

# Dynamics of C

**Change is the only constant** - though an old adage, is quite relevant in the present context. In the backdrop of economic gloom and audacity of hope, it is important to take stock of where we stand, count our blessings and assess the challenges. **GIS Development** spoke to several geospatial industry leaders, decision makers and academicians to gain an objective understanding of the dynamics of change vis-à-vis the dimensions of geospatial content, convergence of technologies, impact of global economic slowdown, growing markets, potential geospatial verticals and the challenges that lay ahead for the industry. Each of the sections of the article discusses elaborately the current and future expectations from the geospatial market.



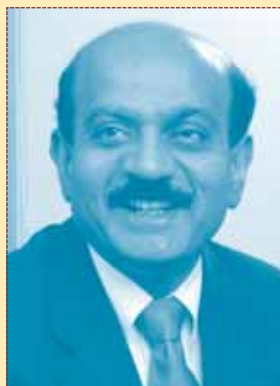
## Expanding dimensions of geospatial content

**E**volution is a human instinct. Be it anthropological, intellectual or scientific, man's craving for a better tomorrow remains unsatiated. The science which found its roots in understanding the earth and its resources has now evolved into being an omnipotent technology tool capable of redefining the contours of the world.

Geospatial technology initially focussed on collecting information through cartographic means to create a 2D map to depict the length and breadth of the land, its resources and national and international boundaries for administrative tasks. On the one hand, we have moved from digitising analogue maps to creating original digital data for specific uses and then on to creating generic data that can be used for a range of different applications. On the other hand, in the last one hundred years, the introduction of aerial imaging technologies has changed the face of cartography dramatically. Today, there is a glut of data in general and specifically, there is a broad range of remotely sensed high resolution data available. While traditional electro optical sources on board satellites are delivering data with a resolution of about half a meter, radar data produces resolutions of about one meter.

With airborne systems, optical resolutions of 10 cm are being achieved.

"Clearly these resolution changes improved the ability to map features which have traditionally required ground based surveying techniques," says Brad Skelton, CTO, ERDAS. Concurring with him, BVR Mohan Reddy, CMD, Infotech Enterprises, says availability of high resolution data has practically demystified the map making processes and feature extraction from ortho-rectified high resolution satellite



**Availability of high resolution data has practically demystified the map making processes**

**BVR Mohan Reddy**  
CMD, Infotech Enterprises

# Change

imagery (HRSI) is gaining ground rapidly, reducing reliance on field-based operations.

Talking about the accuracy of data, we can't but acknowledge the explosive innovation in acquiring precise geospatial information. The unanimous choice of all industry leaders for achieving precision is the use of laser scanning and mobile mapping technologies. Advocating laser scanning, Matt Ball, Editor, Vector 1 Media, says, "This is one technology that will quickly revolutionise surveying." Asserting that laser scanning technology is growing at a rapid pace and that the market for the same will double in the next two years quoting Spar Research report, Lisa Campbell, Vice-President, Autodesk, says, "Ultimately, the growing level of detail will serve to enhance the resulting analyses and, in particular, help create very accurate visual models of the infrastructure and the world around us." In this context, Don Corsswell, President, Optech, points out that the complementarity of mobile and air borne mapping has turned out to be really fruitful. There are places where conducting air-borne survey becomes difficult, such as cities. The datasets obtained as a result of using a combination of both these technologies gives fantastic resolution on all aspects of the city, he argues.

However, security restrictions and government permissions will limit their adoption for some time, feels BVR Mohan Reddy. Once these restrictions are relaxed and procedures streamlined, end-users will be able to exercise judicious choice between available technologies, resulting in better return on investment (ROI), he opines.

Auguring a good demand for such technologies, Ed Parsons, CTO, Google Earth says, "There is huge potential for information products produced from the automated combination of aerial and terrestrial sensing, here LIDAR in particular has an important part to play in creating 3D city models."

After the accuracy and resolution of data are taken care of by innovative sensor technologies, its currency has gained priority in the context of rapidly changing

urban façade. Prof Josef Strobl of Salzburg University says, "Increasingly, we need to not only support mapping tasks, but primarily monitoring assignment. This means that multi-temporal or quasi-continuous flows of data are the foundation of change detection and triggering of database events." Today, we don't just collect data in two dimensions. The geospatial content is primarily moving from 2D to 3D and 4D and also we have been able to understand how architectural drawings or civil engineering data could form part of geospatial composition.

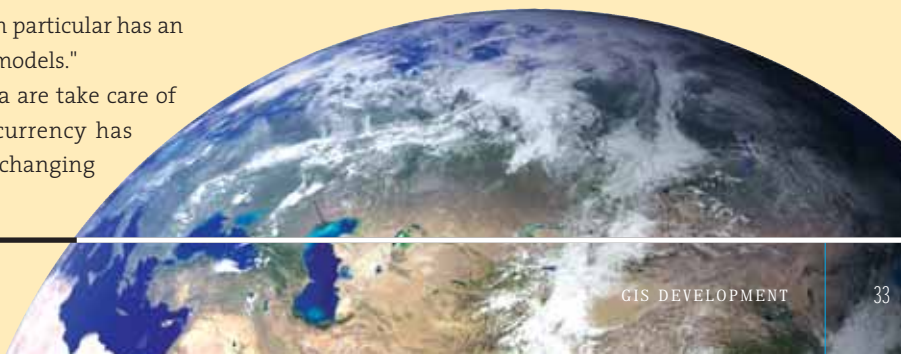
Drawing from these sentiments, Matt Ball says, "The quick and automated capture of 3D city data from mobile platforms are adding a great deal of realism and currency to geospatial exploration systems. The utility of these realistic environments will only increase and it's just a matter of time before our urban areas are accurately captured on an ongoing basis at a high degree of digital reality." Bringing out the importance of these realistic environments and the inclusion of indoor content, Mark Reichart, President and CEO, OGC,



