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Mukund Rao
K R Sridhara Murthi

Perspectives for a National GI Policy

(Including a National GI Policy Draft)

National Institute of Advanced Studies
Bangalore, India

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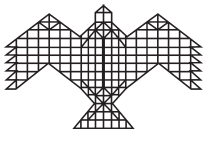
Mukund Rao & K R Sridhara Murthi



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DST SPONSORED NATIONAL GI POLICY PROJECT

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GI (Geographic Information) .....

.....refers to any information that has a geographical or location context. The GI includes satellite images, aerial images/data, maps – topographic and thematic, ground survey data, positioning data, geo-tagged attributes/tables etc and also the derivatives from their processing – all of which are amenable to visual display, integration and processing and serving as maps/images in the spatial domain.

Policy.....

is declared objectives that a government seeks to achieve and preserve in national interest ....

..... typically a "Statement of Intent" or a "Commitment" to guide decisions, actions and achieve developmental outcomes for the nation.

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India needs robust information and decision support systems to aid decision making process for planning and implementation of various developmental programs. Geographical Information Systems or GIS will be mainstay around which such information and decision support systems can be built.

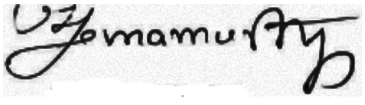
Government of India is taking up the implementation of a National GIS – the core of which is a well-founded GI architecture that is seamlessly available for the whole nation and is continuously maintained/updated and will power many a GIS Decision Support applications for governance, enterprises and citizens. In fact, most ministries/departments have endorsed and plan to use National GIS and presently the approval process is on-going so that National GIS can start as soon as possible as a major 12th Plan initiative.

Policy is an important aspect envisioned in National GIS. This not only needs a National GI Policy – which is all encompassing and oriented towards National GIS but we will have to back it up with appropriate down-stream procedures/practices and sound technical standards/protocols. A large awareness needs to be also created for important and relevance of Policies, Practices and Standards – across government, industries and academia and even for citizens.

I am happy that NIAS has taken up this project and brought out this report on National GI Policy – even going ahead to propose a draft National GI Policy. This report is the outcome of the work undertaken by NIAS Project team and also is based on detailed consultations held with many experts. NIAS also organised a National GI Policy Roundtable where experts debated various issues and a set of recommendations were arrived at.

This is a first of the kind report on National GI Policy – comprehensively covering imaging, mapping, surveying, GIS and positioning a holistic policy perspective for National GIS. The report has built a foundation for the Policy and many a details have to be worked out. may still have gaps to be addressed. The report is now submitted to DST and they will take up the next steps in formalizing the Policy.

I thank all experts who contributed and also congratulate the NIAS Project team for bringing out this excellent report.



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EXECUTIVE SUMMARY

1. Geographic Information Systems (GIS) have been making tremendous impact globally for decision support applications in recent times. With the heritage of many programmes in Imaging, Mapping and GIS, India is now planning to establish a National GIS – the successes of which would critically depend upon a good integrated Policy framework.

2. Department of Science and Technology (DST), Government of India (GOI) has sponsored a project on National Institute of Advanced Studies (NIAS) for Policy Research in Geographic Information (GI). Subsequent to a thorough study by a team of experts, NIAS had organized "National GI Policy Roundtable" inviting experts from government, industries, academia and NGOs. Based on discussions and inputs emanating from the meeting, it had prepared an integrated National GI Policy document.

3. The context and relevance of a study on GI policy for India assumes enormous contemporary significance. India is on a path of progress and growth, requiring a vastly different information regime to arm itself for meeting the future developmental challenges. To effectively confront these, India needs to be powered by very efficient national information systems that will have to be the foundation for the governing as well as the governed – bringing assessment of development needs, bridging disparity and gaps, promoting equity, transparency, inclusivity and citizen participation. Geographical Information Systems have emerged as effective tools towards such objectives.

4. It is observed that in spite of fairly wide usage of GIS as a technology, the full potential of GIS has not been exploited in the country for decision-support by planners, decision-makers, citizens and many others who are stake holders for governance. Although many initiatives have been successful in proving GIS application potentials in a "project mode", GIS is yet to get a "service orientation" and get assimilated to become a part of the process of governance, planning and nation-building in a significant manner. The main reasons for this situation are (i) lack of easily available and regularly updated GIS-Ready data for the nation, (ii) lack of comprehensive, easy-to-use GIS Decision Support System, and (iii) absence of an integrated and overarching system to foster high-level of national capability in this field.

INTERNATIONAL SCENARIO IN GI POLICY

5. Globally, information has emerged as a key determinant in shaping contemporary societies and supremacy of nations. In particular, the GI and GIS have emerged over past few decades as vital differentiators for Decision Support Systems in diverse spheres such as governance, business endeavors and citizen centric activities.

6. Landscape of GIS policies in different countries across the globe presents a varied picture. Study of GI Policies in Americas, Europe and Asia indicate strong interests for public investments in GI assets and applications, developing institutional infrastructure and regulations for national security, albeit to varying degrees. The policies also focus on promoting the role of private sector for adding value to public investments, for delivery of services and in advancing technological frontiers. It is also evident that the policy landscape has been continuously evolving in order to meet the challenges of the changing environment of GIS

7. Complementing the progress on policies in individual nations, several international fora are also contributing to the policy evolution. Group on Earth Observations (GEO), which is a voluntary partnership of governments and international organisations, aims to provide by 2015 a shared, easily accessible, timely, sustained stream of comprehensive data of documented quality, as well as metadata and information products. Visions for global approaches had contributed to concepts like citizen participation in GIS.

8. Analysis of GI policies at international level leads us to some important conclusions. While during the last decade thrust was on building spatial data infrastructures and sharing of data available with different agencies, the GI policies are now moving beyond emphasis on sharing of data and sustaining of the spatial data infrastructures. They are progressing towards systems that ensure readily usable and current data which different users (in government, business enterprises and citizens) need and the systems that deliver affordable and timely services. The governments are increasingly recognising the diverse roles of GI (public good, commercial and quality governance) and are investing in infrastructure as well as national capabilities for technology, institutions and human resources. They are innovating overarching policies to realise these through engagement of diverse stake-holders. Globalization has diversified information sources, revolutionized the instruments of delivery and outreach and paradigms of access and utilization of information. GI, as a facet of this new order, demands active response in policy-making.

CURRENT ECO-SYSTEM OF GI POLICY IN INDIA

9. India is passing through a crucial stage as far as geospatial technologies and 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.

10. 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.

11. 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.

12. 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 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.

13. 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.

14. 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.

15. 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.

TOWARDS A GI POLICY – CAPABILITY CONSIDERATIONS

16. Seven basic segments have been identified that describe national capability in GI. These are (i) Imaging Capability, (ii) Precise Positioning Capability, (iii) Advanced Surveying Capability, (iv) Mapping Capability, (v) GIS Capability, (vi) GI Knowledge Capability and (vii) GI Policy Capability

17. Few nations have a comprehensive GI policy environment that defines the end-to-end regime of GI and assured availability of GI; some nations have fragmented GI policy environment that compartmentalizes policies on various elements such as commercial satellite service capability; distribution/provision of images; distribution/provision of topographic maps; permission to conduct aerial survey and use of aerial images/data; broad guidelines to share GI data etc; most other nations do not have clear policy definitions for GI and manage with work-around rules/positions evolved in a reactive manner.

18. Many nations have progressed over time from a regime of restricting the availability of GI, driven by national security and defence considerations. Over the past two decades, rapid advances in technology are rendering such “restriction based” regimes futile and obsolete. Objectives of security need to be achieved through more innovative regulations, taking advantage of the very same advances. Globally too, a realization is dawning that a

more cooperative approach is essential to share experiences/capability in GI and to bring at least a "minimum commonality" of policy considerations across nations.

TOWARDS A GI POLICY – CROSS-CUTTING CONSIDERATIONS

19. National Security consideration – GI information has national security impacts and also extremely essential for national security and defence needs. On the other hand, improperly devised and highly restrictive policies that curb innovation and growth of GI technology in the country can handicap the security/defence system. Most nations have the following concerns from a security point of view:

- Knowledge of who is using GI – mainly to "isolate" any user who intends/plans to use GI against the national interest.
- The nature of use of the GI– is it benign/permissible OR is there any use against national interest.
- Can every user of GI be tracked and whether use of GI can be "assessed" in real-time. This is to determine the benign user as against one who uses against national interests.

20. Technologically, with present-day advances in imaging, internet and computing technologies, it is virtually impossible for a democratic governance system to adopt totally restrictive regime for access to information. Any nation today can set up a global GI server that can serve GI content of any part of the globe to an individual without any difficulty. A desirable strategy is to be in the fore-front of technological capability and being able to sift the use, adopt online analytics and audit to determine each transaction (analog/digital) related to GI information and also counter global GI content dominance by helping to grow/position Indian global GI services.

21. Social relevance issue – As GI related activities vitally serve government, enterprises and citizens, a National GI system is to be considered as a basic social infrastructure that helps the nation as a whole. This founding for proper development and usage of GI and establishing the foundation of National GI and its benefits needs to be taken as a national commitment. Any subsequent business model for GI related activity could happen as a sequel to this founding activity – just as it happened in any other sector (telecom, roads, aviation, railways etc – in most of these sectors the business sector grew only when the founding investments for the infrastructure had already been made by government and provided the "platform" and standardization for a business model to develop).

22. GI Legal Issues – Globally, various legal issues that could apply to GI are identified and 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. Existing laws and policies in these areas are to be aligned to the new environment and capabilities unfolded by advances in GI.

23. Creating industrial capacity – Many governments recognize that industries also are partners in national GI development and that anchor-tenancy model could create a healthy, sustainable and competitive industry and justify private sector involvement. Government could consider incentivizing industry with limited-period tax rebates/ concessions on using indigenous GI technology/data; developing new and indigenous GI technology (instruments, software, data, citizen services etc) and many other methods.

CRITICAL ISSUES (OF IMPORTANCE) FOR A NATIONAL GI POLICY

24. NIAS team has identified and analysed all critical parameters that contribute to the constitution of "Capabilities " in GI and their input for policy and also all relevant cross-cutting issues for the policy, fitting into Indian context.

25. All in all, a set of 62 parameters relating to "Capabilities" domain have been analyzed to enable a "holistic" approach to Policy definition. Of these sixty-two parameters:

- 14 parameters deal with "Imaging" segment, reflecting leadership in Imaging capability, long-term strategy, global placement, service level requirements, performance needs and support for National GIS content.
- 11 parameters are relevant to "Positioning Capability" that recognize the needs of Positioning as a service and the strategic approach for this.
- Further, 9 parameters pertain to with "Advanced Surveying" that have clearly identified critical gaps in bringing benefit of aerial survey capability in India and an urgent need to bridge this gap; stream-lining and standardizing ground-surveying activity and its contribution to National GIS.
- "Mapping capabilities" are reflected through 7 parameters that bring out clear gaps in mapping domain and availability of up-to-date digital topographic maps and also in thematic mapping content in India.
- 14 parameters pertain to "GI Content capabilities" that underscore the importance of DATA/CONTENT for the growth of GI usage and applications and benefits.
- Lastly, 7 more parameters that embody the needs to pursue GIS application services in the Decision Support Systems and also needs for indigenous capability in GIS software.

26. This parametric-analysis clearly pointed out that, in spite of high potential and achievements in the country, when one looks at different segments that go into defining GI availability/Accessibility and usage, there are systemic enhancement/improvements required in several aspects, such as generation of GI, organisation of GI, accessibility of GI, usage of GI – all of which requires a vision towards making GI availability as a service-orientation, long-term planning for generation and updation of GI, adherence to standards of GI, organisational "tweaking" to institutionalize GIS activities and an inclusive approach to driving GI for benefit and as per need of user segment. It is also clear that excellence in leadership, performance orientation and accountable actions would also go a long way in making the GI sector. These can be best addressed by a vibrant and responsive policy-making and policy-adapting goals for National GIS and an organisational framework of aligning to the goals.

27. Consultations with experts and diverse groups (GI generators, users, security agencies etc) have been held in a 2-day Roundtable meeting held at NIAS (where ~40 experts participated) and the recommendations have been very valuable for the study. The inputs under-pinned the need for a "holistic" GI Policy (encompassing various elements of GI); endorsed and highlighted the need for National GIS and also recommended the mandating of use of GI in government agencies/activities. The Roundtable, while re-iterating the need for open and transparent regulations and procedures related to GI had also identified the structural and substantial lacunae in the current policies which prevented the realization of maximal potential in GI in various sectors. The need for a "seamless, standardized and nation-wide" National GIS system and the need for an organisational focus were also re-iterated. GI Policy-making must be "holistic" rather than existing "silos" of sectoral policies that leave many cross-cutting gaps. Issues related to what private sector can do – especially in generating and serving GI and GIS Applications on National GIS was also recognized as imminent need. It was also suggested that GI Policy making and implementation actions must be separated and adopting a "consultative and participative" process for GI Policy-making and review have been strongly recommended. Emphasizing that GI needs support of government to further evolve and develop, the Roundtable stressed that national capability in GI must get developed for the nation to maintain leadership in this important technology.

28. In specific, the user consultations showed that 3 major issues are seen as "limiting factor" in the existing RSDP and NMAP and which are posing challenges in usage of satellite images and maps – these pertain to

    a. **Image Masking in RSDP** where sensitive and vital areas/points are masked out before satellite images of better than 1m resolution are distributed to Indian users. Masking of images is seen as an "oriental method" at denial which does not

serve modern day purpose and only limits genuine Indian users to reduced access to such data – especially in urban planning/management (where large masked out areas renders planning/mapping impossible and leaves "holes" in mapping/GIS and development). This practice of "masking" must be done away with – especially when images are being distributed on registration.

b. **Non availability of updated/current, GIS-based topographic maps as per NMP:** Even though NMP, 2005 is in operation there is no clarity on availability of updated topographic maps of the country in GIS-ready formats. Most users whom we discussed mentioned that GIS-Ready maps are not available from SOI. Internal discussions with SOI also confirmed that while scanned/digitization of all 1:50K maps have been done, the vectorisation is still in old formats (SOI DVD – whish is spaghetti and non-GIS compliant format) and that GIS formatting is yet to be taken up/completed. Thus, NMP is seen as serving an outdated topographic mapping regime and servers very little purpose.

c. **Non availability of GIS-ready elevation data to India users:** Even as the country has Cartosat-1 stereo for the past 7 years which can provide GIS-ready elevation data of about 4-5m elevation accuracy AND even as SOI topographic maps on 1:50k scale has 20 m contour data that can provide GIS-Ready elevation data of about 6m elevation accuracy, the Indian users are still in denial of GIS-Ready elevation data access/availability. Elevation data is important for determining slopes, aspect, physiographic, relief analysis, line-of-sight determination and 3D perspectives – which are important for various GIS based Apps for governance/planning/infrastructure development/disaster management support etc.

GOALS AND OBJECTIVES OF NATIONAL GI POLICY

29. From the Indian context, the national goal for GI for next 10 (or 25)-years needs to be:

- Evolving and establishing a National GIS in next 3-5 years
- Through the establishment of National GIS, develop national capabilities in GI that will, at national level, contribute to the goals of improved governance and inclusive democracy and, at international level, position India as a front-end nation in GI technology

30. Within above goal, the immediate need is for developing National GIS as a system to make nation-wide, seamless, standardized GI easily available, accessible, usable and, thereby, bringing value-benefit to the nation in better governance/development; developing GI commerce activities and serving to citizens g-services (GIS-enabled e-services).

31. In the longer-term, the imperatives of a widely-used and pervading National GIS will push India to be in the fore-front of GI technology in the world and maintain a level of "supremacy" that would be of great technological/economic advantage to India.

DRAFT NATIONAL GI POLICY

32. Built on the foundations of existing GI capability in the country, aiming at evolution of a front ranking National GIS system and envisioning a future that can ensure India's improved governance/development and prominent position among world nations in this field, a DRAFT NATIONAL GI POLICY HAS BEEN PROPOSED.

33. The "holistic" proposed draft of National GI Policy has been worked out and includes a Preamble, Vision, Definitions, policies required for National GIS, imaging, positioning, Surveying and Mapping, GIS DSS, GI Eco-system issues and some other general aspects related to GI.

34. The text of the ***Draft National GI Policy*** is available as Annexure-II of this report.

35. With the submission of this report on national GI Policy and the Draft National GI Policy document to DST, NIAS has completed the task of the sponsored project from DST. It is now upto DST to take up next steps in the policy-making direction for National GI Policy.

1. Background

1. India has successful programmes of Images, Mapping and GIS and is now planning to establish a National GIS – the successes of which would depend upon good Policy framework which are integral and also changing and evolving over time. India has Open Map Policy for topographic maps, and RSDP for Images and they are among the key elements that define the environment for GIS in India. But India needs to build further on the existing policy elements to shape an integrated GI Policy that will be the foundation of National GIS and that which can promote the growth of the GIS technology and its wide usage – at the same time building safeguards and checks-and-balances to protect national interests. In fact, many past discussions have pointed to that need and NIAS is endeavoring through this work to fulfill that national demand.

2. Department of Science and Technology (DST), Government of India (GOI), in January, 2012, has sponsored a project to National Institute of Advanced Studies (NIAS) for Policy Research for Geographic Information (GI). NIAS has invited 3 eminent experts to be a part of the NIAS Project team – Dr Mukund Rao, an expert in EO/GIS (Principal Investigator) and Adjunct Faulty at NIAS; Mr K R Sridhara Murthi, a senior expert and Adjunct Faculty of NIAS with background in space commerce and technology policy management and Maj Gen Gopal Rao, an expert in Mapping and GIS and a senior expert faculty from NIAS (who contributed till January, 2012).

3. As part of its initial research, NIAS Project Team has studied and has researched:

   3.1. **the international scenario of GIS and Image Policies by studying the existing and emerging policies of som**e nations active in this field across the world and also addressing related legal principles – especially in USA, Europe, UK, Japan, China and others. Multi-lateral frameworks and fora like GSDI, GEO-CEOS, IAF, ISPRS and AGI, who also address these issues, were studied. A systematic assessment and comparative analysis is attempted with a possible trend-definition of the Policy scene in the international domain.

   3.2. the **national eco-system and environment of GI policy** as a framework – especially from the technology, user needs and national security considerations. In specific, a key assessment of the individual policies existing for satellite remote sensing in the form of Remote Sensing Data Policy RSDP), Open Map Policy for topographic maps and the National Data Sharing Policy that spells out sharing principles of information generated using public funds.

3.3. **Integrating framework of a National GI Policy** – integrating survey data, maps, images and geo-databases and outlining national guidelines for its creation, usage, sharing and also creating a national regime for its protected interests and development.

4. With a view to broad-base expert consultation/discussion, NIAS had organized a "National GI Policy Roundtable" of key invited experts from government, industries, academia/ NGOs providing a platform for more incisive discussion and debate on the policy issues. This roundtable had served the purpose of providing a GIS Policy Perspective base and created a broader consensus of a National GI Policy.

5. Based on discussions and inputs emanating from the meeting, NIAS has refined this the National GI Policy document – which is submitted to DST.

1.1. NATIONAL GIS

6. As the overall National GI Policy effort has emerged in the context of National GIS and also keeping in mind the eco-system of GI in the country, it is essential to understand the National GIS concept. The detailed document of National GIS vision is available on the web-site of Ministry of Earth Sciences at (http://www.moes.gov.in/national_gis.pdf).[1]

7. India is on a path of progress and growth. In the 12th Plan, focus is on agriculture; manufacturing; infrastructure, rural connectivity, health and education services and addressing special challenges for vulnerable/deprived areas. Developmental activities in India will demand a new paradigm and Governance regimes will need considerable change. India will require a vastly different information regime to arm itself for meeting the future developmental challenges – powered by very efficient national information systems that will have to be the foundation for the governing and the governed – bringing the assessment of development needs, bridging disparity and gaps, bringing equity, transparency, inclusivity and citizen participation. One such area is Geographical Information Systems – a system (of hardware/Software/data/applications/policies) that deals with spatially referenced and geographically tagged/linked data.

8. Over the years, India has developed successful activities in Imaging (from satellites, aerial platforms), Mapping (topographic and thematic), positioning and surveying and GIS (databases and applications) – both in government and commercial domain. GIS technology is widely used and a good knowledge-base has been created over the

[1] ICG (2011). Implementation of a National GIS under INGO – Programme document. A National GIS Vision document prepared by Planning Commission's Interim Core Group and published by Ministry of Earth Sciences in October, 2011.

years. GIS based initiatives (or projects) of the Natural Resources Information System under National Natural Resources Management System (NNRMS); National Spatial Data Infrastructure (NSDI) of Department of Science and Technology (DST); Bhuvan Image Portal of Department of Space (DOS); Delhi State Spatial Data Infrastructure (DSSDI) of Delhi State; National Urban Information System (NUIS) of Ministry of Urban Development (MUD); establishing G2G GIS by National Informatics Centre (NIC); recent efforts at modernization of land records under NRLMP; various City-GISs (example Mumbai, Bangalore, Kanpur, Kolkata and many others) and many others have been implemented. In addition, various GIS initiatives of the states (of particular mention is Gujarat, Maharashtra, Karnataka, AP and many others) have helped bring good and operational examples of state-wide applications of GIS. These state level efforts, in addition to establishing the relevance of GIS for development in a wide spectrum of areas, provide significant insights into successful policy making. In addition to government agencies, many private sector agencies have also been successful in implementing GIS solutions and in providing GIS services.

9. In spite of fairly wide usage of GIS as a technology, the full potential of GIS has not been exploited for decision-support by planners, stake holders for governance-process, decision-makers, citizens and many others. Some of the initiatives have certainly been successful to prove GIS application potentials in a "project mode" but GIS is yet to get a "service orientation" and get assimilated to become a part of the process of governance, planning and nation-building in a significant manner. The key gaps that are faced in the country are:

    9.1. how can the nation ensure that its decision making/governance process is supported by a comprehensive, easy-to-use GIS Decision Support System that brings scientific, participatory and quality dimensions into decisions, planning and development
    9.2. how can the nation ensure that GIS-Ready data is always easily available and maintained/updated – by adding that critical capability differentiator over the images and maps that have already been invested in
    9.3. how can India maintain a 1high-level of national capability in this important technology area and also leverage itself to be in the fore-front of GIS technology at the international arena

10. Realizing the importance and relevance of GIS and also to cover the gaps existing, Government of India (GOI) is considering a NATIONAL GIS as a new information regime supporting good governance, sustainable development and citizen empowerment through GIS Decision Support services for governance, private enterprise and citizens and by maintaining a nation-wide, standardized, seamless and most current GIS Asset for the nation.

10.1. National GIS is envisaged to bring vast benefits to governing systems and also to the stakeholders (citizens) by bringing about the geographical depiction of disparity (gaps/needs) and development and form the basis of a "new" DSS that is powered by latest image and map information and transforming reams of tables into graphic maps.

10.2. At the same time, GIS is recognized as an arena of technological and developmental edge. In the transforming world, nations that will possess a sound and progressive system of geographical information management will lead and chart ways in their national and international arena far ahead of those that would use more traditional forms of information management.

11. As per the National GIS Vision document, for National GIS to be successful, it is recognized essential to have a National GI Policy and define how activities of GIS data usage and applications can be undertaken in the country. Further, National GIS Policy would also overarch with national policies of RS, Maps, Data Sharing principles, Security Classification etc so that GIS activities are fully operational across users and in national interest.

12. India needs to have a comprehensive National Geographical Information (GI) policy with respect to GI technology and applications and address issues of national strategic relevance, technological supremacy in GI, wide-spread usage of GI in society, address privacy, data quality, intellectual property rights and national security issues – all of which are yet to be well-defined and to be made clear. Such a strong policy, combined with coordinated approach to data creation and sharing, and development of a common infrastructure is seen as essential to proliferate the use of GIS by the various GOI users as also those in various states. A well developed National GIS policy can also guide the policies and decision support roles of various vertical segments such as Soil information systems, hydrological information etc

13. Many states have implemented state-wide GIS that have been successfully put to use in governance. The state of Gujarat's GIS is one such example – it has been built/developed as a seamless state-wide GIS and is impacting governance and decision-making in areas of GIS based DSS for MNREGS, forests right act implementation, sustainable agriculture production, disaster management, irrigation management, village-level amenities planning etc that has been developed and used in Gujarat, Maharashtra, Karnataka and many others. These examples have shown how GI usage are implemented in sectors like Rural Development, Urban Development, Infrastructure development, Facilities development and Utilities development. Learning from these examples, focus of National GIS must be to meet the GIS applications need of users – stressing the aspects of affordability, acceptability and adoptability of GI.

