticism when things go wrong*

Mike Dastie
CEO and Founder, Quadrant

Rise of Indoor Positioning

In a world of increasing customer intimacy, venue-based marketing strategies and increasing demand for location-based services and application by smartphone users, the rise of indoor positioning services (IPS) is but obvious.

Indoor Mapping is not possible without highly precise location. It combines the power of GPS and precise mapping to the place where human beings spend 70% of their time – indoors. According to the United States' National Geospatial Advisory Committee (NGAC), indoor positioning services provide the ability for real-time tracking of location information on people or objects indoor with the help of sensory information from automated devices.

The global indoor location market is estimated to touch $40.99 billion by 2022 from $5.22 billion in 2016 at a compound annual growth rate (CAGR) of 42.0% during the forecast period. Moreover, retailers are expected to spend $2.4 billion annually on beacons and asset tracking in 2020. It's no surprise then that there are hundreds of startups competing for visibility in the emerging indoor location and proximity marketing arena.

Indoor positioning can be broadly classified into: magnetic positioning, SLAM, radio waves, mobile sensors and RFID. However, it must mentioned that there is no standard way to build an IPS.

The wide availability of sensor-rich mobiles has boosted the possibility for accuracy of indoor positioning services. In addition to sensors like GPS (which usually doesn't work indoors but if there is satellite signal the smartphone can determine its position) and Bluetooth, modern-day smartphones are equipped with a variety of sensors like barometer, acceleration sensor, gyroscope, mobile phone antenna, Near Field Communication (NFC is a radio standard with a maximum range of 10 cm and is being used for contact-free payment by AndroidPay and ApplePay) and camera (the smartphone cameras receive visible light communication signals and can be used for virtual reality applications).

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," adds Singhal.

The Way Forward: Precision, Precision & Precision

The democratization of this data would provide impetus to new innovations in a number of sectors. Data scientists across the world are working on increasing the accuracy of location data and refining the data algorithms. An increase in data quality is directly linked with increased efficiency and underscores the criticality of highly precise location data.

Location accuracy is an issue that drains financial resources. One of the ways around is very high frequency data and crosschecking whether or not a person is at the said location.

The next generation consumer is going to be a mobile entity — be it a drone, self-driving car, or an autonomous robot. "We have these hybrid entities, or humans wearing AR and you are exactly not sure what they are. These people and devices need context and information in order to do their job well," explains Elbaz.

Location intelligence is undoubtedly the next stage of evolution and offers a lot of prospects not only for the location and geospatial segments, but also for every industry that will be affected by automation.

Location would be the fulcrum of a geo-aware world. Figuratively speaking, it will be the axle connecting the various wheels in the streetcar called automation. Advancements in location technology would fundamentally alter not only the way individuals interact with technology, but also create a new paradigm where the primary users of location technology would be machines and platforms.

Aditya Chaturvedi, Assistant Editor
aditya@geospatialmedia.net

All GNSS civilian signals

TRIUMPH 3

Based on the TRIUMPH 3 chip with 864 channels

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

see back page >

After adding the high precision built-in inclinometer, now we added

motorized auto focus for the J-Mate high precision camera

J-Mate Overview

6 pages inside >

JAVAD

J-Mate Quick Overview and Update to Videos

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

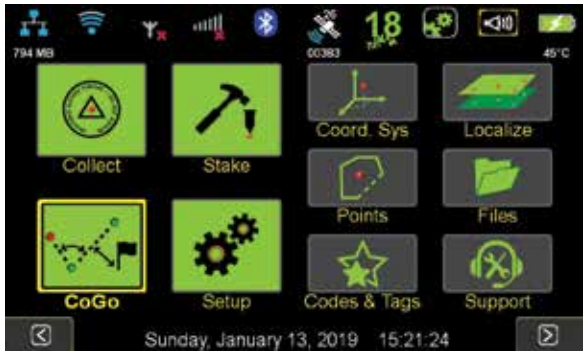
One major improvement that we did recently is to add motorized control of the camera focus feature.

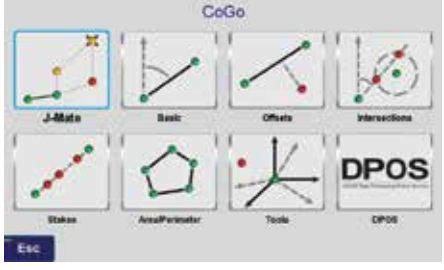
As with the TRIUMPH-LS, with the J-Mate we also provide software improvement updates regularly and free of charge. Download the J-Mate update in your TRIUMPH-LS and then inject it to the J-Mate. When you connect the TRIUMPH-LS to the J-Mate, the injection will be done automatically; but with your consent.

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

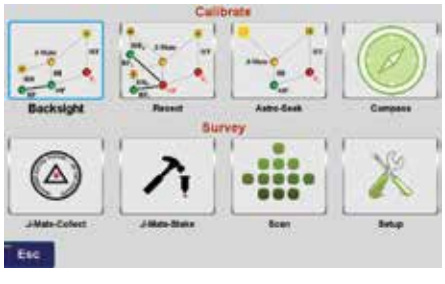
Connecting J-Mate to TRIUMPH-LS:

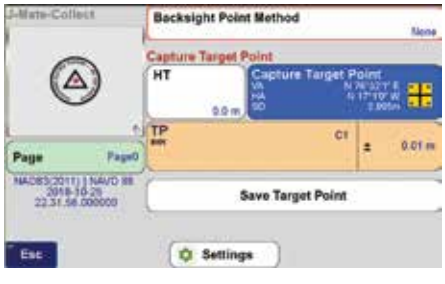
TRIUMPH-LS communicates with the J-Mate through Wi-Fi. Turn on both the TRIUMPH-LS and the J-Mate. Click the Wi-Fi icon of the TRIUMPH-LS Home screen to connect to the J-Mate, much the same way as you connect TRIUMPH-LS to your Wi-Fi access point. J-Mate has ID of the form JMatexxx.





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





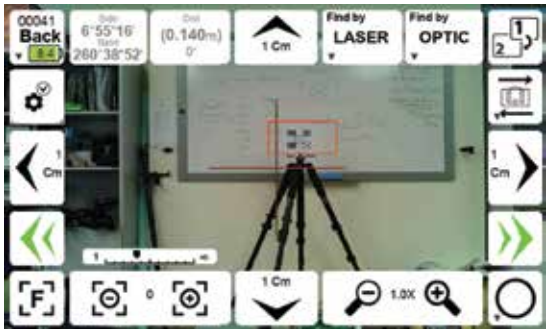
Finding the target automatically:

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

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

2) Second is search by laser for the object of the specific flat size and focus on its center, including the J-Target that we supply.

3) Third is with the camera to search for the J-Target. We will discuss these later.



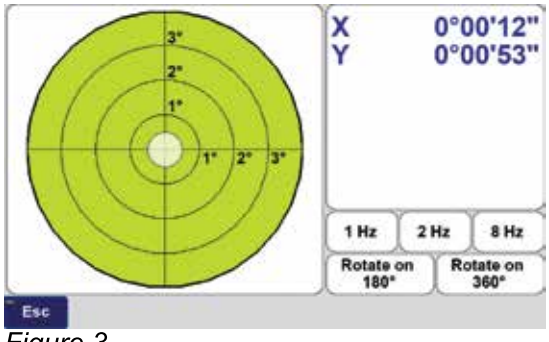


Figure 3

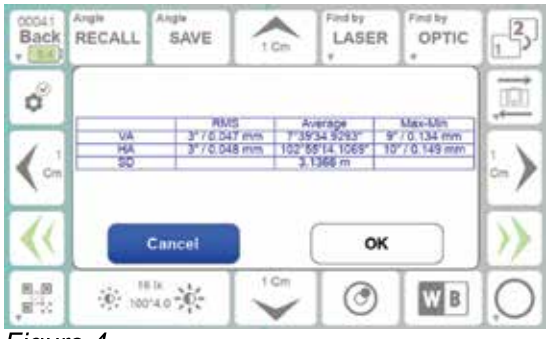


Figure 4

Figure 5

Switching between the two cameras:

You can view the scenes by the wide-angle (about 60 degrees) camera of TRIUMPH-LS, while sitting on top of J-Mate; or by the narrow angle (about 5 degrees) precise camera of the J-Mate. Click Button **"8"** of Figure 1 to switch between the two. A rectangle on the wide angle camera of the TRIUMPH-LS shows the viewing area of the J-Mate camera which helps in aiming to targets.

Viewing the embedded Inclinometer:

Hold button **"8"** or click button **"19"** of Figure 1 to see the embedded 0.001-degree electronic inclinometer of the J-Mate as shown in Figure 3. It updates 10 times per second.

Taking a point:

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

You can also automatically take measurements around that point. Hold Button **"10"** to set up the area around the target.

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

Viewing the measured points:

Clicking button **"7"** in Figure 1 will change some control buttons. Hold it long and you will see live view of the points taken by J-Mate (Figure 5).

Measuring angles quickly:

Aim at the first point and click button **“2”** of Figure 1. Then Aim to the second point and click this button again. You will see the horizontal angles between the two points. You can save the measured angles in clip boards and use it elsewhere when you need.

Saving and Recalling Orientations:

Aim at a point and click button **“17”** of the Figure 1 to save the horizontal, vertical, or both of that orientation (Figure 6). Click button **“16”** to rotate to that saved orientation.

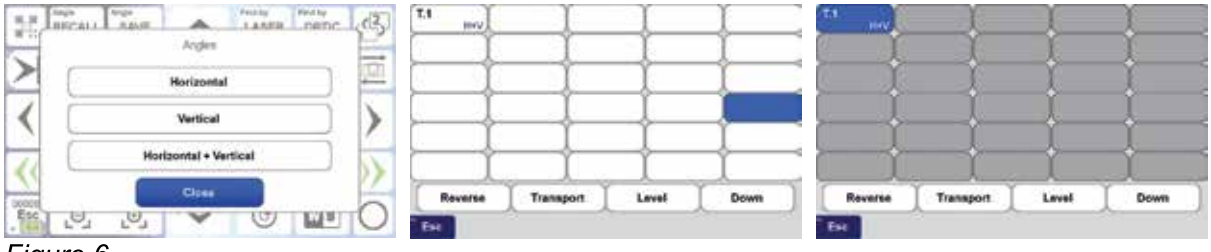


Figure 6

Scanning, snapping and finding targets:

Hold button **“5”** of Figure 1 and see the screen on the right in which you can select some parameters. Then click the “Select Target” button which takes you to the screen below. In this screen you can select the type of objects that you want to detect and measure automatically.

You can search for J-Targets, Tubes, and Corners. Corner is when the linear surfaces change direction.

You can select and set the parameters of each target.

You can view the 3D image of the scanned file in the “File” icon of the Home screen of the TRIUMPH-LS as shown at the end of this article.

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

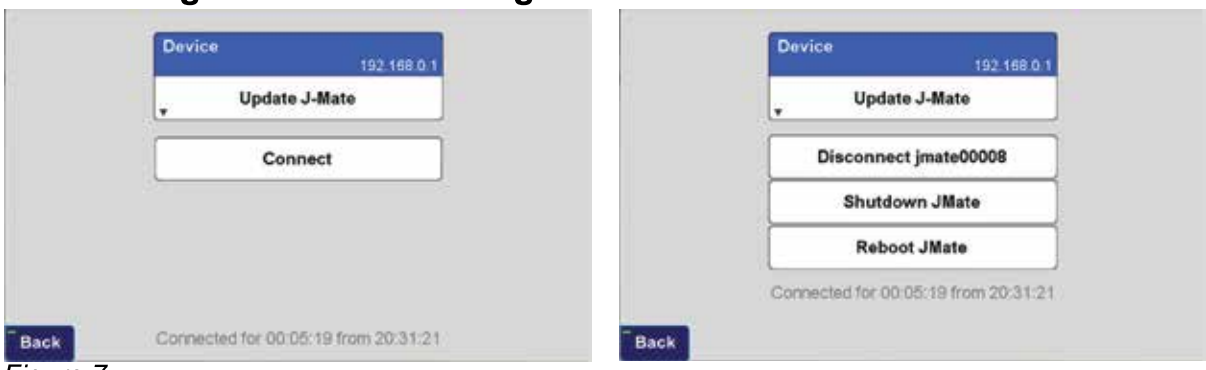


Figure 7

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

View range and angular measurements

Boxes **"2"** and **"3"** of the Figure 1 show the range and angular measurements. It reads up to 20 times per second. Click box **"3"** to enter the measured offsets between the two cameras.