**Resolution changes improved the ability to map features which have traditionally required ground based surveying techniques**

**Brad Skelton**  
CTO, ERDAS

says, "It is now important to provide a level of detail about the indoor environment commensurate with our growing digital connection to the outdoor environment. Indoor location technologies are only now emerging, but I believe this will be a major 'next generation' trend for the community - providing comprehensive indoor 'geospatial' services for a range of indoor needs". Collectively, all these advancements are fuelling an appetite for more and better geospatial information.





## Converging technologies and integration with mainstream IT

The expansion of definition of what constitutes geospatial content is driven by tremendous innovation in the technologies used to generate them. Geospatial technologies grow with the technologies they depend on like faster processors, better displays, wireless networks, online databases, fixed and mobile sensors etc; they also grow new branches and spawn new hybrids as inventive minds seek new solutions.

Today, convergence is the key at the core of which is the 'blurring of boundaries' between GIS and CAD. GIS analyses the world as it is, based on observations and representations of reality. CAD looks ahead with a focus on planning, putting designs for future features on the map. "Combining representations of current realities with the (alternative) futures of CAD-based designs probably holds the most important potential regarding convergence," opines Prof Josef Strobl. This trend is clearly visible as government agencies, utilities and other organisations adopt infrastructure modelling that is beyond a mere '3D shell'. "It delivers a visualisation with all of the intelligence we come to expect in a GIS and the precision engineering detail we find in CAD," says Lisa Campbell, VP, Autodesk. As CAD, facilities and geospatial site information exist in 'stovepipes' at each stage of a building's or capital project's life-cycle, virtually everything in our built environment costs more than it should to design, build, operate and maintain. Mark Reichardt advocates interoperable Building Information Models (BIM) to correct this situation.

The list of converging hardware and software technologies keeps growing: wireless networks, computing devices, storage devices, sensor webs, distributed processing, grid processing, modelling and simulation, data

discovery, imaging, location technologies, semantic processing and others. We really ought to do all we can to facilitate the convergence of geospatial technologies with developments in these supporting technologies. "The technical boundaries that separate these technologies are often bridged by consensus standards that define open standard interfaces and encodings. Standards also lubricate commercial roll-out of new offerings, because customers appreciate 'plug and play' components they can use in new combinations to solve their problems," analyses Mark Reichardt.

The convergence of imagery and geospatial data tools is occurring within the enterprise and vendor communities as traditional geospatial software vendors are adding more imagery capabilities and imagery software vendors are adding geospatial capabilities. "This is a natural industry progression and both geospatial and imagery software vendors are pushing the capabilities to make the import and manipulation of imagery a more seamless experience," says Matt Ball.

What Google spawned was nothing short of the Great Awakening. The advent of Google Maps was not the 'GIS killer' or 'killer app'; it was a GIS promoter, according to *Directions Magazine*. It was the platform that allowed more people to see the utility of geospatial information, and that sharpened the focus of the companies that birthed the technology in the first place. We only have to look at the birth of the map mashup to see what happened. Mashups do one thing very well. They link a map platform with geographically referenced data.

The availability of data, such as a Web service that results from the creation of geospa-

tial standards, allows a simple display of information. From humble beginnings, a genie's bottle opened and basic mashups begat mashups 2.0, 3.0, etc. Both old and new geospatial software companies have embraced the mashup and have found new ways, and new data sources, to display information.

Web GIS represents only one face of the convergence of technologies. Convergence can happen at device level, like GPS enabled cellular phones and GPS enabled PDAs for navigation; at data level, like maps and high resolution imagery at street level and at application interface level for mashups, says Prof AR Dasgupta. The convergence of geospatial technologies with the vast proliferation of mobile technology is opening up new vistas of business lines in popularly known fields of location based services. "This market has grown at a much faster rate than the rate of growth the last decade saw in mobile telephones," exclaims KCM Kumar, CMD, Speck Systems.

While on the one hand, we have convergence of different geospatial technologies like GIS, GPS, imaging and surveying, on the other hand this group of geospatial technologies have also converged with mainstream IT technologies which have added to the processing and analytical capacities of geospatial tools. This has also enabled creation of such data structures which could be merged with datasets of other disciplines and ultimately help expand the utility of geospatial datasets in the mainstream development activities.