1.2. POLICY – A PERSPECTIVE

14. A policy is typically described as a principle or rule to guide decisions and achieve rational outcomes. A Policy can be considered as a "Statement of Intent" or a "Commitment". For that reason at least, the decision-makers can be held accountable for the "Policy". Government executive orders and parliamentary rules of order are all examples of policy.[2]

15. Policy Studies are the combination of situational analysis and evaluation and "involves systematically studying the nature, causes, and effects with particular emphasis on determining the policies that will achieve given goals."[3] Policy Studies also examines the conflicts and conflict resolution that arise from the making of policies in civil society, the private sector, or more commonly, in the public sector (ie government). Many governments recognize the importance and look forward to external inputs from "think-tank" organisations for policy inputs – the justification being that external agencies can undertake and spell-out multi-dimensional issues related to policy that becomes input to government to consider.

16. In India Policy Studies are becoming more relevant with a large number of organizations getting involved in Policy Studies and "helping" society and governments with different inputs and analysis that helps the overall process of national policy formulation. The Telecom Policy, the IT Policy and many others are key examples where external inputs have helped government in policy formulation.

17. Geographic Information (GI) Policy generally has been undertaken by most nations within government but many external non-government agencies have provided valuable inputs. The very nature of governance, which has to balance all sides and resolve turf-conflicts, poses a challenge to government agencies to come out clearly and champion a GI Policy. With multiple agencies involved in GI activities, one agency's aspirations crosses over the aspirations of another agency and it become difficult for a policy formulator to decide one-over another for any specific aspect of GI Policy.

18. It is a unique step taken by DST, Government of India to involve NIAS as an external "thinking and input giving" organisation to address GI Policy issues.

19. NIAS recognizes a eight step policy cycle - Issue identification, Policy analysis, Policy instrument development, Consultation (which permeates the entire process),

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2 http://en.wikipedia.org/wiki/Policy

3 Stuart Nagel (1980). The Policy Studies Perspective. *Public Administration Review* Vol. 40, No. 4 (Jul. - Aug., 1980), pp. 391-396. Published by: Blackwell Publishing Article Stable URL:http://www.jstor.org/stable/3110267

Coordination, Decision, Implementation and Evaluation. [4] **What NIAS is doing for DST in this project is FIRST 4 steps and once the report is submitted then DST has to take up the subsequent 4 steps for finality**.

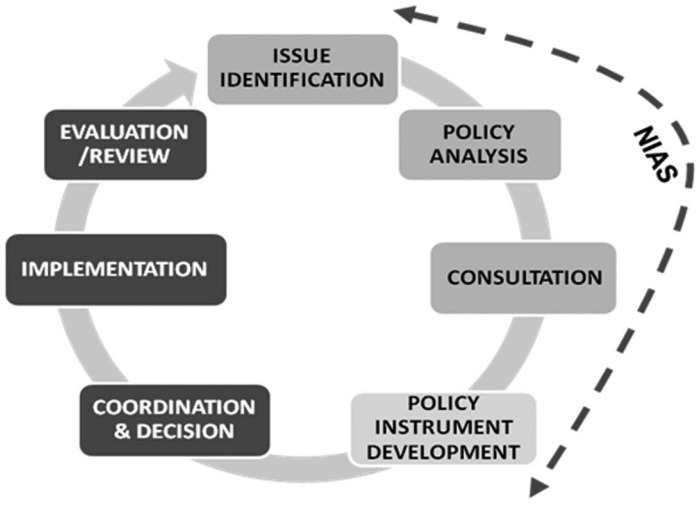

Figure - 1: Policy Cycle and GI Policy study at NIAS

20. NIAS also recognizes that Policy is generally confused to Procedures/Protocols – Policy is a broad statement of intent and an "envelope" of guiding principles AND should not state normally WHAT IS ACTUALLY DONE, which NIAS refers to as either procedure or protocol. Policies are generally adopted by government whereas procedures or protocols would be developed and adopted by sub-government bodies/ executive officers. Policies can assist in both subjective and objective decision making. Policy differs from rules or law. While law can compel or prohibit behaviors (e.g. a law requiring the payment of taxes on income), policy merely guides actions toward those that are most likely to achieve a desired outcome.

21. NIAS, thus, has set a bounding limit of its actions in this project as follows:

    21.1. Conduct an objective Policy Study for GI Policy for the nation
    21.2. Address all aspects of GI related issues, analyse the various issues, develop a Policy instrument and undertake Consultation to permeate the entire process
    21.3. Submit a Policy Study report with a GI Policy instrument to DST – who can then take up the implementation related steps.

[4] Catherine Althaus, Peter Bridgman & Glyn Davis (2007). The Australian Policy Handbook (4th ed.). Sydney: Allen & Unwin.

2. International Scenario in GI Policy

22. Globally, information has emerged as a key determinant in shaping contemporary societies and supremacy of nations. In particular, the GI and GIS have emerged over the past few decades as vital differentiators for DSS in diverse spheres such as governance, business endeavors and citizen centric activities.

23. There is hardly any nation in the world that does not rely on GI for its planning, development and defence/security needs. In fact, many nations have developed heavy reliance on GI and use of advanced technologies of satellite images, surveying and mapping, GIS databases and integrated applications to the extent that there is an overall characterization of a "geospatial divide" that is emerging between those that have advanced programmes with those that have lower capability.

24. In the last decade, many nations have considered a "cooperative sharing" framework for maps and images under the Spatial Data Infrastructure (SDI) concept – where map/image data generating agencies agree to share their maps/images as per defined standards. India too embarked on a national SDI (NSDI) in early 2000s and from 2005 onwards a NSDI Secretariat coordinates the SDI activities under the Department of Science and technology. However, the framework of SDI is becoming more of a sharing-platform of map generating agencies (putting up whatever maps are generated) and serves in a limited manner for usage of GIS by user agencies/ministries/citizens as part of a decision-making process. Thus, the SDI concept is unable to bridge and close the ever-existing gap between what map/image data is readily available with what GIS image/data the decision-process requires. Many nations and corporate entities have realized this gap and recognize that a nation-wide, seamless GIS data that is readily available is required and that it is fundamental to make GIS a part and parcel of decision-process.

25. From a global perspective, GIS is becoming a critical capability that provides of technological edge to nations. In today's transforming world, nations that possess an advanced and progressive system of GIS would lead and chart ways in their own national and in the international arena far ahead of those that would use more traditional forms of information management. GIS technology is gaining critical importance in the international and multi-lateral frameworks – like, addressing cross-cutting issues of environment, rivers/drainage systems, borders, climate change and even in homeland security cooperation and in defence (particularly as defence equipment and systems are based on geospatial technology usage).

2.1. ANALYSIS OF GI POLICY OF SOME NATIONS

26. Over the years, growth in geospatial technologies and new possibilities that are unfolded by them in almost all sectors of economic and social development had been phenomenal. This rapid progress had brought many issues of policy to the fore.

27. The wide availability of satellite data and digital forms of map information through networks had rendered the erstwhile policies in many countries of restricting map information to citizens obsolete. The mass markets for spatial information has become a reality and this trend is only likely to grow. There had been explosive growth of actors involved in the generation and use of spatial information, often spread in different regions and different legal jurisdictions. This on one hand can lead to ambiguity and complexity in determining liability for any damage caused in the use of information. On the other hand, trends to access or track personal information and behavior of individual citizens for commercial ends can grow easily with the available technological means and modern information tools, making policy maker's job highly challenging for effectively protecting privacy rights without undue impact on business or public interest.

28. In tandem with these challenges, there are also other issues of policy directed towards enhancing beneficial impacts of spatial information in a rapid way. For example, last decade witnessed a major trend towards "cooperative sharing frameworks" for maps and images in various countries under the Spatial Data Infrastructure (SDI) concept – where map/image data generating agencies agree to share their maps/images as per defined standards. Some nations of the world nations are now embarking, as a logical next step, on policy definition to bridge the ever existing gap between just sharing what is readily available and what the decision makers at different levels and different domains really require. Both the advanced and emerging economies are increasingly realizing this gap and recognize that a system to ensure ready availability of nation-wide, seamless GIS is fundamental need to economically and effectively support diverse needs of governance, business enterprises and citizens. Nations like USA, Korea, China, Australia, Brazil, Indonesia and some European nations are already in the process of extensively working on a nation-wide GIS and also in establishing a GIS which supports government and citizens with most advanced technologies [5].

29. A more detailed view of policy environment in a few countries are provided in the following sections as a prelude to the analysis of dynamically emerging scenarios of GI and their possible impacts in the context of evolving India's domestic policies in this field.

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[5] The website of Global Geospatial Information Management (GGIM), an initiative of United Nations provides reports and resources relating to national policies on GI at http://ggim.un.org/sdi.html and the country reports of various countries to the High Level Forum of GGIM at http://ggim.un.org/default.html

2.1.1. GI Policies in the USA

30. The foundations of the geospatial information policy in the USA rest upon the strong Freedom of Information Law. Upon this foundation, the edifices of the GI policies have been built. The US government agencies provide wide access to all the geographic datasets generated by them to the public and they are prevented from acquiring copy right on such datasets. Access restrictions apply only to exceptional few identified under law as protected data. Private Citizens can acquire all geographic data produced or held by the US government agencies at the cost of reproduction. No restrictions for reuse of such data or for adding value on them are applicable. The use of data is open not only to agencies of government at different levels, but also to non government agencies or to the private citizens for either 'for-profit' or 'not-for-profit' activities. Federal agencies facilitate public access to the geographic information data sets, by putting them into web.

31. Well defined organizational mechanisms and structure for coordinated use, sharing and nationwide dissemination of geospatial data exist in the USA. As can be seen, the US policies are distinguished by the mechanisms to involve Non-federal organizations and institutions along with federal agencies in the tasks related to geospatial information management, data sharing, and coordination. US law and policies promote nation's leadership in commercial remote sensing satellites and Satellite data up to a resolution of 0.5 meter is licensed by the US commercial satellite operators to users outside USA.

32. An organisational focus for coordinated use, sharing and nationwide dissemination of geospatial data is established through the **Federal Geographic Data Committee (FGDC),** participated by ten cabinet level departments and 9 other federal agencies, under the chairmanship of Secretary Interior. This coordination policy, established in 1990, through the Office of Management and Budget (OMB) Circular A-16, "Coordination of Geographic Information and Related Spatial Data Activities," provides for improvements in the coordination and use of spatial data, and describes effective and economical use and management of spatial data assets in the digital environment for the benefit of the Federal Government and the Nation. Yet another major epoch had been the initiative for development of **National Spatial Data Infrastructure**, covered by the Executive Order 12906 issued in 1994, and which was intended to be the base resource and structure among geospatial data providers and users at the national, state, and local level. NSDI included the processes and relationships that facilitate data sharing across all levels of government, academia and the private sector. A major challenge that continues for NSDI is fully achieving the goal of seamlessly coordinating disparate types of geospatial data.[6]

6 Peter Folger (2011). Issues and Challenges for Federal Geospatial Information, May 18, 2011, CRS Report for Congress, R41826, accessed on http://www.fas.org/sgp/crs/misc/R41825.pdf

33. A supplemental guidance to Circular A-16 was issued in November, 2010, designating geospatial data as a "capital asset", and laying down **portfolio centric approach**[7] to the acquisition and management of National Geospatial Data Assets in terms analogous to financial assets.

34. While the FGDC promotes the coordinated development, use, sharing, and dissemination of geospatial data at the national level, the **National States Geographic Information Council (NSGIC)** promotes the coordination of state wide geospatial activities in all states, and undertakes advocacy for the states in national geospatial policy initiatives to help enable the NSDI. NSGIC has been promoting the development of State wide Spatial Data Infrastructures (SSDI), under a partnership called the 50-States Initiative, which is intended to lead to the creation of an SSDI for each state. A priority for NSGIC is a program under development, called Imagery for the Nation (IFTN) that would collect and disseminate aerial and satellite imagery in the form of digital ortho-imagery. IFTN represents an effort to establish one coherent set of geospatial data that is organized for the benefit of many stakeholders at the federal, tribal, regional, state, and local levels. It is noteworthy that this scheme leverages on (i) plans to incorporate annually updated **one-meter resolution ortho-imagery** over all states except Hawaii and Alaska under the existing National Agricultural Imagery Program (NAIP) administered by the U.S. Department of Agriculture and (ii) plans to collect **one-foot resolution imagery** by the program administered by USGS every three years for 50% of the U.S. land mass (barring sparsely populated areas of Alaska). The program would also provide 50% matching funds for partnerships to acquire **six-inch resolution imagery** over urban areas with at least 1,000 people per square mile as identified by the U.S. Census Bureau.

35. In 2012, US is discussing a Map It Once, Use It Many Times Act to establish the National Geospatial Technology Administration within the United States Geological Survey to enhance the use of geospatial data, products, technology, and services, to increase the economy and efficiency of Federal geospatial activities. [8]

36. Of late, a US Congressional Research Service study has started discussing about a National GIS for US as a national investment in critical infrastructure, both by directly supporting these national GIS and geospatial efforts, but also via secondary effects." [9]

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7 Vivek Kundra (2010). *Geospatial Line of Business OMB Circular A- 16 Supplemental Guidance*, Office of Management and Budget, November 10, 2010 accessed on http://www.whitehouse.gov/sites/default/files/omb/memoranda/2011/m11-03.pdf

8 H. R. 4233 (2012). To establish the National Geospatial Technology Administration within the United States Geological Survey to enhance the use of geospatial data, products, technology, and services, to increase the economy and efficiency of Federal geospatial activities, and for other purposes. March 2012

9 Peter Folger (2011). Issues and Challenges for Federal Geospatial Information, May 18, 2011, CRS Report for Congress, R41826, accessed on http://www.fas.org/sgp/crs/misc/R41825.pdf

37. Involvement of Non-federal organizations and institutions in the tasks related to geospatial information management, data sharing, and coordination is facilitated through a **National Geospatial Advisory Committee** whose membership includes the private sector, nonprofits, academia, and governmental agencies and this committee advises and recommends FGDC on matters related to the management of federal geospatial programs, the development of the NSDI, and implementation of the OMB Circular A-16 .

38. Since 2009, there has been an advocacy for creating a national GIS and for renewed investment in the national spatial data infrastructure, considering such investments part of the national investment in critical infrastructure.

39. In the field of making high resolution satellite data widely available all over the world through commercial channels, the USA led the initiative through a set of new legal and policy measures such as the Land Remote Sensing Act of 1992[10] and the Presidential Decision Directive (PDD) of 1994[11], which provided framework for licensing private remote sensing satellite systems and which loosened restrictions on the sale of imageries to foreign entities. The new national policy announced on April 25, 2003[12], which superseded the 1994 PDD, further lays down the US Policies in Commercial Remote Sensing. This included the statement that United States Government shall utilize U.S. commercial remote sensing space capabilities to meet imagery and geospatial needs. Foreign commercial remote sensing space capabilities, including but not limited to imagery and geospatial products and services may be integrated in United States Government imagery and geospatial architectures, consistent with national security and foreign policy objectives. The US law has provisions for shutter control policy – which allows the US government to limit collection or distribution of data by the US commercial satellites during specific periods when national security or foreign policy interests could be compromised. Satellite data up to a resolution of 0.5 meter is licensed by the US commercial satellite operators to users outside USA. The equipment and software for receiving and processing data directly from US satellites need export authorisation of the US government.

2.1.2. EUROPE

40. European geographic information policy had been outcome of the broader context of bringing the benefits of Information Society within the reach of all Europeans. The origins of GI policies also relate to the objectives of realising integrated European market, under

10 Land Remote sensing policy Act 1992 a digest- ttp://www.fws.gov/laws/lawsdigest/LANDRS.HTML

11 Fact Sheet (2010) - Foreign Access To Remote Sensing Space Capabilities, The White House, Office of the Press Secretary, http://www.fas.org/irp/offdocs/pdd23-2.htm

12 US Commercial Remote Sensing Policy (2003) at http://www.fas.org/irp/offdocs/nspd/remsens.html

fair conditions and developing of European trans-border regions as envisaged in Treaty of Maastricht.

41. EUROGI is the European umbrella organisation for GI and it addresses pan European policies related to this field. It cooperates with other organisations like Joint Research Centre (JRC), which deals with scientific and technical aspects relating to policy. An Inter service Committee for GI (COGI), which is established within EC, deals with strategies that can improve coordinated use of GI within Commission services and improving efficiency and cost effectiveness of European policy monitoring.[13]

42. Across various countries of Europe, the policy environment relating to spatial data varies. While some countries like Netherlands, Portugal, Finland were early to establish National Spatial Data Infrastructures, other countries such as Germany, Italy and Belgium had focused on use of GI on regional/ local development issues. Predominant proportion of GI data is collected by government for security and other purposes.[14] Most countries in Europe had adopted policies for access in respect of information held by Public sector. Legislative measures include Data Protection Legislation, which gives access to individuals to their personal records and Freedom of Information legislation etc. Concerns on possible infringement of privacy rights are increasingly expressed and debated, in the environment of multiple actors involved in the collection and modification of large volumes of spatial data including personal details which are accessible in digital domain with sophisticated technologies available for data mining, processing and networking. Privacy rights are addressed in Europe by the European Convention for the Protection of Human Rights and Fundamental Freedoms 1950 (ECHR), which in its Article 8, guarantees a right to respect of a person's private and family life, home and correspondence and that no public authority has the right to interfere with this right except in accordance with the law and as necessary in a democratic society in the interests of national security, public safety or economic well-being of the country[15].

43. Policy debates on pricing issues and public good investment in "core" data for consumption in public domain, Meta data services and strategies for proactive dissemination of core data held by public sector are continuing concerns. Some advocate that core data which is essential for public should be made available free of charge and any value additions should be charged. Others differ but advocate that pricing levels should not deter wide use of GI.

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13 Alessandro Annoni (2009). National Geographic Information Policies in Europe: An Overview, European Commission - Joint Research Centre.

14 M. Craglia (2000). Europe: National and Regional Perspectives, Report of the EUROGI-EC Data Policy Workshop, 17 January 2000

15 George Cho (2010). Overview on Legal Issues, Privacy Conflicts from High Resolution Imaging, Source: ESPI Report 25; August 2010.

44. Since geographic information is vital to the Europe's strategies on multiple sectors such as environment, security, agriculture, policy monitoring and so on, a legal framework was adopted by the Council and the European Parliament through its Directive 2007/2/EC[16] for setting up and operating an **Infrastructure for Spatial Information in Europe (INSPIRE**) based on infrastructures for spatial information established and operated by the member states. The purpose of such infrastructure is, in the first instance, to support the formulation, implementation, monitoring, and evaluation of Community environmental policies, and to overcome major barriers still affecting the availability and accessibility of pertinent data.

45. The Infrastructure for Spatial Information for Europe is being developed based on certain principles such as (1) collection and maintaining of spatial data should be at the level where that can be done most effectively, (2) seamless and interoperable features vis a vis multiple sources and sharing among many users and applications, (3) amenability to share among all the different levels of government though collected at one level of government, (4) unrestricted availability of spatial data needed for good governance, and (5) user friendly meta data services[17]. INSPIRE is result of three years of intensive consultation among the EC Member States and their experts, a public consultation, and the assessment of the likely impacts. The European Commission adopted the INSPIRE proposal for a directive in July 2004. An amended proposal was adopted by the Council and European Parliament in March 2007, and came into force on 15th May 2007.

2.1.3. Japan

46. Japan has pursued strong policy and legislative measures to promote development and use of GI for developmental needs. An important recent initiative had been NSDI Act of Japan, which was enacted on May 2007. This act intends to facilitate national government agencies, local governments, and private sectors to take measures to promote the utilization of geospatial information, as vital input to construct a sound and prosperous society. The act addresses measures relating to production and distribution of data but also human resource development[18]

47. National government and local governments are charged with responsibility to develop and utilize **Fundamental Geospatial Data** (FGD), which will provide framework

16 The INSPIRE Directive 2007/2/EC accessed through http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:108:0001:0014:EN:PDF

17 See European Commission's website about on INSPIRE at http://inspire.jrc.ec.europa.eu/index.cfm/pageid/48

18 Yukiko Tachibana (2009). New NSDI and National Mapping Policy of Japan, E/CONF.100/IP.5, Eighteenth United Nations Regional Cartographic Conference for Asia and the Pacific, October 2009, United Nations Economic And Social Council.

geospatial information and conforming to the specification regulated by Ordinance of the Ministry of Land, Infrastructure and Transport (MLIT). The focal organisation for realising seamless FGD is the Geographical Survey Institute (GSI) on a scale of 1:2500 in urban area (1/4 of Japan in area) and on a scale of 1:25000 in other areas. GSI's development of 1:2500 scale of FGD, the Japan's national spatial data infrastructure, relies on integrating large-scale map digital data provided by the national and local governments.

48. As regards the access policy, Japan's approach is to permit wide and open access to the contents of FGD. These contents can be browsed on the Internet and downloaded from the Internet for free of charge. Public good investment approach is evident for developing the spatial data infrastructure which serves as a base for diverse applications and value additions. Such infrastructure also provides the basis / reference for inter operability, high quality standards and sharing of data. Local governments are required by the law to develop and update large-scale map called "City planning map" across urban area ("city planning area" defined by the City Planning Act).

49. Japan has other legislations that ensure standards of mapping and coordination among providers of data and regulators. The Survey Act requires national and local governments to formulate specifications of survey which define procedures and accuracy of survey conducted by them. Also this Act requires them to gain approval of the Minister of Land, Infrastructure, Transport and Tourism for their specifications. The Act also requires national and local governments to submit their survey results to the GSI.

50. The design and implementation plan for Japan's national spatial data infrastructure had been embodied in "Grand Design of Fundamental Geospatial Data", which was released on July 2009 by the GSI. Grand Design outlines ideal model of FGD which provides unique reference data set for generating a variety of geospatial information, which is regularly updated and freely accessible through web. It specifies the role of the GSI and stakeholders such as national government agencies and local governments in developing or updating FGD. It also outlines cooperation envisaged between the GSI and stakeholders. GSI has undertaken to develop in cooperation with stakeholders "Digital Japan Basic Map" which is nation's new basic map replacing 1:25000-scale topographic maps. Digital Japan Basic Map is expected to be used for various purposes, especially for public administration including land management, disaster measures and environment protections. In the preparation of large scale maps, GSI will be lending other stakeholders with aerial photographs and digital ortho images. According to this plan the national government agencies and local governments will undertake development and updating of digital survey data and digital map data including city planning maps and maps for road management and in cooperation with GSI to facilitate updating of FGD and improve its accuracy.

2.1.4. Brazil

51. Brazil has a large land area of about 8.5 million square km, with more than half of its area in forests and holding about 12% of world's fresh water supplies. With a size of population around 190 million, Brazil is an example of an economy emerging with strength of both traditional and modern economic enterprise, combining agriculture and industry, and powered by communications and information revolutions.

52. Brazilian policies reflect the **recognition of public good nature of information** and providing free and wider access to information that enhances benefits to society. The free software strategy which was pursued as part of national e- governance strategy, and the portal for public software are examples of the aforementioned policy orientation. Brazil had taken legislative initiatives for **open access to public information**, which was passed by the House in April 2010. The scope of this includes information held by public funded non-profit entities also.

53. Brazil through its space agency INPE operates its own remote sensing satellites for earth resources application, thus maintains archives of satellite data and has established processing capabilities and contributing to GIS.

54. Existence of mature institutions in Brazil such as Brazilian Institute of Geography and Statistics, along with others had contributed to transition from conventional mapping approach to use of GIS technology.

55. A major initiative in Brazil relating to spatial information activity is the evolution of Spatial Data Infrastructure for Brazil. In November 2008, through an executive order the **Brazilian Spatial data Infrastructure INDE** (Infrastructura National de Dados Espaciais) was defined and created. The objectives of INDE include creation of Meta data catalogues, integration and sharing of geospatial data created and maintained by different government agencies in Brazil and enabling their easy **access and sharing through Internet.**

56. Implementation of INDE is supervised by a structure called CONCOR (Brazilian Committee of Cartography), which is participated by representatives of 17 ministries, the President's office, cartographic service of military and the association of aerial survey companies. [19]

57. The national policies on spatial data infrastructure essentially promotes a collaborative strategy and aims to take advantage of existing expertise and infrastructure, to encourage

[19] Davis Jr., Clodoveu A. and Frederico Fonseca (2011). National Data Spatial Infrastructure: The Case of the Brazil. Washington, D.C: Available at http://www.infodev.org/publications

partnerships, to promote sharing of data and technologies and ensure wider access through free and open access policy. It encourages the providers of information to generate their own funding sources to support their efforts and contribute to sharing of data.