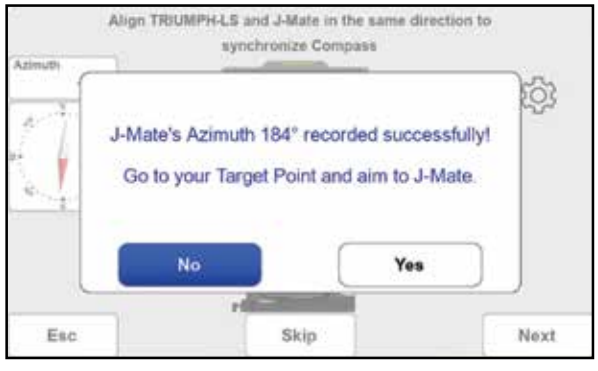
Automatic finding of the Target:

Click the J-Target icon (**"21"** of the Figure 1). You will be guided through the following steps to aim at your target point:

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

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

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



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

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

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

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

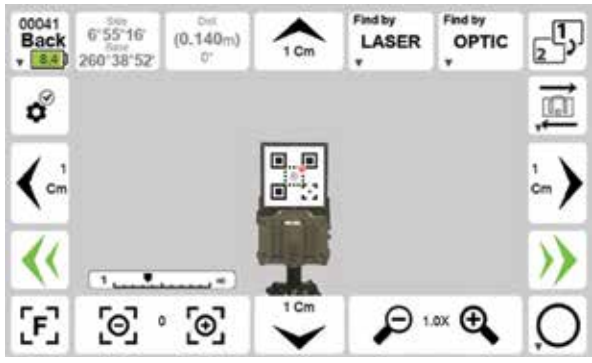
4. Click "Optic" if you want the J-Target panel to be scanned and centered automatically.

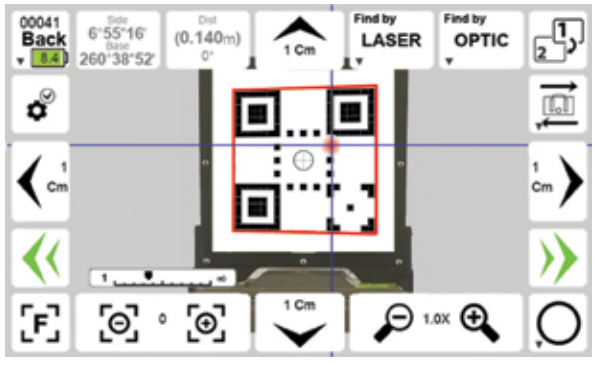
When J-Mate focuses on the center of the J-Target, you can click the "Take" button. You will be asked if you want to record the point.

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

The center of the J-Target is vertically collocated with the GNSS antenna and you don't need to be exactly perpendicular to the J-Mate path.

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



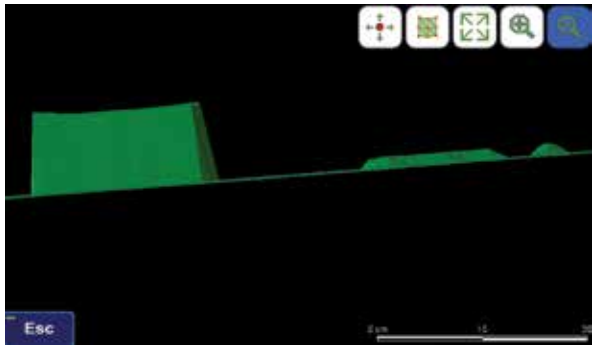


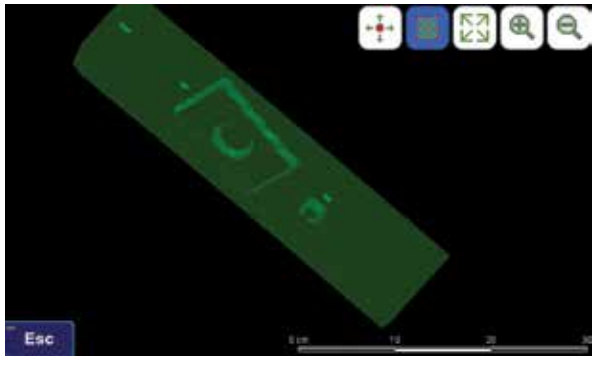
View scanned Images:

You see the 2 views of the 3D scanning

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

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





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

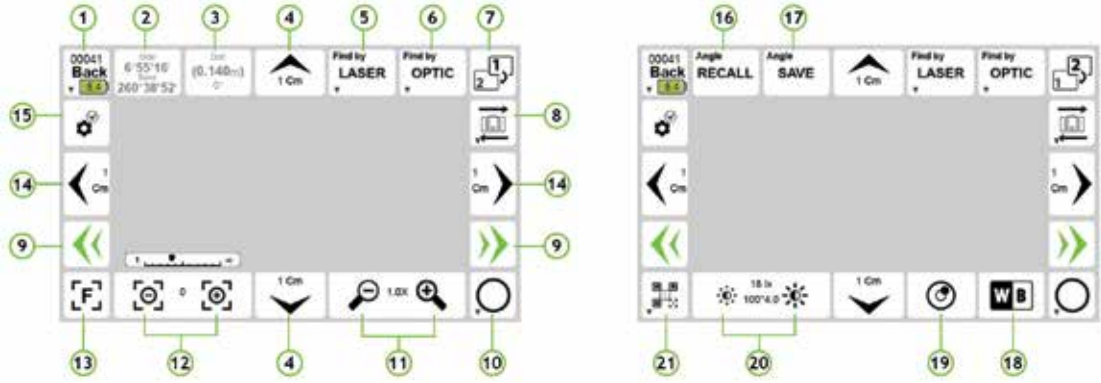


Figure 1

This is the **Main Navigation Screen.**

Clicking the button **"7"** in Figure 1 will switch some controls as shown above.

Aiming at Targets:

You can find targets manually or automatically.

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

1. There are Left/Right/Up/Down buttons around the screen (**"4"** and **"14"**). Each click moves the J-Mate according to the value that you assign to them in the setup screen (**"15"**), as shown in Figure 2.

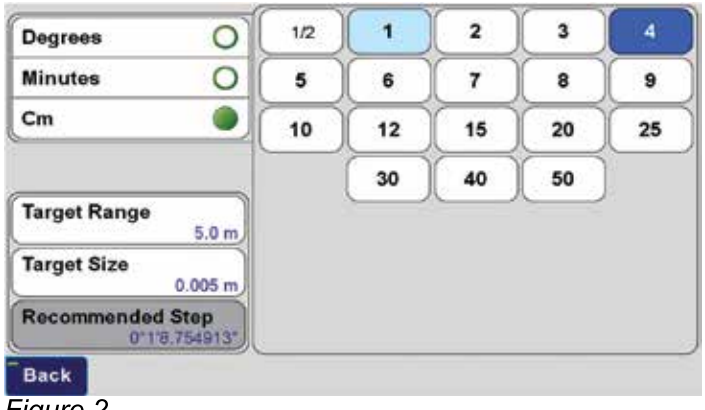


Figure 2

2. While holding these buttons down, J-Mate rotates about 5 degrees per second.

3. Buttons **"9"** are "Fast Motion" buttons. While you hold them the J-Mate rotates about 30 degrees per second.

4. You can point J-Mate towards points by touching points on the screen and by gestures.

5. You can also rotate the J-Mate manually while it is not moving automatically, but limit that to the small rotations, not to apply backpressure to motor.

Motor manufacturer does not prohibit manual motion, but we think it is better to avoid it as much as possible.

TRIUMPH-3

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

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

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

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

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

Ideal as a base station

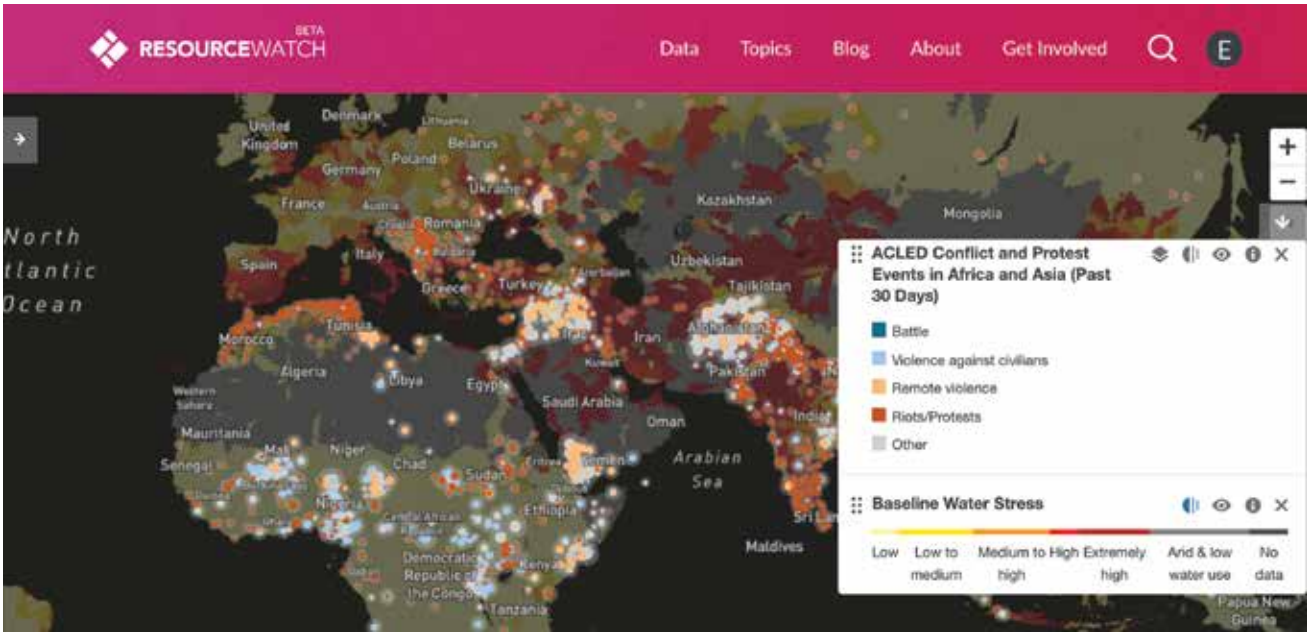
From Climate Change to water risk, poverty to migration, issues concerning human health and environment are interconnected. Insights into these issues can be found on the Resource Watch platform.

By Janet Ranganathan

MONITORING THE PLANET'S PULSE

In November 2018, as wildfires spread rapidly across Camp in California, hospitals had to act fast to care for burn victims. The nearby Feather City Hospital caught fire and patients were urgently transferred to the University of California, Davis, Burn Center, which wasn't used to seeing so many patients. At least 85 people died in the fire and over 150,000 acres were burned making it the largest and deadliest California wildfire on record. Unfortunately, it might not take very long for this record to be broken. Hotter, drier conditions in the Western US have contributed to a longer fire season and larger fires.

These devastating fires make it clear that Climate Change is not a far-off threat. It's happening right now and it's a public health emergency.



Armed conflict and water stress data used by the Water, Peace and Security initiative shown on Resource Watch

Be it wildfires, heatwaves, droughts, or floods, there is no separation between environmental health and human health. Large, deadly wildfires are symptoms of bigger problems, much like a fever is to flu. To understand environmental health, we need to do more than track the symptoms: we need information on the root causes and underlying drivers of the problems.

Policymakers, analysts and business leaders need high-quality information on the social, political and physical drivers of environmental problems, and how they are interlinked, to understand the best place to intervene and inoculate against crises in the future. We need clear and open information on the pulse of our planet.

Transparency Through Open Data

One year ago, World Resources Institute and more than 30 partners launched an open data monitoring platform to advance a healthy planet where people and ecosystems thrive. Resource Watch leverages technology, data and human networks to bring much-needed transparency on the state of the planet.

Our team curates and compiles data from satellites, governments and peer-reviewed sources on the planet's pulse. Users can visualize data on how wildfires affect air quality and explore data on precipitation and temperature changes. From climate change to poverty, water risk, political instability and human migration, all of these issues are interlinked, and you can find data and insights on their status on the platform.

In just one year, the platform has been used by thousands of people in 178 countries. Analysts and journalists have used the data to monitor and mobilize change on the ground. Some examples of the change we have made in just twelve months are described below.

