# "NEWSPACE" EMERGING PERSPECTIVES FOR EO AND GI POLICY

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## ABSTRACT

There is a new scenario developing with the advances in the Earth Observation, Positioning and Geographical Information (GI) domain. While on one hand, the power of ¨EO and GI" is changing the way governance, commerce, resource management, environmental protection, aviation, security and even a citizen's life is impacted - either in a direct or indirect manner, images of the earth are now being collected from variety of easily-operable government- and private-platforms – satellites, aircrafts and Unmanned Aerial Systems (UAV) or Drones (say, from DigitalGlobe, SPOT, IRS, Landsat, RapidEye and more recently Skybox and PlanetLabs and ultra-high resolution imaging from Aerial Survey companies, Drone Imaging companies etc). Till the mid-2000s almost all of EO and GI data holdings were mainly in government domain – but now large number of private-sector EO and of GI data holdings - like Google, ESRI, Microsoft, Positioning services, EO and GI enterprises in various nations etc have emerged as commercial enterprises and offer value-addition to EO images and development of down-stream GIS applications. In a way, private sector has over-taken in volumes of EO and GI data holdings across the globe and are bringing extensive proliferation of EOs and GI.

What are the policy and legal framework that will become relevant in this "NewSpace" domain and that too with the easy integration of these 3 technologies – EO, GI and Positioning? No doubt, this scenario will pose newer continuing challenges in the newer market driven developments and will have to be driven by more cooperative and sharing across nations and communities.

This shift of a government- and private-ownership of EO and GI; the availability of the high resolution EO images (presently 0.3m from satellites and even 0.1m from UAV platforms) in the commercial domain; high-level Positioning services across the globe and easy fusion of geo-tagged GIS data is bringing in a new paradigm. One change it will trigger is that the divide between the "free access" societal EO and GI requirements for supporting developmental activities; "commercial access" of EO and GI for enterprise and business applications and the "restricted" security requirements for human security and intelligence applications are getting blurred.

Seamless fusion and integration will be easy on a hand-held device - interoperability, integrity, reliability and better positioning and location accuracies will drive EO and GI into citizen's hands and also greater efficiency in governance, society, commerce and improved public and private decision making.

Private ownership of EO and GI data, alongwith public ownership data thru government missions, will require addressing many challenges - protection of privacy (nation's, society, enterprises and citizen's); easy access rights to EO and GI data held by governments, private enterprise; EO and GI information liability; copyright and IP etc will have to be clearly defined in the context of EO and GI data. National security considerations will still be important – even as use of EO/GI information could be thwarted by improperly devised and highly restrictive policies.

This paper will discuss several policy and legal issues in these areas – specifically in the context of EO and GI technology management, EO and GI data, EO and GI applications etc and brings to fore the need for an international consensus on the future "NewSpace" policy regimes.

## 1. INTRODUCTION

(This paper builds upon an earlier research analysis undertaken by the 1st two authors and develops further the possible policy regimes in the context of recent developments in EO and GIS"[1]. For a more detailed exhaustive list of references of use/relevance, reader is directed to this paper.)

[1] Legal issues relating to convergence of imaging, positioning and spatial databases – Mukund Rao and KR Sridhara Murthi. Paper presented at 56th International Astronautical Congress, Fukuoka during October 2005 in Session E6.3: Legal Issues Related to New Developments in Space Applications: Navigation, Remote Sensing and GIS.

Over the years, space-based EO has made tremendous advancement. EO images have now become a part and parcel of many human activities and there are many examples of how society have benefited from use of EO data. EO data have helped create valuable geospatial content across the world and have spawned many Geographical Information Systems (GIS) applications. Recent developments and easy availability of positioning information – and its integration with EO images into GIS has opened up new vistas of applications across the world. A host of young, dedicated communities are emerging that are undertaking innovative and impacting applications that are centric around EO, GIS and Positioning and its advancement – which are extremely user-focussed, easy to access and very timely.

Policies and legal understanding the impact of EO, GIS and Positioning technology and applications, however, are underdeveloped and unclear. Ownership of digital geo-spatial data, protection of privacy, access rights to spatial data compiled and held by governments, and information liability are still developing in the context of spatial data. Now, concept of NewSpace has emerged – mainly referring to private and entrepreneurial space activities - a concept affiliated with a rapidly emergent "privatisation of space activities" through a new role formation between public, private and academia – all of them addressing low-cost space technology, applications and policy. In a way, recent EO and GIS is really emerging as "NewSpace" EO and GIS.

This is a policy-analysis study for assessing how global EO and GIS developments will require a more detailed and newer articulation of policy definition – in the context of geo-spatial information and also for addressing future aspects of how global society will cope with these developments. In fact, this study aligns to the concept and requirement of global "NewSpace" EO and GIS.