58. It also envisages emergence of local level Spatial Data Infrastructures becoming part of National level SDI. Similar integration of nonofficial data bases, including databases from research community is envisaged. Major focus for future is to achieve coordination and contribution of GIS into e-government initiatives.

2.1.5. China

59. Development of National GIS system in China is more than a decade old effort. The early manifestation of China's GIS development was seen in Digital Earth/China effort, involving integration of remote sensing, positioning technologies and other geographical data in GIS domain. The major constraints that were to be overcome included non availability of digital maps in most of the map scales, lack of uniform standards, restrictions on the use and relatively higher cost of local level maps[20]. The State Bureau of Surveying and Mapping of China[21] has been centrally responsible for administering the national surveying and mapping activities in China. Local governments generate and manage large scale maps for their needs such as urban maps and conduct surveys for them. Generally the thematic surveying and mapping such as land use, forestry, geology etc, is undertaken by state agencies responsible for them. A law promulgated at state level for all surveying and mapping govern the generation and use of maps and rigid standards for different scales are specified. All these were evolved in pre GIS era and major challenge is adapting/ augmenting them to the needs of GIS era.

60. China has paid great attention to construct its Spatial Data Infrastructure called, the Digital China Geospatial Framework (DCGF). This infrastructure is organised at four levels, namely, levels. The Chinese Spatial Data Infrastructure comprises of spatial data sets, technologies and infrastructure, bound together by standards and implemented through coordinated institutional mechanisms and legal frameworks. The *Law of Surveying and Mapping*[22] and other government statutes provide legal basis. The national standards

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20 Yunfeng Kong Hui Lin (1999). China's National Geographic Information Strategy: Lessons Learnt from First Generation Initiators, *Towards digital Earth — Proceedings of the International Symposium on Digital Earth Science Press,1999*

21 Activities of SBSM in the field of Digital earth development can be found in Xiangwen Jin, Construction of the National Spatial Data Infrastructure Under China's Digital Earth Development Strategy, *Towards Digital Earth — Proceedings of the International Symposium on Digital Earth Science Press ,1999*

22 "Surveying and Mapping Law of the People's Republic of China" (2010) – National Administration of Surveying, Mapping and Geoinformation, accessed at http://en.sbsm.gov.cn/article/LawsandRules/Laws/200710/20071000003241.shtml

are being elaborated to support the DCGF. The standards are applicable to datasets with scales ranging from 1:1 million to 1:500 and organised at National, Provincial, Municipal and County levels. The core part of the national geospatial database, DGCF, has been completed. The coordination for data sharing and implementation of standards is achieved through the National Committee for Geospatial Information Coordination, which is an inter ministerial organization consisting of ministries that have GIS-related activities[23]. It has been active to strengthen the cooperation and data sharing. All the provinces and most municipals have established Geomatics centres to carry out the DCGF construction. A lot of effort is also made to promote wider use of DCGF in governments through network based information distribution system. Among the issues that have been slowing the process are insufficient frequency of data updating, data exchange problems and strict classification system[24]. There is expectation speed up growth of the geospatial information industry by increasing demand for more and more public oriented geospatial products derived from DCGF. One of the broader roles envisioned for Spatial Data Infrastructure in China is harmonising the Chinese society. [25]

61. Recent times have also seen legal developments in China that impinge on the issues that arise in the context of GIS, particularly the easy access to personal data over Internet that may infringe on the right of privacy of citizens and thus cause them damage. The new *Tort Liability Law* which became effective in July, 2010 has provisions which enable citizens to seek remedies in such cases. However, one limitation is that the provisions on protection against infringements on personal data is currently scattered among various laws in China and there is no standard definition of personal data.

2.1.6. GSDI

62. The Global Spatial Data Infrastructure (GSDI) is born out of the vision to facilitate greater sharing of knowledge by way of promoting standardization in the establishment of spatial data infrastructures throughout the globe in order to greatly simplify search, information extraction and management practices.[26]

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23 Jun Chen, Jlng U, Jlanbang He, and Zhllln U (2002). Development of Geographic Information Systems (GIs) in China: An Overview in Photogrammetric Engineering & Remote Sensing, Vol. 68, No. 4, April 2002, pp. 325-332.

24 Dr. Pengde Li, Lan Wu, Dr. Xuenian Xiao (2008). SDI in China:Progress And Issues in The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences. Vol. XXXVII. Part B4. Beijing 2008.

25 LIU Ruomei, JIANG Jingtong (2005). Establishing the Environment for sharing Geographic Information in China, accessed at http://www.cartesia.org/geodoc/icc2005/pdf/oral/TEMA6/Session%207/LIU%20RUOMEI.pdf

26 Harlan J. Onsrud (2012), The Global Public Commons and Marketplace in Geographic Data: A Conceptual Model for Meeting the Needs of Government, Commercial, Scientific and Non-profit Sectors, a paper at the Global Spatial Data Infrastructure, 7th Conference, Bangalore. 2004, accessed on 27 March 2012 from http://www.scribd.com/doc/6692003/

63. Important evolutionary concepts that triggered out of the global vision for the spatial data infrastructures are the models for creation of new knowledge resources of geo spatial information by participation of thousands and millions of citizens working individually or collaboratively, taking advantage of opportunities of the Internet age. Prof Onsrud points out that when the production of important "public goods" is involved, government funding for direct production may be the most practical and efficient means for producing information goods. However for GSDI component of commonly sharable information, alternate economic model, which is based on open source movement, can provide realistic possibilities of generating revenues from production of spatial data and products other than through royalties or rents in use of those products.

2.1.7. GEO

64. GEO (Group on Earth Observations) is a voluntary partnership of governments and international organizations. It provides a framework within which these partners can develop new projects and coordinate their strategies and investments. As of September 2011, GEO's Members include 87 Governments and the European Commission. In addition, 64 intergovernmental, international, and regional organizations with a mandate in Earth observation or related issues have been recognized as Participating Organizations.

65. GEO is coordinating efforts to build a Global Earth Observation System of Systems or GEOSS [27] on the basis of a 10- Year implementation plan for the period 2005 to 2015. The Plan defines a vision statement for GEOSS, its purpose and scope, expected benefits, and the nine "Societal Benefit Areas" of disasters, health, energy, climate, water, weather, ecosystems, agriculture, and biodiversity.

66. Through its GEO portal, GEO aims to provide by 2015 a shared, easily accessible, timely, sustained stream of comprehensive data of documented quality, as well as metadata and information products, for informed decision-making. The efforts of GEO are relevant in the context of wider cooperation at global level for voluntary sharing of earth observation data, without major conflicts with commercial developments and supporting international cooperative efforts of its participants in areas such as interoperability of sensors, calibration and validation and data management.

2.2. COMPARATIVE ANALYSIS OF INTERNATIONAL POLICIES

67. From the foregoing depiction of policy status and evolution of spatial data infrastructures and information, the comparative picture of the key dimensions of policy in these countries is summarized in **TABLE - 1**.

[27] http://www.earthobservations.org/about_geo.shtml

68. Some of the important directions where GI Policy is emerging are [28]:

68.1. **GI policies are moving beyond spatial data infrastructures**: World over it is realized that spatial infrastructures had mainly addressed sharing of whatever data available from diverse spectrum of providers rather than ensuring availability of current data whatever the users needed. Even in nations with well advanced and meticulously planned systems like those in the US, coordination among federal, state and local governments and the private sector is proving to be very challenging and it is calling for efforts to create a National GIS (or NSDI 2) to address above gaps.

68.2. **Public good value of GI is recognized**: A complete range of geospatial data which is essential for governance and for empowering people by way of creating transparency and creating necessary checks and balances in a democratic society will not be adequately provided by a market mechanism and hence governments themselves have to invest into capability of supply of such data and updating them in a reliable manner. In reality, however, generation and use of geospatial information combines public good as well as private good. When used by government agencies for governance needs or by citizens at large to create informed society, they serve public good. When the data is used by private sector in a market driven application, it results in private good. Policy should encourage and ensure the widest possible use of geospatial data because of its non-excludable public good nature, and it's resulting in maximum welfare. The question of free availability or pricing of data should be based on societal value and nature of use.

68.3. **Availability and Access to GI - issues are multi dimensional**: First and foremost, a significant amount of data is collected by government agencies at tax payers' expense and this should truly serve public interests through a clear-cut policy framework. Secondly, if the data has to be widely available, it should be affordable to all sections of society and the governments' norms on pricing have a great influence on the accessibility. Thirdly, since the data are held by multitude of agencies within the government, an overarching policy on access is needed to overcome barriers of organizational culture and practices of individual agencies for assuring timely and effective access. World's experience points to the need for effective coordination and collaboration among agencies at national, regional and local levels. In this context, the importance of standards for interoperability and integration cannot be over emphasized. Data access policies also need to reconcile the roles of government and private sector. The international policies that provide access to data, particularly the satellite data through commercial channels, need to be taken cognizance of.

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28 Mukund Rao (2012). International Scenario of GI Policy and Analysis of Indian GI Policy Eco-system. Analysis as part of this study report and presentation made at NIAS GI Policy Roundtable Meeting held on June 19/20, 2012 at NIAS, Bangalore (for pdf of presentation please contact NIAS Principal Investigator).

68.4. **Data Quality goals are foundational**: Data Quality affects the nature of use and also resulting benefits or impacts use. This has implications for user as well as legal consequences for provider. It is in this context that a framework for quality standards for different categories of use of geospatial information is necessary. The data generators or providers should specify fitness of any information product in terms of its quality levels for a specific use and seek appropriate waivers/indemnities from consequences of uses other than intended. These could be secured through either contractual arrangements with users or under the provisions of relevant existing laws. It should be ensured that any indemnity sought by the providers is without prejudice to norms of public safety, health or other risks to larger sections of population

68.5. **Data protection laws need to respond to realities of digital era**: Data protection should seek to balance between need to promote innovations through wider use on one hand and incentivizing data generators to invest into and produce data on the other. Therefore, copy right protection laws should be fine tuned to adapt to specific characteristics of electronic data.

68.6. **National and Global Security is important concern and the policies must adapt to technological and environmental changes**: Advent of high resolution commercial remote sensing satellites has revolutionised access to high quality image data on any part of the globe in the world markets. However, there is no uniformity in the policies nor there is harmonized legal regime at international level with reference to access of high resolution data by citizens in different countries and even government entities. Hence, at national level, a pragmatic approach is necessary which can address national security concerns and at the same time effective implementation of policy. Security aspects related to national GIS is mainly to be addressed through technical resource architecture, access policy, integrity, risk management and reliability considerations. Maintaining certain level of national capability in this field through research and capacity building (at the state of the art level) is central to national security requirement.

68.7. **Commercial market development/Pricing policies are to be rational and should find harmony with societal goals**: Data pricing has influence on level of access. However, pricing policy should facilitate generation of markets for geo spatial information, which is derived from the data through value addition processes that are normally dealt efficiently by market oriented institutions. In general, there is a need to achieve a reasonable balance between cost recovery by the public sector data providers and the value which a user derives. Wherever, government owned mapping agencies also compete with private sector, rules for level playing need to be laid down.

68.8. **Rights to Privacy is going to be increasingly relevant issue that need fine tuning of laws and balancing with market development needs:** Integrating power of Geospatial Information with increasing volumes of digital data bases containing personal data is a cause of concern as the markets for geospatial information are expanding. The problem also relates to large sections of population, which are covered by this development. While commercial organisations in the private sector are less constrained to seek and use personal data for market development or commercial ends, the government agencies share greater concern on the need to effectively address protection of privacy.

68.9. **Issues of Liability should be linked to other components of GI policies**: Intended use of data determines the requirements on data quality, the level of detail and other characteristics of data. Since geospatial data in digital domain combines various sources of data and different actors take part in data generation and value addition processes it is necessary that providers at each stage ensure that their intended use is consistent with the purpose for which the data is prepared and limitations of liability is conveyed or governed through contractual or other means. With ever increasing use of geospatial data on operational basis, this issue will assume greater importance in future.

68.10. **Overarching Geospatial Information framework is the need of the hour**: Historically policy frameworks related to various aspects and components that go into geospatial information had taken place in an independent and compartmental way and the time is now ripe to examine and harmonize these disparate policy elements into a harmonious chain that are consistent with each other. The technology and application developments in the geospatial field have already overtaken and the even the activities at national, regional and local levels are increasingly influenced by global developments since great volumes of spatial data which flow are powered through Internet and other technologies. However, these developments also on the other hand present unprecedented opportunities to improve governance, empower citizens and strengthen decision support in the growth of enterprise activities. The approach to policy making should not be restrictive for innovations of applications as well as possible future advances in technology but should respond to any new challenges such advances may bring about. Thus, need of the hour is a holistic policy that considers and harmonises the various cross domain issues, resources, capabilities needed for the country and also technological leadership goals.

3. Current Eco-System of GI Policy in India

69. India is passing through a crucial stage as far as geospatial technologies and applications are concerned, as appears in NIAS's discussions with many experts in the country. 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 (be it government sector, private enterprises applications, academia demand or even citizen demand and awareness of GI) – so the demand is high; 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 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 license purchase of GI software (mostly foreign sources) and systems, undertaking specific projects and applications and thereby having considerable experts in this field – 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 at the national scene.

70. Some of the critical reasons for this paradoxical scenario are attributed to:

70.1. Non-availability of GI content for the nation; had GI content for nation "readily" and "easily" available then the applications and use of GI would have been manifold and orders higher than now.

70.2. 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 NATIOPNAL GI GOAL to which all of them worked. As a result, we have done many projects but a national visibility and impact from these projects (which started and ended) have yet to be seen.

70.3. 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 grow the technology, align and coordinate activities, position best practices, bring accountability/responsibility, create and assign due value to GI activities and make GI usage all-pervasive and easily possible.

71. What is the status of Policy-making in India as far as GI is concerned? India has been addressing policy issues related to maps and images and it was in 1967 that the first de-restrictions of topographic maps started and now there are key elements of the National Map Policy, Remote Sensing Data Policy and NDSAP. But the need of the National GI Policy is to cover maps but also aerial photos, satellite images, data from trigonometric, gravity and magnetic surveys; should enshrine a mechanism for quality assured GI products, GI

Apps services and solutions both from industry and government and should ensure use of geospatial data in all activities of governance, management and development.[29]

72. In fact, the policy issue of de-restricting and distribution of topographic maps have been on-going for a few decades. Sufficient debate and discussions have been had on digital topographic data and concerns of digitization of copyrighted topographic maps of SOI. Availability of digital satellite images has also placed sufficient impact on policy debate. Concerns of security still prevail in policy discussions - though one is unable to place the "right finger" on the security concerns - which mainly appears to be around "wrong use against national interests".

73. One study in 2006 has noted that technological advances in remote sensing capabilities, wider participation of commercial firms and the possibilities of 'processing' data to create value-added information have given rise to a range of policy and legal issues in the geographic information (GI) field. How far satellite images and GI can still be considered a 'public good' conflicts between commercial and national interests, especially where security is concerned, sovereignty and the rights of sensed states, shutter control vs transparency, data access, IPR and infringement of privacy are all discussed. A multilateral debate to formulate a GI policy that will take account of these while ensuring that the full benefits of remote sensing are available to society is called for. [30]

74. However, of late considerable debate has happened and there is a more practical thinking in various circles to a more pragmatic policy-making.

75. India has 5 different policies in position which pertain to GI elements, as of date:

75.1. A National Map Policy (2005) defines the scope, distribution and liberalizing access of digital SOI topographic maps spatial data to user groups without jeopardizing national security. [31]

75.2. 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. [32]

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29 R Sivakumar (2012). Evolving a National GI Policy – Presentation made at NIAS GI Policy Roundtable Meeting held on June 19/20, 2012 at NIAS, Bangalore (for pdf of presentation please contact NIAS Principal Investigator).

30 Mukund Rao, K.R. Sridhara Murthi (2006). Keeping up with remote sensing and GI advances—Policy and legal perspectives. Space Policy 22 (2006) pp 262-273.

31 National Map Policy (2005) from http://www.dst.gov.in/scientific_services/nationalmappolicy.pdfhttp://www.surveyofindia.gov.in/tenders/nationalmappolicy/nationalmappolicy.pdf

32 CAR (2010). Civil Aviation Requirements, 2010 for flight clearances for undertaking Aerial Photography, Geophysical Surveys, Cloud Seeding etc from http://dgca.nic.in/cars/d3f-f1.pdf

75.3. A Remote Sensing Data Policy (RSDP (2001 and 2012) defines the distribution process of satellite images to different category of users.[33]

75.4. The Delhi Geographical Spatial Data Infrastructure (Management, Control, Administration, Security and Safety), Act, 2011 defines the mandatory sharing, accessing and utilisation of Delhi Geo-Spatial Data.

75.5. A National Data Sharing and Accessibility Policy-2012 (NDSAP-2012) provides an enabling provision and platform for providing proactive and open access to the data generated through public funds available with various departments / organizations of Government of India. [34]

76. It is important to look at these policies in the context of time-frame in which they had been evolved and it must be recognized that with time and technological developments these policies may require changes and review. It must also be under-scored that in the time-frame in which they were adopted they were a landmark and impacting – if one considers the scenario prevailing till then. The subsequent "microscopic" analysis of the four policies attempts to bring out the genesis and challenges by which they evolved and were adopted and it does not intend to be a cursory-critique. In fact, it is felt that such analysis helps in learning lessons for the future National GI Policy.

3.1. NATIONAL MAP POLICY, 2005

77. The NMP-2005 is a result of intense discussion and debate in the country that emanated from the "urgent need" to have digital topographic maps. Discussions, which started from 1999 onwards and weaved through various government meetings, centered on one major issue of "addressing security and defence concerns". The concern was that if digital topographic maps are made easily available then "defence and security COULD be compromised and WOULD be difficult to detect". This "vexed issue" was pitted against international developments of easily available google images at 1m for any area in the country, commercial availability of US 1m images; commercial availability of Indian satellite images at 5.8/2.5m and even 1m resolution and a "porous digital world" where communicating digital data was a finger-tip action.

78. Ultimately, the concept of 2 series topographic maps – one, for defence forces and another for civilian purposes as Open Series Maps. Content details, accuracy, frameworks/

[33] RSDP (2011). Remote Sensing Data Policy, 2011 from http://www.isro.org/news/pdf/RSDP-2011.pdf

[34] NDSAP (2012). National Data Sharing and Accessibility Policy, 2012 from http://www.dst.gov.in/nsdi_gazette.pdf

projections/datum were "separated out" so that the civilian maps do not impinge on "security considerations". SOI was identified to implement this and create the operating processes for this Policy.

79. Appearing at having "hit the nail" on the vexed issue of "security concerns", it soon became clear that making 2 series maps FROM ONE SOIs NATIONAL TOPOGRAPHIC DATABASE was quite a challenge and would require extreme technical and programmatic control. At the same time, it soon dawned that the digital Open Series Map is only a "red herring" and that the security concern would still prevail.

80. National Map Policy-2005 outlines the tenets by which digital map data of SOI are distributed and made available and now SOI has plans for generating and making available 1:10k large scale maps for the country. SOI has outlined an operating procedures for implementing the NMP-2005 which pertain to screening for border areas, user's use-case etc and also noted that the restriction zone has been revised to just 50kms on international border/J&K and NE areas.[35]

81. A major aspect on NMP was that while it stated with intent to liberalize access to SOI topographic maps in digital content it is more a "work-practice policy" for SOI as far as its own topographic map holdings are concerned. The NMP thus makes out to be a mapping policy of "SOI maps" and there is no commitment/mandate for mapping programmes as per a policy direction for the nation. The critique is that it did not define a road-map for mapping sector and struggled to even make a road-map for SOI maps.

82. In present day perspectives, the NMP of 2005 lacks a few important requirements of a POLICY – time-line definitions and service level guarantees by SOI to users; a time-line commitment by SOI to make regularly (define regularly) updated topographic maps available for the nation and also to broad-base MAPPING to include generic mapping needs of country as against just TOPOGRAPHIC MAPS and to, in a larger context, to involve users/industries/citizens as part of transparent and participatory policy defining/updating process.

83. So, if one were to re-define NMP in 2012 time-frame, it could be appropriate to introduce time-line guarantees and service-level guarantees for the topographic map services of SOI and also of how India can be assured of national maps which are updated and improved.

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35 RC Padhi (2012). Operational Aspects of National Map Policy. Presentation made at NIAS GI Policy Roundtable Meeting held on June 19/20, 2012 at NIAS, Bangalore (for pdf of presentation please contact NIAS Principal Investigator).

84. There is also a general assessment is that the NMP intent has not been completely translated into accessible actions for users. Specific questions exist on NMP-2005

84.1. what scales of (erstwhile) SOI topographic maps are available as OSM for whole country in digital GIS ready format;

84.2. has the "....detailed guidelines regarding all aspects of the OSMs like procedure for access by user agencies, further dissemination/sharing of OSMs amongst user agencies with or without value additions, ways and means of protecting business and commercial interests of SOI in the data and other incidental matters" been issued as mentioned in NMP-2005; can there be a time-line guarantee for SOI clearing international boundary maps for publishing by users;

84.3. there is no commitment in NMP-2005 of SOI (as national mapping agency) being constantly mandated to prepare larger-scale maps; NMP-2005 talks of "…Ministry of Defence has from time to time issued detailed guidelines on various aspects of map access and use. These instructions shall continue to hold good but for the modifications cited herein" - what are these time-to-time guidelines, should it not form a part of the NMP.

84.4. NMP does not define a road-map for mapping sector and revitalize and grow the mapping sector in the country.

3.2. REMOTE SENSING DATA POLICY, 2001 & 2011

85. India has a successful Remote Sensing programme through its Indian Remote Sensing satellites. Right from 1988, IRS systems have provided national imaging capability – starting with 36.5m and progressing to 1m in 2010 time-frame. As the demand and use of images increased and spread into various sectors of government – agriculture, forestry, urban, landuse, water resources and many other areas and private sector started using images for commercial services and solutions – a great thrust was provided to GIS in the country as these images and theme applications started the trend of GIS applications for different sectors. Thus, images started to become the "mainstay" of the GIS regime and its power for mapping grew bounds and even "challenged" the conventional topographic maps by easily accessible maps (though accuracies were debated upon) and easily serving user needs. Thus, while on one side the till then SOI topographical maps were challenged from policy aspects and on other hand imaging technology "blew the lid" off for mapping sector and a new genre of image-based maps became an alternative. [36]

86. RSDP-2011 (for which DOS is the nodal agency) defines the regulations for acquisition, dissemination of satellite images through NRSC. ISRO/DOS had positioned a RSDP-2001

[36] Mukund Rao, V Jayaraman and KR Sridhara Murthi (2001). HighRes Imagery – Are We Entering the No-More – Secrets Era? Paper presented at the 52nd International Astronautical Congress held at Toulouse, France during October 1-5, 2001.

which governed how satellite images were acquired and distributed from 2001 onwards and the recent RSDP-2011 now allowed even 1m images to be dissemination to users. The RSDP-2001 and RSDP-2011 embeds the concept of a High Resolution Image Clearance Committee to address the need of various users for 1m images. [37]

87. The first RSDP was adopted in 2001 when Indian imaging corresponded to 5.8m and the availability of Indian 2.5m or 1m was in still on "planning boards" BUT the first set of 1m images from IKONOS made way into the image market, including in India. The RSDP-2001 provided the first "framework" for a comprehensive imaging policy to the needs of 2000 Indian and global imaging technology – for the first time remote sensing was identified as a "public good" and the concept of national commitment to continued imaging programme through IRS was included (which meant that India would be assured of images from IRS systems as a government commitment) AND also introduced the concept of "one-window" access to any image (Indian or foreign satellite). Another concept that RSDP-2001 started was that a "regulatory use-determination" concept was introduced (mainly to stave off the hard-block of private sector access to 5.8m images "could become a security concern") whereby for images upto 5.8m would be "available on non-discriminatory basis" but images better than 5.8m would be "regulated" for private sector users on case-by-case basis. The RSDP-2001 carried a MAJOR ISSUE – images would be screened to obliterate some geographic regions (then called Vital Areas/Vital points) so that such "map-erasing" methods also are applied to images.