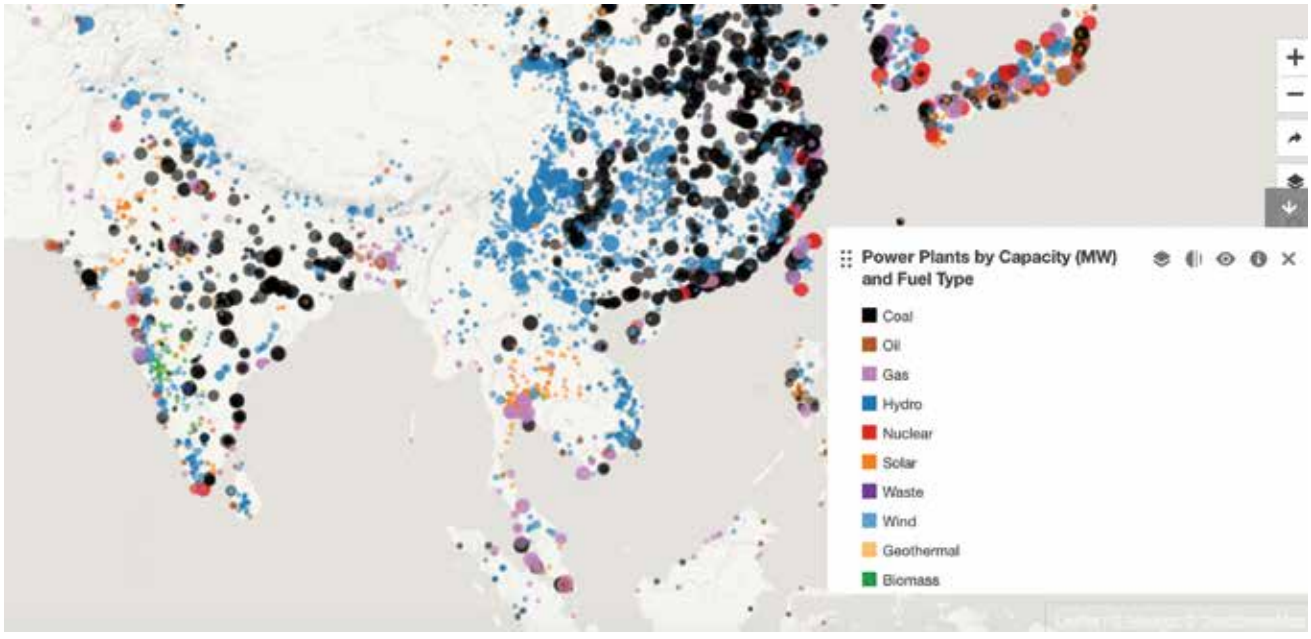
Preventing Future Conflicts

In 2017, water played a major role in conflict in at least 45 countries, especially in North Africa and the Middle East. This is not just regional crisis plagued by drought; it's also a global security issue because lack of water contributes to food insecurity, which in turn contributes to migration and insurgencies.

The Water, Peace and Security (WPS) initiative uses Resource Watch to trace the role of water in social unrest with data on water stress, conflict events and political stability. The early warning system they are developing to predict when conflict might be triggered will provide actionable information to local officials, so that they can intervene before conflict arises and spreads. An early prototype was recently used to preview water-driven conflict hotspots at a United Nations Security Council meeting.

Another use-case was provided by a health specialist at Save The Children who uses Resource Watch regularly. Looking at flood patterns in rural Bangladesh, the specialist uses Resource Watch to estimate how flooding might lead to human displacement and reduced access to health services. The specialist is also looking at how gender inequality and internet access might be correlated with women's access to contraception.

To understand environmental health, we need to do more than track the symptoms: we need information on the root causes and underlying drivers of the problems



Global Power Plant Database developed by World Resources Institute

We have developed our own open data on the world's power plants. Created by World Resources Institute (WRI) in 2018, the Global Power Plant Database is a comprehensive, open source database of power plants around the world. Each power plant is geolocated and contains information on plant capacity, generation, ownership and fuel type. When overlaid with WRI data on water scarcity, researchers found that 47 percent of the world's thermal power plant capacity and 11 percent of hydroelectric capacity are located in highly water-stressed areas.

Building on Open Data Infrastructure

All the work we do on Resource Watch and the application programming interface (API) on which it's based, is open-source, which means organizations can build their own applications on top of what we have built, like building Lego blocks on our infrastructure. The API serves as a public good by saving other organizations money and time from building their own data infrastructure.

We are thrilled that several applications have harnessed this public resource for connecting to data. Some examples are: The Partnership for Resilience and Preparedness, Global Partnership for Sustainable Development API Highway, MapX, Insights2Impact, Global Forest Watch, Congo Forest Atlases, Climate Watch and Aqueduct. These applications have benefitted from the investments we have made into designing data architecture, standardizing data and metadata and creating online functionalities. Applications can focus their resources on meeting their users' needs because of these investments.

Transparent data can drive accountability and more responsible decision making.
Empowering people with information will drive greater accountability

Monitoring to Mobilize

Transparent data can drive accountability and more responsible decision making. Empowering people with information on the crisis, and how it affects them, will drive greater accountability from those responsible and from those in a position to act to prevent further degradation.

During our next phase, we will be bringing Resource Watch closer to the ground by incorporating higher resolution imagery and enabling users to upload localized datasets. We will empower local champions with the data they need to make more sustainable decisions or hold those in power accountable. This will require getting more local data on the platform and building a user community that takes evidence-based action for ecosystem conservation and restoration.

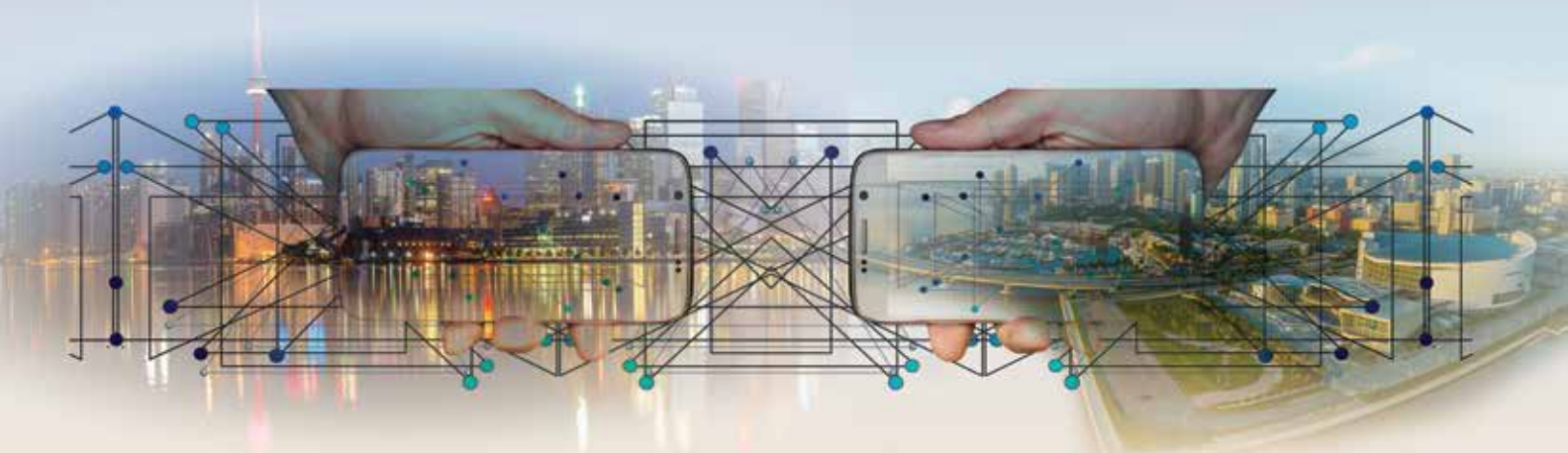
The work we have done over the past year would not have been possible without our partners and funders, and we hope you will join us by using Resource Watch and telling us how to make it better for your needs.

There is no silver bullet solution, or a single pressure point to tackle the climate crisis. It will require an army of actors, an array of interventions and a menu of pathways in the right places. We need your help to scale data transparency and action across the globe.

Janet Ranganathan, Vice President, Science and Research, World Resources Institute
janetr@wri.org

DATA STANDARDS FOR URBAN PLANNING

OGC members from geospatial or built environment communities help in informing, developing and applying the standards that can knit together successful cities of tomorrow. **By Greg Milner & Josh Lieberman**



We hear the term "smart cities" a lot these days, but asking people to define what an ideal smart city actually is often leaves them at a loss for words. It's a hazy concept that has come to represent the future of urbanism, and often the explanation comes down to something like this: "[mumble mumble mumble] BIG DATA!"

As a standards organization, the Open Geospatial Consortium (OGC) operates with a specific idea of what a smart city should look like: one where data from disparate sources and isolated systems can be thoughtfully combined in new ways to build solutions to city challenges and benefit citizens and other stakeholders. Datasets that were never "made for one another" are nonetheless able to enrich each other because they literally describe a common ground in the urban environment. By integrating data from various systems throughout a city, we gain improved understanding of a city and its health.

Creating Urban Models

A helpful concept for smart cities is that of the Digital Twin. In a functioning Digital Twin, data describing the real world is being continuously and seamlessly ingested, modeled and analyzed. The resulting virtual world evolves synchronously and nearly simultaneously with its real-world counterpart, opening a quantitative window into how the real world behaves. It can also show the potential impact of real-world changes, such as sudden flooding events or gradual population shift, and what might be done to prepare for, or respond to these events.

While a 1:1 real-time Digital Twin will remain unachievable for the foreseeable future, the concept illustrates the value of creating an "urban model" that represents just the *essential* elements of a city using data pulled from different sources. Unifying the required data doesn't have to be difficult: many of the mechanical problems of joining disparate data sources can be solved by using current technologies coupled with common formats and interfaces — standards.

OGC has a strong portfolio of standards relevant to urban models and for cities becoming "smartly functional". However, a successful urban model also requires bridging two previously disparate digital perspectives: the integrative, layered geospatial perspective used to understand how different elements of a city or landscape fit together; and the constructive, detail-oriented Building Information Model (BIM) perspective used to build and maintain the individual structures that fill a city.

This isn't just a question of competing scales. What makes the urban model powerful is also what makes it tricky to integrate. Contained within BIM is a wealth of detailed semantic information describing structural components and how they fit together into functioning buildings or other elements of the built environment. Geospatial models map features and how they relate to one another by type and position. The question is which part of a BIM conglomerate of brick and steel is the same reality as that map symbol laid out with many others in a neighborhood, and which parts are useful to maintain in a city-wide model representing human interests?

Aligning Paradigms

This alignment of the two paradigms is tough, but by no means insurmountable: OGC is actively collaborating with buildingSMART International through their Integrated Digital Built Environment Subcommittee to jointly develop standards that allow the details — both semantic and spatial — of BIM models to take their place within the greater contexts of city-wide geospatial models. The IDBE SC will soon release its first technical documents.

The challenge of assembling city data into meaningful and actionable urban models has many aspects: bringing data together from diverse systems; reconciling the very different perspectives of the BIM builder and geospatial analyst; and collecting, aggregating, processing and integrating information from single-purpose information systems and sensors or other sources, and making that data easily available to specific decision-making applications for city stakeholders. Ideally, each component and stage of such a system can contribute to new models and applications through conformance with data access standards. The reality today, however, is that many such systems have already been installed, but without the necessary standards support to enable data to be shared. What is needed is a move towards a sensible and effective approach for a city to become "smarter" in place.

Realizing this, in 2016, OGC headed the European Innovation Partnership on Smart Cities and Communities (EIP-SCC) ESPRESSO program. ESPRESSO was created in order to develop a conceptual "Smart City Urban Platform" based on open standards. Two major pilot programs were established in the Dutch city of Rotterdam and in Tartu, Estonia. The Rotterdam pilot updated its existing 3D city model using CityGML, and began integrating new forms of sensor information, as well as data previously collected manually. The Tartu program moved to integrate systems that measure energy use, with the aim of becoming Europe's most energy-efficient city.

In studying the results of ESPRESSO, OGC recognized two major concepts critical in cities moving their existing systems towards open standards:

Minimum Interoperability Mechanisms (MIM), a concept developed by Open & Agile Smart Cities (OASC), refers to specifications and architectures that do not attempt to encompass every conceivable aspect of a city but instead allow systems to be connected only when and where needed. They enable future innovation and adaptation without requiring wholesale reconstruction of existing functioning systems.

Pivotal Points of Interoperability (PPI), a concept developed by the National Institute of Standards and Technology (NIST), are component standards and methodologies so widespread and useful that, even in an isolated system, vendors don't think about not using them. In other words, it's an existing system integration practice that also happens to facilitate data access and sharing between other systems.