## 2. EO AND GIS – RECENT DEVELOPMENTS

In today's "smart world", every organization and individual is deeply impacted by availability and access to INFORMATION that describe and represent events across the globe. Information of the world is needed on an instant basis – be it about disasters, environment, travel, war and security, forests, pollution etc and many others. There is no denying the fact that an ability to better understand the world and its events is fundamentally changing – SO ALSO is the way humanity makes or takes decisions on a ever-constant basis - increasing the profitability of businesses and enterprise that deal with instant and detailed information about any part of the world and the ability to make it available for the welfare of societies worldwide.

With the easy-availability ("select-pay-download-use") of these EO images for any part of the globe, the outlook of any nation for dissemination and use of these images will have to adjust to these technological and market-driven developments. The world has moved from an era where only a handful of governments had access to high-resolution imagery to one in which every government, every enterprise, every nongovernmental organizations, every public group and even every citizen has access to these images. This new open-ness offers enormous benefits for nations and societies and citizens across the globe and yet governments throughout the world are still getting prepared for the era of global geo-spatial transparency.

The other major technology that has changed the scenario is the Geographic Information System (GIS) – which allows for handling maps in the digital domain and allows powerful integration of various maps datasets to create newer visualization of information and simulation of patterns that enhance knowledge. Thus, GIS have come to handle Geographic Information (GI) and these include images, maps, positioning data etc. Increasingly, GIS constitute the core of the information management systems of nations and their entities. The data and processing capabilities offered by the technology also constitute a significant component of the emerging national information infrastructure in many nations. The use of spatial data promises greater efficiency in commerce, improvements in the environment, health, and safety, increased convenience for consumers, more citizen participation in governance, and improved public and private decision making generally.

The third major technology that is emerging is the precise Positioning and Navigation datasets through satellites that use radio ranging to fix precision position of object. The precision of position is so high and so easy to obtain using a device that the dataset is a major GI input for a variety of aviation navigation and personalized navigation systems. Coupled with terrestrial or satellite communications systems, these technologies are being used in automobile navigation and information systems, fleet management systems, asset tracking systems and other consumer and commercial applications. Location-enabled cell phones are coming soon, and location technologies, wireless devices and the Internet are converging to become one of the hottest commercial technology sectors. There are many different markets for location technologies at various levels, including OEMs, system integrators, value-added resellers, etc., each with its own unique risks and business models. End users range from consumers to municipalities to international shipping fleets. Fortunately, this

technology does not present insurmountable legal obstacles that will prevent its further development and widespread commercial application.

For the first time, the world is witnessing the "coming together" of these 3 important technologies – EO imaging, GIS and Positioning. This combination is greatly impacting the thought and decision-process – much of human thought is slowly becoming "geographical" or "geo-spatial" – the WHERE is becoming extremely important characteristic of any information – be it natural resources, environmental, social, economic, financial, cultural or any other dataset.

### 2.1. "NEWSPACE" EO AND GIS - SITUATIONAL-AWARENESS

Let us look at some of the significant developments and the emerging challenges are:

- Large proliferation of Earth observation missions. Today, a large number of nations have built/operate EO systems and almost all nations utilise EO technology in a variety of applications. Thus, the scope of EO has expanded vastly and much focus is being placed on global missions, international cooperation, newer EO instrumentation and wide range of local/regional and global applications. Today, a diverse constellations of multiple satellites including Landsat 7/8 from US, Resourcesat, Cartosat and Radar Imaging (RISAT) satellites from India; SPOT and PLAIDES series from the French Airbus as well as many Chinese, Russian and Japanese satellites from the traditional players orbit the planet collecting multi-band images of the earth's surface, adding several million square Kilometres (SKM) and peta-bytes of data every day.
    - Emergence and increasing commercial EO satellites that provides global coverage of valuable EO data and caters to many national and international requirements. Commercial EO satellites (DigitalGlobe, SPOT, RapidEye and more recently Skybox, PlanetLabs, Urthecast and many others), their operations, data distribution and civilian/business applications are major topics of discussion in EO. Many businesses (like Google, DigitalGlobe, ESRI, Microsoft and many others) support/provide value-addition to EO data and development of down-stream EO/GIS applications.
    - Constellations are order of the day. The DMC (Disaster Management Constellation) offered an international program led by SSTL (Surrey Satellite Technology Ltd) and is a network of five affordable LEO microsatellites. The programme provides a daily global imaging capability at medium resolution (30-40 m), in 3-4 spectral bands, for rapid-response disaster monitoring and mitigation, Land cover and vegetation information, Hydrology mapping, Fire and burn scar mapping, Flood monitoring etc.
    - For example, India has also witnessed a progressive evolution of EO over time, from the 36/72m resolution image from IRS 1A, in 1988, to the current day 1m resolution imagery from Cartosat-2 – a suite of EO systems and payloads offering global coverage. The roadmap of India indicates further advancement in the EO technology leading to 0.3m resolution imagery by 2017/18, in addition to a high resolution geostationary imager proving constant vision of the this part of the Earth.