88. RSDP-2001 then-onwards stream-lined image dissemination from IRS and systems and also continued IRS systems in subsequent Cartosat-1, Cartosat-2, Resourcesat-1 and Resourcesat-2. But it faced its own challenges for users. Foreign satellite images HAD TO BE routed through the national agency – National Remote Sensing Centre (then Agency), NRSC. Further, the image obliteration as a screening process was also a challenge as obliteration led to apparent "pointing" to those areas. With obliterated images mainly in urban areas, many urban users were "denied" images of certain regions that "were obliterated" but still required urban planning. Over time, it was also clear that the maps generated from 1m images (with good positional corrections and image processing/ mapping techniques), the spatial content easily matched (or even better) the then SOI topographical maps on 1:50k scale. Thus, image based BASE-MAPPING also got a fillip and most GIS users started using 5.8m/2.5m/1m images for base-mapping and their GIS applications – that served the purpose of many a civilian application.

[37] J Krishnamurthy (2012). EO and Image distribution policies. Presentation made at NIAS GI Policy Roundtable Meeting held on June 19/20, 2012 at NIAS, Bangalore (for pdf of presentation please contact NIAS Principal Investigator).

89. With India also launching 2.5m and 1m images in 2004 and 2006 and the larger proliferation of 1m images from US commercial satellites, the 5.8m thresh-hold of RSDP-2001 as "regime for non-discriminatory access" was rendered irrelevant. Then started the re-visit need of RSDP-2001 and the RSDP-2011 was evolved ahead to lower the bar of "non-discriminatory access" to 1m – but then retaining all other aspects of RSDP-2001.

90. RSDP-2011 clearly states the process of access of Indian and foreign satellite images from NRSC as single-window mechanism for distribution. All users are made available images up to 1m without any discrimination; Private sector access to images of 1m and better has regulatory aspects to be adhered to through a High Resolution Clearance Committee (HRC) and all 1m images and better are "screened".

91. A major path-way in RSDP-2001 was the concept of "licensing" RS satellites and RS data acquisition/distribution in India – even as it identified the NRSC as the government data acquisition/distribution agency. But with the inclusion of "licensing" concept, it has kept the opening for private RS satellites and private agencies to acquire/distribute in India. However, no such licensing application has been made till now – though market-talk indicates few private players considering licensing applications for acquiring or distributing foreign satellite images in India. What is lacking in post-RSDP time-frame, is details and clarity on licensing terms and how the licensing applications will be made and administered. Further, with NRSC being designated government-agency, what cross-implications would be encountered and implemented is also not clear. This needs to be bridged as it is not impractical to envisage many such licensing requests for acquisition/distribution of RS data and even for privately-owned and operated Indian RS satellites.

92. In present day perspectives, the RSDP-2011, though quite progressive to considerable extent, still lacks a few important requirements of a POLICY – time-line definitions and service level guarantees by NRSC to users; a time-line commitment by ISRO to make regularly (define regularly) updated and enhanced imaging satellites available for the nation and, in a larger context, to involve users/industries/citizens as part of transparent and participatory policy defining/updating process and enable 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.

93. So, if one were to re-define RSDP in future time-frame, it could be appropriate to introduce time-line guarantees and service-level guarantees for the imaging services and also of how India can be assured of national imaging which are updated and improved.

3.3. CAR, 2010 FOR AERIAL PHOTOGRAPHY

94. In the Aerial Survey CAR-2010, a single window clearance system has been promulgated through DGCA for all aerial survey tasks. This is a major departure for aerial surveys – earlier which meant multiple application process has now become one-application and once clearance covering all aspects. It is now the DGCAs responsibility to obtain internal approvals/clearances of various ministries and determine a "collective" clearance for the application.

95. However, CAR, 2010 still are operational guidelines for permission seeking for aerial surveys BUT the Policy imperatives for aerial survey is lacking – it does not show a road-map and how growth of aerial survey would happen.

96. If we look within India in last 10 years – not more than 500,000 sq kms must have been surveyed using aerial instruments. This is a miniscule against potential and demand for urban areas (which are almost 2-3% of the country), land records (which are for large parts of each state), infrastructure (large areas). The impetus to this major requirement is lacking and one needs to see how aerial survey can "get easily and cost-effectively done" so that users get benefit from this important technology.

97. So, if one were to define GI Policy considering aerial survey capability, it would be appropriate to introduce a holistic road-map for growth in this aerial survey sector and make actions that ease the conduct and benefit of aerial imaging/lidar/surveys. Of course, time-line guarantees and service-level guarantees for the aerial services and also of how India can be assured of a vibrant aerial imaging capability which are updated and improved. In addition, in a larger context, it would be appropriate to involve users/industries/citizens as part of transparent and participatory policy defining/updating process for aerial surveys.

3.4. THE DELHI GEOGRAPHICAL SPATIAL DATA INFRASTRUCTURE (MANAGEMENT, CONTROL, ADMINISTRATION, SECURITY AND SAFETY), ACT, 2011

98. This Delhi Geospatial Act, 2011 is a unique of its kind and the first to be promulgated in a state of the country – Delhi. Delhi state has created a state GI content that includes about 48 lakh buildings, 3 lakh manholes and nearly 17,000 kilometres, demographics of the capital and utilities like storm-water drains, sewer lines, infrastructure projects and urban planning details under a Delhi State Spatial Database.

99. Using this data, the state can track properties that are evading tax and issue notices. Similarly, in case of unauthorized constructions, the department will be able to see the building status through the high-resolution maps and check the status of a property on the platform. Verification on the ground will then reveal if any unauthorized construction has been done. The e-governance initiative under the new Act will also allow direct monitoring through the control room at Delhi secretariat in case of a natural or manmade disaster.

100. The Act now mandates all state departments and civic agencies to mandatorily access, use and share information through secured communication networks. Delhi state recognized that there are too many agencies like MCD, DDA, DJB and state departments which makes coordination and decision-making process cumbersome. The Act links departments with the GIS database and is being seen as an effective way to bridge the gap and cut down on red tape.

101. The Act involves the GSDL – a joint-venture created by Delhi State government, Delhi State agencies (Municipal Infrastructure, Planning, Education, Social Welfare, Health Care Services) and citizens and commits to generate/use/share/update GI data and services. The Act states how the access to GI data is provided, how a revenue model is being attempted, how updation of data over time is envisaged, how access by private agencies/contractors through specific SLA terms, how departments update and own their process-data and how value-addition is envisaged. [38]

102. However, there are implementing challenges for this Act – it has taken lot of time for the project to be completed (almost 3+ years) and the GI data of the project is based on 2005 aerial photographs – almost 7 years old GI. Updating this GI content is a challenge and adding updated developmental attributes is yet another challenge. It would be essential to build in the approval/monitoring/sanction process of urban assets into the GI content updating process.

3.5. NATIONAL DATA SHARING AND AVAILABILITY POLICY (NDSAP), 2012

103. The NDSAP, 2012 is designed to promote data sharing and enable access to Government of India owned data for national planning and development The Policy is to apply to all data and information created, generated, collected and archived using public funds provided by Government of India directly or through authorised agencies by various Ministries/Departments/Organisations/Agencies and Autonomous bodies.

38 P K Srivastava (2012). Delhi Policy for Geospatial data. Presentation made at NIAS GI Policy Roundtable Meeting held on June 19/20, 2012 at NIAS, Bangalore (for pdf of presentation please contact NIAS Principal Investigator).

104. It aims to facilitate access to Government of India owned shareable data and information in both human readable and machine readable forms through a network all over the country in a proactive and periodically updatable manner, within the framework of various related policies, Acts and Rules of the Government, therefore, permitting a wider accessibility and use of public data and information. [39]

105. Subsequent to the adoption of the Policy, Planning Commission has constituted an Oversight Committee for Implementation of National Data Sharing and Accessibility Policy (NDSAP) – 2012 in the Planning Commission. [40]

106. The NDSAP is a positive step in sharing of public data across various government agencies, supporting planning and development and enable access to government data. However, we are to see some progress in this and it would be good to even obtain a metadata/list of government data shareable with different agencies, if these datasets can be "vetted" as national data (we presume that all data holding cannot get a national data tag and this would require authentication, quality tag etc) and usable for planning and development support, actually these data are organised in a national database that is accessible and available 24X7. Critical first steps could help resolve even simple issues, like authentic and nationally certified list of district/taluka/panchayat/village; boundaries of international/states/districts/villages as a basic dataset; project listings undertaken with public funds till now with location tag (this will help determine where funds are being used and determination of a fund-use/unit area index); annual and five-year plans/programmes of each state and the nation and many other detailed dataset of each agency.

107. In the context of GI, NDSAP needs to get sharing of data across the related agencies – like SOI (for its Open Series Maps), ISRO (for its images), GSI (for geological maps), FSI (for its forest maps) etc and also from state agencies. This needs to be addressed.

108. A major apparent aspects of NDSAP is that it is not clear whether public access is included in NDSAP, 2012 – else it is a major gap that needs to be addressed.

109. So, if one were to address NDSAP implementation, it would be appropriate to introduce a holistic road-map for Data Sharing, time-line guarantees and service-level guarantees for each government agency to list/populate/share its data and also of how Indian public can be assured of access to government data needs to be further worked on.

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39 NDSAP Approved – PIB Press Note from http://pib.nic.in/newsite/erelease.aspx?relid=80196

40 Oversight Committee for Implementation of NDSAP, 2012 – PIB Press Note from http://pib.nic.in/newsite/erelease.aspx?relid=83848

110. In addition, in a larger context, it would be appropriate to involve users/industries/ citizens as part of transparent and participatory policy defining/updating process for NDSAP.

3.6. ANALYSIS OF EXISTING POLICIES

111. What are the key learnings from the existing Policies? [41]

111.1. National Map Policy, 2005 – which mainly encompasses SOIs topographic maps distribution in digital formats but is yet to be fully implemented/practiced. Here the key aspect is that new, modern and operational procedures that facilitate meeting user demand and being progressive are required.

111.2. Remote Sensing Data Policy, 2001/2011 – pertaining to satellite image distribution which still is, in practice, "denying" 1m images to many non-government users. Here the issue is also of a "conflict of interest" issues where the policy-maker (DOS) is the policy-implementer (NRSC is under DOS) – what is needed is an "arms distance" between policy making and implementing the RSDP. Yet another aspect is lack of easy/transparent details/clarity on "licensing" of RS satellites and RS data acquisition/ distribution model allowing equal opportunity for private agencies to distribute satellite images data.

111.3. Aerial Survey Civil Aviation Regulation, 2010 – procedures for single-window aerial survey procedures but which has still not spurred great growth in aerial surveys. With limiting- and time-unlimited operational practices, the aerial survey market is a "blank" in India as against the potentials that it can make.

111.4. Delhi Geo-Spatial Act, 2010 – sharing and use of Delhi's GIS data by Delhi government agencies. This is pertaining to state of Delhi and a good attempt to share data – but needs operational procedures and rules for implementation with success.

111.5. National Data Sharing and Access Policy, 2012 – a general data sharing policy for data generated by public funds but no specific GI provisions in the NDSAP..

112. Key GI users have called for furthering National GIS would require leadership and vision and a pragmatic Policy foundation that will enable the right GI data to be generated and

[41] Mukund Rao (2012). International Scenario of GI Policy and Analysis of Indian GI Policy Eco-system. Analysis as part of this study report and presentation made at NIAS GI Policy Roundtable Meeting held on June 19/20, 2012 at NIAS, Bangalore (for pdf of presentation please contact NIAS Principal Investigator).

made available at right places in government and citizens for supporting development and governance. There is a gap in GI knowledge and capability – whereby projects get defined, implemented with technical finesse but most times get embroiled in awareness (and mystification) issues, technical gaps, capability gaps, non-standardisation issues, commitment and drive for success. GIS requires good technical leadership and these aspects must be included in the Policy definition. A very commonly mentioned example relates to satellite images that are masked – these make images less useful for any development as there cannot be "holes" or masks in urban and rural plans. [42]

113. Agencies need to must willingness to share GIS and services across organizations; balancing need for thoughtful design and sustainable system with desire to show results quickly; need for standards that addresses heterogeneous formats, Scales, Projections, and Accuracies. Users have also pointed out that GI from two agencies/sectors cannot be overlaid accurately and stringent ownership issues stifle sharing. New models for GI sharing are required and this can be done by a national GI repository and building various Map services to serve as Apps domain. Key concern is also of widely using free global map services of Google, Bing, Esri where relevant and critical questions are raised on whether these global services are really available free of cost; whether the terms of reference of these global services are understood properly by users; what if services are withdrawn and also what security aspects related to such services.[43]

114. It must be stressed that GI "not accessible" is as good as "not generated". While NMP, RSDP and NDSAP are there "on paper", the immediate need is - CLEAR Do's and Don'ts relating to these Policies. The concept of Policy FAQs – addressing the existing policies, rules, guidelines, directions, what can be done and what cannot be done, who to approach for any problem-solving etc will be useful as it will guide users for not committing mistakes rather than "action" after mistakes are made. This is a value principle that can drive the National GI Policy to bring transparency, accountability and effective utilization of human/financial resources without hampering the national interests.[44]

115. From a decision and governance perspective, GIS DSS is one element of larger Enterprise Suite (like what Ministry of Panchayati Raj is doing) as a symbol of modernity, efficiency, accountability & induce mass ICT culture. A major application would be the need for geo-

42 Sudhir Krishna (2012). Keynote Address on GI Policy supporting urban development. Keynote address at Inaugural session of NIAS GI Policy Roundtable Meeting held n June 19/20, 2012 at NIAS.

43 Vandana Sharma (2012). GIS Data and Application Services - Policy Perspective and NIC Experiences. Presentation made at NIAS GI Policy Roundtable Meeting held on June 19/20, 2012 at NIAS, Bangalore (for pdf of presentation please contact NIAS Principal Investigator).

44 Vinod Bothale (2012). User Application needs and GI Requirements Inputs for National GI Policy. Presentation made at NIAS GI Policy Roundtable Meeting held on June 19/20, 2012 at NIAS, Bangalore (for pdf of presentation please contact NIAS Principal Investigator).

tagging large volumes of attribute (like, PR assets) data – and there are no standards for this. The challenges for the National GI Policy would be on standardizing methodology to be adopted for preparing National level GIS backbone data for loal areas (say, for Panchayats). [45]

116. GI Industries in India see a different challenge from a Policy perspective. With most industries driven by revenue-goals, the larger participation in national objectives are lacking or are less visible. Further, the urge to achieve excellence and provide high-quality products/solutions seems dwarfed in the cloud of cost-competition, extending schedules, poor HR policies and less focus on GI as a knowledge activity. GI industries seem to lack a collective drive – thus a common vision that jells with national objectives is lacking. There are very few Indian GI software, commercial IP of GI solutions and the major thrust is to "use Indian hands and knowledge" for off-shore profitable projects.

117. In an emerging collective view from Indian GI industries, they envisage geospatial technology to become an integral part of government, public and private enterprises to develop the economy and drive efficiency thereby improving the quality of the lives of billion plus citizens of India. Two key enablers are identified by GI industries for growth – a good Policy framework and many National level GI programmes which can promote inclusive growth, transparency, responsive governance and awareness. Industries see 2 challenges - Data availability (issues of data creation, data access, IPR, licensing, data sharing and collaboration, supply-chain, data standards and certification) and Geospatial Ecosystem (as niche technology, usage is sporadic and fragmented, appropriate scoping in National Programmes, adoption of new geospatial technologies, business model for dissemination of data and services and trained manpower). The focus industries also want is on GI Content, deployment of many GI Applications, a single-window regulation and thrust for capacity-building. [46]

118. National GI Policy must have legal founding and the main aim of INGO should be acquiring/generating, processing/organising, distributing/sharing, using/promoting use, maintaining/updating and preserving/archiving GI data and towards this the constitutional Charter of INGO must contain legal provisions that enable it to perform its role. Some of the challenges that GI would face (like any other information) is its coverage under Copyright at, Liability and use of GHI in justice delivery systems. Legal

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45 Sushil Kumar (2012). GIS as part of e-Panchayat to make Panchayati Raj Institutes the symbols of modernity, efficiency, accountability & induce mass ICT culture. Presentation made at NIAS GI Policy Roundtable Meeting held on June 19/20, 2012 at NIAS, Bangalore (for pdf of presentation please contact NIAS Principal Investigator).

46 Rajesh Mathur (2012). National GI Policy – Industry viewpoint from AGI and FICCI. Presentation made at NIAS GI Policy Roundtable Meeting held on June 19/20, 2012 at NIAS, Bangalore (for pdf of presentation please contact NIAS Principal Investigator).

experts opine that how existing RSDP fails on the Rights to Access issue by a denial mode for 1m images to its own non-government (and citizens) and also fails to cover access from outside India. Legally, access to any information generated by public funds and under RTI must not be denied in any manner – especially in light of RTI – which would be applicable to GI. Technological safeguards has to be built into National GI Policy for unauthorized access and subsequent action of being able to detect any such unauthorized access. Another aspect to keep in mind is that National GIS would be "liable" for GI services provided and thus must address accuracy and reliability of data that can be proven and established by law – such provisions must be built in. It would be good if legal community is associated in making the National GI Policy and its review. [47]

119. From a security agency perspective, the key concern/worry is that the GI data includes VAs/VPs; images and maps show latest development features; magnetic data reveals important mineral resources; gravity data has sensitivity from use for missiles; Lidar data provides accurate heights and thematic maps reveal strategic planning aspects. While the 2-series topographic maps in National Map Policy address some issues, the characteristics of the "restricted zone" in NMP, which still includes a 50 km zone, the NE region, the J&K region – where digital topographic maps are restricted and not publicly available. The aerial survey security clearance process is managed by a pre- and post- aerial survey security activity for image scrutiny and clearance through an inter-departmental committee. Even in RSDP, images of 1m are to be cleared through a High Resolution Committee for non-government users and the process adopted is of image scrutiny, user agency scrutiny and the clearance process adopted. [48]

120. In a far-reaching visualisation, the following issues are suggested to to be covered in the GI Policy formulation[49]:

120.1. National GIS Asset – as a nation-wide GI content must be created and constantly updated with a core of applications oriented Decision Support as the final goal.

120.2. Data created by government must be shared and accessible without any availability-denial. Thus, the goal must be to open up the vast amount of GI data available with government.

120.3. The nation must have a commitment from data generators/providers of their

47 Ranjana Kaul (2012). National GI Policy – Legal Challenges. Presentation made at NIAS GI Policy Roundtable Meeting held on June 19/20, 2012 at NIAS, Bangalore (for pdf of presentation please contact NIAS Principal Investigator).

48 SV Chinnawar (2012). National GI Policy and security Issues. Presentation made at NIAS GI Policy Roundtable Meeting held on June 19/20, 2012 at NIAS, Bangalore (for pdf of presentation please contact NIAS Principal Investigator).

49 T Ramasami (2012). Inaugural Address on National GI Policy – a much needed perspective. Inaugural address at NIAS GI Policy Roundtable Meeting held n June 19/20, 2012 at NIAS.

commitment to update, maintain and generate newer GI datasets as required/ mandated in a time-bound manner.

120.4. Social sensitivity in data generators must be primary – generate what users want must be the goal and not make available what generators can. The focus must be on what users or nation wants and meeting that need. The demand side must dictate policy and national needs.

120.5. Policy must address the key issue of security agencies – especially related to how to ensure that GI data is not "mis- or abused" against national interest. This must be assessed and must get addressed in the Policy.

120.6. Policy-making and policy implementation must be separated from organisational point of view and not positioned under same organisational frame.

121. In comparing Indian GI Policy scene, the following becomes very apparent:

121.1. Considering Policy in a fast changing environment, need to build in and evolve a long-term commitment to GI Policy and not to see GI policy as a "snap-shot" one time event.

121.2. A holistic view on GI Policy is required as against piecemeal one-time policy positioning – even as the holistic National GIS Policy elements may be managed and implemented by different agencies (like DOS could be responsible for Image part; SOI may govern the Topographic Mapping part and so on).

121.3. Wide-spread usage of GI in governance and public activities and national growth impetus of GIS is required.

121.4. Need for "mandated" use of GI in governance at national/state/local levels

121.5. Cover cross-cutting issues of Policy in a holistic manner with clear definition of Do's and Don't's

121.6. Define clear and transparent practice for the Policy to make it a strong implementation mechanism

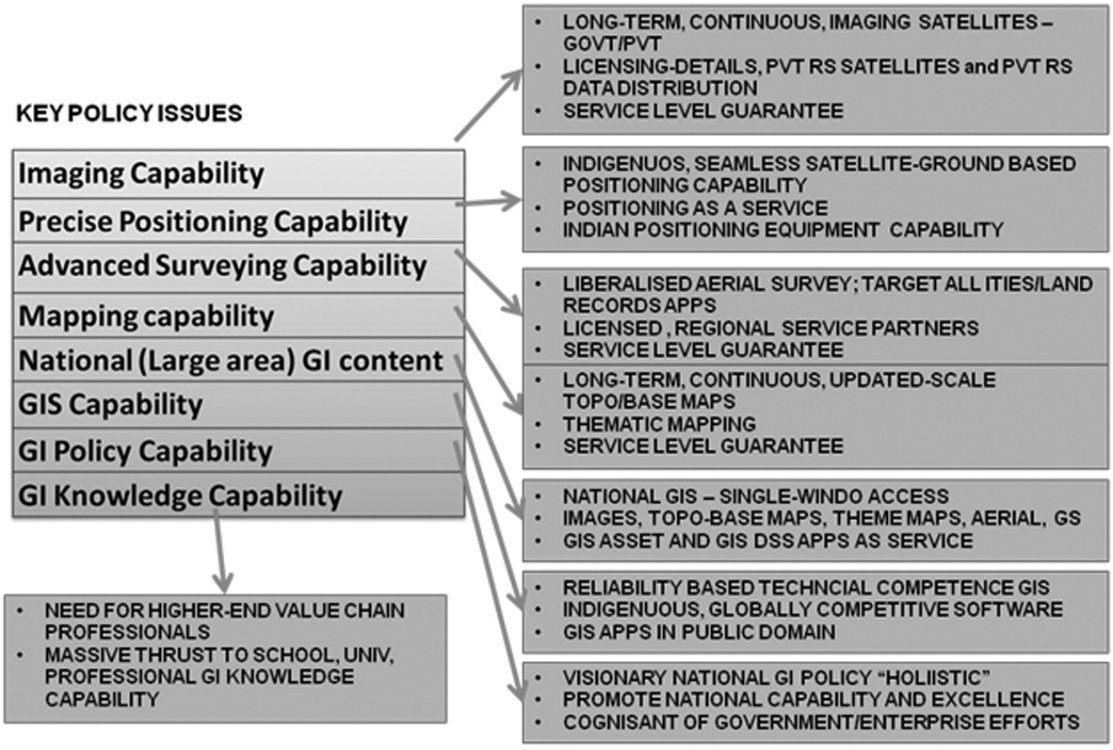
121.7. Security concerns have to be addressed and systems and mechanisms are required to detect and plug any mis- or abuse of GI.

3.7. TOWARDS A GI POLICY – KEY DRIVERS

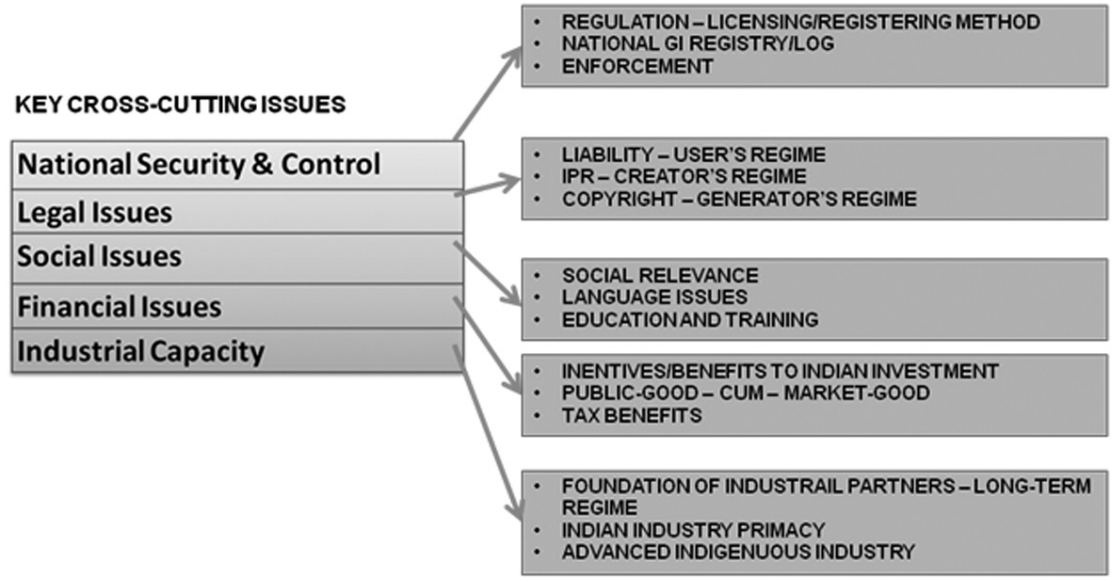
122. From a Policy Analysis point of view, there are key important considerations that go towards defining a GI Policy. These "drivers" for the GI Policy ultimately set a POLICY GOAL and are of 2 types:

122.1. GI Capability Drivers – a set of parameters that define the capability of a nation in GI and that are fundamental in defining a GI Policy. High Capability in these drivers could set a goal of maintaining that capability or even enhancing the

capability to front-rank; similarly, lower the capability the goal could be to acquire capability or even source it from outside.