The shortest path from status quo to smart data integration and urban models is where **PPI** opportunities coincide with **MIM** needs.

Imagine that a city has a system that analyzes the flow of traffic on its streets using video data taken from cameras installed for the purpose. In a typical system, the traffic cameras feed their data through a custom network into a closed single-purpose system for storage, retrieval and analysis. Suppose that the results are so successful that the city's transportation department wants to similarly analyze pedestrian traffic. They then learn that the vendor's pedestrian package has lately been deprecated and are advised by a re-seller that a new system – cameras and all – will have to be purchased for the task.

It turns out, however, that such a closed vehicle monitoring system often feeds its video data into a commoditized data storage system, a potential PIP supporting standards like SQL and JDBC. While refitting hundreds of cameras to support standard interfaces would be a major hurdle, commodity data storage systems can often be (or already have been) assembled into "Data Lakes". A Data Lake is a MIM that lets just enough light into closed systems, and with it, allow the standards-based mixing and matching of data from different sources needed to power versatile urban models – or in this case to feed an application that analyses pedestrian traffic using video data.

Data standards underpin MIM and PPI, as well as opportunities such as Data Lakes, and thus support the organic growth of urban digital models. This "plug and play" approach sustains capabilities through generations of vendors and technologies and allows players of all sizes to innovate and participate in the smart city market. Standards can also prevent cities from having to commission overly complex, expensive, all-in-one solutions to what are often just new sequences of distinct but common challenges.

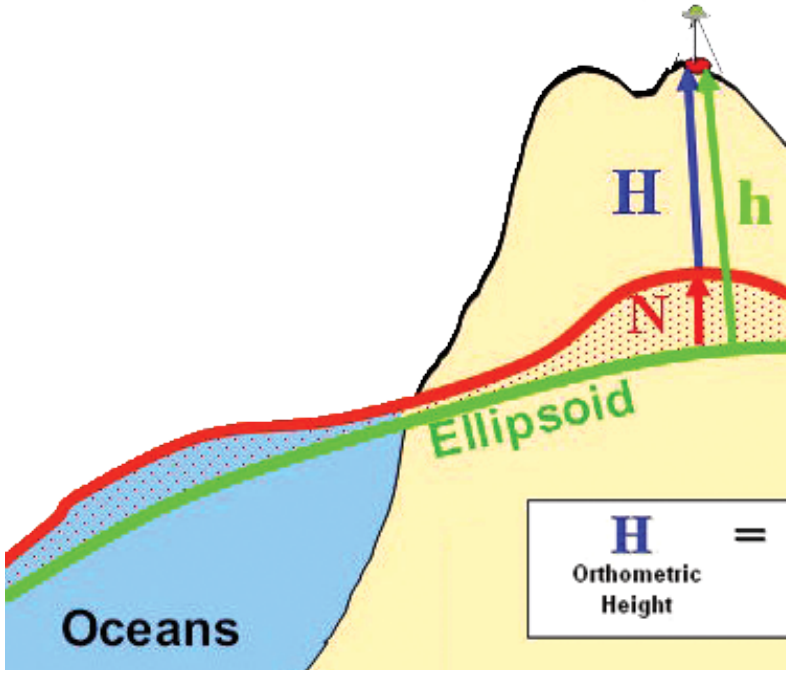
Creating truly smart cities, where bringing together data is a means to bringing together communities, is both a moral and financial imperative. As the world becomes more urbanized, cities need to meet the challenge of upholding quality of life in the face of growing populations, dwindling resources and changing climate. OGC members, whether from the geospatial or built environment communities, help to inform, develop, and apply the standards that will knit together the successful cities of tomorrow.

The shortest path from status quo to smart data integration and urban models is where PPI (Pivotal Points of Interoperability) opportunities coincide with MIM (Minimum Interoperability Mechanisms) needs

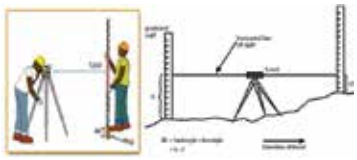
Josh Lieberman, Director, Innovation Program, OGC. *jlieberman@opengeospatial.org*
Greg Milner, Freelance Writer

Geoid Model of India

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

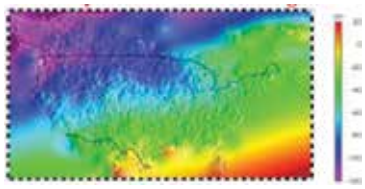


High Precision Levelling

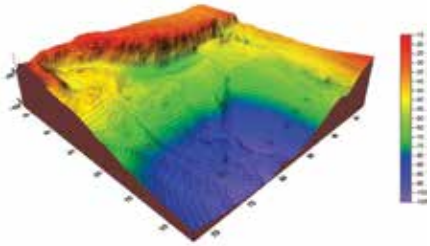


GNSS Observation

Hybrid Geoid Modeling



IND Geoid (β-version)



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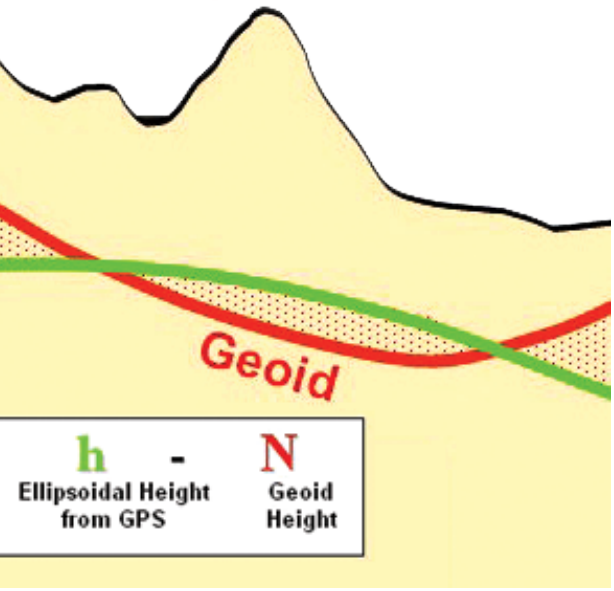
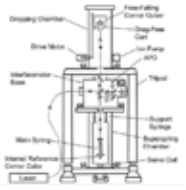
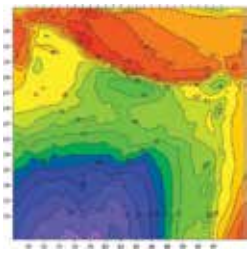


Gravity Observation





BENEFITS

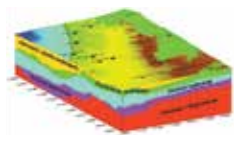
High resolution geoid will generate geoidal undulations of high accuracy all over the India.

Orthometric height will be easily derived using GNSS observation

$$H = h - N$$

The time consuming & tedious work of levelling will be reduced

Subsurface geological condition may be analysed



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MAPPING MISSING COMMUNITIES

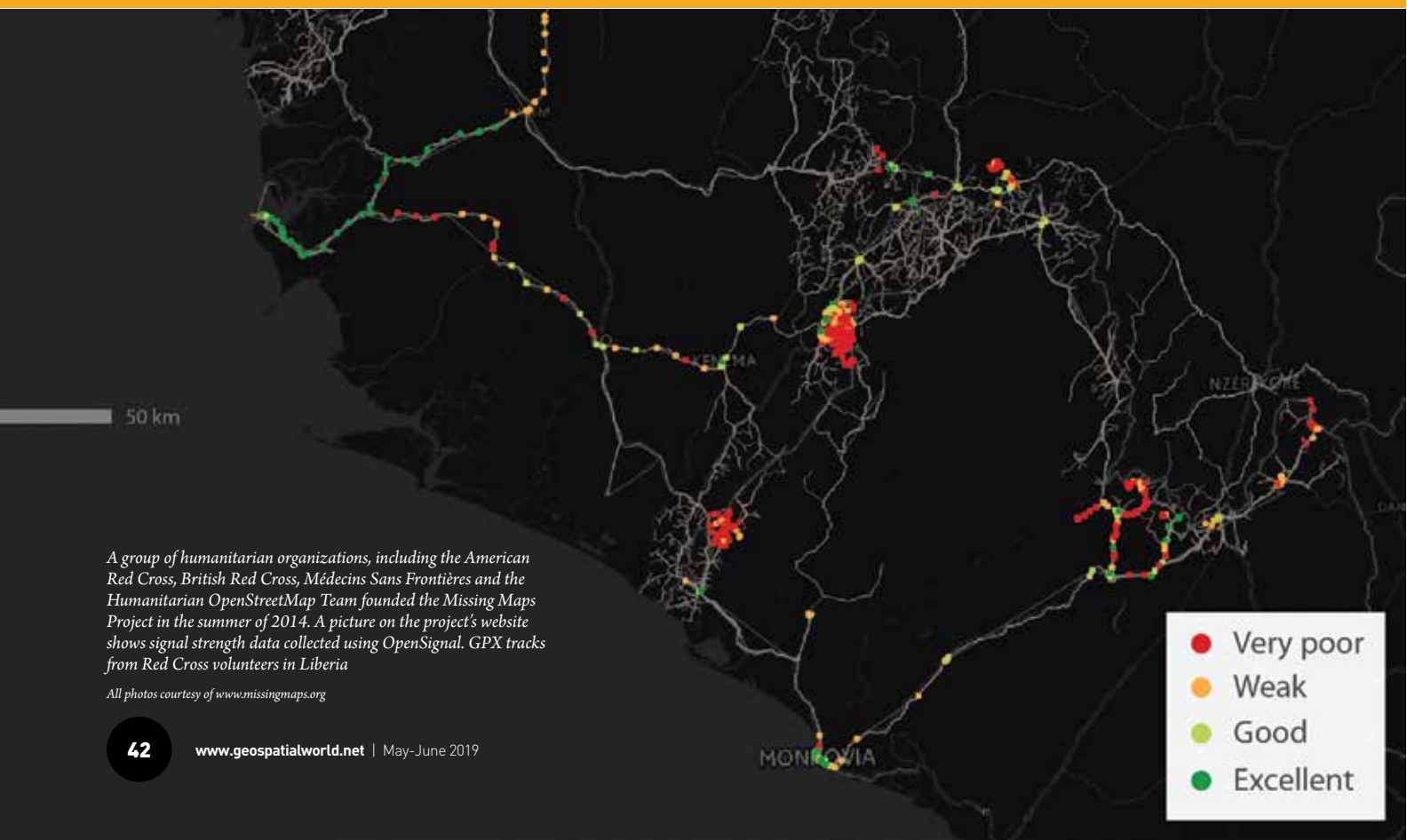
Set up by a group of humanitarian organizations, the Missing Maps Project brings disaster-hit areas and communities on the map to assist resource allocation and relief work.

By Avneep Dhingra

Mankind is no stranger to natural disasters and disease outbreak. Every year, more than one million people across the globe lose their lives to epidemics and calamities like earthquakes, floods, storms, hurricanes and landslides. The number of those displaced, or affected, is a lot higher. While rescue and relief organizations may differ on the extent of devastation (number of deaths and cost of destruction), almost all of them are in agreement on this one fact: we need innovative and scientific ways to deal with disasters.

Though inaccessibility and paucity of resources continue to plague disease/disaster-prone areas in underdeveloped and developing countries, another problem that often hinders rescue and relief work in times of crisis is the absence of these areas from maps. Be it places in Vietnam, Tanzania, Myanmar or Belize, often, no maps means delayed response and uneven allocation of resources.

To bridge this gap, and to make relief and rehabilitation operations more effective, a group of humanitarian organizations, including the American Red Cross, British Red Cross, Médecins Sans Frontières and the Humanitarian OpenStreetMap Team (HOT) founded the Missing Maps Project enduring the summer of 2014. The initiative was designed to help remote communities better



A group of humanitarian organizations, including the American Red Cross, British Red Cross, Médecins Sans Frontières and the Humanitarian OpenStreetMap Team founded the Missing Maps Project in the summer of 2014. A picture on the project's website shows signal strength data collected using OpenSignal. GPX tracks from Red Cross volunteers in Liberia

All photos courtesy of www.missingmaps.org

prepare for emergencies. By mapping out the locations of buildings, houses and roads and points of interest like health facilities and schools in vulnerable areas/communities, the project identifies potential hazards and possible evacuation routes, which ultimately strengthens locals in the event of a disaster.