Substantiating this idea, Matthew O'Connell, CEO, GeoEye says, "All things digital are converging and they are 'flattening' the



**Web GIS represents only one face of the convergence of technologie**

**Prof Arup Dasgupta**  
Managing Editor (Honorary)  
GIS Development



**Combining representations of current realities with the futures of CAD-based designs holds potential**

**Prof Josef Strobl**  
University of Salzburg





The many faces of convergence

globe. While the technologies behind these individual technologies are unique and distinct, the products they produce are digital and can be merged and applied in a geospatial environment to help customers in business and government solve challenging problems".

"What makes GIS different though is data," asserts BVR Mohan Reddy. He says a 'geo' database is increasingly seen as the underlying single corporate view of an organisation's assets. This is a fantastic outcome. The overall reason for nearly every IT solution - is to make a decision or support a transaction. "As technologies converge," says Jeff Akers, President, CH2M HILL, "IT users can focus on solutions that support transactions or decisions. Success will be a business success rather than simply the success of making technology work because we can. We will make better decisions, we will process more transactions, we will go about our business with better clarity - and success will be in the commodity of our own business instead of sub-optimum solutions within technology instead of within solutions."

Talking about emerging trends in convergence, Matt Ball says, "Some of the emerging trends in mainstream IT have broad implications for geospatial market. The first is open source software, which has a strong and growing footing in the geospatial arena that will continue to grow. In the broad IT market, open source is predicted to see continued growth, with some predicting that it will represent 40% of all software and IT jobs by 2020. The second is cloud computing, where ubiquitous access to data and processing power on remote servers is being fed by open platforms. GIS continues to deliver the tools for open services that will accelerate the adoption and importance of the cloud in coming years". Predicting the future of convergence, Ed Parsons says complex geospatial functionality will disappear behind great interface design and brilliant process engineering in the numerous applications it will build. Applications apart, Christian Heipke of the University of Hannover feels there is lot of methodological similarities between image-related and GIS/vector-related issues. He foresees a further integration in this arena. Extending this idea to business domains, Brad Skelton

says imagery is now an integral part of decision support systems and it is expected that access to these systems be universal. Tools and technologies are now under development which will provide on demand geo-processing beyond simply viewing imagery.

At the organisational level, GIS, which was once considered to be a niche technology, has now become a part of the IT strategy of several corporate CIOs, says Rajesh C Mathur, President, ESRI India. Many organisations are in the process of migrating their GIS to enterprise level implementation and integrating it with ERP, CRM, SCADA and other IT subsystems.

This development has also redefined the role and profile of GIS professionals. They not only need to be proficient in GIS and its applications but should also have a good understanding of IT tools like RDBMS and ERP. Acknowledging the fact that geospatial technology is becoming part of mainstream IT, Maj Gen R Siva Kumar, CEO, NSDI-India, infers, "The day is not far when IT will become a subset of GT."



## Impacts of global economic slowdown

It is a reality today that the world is passing through economic slowdown. Rather, let's call it a phase of economic corrections. The ongoing economic corrections have affected the fundamentals of the economy as a whole and are not limited to one particular industry. Geospatial industry, being part of the global economy, is definitely affected. Let's analyse the good and bad of economic slowdown by taking stock of the industry leaders' opinions.

Notwithstanding fears of economic downturn, many industry leaders are actually quite optimistic about the health and growth of geospatial industry. Sample these -

- I am confident that the geospatial industry will slow in some sectors while remaining healthy if not vibrant, in others

- Lisa Campbell

- During this economic slowdown, the geospatial industry may actually be positively affected

- Brad Skelton

- India will continue to invest substantially into urban and rural infrastructural development and, in general, in developmental governance. In this scenario, geospatial technology will be the main enabler in bringing intended benefits to the stakeholders

- BVR Mohan Reddy

- Geospatial information and technologies help organisations save money and increase productivity, so, despite the world economic slowdown, we have reason to be optimistic

- Mark Reichardt

Taking a judicious stance, some feel this is a common process of business cycles. Perhaps the present cycle seems more pronounced than previous downturns, but this has happened before and will recover and will happen again. Analysing this aspect, Jeff Akers says, "In powerful 'up' cycles, I believe the industry has excess investment capacity and invests in technology decisions that 'might' prove to add value - and just like wildcatting for oil, these investments can pay off with big dividends. With the downturn of the business cycle, we tend to demand real business results. This is an inevitable outcome, but is a real discriminator within technology between technologies that add value and technologies that are interesting, but not vital or valuable. I think the periodic contraction and the re-evaluation of true value added is like a ratchet to our business. It establishes a new proven, must-have technological floor - where value is added, everyone must adopt that technology to simply compete. And non-value-added technologies are weeded out leaving exactly what but only what we need for business success. It moves the technology forward below which we will never retreat because the business value to compete in a tighter world has been proven."

In the past, much of GIS spend was discretionary - hence the

industry was vulnerable to economic slowdown. This is less of the case now. Elaborating on this, BVR Mohan Reddy says, "Much of the GIS expenditure has moved from capex to opex and is part of the essential day-to-day running of an organisation. Second, a lot of the upfront expenditure in terms of buying the underlying technology and capturing the data has been undertaken. There are also much better metrics around the benefits of using GIS and geospatial, which means ROI business cases can be better articulated and managed." This effectively means there will be impacts from the global slowdown, but not as bad as it could have been, he opines. Responding to the immediate cash crunch and financial crisis, governments across the globe sprang into action to take immediate corrective action to support their economies. One of the first things most of the governments have undertaken is increase government spending, particularly in infrastructure, to improve money circulation in the market. "Geospatial services, being one of the first activities to be undertaken in infrastructure development, these services should see substantial increase in the volume of business in the coming years," asserts KCM Kumar.