122.2. Cross-cutting Issues – which are mainly parameters external to GI that impact policy definition. For example, national security concerns, financial issues of incentives/subsidies etc



123. From our perspective, both these are extremely important to assess and determine and which would ultimately impact the GIS Policy definition.

3.7.1. TOWARDS A GI POLICY – CAPABILITY CONSIDERATIONS

124. Eight basic capabilities have been identified that describe national capability in GI:

124.1. **Imaging Capability** – a capability of acquiring images at will – mainly from satellite platforms. This capability allows a nation to image any part of its own country or any part of the earth and uses it for its own usage of governance or based on commercial considerations for revenue. What distinguishes the imaging capability is the ability of satellites imaging resolution (today satellites image upto 0.50m resolution), spectral bands (generally 4-8 common bands in optical and IR regions are prevalent), night-imaging capability (using Radar imaging capability), stereo-imaging capability (to determine heights and view 3D images) and also collecting data of atmosphere/oceans (using specialised temperature, wave, air-chemistry, humidity etc measuring instruments).

124.1.1. These satellite images are used to prepare accurate map of earth features, map changes over time (suing temporal satellite images) and for detailed information or intelligence of objects.

124.1.2. The easy availability of these satellite images is yet another key consideration and when easily available (even at cost), images are extremely useful sets of GI that help nations to undertake and monitor development and also gain supremacy in the growing area of image commerce.

124.1.3. Some nations, including India, have their own satellites that provide images and serve globally; other nations source satellite images from outside but have the capability to consume these images internally for their needs but are "still dependant" for images; some nations have none and source total – end-to-end capability and are totally "dependant".

124.2. **Precise Positioning Capability** – a capability that uses advanced satellite technology to determine precise positioning of objects embedded with a receiver device. Such Global Positioning Systems (GPS) that provide precise positioning capability are a series of satellites that orbit around the Earth and "fix" positions upto ~1m precision on the earth.

124.2.1. Precision "fix" of position is vastly used in moving objects (like cars, trucks, aircraft, satellites, trains etc) for obtaining autonomous position fix and to "know the location".

124.2.2. Such precision "fix" position are also closely repeated/extended to provide a precision-survey capability and ability to easily map features on ground suing a tracking device.

124.2.3. Some nations have their own satellite-based Positioning Systems that provide position "fix" as a service and serve globally; other nations use these satellite-position fix capability from outside but have the capability to consume these position information for their needs but are "still dependant" for the satellite-position and devices capability; some nations have none and source total – end-to-end capability for positioning needs and are totally "dependant".

124.3. **Advanced Surveying Capability** – a capability that allows ground or aerial (just above the ground) to survey smaller areas to obtain very accurate and precise location and attribute information of objects. Aircraft-based, helicopter-based, vehicle-based, ship-based survey platforms are widely used. Specific survey instruments – like Imaging cameras, terrain mapping Lidar systems, video cameras, hand-held Positioning devices, Total Stations, Profiling Radars, Theodolites, geophysical instruments – magnetometers, gravimeters, resistivity meters etc and many other survey instruments are used to collect variety of survey data for different applications.

124.3.1. Such advanced survey provides high-accuracy images, terrain and 3D perspectives, position and distances/angles, underground objects etc that are widely used to then prepare maps and GIS databases of the detailed surface and underground features.

124.3.2. Such survey data and its maps are of large scale and are generally generated for small areas due to logistical difficulties and efforts/time/cost required for large areas.

124.3.3. It is also difficult to repeat these surveys and are generally done once or very less frequently – again due to efforts/time/cost required.

124.3.4. Some nations have their own advanced surveying capability that generate aerial images/data, ground survey data as required (and sometimes also provide service globally); other nations have very limited surveying capability and "totally dependant" for platforms/instruments and capability and source total – end-to-end capability.

124.4. **Mapping Capability** – a capability that allows nations to generate precise, timely and updated maps of different types – mainly in digital form. Fundamental mapping capability is to generate base topographical maps, thematic maps of different natural resources, physical features, maps of social and economic aspects

and, in present times, maps based on geo-tagged attribute data. Most mapping is based on use of satellite images and advanced survey-based data (either aerial, ground based surveys using different instruments). The most important ability of mapping capability is related to ability of re-mapping and keeping maps upto-date (and even amenable to note changes over time) and ability to have digital maps amenable to GIS processing and serving.

124.4.1. The Mapping capability requires recourse to use of satellite images, survey data and also cartographic knowledge that allows generating different maps. This is an advanced knowledge system that has to be developed and nurtured.

124.4.2. Most nations have a dedicated agency for Mapping (mostly topographic and base maps) but are in-effective in generating scales of maps that technology can produce (say, 1:10k), regular/timely update process due to technology gaps.

124.4.3. Most nations also lack seam-less digital maps amenable to GIS processing for their nations and mainly still use paper or scanned or un-topological data.

124.4.4. Very few nations have such seamless nation-wide digital GIS ready maps.

124.5. **GIS Capability** – a capability that allows use of advanced software that handles images/maps in large GI databases – and even allowing geo-linking with tabular data; building GIS applications and DSS that allow integration of different information to help decision-making and ability to detect and notice changes over time. Today, this capability is so advanced that GIS is used to organise and maintain large databases and serve them over networks to remote areas and provide web-mapping and web-GIS capability as a service-orientation. The Industry in India had been handicapped by the delays and constraints on access to data and would also like see the potential of GI as service unleashed. This capability is emerging as a critical capability by which nations are investing large resources to create, maintain and use large GI databases and applications for whole nations and even for the whole world.

124.5.1. This GIS capability requires advanced generic software development by which some nations have developed their own GIS software capability indigenously and make available for their GIS applications/services.

124.5.2. Others that depend on commercially available GIS software and develop customization of applications on a specific GIS Platform and provide services over web/networks.

124.6. **GI Knowledge Capability** – a capability that allows the generation of advanced and future knowledge related to GI and also enables innovation system in generation and use of GI for society. This capability is a function of education system and creation of a GI culture. It is only when there is a critical number of human resources and that also which is constantly evolving from basic levels to advanced knowledge/experience levels, implementing the GI is difficult.

124.6.1. GI knowledge has to be imbibed right from young age and is recognized that it must be a part of the school-, university- and research levels of education.

124.6.2. Few nations have systematically embedded GI knowledge into their education systems and provide school-, graduate and post-graduate level courses and knowledge levels – thus they have a high-level knowledge capability that serves them and many other nations; most nations have limited investment in educational system and gain limited from such a capability.

124.7. **GI Policy Capability** – a capability that enables the wide use and growth of GIS technology and its applications. The policy landscapes in respect of GI presents a picture of wide diversity - these diversities manifest as a collection of highly fragmented policies while at the other end they depict the trend towards integrating them into a mosaic, which fits into broader objectives such as attaining national technological supremacy/independence in GI, empowering people with information and increased transparency in governance. In addition, policy should define clearly the roles and linkages among various stakeholders- for example the various line ministries who would generate and maintain GI assets for supporting the decisions relating to their own sectors as distinct but related to National GIS assets and the level of support they would derive from National GIS.

Policy and legal regimes for managing the varieties of spatial data, their usage and access and their commercial potential, however, are underdeveloped and unclear. Ownership of digital 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 images and GIS. Moreover, it is spatial data products and services, as opposed to other forms of electronic data, that agencies at a variety of levels are attempting to sell, thus prompting legislative and other efforts by owners to restrict access to spatial information in digital form. In short, because of the great value of GIS, its potential for altering government's relationships with citizens, and its potential for intrusiveness, concerns over the handling of digital

spatial data will be substantial factors in society's reconciliation of competing social, economic, and political interests in electronic data generally. [50]

124.7.1. Few nations have a comprehensive GI policy arena that defines the end-to-end regime of GI and assured availability of GI; some nations have limited GI policy definitions that have compartmentalized various elements - such as commercial satellite service capability; distribution/provision of images; distribution/provision of topographic maps; permission to conduct aerial survey and use of aerial images/data; broad guidelines to share GI data etc; most nations do not have clear policy definitions for GI and manage with work-around rules/positions based on "as it comes".

124.7.2. Many nations have progressed over time from a regime of "restricting" or "making availability difficult" for GI driven by national security and defense considerations. However, over the past 2 decades, technology is fast over-taking to advances that are rendering such "restricting" regimes useless BUT a realization of "regulatory" approach being more relevant.

124.7.3. Globally, a realization is also coming that a more cooperative approach is essential to share experiences/capability in GI and bring a "minimum commonality" of policy considerations across nations.

3.7.2. TOWARDS A GI POLICY – CROSS-CUTTING CONSIDERATIONS

125. 5 cross-cutting considerations are identified as critical:

125.1. **National Security consideration** – an important consideration for defining a GI Policy for any nation. The diverse measures evolved for ensuring national security in case of images, maps and other forms of spatial information need to be integrated into GI policy preserving relevance to the basic objectives of national security. It is obvious and clear that GI information has national security impacts BUT with proper Policy management and governance it is easily possible to address the security considerations. At the same time, GI also is extremely essential and required for national security and defence needs – thus being in fore-front of the GIS technology also helps being in fore-front of defence/security requirements of GI. Rather, not allowing the GI technology to grow in the country can also undermine the security/defence preparedness for any nation and render it "handicapped" in national interest. In our analysis, most nations have the following concerns from a security point of view is:

[50] Mukund Rao & K R Sridhara Murthi (2005). Remote Sensing Images and GI Information – Policy and legal perspectives. Proceedings of the IISL Regional Conference on "Bringing Space Benefits to the Asia-Pacific Region" held in Bangalore, India during June 26 – 29, 2005

125.1.1. Knowledge of who is using GI – mainly to "isolate" any user intends/ plans to use GI against the national interest.
125.1.2. What is the use of the GI that a user is putting to – is the use genuine/ permissible OR is there any use against national interest.
125.1.3. Can every user of GI be tracked and a users use of GI be "assessed" in real-time. This is more from any analytics to determine the genuine/ good user against the anti-national;/bad user.

Technologically, today with advances in imaging, internet and computing technologies, it is virtually impossible for any democratic governance system to adopt restrictive/limiting practice as a Policy regime (as in the past). Today, any nation can set up a global GI server that can serve GI content of any part of the globe to an individual without any difficulty (aka Google, Microsoft, ArcGIS online and even our own Bhuvan and many others).

Thus, it must be recognized that it is not feasible for India to "fight" the GI access issue by restricting/limiting BUT be in the fore-front in a different way by:

125.1.4. Distinguishing the "good vs bad" user and use
125.1.5. Adopting online analytics and audit to determine each transaction (analog/digital) related to GI information
125.1.6. Matching global GI content dominance by positioning Indian global GI services – serving national use by attracting to Indian GI services and also "countering" other global services in a competitive manner.

125.2. **Social relevance of GI** – related to generating an environment of "advantage to all" for GI related activities in government, enterprises and citizens as a basic social infrastructure that helps the nation, as a whole. This founding for proper development and usage of GI and establishing the foundation of National GI and its benefits needs to be taken as a national commitment.

It has been adequately demonstrated that GI has impinging impact on society. A clear case in example is Gujarat's GIS and how it has been built/developed as a seamless state-wide GIS. Gujarat has clearly shown how GI impacts society in a positive way and has built specific examples of GIS based DSS for employment guarantee programmes, forests right act implementation, sustainable agriculture production, disaster management, irrigation management, village-level amenities planning etc. The focus has been on GIS based DSS and emphasis is to meet the GIS needs of users – stressing the

aspects of affordability, acceptability and adoptability of GI. This is a classic example of the social relevance of GI. [51]

As a policy, any subsequent business model for GI related activity could happen as a sequel to this founding "societal good" gets established – just as it happened in any other sector (telecom, roads, aviation, railways etc – in most of these sectors the business sector grew only when the founding investments for the infrastructure had already been made by government and provided the "platform" and standardization for a business model to develop). A strong view point is emerging that in the vastly changed environment, GI policy needs new thinking and it should have a live connection with issues of society like economic development.

125.3. **GI Legal Issues** – In a recent book on *Geographic Information Science: Master the Legal Issues*[52], a collection of articles on GI Policy and legal implications of sharing public sector spatial information data covering issues of contract, liability and negligence of erroneous and inaccurate data, ownership of tangible and intangible property rights and the question of privacy. Various examples of the legal frameworks in different countries have been provided that brings out a total analysis, explanation and description of court decisions and reasoning of law.

Globally, various legal issues that could apply to GI are identified and 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. [53]Legal nuances relating to IPR, security of data, product liability and other issues in the Indian context have been analysed in by some legal experts and these need to be integrated in the policy[54]

125.4. **Financial benefits regime** – as a promotion of GI whether any financial benefits could accrue to National GIS involvement – in terms of limited-period

51 TP Singh (2012). Social Benefits of GI and Policy Expectations. Presentation made at NIAS GI Policy Roundtable Meeting held on June 19/20, 2012 at NIAS, Bangalore (for pdf of presentation please contact NIAS Principal Investigator).

52 George Cho (2005): Geographic Information Science: Mastering the Legal Issue. A Wiley publication

53 Harlan Onsrud 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

54 See National GIS Policy Legal Challenges, A presentation by Dr Ranjana Kaul, Dua Associates, New Delhi, at National GI Policy Round Table, NIAS

tax rebates/concessions on using indigenous GI technology/data; developing new and indigenous GI technology (instruments, software, data, citizen services etc) and many other methods.

125.5. **Creating industrial capacity –** Government must recognize that industries also are partners in national GI development and that anchor-tenancy model could create a healthy, sustainable and competitive industry and justify private sector involvement. This is a standard feature even in advanced countries like US where anchor tenant role of the government plays a critical role for the success of industry**.** Association of Geospatial Industries advocates[55] that creation of industrial capability and industry involvement in this field is an essential strategy for maximizing economic, social and governance benefits and in that context policy is a key instrument that should enable participation of industry in the creation and deployment of GI,

126. **TABLE - 2** shows the details of the GI capability analysis for a policy analysis and understanding the relevance and importance of GI and especially where India stands. From this table, it is clear that India has achieved key head-advantage in the field of GI:

126.1. A long and technically stable knowledge heritage and strength in surveying, mapping, imaging and GIS applications
126.2. Indian has excellent imaging capability that can be unique national input to National GIS BUT can also be globally successful strength
126.3. It has long conceptualized larger systems – Natural Resources Information System, National Spatial Data Infrastructure, 1:10k Mapping that have been stable and timely concepts BUT has lacked implementation drive.
126.4. Large base of GIS projects that have been completed – thereby creating a large knowledge base of GIS
126.5. Large number of professionals in GI activity in India – both in government and private sector.
126.6. The first country that is already working on a National GIS.

127. The issue now is WHAT IS THAT GI POLICY that can capitalize on these gains and keep India in the fore-front of GI technology and applications.

55 See Industry view point, Presented at National GI Policy Round Table , NIAS, by Mr Rajesh Mathur, Member, AGI Governing Council and Co- Chair , FICCI Task Force on Geospatial Technologies at National GI Policy Round Table, NIAS

4. Critical Issues (of importance) for a National GI Policy

128. Based on the GI critical capability and cross-cutting issues assessment discussed in earlier chapter, we have undertaken an analysis of identifying detailed parameters and their Indian context for the GI policy. The detailed are as follows:

128.1. A set of ~62 parameters have been analysed to determine the "holistic" nature of the Policy definition.

128.2. 14 Imaging parameters clearly bring out the leadership in Imaging capability and the need to maintain and enhance this leadership with a long-term strategy, attain global lead and "dominance", enable time-bound service level guarantees for imaging services and committing to National GIS content.

128.3. 11 Positioning parameters have shown that India is at the fringe of indigenous capability in positioning satellites but must recognize the value of Positioning as a service and bring about a strategic approach for this.

128.4. 9 Advanced Surveying parameters that have clearly identified critical gaps in bringing benefit of aerial survey capability in India and an urgent need to bridge this gap; stream-line and standardize ground-surveying activity and its contribution to National GIS.

128.5. 7 Mapping related parameters that bring out clear gaps in mapping domain and availability of upto-date, digital topographic maps and also in thematic mapping content in India.

128.6. 14 GI Content related parameters that underscore the importance of DATA/ CONTENT for the growth of GI usage and applications and benefit.

128.7. 7 GIS related parameters that clearly bring out the need to pursue GIS applications services in DSS and also in need for a strong drive for indigenous capability in GIS software and expertise.

129. **TABLE-3** details the 62 parameters that have been analysed to determine a holistic National GI Policy. Some of the salient aspects from these 62 parametric-analysis include:

129.1. A long-term strategic national imaging capability needs to be furthered and sustained. Consultative mechanisms and transparent procedures for user inputs/ analysis in determining this strategy and its review are required – a national-level forum for this is essential.

129.2. While national RS capability needs to be strengthened, it may be appropriate to

consider a national capability that includes both public-funded and privately-funded RS satellite systems – meeting specific operational and scientific needs.

129.3. Going forward, licensed and competitive mechanisms for acquisition/distribution of RS images in India may have to become a reality. Competitive market-terms could build into operational systems and bring in royalty-based returns to the national capability. License terms and detailing have to be worked out for these that are applicable equally.

129.4. Continuous and advanced technology upgradation in maintaining a vanguard RS capability is required. Programmes that build and innovate on technological aspects are required.

129.5. India must maintain the lead in global arena as far as RS imaging capability is concerned. While global, commercial RS systems would be highly competitive they would also have to be matched at national level capability.

129.6. Imaging and image-distribution services must be embedded with service-level and quality-guarantees.

129.7. India must develop and establish Positioning as a service as positioning forms a major component of GI and GIS applications. A strategic policy-definition is required for a satellite-ground based integrated capability.

129.8. IRNSS is a critical capability as part of Positioning as a service – the ground and user segment dove-tailing for this is required to be taken up in a strategic manner. Ahead of the first 7 IRNSS satellites, visibility for future continuity missions is called for.

129.9. A long-term strategic national Positioning satellite capability needs to be furthered and sustained. Consultative mechanisms and transparent procedures for user inputs/analysis in determining this strategy and its review are required – a national-level forum for this is essential.

129.10. Ground-based equipment is crucial for the positioning applications and user and India needs to develop this element in a strategic manner that integrated IRNSS and other satellites with the ground application needs.

129.11. Aerial imaging and lidar data are critical survey methods and Indian cities (almost 5000+ cities/urban areas), land records re-survey base, DMS support are key areas that can benefit. Aerial survey procedures need stream-lining and easier procedures (time-bound) are required. Aerial survey an be easily developed in private sector on licensing basis.

129.12. Standards for ground survey and quality survey data are essential to being in a high-level of standardization of ground-survey data collection. Licensed approach to ground-surveying are essential.

129.13. A long-term strategic national surveying capability needs to be furthered and sustained. Consultative mechanisms and transparent procedures for user inputs/analysis in determining this strategy and its review are required – a national-level forum for this is essential.

129.14. Ground-survey and aerial survey equipment design and manufacture in India must also be considered from a self-reliance point of view.

129.15. Topographic mapping as a national activity must be furthered and mandated for regular digitalized updation. This is essential for boundary and internal feature mapping as an authoritative source.

129.16. Thematic mapping (geological maps, landuse maps, soil maps etc) use the satellite image or topographic base and are depiction of a theme – thus these maps are totally different from topographic maps. The thematic maps are user-driven and meet a user need.

129.17. While the present NMP, 2005 mainly pertains to SOIs topographic maps, a more comprehensive policy-formulation for Mapping is required – catering to topographic maps separately and thematic maps separately as these are 2 different elements.

129.18. A National Mapping Standard is required that clearly defines the standards adopted for Topographic mapping and thematic mapping. This Mapping Standard must be adopted for all mapping activity.

129.19. A National Spatial Foundation Dataset must be organised and made available to any person/agency as a national resource – so that any mapping is based on this foundation dataset. This is critical and very important.

129.20. A well-defined, standardized, seamless, nation-wide GI content must be available and maintained. National GIS has identified 41 GI features as common content. This set of common GI features must form the National GIS Asset and form a common base for all GIS users.

129.21. In addition, the national GI Content must also include "pockets" of detailed aerial-image based city-level GI that is stitched into the National GIS Asset.

129.22. Private sector can also power the generation of National GIS Asset and also this activity is, in future, amenable to a PPP model based on licensing/royalty.

129.23. A long-term strategic national mapping capability needs to be furthered and sustained. Consultative mechanisms and transparent procedures for user inputs/ analysis in determining this strategy and its review are required – a national-level forum for this is essential.

129.24. It would be a good strategy to indigenize the GI efforts – generation, processing with software and services to best possible extent. Thus, any indigenous effort must be encouraged and stress should be on reliability/robustness/long-term efforts of such indigenous efforts.

129.25. National GIS must avail of best and state-of-art technology, data and applications and all efforts must be to maintain high standards, quality, reliability and long-term sustenance of National GIS.

129.26. National GI Policy must be "holistic" and must embed a policy-review, feed-back and updation process. This process must be based on levels of consultation and feedback in a open and transparent manner.

129.27. GIS education needs great thrust and efforts to embed spatial-culture are required with actions at school-level itself. University support systems for GI education must be maximized to create a knowledge-fore in GI. Professional training in GI at mass-levels would be required for present and next-generation professionals.

129.28. The National GI Education and Training Policy must be formulated as based on MHRD GIS Education Task Force, 2012.

5. National GI Policy Consultation

130. One of the main activities taken up by NIAS Project team was to organise a consultation with experts. A Consultation Roundtable meeting was organised in NIAS on June 19/20, 2012 where 43 experts from different agencies in India participated and debated the NIAS draft report and on key issues related to the Policy.

131. The meeting discussed the importance of good Policy is getting realized now than never before and government is considering various policy initiatives to streamline governance and development. Policy making is a LARGER NATIONAL ISSUE and not just a government perspective. Policy studies and Analysis are becoming important and NIAS is helping in this regard. The NIAS draft report (which had been circulated to all participants in advance) has documented the issues related to GI Policy.

132. The following important points were highlighted and discussed in the Roundtable consultations:

132.1. A holistic National GI Policy that will establish National GIS, promote/mandate use of GIS in governance/citizens and also maintain leadership of India in GI technology is essential.

132.2. Considering Policy in a fast changing environment, need to build in and evolve a long-term commitment to GI Policy

132.3. Government must provide leadership and facilitate a GI Policy that mandates National GIS data service and number of GIS apps DSS deployment to be positioned and maintained by government and accessible to any Indian group/ citizens.

132.4. There should be no shying away from regulations and adhering to procedures in GI – all users/generators/providers must subject themselves to an open and transparent regulation process – including registration/audits/scrutiny etc in the national interest.

132.5. Learning from NMP experience, the GI Policy must bring clear Do's and Don't's and also simplified operational procedures foe policy implementation.

132.6. There should not be denial to any Indian of publicly generated GI – rather the foundation must be on open-access (RSDP was discussed in detail in this regard).

132.7. GI Policy making/revising must be an open and transparent and inclusive process involving government users, industries, academia and experts in the country.

132.8. It would be better to have arms-distance between policy-maker and policy implementer and not to co-locate them – with a view to position the best

interest of GI. To this end, the suggestion of Secretary, DST to have existing NSDI Secretariat to make policies and INGO/National-GIS as implementer was discussed and broadly endorsed.

132.9. GI Policy must be driven towards users – with generators/providers meeting the needs. The focus must be on what users or nation wants and meeting that need. The demand side must dictate policy and national needs.