Standard Operating Procedure

If you browse the Missing Maps website, you find three steps listed under the "How We Work" header. These include: remote volunteers tracing satellite imagery into OpenStreetMap; community volunteers adding local details such as neighborhoods, street names and evacuation centers; and humanitarian organizations using the mapped information to plan risk reduction and disaster response activities to save lives. The twofold objective behind these three steps is to map the most vulnerable places in the world so that international, national and local NGOs can use these maps to better respond to crises and to support OpenStreetMap, specifically the Humanitarian OpenStreetMap Team (HOT), in developing technologies, skills, workflows and communities.

"Missing Maps works to provide free, open data to any humanitarian or development project that needs it. Rather than every humanitarian organization across the world working to develop data sets in private systems, through Missing Maps, we are able to be more efficient — working together to close the gap in the global map, which anyone can benefit from both now and in the future," explains Rebecca Firth, Director, Community & Partnerships, Humanitarian OpenStreetMap Team.

Objectives and Targets

Using OpenStreetMap ensures that all data gathered under the project banner is free, open and available for use under OpenStreetMap's open license. OpenStreetMap is an initiative to create and provide free geographic data, such as street maps, to anyone and everyone. Supported by the OpenStreetMap Foundation, the initiative is dedicated to encouraging the growth and distribution of free geospatial data.

According to Missing Maps, all "in-country" activities, i.e., local mapping and data collection, are carried out in collaboration with the local population. Placing "people before data", the project puts in place a plan to ensure access to technology and training for the locals, even after the relief work is over. Further, Missing Maps members keep contributing to the data repository with special emphasis on building and leaving behind local capacity and access.

"The activities under the project are designed to be accessible and open for participation for individuals who want to contribute towards the common objectives," says Jorieke Vyncke, Missing Maps coordinator, Mission Unit, MSF UK.

Partners and Contributors

Missing Maps is an open, collaborative project in which one can help to map areas where humanitarian organizations are trying to meet the needs of vulnerable people. As far as NGOs, educational establishment or civil society groups are concerned, membership of the Project is open to anyone willing to contribute to the goals and abide by the ethics. The approval of membership is the responsibility of the member organizations.

For those willing to make individual contributions, the project has a large network of volunteers, and anyone can become a part of it by doing some mapping. By using MapSwipe, a mobile application developed by The Missing Maps Project, one can search satellite imagery to help put the world's most vulnerable people on the map. Users of this app swipe through satellite images of a particular region, tapping the screen when they see certain features including settlements, roads and rivers. This information is fed back to mappers who need it to build detailed and useful maps. For beginners, Missing Maps website has a couple of

The initiative was designed to help remote communities better prepare for emergencies

Facebook's Plan to Map World Population Has Missing Maps Connection

Social media giant Facebook's plan to nearly map the whole world's population has a Missing Maps connection. The team involved in the ambitious project includes former American Red Cross employee and Missing Maps co-founder Drishtie Patel. When Patel joined Facebook in 2016 to work on this project, the two organizations realized that the company could offer significant help to improve the efficiency of volunteer mapping for programs in the humanitarian sector.

Digital volunteers with the Missing Maps Project used these AI-powered maps to filter out the 97% of the terrain in Malawi that is entirely uninhabited. Volunteers with Missing Maps, could then concentrate their efforts on mapping the remaining 3%, knowing that they weren't overlooking any small, remote communities. With guidance from the maps, Red Cross volunteers in Malawi were able to locate communities so they could answer questions about the vaccination process and address the concerns of those who otherwise might not have brought their children to be immunized.

"Facebook's high-resolution population maps have supported the Humanitarian OpenStreetMap Team and Missing Maps' mission of putting the world's most at-risk places on the map. The maps from Facebook ensure we focus our volunteers' time and resources on the places they're most needed," Tyler Radford, executive director of the Humanitarian OpenStreetMap Team, which participates in the Missing Maps project, was quoted as saying.

tutorial videos that can be used to understand the basics of mapping.

For individuals who already know mapping and have done it in past, there is an option of functioning as a "validator", someone who is entrusted with the responsibility of verifying the authenticity and accuracy of the data created. Those selected for the role can use JOSM Editor, a customizable editor for OpenStreetMap with a number of tools and plugins for simplifying mapping and validating. Apart from these, Missing Maps teams periodically visit areas in countries and hold technology trainings for communities.

How Mapping Helps

In 2017 when Conakry in Guinea witnessed an outbreak of Measles, the project supported field teams of Médecins Sans Frontieres (MSF) in the preparation and follow-up of the measles vaccination campaign. This dataset was key for producing epidemiologic maps displaying the vaccination coverage per neighborhood based on the total population and the total number of children vaccinated per site. The process involved formatting training data collectors in using the mobile data collection and navigation app OsmAnd, collecting points of interest in Conakry in order to improve existing base maps in the area, and collecting and aggregating general data on each vaccination site to input this into a common GIS database.

Similarly, to carry out a surveillance project on malnutrition crisis in Nigeria the same year, Missing Maps assisted the MSF teams in creating baseline map data. Base maps of the area where MSF was working and multiple advanced analysis maps displaying assessment results were prepared. The base maps produced for assessment results were used to efficiently dispatch teams to precise and defined locations and to help the field teams navigate the villages and identify points of interest effectively.

With the help of geospatial data, the Missing Maps Project has been able to make a difference on the ground for populations in crisis.

By mapping out the locations of buildings, houses and roads in disaster-hit areas, the project identifies potential hazards and possible evacuation routes

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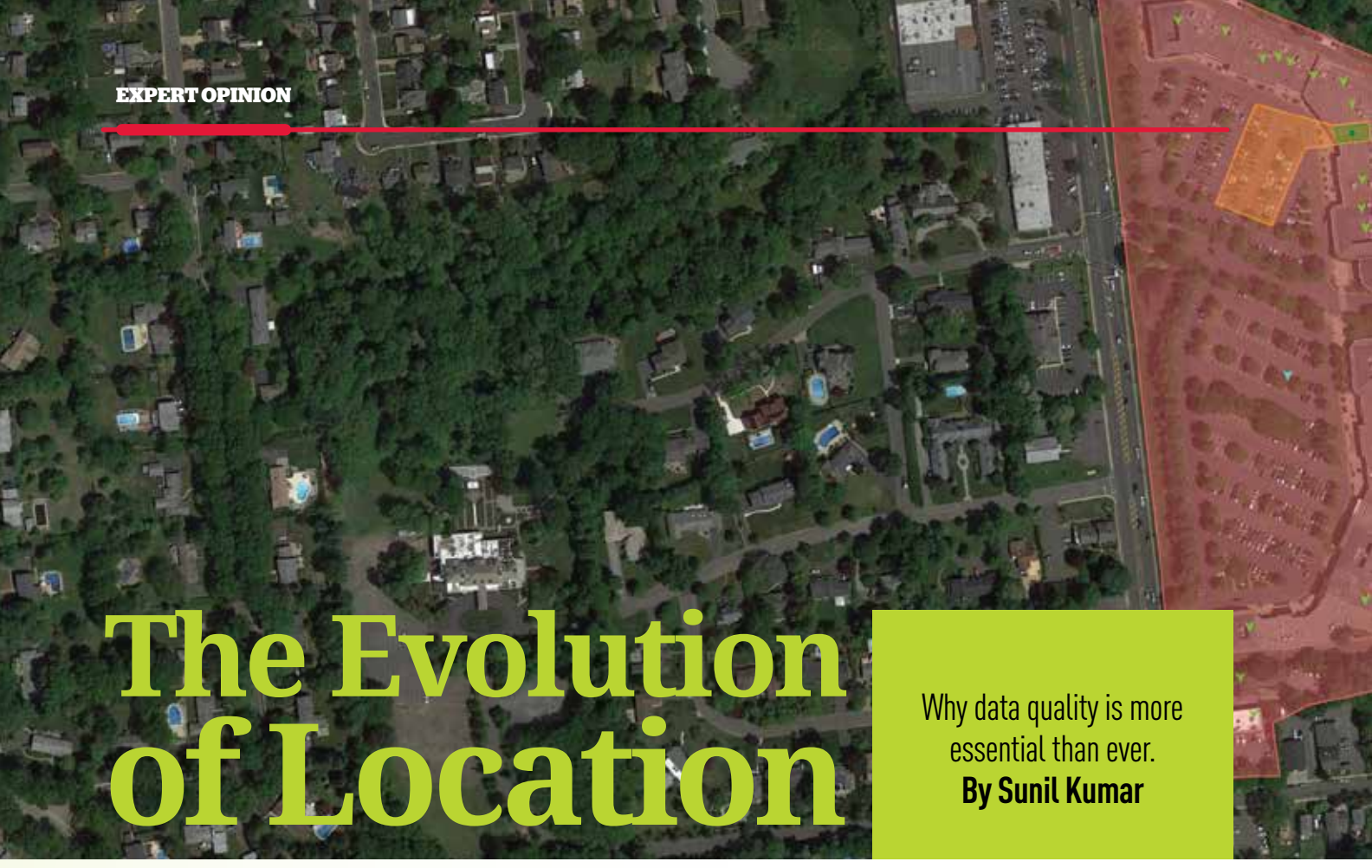


The Evolution of Location

Why data quality is more essential than ever.
By Sunil Kumar

Over the past several months, there has been increased conversation about location intelligence and the location industry overall. While the value of location is clear — 90% of all retail transactions still happen in the real world — the biggest challenges location companies face as technology changes are accuracy and trust. While it is important to advertisers that they can trust the quality of the data they use, it's also crucial that technology providers deliver on those promises. At GroundTruth, quality location data is the foundation of everything we do, and it's now more important than ever that we collect and deliver high-quality information as we expand our services and platform offerings.

The Evolution

Back in 2009, when GroundTruth was founded, smartphone adoption was still very low. A mere 17% of Americans owned a smartphone. However, today, adoption is at 71.4%, a four-fold increase from when we started. In addition to smartphone adoption, the methods by which location data is gathered have changed significantly through the years, and GroundTruth has developed methods that are far more sophisticated, allowing us to collect higher quality data than ever before.

While there are several ways to capture location data, not all methods are created equal, and the quality of the data collected varies by method. At GroundTruth, data quality is defined by everything we do to accurately assess whether a physical "visit" has occurred. Visits are the KPI (key performance indicator) based on which we have built our business. It's how we are able to relevantly reach people based on where they are; it's how we are able to build better audiences based on where they have been; it's also how we are able to build predictive targeting products and performance-based buying models like our revolutionary Cost Per Visit.

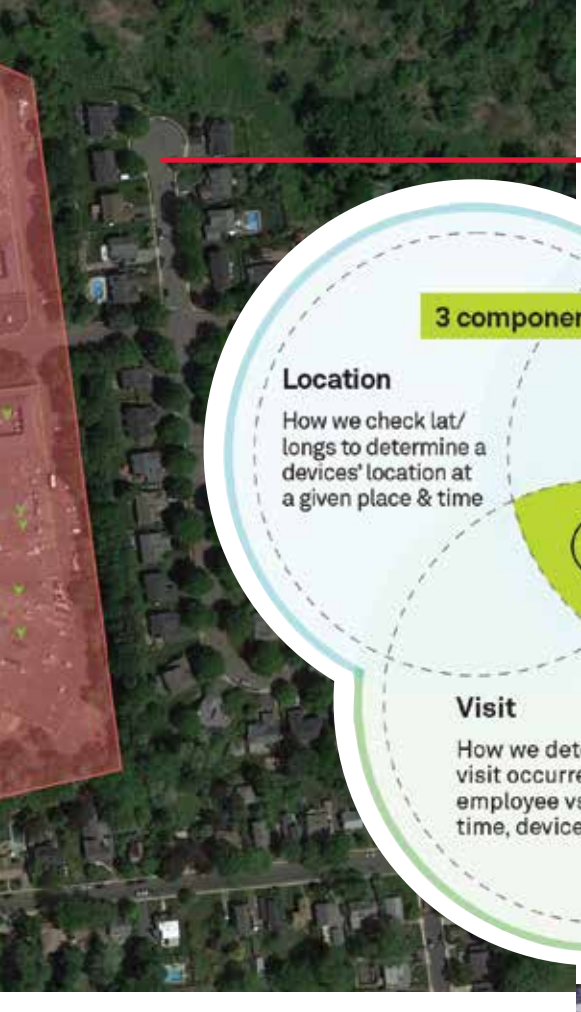
To accurately define a visit, we apply three key areas of data purification, which have been developed internally over many years of research and implementation.

Location Determination

Data quality begins with verifying the accuracy of a device's location signal. There are several factors our patented location determination technology checks and filters to ensure that the lat/longs tags we have and use are geo-precise. This includes filtering out centroids, randomized lat/longs, abnormal pattern recognition, outlier signals and carrier IP signals.