- Advanced development in sensor and instrumentation technologies, expanding capabilities to optical, IR, Microwave regions of the electromagnetic spectrum with extensively improved geometric resolution, spectral resolution and radiometric sensitivity – apart from temporal coverage. Space technologies in the process of revolutionary changes brought-in the new class of operational mini and microsatellites and constellations - smaller, lighter, more inexpensive satellites-to collect observations from space. Radical miniaturization of integrated subsystems and relatively favourable prices of commercial components (COTS – Commercial Off-the-Shelf Components) have enabled considerable lowering of costs for development, launching and EO satellite use. These fundamental changes have redefined the space business once reserved only for big research and development institutions from select few countries.

- Improved data communication technologies, including the revolution of the internet, have made it very easy to deliver large volumes of EO data to users on a near-real-time basis – so that instant use of EO data can be made for many mission-critical applications and brought EO data to the desk of citizens across the world.
- Advances in digital data analysis and geo-spatial data fusion – with data mining and data analytics have enabled quick and rapid information extraction from EO data and enabled the emergence of a vibrant geospatial industry. At same time, large scale hardware implementations (e.g. Cloud Computing) and capable software that process EO data and ingest critical geo-spatial information into GIS applications.

- EO applications have opened up in many new areas – which impact citizens, societies, enterprises and governments in a major way - enabling the sustainable development plans for our Earth. Today, most nations use EO data for inventory/mapping, improved statistics, improved decision making and managing disasters and many other national development and global collaboration activities.

- EO has spawned the growth and usage of geo-spatial technologies and applications. EO images/data and GIS have become so "coupled" in the user domain that without EO images/data GIS decision-solutions are almost impossible and, in inverse, wide GIS usage is creating newer and innovative demand on EO technology.

    - The easy-generation of geo-spatial information sets across the world has driven GIS database activities in a major way – we now see vast amount of "integrative" GIS datasets across the world – both in public-free, public-commercial and "restricted" domain. Geo-spatial data have had substantial impact on government and business throughout the world. Increasingly, spatial data constitute the core of the information management systems of both private companies and public agencies. The spatial data and processing capabilities supplied by the technology also constitute a significant component of the emerging National GIS and even elements of a Global GIS.

- A number of inter-governmental programmes around EO/GIS have emerged and are coordinated through UN-OOSA, GEO, ISPRS, GSDI etc and these efforts have made phenomenal advances in regional and global applications development of EO and GIS.

## 3. PRESENT INTERNATIONAL FRAMEWORK TRENDS

With the advent of satellite remotes sensing, the UN led the way for an informed debate on the use of satellite images by way of a basic legal framework established by the United Nations for conduct of outer space activities. A landmark development was the adoption of a resolution by the General Assembly of the United Nations in 1986, on Principles Relating to Remote Sensing of the Earth from Space (http://www.oosa.unvienna.org/SpaceLaw/rs.html). In general, UN resolutions are recommendatory in nature, and not legally binding as are international agreements. In many cases though, UN resolutions incorporate already adopted Principles from prior treaty law or international customary international law and, if so, to that extent such Principles remain binding[2]. These principles essentially recognized that imaging from space required no prior consent of sensed country. At the same time, it was also stipulated that remote sensing activities from space shall not be conducted in a manner detrimental to the legitimate rights and interests of the sensed states. The resolution also established the guiding principle of non-discriminatory access by the sensed state for data concerning its territory. While reiterating the goal of promoting international cooperation in the conduct of remote sensing activities, the resolution emphasized that remote sensing activities should be conducted with due regard to the needs of developing states. These principles, although adopted in the form of a non-enforceable resolution, enjoyed a wide consensus, guiding and providing a basis for several international agreements between the providers of remote sensing data and the recipients.

However, since the time of adoption of UN resolution and the above initiatives, significant changes have occurred in the field. These include: (i) improvements in technologies that enabled satellites to provide data with much better spatial, spectral and temporal characteristics, (ii) entry of many more state players who owned and operated remote sensing satellite systems and (iii) evolution of commercial systems providing high resolution data. From legal perspectives, the last of above three trends assumes great significance. A significant trigger for evolution of commercial systems for high resolution data came in the new atmosphere of post-cold war era through the new legal and policy measures.

As against this, the map information, which had more historical origins, did not go through an international debate and remained in the purview of individual nations. Many governments had a stronghold on map censorship, concealment and information falsification for military and economic amelioration. The growth of business and commerce also is a major factor in the way map information is available and accessible. This has also changed the demands and legalities for mapmakers. Thus, the policy regimes for GI and map information have always been a nation perspective and there have hardly, even now, been debates at

[2] Gabrynowicz, J. I. (1993, November). The promise and problems of the Land Remote Sensing Policy Act of 1992. Space Policy, 319-328.

international level to come to an international understanding on map information. What is needed is a pragmatic Policy consideration – which can emerge from international debate and an inclusive process for all nations.