Assessing the long and short of the implications of this downturn, it is felt in several quarters that the anticipated growth in engineering design, consumer markets like LBS and in ITES will get affected quite visibly in the short term. These industries are conscious and cautious towards investing in new technologies and might put new initiatives on hold for some time. This will limit the expansion of geospatial industry at this stage. Traditional and mainstream markets like utilities, governance, infrastructure, defence or land will slow down a bit in the short term but will not be affected too adversely. This presumption is based on the fact that most of the industries are looking at continuing their existing technological support systems and geospatial has already been a part of technology solutions for these sectors. Talking about long term implications, geospatial industry will not get affected adversely. Rather, it would be one of the few technologies that will find itself as an active partner in rebuilding the economy. Talking about the effects on high-resolution imagery market, Jill Smith says, "In tough economic times, efficiencies are sought and costs scrutinised closely. The return of invest-



**Economic slowdown is a real discriminator between technologies that add value and technologies that are interesting but not vital**

**Jeff Akers**

President, CH2M HILL



# Advantage, Geospatial Industry



**Matthew O'Connell**  
Chief Executive Officer  
GeoEye

The year 2008 was the worst in Wall Street's history since the Great Depression. The Dow Jones was down 34 percent, S&P down 38 percent and Nasdaq down 41 percent, its worst trading year since the exchange was created in 1971. Globally, stocks were down 48 percent. In the US, investment banks Bear Stern and Lehman Brothers collapsed, 2.7 million employees in the financial sector were laid off, billions were drained from retirement accounts, the auto industry was near bankrupt and a Republican President effectively nationalised parts of the economy. Now a new US President is offering a stimulus package worth nearly a trillion dollar to boost the economy, create jobs and stop the slide.

Commercial remote-sensing industry is not immune to these market forces. There is concern that governments around the world, plagued by demands on their treasuries to provide support to banks and basic industries, may cut back on spending for vital information services, such as geospatial information. Companies focussed on local collection of data and geospatial information worry that local budgets may not sustain the same level of revenues as in recent years. And the market turmoil affects all publicly traded companies, even the strong ones. This business is not for the faint of heart, or for those easily distracted, or those who require instant gratification. Singer and humanitarian, Bono said, "The going rate for change is not cheap-big ideas are expensive."

Having acknowledged the turmoil caused by the financial sector, one has to remember that there is some good news for our industry. The geospatial sector is somewhat insulated from the general economic malaise, especially those companies that provide crucial information to defence and intelligence agencies around the world. However, even those of us who have strong government contracts and increasing revenues, like GeoEye, are not immune to the unease resulting from the global economic turmoil. The continued terrorist activity around the world - even in Mumbai - has made it clear

that we must continue to be vigilant. So, defence and intelligence agencies will continue to be steady consumers of geospatial information.

One may also see a bright spot for the US industry in the policies of President Obama. He has committed to upgrade US infrastructure as part of a massive stimulus plan. The American Society of Civil Engineers estimates that \$1.6 trillion are needed to bring America's infrastructure up to "good" by 2010. Every infrastructure project has a geospatial component or reference to a physical location on the surface of the globe. While creating jobs by upgrading the nation's physical infrastructure, we can also create jobs by upgrading the nation's digital infrastructure or what some have called a "digital stimulus." It's more transformative in the long run. Other governments around the world are focussing on infrastructure spending as a way to stimulate their economy as well.

A new report by the US-based Information Technology and Innovation Foundation presents the case of investing \$ 30 billion in the United States' digital infrastructure including health, information technology, broadband access and other innovations that will stimulate a new economy. Infrastructure such as roads and bridges are important; "pavement" is fundamental but so are "pixels" or spatial technology in a globalised and

digital world. Growing world population will drive technology development and fuel the market. Last year marked the first time in human history that more people lived in urban areas than in rural ones. That means 3.2 billion people now live on about 2.8 percent of the Earth's surface.

This trend will continue. Today, in any given minute in the US, 40 babies are born, in China it is 160 and in India it's 280. The changing dynamics of population demographics and the natural competition for resources -complicated by the impact of climate change -- will put tremendous pressure on governments at all levels to have the best possible information readily available in an enterprise fashion across all functions of government. Governments and companies in the 21st century are facing multiple challenges, so any technology that helps ease the pain and "bring order from chaos" is valuable.

Socrates is quoted as saying that, "Man must rise above the clouds and look back upon the Earth because only then can he understand the true nature of things." We now have the tools to be able to do just that. Despite the turmoil in the economic sector, the world is more aware every day that geospatial information has the power to help our nations provide better lives for the world's citizens and to help those nations do so more cost-effectively. So the future for our industry continues to be very bright and we are well-positioned to help solve some of the world's most challenging issues.

ment analysis on using satellite imagery as a way to minimise start-up operations for engineering and infrastructure projects, evaluate new areas without onsite presence and reach remote areas for energy exploration makes it a solution well suited to identifying more cost efficient processes."