Place Determination

Mobile location signals we see on our platform are then mapped back to a business or point of interest (POI) through the use of our proprietary Blueprints technology. Blueprints is the only mapping platform that accurately defines multi-layer geo-boundaries for POIs, which is necessary to understand what businesses and places mobile users visit and how they engage with their surroundings. Blueprints is also an example of our "privacy by design" approach to building products. We have built a blacklist of locations that are never able to be used to target or measure campaigns from. Not only



do we not use data that would be sourced from such locations, our platforms do not even collect this data.

Visit Determination

The ability to distinguish and verify real visits is what we call Visit Determination. After we have verified the location signal, matched it to a place via Blueprints, the third and final step is determining whether a visit has occurred. Several key factors enter into the complex calculation of whether we deem a visit to be 100% verified. The factors we use to filter a visit include dwell time, location signal's horizontal accuracy, user speed and store hours. Visit Determination provides the basis for how we are able to provide accurate attribution and performance products like Cost Per Visit.

In addition to focusing on data quality, GroundTruth is also dedicated to protecting the data collected. As consumers become more focused on privacy and their own data rights, we feel it's just as important to remain focused and forward thinking when it comes to protecting data and developing the types of responsible practices that instill consumer trust in the industry. At GroundTruth, we don't view privacy as a box to be checked or a passive policy to put on the shelf. We think of privacy as a proactive practice that has an influence on our decision-making every day.

What Lies Ahead

We know location marketing offers huge potential for brands, and as buyers begin to realize the value of visitation-based performance, we are also seeing brands adjust their marketing strategies accordingly to be more efficient in driving in-store visits. In order to keep working with our brand partners, we need to ensure that we are maintaining our high standards for data quality.

Today, GroundTruth sees roughly 125 million monthly mobile users on our platform, and our mapping technology allows us to continue to enrich the data we receive. This data is the core for building location and audience segmentation and we've done a great job perfecting this process over the past 10 years. As we look to the future, however, we believe AI and predictive modeling will play a vital role here. We are currently heavily invested in both and are working towards building a platform that is able to better predict store visitation behavior. We also believe machine learning is central to the future, as well as the success of GroundTruth, and we are excited for the next decade that lies ahead of us.

The biggest challenges location companies face as the technology changes are accuracy and trust. It's important that technology providers deliver their promise of quality data

Sunil Kumar, CEO, GroundTruth

TRACKING A DONKEY'S LIFE

A UK-based charity is using location and other technologies to assess and improve the living and working conditions of equines in South Asia. **By Avneep Dhingra**

A donkey's life is not easy. Apart from being propelled into backbreaking and hazardous work at a very early stage, the animal changes hands on numerous occasions in its prime. And different masters means different living conditions, varying welfare standards and often, injuries. In an attempt to "transform" the lives of donkeys and mules deployed in the brick kilns of India and Nepal, The Donkey Sanctuary, a UK-based animal welfare charity, is extensively using location and other technologies to achieve its target.

How it Works

According to the charity, the life cycle of donkeys and mules has many

Most of these equids start training even before they are a year old, carrying small loads alongside their working mothers

All photos courtesy of The Donkey Sanctuary

stages. Through its program, the charity focuses on the welfare of working equines from birth and early training in Indian brick kilns to the end of their lives in the mountains of Nepal. The charity started funding Donkey Sanctuary India and Animal Nepal in 2003 and 2009, respectively.

The Donkey Sanctuary has developed the Equid Assessment Research and Scoping (EARS) tool, which places technology at the center of its research strategy. The EARS tool utilizes the Open Data Kit (ODK) for data collection in resource-constrained environments, enabling the charity and its partner organizations to track animal welfare assessments using GPS. ODK is an open-source suite of tools combined with a global community of users that explores how technology can improve the lives of under-served populations. With the introduction of EARS, this now includes the world's donkeys and mules. Some of the users of ODK include WHO, USAID, CDC and Google.

So far, EARS has been used to collect over 1,300 animal welfare assessments in the brick kilns of Nepal. "What excites me most about the EARS tool is the ability to get data in the hands of everyone working to improve the life of donkeys," says Dr Joe Ryding, head of data and statistics at The Donkey Sanctuary.

By using ODK and GPS positioning, the charity can investigate spatial relationships within assessment data, which helps in directing interventions where they can have the greatest impact.

An example of the potential for geospatial analysis using EARS is the mapping of animal welfare hotspots — areas where hoof problems, or wounds related to harness might be a concern. "Additional environmental and human factors can then be investigated in a geospatial context. For instance, using digital terrain models to understand working conditions, remote sensing for vegetation monitoring and land classification and web maps to examine the availability of local service providers. Using geospatial technology and knowledge, combined with 50 years of donkey and mule experience, allows The Donkey Sanctuary and its partners to develop interventions that can have a lasting impact," explains Dr Ryding.

By using POLAR trackers, the charity can monitor the work done by donkeys and mules, linking heart rate to GPS tracks for knowing elevation and distance travelled

The Life Cycle

For a donkey or a mule, life begins in India, with the animal staying with its mother for the first few months. According to the charity, most of these equids start training even before they are a year old, carrying small loads alongside their working mothers. By the time they turn two and a half, they start working independently and are often sold in local equine fairs. Barabanki district in the northern Indian state of Uttar Pradesh hosts one of the largest equine fairs in the country, with anything from 7,000 – 10,000 congregating for sale each October.

A large number of equines sold in Barabanki are loaded into trucks for a 250-km journey to Nepal border. As the Nepal government doesn't allow live transport of animals, these donkeys and mules walk the final 3 km across the border to Nepalgunj, where they are again sold to locals and are made to work in trekking, transportation of goods and in the brick kilns. The kiln season in Nepal runs from December to May-June, just before the rains. With the advent of monsoon, the equines are sold again — this time to people in the mountains. In a majority of cases, these animals are abandoned when they grow old and are unfit to carry heavy loads, and finally die in the mountains.

According to the charity staff, by using POLAR trackers, they can also monitor the work done by donkeys and mules, linking heart rate to GPS tracks for determining elevation and distance travelled. The Donkey Sanctuary has used this technology in the brick kilns in Nepal to understand more about a typical working day for an equid. In the kilns where Animal Nepal works, rest periods, along with a mandatory day off (Saturday) has been introduced for the animals.

Future Prospects

The Donkey Sanctuary is now also exploring the possibility of using open source data (including satellite data) to help with its animal welfare work. This includes using geospatial outputs to help identify industries and locations where equid power is utilized. The first part of the project involves the use of earth observation (EO) data to locate and map equid powered brick kilns across India and Nepal. Researchers at the University of Nottingham have used high resolution imagery to map 55,387 brick kilns across the "Brick Belt", which covers India, Pakistan, Bangladesh and Nepal. The Donkey Sanctuary is looking to further this work by examining these locations to identify EO signatures associated with equine kilns.

Ceris Turner-Bailes, The Donkey Sanctuary's global programs director, says, "We understand the value that working donkeys and mules provide for families and we approach our work holistically, with the owners, their livelihoods and their families in mind. We are developing a life cycle approach to our work in India and Nepal, with a heavy focus on national advocacy and building the capacity of local service providers to meet the needs of equine-owning communities."

Clearly, location and other technologies have provided the much-needed push to the UK-based animal welfare charity's initiative.

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Jennifer Abrahamson (extreme right) in West Bengal, India, with adolescent girls learning about their land rights.

HER FAIR SHARE

Discriminatory social norms continue to stand in the way of gender equality. The Stand for Her Land Campaign was founded to build a global movement to close the gap between laws and what actually happens on the ground in communities and countries, emphasizes **Jennifer Abrahamson, Chief of Advocacy and Communications, Landesa**

Why are women's land rights important for economic growth and social wellbeing?

Land is the foundation — both literally and figuratively — for economic growth and social well-being. Without the right to land, it is difficult to grow crops for food and to generate an income. It is difficult to secure loans and credit needed to invest and grow farming businesses. In rural areas and urban settlements alike, land rights are needed for securing shelter and housing. When women don't have equal rights to own, inherit, manage and use land, their decision-making power in the household is diminished and their dignity is denied. Without inheritance rights, women and their children are often left to fend for themselves, compromising their health, nutrition, education, safety and their futures.

Can you quote some statistics on the current status of women's land rights around the globe?

We know that in half the countries of the world, women are still unable to realize their equal rights to land — even in countries where laws exist that protect those rights. Discriminatory social norms from

When women don't have equal rights to own, inherit, manage and use land, their decision-making power in the household is diminished and their dignity is denied. Without inheritance rights, women and their children are often left to fend for themselves, compromising their health, nutrition and education

time immemorial continue to stand in the way, along with other structural barriers that prevent women from accessing their legal rights.

Although a legal gender gap persists, great progress has been made in recent years in many countries across the world, including countries like India, Kenya, Liberia and others. Even then, implementation and enforcement of those laws is altogether a different story.

What is the Stand for Her Land campaign all about?

The Stand for Her Land Campaign was founded to build a global movement to close the persistent gap between laws and what actually happens on the ground in communities and countries.

The vision of the campaign's founding partners is to support and sustain the activities of the real change makers: civil society groups and other non-governmental advocates working on the ground. We will support them as they take up the mantle of the campaign and work collectively to identify and tackle the barriers in their own communities and countries. We aim to build a global network of country coalitions and integrate the campaign's mission into the existing ones — that can share effective strategies and approaches. In the pilot phase, which runs through 2020, we hope to get the campaign off the ground in 5-7 countries worldwide. And ultimately, we envision the campaign to expand to 40 more countries over the next decade.

What qualitative or quantitative changes you wish to see through the campaign? How will you measure success?

We have intentionally aligned the campaign with what's known as the 2030 Agenda — the lifespan of the UN Sustainable Development Goals — of which women's land rights are a part. Although we have not set precise targets yet, we are in the process of conceptualizing the design for a rigorous impact assessment framework that will draw the linkages between the campaign and data collected around women's land rights in countries. Ultimately, we aim to empower millions of women around the world to be able to fulfil their land rights in their lives, not just in law.

What is the role of each partner?

Right now there are five founding partners — Landesa, Habitat for Humanity, Huairou Commission, the World Bank and UN Habitat's Global Land Tool Network. This group will work in service to the campaign, coordinate activities, provide a global platform for country coalitions and build out global communication and advocacy tools.

We envision the campaign expanding greatly at the global level and at the country level. New partners will represent a diversity of issue areas impacted by women's land rights: groups that work on women's rights and empowerment; development and poverty alleviation; food security; indigenous rights; health and nutrition; climate justice; and many more. Each partner will bring unique added value to the larger effort.

But in the end, we envision a chorus of voices coming together to speak as one to effect sustainable change. Together, these voices will have a great chance to shift age-old social norms and structural barriers that prevent women from realizing their land rights across different continents, countries and cultures.

What role do you see for the mapping or geospatial community here?

We see a significant and singular role for the mapping and geospatial industry. Unfortunately, there is enormous work that could be done to strengthen the country coalitions. For example, these tools could help measure changes within communities where campaign coalitions are working. Mapping or geospatial technologies could bolster the campaign by identifying land that is owned, controlled and managed by women in the earlier stages of the campaign, and help measure change as the campaign progresses.

The renovation of Atlanta's Alliance Theater utilized trailblazing technology to pair hand-crafted woodworking with cutting edge design and prefabrication

Photo by Greg Mooney.

THEATRE REIMAGINED

The $32-million transformation of Atlanta's Alliance Theatre is a master class in design and prefabrication collaboration

The Woodruff Arts Center is the cultural heart of Atlanta, Ga. The storied Midtown campus opened its doors in 1968 and serves as the home of the Grammy Award-winning Atlanta Symphony Orchestra, the High Museum of Art, and the Tony Award-winning Alliance Theatre.

The 650-seater Alliance Theatre stages large amplified musicals as well as spoken-word theatre that are reliant on natural acoustics. To maintain the venue's national reputation, the Woodruff's leadership authorized a comprehensive top-to-bottom renovation of the theatre in 2015. The objective behind the first such exercise since the theatre's opening was to improve the patron experience through an assortment of design enhancements, updations and innovations.

Woodruff officials conducted a national design competition to determine the architect for the $32 million project and chose New Orleans-based Trahan Architects. The founder and principal of Trahan Architects, Trey Trahan, FAIA, says, "The theatre will truly be a one-of-a-kind place for creating community in the performance space."