Before we go on, we would like to draw some parallels – just to bring issues into perspective and define as to why issues of policy and legal aspects are becoming important today. The illustrations below are merely for the purpose of establishing "prima-facie" that there are issues that cannot be ignored and that we must look at the images and GI in the right perspective.

First, imagine that a person is photographed, without his knowledge, by a low-quality imaging system where he was seen in a group and his individual details were not seen. As against this, imagine that the same person is photographed, again without his knowledge, but this time using a very high quality and sophisticated imaging system enabled by advancement of technology. By all probability, in the former case the individual would not be too worried about his being photographed (as the image so generated had no graphic details of the individual and in fact was of a group, of which he was seen as one of them). However, in the latter case, the individual would be immensely worried. However, presently, he could easily get legal protection (under national or international law), provided he proved of being imaged and the harm established.

Something akin to this is what is happening in the remote sensing image arena. Earlier, with the resolution of the imaging systems are being coarse, the UN Principles provided sufficient "protection" for nations being imaged – though they were not too worried because of the broad resolutions and coarse information. However, with the availability of high resolution images, the nation's worries have started (just like the individual mentioned above) – as they feel that information of their territories is being imaged for which they have no control.

The parallelism does not end here. Let us continue with our analogy. If the detailed photograph of the individual is then commercially sold and made use of by different groups to endorse product (commercial use) or create gossip (infringement of privacy) or harass the person (individual security issue) and so on, then the individual is further extremely worried. His worry is that information about him (which he considers personal) is now available, without his knowledge, to one and all – thus contrasting the fundamental aspects of good society.

Thus, when nations see that high resolution detailed images of their nations are being acquired and sold, without their having any control, and that the information is used in advantage of certain specific groups and sometimes without the involvement of the related nation (which they consider national interest) and even against the nation (which they consider against national security), the nations are also extremely worried.

With modern techniques of photo and image processing, it is possible to morph/suture/compose/merge photographs and create distorted image from the original photograph and use the same to "threaten or black-mail" the individual (the threat perception). This is what individuals and good citizen's be afraid of. On similar lines, nations would be worried whether the images of their nation could be "processed" and create trouble for them from outside their soils.

Let us go on with our analogy. Suppose there are extremely advanced techniques and methods (exclusively available with a select group) to extract multitude of information about the individual (who was photographed) from the photograph itself and generate a very comprehensive biological and financial database of the individual. If this information/database of various parameters, is then integrated with some other external information available with the select group, and is utilized for the benefit of the individual then it is ok. However, if the information is commercially or otherwise exploited which may not be in the benefit of the individual (in fact even detrimental to him), this would lead to serious repercussion from the individual and society.

This is where the concept of GIS comes in where information on a event, nation, resource, business, etc. is organised in a multi-layered database and is used for a variety of "good applications" of society then it is a positive trend but if the information is exploited against the interest of the local society, nation then the society has serious objections. Multitude of issues come up to the fore and the need for protection from such "abuse or misuse" of the database becomes very relevant.

Thus, one will see how issues of privacy, national interest, threat perceptions, commercial benefits, societal good, etc become relevant – not just in the context of the examples mentioned above but very much so for images, GIS databases and other elements. Of course, technological changes and developments – especially the ability to image great details, the digital processing technology, the internet technology (allowing easy

dissemination of information) etc are also major "drivers" that are calling for changes in the environment and culture for the creation and use of Images and GI.

We believe that, as we paint this scenario to illustrate the perspectives, the realities are there for us to see – even as we cannot wish away these perspectives. It requires that we understand them and create a regime that provides comfort for one and all (just as the individual want to feel safe and comforted but is always on guard, nations too may like to feel safe and comforted from such technologies and possible damages).

## 4. EO IMAGES – POLICY ISSUES

It is important that EO images and GI are positioned as Public-Good – with or without commercial connotations. One definition of 'a public good' comes from economics. A private good is one that solely benefits the person who has possession of it while the benefits of a public good are shared. Examples cited are defense as a public good and a consumable such as a chocolate bar as a private good. Characteristics of 'a public good' thus are that there is non-rival consumption and that the cost does not depend on the number of users[3]. This raises a question "Are information goods in general public goods?". Love answers "sometimes yes, sometimes no, and sometimes partly yes and partly no." In order to better answer the question of availability to government information, Love introduces the concept of 'merit good'. A merit good is one "for which consumption should be encouraged, based upon non-market value judgments by society." Education is cited as an example of a merit good. Much government information, Love says, also fits this example. Thus the information should be made available not solely on economic judgments but also using social criteria. Although Love does not elaborate on what the basis for these social criteria would be, he does put the question into the proper realm for questions of law and policy exist not just in the economic sphere but are really questions of values.

One criterion for determining societal value is the utilitarian concept of "the greatest good for the greatest number." Although the concept is easy to understand in general terms, the application of the utilitarian principle to specific cases can be problematic. One value in many nations is that of an open society where the greatest good can be achieved with an informed electorate. This implies ready access to data with that access ensured through government subsidy if necessary.