Lisa Campbell expects business geographics for retail chains and restaurants to shrink as those industries see an overall slow-

down in consumer spending globally. Meanwhile, Lisa feels, stalwart GIS customers like water and power utilities firms will still invest in these technologies. Indeed, for many utilities focussed on building new physical networks and adding capacity, the current slowdown in real estate growth offers an opportunity to redirect their budgets to IT and automation. According to Matt Ball, there seem to be no immediate plans for cutbacks in military spending, making geospatial intelligence a continued bright spot for the geospatial market. In fact, he feels the increased



## Potential markets in terms of geographies

The essence of geospatial technology is all about mapping the earth and its resources - manmade and natural. If we look at the geography of the world, more than 2/3 rds is in the process of development. Naturally, these developing regions offer growth markets. The amount of investments required for developing geospatial information and infrastructure in the developing countries of Africa, Latin America and Asia is huge and these economies should take the second mover advantage and invest in the latest technologies to create up-to-date geospatial information infrastructure and build their development plans based on this.

A majority of the industry leaders we spoke to agree that the biggest market opportunity at the moment in terms of geography lies in Asia, which includes China and India. These countries are followed by Latin America and Africa. Acknowledging this, Brad Skelton says, "China and India will continue to be growth markets, despite the worldwide economic downturn. These countries have large, skilled populations and a need for infrastructure improvement. We also see continued growth in South America as the awareness and adoption of geographic information increases."

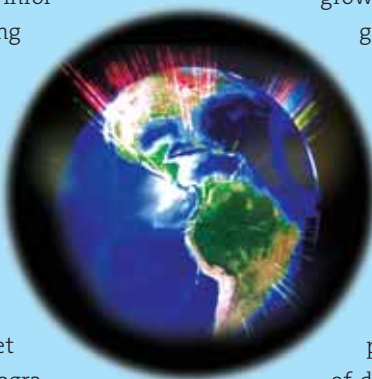
Concurring with Brad's view, Mark Reichardt says, "Per-

haps the main factor in terms of geographic markets is that developing nations are embracing new information technologies. In Asia, the Mid-East, Central and South America and Africa, there has been huge growth in the use of cell phones, and in these regions the use of the Internet is growing rapidly. Over the next few years, this

growth will surely continue as the price of most devices and services go down and as user interface technologies enable easier use and more culturally tailored user interfaces and services."

This does not mean that there are no opportunities in Europe and America, though. They are well-developed markets and still offer tremendous market potential in terms of currency and accuracy of data and its integration into mainstream development activities. Extending this argument, Jeff Akers opines that geospatial industry is poised to grow across the globe. "As new data coverages are available, there is a data market across the globe. As we have new technologies, there is a technology play everywhere and the existing technology needs to be upgraded. As we have application and solution breakthroughs, the global economy is the market. I don't see any specific sub-market better or worse than any other."

Taking a slightly different stand, Josef Strobl says, "As the



instability of uncertain economic times will likely lead to an increase in investment as governments strive to gain a better

understanding of rivals and a better handle on internal factions. Though energy markets are complex and hard to forecast, Mark Reichardt feels it is likely that once the economic recovery packages begin to stimulate energy-intensive activities such as cement production, steel production and operation of heavy earth-moving machinery, demand for petroleum will rise, and energy will become more expensive. Simultaneously, climate negotiations will lead to carbon restrictions, and this will make energy even more expensive. Competition for oil and increased nuclear industry activity will have serious security implications, which involves geospatial technology. So, during the complex transition away from fossil fuels over the next several decades, businesses and governments will have plenty of need for geospatial technologies.

The market corrections were long overdue and inevitable. Year after year, growth projections increased in an unsustainable



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**Jill Smith**  
President & CEO, DigitalGlobe



**Brazil, Russia, India and China-the so called BRIC countries-have emerged as a driving economic force due to fast development**

**Matt Ball**

Editor, Vector 1 Media

geospatial industry is part of the 'knowledge society' and therefore does not react quickly to regional economic effects, markets grow where development and construction is under way, and where societal factors like environmental concerns take center stage, or where internal or external security plays a dominant role. These markets are not necessarily satisfied by local factors, though." According to Matt Ball, Brazil, Russia, India and China-the so called BRIC countries-have emerged as a driving economic force due to fast development. It's likely that these countries will continue to invest and grow at a rapid pace, because collectively they represent 25 percent of the world's land, and forty percent of the world's population.

Going by these opinions, it is evident that different geographies offer different kind of opportunities. For example, Asia, Latin America and Africa offer more opportunities for large-scale mapping and Europe and America offer opportu-

nities on regular updating and its integration with development activities (applications).

In this revolutionary phase of change in geospatial awareness, India finds a special position of leadership in terms of markets and capabilities, according to KCM Kumar. The billion strong market for location based equipment is a powerful magnet towards which all geospatial companies in the world are attracted. The economic steps India has taken are on par with world leaders in terms of infrastructure investment and the current scenario has compelled India to also look at substantial investment in the areas of crisis management at the national level.

The modifications made by government in its mapping policy by opening its skies to private industry will stand in good stead. Intelligent maps created will find application using proven software to provide solutions to Indian consumers and governing bodies.