132.10. Central and state government agencies must be mandated to use and embed GI in their work process and decision-cycle and towards this National-GIS must provide all technical and managerial support.

132.11. Aerial data (images, Lidar etc) have immense potential and GI Policy must make the wide use of this technology possible in urban areas, land records, disaster management etc. India must make concerted efforts to make aerial data widely collected and utilized – and promote private sector investment and participation in this.

132.12. Indian satellite imaging availability (at <1m pan and xs; highly temporal XS) must be assured/continuous and the characters of this must be in drawn up in consultation to users. Else foreign imaging capability will dictate and cater to national GI demand.

132.13. Immediately position an open and inter-operable National GIS Standard (as per National GIS Vision) and ensure that all national GI is on this standard.

132.14. Allow and encourage private sector GIS generation and ingest to National GIS and private sector GIS Apps publishing on National GIS.

132.15. GI Policy must stress on the aspects of affordability, acceptability and adoptability of GI

132.16. Carefully consider provisions of Copyright Act, Liability and use of GI in justice delivery systems, RTI etc in framing GI Policy.

132.17. GI Policy should aim to strengthen the existing educational/university institutions and to make geospatial tools a part of training as a knowhow for all government officials.

133. At **ANNEXURE-I**, the full record of the GI Policy Roundtable meeting is placed.

134. In specific, the user consultations showed that 3 major issues are seen as "limiting factor" in the existing RSDP and NMAP and which are posing challenges in usage of satellite images and maps:

134.1. **Image Masking in RSDP:** As per RSDP provisions, sensitive and vital areas/ points are masked out before satellite images of better than 1m resolution are distributed to Indian users. Masking of images is seen as an "oriental method" at denial which does not serve modern day purpose because the masked area

becomes clear and apparent and thereby "drawing direct attention" to such critical points of national security. Further, it is easily possible to "fill" these masked areas by procuring same satellite images from outside India (where RSDP cannot get applied). Thus, when technologically it is easily possible to "see through" the masked area, it only limits genuine Indian users to reduced access to such data – especially in urban planning/management (where large masked out areas renders planning/mapping impossible and leaves "holes" in mapping/GIS and development). This practice of "masking" must be done away with – especially when images are being distributed on registration.

134.2. **Non availability of updated/current, GIS-based topographic maps as per NMP:** Even though NMP, 2005 is in operation there is no clarity on availability of updated topographic maps of the country in GIS-ready formats. Further, the availability of old/outdated (of 2000 era) topographic maps does not serve any purpose at all when most advanced and recent images are available. There is no information from SOI website or any other source where authentic information on this could be obtained. Most users whom we discussed mentioned that GIS-Ready maps are not available from SOI. Internal discussions with SOI also confirmed that while scanned/digitization of all 1:50K maps have been done, the vectorisation is still in old formats (SOI DVD – whish is spaghetti and non-GIS compliant format) and that GIS formatting is yet to be taken up/completed. Thus, NMP is seen as serving an outdated topographic mapping regime and servers very little purpose.

134.3. **Non availability of GIS-ready elevation data to India users:** Even as the country has Cartosat-1 stereo for the past 7 years which can provide GIS-ready elevation data of about 4-5m elevation accuracy AND even as SOI topographic maps on 1:50k scale has 20 m contour data that can provide GIS-Ready elevation data of about 6m elevation accuracy, the Indian users are still in denial of GIS-Ready elevation data access/availability. As against this, digital elevation data are available from global/commercial sources which are at 30m elevation auracy and are made to use by Indian users. Elevation data is important for determining slopes, aspect, physiographic, relief analysis, line-of-sight determination and 3D perspectives – which are important for various GIS based Apps for governance/planning/infrastructure development/disaster management support etc.

6. National GI Policy – Proposal

135. It is evident that national efforts for GI have been dissipated and need to be aligned and consolidated towards a common GOAL in national interest. While a National Goal would help bring national focus to GI and enable different agencies to align their individual activities towards this goal. Thus, all agencies (in government, enterprise and for citizens) could orient and pursue their activities in a genuine and safe manner BUT also help achieve individual element excellence. For example, under the National Goal (identified above), it would be the drive of ISRO to pursue further excellence in imaging systems; SOI to pursue excellence in national mapping systems; private agencies to pursue national projects and so on.

6.1. GOALS AND OBJECTIVES OF NATIONAL GI POLICY

136. From the Indian context, the national goal for GI for next 10 (or 25)-years needs to be:
- Evolving and establishing a National GIS in next 3-5 years
- Through the establishment of National GIS, develop national capabilities in GI that will, at national level, contribute to the goals of improved governance and inclusive democracy and, at international level, position India as a front-end nation in GI technology

137. Implementation of the National GI Policy would enable 2 important policy sub-elements to be achieved:

137.1. Enhance national capability of GI - making GI easily available, usable and practicable and bringing value-benefit to government in governance/ development; enterprises in GI commerce activities and citizens for availing e-services and participation in democratic governance.

137.2. Be in the fore-front of GI technology in the world and maintain a level of "supremacy" that would be of great technological/economic advantage to India

137.2.1. India's achievements till now in imaging, mapping, GIS applications and ITES are elements that can drive to achieve this goal.
India must continue to play a meaningful and "dominating" role in global GI forums and influence/shape international cooperation activities.

6.2. ELEMENTS OF NATIONAL GI POLICY

138. Regulation methods and procedures need to be the foundation of addressing national security issues – to "identify and protect" good use/users and "isolate" wrong use/user – thereby ensuring that genuine national development use is protected. Regulation can also encourage national and indigenous GI technology – software, data, GIS applications, citizen benefits etc and "credit" those that contribute and enhance national GI capability.

139. The National GI Policy must clearly define a single-window regulatory protocol to enable the GI Policy implementation and smooth conduct of GI activities.

140. Aligned to the main National GI Policy, one also has to consider the following sub-elements:

    140.1. Imaging, whereby it would be appropriate to outline and implement a long-term National Imaging strategy. This could be an extension of RSDP, 2011
    140.2. Positioning, whereby implementing a long-term Indian positioning service strategy
    140.3. Surveying, whereby the national strategy for aerial surveying and ground based surveying is defined
    140.4. Mapping, whereby the National Mapping strategy is outlined. This can be an extension of NMP, 2005.
    140.5. GI Content, whereby the nation-wide, seamless GI content gets created, maintained and available.
    140.6. GIS, whereby wide-range of GIS data and applications services are positioned to achieve the National GIS application services

141. The National GI Policy must also address the attendant legal issues of both making GI content available and usage of GI Content.

142. The National GI Policy must define clearly do's-and-dont's of contributing to National GIS and also of GI Data Sharing – in consonance with NDSAP, 2012.

143. The National GI Policy must define a regular review/updation process.

144. National GIS organisation could be responsible for all activities related to National GI Policy and can coordinate for individual element policies of RSDP, NMP.

6.3. DRAFT NATIONAL GI POLICY

145. The intent is to provide a draft text of National GI Policy – that reflects the collective views of experts and is based on policy analysis of multiple parameters.

146. Based on foregoing considerations, analysis and consultations a draft text of the tenets of a National GI Policy which is arrived at is placed in **ANNEXURE-II**.

7. Broad Next Steps and Directions

147. Subsequent to submission of report, it is expected that DST and Government of India will take up the next steps for adoption and implementation.

148. Recalling that NIAS recognizes a eight step policy cycle - Issue identification, Policy analysis, Policy instrument development, Consultation (which permeates the entire process), Coordination, Decision, Implementation, and Evaluation. – **NIAS has completed the first 4 steps of the Policy Cycle and it is hoped that DST would take up next 4 steps of the Policy cycle for implementation of the proposed GI Policy.**

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TABLE – 1: COMPARATIVE ANALYSIS OF INTERNATIONAL POLICIES

Policy Dimensions	USA	Europe	Japan	China	Brazil
Data Access	Open access policy is operative. Information resources of federal govt. are put into public domain. Federal Agencies are not allowed to secure copy right of their works. Only 9 narrowly defined exceptions apply to obligation for disclosure of data held by govt.	Access policies vary across the countries in Europe. Most countries provide access to information held by public sector. Conflict of interest still exist between National agencies for mapping and Private sector. Pricing issues dominate in influencing level of access.	The Government of the state shall, in principle, provide, free of charge through the Internet, the Fundamental Geospatial Data and other geospatial information that it possesses.	Access policies are evolving under 3 categories (1) governments use (2) public service and (3) value additions / analysis .The State Bureau of Surveying and Mapping plays a focal role for access, data sharing and meta data services through its filial organisations	Brazilian policies reflect the recognition of public good nature of information and providing spatial data free of charge from INDE for registered users.
Right to information	Freedom of Information Act and the Open Records Laws of the individual states govern the rights of citizens.	Most European countries have specific laws on Access to information. The Council of Europe Convention on Access to official documents, provide the public the right to access official documents:	Law Concerning Access to Information Held by Administrative Organs (1999), came into effect in 2001. Regulations apply for local governments also for information disclosure.	The State council of People's Republic of China (PRC) promulgated in April 2007 "Regulations of PRC on Open Government Information" that became effective on May 1, 2008.	On November 18, 2011, Brazil enacted the Law of Access to Public Information that fulfils citizen's request for public information within 30 days of a request

Policy Dimensions	USA	Europe	Japan	China	Brazil
Right to Privacy	Evolved along the lines of Common law rights. Right to individual privacy dealt with under the first, fourth, fifth, ninth and 14th amendments to the constitution. Stronger constraints on government entities for collection, sharing and access to personal data	EU provides data protective regime in the form of a Directive. Constitutional provisions exist in all countries. National policies on protection of personal data vary across the countries. Collection and marketing of socio economic data is in practice.	In April 2005, the Act for Protection of Personal Data, applicable to public and private organisations and individuals, was enforced in Japan. Cultural issues are dominant factors to reckon with.	New regulations titled "Several Provisions on Regulating Market Orders of Internet Information Services" effective from March 15, 2012, requires service providers to give stronger protection for the personal data, prescribing notice and consent requirements, limitations on collection and use.	Article 5 of the 1988 Constitution of Brazil provides for protection of privacy and ensures compensation for damages. The Information Technology Law, has guidelines on privacy in the context of stored, processed and disclosed data
Copyright/ other protection	Copy right protection of databases is possible if authorship and creative arrangement of data exist. Copy right does not prevent use of data for value addition. In practice, data protection is sought through other means too namely contract law, trade secret, misappropriation laws etc.	EU Directive on IPR covers *sui generis* protection of databases, even if ingenuity element is absent. This is automatic and independent of copy right. Data protection is also ensured by other means such as contract and trade secrecy. EUROGI encourages open GIS efforts.	Copy right law does not specifically mention geospatial data. Copy right exception applies on software for personal use. Public institutions are bound by "Guideline regarding Distribution of Governmental Geographic Information" (2003).	China's IPR laws date back to 1979. Domestic IPR protection covers trademarks, copy rights, and patents through legislation, administrative regulations, and decrees. China is also party to most of international conventions and laws on IPR. As adherent to Berne convention, China permits copyrighting software, albeit with details including source code.	Brazil has undertaken consultations to reform its copyright act with an aim to bring it up to date with the digital age, and strengthening the rights of authors and consumers. No information on IPR specific to GI.

Policy Dimensions	USA	Europe	Japan	China	Brazil
Liability	Liability applies as per fitness for use laws and as per Contractual obligations.	Provider's liability to be covered by contract failing which other laws will apply. Fitness for use principle which is used need support of quality standards(partially available)	Japan's Product Liability Act 1994 attracts strict liability, or liability without fault, based on contract law provisions. Manufacturers are responsible and not sellers.	Tort Liability law has provisions relating to infringement of protection of personal data. Mishandling of personal information by data users can inflict liability.	Common Product liability laws and contract provisions determine liabilities
Serving Public interests	Strong federal, regional and local programs that promotes growth of technology, enterprise and services (Ex: Imagery For The Nation). Federal government undertook to develop NSDI involving state, local and tribal governments, academia and the private sector	Substantial public investments in data generation and updating by National Mapping and other agencies as well as local bodies are being made. Spatial data infrastructures at national level have by and large attracted public investments. The core GI data for public access is also generated with public good objective. Most data generated by governments are used for security.	Public investment in Spatial Data Infrastructure and fundamental data assets, at different scales Government invests in updating too. Major uses promoted are in the fields of (1) land development (2) administration (3) Public safety & security (4) new industries and services	Government agencies have made a great deal of investment to acquire geographical information and in creating Spatial Data Infrastructure at national, provincial, municipal and county levels. Investments come from these different levels of the government.	Policy recognizes value of public good investments in spatial data infrastructure and open data policies.

Policy Dimensions	USA	Europe	Japan	China	Brazil
Security	National security exceptions for commercial activities relating to imaging from space and mapping are integrated. Policy provides for use, by the security agencies, of civil commercial capabilities and systems operated by private sector	Security provisions to data access are defined through policies of mapping agencies. While high resolution optical data is accessible more freely, high resolution radar data is restricted. In digital domain the policy of downgrading data for access is not suffice and commitment of end use needs to be ensured.	National government establishes balance between security and promoting the utilization of geospatial information by framework for items that are considered from a perspective of national security.	Strict classification system regulates distribution. Most GIS produced are accessible for internal consumption.	Data providing agencies specify access restrictions. National security agencies are represented in the commissions that coordinate policy on cartography and spatial information.
Pricing/ Market development	Government held data available to citizens at the mere cost of replication. Pricing of value added services are market determined.	Cost recovery principle used in UK and France for geographic data produced by national mapping agencies. Other countries have partial recovery or adhoc approaches. Private sector demands level playing with government mapping agencies, in case of value added products.	Free Use of fundamental geospatial data sets by private sector encouraged. Free Market approach for value additions	Digital China Geo spatial Framework and Digital Region Geospatial Frame work, Digital city Geospatial Framework etc create common environments and platforms for value additions. Industry role mainly as contractors for mapping agencies.	Commercial sector is engaged in data providing (digital cartographic information) and services such as proprietary solutions based on commercial software or open software. Satellite data is made freely available.

Policy Dimensions	USA	Europe	Japan	China	Brazil
Standards / Quality	In the forefront of evolving standards and promoting innovations. Strong and diversified efforts to continuously review, update and implement standards. Federal standard for Spatial data exchange has a section on data quality.	Standardisation of spatial data is actively pursued. National bodies for standards exist in many countries and developing national spatial data standards. Two working groups deal with GI in CEN, the European standardization organisation. In geographic data exchange, lineage information inclusion is obligatory to enable assessment of fitness for use	Technical standards for Fundamental Geospatial Data (FGD), had been prescribed by the Ministry of Land, Infrastructure and Transport for maximum sharing , usage, seamlessness and interoperability. The State and local governments are required to follow these in their surveys.	Several standards including spatial data transfer standards have been evolved. (adapting other international standards) Further developments undertaken on data quality control, navigation maps, meta data standards etc.	CONCAR had renewed definition of cartographic standards and defined the metadata profile within the scope of INDE. An overarching architecture, e-ping used for interoperability in the Brazilian e-government. Geographic web services and data formats yet to be integrated into interoperability catalogue.

Policy Dimensions	USA	Europe	Japan	China	Brazil
Institutional arrangements	Detailed and well defined organizational systems and policies evolved. These are subject to review periodically. OMB, Federal Geographic Data Committee, National States Geographic Information Council and National Geospatial Advisory Committee ensure policy coordination among all stake holders.	Diverse institutional environment. Coordination mechanisms exist and effective coordination strategies at different levels are still under evolution	Roles of National and local governments are well defined. Ordinance of the Ministry of Land, Infrastructure and Transport (MLIT) prescribes responsibilities and use of NSDI	National Mapping agency SBSM and inter-ministerial committee plays focal role. China Association for GIS facilitates exchanges among diverse stakeholders Research is mostly funded by NNFSC.	Brazilian Ministry of Planning, Budget and Management brings focus through coordinated efforts of IBGE, the mapping agency and CONCAR, the cartographic committee, and the Secretariat of Logistics and Information Technology (SLTI)
Policy trend	From the provision of data, paradigm now is towards the use of spatial data. Emphasis for local data generation and overcoming challenges to sharing will be major thrusts. Private sector will continue to innovate and grow	Priorities are (a) promotion of greater use of geographic information and (b) creation of stronger markets. Harmonization of policies across the Continent is also another priority.	Continued Public investment into Fundamental spatial data assets and continued free availability through Internet will be the trend.	Operational use of GIS is growing. NSDI implementation is continuing. GIS Industrial growth has been in progress. Trend is towards expansion, GI efforts at lower levels of government.	Broadband connectivity infrastructure expansion to improve access. Strategies for updating and enhancing SDI databases. Possible Emergence of service based SDI.

TABLE – 2: BROAD GI CAPABILITY – POLICY CONSIDERATION

No	GI Capability	Category	Examples of Principle Nations	Remarks
1	Imaging Capability	Build, operate, utilise and offer service of satellite imaging capability	USA, Canada, China, India, Russia, France, Japan, Germany, Brazil (many other nations like Thailand, Nigeria, Korea etc have sourced satellites and have operated for imaging capability)	Today satellite systems from these nations have 0.5m imaging capability, radar imaging and ocean/atmospheric observation capability on a continuous basis
		Consume satellite imaging service from other nations BUT have capability to utilise	Almost all nations	Most nations source satellite images mainly from USA, Canada, and France. Japan, India (of late Indian data availability globally has reduced), Brazil etc also provide images.
		Lack even capability to source satellite images and even utilise images	Some African nations	Agencies from USA, Europe, Russia, Japan offer such end-to-end services
2	Precise Positioning Capability	Build, Operate, utilise and offer services of Positioning satellites	USA, ESA, Russia	India and China have announced satellite positioning programmes and in future would have this capability
		Source Positioning satellites BUT have capability to utilise precise positioning data	Almost all other nations (including India)	Most nations use US GPS systems to a large extent; some use the Russian Glonass; European Galileo yet to pick up

No	GI Capability	Category	Examples of Principle Nations	Remarks
3	Advanced Surveying Capability	Aerial, Ground, Ship-based surveying with imaging, lidar, GPR, GPS, total stations etc surveying capability and use of such data	USA, UK, Germany, Russia, France, India, Japan, European nations etc have this capability	Large number of companies from these nations has excellent capabilities and maintains large technical capability. In India, not many companies BUT few government agencies have aerial and ship-based survey capabilities BUT ground-surveys are provided by large companies.
		Source Aerial, Ground, Ship-based surveying with imaging, lidar, GPR, GPS, total stations etc surveying capability BUT have capability for use of such data	Many nations in Middle East, smaller European nations, Asia-Pacific nations adopt this approach	
4	Mapping capability	Ability to generate large scale maps in digital, seamless, nation-wide amenable to GIS processing	USA, UK and some more have at large scales. Some nations have at smaller scales of 1:50k #India still has to demonstrate such seamless maps at smaller scales, nation-wide that are amenable for GIS processing	India is aiming to generate seamless, nation-wide GIS ready data as part of National GIS
		Use old and historic maps, update smaller areas as required, non-digital maps.	Many nations adopt this approach	

No	GI Capability	Category	Examples of Principle Nations	Remarks
5	National (Large area) GI content availability	Availability of seamless, nation-wide (even global) GI content (at large scales that technology is available today) that is readily amenable to GIS usage of applications services	USA, UK and some other nations have nation-wide, seamless GI content at large scales; some nations (including India) have limited feature content at smaller scales.	India plans to have such nation-wide, seamless large scale GI content that is readily amenable to GIS processing and usage as part of National GIS.
		Use commercial/private or whatever is available as GI content	Many nations adopt this approach and use GI content that is available from Google, Microsoft, ESRI etc (and add specific content as required)	
5	GIS Capability	Indigenous GIS software, large GI databases, wide range of GIS applications and DSS and GI services	USA, France, Russia, China	India also has 1 or 2 indigenous GIS software commercially available
		GIS utilisation capability with lower-level of GIS software development But more of customisation and applications development	India has a large expertise of customisation and applications development using commercial GIS; Many other nations have this capability	India and most other nations (including Canada, UK, Japan, Australia and many others) use commercially available GIS software from USA BUT have high capability of GIS databases and application services
		Nation-wide, up-to-date large scale GI Content	USA, France, UK and companies like Google, ESRI, and Microsoft etc have such global/nation-wide GI content.	In India, nation-wide GI content is available in a very limited manner - either at smaller scales or a set of limited features or old/historical data. India has announced National GIS that would provide seamless, nation-wide and upto-date GI content.

No	GI Capability	Category	Examples of Principle Nations	Remarks
6	GI Policy Capability	Well-defined comprehensive GI Policy that covers end-to-end and clear definition of what can be done and what cannot be done	USA, China, UK seem to have quite good comprehensive policies that tend to be end-to-end and cover total spectrum.	At international level, there is a large realisation to cooperate on GI Policies. However, efforts to GIS standards have wider definition and acceptance at global level. Efforts at open, inter-operable and technology-agnostic generic standards are prevalent.
		Some limited policy definitions which pertain to a particular elements - images, topographic maps etc	India has defined such specific policies for RS data, topographic maps, data sharing, aerial survey guidelines etc	
7	GI Knowledge Capability	End-to-end advanced GI knowledge capability in schools, universities and professional practice	USA, China, India, Japan, UK, Canada and many other nations have this capability.	India has school level and university graduate and post-graduate courses and professional GI courses that is building GI knowledge capability. India has also a Geospatial Education Strategy being worked out by MHRD.

TABLE – 3: Critical Issues (of importance) for a National GI Policy

No	GI Capability	Critical Issues for India to consider for GI Policy	Inputs for determining GI Policy
1	Imaging Capability	What is the present satellite imaging capability of India?	India's present operational capability in 2012 is at 1m resolution panchromatic; 2.5m stereo panchromatic imaging; 55/23/5.8m 3/4-band multi-spectral imaging; single-frequency, multi-polarization, 3m resolution radar imaging and 8-band ocean color imaging and Ku-band scatterometer.
		Is there a Policy for satellite images in India?	Yes, Remote Sensing Data Policy, 2001 and its updated version of 2011 are official policy statements for satellite data acquisition/distribution in India.
		Is it essential/important for India to continue the building/owning/operating of its indigenous imaging satellites (against just sourcing images from outside)	Yes. It is extremely important for India to continue to build upon its technological advances in imaging satellites and assure, maintain continuity and position newer capabilities with advancing technology. Very few nations have this capability and images are becoming a very important technological capability. While images can be sourced from outside to meet demand, it is non-availability or denial of such images that must be covered for - to maintain that upper hand for national requirements of societal and security needs. In fact, India must have a National Imaging Programme that assures the country of a base-line imaging capability for long-term and also assure sufficient technological advancements in the imaging service over time.
		At present, what is the future vision of Indian satellite imaging capability?	As per ISROs 25 Years vision of Indian EO programme published in 2002, the vision is to provide leadership and continuity in earth observations through an operational EO infrastructure specifically for natural resource management, cartography and mapping, ocean, weather, climate change and earth system science studies [56] In the 12th Plan Working Group proposals of DOS, 8 EO missions are planned for ocean, weather and land/water imaging systems going upto 0.25m pan/1m XS. [57]

[56] Mukund Rao; V Jayaraman; S Kalyanraman; K Thyagarajan; K R Sridhara Murthi; Kasturirangan K (2002). Future Perspective and Long-Term Strategy of the Indian EO Programme. Paper presented at the 53rd International Astronautical Congress, World Space Congress-2002 during October 10-19, 2002 at Houston, USA.

[57] Planning Commission (2012). 12th Plan Working Group Report of Department of Space from http://planningcommission.nic.in/aboutus/committee/wrk-grp12/sandt/ wg_dos2905.pdf

No	GI Capability	Critical Issues for India to consider for GI Policy	Inputs for determining GI Policy
		Is the next 25 years technological status of Indian imaging capability adequate to meet the nation's GI needs of National GIS?	Presently, 2.5m images and 1m images are available in a sporadic and non-contiguous and non-temporal/systematic manner. As per many urban, APDRP and many state users, they are unable to obtain 1m/2.5m images when they want for the area that they want from IRS systems. This is because there is only 1 satellite each and with small swaths the contiguity and temporality of large area coverage is not available, multi-date/year archives are not yet built and available. As per 12th Plan, India is planning for ~0.64m pan/2.5m XS imaging in 2014-15; continuation of 55m/23m/5.8m XS imaging and a 0.25m pan/1m XS in 2016-17. For National GIS, this "limited availability" poses a challenge that 1:10k National GIS Asset generation for nation-wide would have to depend upon mix of Indian and non-Indian sources of images – further posing challenges to GI processing/analysis in terms of issues related to data compatibility, usability and rationalization and costs.
		Are there critical gaps in the national satellite imaging capability in the next 25 years vis-a-vies national needs?	With the global EO systems already in 2012 at 0.5m pan/2m XS levels, India is planning such imaging in 2017-18 time-frame. With National GIS requiring repeated, continuous, contiguous, timely, <1m images for 1: 10K GIS Asset, there would be a major national gap that needs to bridged. Further, if the global systems stop operations and Indian imaging is having a gap, then National GIS at scales of 1:10k would be impacted. National GIS also requires satellite images and distribution in real-time of <24 hrs (this is being done by comparative global missions) and long-term systematic archives of past and future Indian images for powering change detection and temporal applications in development analysis, investment analysis, legal cases, disaster management etc.