Welfare and Good also have an impact on GI product market perception. The arguments are made considerably more complex by the fact that the information in GIS is a non-excludable public good (eg one which exhibits non-rivalrous consumption) produced jointly with a private good in a competitive market. Land survey maps are private goods in their use in land transactions: one person's plan cannot be used in another's land transaction. On the other hand the GI in the plan is a public good. Since each new unit of information can be provided at no additional cost to all purchasers (and assuming that more information is better), then the demand for the information will depend not only on the per unit price, as is true for private goods, but also on the quantity of information produced[4].

### 4.1. EO IMAGES – COMMERCIAL AND NATIONAL CONSIDERATIONS

The Principle IV of the Resolution adopted by the UN stipulated, inter-alia that remote sensing activities "shall be conducted on the basis of respect for the principle of full and permanent sovereignty of all states and peoples over their own wealth and natural resources, with due regard to the rights and interests, in accordance with international law, of other states and entities under their jurisdiction. Such activities shall not be conducted in a manner detrimental to the legitimate rights and interests of the sensed state".

Availability of improved quality of remote sensing data, particularly at a level of <1 meter resolution or better, has also raised growing concerns in various states on "proper" use of data. The ready availability of <1 meter resolution images in the market place and the promise of new data of similar or higher resolution with better spectral characteristics including hyper spectral data and even all weather radar data of improved quality are leading to an era of growing transparency. Of particular relevance to the remote sensing is the information that can be derived on certain vital installations of infrastructures that have bearing on national security, public health and safety, economy and public morale. This will mean meeting a twin set of requirements - firstly to generate information which will assist governments in the task of their protection and secondly taking necessary safeguards to ensure that such information is used exclusively for legitimate purposes. These concerns share a

[3] Love, J. (1994). Pricing government information. Available: www.essential.org/tap/pricing.html.

[4] Siebrasse, N. and J.D. McLaughlin, (2001). "Contested Markets and the Optimal Breadth of Copyright Protection: The Example of Surveyors' Plans of Survey," New Brunswick, Canada. Found on internet at www.spatial.maine.edu/tempe/siebrasse.html

view that sensed states do not have any jurisdiction over commercial entities from other states that carry out imaging over their territories and sell imageries to any one who pays.

In light of this, the spirit of UN Principles and each nation's legitimate rights and interests could be perceived opposite (i) if they have no definite means to know whether their territory is imaged by commercial operators and (ii) if they have no access to the data of their territories on a non-discriminatory basis soon after they are imaged.

Since the data availability from commercial systems providing high resolution data will be mainly driven by the market considerations, the affordability for accessing such data will be another major issue for a large number of states, particularly for developing states. The policies adopted by the commercial operators also show that the sensed states do not have priority for acquisition of data over their territories if they are unable to pay the high premium, which the other customers in any part of the world are ready to pay, even if those customers make such request later than the sensed state.

It is noteworthy that certain measures are taken in the US and Indian (and others) Policies to impose conditions on its licensees such as the so called "shutter control" obligations (which can be imposed during specific periods when national security or foreign policy interests are determined to be compromised) and for provision of access to the government of downlink formats and data. Further the governments also stipulate that licensees should make available to the government of any country un-enhanced data concerning the territory under the jurisdiction of such government as soon as such data are available and on reasonable cost terms and conditions, subject to all other conditions of its licenses. However, such measures are not universally standardised and each nation adopts its own practice.

Such trends of regulation of remote sensing data are apparent in many nations. International law entitles of all States to freely acquire satellite imagery without the consent of the sensed States. Subject to the applicable principles of international law, a sensing State is entitled to determine the distribution or denial of satellite imagery. The 1986 UN Resolution recognizes the right of the sensed State to have access, on a non-discriminatory basis, to satellite imagery of its own territory. However, contrary to the provision of this Resolution, several States have started making such access subject to their national security concerns, foreign policy interests or international obligations[5].

### 4.2. EO IMAGES – REQUIREMENT OF GLOBAL COOPERATION

The Principle IV of the Resolution adopted by the UN stipulated, inter-alia that remote sensing activities "shall be conducted on the basis of respect for the principle of full and permanent sovereignty of all states and peoples over their own wealth and natural resources, with due regard to the rights and interests, in accordance with international law, of other states and entities under their jurisdiction. Such activities shall not be conducted in a manner detrimental to the legitimate rights and interests of the sensed state". The advent of commercial systems, with capabilities for worldwide dissemination of high quality remote sensing imageries, which can provide a great deal of details of the land surface and oceans is posing, according to some, challenges to concerns of states.

As EO data availability is also driven by market considerations, the affordability for accessing such data is becoming a major issue for a large number of states. As there are concerns about governments losing some degree of control over information about their territory, there could be tensions, particularly when a state considers that entities abroad have exploited information about its territory, even as it had no fair and affordable access to the same. Some threats could be in form of – industrial espionage, and potential use of imagery by anti-social groups, terrorists and anti-nationals. Commercial exploitations of natural resources in another country without the knowledge of its government and could possibly gain strategic advantage in negotiations.