This fast growing market not only calls for companies with proven track record but also demands understanding of the Indian psyche and the need for hand-holding of the customer even after the sale is made. It will therefore be interesting for many of the international giants to set up partnership or association with Indian companies who already have established base in providing services in geospatial business here, KCM Kumar says.

All the Third World countries started realising the need and utility of spatial data warehousing and are making significant efforts to create respective infrastructure on war-footing.

manner resulting in high level of consumerism and unsustainable utilisation of resources. This growth had to be checked by the



**Once the economic recovery packages begin to stimulate energy-intensive activities, demand for petroleum will rise**

**Mark Reichardt**

President & CEO, OGC Inc.

economy itself. Once the market corrections are done, which is expected to be done by June 2009, countries across the world will start rebuilding their economies afresh. During rebuilding, geospatial information and technologies will be utilised for infrastructure development, financial management, insurance and disaster management and of course, rural and social infrastructure building. Any economy will grow consistently only when there is a judicious balance between rural and urban infrastructures, accessibility, network and facilities. For that, we definitely need to put more geospatial technologies to work. It is imminent that political and economic leaders realise this important aspect and take decisions to bring in stable and judicious economic development. As the adage goes that 'the times of crisis are always also the time of opportunities', geospatial industry is poised to be buoyant and the recession-proof geospatial technology is all set to prove its mettle as a valuable tool in rebuilding the world economy.



## Potential growth verticals

Though different industry specialists predict growth in diverse range of verticals, they announce in coherence that geospatial technology is poised for growth, the economic downturn notwithstanding. Traditional markets like infrastructure, governance, analysts predict, will continue to grow and strengthen themselves as the importance of geospatial content and technologies increases by the day. Concurring with this prediction, Brad Skelton says, "While defence will continue to be the largest single market for geospatial technologies, there will also be growth in the infrastructure development area. Additionally, there will be a growing use of geospatial technologies in the areas of security, monitoring shipping and other activities associated with the world's ports."

Agreeing to the opinion that the major utility and applicability will remain in the areas of services and infrastructure, Prithvish Nag, Director, NATMO, feels this includes soft infrastructure as well. "Demand for information, legislature for public access and right to information has compelled to act in this sector."

Geospatial technology and information will become part and parcel of consumer behaviour and the markets associat-

ed with consumers and will be primarily driven by location-enabled services. In the long term, LBS will mature into a huge market. Giving wings to this optimism, Jeff Akers says, "There is a growing consumer play - many more consumers are looking at satellite imagery to plan a vacation, or are using online maps to plan a business or pleasure route. In reciprocal response, there is a growing spatial play to manage consumers whereby retailers are using demographics, locations and access as they plan their marketing."

There is a play in nearly every industrial market - where are the supplies, where are the demands, and how do we optimise them. The traditional natural resource conservation and management market has matured and is not growing, according to Rajesh Mathur. A growing percentage of the world's population lives in cities.

The move to create more efficient cities points to a great many opportunities for geospatial application, including the development of digital city models, according to Matt Ball. Geospatial tools will find and can make relevant contribution to bigger challenges of the world order - climate change, environment, global warming and the programmes and initiatives identified under Millennium Development Goals





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**Prithvish Nag**  
Director, NATMO



What was once considered to be a niche technology, has now become a part of the IT strategy of several corporate CIOs

**Rajesh C Mathur**  
President, ESRI India

(MDGs) while contributing equally to rural development and land management.

As we gain a better handle on the impacts that humans have on the environment, the need for more holistic ecosystem management will feed advancements in geospatial tools. The sensor web, coupled with connected and distributed systems (systems of systems) will greatly improve our powers of earth observation. With the impact of global climate change more closely tied to economic and societal ills, we'll need to increase our understanding of these linkages and geospatial technology is uniquely capable to provide that feedback, infers Matt Ball.

Another technology growth area that will impact our industry is the increasing use of 'cloud computing', an emerging architecture by which data and applications reside in cyberspace rather than on company servers or desktop hard drives.

The major overall trend pulling in other market sectors is the growing availability of geospatial capabilities in information systems of all kinds, proclaims Mark Reichardt. Largely due to vendor implementation and market uptake of standards, now consumers, businesses and governments

have much more access to geospatial data and applications than they did previously. This represents a diffusion of all the geospatial technologies, since an earth browser, for example, typically depends on value chains that involve earth imaging data, vector data, location services and photogrammetry.

The new business world of diffused geospatial resources involves a wide variety of products, contract services (including out-sourcing contractors), Web services and consulting. Giving a parallel account, BVR Mohan Reddy says, "There is also a growth market in the consolidation of multiple GIS systems as organisations merge and combine which means migration and integration opportunities (although the economic slowdown may impact this).

One industry worth special note is the Architecture, Engineering, Construction, Owner, Operator (AECOO) industry. There is a huge unmet need for all the stakeholders of a building or capital project (such as an airport) to have access to comprehensive information about the facility over the lifetime of the facility, as might be appropriate given the role of the stakeholder. Geospatial information makes up part of the facility's "Building Information Model", or BIM, the information that should be online and accessible to anyone who has a need and permission to access the data.