No	GI Capability	Critical Issues for India to consider for GI Policy	Inputs for determining GI Policy
		How does India envisage to bridge any gaps in satellite image capability in next 25 years?	National GIS would mainly be worked on Indian images but if Indian images are un-available and does not meet the requirements of National GIS, then National GIS would then depend upon non-Indian images. National GIS systems must work with Indian EO system to plan, position EO missions that meet national needs of National GIS.
		Are there any critical satellite technology area that limits India and creates those critical gaps in imaging capability? Are there methods to bridge this? Will it be a permanent limiting factor?	Based on discussions with some EO experts in India, the key challenges for maintaining a long term continuum for an assured ~50m XS high-repeat imaging; ~10-20m XS; 0.25m pan/stereo imaging; multi-band radar imaging; hyper-spectral ocean imaging capability are – Detector array coated with filter overlaid with Read Out Integrated Circuits (ROIC), Devices technology – linear devices, Array CCDs and Time Delay Integration (TDI) devices, Active Pixel Sensors (APS), Precision Star Sensors, Ka Band transmission, On-board Data Processing, High Accuracy Gyros, High Torque wheels, multi-band SAR Technologies, Mass Storage devices etc Ability to build and operate EO satellites in quick time-frames of <2 years for building/launching and real-time (<24 hrs operations) are also required as one cannot have a situation where in 2017-18 India will have 0.25m/1m imaging capability that global systems provide in 2012 itself. India must actively explore the possibility of private sector licensing for EO satellites, as provided for in RSDP-2001 and RSDP-2011, building/owning/ operating and image distribution and services so that this critical technology and time-gaps could get removed. Even for existing Indian satellite image data acquisition/distribution, licensing is provided for in RSDP-2001/2011 and this must be positioned. This will enable competition and also help return revenue/royalty to Indian EO programme when Indian and global markets are licensed in a transparent process.

No	GI Capability	Critical Issues for India to consider for GI Policy	Inputs for determining GI Policy
		Are non-Indian satellite image data available and used in India	Yes, images from US GeoEye, DigitalGlobe systems are very widely used in India as they provide images at <1m panchromatic and 2.4m 4-band multispectral data on demand basis. Apart from this, Landsat images from - http://landsatlook.usgs.gov/ - Global Landsat Archive are used in large numbers/volumes by Indian users. With Landsat data available free of cost from the portal, many user segments that depend upon ~15m XS are fully using this free-data availability.
		Does the regulatory approach serve well and what are its major limitations/success?	Masking of images is a major draw-back as sensitive and vital areas/points are masked out before satellite images of better than 1m resolution are distributed to Indian users. The masked area not only becomes clear and apparent and thereby "drawing direct attention" to such critical points of national security, it is easily possible to "fill" these masked areas by procuring same satellite images from outside India Masking only limits genuine Indian users to reduced access to such data – especially in urban planning/ management (where large masked out areas renders planning/mapping impossible and leaves "holes" in mapping/GIS and development). This practice of "masking" must be done away with – especially when images are being distributed on registration. The regulatory approach of HRC, though well-intentioned seems to have become a one-stop "bottle-neck" for non-government agencies to procure 1m and better images from NRSC. There are no binding, service-level guarantees for delivery of 1m images and it takes in-ordinate time (and many a times non-starter) for delivery of images thru HRC system. A careful analysis of HRC system performance (how many cases registered, how many cleared in what time-frame, how many rejected) etc would be worthy to look at a "satisfaction index" of users for 1m images. It may also be appropriate to have time-line guarantees for such clearances to happen so that a performance-pressure is also on the HRC for addressing each case with care. In our view, the "bottle-neck" of HRC system an be a classic case for forcing and encouragement to 1m data usage outside RSDP and also in a non-policy framework. Thus, if the RSDP-HRC system is time-bound and user-sensitive then it can make most users benefit and also "disable" any possible/potential non-policy usage of 1m data.

No	GI Capability	Critical Issues for India to consider for GI Policy	Inputs for determining GI Policy
		Is a time-line definition or service guarantee time essential for image delivery (from NRSC) and regulatory processes (like HRC etc) and what should it be?	Service Level Guarantees have to be the order of the present day – even for government sector. With government even debating Service Level Guarantee Bill, it is high time that Image and GI Policies are also embedded with time-line and service guarantees – this will not only make the servicing agency publicly accountable and also have commitment to quality and timeliness of service BUT users would also be able to question/redress on quality of service and its timeliness. RSDP and HRC and NMP must have SL agreements embedded – this will certainly make the policies more user-oriented and also bring efficiency in services.
		Is there a national forum where the long-term needs of government/private/academia (in general Indian society) and availability of images are determined and assessed and after considering technological status, the broad mission-definition manifest is worked out/reviewed/modified and publicly available?	While user inputs are obtained from task-oriented OR one-of discussions in professional meetings, they do not focus as "change-agent" and improvement in service and policy improvements. All such mechanisms do not discuss RSDP and User issues of image usage in a serious manner and thus do not really address the Policy related issues. It would be essential to have a National Forum under National GIS for an open, transparent, committed annual discussion on Policy perspective and experiences of any individual/entity addressing and cycle these feedbacks into RSDP and National GI Policy Review (which will also improve the present decadal review of RSDP Policy to a more time-bound frequent review and changes).

No	GI Capability	Critical Issues for India to consider for GI Policy	Inputs for determining GI Policy
		Would it be appropriate to encourage and develop a private sector investment in routine imaging satellites that can offer commercial imaging services?	The NIAS team feels that the key issue facing India RS today is the ability to meet national requirements of National GIS and other user needs in a long-term strategy and making it happen within India (rather than making the needs met by image sources from outside) – with the main view of retaining and further building Indian capability in RS. India must actively explore the possibility of private sector licensing for EO satellites, as already provided for in RSDP-2001 and RSDO-2011, building/ owning/operating and image distribution and services so that this critical technology and time-gaps could get removed. Even for existing Indian satellite image data acquisition/distribution, licensing possibilities to private sector is provided for in RSDP-2001/2011 and this must be immediately positioned. This will enable competition and also help return revenue/royalty to Indian EO programme when Indian and global markets are licensed in a transparent process.
		What are the eco-system issues for Indian private imaging satellites?	India must look at the RS eco-system as a "national issue" (rather than a single organization's issue/concern) and make way for integrating government+private+academia capability-building/utilising in the overall environment of an national capability in RS – which includes the present government capability but also adds on an industrial capability for a long-term sustenance and growth. The NIAS team feels that with the rapid technological advances being made, the challenges of competition, the large internal demand for RS and also to grow the national technological capability, it is just not possible to sustain these in just the present government frame-work and a public-private participation is utmost critical for national good in this technology. The change towards private/licensed RS satellites meeting defined national demand + making global commercial forays in a "business model" will bring great returns of value and contribution to the nation and also maintain a national capability.

No	GI Capability	Critical Issues for India to consider for GI Policy	Inputs for determining GI Policy
2	Precise Positioning Capability	What is the present positioning capability in India?	India has a large usage of ground-based precise positioning devices that are based on US GPS systems or Europe's Galileo systems or Russian Glonass systems. As of now there are no Indian satellites that provide precise positioning service. SBAS experimental system, GAGAN, for precise positioning for air transportation applications is near operational. However, the Indian INSAT system does provide satellite based augmentation of position as a service to specific sectors. India has plans for launch of an Indian Regional navigational Satellite System (IRNSS) which would be operational from 2013 to 2015.
		Is there a Policy for precise positioning satellites/ services in India?	No. Policy does not exist.
		Is it essential for India to continue the building/ owning/operating of its indigenous precise positioning satellites (against just sourcing services from outside)	Yes. It is extremely important for India to continue to build upon its technological advances in positioning satellites and assure, maintain continuity and position newer capabilities with advancing technology. Very few nations have this capability and positioning has equal civilian and defence ramifications and is becoming a very important technological capability. If India sticks to sourcing satellite services from outside to meet positioning data demand, it is non-availability or denial of such positioning satellites (which has happened earlier with US GPS systems) that needs to be covered for - to maintain that basic level for national requirements of societal and security needs. In fact, India must have a National Positioning Service Programme (integrated satellite and ground based) that assures the country of a base-line positioning service capability for long-term and also assure sufficient technological advancements in the service over time.
		At present, what is the next 25 years Indian satellite positioning capability?	India's IRNSS system that will be operational in 2013-2015 time-frames would provide service for 5 years mission life. There is no visibility of plans ahead of this IRNSS and 2015 and ahead time-frame.

No	GI Capability	Critical Issues for India to consider for GI Policy	Inputs for determining GI Policy
		Is the next 25 years technological status of Indian positioning capability (satellite and ground) adequate to meet the nation's GI needs of National GIS?	Positioning is becoming an important element of any nation's activities – requiring the need for precise-positioning information within government, enterprises and for citizens. Positioning is not just static information of a location but is constantly dynamic information required for decision-making and efficient solution and practices. Positioning will emerge as a critical national SERVICE and it will become a need for every citizen, society, government and industries for their activities of day-to-day life, governance and business growth. In making Positioning as a Service, key technologies of instrumentation, larger network of systems, applications services etc become meaningful. Not only good precise positioning equipment are required but also establishing National Referencing Network as a national facility becomes important. So is the need to position the up-end integration with applications and solutions – in GIS, Imaging and other user applications. Thus, this has to be holistically developed – where just pushing equipment business is at the base of the pyramid (more equipment more revenue) but a VRS is the mid-end of the pyramid – as a national facility that provides a service of position correction and transmits to any hand-held enabled service. Integrating with front-end application is also important. This integrated approach to Positioning is important in INDIA in the coming years.
		Are there critical gaps in the national satellite and ground based positioning capability in the next 25 years vis-a-vies national needs?	India much depends upon outside technological capability for Positioning technology – in terms of GPS/Glonass/Galileo satellites and ground systems. With IRNSS yet to be launched, a shift towards an Indian satellite will happen but ground systems and services have to be "indigenised" and this is yet a challenge to be addressed. It is also essential to develop a long term strategy for Positioning – ahead of presently planned IRNSS BUT also in an integrated development of space, ground and user system/services.
		How does India envisage to bridge any gaps in positioning capability in next 25 years?	While presently, India has no option but to depend upon foreign Positioning capability (satellites, ground equipment and even services), a long-term strategy on this is required. A debate must happen in India amongst all experts to work on a 25-50 years strategy for Positioning and making Positioning a national service.

No	GI Capability	Critical Issues for India to consider for GI Policy	Inputs for determining GI Policy
		Are there any critical technology area that limits India and creates those critical gaps in positioning services capability? Are there methods to bridge this? Will it be a permanent limiting factor?	Long-term sustained Positioning services will require indigenization of ground systems and services to be developed as a crucial technological capability – reducing dependency on out-sourced equipment and solutions. Crucial tie-ups with global leaders to manufacture and develop key ground equipments in India and creating an environment for same may be appropriate.
		Are non-Indian satellite positioning data available and used in India	Yes, a large number of ground positioning devices are based on US GPS systems or Russian Glonass or Europe's Galileo systems.
		Is there a national forum where the long-term needs of government/private/academia (in general Indian society) and availability of positioning are determined and assessed and after considering technological status, the broad mission-definition manifest is worked out/reviewed/modified and publicly available?	At present, all user inputs are obtained from task-oriented committees OR one-of discussions in professional bodies but they do not focus as "change-agent" and improvement of service or policy issues. All such mechanisms do not deliberately discuss on Positioning Policy and User issues in a serious manner and thus do not really address the Policy related issues. It would be essential to have a National Forum under National GIS for an open, transparent, omitted annual discussion on Policy perspective and experiences of any individual/entity addressing and cycle these feedbacks into a Positioning Policy and National GI Policy Review.
		Would it be appropriate now to encourage and develop a private sector investment in routine positioning capability (satellites, ground services) that can offer commercial positioning services?	While industrial capability building must be a goal, this sector needs technological seeding to emerge as a major national requirement and activity – focus for next few years must be on these lines. Thus, government has to take a larger and committed role in this national arena of Positioning and build an eco-system that may, in future, become a private sector activity. However, involving private sector agencies in this initial national effort can be ensured so that simultaneous industrial capability is also developed.

No	GI Capability	Critical Issues for India to consider for GI Policy	Inputs for determining GI Policy
3	Advanced Surveying Capability	What is the present surveying capability in India?	India has very limited operational capability of aerial survey. Except government agencies - like Defence, National Remote Sensing Centre etc, there are no agencies that provide aerial survey capability. Private sector efforts to provide aerial survey services (mainly as a sourced integration effort of aircraft, instruments, knowledge etc) are hardly indigenous. Eco-system enhancements are required to open up this area and create a good sustained capability of aerial survey - with instrumentation in imaging, lidar, geophysical instruments etc Ground surveying is widely done for small and local areas using ground based instruments - GPS devices, Total Station etc. Most of these surveys are carried out by Indian private sector and Indian state land survey agencies. Ship-based surveys in Indian oceans are mainly sourced from outside though limited ship-survey capability exists in Indian ocean/earth science agencies.
		Is there a Policy for precise surveying in India?	No. A comprehensive Policy does not exist. However, there is an Aerial Survey Guideline that defines the process for seeking permission for aerial surveys. Similarly, ground surveys are more governed by respective State Survey Manuals.
		Is it essential for India to building and develop its indigenous survey capability?	Yes. It is extremely important for India to build its ground survey capability (instruments, knowledge) as the demand for surveying is very large in land records, land acquisition, property mapping, boundary and de-limitation exercises, engineering structures design etc - which are critical requirement. Similarly, India needs to position its own operational and sustained aerial survey capability (of aircrafts, instruments, knowledge) as demand for large scale urban mapping, cadastral surveys, disaster surveys, terrain mapping etc is extremely large.

No	GI Capability	Critical Issues for India to consider for GI Policy	Inputs for determining GI Policy
		What steps are required for improving aerial survey capability in India - technology, eco-system, service approach etc	Aerial imaging and data must form the platform foundation for all the cities/ towns of India and also for disaster management support. Thus, a policy initiative to over all the Indian cities and critical areas must be worked out with an embedded plan for regular re-imaging over 5-10 years (atleast). This large-scale foundation will be critical and useful to all cities/towns and also help plan DMS in a better way. In addition, it will make this activity an "industry" and then private sector involvement and participation an be ensured. Thus, government must create this demand-base – which is essential for development and found an industrial activity of aerial surveys, instrumentation and large-sale data organisation for cities/towns.
		Are ground survey capability adequate and what are the di ficulties faced in this capability?	While ground survey (spatial and non-spatial domain) capability is well developed in almost all states it is the quality and catering to volumes that appear to be major factors to address.
		Are there issues of quality in survey capability - are proper standards followed and are data from survey of good and reliability.	Yes, survey quality assessment is a key issue and there need to develop a set of standards that specify survey quality needs and develop methods for assessing survey quality and make it more useful. National GIS could work on this.
		What overall steps are required to create an impacting policy requirement for survey capability enhancement in India?	National GIS must address the Survey Policy elements by debating and assessing survey needs, survey capability and also quality needs. This must be a part of National GI Policy.
		Are there any critical technology areas that limits India and creates those critical gaps in survey capability? Are there methods to bridge this? Will it be a permanent limiting factor?	The only issue apparent here is once again an issue of indigenous capability of survey equipment – almost all survey equipment and technology is soured from outside and this high-dependency could get addressed by a proper policy and environmental development for indigenization of survey equipment and technology.

No	GI Capability	Critical Issues for India to consider for GI Policy	Inputs for determining GI Policy
		Is there a national forum where the long-term needs of government/private/ academia (in general Indian society) and availability of surveying are determined and assessed and after considering technological status, and actions are worked out/reviewed/ modified and publicly available?	While user inputs are obtained from task-oriented OR one-of discussions in professional meetings, they do not focus as "change-agent" and improvement in service and policy improvements. All such mechanisms do not deliberately discuss on Surveying Policy and User issues in a serious manner and thus they do not really address the Policy related issues. It would be essential to have a National Forum under National GIS for an open, transparent, omitted annual discussion on Surveying Policy perspective and experiences of any individual/entity addressing and cycle these feedbacks into a Policy and National GI Policy Review.
4	Mapping Capability	What is the present level of mapping capability in India?	India has very strong mapping capability in its national, state and private sector agencies. Topographic mapping is undertaken by SOI - which seems to be struggling to meet its obligations of providing new and updated topographic/ base maps for the country. Thematic mapping is undertaken by many central agencies (like GSI, FSI, NRSC, SLUSI etc) and they undertake project-based mapping of good quality and turn-around. Similarly, the states have State RS Centres and other agencies that carry out state-wide mapping and most of them are efficient to meet their requirements. Private sector agencies undertake satellite-based and aerial-based and ground-survey based mapping as a service and there is a large pool of agencies that have high-level of capability.
		Is there a comprehensive Policy for Mapping in India?	While a comprehensive Mapping Policy does not exist, a policy for topographic maps exists in the National Mapping Policy – which basically addresses the issue of distribution and dissemination of topographic maps. However, there are Mapping Standards - like NNRMS Standards etc that define standards for mapping from satellite images. For aerial images mapping and ground-survey based mapping, standards are adopted on case-by-case basis by relevant agencies.

No	GI Capability	Critical Issues for India to consider for GI Policy	Inputs for determining GI Policy
		Is it essential for India to building and develop its indigenous Mapping capability?	Yes. It is extremely important for India to build and constantly develop its Mapping capability with large efforts at standardization as demand for mapping is growing from various sectors. Maps form the basic raw GI input to National GIS and thus a comprehensive capability building, standardization and Policy needs to be addressed.
		What steps are required for improving Mapping capability in India - technology, eco-system, service approach etc	Mapping technology and capability is well established in India as India has a long history of systematic mapping and also has been preferred mapping out-source for many nations in recent past. However, what needs to be worked on is a standardization of mapping and norms for systematic, high-quality mapping that will support National GIS. Another issue is the need for a standard National Spatial Foundation data that will be the basis for any mapping – else mapping is based on different base and it becomes difficult to integrate them in GIS. This is critical issue to be addressed in National GI Policy.
		Are there issues of quality in Mapping capability - are proper standards followed and are data from survey of good and reliability.	Quality is a key concern – especially when maps are to be ingesting to GIS. With no basic standards, mapping is sometimes project-centric and planned/ designed to meet needs of the project – but may not fit into a national frame of a GIS.
		What overall steps are required to create a impacting policy requirement for Mapping capability enhancement in India?	Development of a National GI Mapping Standards; freely making available a National Spatial Foundation dataset as a base for any mapping; National GIS Quality standards and a clear National Mapping Policy (going beyond just topographic maps and including all thematic maps).

No	GI Capability	Critical Issues for India to consider for GI Policy	Inputs for determining GI Policy
		Is there a national forum where the long-term needs of government/private/ academia (in general Indian society) and availability of Mapping are determined and assessed and after considering technological status, and plans/actions are worked out/reviewed/ modified and publicly available?	While user inputs are obtained from task-oriented OR one-of discussions in professional meetings, they do not focus as "change-agent" and improvement in service and policy improvements. All such mechanisms do not deliberately discuss on Mapping standards; Mapping Policy and User issues in a serious manner and thus they do not really address the Policy related issues. It would be essential to have a National Forum under National GIS for an open, transparent, committed annual discussion on Mapping Policy perspective and experiences of any individual/entity addressing and cycle these feedbacks into a Mapping Policy and National GI Policy Review.
5	National GI Content	What is the present level of national-level GI content available in India?	India does not have serious and operational efforts at generating nation-wide seamless GI content. Many agencies have analog/paper maps for the nation that are time-stamped, not seamless and not digital. Today, technology allows for creating high-depth GI content (compatible to large scales) and these efforts are being planned in National GIS. Today, the best available digital nation-wide GI content pertains to single time-stamped 23m/5.8m images, time-stamped small scale thematic information on landuse, forests etc. Some private sector agencies also have nation-wide GI content that are mainly navigation-focused.
		Is a nation-wide, seamless, updated, GI content essential for India?	Yes, a nation-wide GI Content is extremely essential for India and now this has been envisioned in National GIS. Such nation-wide, seamless, updated GI content would boost utilisation and support quick planning and development activities - unlike each project generating its own content as is happening today. India needs methods and processes by which a seamless, national GI content can be organised by "part-to-whole" approach and enable STANDARDISED AND COMPLIANT GI content ingest into national GI Content. Thus, a create-once-use-much is what is required.

No	GI Capability	Critical Issues for India to consider for GI Policy	Inputs for determining GI Policy
		What lowest level of nation-wide GI Content is required for India?	At the basic level, the need for a National Spatial Framework (NSF) content is essential (including standard administrative boundaries, major rivers, major roads, major cities etc) so that any mapping and GIS is based on this NSF. National GIS has identified ~41 features as basic for National GSI and this must get established. In addition, GIS DSS specific content would also get established over time. Non-spatial data and tabular data in geo-tagged format would also get included. Every city must have aerial images and specific elevation data collected, processed and organised in City-GIS, as part of National GIS.
		What should be the level of updating and "keeping alive" the nation-wide GI content?	NSF must be formally released every year/2 years. National GIS content must be updated as per update cycle. Aerial data for every city must get updated every 2-5-10 years (based on the size of city and its problematic needs) at the least.
		What is the minimum nation-wide, standardized dataset that should be available in public domain (as a template for one and all to use)?	All National GI content generated under National GIS (that is NSF, National GIS content of ~41 features and processed DSS-based inputs) must be available in public access domain – though there can be access rules for these.
		Is there a national forum where the long-term needs of government/private/academia (in general Indian society) and availability of National GI content are determined and assessed and after considering technological status, and plans/actions are worked out/reviewed/modified and publicly available?	At present, there is no direct mechanism for user inputs on National GI but sporadic inputs/discussions do happen from ad-hoc discussions in professional bodies. Recently, the National GIS Interim Core Group (IG) had conducted detailed and exhaustive discussions on National GIS and related issues. It would be essential to have a National Forum under National GIS for an open, transparent, omitted annual discussion on National GI perspective and experiences of any individual/entity addressing and cycle these feedbacks into a National GI Policy Review.

No	GI Capability	Critical Issues for India to consider for GI Policy	Inputs for determining GI Policy
		As creating national GI content requires large efforts, what is the best way to pool government (central/state) and private sector agencies to get such GI Content organised/ updated.	Considering the GI climate in the country and also the capabilities in government/ private/academia, it would be best for National GIS to be developed as a public-good drive by government. Thus, government must lay down policies and establish National GIS – thereby for the first time establishing the National GIS and invigorate the GI eco-system for a national capability of excellence. Private sector can be the source for undertaking and implementation tasks with academia providing the key education/research inputs. Ultimately, in about 5-10 years when the National GIS has been operationalised, it will be appropriate to adopt licensing of key National GIS elements (Asset, DSS Apps, GI Education/Training etc) to private sector – thereby bringing value to the nation and also migrating the key elements of National GIS to private sector.
		What are the standards-parameters, processes that need to get defined for creating this National GI content.	As defined in National GIS Vision document, the National GIS Standards and Process documents must get developed.
		Should it be a governmental responsibility/commitment to make such nation-wide, seamless, GI content available as a "public-good" and thereby boosting GI usage and supporting governance and national development (including commerce).	Yes. National GIS must be a social responsibility of government in public- and merit-good principle. GI activities in India are yet to be organised into a eco-system" as a vibrant industry. Further, GI must emerge as a critical technological capability in the country and also for India to play a meaningful and prime role in global scene. Thus, nurturing and building the National GIS that benefits the nation and also builds the internal capability is utmost essential.
		What should be the access policy for National GI Content?	Keeping principles of NDSAP, RTI and also the vision of National GIS, any content of National GIS must be publicly accessible – though access terms could prevail. Further, content ingest to National GIS must get standardized so that any good quality GI content generated in country can benefit National GIS. National GI Policy must encourage these.