There are, however, significant benefits of transparency created by the availability of high quality EO images including their use by NGO's, media, environmental groups and governments. These benefits cannot fully fructify unless international community develops means to harmonise the policies and legal measures. National regulations to restrict physical flow of information products in the age of Internet are ultimately not going to be very productive. Hence there is a need for evolving acceptable legal norms for the operations of commercial operators – taking into account the basic needs of civil societies' rights for information and the legitimate concerns of the governments to maintain the rule of law in the territories under their jurisdiction.

[5] Jakhu, Ram (2003). International law governing acquisition and dissemination of satellite imagery. In Journal of Space Law vol 29.

## 5. LEGAL ISSUES OF POSITIONING AND NAVIGATION

For obvious reasons, the legal issues in the Positioning and Navigation depend on numerous factors, including the precise commercial applications, business operations and markets involved. With proper evaluation, planning and action, steps to reduce legal risks can be taken in a timely manner. For manufacturers, system integrators, vendors and service providers, users issues include Product Liability issues, issues Related to Signal Accuracy, Integrity and Availability, regulatory issues, IP and also Privacy intrusion issues.

It is also seen that general trend in positioning and navigation services is to "integrate" capabilities (with EO, GIS, IT solutions etc) to offer innovative services. These often involve developing sophisticated, cross-industry contractual relationships between auto component manufacturers, electronics component manufacturers and content providers, among others. This calls for coordination of multiple agencies and unless there are strong legal interfaces, disputes can arise as to who is responsible for a "liability".

## 6. GI – POLICY ISSUES

GI forms part of many a user-application and is more tuned to establishing National and Regional GIS or National Spatial Data Infrastructure (NSDI) that is emerging as an important element of information society. What is the likely distribution of social benefits and costs of GIS databases in respect to poor versus wealthy societies, urban versus rural communities, large versus small businesses, and developed versus developing countries? Will use of GIS widen or narrow socio-economic gaps between different segments of the population? How will different societal attitudes toward the proper role of government in handling personal data affect society's ability to benefit from wide scale sharing of geographic information? Can or should the technology be instituted in such a manner that will promote equity in the distribution of its benefits and costs?

Legal issues differ based on what type of GIS product or service is being considered. GIS tools, data sets, Application Program Interfaces embedded functions could be treated under existing and proposed software protection legislation. Specialized GIS applications such as land registry, land use, utilities, environmental monitoring may contain personal/customer data or data with far reaching financial, health or safety consequences. Any misuse or commercial loss due to poorly constructed or managed systems will have legal ramifications to the vendors and users. The GIS containing personal data such as marketing research, Census data, public authority data etc., will be governed under the data privacy or data protection legislations. Also, GIS in critical systems such as flood control and civil protection, require high data accuracy, and this has implications for protection of life or property. Inaccuracies could invite liability or prosecution of data providers and software interface developers. Further the new possibilities for incorporating Virtual Reality (VR) functions to GIS products can give rise to problems of ownership of data, software elements, and search engines and so on. Hence basic problem is one of different actors who become involved in creating product or service. There are also other issues such as using GIS as the "value added" element to permit legal resale of otherwise "not for resale" datasets drawn from the public domain. In summary the various legal issues that could apply to GIS products and services could cover many of the following legal aspects: (i) IPR / Copyright and neighboring rights, (ii)Data Protection, (iii) Confidentiality/ data privacy, (iv) Competition Law, (v) Licensing, (vi) Consumer protection / fitness for purpose, (vii) Product and services liability, (viii) Censorship and other information content related issues, (ix) Health and safety legislation, and (x) Patent law – especially as GIS systems become more complex[6].

### 6.1. NATIONAL GUIDELINES – FGDC EXAMPLE

FGDC has issued a new set of guidelines for provide a method for balancing security risks and the benefits of geospatial data dissemination[7]. US agencies note that many public, private, and non-profit organizations originate and publicly disseminate geospatial data. Dissemination is essential to the missions of many organizations and the majority of these data are appropriate for public release. However, a small portion of these data could pose risks to security and may therefore require safeguarding. Although there is not much publicly available geospatial information that is sensitive (Baker and others, 2004, page 123), managers of geospatial information have safeguarded information using different decision procedures and criteria. The FGDC guidelines provide standard procedures to:

- Identify sensitive information content of geospatial data that pose a risk to security.

[6] Onsrud, H.J. and R. Reis, (1995). "Law and Information Policy for Spatial Databases: A Research Agenda," 35 Jurimetrics, pp. 377-393. www.spatial.maine.edu/tempe/onsrud_2.html

[7] FGDC (2005). Guidelines for Providing Appropriate Access to Geospatial Data in Response to Security Concerns. A US-NSDI guideline document of June, 2005 from www.fgdc.gov

- Review decisions about sensitive information content during reassessments of safeguards on geospatial data.