Talking specifically about India, the fastest growing markets are the power and land records verticals, according to BVR Mohan Reddy. Government of India has announced huge funding for modernisation of land records and power distribution reforms aimed at energy audit and reduction of AT&C losses. Urban planning and management and telecommunications are the next fast growing areas. Rural development is potentially a huge market, but it is dormant at this time, for want of appropriate implementation models. concludes Reddy.

**Another technology growth area that will impact our industry is the increasing use of 'cloud computing', an emerging architecture by which data and applications reside in cyberspace rather than on company servers or desktop hard drives**

## Major challenges before the industry

Being a fledgling, geospatial industry is in the eye of several challenges, its lack of maturity being the primary one. Geospatial industry needs to take a mature approach in cultivating and improving its presence in the global market. It needs to come together, organise and work towards raising the profile of the industry worldwide. It needs to have its own set of industry associations at national, regional and global levels which could represent the geospatial industry as a whole and address the common concerns and issues of this industry in the world. This kind of framework should work towards promoting and expanding the business opportunities for geospatial industry worldwide.

Many professionals in the industry advocate associating with IT related bodies to help the nascent industry to tie up and work with other agencies. It might not always serve the purpose. Alternately, bringing in maturity within the industry by developing certain standards and certain common minimum agreements is important for the industry.

### Dearth of skilled manpower

The most important challenge for the industry today is the shortage of skilled manpower. This shortage is felt across the globe irrespective of geographies. Even in Europe, Christian Heipke says, there is dearth of highly qualified young professionals to fill the different positions in industry and academia. Also, the number of engineering students is still too low (this is particularly true for Germany). To counteract this, Heipke says, "We are addressing the needs of young people (for ex., by putting in more basic math courses as this subject is increasingly neglected in high schools), by continuously revising our curricula (for ex., by putting more emphasis on environmental issues) and using marketing tools. But we

have had limited success till today."

Extending this argument, Maj Gen Siva Kumar feels that there is not enough geospatial literacy amongst planners, users, academia and the industry as well. Identifying another problem area within this, Prithvish Nag says, projects can be transferred to different locations due to the available ICT backbone, but availability of manpower and technology always play the limiting factors. So far, India has been a popular destination for such outsourced projects. But this might take a dent with the slowing down of the economy.

The other major source of geospatial projects in India is the government and its numerous wings. But there is no continuity in the flow of projects, Prithvish Nag opines. The industry is therefore shy of making large investments. In several cases, geospatial activity is not the main function of an industry. The risk is shared by taking it along with other sectors like involving in ICT, selling of hardware and software and even running training courses.

At the core of every geospatial project in India, there is a considerable component of field survey and field data collection, requiring large land armies with adequate training to be deployed in the field for extended periods of time. However, in view of the fact that, hitherto, most of the land surveys and field data collection were carried out by the government staff in India, such skills have not percolated to the private industry. While the private sector has created a fairly decent force of field surveyors with adequate experience in operating various survey instruments, the relevance of field-collected data and the required methods of collection, associated with cadastral surveys, corridor surveys, urban and utility mapping an natural resources surveys, has yet to dawn upon



There is not enough geospatial literacy amongst planners, users, academia and the industry as well

**Maj Gen R Siva Kumar**  
CEO, NSDI - India



Even in Europe there is dearth of highly qualified young professionals

**Christian Heipke**  
University of Hannover





Lack of trained professionals is a major concern for the industry

the private sector in a broad-based manner, according to BVR Mohan Reddy. With very large scale urban and utility infrastructure development, cadastral surveys, irrigation projects etc. underway in the country, there is a serious dearth of trained survey professionals in the country, which is affecting the quality and, hence the utility, of field-collected data.

The urgent need of the hour is to invest into building capacities and churning out professionals who can contribute to the ongoing process of knowledge building in the field of geospatial industry and be a competent workforce to develop solutions for the upcoming markets. There is definitely dearth of adequate number of research and education institutions which can provide and serve skilled manpower on regular basis. Reddy makes it clear that this problem can only be tackled by taking up capacity building as a joint mandate between the government and the industry.

### Technology challenges

Talking about technology challenges, Matt Ball puts integration of 3D views seamlessly among CAD, GIS and BIM as the most significant technical challenge. Both CAD and GIS serve important roles and, while the boundaries have blurred with CAD-based software offering GIS features and vice versa, it is critical to incorporate the strengths of each into a single solution that also includes maturing technologies for visualisa-

tion, social networking and more, according to Lisa Campbell. We continue to see geospatial technology mainstream into traditional IT; consequently it is seen less often as specialised tool and more often as a piece of an organisation's overall IT solution. For example, this is witnessed when traditional CAD customers demand more integration of their design information with larger corporate knowledge base. The geospatial industry must embrace the IT universe more fully and assert itself, not as the central, organising principle for an organisation's data and applications, but as a critical component to a complete IT solution.

Thanks to OGC, much is being done to establish industry standards and improve interoperability. But there needs to be much more research and research coordination in the area of interoperability, Mark Reichardt opines, particularly as

**Geospatial industry needs to take a mature approach in cultivating and improving its presence in the global market. It needs to come together, organise and work towards raising the profile of the industry worldwide.**



Another biggest challenge before the industry is the availability of geospatial data

**Ed Parsons**  
CTO, Google



The Indian geospatial industry faces challenges in terms of ownership of data and responsible processing of data

**KCM Kumar**  
CMD, Speck Systems

leading scientists and practitioners recognise that the 'big picture' goal is a 'system of systems' approach, as exemplified in GEOSS, the international effort to develop a Global Earth Observation System of Systems.