Audacious Vision

What Trahan envisioned for the "one-of-a-kind" distinction is audacious in scope and ambition. The bold concept marries two disparate forms – handcrafted woodworking with cutting edge design and prefabrication – to create a showcase of nature and technology that reinvents the theatre-going experience.

Trahan worked alongside practice colleagues Leigh Breslau, AIA, an expert in public and cultural space design, Brad McWhirter, AIA, technical director, and Robbie Eleazer, AIA, project lead and design architect, as well as staff designers. "It's an arts campus with very sophisticated architecture," explains Eleazer. "We wanted it to be humanistic and inviting."

The owner also challenged the Trahan team to create an enduring work of beauty exemplified by the woodturning art created by the acclaimed Moulthrop family. "The trick was how to make this affordable. Our budget was less than half of what initial estimates projected," says Breslau.

The design solution pointed to wood, but what form and shape should it take? "I remembered the work of Matthias Pliessnig and his beautiful benches of reclaimed wood," recalls Trahan. Pliessnig is a Brooklyn artist who creates free-form furniture and sculpture. With Pliessnig, the Trahan team devised a concept that involved the integration of 100,000 linear feet (nearly 19 miles) of expertly milled white oak threads in the theatre chamber's design form.

To help sell the idea, Pliessnig was commissioned by the architect to create a single panel of shaped threads. The panel was presented to the board in a dramatic 1:1 scale, demonstrating what the reimagined theatre could look and feel like.

Success Through Iteration

The swooping, swirling wood-threaded panels now had to be created and installed at scale. The magnitude dwarfed anything Pliessnig had previously accomplished on his own. Eleazer says a call went out to three millwork fabricators. Soon, one clear-cut favorite emerged: a family-owned and operated design assist and fabrication company out of Plaistow, N.H., CW Keller and Associates. The New Hampshire fabricator counted on an assortment of in-house advantages, including:

- Major investments in computer numeric control (CNC) milling processes
- A team of skilled woodworking and engineering professionals with a 40-year history of applying innovative solutions to challenging customer assignments
- Trusted alliances with leading manufacturing technology names, which was to prove indispensable in the design and assembly work that was to follow

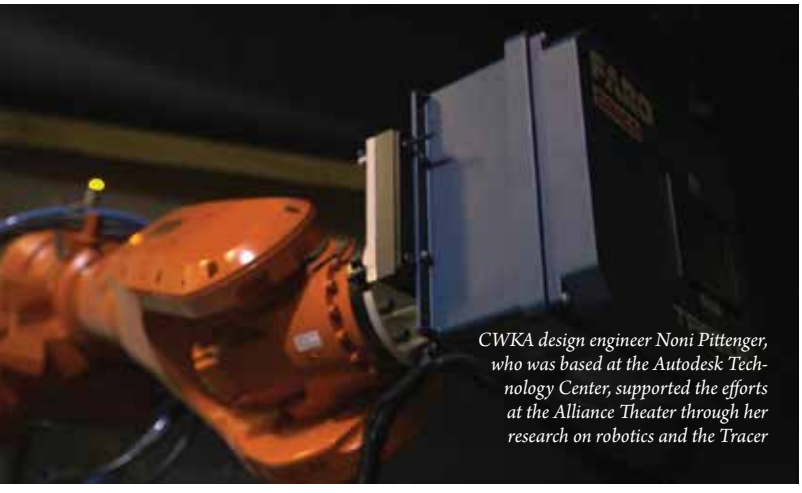
Working from construction drawings of the reimagined theatre chamber created by the Trahan team, CWKA teams set out to understand the workflow, materials and fabrication process. There were questions like how much would it cost, what tools do you use, and how do you safely transport the prefabricated parts from a New Hampshire workshop to Midtown Atlanta, a distance of 1,110 miles? Also, how do you accurately prefabricate so it perfectly syncs with the work of

the steel fabricators and concrete contractors? The construction plans called for more than 200 customized panels representing nine design types, each type formulated to meet strict acoustic requirements.

Let Laser Light the Way

The key to next steps at CWKA was a reliable understanding of the existing theatre's precise dimensions. Around 2010, CWKA purchased a Focus Laser Scanner from FARO® Technologies. "The ability to go to a job site, laser scan it and bring that data back to the shop is something we built into our workflow very quickly," CWKA president Shawn Keller explains.

Keller adds, "We ran some quick numbers. If the laser scanner saves us five field survey trips or change requests in the first 18 months, it's paid for itself." According to Keller, the goal was met by a



CWKA design engineer Noni Pittenger, who was based at the Autodesk Technology Center, supported the efforts at the Alliance Theater through her research on robotics and the Tracer

"10-fold factor at the end of the day."

Keller's Lead Engineer on the project, Matt Arsenault, agrees, "Our craftsmen are more effective because they're more confident. It's integral to our workflow now."

The team at Trahan designed the 200-plus theatre panels using an assortment of software. The principle applications were Rhinoceros 3D® (Rhino), Autodesk® Maya®, Grasshopper®, and Autodesk® Revit®.

"We don't have a single platform that gives us everything we need," explains Eleazer. "Every platform does some things great and other things not-so great."

Arsenault says, "We do nearly all our modeling with Rhino and Grasshopper. We can adapt site conditions to our tolerances since all our modeling is computational."

The software used for scanned point Cloud data and registration was FARO SCENE. Arsenault singles out another FARO software application, **FARO BuildIT Construction**, as a key project application. BuildIT wasn't introduced to CWKA until after panel prefabrication work was well along. However, it proved to be hugely instrumental in not only fabrication but also installation, thanks to the hardware it supports, the FARO Tracer^{SI} Laser Projector, or Tracer for short.

Tracer to the Rescue

Input vs. Output: To understand the value of Tracer, it's important to contrast the differences between laser scanning and laser projection. Ben Parkin, a FARO applications engineer, says, "A laser scanner collects a point Cloud of data within the environment you're investigating, like the Alliance Theatre chamber. It's an *input* device, gathering information.

"The FARO Tracer, by contrast, is an *output* device, projecting data from a model Trahan may provide and literally projects that information. It's a virtual templating solution," Parkin says.

Architect Eleazer likens the functionality to a "spatial mold" that eliminates the waste of hundreds of registration rips, pallets, and plywood sections. "The technology allows us to work in a more responsible way with a level of digital honesty no one could argue with," Eleazer says.

For Arsenault and CWKA, Tracer advanced the project on two fronts.

Fabrication: A Prayer Answered: The CWKA team wondered how they were going to bend and place each white oak thread with the required level of precision. "We didn't know the Tracer existed at that point. It changed everything," Arsenault recalls.

Installation: Leap of Faith: Virtually templating – projecting extremely accurate templates on a manufacturing surface – is the gold standard for fabrication precision in aerospace manufacturing. The idea of applying the same technology to construction is still in its infancy. "The Tracer is vastly quicker and more effective than laying out with a tape measure and checking it three or four times only to discover weeks later the manual tape measure reading was wrong," says Arsenault.

CWKA immediately applied the Tracer to panel fabrication, precisely bending and setting each white oak thread with digital precision thanks to the projected green-illuminated template. They also quickly reasoned, if the Tracer works wonders for panel fabrication, why not panel installation back in Atlanta? Keller says applying laser projection to panel assembly "was the only place we made a leap of faith."

West Coast Lifeline: However, that leap of faith had a safety net: the Autodesk Technology Center at Pier 9 in San Francisco. Working alongside Autodesk researchers at the facility was CWKA design engineer and Pier 9 Innovator in Residence Noni Pittenger. As templating issues surfaced in Plaistow or Atlanta, a call to Pittenger put in motion some of the industry's top minds in solving the question. "We needed to apply digital tools in the field to confirm digitally designed work," Pittenger says.

For Autodesk, as well as FARO, the insights gleaned from the Alliance Theatre project are helping inform new ways to innovate product for construction customers.

Faith Rewarded: Meanwhile, Keller's leap of faith was quickly rewarded. The projection system proved to be an essential element to panel installation in the theatre chamber. Arsenault says the effect of seeing templates projected on theatre walls was galvanizing to an audience beyond CWKA and Trahan. "Other trades ask us if we can do it for them," he grins.

Courtesy: Faro Technologies

OPEN DATA

To Address Social Issues and Tackle Ecological Challenges

Open data is playing a crucial role in disaster mitigation and is helping those grappling with social challenges. It is a must for ensuring sustainable development. **By Melanie Eckle**

Geospatial data is key for empowering citizens around the globe and to achieve the SDGs — if geodata is made openly available and easy to be put to use.

Many places in the world are still missing from maps, which leads to serious challenges for local development, humanitarian projects, and disaster management. Since 2010, the Humanitarian OpenStreetMap Team (HOT) came together to address this challenge by coordinating a global network of volunteers to support humanitarian action and community resilience through open mapping.

Open Data for SDGs

The core of these efforts is OpenStreetMap (OSM), which, similar to Wikipedia, is a free and openly editable map of the world. The use of OSM for disaster and humanitarian purposes was catalyzed nearly a decade ago, when Haiti was struck by a severe earthquake, leaving a great number of people in dire need for aid. By making use of satellite imagery, members of the OSM community mapped general infrastructures as well as disaster-related services and features. Haitian diaspora and people on the ground added additional local information, creating an up to date map of Haiti. The local information ranged from basic building functions to emergency centers.

Since 2010, more than 165,000 mappers have contributed to HOT projects. These volunteers work both remotely and locally. Remotely, making use of satellite and drone imagery and the OSM editors, and locally, using smartphone apps and GPS as well as paper-based methods, depending on the resources available.

Apart from major activations, for e.g., the Nepal Earthquakes 2015, when more

HOT is always following the principle 'local people, local tools, just add knowledge'

than 9,000 mappers contributed, or recent efforts after Cyclone Idai, that were already supported by more than 3,000 mappers, HOT has supported numerous community projects to support open data use to meet the SDGs. HOT is hereby always following the principle "local people, local tools, just add knowledge".

Tanzanian Experience

Two of these projects are located in Tanzania. The Ramani Huria ("open map") project was launched in 2015 and has since then focused on creating a detailed map of Dar es Salaam, engaging with local leaders and community members, and teaching free, open source data collection.

The city is not only one of the fastest growing in the world but is also prone to floods, which has caused fatalities and high levels of displacement over the last couple of years. The Ramani Huria team mapped basic infrastructures in the city, worked with local communities to understand their flood exposure, and is currently combining exposure and flood hazard data to conduct risk analyses, improve flood mitigation plans and raise awareness of potential future disasters and natural threats.

The second project, Crowd2Map, focuses on rural Tanzania and the fight against gender-based violence — again through open map data. By mapping local villages, the project supports local development and helps prevent Female Genital Mutilation (FGM). While FGM(Female genital mutilation) is illegal in Tanzania, it is still practiced in different rural regions. By putting rural Tanzania on the map, girls can find shelter and support in local Safe Houses run by our local partner Hope for Girls and Women Tanzania. Additionally, Hope can use the maps to find girls at risk and run outreach programs around the risks of FGM. Mapping villages, in turn, helps to localize girls that are in danger of being cut. Consequently, thousands of girls have been saved through the power of an open map.

Multi-pronged Engagement

In all of these efforts, HOT is not only coordinating the response but also supporting through providing the latest technology and by establishing partnerships and collaborations. HOT is thus an enabler and facilitator and building bridges between the worldwide mapping community and partnering organizations, including governmental, non-governmental, non-profit, and humanitarian organizations, as well as, research institutes.

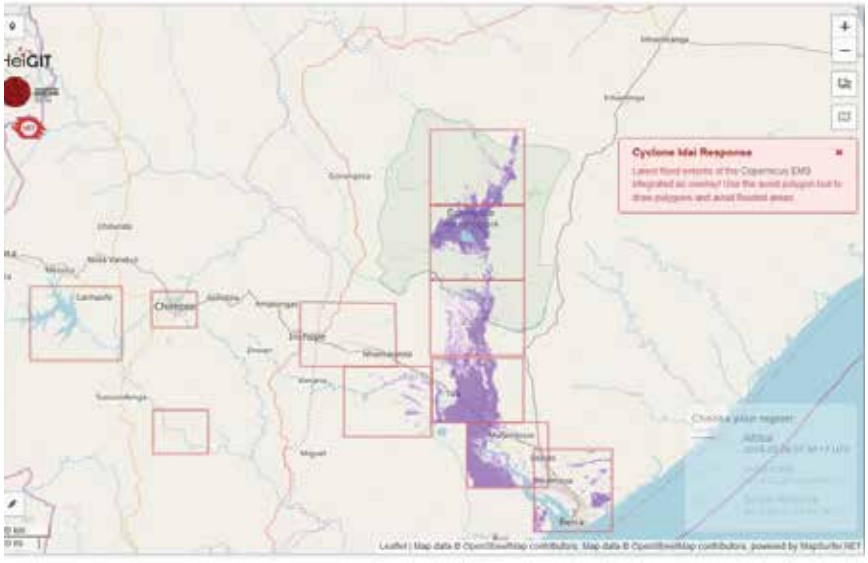
The latter are playing a crucial role in assessing the usability of the collected data and to facilitate potential contributors to support the efforts of HOT, and for potential beneficiaries to easily put the data to use.