It is interesting to note that guidelines are very exhaustive and are more a process of transparency and "self declaration" for the access of the data. The guidelines propose a step-by-step approach that includes any agency to evaluate what it would do for the geo-spatial data.

On the other hand, a major global initiative of public access to image sand GIS information has been positioned by Google as part of their Google Earth portal – where high-resolution images and maps of almost all parts of the globe are accessible in the public domain – thus bringing in transparency to GI access but also raising "hot debates" on impinging on security. Technology allows Google-like and other such initiatives to bring in public access but with the regulations being discussed (like FGDC and others) would such initiatives become extinct or get regulated.

It is hard to imagine US laws recommending restriction to some images (say of critical areas) which can be easily accessed on public portals. Would such IT initiatives be liable to regulation and adhere to "national" or "international" laws. Who would define what should be "restricted" and "regulated" and how – the nation in question, the technology owner, the service provider or an international understanding? This is the crux of the issue.

### 6.2. EO AND GIS RELATED POLICY – INDIA[8]

India is passing through a crucial stage as far as EO and GIS applications are concerned. There is a paradox in the national GI eco-system – one side, demand for GI and GIS applications has never been so high and is pervading almost all sectors of society; on the other hand, India is "yet to arrive" at the GIS scene – government users recognize the immense use of GI but still "clamour" for GI applications, private enterprise's struggle for providing GI services and solutions and academia mostly make-do with old/obsolete GI capability. Another paradox is that India still makes considerable annual financial investment in GIS – in terms of license purchase of GI software (mostly foreign sources) and systems, undertaking specific projects and applications and thereby having considerable experts in this field – which is a good foundation. On the other hand, these are all dissipated and so largely "chunky" and "piecemeal" capability that has not made any COLLECTIVE and big impact on the national scene.

Some of the critical reasons for this paradoxical scenario are attributed to (i) non-availability of regularly updated GI content for the nation, (ii) lack of a coordinated, aligned and professional effort at furthering the national goals of GI generation and usage – government agencies have "pulled" in different directions and have not set/defined a NATIONAL GI GOAL to which all of them worked and (iii) lack of a holistic NATIONAL GI POLICY – which aims to look ahead and make a road-map for all elements of GI and helps to make GI usage all-pervasive and easily possible.

India has 5 different policies in position which pertain to different aspects of GI as of date:

- A National Map Policy (2005) defines the scope, distribution and liberalized access of digital Survey of India (SOI) topographic maps to user groups without jeopardizing national security.
- A Civil Aviation Requirement (CAR) was issued in 2012 detailing procedure for issuance of flight clearances for agencies undertaking aerial photography, geophysical surveys, cloud seeding etc.
- A Remote Sensing Data Policy (RSDP (2001 and 2011) defining the distribution process of satellite images to different category of users.
- The Delhi Geographical Spatial Data Infrastructure (Management, Control, Administration, Security and Safety), Act, 2011 defining the mandatory sharing, accessing and utilisation of Delhi Geo-Spatial Data.
- A National Data Sharing and Accessibility Policy-2012 (NDSAP-2012) providing an enabling provision and platform for proactive and open access to the data generated through public funds available with various departments / organizations of Government of India.

In present day perspectives, the National Map Policy 2005 need improvisation in terms of committed plans for updating maps, service level guarantees to users, diversification of mapping concept (beyond

[8] Perspectives of a National GI Policy (Including a draft Policy) - Mukund Rao and KR Sridhara Murthi. A report of National Institute of Advanced Studies, Bangalore. Report No: R11-2012. (www.nias.res.in/docs/R11-2012-GI-Policy.pdf)

topography) and appropriate participative measures for users/industries/citizens. Similarly the Remote Sensing Data Policy -2011, though quite progressive, still lacks a few important requirements of a POLICY – time-line definitions and service level guarantees to users; timely and committed enhancements for national imaging capabilities, involving users/industries/citizens as part of transparent and participatory policy-making process and enabling access to data from global commercial satellites in a more rational manner. Considering the technological capability of the country, even positioning into global market in a more prominent way needs to be considered.

Similar revitalisation of policies relating to aerial survey capability and services is relevant apart from need for a holistic road-map for growth in this aerial survey sector. While the Delhi Geospatial Act, 2011 and National Data Sharing and Accessibility Policy-2012 are progressive steps, they also need further consolidation when seen in context of the goal for realising the maximum potential of GI for national needs in diverse areas.

Foregoing analysis of current ecosystem indicates all the above mentioned policies together do not ensure the regular and easy availability and accessibility to GI in a updated, standardized and seamless manner for the nation that can make an impact to economy of our society. Hence, there is a need for envisioning a set of core capabilities related to GI as a policy goal at national level matching with the needs, aspirations and strengths of the country and filling the aforementioned gaps in the current policies. It is also necessary harmonise these GI policies from various cross cutting considerations like national security, social and legal environments[9].