Another biggest challenge before the industry is the availability of geospatial data. The restrictive practices of some organisations and governments in terms of making their geospatial information publicly available has been a great concern, feels Ed Parsons. The industry lacks well-defined and rational policies with regard to creation, management and accessibility of geospatial data (mapping policies) even in the most advanced countries. The need of the hour is to have an updated, relevant approach in terms of policy framework for this industry.

There's a growing global movement for 'open access' to scientific data and that movement intersects with the growing recognition of the need for an academic focus on interoperability, Mark Reichardt analyses. Also, open access to geospatial research data will result in a sharp rise in the number of people who need to be trained in the use and development of geospatial data and technologies, including scientific models that incorporate these. According to Mark, this need for more research and education represents an important challenge to our industry.



**The value of geospatial data is greatly enhanced by the integration of complementary data, But putting data from different sources into the same database, map or display screen often requires extensive manipulation**



There are significant challenges in the interoperability of model-based designs, including the designer's insistence that models are intellectual property, Matt Ball says. Concurring with his idea, BVR Mohan Reddy says, copyright and intellectual property right issues will be important as in any other area of IT. Another challenge that presents itself is the widespread access and exposure to free geospatial tools. While these tools are increasing the size of the marketplace, the fact that they're free has served to erode some of the value of the market. Integration of disparate geospatial data is a major challenge and also an opportunity, according to BVR Mohan Reddy. The value of geospatial data is greatly enhanced by the integration of complementary data. But putting data from different sources into the same database, map or display screen often requires extensive manipulation. He suggests the promotion of international standards for metadata and open transfer formats to make data integration more seamless to the benefit of all.

### Challenges specific to India

While the economic growth and world scenario seems to be encouraging for geospatial business in India, the Indian geospatial industry still faces some challenges in terms of ownership of data and responsible processing of data, according to KCM Kumar. These issues can be addressed by policy makers by introducing a code of conduct in terms of the way data should be acquired, processed and warehoused, the agencies which should be allowed to do so, private as well as public, security and safety measures and controls to be installed in the respective agencies to ensure that such licensed agencies can continue their work unhindered expeditiously. The time is not far when these issues would be addressed effectively to meet the challenges of the industry.

On the services side, one of the major challenges for the



**It is critical to incorporate the strength of CAD into GIS and vice versa**

**Lisa Campbell**  
Vice-President, Autodesk

geospatial industry in India is the wide gap that exists between the expectations of the customers and the performance of the industry, as BVR Mohan Reddy puts it. This could be partly due to lack of clarity of specifications by the clients and partly due to lack of domain-specific knowledge on the part of the industry in translating the specifications to acceptable deliverables. The quality-focus of the clients and the cost-focus of the industry need to be blended into one single forward approach that can take care of both the concerns, Reddy opines.

### Clear definition sought

Lack of a clear definition with regard to the composition of geospatial industry is seen as another challenge. There are different schools of thought, each presenting this industry with different name. Geomatics, geospatial, geoinformatics are just a few usages. We need to have a clear definition and composition of the industry to give a collective recognition and have a collective strategy to promote the industry.

As always with any element of IT - we need to demonstrate the 'real value'. Nice technology is a luxury in a growing economy, but when things contract, we need to make a clear case for added value. If geospatial industry can crack this challenge, we no longer have a collision between the technology leaders and the financial leaders. If we can show the 'value' that spatial technology brings to the bottom line, if we can prove that better transactions are performed, or better decisions are made, we have an advocate in our business leaders to keep this technology in the boardroom. And there lies the real challenge, infers Jeff Akers.

## Conclusion

Much has been discussed but much more remains to be talked about for geospatial technology is one tool that finds application in a vast diversity of human endeavours. With geospatial technology taking root and successfully obtaining the mandate of decision-makers worldwide, public-private partnership models are gaining ground and the day is not far when geospatial technology and analysis will get into the mainstream of governance and business management.

Spatial Law is an emerging area focussing on the wide range of legal issues associated with geospatial technology and the collection, distribution and use of geospatial data. Important legal issues include liability, privacy, national security and intellectual property rights (IPR) in spatial data. The number of consumer and business applications for spatial technology is rapidly growing, and as a result, an understanding of Spatial Law is increasingly important for the practicing attorney, according to Mark Reichardt.

Also, there are some elements of Spatial Law that are not well defined in any nation's body of law. The time is now to begin addressing these shortcomings through well-informed education to better inform those who will be called upon to address legal, regulatory and policy implications of the use of spatial information. It is also time that the industry draws its own ethics code and support nation building by empowering people through geospatial data, Maj Gen Siva Kumar says.

So far, our geospatial reference has been the earth surface - we use it for underground minerals and oil, we use it above ground for skyscrapers and mountains, and underwater for shipping channels. Let's end on a positive note in Jeff Akers' words about the future - a GIS of the solar system for space travel, and more locally for spatial planning of our own homes, energy conservation and for a better tomorrow.

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