In this regard, the GIScience Research Group at Heidelberg University has supported HOT's work since it began, through research and application development — to support open map data creation, analyses, and use.

These efforts have shown great potential for humanitarian projects and disaster management and are since 2016 also further supported and strengthened by the Heidelberg

HOT is a facilitator that builds bridges between the worldwide mapping community

HOT is an enabler and facilitator and is building bridges between the worldwide mapping community and partnering organizations, including governmental, humanitarian and research institutes

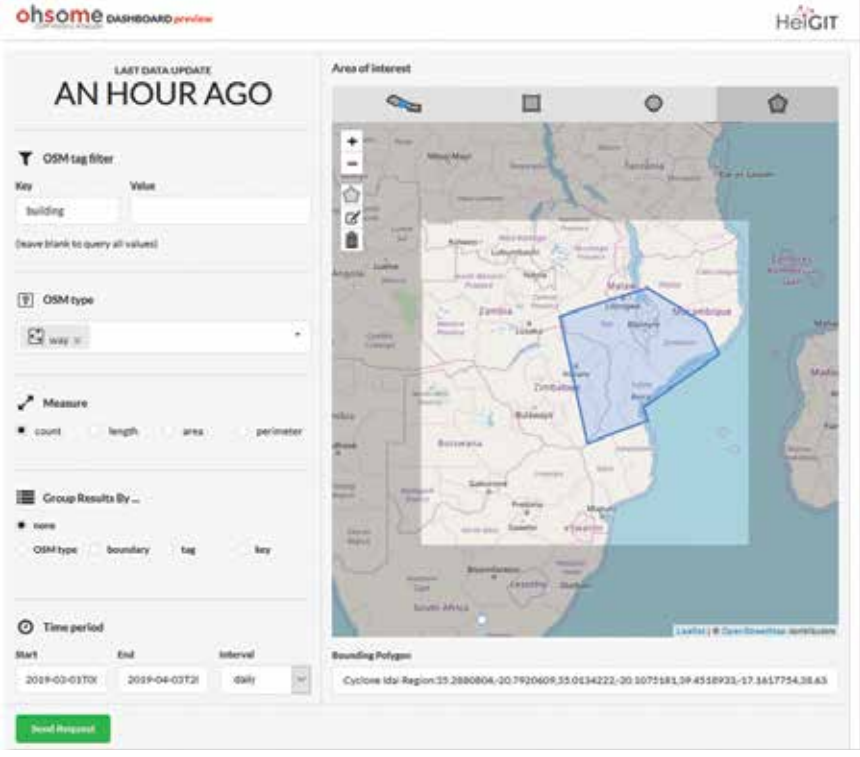


Open map data has great potential to improve the lives of those suffering in developing and underdeveloped countries

Institute for Geoinformation Technology (HeiGIT) team, which was launched by the GIScience Group with the main aim to improve knowledge and technology transfer from fundamental geoinformatics research to practical applications.

The HeiGIT team focuses primarily on open map data and related applications and services – all around the use of open geodata. HeiGIT is split into a number of specialties. The Location-based Services and Navigation team develops a variety of services fit to serve a large range of use cases and applications, based on OSM and other sources of free spatial data. The Big Spatial Data Analytics team creates processes and tools for assessing the quality and enriching heterogeneous Web 2.0 data by applying innovative methods from spatial data mining and deep learning.

The Geoinformation for Humanitarian Aid team builds a bridge between these teams to facilitate knowledge and skill transfer to humanitarian and disaster-related applications. Recent examples that show the potential of the collaboration of the HeiGIT teams and HOT are a special instance of the open route service for disaster management and an ohsome OSM History dashboard that were both developed for Cyclone Idai and building on the main services of the team.



Many places in the world are still missing from maps, which leads to serious challenges for local development

These were adapted to fit needs and requirements in disaster response activities. The Idai specific open route service for disaster management was updated every 90 minutes to consider the latest OSM data available. Integration of latest flood extends, furthermore, allowed us to easily bypass flooded areas. Likewise, the Idai ohsome dashboard enabled analyses of the latest OSM data and thus activation monitoring and data analyses.

These are only some of the examples that show the great potential and impact open map data can have and most importantly the great things that we can achieve collaboratively. To learn more about HOT and HeiGIT, find us at *hotosm.org and heigit.org.*

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THE FUTURE LOOKS EXCITING

GEOTECH, the developer, and manufacturer of Lidaretto, is located in Bratislava, Slovakia. Founded in 1994, the company has deep experience with different data capturing and measuring technologies, and has been a local representative of Leica Geosystems for over 20 years. **Erik Frohmann, Commercial Director, Geotech,** believes that the intense competition in the LiDAR market will not only result in better technology but also cost optimization.

Tell us about your product line?

Our flagship product Lidaretto is a compact, lightweight, and multiplatform mobile LiDAR mapping system. This means it can be used for easy 3D scanning on suitable moving platforms such drones, cars, boats, backpacks or even the tripods. Multiplatform use is the main idea of Lidaretto – this means the user has to invest only once in the technology, which can then be used optimally according his application.

Currently, we offer three models of Lidaretto depending on the version of LiDAR module. The difference lies is in the number of channels, range, weight, and the price of the models. We are also offering some other options like dual GNSS or support of new signals of Galileo and Beidou for increased accuracy, and availability in difficult field conditions. We have developed our PC software Lidaretto Creator for easy generation of point clouds, and we have still more ideas in the mind, and keep improving our capabilities.

What is your customer base and in which geographies are you operating?

The right customer for Lidaretto is anyone looking for a LiDAR mapping system at an affordable cost. LiDAR-based mobile mapping is a very efficient way of data capturing comparing to traditional "surveying" methods, e.g. using RTK GNSS rovers or total stations. We believe that in the near future the number of used systems like Lidaretto will grow significantly. We are most active in Europe but we also have many inquiries from overseas. We are looking for local partners to help us sell and provide support on Lidaretto systems.

Who are your partners?

If you mean partners who supply us the main components for Lidaretto, they are Velodyne which has proven LiDAR modules, and NovAtel with its premium positioning technology. We integrate high-end technologies in one product in order to bring to the market quality, and reliable solution that will make our customers satisfied.

How do you foresee the future of solid state LiDARs?

We are keeping our eyes on all the news about developments in the LiDAR field, and believe that the future will be exciting. The competition in the LiDAR market will bring not only better technology but also decrease the cost which enable to use it by much larger base of the customers.

Compact, Lightweight & Multiplatform LiDAR

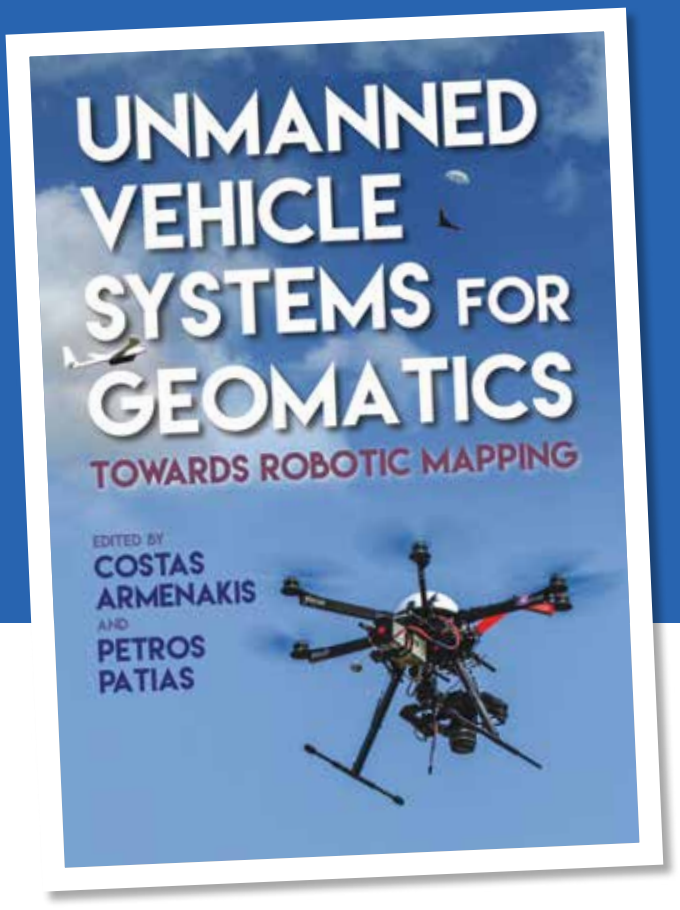
Geotech recently launched Lidaretto, a new compact, lightweight and multiplatform LiDAR solution for mobile mapping. Lidaretto can be mounted on a drone, car, backpack, boat or even a tripod, depending on the application.

Scanning with Lidaretto is a very effective way of capturing huge amounts of 3D spatial data in comparison to traditional methods. Lidaretto Creator software can be used intuitively to select which part of the LiDAR data will be exported, allowing users to set several parameters and select the desired coordinate systems in which the points clouds will be outputted.

The idea behind it is to offer a quality solution for an affordable price, and bring LiDAR mapping technologies to those who think the LiDAR is too expensive for the investment.

Key Features

- Combination of LiDAR and positioning produces accurate point clouds as per clients requirements
- Easy to operate and doesn't require any specialised skills
- Made for professionals with a limited budget



UNMANNED VEHICLES: PAST, PRESENT AND FUTURE

EDITED BY:
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PROF. ARUP DASGUPTA

Unmanned Aerial Vehicles (UAV), Remotely Piloted Vehicles (RPV) and drones are the names given to a class of vehicles which can carry payloads and be guided remotely through wireless controls. Their use, from recreation to warfare, has been around for several years and their use in Geomatics has been steadily rising. The book titled 'Towards Robotic Mapping' is an excellent addition to the knowledge base of Unmanned Vehicle Systems as it covers many aspects — technology, operations, theoretical basis of data acquisition and processing and applications. It is interesting that the word aerial has been left out of the title, and rightly so, because while UAVs tend to steal the show, there are many remotely piloted systems for land based and waterborne robotic vehicles.

The introductory chapter gives an excellent overview of the technology and in particular its use in mapping. It covers systems, their usage, sensors, navigation, regulatory issues and limitations. The second chapter establishes the mathematical framework for the reference coordinate system and transformations in the context of mobile mapping. It then goes on to mission planning, before explaining other aspects like bundle block adjustments, sensor georeferencing and associated mathematics. A section on 3D surface reconstruction using dense image matching and a combination with LiDAR point clouds to generate complete surface model is well discussed.

It is also to be noted that the problems associated with land-based RPVs in terms of localization in an unknown environment is unique. There is a complete chapter on the mathematics of localization in terms of position and orientation of sensors on robotic ground vehicles. Use of such systems for outdoor and indoor mapping is included.

Sensing and control of UAVs is covered in detail with attention to all types of UAVs and includes discussion on advanced areas like intelligent systems of control and sensing. Hardware for control and sensors ranging from cameras to LiDARs, as well as non-imaging sensors, are discussed. A brief discussion on the pros and cons of low-cost UAVs is presented cogently. Though today most regulations insist on line of sight control, the book also discusses the future possibilities of autonomous flight planning and execution.

The core issues of data acquisition and mapping is discussed briefly and illustrated with many examples to bring out best practices. The book ends with two very important chapters. One is on the emerging trends in technology where the discussion is focussed on the trends relevant to Geomatics. The other chapter is on the future outlook and challenges. The latter discusses issues related to privacy, government regulations, legal aspects, as well as technological issues.

The technology of Unmanned Vehicles is still evolving and their serious use for mapping is at a nascent stage. This book does a very good job of bringing together all aspects of UVs for Geomatics applications and should be an essential textbook for professionals in the field, or those contemplating an entry into the field of robotic mapping in Geomatics.

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Amsterdam, The Netherlands

GEO BIM 2019

GeoSmart India
3-5 December 2019
Hyderabad, India

GEO SMART INDIA

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GEOBUIZ SUMMIT

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