## 7. KEY POINTS FOR EO AND GIS POLICY DEFINITIONS

Notwithstanding the FGDC guidelines and the Google Earth initiatives or Indian policies (or other such initiatives across the world), in summary, we point out some of the critical points that are prime in defining a good policy definition for images and GI – these are some perspectives but one can build upon these and generate a paper that becomes comprehensive for a policy definition exercise. Some of the key issues that need to be considered for defining a good national and international framework for policy on EO and GI:

- Need to re-look and re-address the 1986 UN Principles on Remote Sensing and arbitrate a new international regime of understanding for images from satellites. This framework will have to encourage nations to recognize the need for a over-arching understanding for satellite operators (both government and commercial), nations that are imaged and global image user community.

- Recognise that satellite images, including high-resolution images, are essential to support development activities. As has been mentioned earlier, a large number of societal development activities or "societal good" depends critically on the availability of satellite images – disaster management support; land and water management; environmental monitoring; mapping of various themes; for planning and managing urban facilities/infrastructure; rural development; cadastral mapping; national infrastructure development – roads/ highways, telecom, power and many others. Many of these societal issues are trans-national.

- National (security or commercial) interests will have to be fully taken into consideration to ensure that nation's interests are not compromised. Possibilities of necessary steps for non-disclosure and second-order dissemination are already being discussed.

- Recognise that imposing any control on foreign private satellites for "imaging" over any region is truly not possible. With the highres satellites, images of any region would be acquired and made available to any user in any country – especially when commercial considerations and demand will drive data sales. While shutter-control is available to the country licensing the satellite (like, say USA can regulate imaging/dissemination/use of images over its or a specified territory), the "sensed state" will not be able to regulate any control on the commercial satellite for imaging over its territory.

- The "rights" of the sensed state may emerge stronger in the coming days and it may be difficult to ignore/by-pass this aspect in defining the international framework. However, international discussions/consensus needs to be built on the role/privileges of "sensed state" for imaging over its territory. It may be appropriate to move for atleast a consensus that provides comfort to "sensed states" by sharing the information on users who use images of their territories.

[9] Perspectives of a National GI Policy (Including assessment of National Remote Sensing, Map and Data Sharing Policies) – Mukund Rao, K.R. Sridhara Murthi and V S Ramamurthy. Paper Presented at 56th IISL COLLOQUIUM ON THE LAW OF OUTER SPACE, International Astronautical Congress, Beijing, 2013.

Similarly, key Points underlying a GI policy would have to consider:

- Recognize that creating high quality spatial data is very expensive
- Data maintenance can be almost as expensive as de novo data creation. As a result, many data originators will be devoting much effort to this aspect in the coming years.
- Many organisations are capable of creating data on a limited area, project basis. Creating, updating and managing detailed national spatial databases is however a very different and non trivial matter. Those with these skills and track record have a real competitive advantage, especially where Intellectual Property Rights are vested in the holders of the data
- Private sector data sets are typically derived from public sector ones and a good copy-right regime is called for
- It is possible to sustain a solid intellectual and economic case for either complete cost recovery or nil cost recovery; any position in between is essentially pragmatism. Where only a fraction of the populace directly benefits from the existence of spatial data, cost recovery policies provide greater equity through ensuring the user rather than the taxpayer pays costs
- Changing the method of access to spatial data may well facilitate different charging regimes: both through perception and charging metric, on-line access to data fosters and permits much larger numbers of small value transactions.
- Promote standards for documentation, archiving, distribution of information, geographic control, and accuracy of analysis. These standards could be developed in collaborative processes with research and resource management institutions. They need not be mandatory, but should be widely known so that all institutes have a reasonable idea for what is expected of them.
- Liability exposure may have a substantial impact on whether agencies and others will be willing to share GIS data and whether they will be willing to offer GIS data for sale in a networked electronic marketplace.

## 8. NEED FOR INFORMED DEBATE UNDER MULTILATERAL FRAMEWORK

An effective solution to the predicaments brought about by the technology developments including convergence of various tools and techniques like GIS, GPS and Remote Sensing data, world wide access to databases by the Internet revolution, interfaces with emerging technologies for visualization such as Virtual Reality and multimedia applications coupled with commercial availability of high resolution data give rise to issues that would warrant a harmonized international framework of legal norms under an appropriate multilateral forum such as UN-COPOUS and UN-Regional Cartographic Conference (RCC), Global Spatial Data Infrastructure (GSDI), ISPRS etc addressing various concerns on access to spatial data, its use, rights of privacy, security and sovereignty of states. It is clear that the world is currently facing far more new challenges, which were not anticipated at the time of evolution of the Remote Sensing Principles by the UN and, even later, when the technological developments in GIS have happened. An urgent debate on these issues is essential to ensure that the full potential and benefits from the EO and GIS is available to society.

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