No	GI Capability	Critical Issues for India to consider for GI Policy	Inputs for determining GI Policy
		What should be the process for incorporating external content into National GI?	Any GI content (survey data, maps, images etc) that meet a quality standard and adhere/comply to National GIS Ingest guidelines must be able to incorporate into National GIS. Procedures for this must get positioned.
		What are key security issues related to National GI content?	As National GIS will be based on survey/images as raw inputs, these are also based on NSF. With no security critical data included, there are no direct security implications of the availability and access to this data. However, it is important for nation to know who is generating/using/value-adding to GI and in National GIS – thus, a process of registering/licensing and registration/license terms (do's and don't's) can be positioned (like it is being done in telecom services, ports, aviation etc). Violation of Registration and any licensing terms must be treated as per law. Such a method will segregate the "good and genuine" users involved in national development activities (be they from government/private/academia) FROM the "mis- and wrong-users". Appropriate verification mechanisms/audits should be positioned by National GIS for regular tracking and detecting wrong-use.
		What are key legal issues related to National GI content?	Legal aspects that need to be considered are Copyright, IPR, Liability, compliance to RTI and NDSAP. National GI Policy must address this.

No	GI Capability	Critical Issues for India to consider for GI Policy	Inputs for determining GI Policy
		What are key social issues related to National GI content?	From a social perspective, no group (be they geographic/ethnic/economic etc character) must be denied of the benefits and availability of National GIS – as then that group would be deprived of scientific and rational planning and development. With transparency in GI access, National GIS must have a true national character and must be for developing national capability. For addressing smaller groups needs and state subjects (like, say Land, Mines etc), National GIS must encourage states to have State-GIS of such state-specific elements but consistent to National GIS on technical aspects and data sharing terms/agreements. Any access to images, GI content and National GIS service must be governed by proper SLAs so that accountability and time-bound services are positioned.
6	GIS Capability	GIS software, large GI databases, wide range of GIS applications and DSS and GI services	Ideally, National GIS must be based on as much of indigenous efforts and capability – as the basic principle is for national capability from National GIS. However, there is tremendous gaps in indigenous capability in robust/reliable computing software like OS, GIS engine, DB engines etc) that can power the stringent needs of National GIS. Further, National GIS needs to be state-of-art and thus needs to be based on computer technology that is high-quality, operational with long-term commitment and cost-effective. Thus, merit and quality must drive National GIS development in all elements. However, National GI Policy must recognize the need for a great thrust to indigenization in all elements of National GIS and must position programmes and activities that make indigenous elements match to the merit/needs of National GIS over time. Thus, with a parallel concerted drive at indigenization (especially in computing technology matched dove-tailed with such efforts in other areas), National GIS must aim to have a long-term Policy/ Actions so that in next 10-20 years a full-scale indigenization of critical elements of National GIS is realized. Only this 2-pronged strategy will make National GIS state-of-art and develop the foundations for high-end indigenization.

No	GI Capability	Critical Issues for India to consider for GI Policy	Inputs for determining GI Policy
7	GI Policy Capability	What are the policies prevailing in India for GI related aspects?	India has been addressing policy issues related to maps and images. In fact, the policy issue of de-restricting and distribution of topographic maps have been on-going for a few decades. Sufficient debate and discussions have been had on digital topographic data and concerns of digitization of copyrighted topographic maps of SOI. Availability of digital satellite images has also placed sufficient impact on policy debate. Concerns of security still prevail in policy discussions - though one is unable to place the "right finger" on the security concerns - which mainly appears to be around "wrong use against national interests". However, of late considerable debate has happened and there is a more practical thinking in various circles to a more pragmatic policy-making. A National Map Policy (2005) defines the scope, distribution and liberalizing access of digital SOI topographic maps spatial data 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 2012) defines the distribution process of satellite images to different category of users. A National Data Sharing and Accessibility Policy-2012 (NDSAP-2012) provides an enabling provision and platform for providing proactive and open access to the data generated through public funds available with various departments / organizations of Government of India.

No	GI Capability	Critical Issues for India to consider for GI Policy	Inputs for determining GI Policy
		What are the pros and cons of National Map Policy (2005)?	The NMP-2005 intents to liberalize access to SOI topographic maps in digital content and is more a "work-practice policy" for SOI as far as its own topographic mapping holdings are concerned. The NMP thus makes out to be a mapping policy of "SOI maps" and there is no commitment/mandate for mapping programmes as per a policy direction. The general assessment is that the intent has not been completely translated into accessible actions for users. Specific questions exist on NMP-2005 - what scales of (erstwhile) SOI topographic maps are available as OSM for whole country in digital GIS ready format; has the "....detailed guidelines regarding all aspects of the OSMs like procedure for access by user agencies, further dissemination/sharing of OSMs amongst user agencies with or without value additions, ways and means of protecting business and commercial interests of SOI in the data and other incidental matters" been issued for OSMs as mentioned in NMP-2005; can there be a time-line guarantee for SOI clearing international boundary maps for publishing by users; there is no commitment in NMP-2005 of SOI (as national mapping agency) being constantly mandated to prepare larger-scale maps; NMP-2005 talks of "..Ministry of Defence has from time to time issued detailed guidelines on various aspects of map access and use. These instructions shall continue to hold good but for the modifications cited herein" - what are these time-to-time guidelines, should it not form a part of the NMP.

No	GI Capability	Critical Issues for India to consider for GI Policy	Inputs for determining GI Policy
		What are the pros and cons of RSDP-2012?	RSDP-2012 clearly states the process of access of Indiana and foreign satellite images from NRSC as single-window mechanism for distribution. All users are made available images upto 1m without any discrimination; Private sector access to images of 1m and better has regulatory aspects to be adhered to through a High Resolution Clearance Committee (HRC) and all 1m images and better are "screened". The flip side is that there are no service guarantee for image availability; HRC clearances time-line guarantee; scope for appeal for HRC decision. RSDP-2011 makes a national commitment to and as a "public good", Government assures a continuous and improved observing/ imaging capability from its own Indian Remote Sensing Satellites (IRS) programme. However, there is no forum for interaction/public discussion on this aspect. While concept of privately-owned (by licensing) RS satellites and licensed private acquisition/distribution of satellite data is intended, no further details on licensing terms/conditions are available. Efforts to promote this concept by which private sector participates happens is required.
		What are the pros and cons of CAR-2010 for Aerial photography, geophysical surveys?	In the Aerial Survey CAR-2010, a single window clearance system has been promulgated through DGCA for all aerial survey tasks. However, while these are operational guidelines for permission seeking, the Policy imperatives for aerial survey are lacking. Very few instances are there of aerial survey being carried out in India on annual basis.
		What are the pros and cons of NDSAP-2012?	NDSAP needs to be backed by operational and transparent procedures for its implementation. While NDSAP should not become a limiting principle, its success will be only when sharing principles are governed by "will to share" recognizing that information shared is information used that can fuel demand for more information.

No	GI Capability	Critical Issues for India to consider for GI Policy	Inputs for determining GI Policy
8	GI Knowledge Capability	End-to-end advanced GI knowledge capability in schools, universities and professional practice	GI education needs great thrust in India and the need to embed spatial-culture is required right from school level to make the GIS experts of tomorrow. A good university and research thrust is also required so that high-end professionals and research can be foundation of National GIS. At the same time, training of present needs is large and needs to be addressed immediately. A clear National GI Education Policy is also required that integrates and thrusts school-, university-, research and training needs in a comprehensive manner. The National GIS Vision addresses this comprehensively and must get implemented.

ANNEXURE-I

NATIONAL INSTITUTE OF ADVANCED STUDIES

RECORD OF NATIONAL GI POLICY ROUNDTABLE

1. National Institute of Advanced Studies (NIAS) has been awarded a policy research project by Department of Science and Technology (DST), Government of India (GOI) to define a National Geographic Information (GI) Policy. As part of this study, NIAS organised a Roundtable Meet to discuss and consult experts in the country on the policy definition for GI in the country. The meeting was organised at NIAS, Bangalore (in IISc Faculty Room) on July 22, 2012. The list of participants is given in **Annexure-1**.

2. The Agenda is given in **Annexure-2**.

3. Prof V S Ramamurthy welcomed all delegates and traced the extensive activities for stabilizing GI activitie4s in India. He recalled that it was in 2002 at Ooty that 6-8 Secretaries of GOI and ~200 delegates in the NSDI Workshop had chalked out a plan of action to progress NSDI and also position a pragmatic policy for GIS. He also mentioned that SOI has to work out a process for updating the maps of the country and also make them available in GIS formats – to spur the GIS activities. He mentioned that over the years, notable strides were made by several ministries and agencies such as DOS, DST, NIC, SOI, GSI, FSI, Ministry of Urban Development, Ministry of Power and even many state government agencies in this regard. Even looking from global perspectives, our programmes like NRIS, NRDMS, NNRMS, NSDI, NUIS, had many unique and visionary underpinnings. However, from a national perspective we have not utilized the fullest potentials of GIS technology yet. The most important reason for this is the absence of a pragmatic GI Policy. He mentioned that with importance of good Policy is getting realized now than never before and government is considering various policy initiatives to streamline governance and development. He observed that that policy making is a LARGER NATIONAL ISSUE and not just a government perspective. Policy studies and Analysis are becoming important and NIAS would like to help in this regard. So when DST needed an independent assessment of GI Policy, NIAS was ready to get this organised. He noted that the NIAS team has done an exhaustive study on policy and has documented the issues related to GI Policy. He mentioned that as an outcome of this study discussion, the GI Policy Framework document would be finalized by NIAS and submitted as a NIAS Report to DST. He hoped that then DST would be able to further take action for positioning the policy elements – thereby spurring GIS activities and also strengthening national requirements.

4. Dr T Ramasami, in his inaugural remarks, mentioned that that India is positioning a National GIS which is a realistic requirement going far beyond just maps and images – it is obvious that the national would benefit considerably by the establishment of National GIS. One of the critical elements for this is a National GI Policy that helps in 2 ways – mandates governance to use GIS in their day-to-day activities as DSS and the other is to create an environment that grows the use and business potentials of GIS. He also noted that the need for GI Policy is felt most by government agencies – who want to use GIS for their tasks and are finding difficulties. He also stressed that what the nation needed was updated GIS-Ready maps and also wide range of applications. The issue is also of debate on free- vs restricted access to maps and images. He also noted that SOI has not been able to adapt to changing needs and a gap has got created – with old maps, obsession to accuracy and also not making GIS in its core business. He also noted that SOI must aim to serve "People of India" (POI) and called for SOI for POI. He also stressed that GI Policy must address much more than maps – there are lots of other tabular data that also can be geo-enabled and used. The issue is also of sharing data that government agencies have – he noted that even now government agencies have "resistance" to share data – that too data that is generated by public funds. He said that very recently, the NDSAP has been adopted by government that clearly outlines and identifies the sharing policy of data with government. He urged that that the GI Policy must be user-centric, neutral to any technology and promote pro-active data ingest/access/sharing and most importantly promote wide applications. The nationalistic character of GI must also embedded in the Policy – like, being nation-wide data, serving/accessible GIS apps to citizens, encourage government agencies to embed GIS as DSS tools etc. He congratulated NIAS and the team of experts at NIAS for working on this project and preparing a draft GI Policy framework document by assessing the international trends, policy drivers and parameters and even suggesting a draft GI Policy framework. He urged all delegates in the Roundtable to discuss in detail and have "out of box" ideas and help in this major DST initiative to have a pragmatic GI Policy direction.

5. Dr Ramasami suggested the following issues to be covered in the GI Policy formulation by the NIAS study team in the report:

   5.1. GI data for the whole country must be created and constantly updated with a core of applications oriented Decision Support as the final goal.
   5.2. Data created by government must be shared and accessible without any availability-denial. Thus, the goal must be to open up the vast amount of GI data available with government.
   5.3. The nation must have a commitment from data generators/providers of their commitment to update, maintain and generate newer GI datasets as required/ mandated in a time-bound manner.

5.4. Social sensitivity in data generators must be prime – generate what users want must be the goal and not make available what generators can. The focus must be on what users or nation wants and meeting that need. The demand side must dictate policy and national needs.

5.5. Policy must address the key issue of security agencies – especially related to how to ensure that GI data is not "mis- or abused" against national interest. This must be assessed and must get addressed in the Policy.

5.6. He suggested that while the existing NSDI mechanism can address policy formulation, INGO and National GIS could have the executive responsibility for the overall National GIS and meeting national goals/needs.

6. Mr Sudhir Krishna mentioned that he appreciated the NIAS team for coming out with a very comprehensive GI Policy document which by and large addresses all key issues that his ministry would relate and identify. He mentioned that MUD is implementing the NUIS programme and one of the key elements is mapping and creating GIS for cities and enabling local urban agencies to use the NUIS data for preparing Master Plans and City development plans. With spatial planning as the fundamental need, the need for GIS for each city is never felt before. He mentioned that furthering GIS towards a National GIS – which his ministry supports would require leadership and vision and a pragmatic Policy foundation that will enable the right GI data to be generated and made available at right places in government and citizens for supporting development and governance. He also mentioned that there is a gap in GI knowledge and capability – whereby projects get defined, implemented with technical finesse but most times get embroiled in awareness (and mystification) issues, technical gaps, capability gaps, non-standardization issues, commitment and drive for success. He urged that GIS requires good technical leadership and these aspects must be included in the Policy definition. In specific he mentioned that satellite images are masked – these make images less useful for urban development as there cannot be "holes" or masks in urban plans. He urged the NIAS team to further include some of these aspects in the Policy document – and urged DST to take up the NIAS report for an inter-ministerial discussion and create traction at ministerial and wider level.

7. The Messages of Dr K Kasturirangan, Member (Science), Planning Commission and Dr Shailesh Nayak, Secretary, MoES was received and read out to participants.

7.1. Dr Kasturirangan conveyed that Government recognizes that GIS is an important tool for meeting the key issues that nation is addressing of good governance – planning scientifically, implementing and monitoring the plans effectively and also assessing the benefits outreach in the most effective and equitable manner. He noted that now, the concept of a National GIS has emerged where a "single-

window" approach for GIS Decision Support for governance is being considered. Noting that even as all these emerge and fructify, the concerns of protecting national interests is paramount and we must make all efforts to have some sort of a regulated approach, in present times.

7.2. Dr Nayak conveyed that the government is taking up the implementation of a National GIS as a major 12th Plan initiative. He noted that Policy is an important aspect envisioned in National GIS and called for a National GI Policy – which is all encompassing and oriented towards National GIS but also back it up with appropriate down-stream procedures/practices and sound technical standards/ protocols.

8. Dr Mukund Rao welcomed all the delegates and made a presentation on what the NIAS team had studied as far as the GI Policy is concerned. He mentioned that Policy development is a cycle of six steps - Issue identification, Policy analysis, Consultation, Policy instrument development – these were being taken up by NIAS team for GI Policy and the outcome would be the NIAS report submitted to DST. In addition, the further 3 steps of COORDINATION & DECISION, IMPLEMENTATION and EVALUATION/REVIEW of a Policy would have to be taken up by DST towards formalizing the Policy and its implementation and subsequent review. He mentioned that the GI Policy scenario in India has made progress over past years but "appears" fragmented (different policies for different elements of GI) and needs an over-arching integrated approach. He also noted that open and transparent public debate and consultations have not founded policy-making in GIS domain in India and have been steered by respective government agencies – this needs to change and the DST sponsored project is the first of a kind of public debate and consultation which must be commended. He also mentioned that Policies are not static and must be constantly reviewed keeping user/market needs, technology trends and also national perspectives in mind. In India policy review seems to happen in a decade cycle (RSDP 2001 and RSDP 2012) and this time-frame hardly matches the rapid changes in technology and also aspirations of users/market in India. Thus, he noted that making a GI Policy is a challenge – this is what has been addressed by NIAS team. He mentioned that NIAS team has done an exhaustive assessment of the international scenario of GI Policy in other countries and has documented the salient features of policies in USA, China, UK and other nations; has assessed and determined the key factors that India must keep in mind while formulating a GI Policy and has analysed these parameters; and, finally has suggested a GI Policy framework to be considered with a draft Policy text. All these have been organised as a NIAS draft report which has been circulated to all delegates (***Ref: PERSPECTIVES FOR A NATIONAL GI POLICY – Draft discussion document Ver 1.0; NIAS Draft Report of June, 2012)***

NIAS team expects inputs on the draft report and any other suggestions as part of the Roundtable discussion. Based on the discussions and further analysis, NIAS would finalise the report for submission to DST and also make it available in the public domain. Towards this, he mentioned that expectations of NIAS and DST from each delegate are very high – with key inputs and suggestions that will help the nation to determine the best GI Policy characteristics.

9. The following presentation were made at the Roundtable:

9.1. Dr Sivakumar outlined the historical perspective of policy related to maps in India and noted that it was in 1967 that the first de-restrictions of topographic maps started. He then outlined the current status of policy activities and summarized the key elements of the National Map Policy, Remote Sensing Data Policy and NDSAP. He mentioned that the National GI Policy must not only cover maps but also aerial photos, satellite images, data from trigonometric, gravity and magnetic surveys; should enshrine a mechanism for quality assured GI products, GI Apps services and solutions both from industry and government and should ensure use of geospatial data in all activities of governance, management and development. In specific, he suggested that the National GI Policy must:

- Harmonise existing Policies on maps, images and address a holistic GI Policy
- Develop and promote a national GI standard by building upon existing NSDI standards and also referring to best standards practices globally
- Mandate use of a geospatial data and technologies for various acts, policies, programmes such as RTE, MNREGA, NRHM, National Mineral Policy, Disaster Management etc
- Address cross-domain issues of how Civil, Defense, Intelligence and Law Enforcement geospatial programs and activities should be coordinated, standardized, aligned and GI sharing
- Address how GI leadership is strategically and nationally important
- include setting an R&D agenda for GI; promoting geospatial technology leadership and wide scope for training of professionals.

9.2. Dr J Krishnamurthy mentioned about RSDP-2011 (for which DOS is the nodal agency) and outlined the regulations for acquisition, dissemination of satellite images through NRSC. He mentioned that ISRO/DOS had positioned a RSDP-2001 by which satellite images were acquired and distributed and the RSDP-2011 now allowed 1m images to be dissemination to users. He specifically mentioned about the High Resolution Image Clearance Committee and how it functioned to address the need of various users for 1m images. He also outlined about ISRO EO

missions, the initiatives of Bhuvan and NRSCs Open EO data archive.

9.3. Maj Gen RC Padhi made a presentation on National Map Policy-2005 and outlined its tenets by which digital map data of SOI are distributed and made available. He mentioned that SOI is making available topographic maps as per this Policy and that plans are also on way for generating 1:10k large sale maps for the country. He outlined the operating procedures adopted by SOI for implementing the policy which pertain to screening for border areas, user's use-case etc and also noted that the restriction zone has been revised to just 50kms on international border/J&K and NE areas.

9.4. Dr Mukund Rao (referring to ***PERSPECTIVES FOR A NATIONAL GI POLICY – Draft discussion document Ver 1.0; NIAS Draft Report of June, 2012)*** outlined a detailed assessment of international scene of GI Policies across the world – especially of USA, China, Europe, Brazil and Japan. GIS Policy parameters of Image/Maps/GI Access; Rights to information/Public sector data ; Rights to privacy; IPR; Liability; Serving Public interests; Security; Pricing etc for these countries have been compared and documented. In specific, he further outlined comparison of in-depth parameters of USA and China – mainly on SATELLITE IMAGES (LICENSED/REGULATED), MAPS/GI READY DATA (REGULATED), AERIAL SURVEY (LICENSED/REGULATED), GROUND SURVEY (REGISTERED), NATION-WIDE GI CONTENT (PRIVATE/GOVERNEMENT), GIS CAPABILITY and POLICIES. He mentioned that while USA has a progressive policy environment that is founded on promoting free-access (making images upto 0.5m resolution available; maps in public domain, GIS activities widely practiced etc), it is China that has set into position a set of policy initiatives that have spurred great growth of indigenous Chinese GI programmes and activities. He mentioned that many Chinese policy documents are available that seem to be based on a regulated/ controlled but growth-oriented drive for GI. He also brought out what large corporate of the world – Google, Microsoft, ESRI and other are doing – especially related to, generating Global Content, Service Orientation/Market drive to GI, Global Access of Data Service, Applications Service, High Investments, IPR, Liability and Market Pricing – thereby re-defining the world of GI into a purely commercial free-market model. In summarized the following for policy regimes globally:

- GI policies are moving beyond SDI's
- "Public good" value of GI is highly recognized by governments
- "Market good" value being increasingly recognised by large-enterprises
- Availability/Access issues are still being "grappled" with

- "Security value" of GIS is recognised – both as intelligence and "potential wrong-use"
- Trend to harmonious societal- and market- goals – "Co-existence"
- Rights to Privacy is increasingly relevant issue
- Overarching GI Policy framework recognised

Dr Rao also outlined in detail the Indian scene of five different GI Policies and compared/analysed the National Map Policy, 2005 – which mainly encompassed SOIs topographic maps distribution in digital formats but yet to be fully implemented/practiced; Remote Sensing Data Policy, 2001/2011 – pertaining to satellite image distribution and still "denying" 1m images to many non-government users; Aerial Survey Civil Aviation Regulation, 2010 – procedures for single-window aerial survey procedures but still not spurring aerial surveys; Delhi Geo-Spatial Act, 2010 – sharing and use of Delhi's GIS data by Delhi government agencies; National Data Sharing and Access Policy, 2012 – a general data sharing policy for data generated by public funds but no specific GI provisions and National GIS Vision, 2012 – towards establishing National GIS. In comparing Indian GI Policy scene, he summarized the following:

- Considering Policy in a fast changing environment, need to build in and evolve a long-term commitment to GI Policy
- Need for growth impetus for GI as a Policy Goal
- Need for "mandated" use of GI in governance at national/state/local levels
- Cover cross-cutting issues of Policy in a holistic manner with clear definition of Do's and Don't's
- Define clear and transparent practice for the Policy to make it a strong implementation mechanism
- Build the goal of National GIS into a "holistic" policy to promote use and benefit of GI and also grow the technology/industry

9.5. Dr NL Sarda mentioned that universities face unique challenge in GI academics – lack of varied data for education/projects. Getting GIS is most times impossible and when data is even purchased turns out to be quite inaccurate and un-authoritative. Thus, universities are forced to depend almost totally for foreign agencies for Indian data. To this end, the concept of National GIS Asset – a single-source of authoritative and GIS-Ready data is most essential. He suggested that a Right to GI must be embedded into RTI – thus making the GI to be generated and available as mandatory by law.

9.6. Dr Vandana Sharma made a presentation of how NIC has addressed National

GIS and focused on the need for tearing down existing departmental-silos – must have willingness to share information and services across organization; balancing need for thoughtful design and sustainable system with desire to show results quickly; need for standards; restrictive Map Policy; heterogeneous formats, Scales, Projections, Accuracies etc.; data from two sectors cannot be overlaid accurately; ownership Issues and non-existent of data sharing models. Dr Sharma called for a national GI repository and building various Map services to serve as Apps domain. She outlined the G2G NICs GI Portal and its data services and Application services for some user agencies. She also analysed the free global map services of Google, Bing, Esri and questioned that whether these global services really available free of cost; whether the terms of reference of these global services are understood properly by users; what if services are withdrawn and also what security aspects related to such services are. In summary, she mentioned the following:

- A strong National GI policy is required which should promote the dissemination of geo-spatial data without compromising National security and interests.
- GIS consortium which shall help in proper data sharing within the Govt. Departments
- Common ICT infrastructure shall promote and proliferate the use of GIS by the various GOI users, which may be extended to States.

9.7. Maj Gen Chinnawar spoke on National GI Policy and security issues. He mentioned that from a security agency perspective, the key concern/worry is that the GI data includes Vas/VPs; images and maps show latest development features; magnetic data reveals important mineral resources; gravity data has sensitivity from use for missiles; Lidar data provides accurate heights and thematic maps reveal strategic planning aspects. He talked of the 2-series topographic maps in National Map Policy and the characteristics of the restricted zone which includes a 50 km zone, the NE region, the J&K region – where digital topographic maps are restricted and not publicly available. He also outlined the aerial survey clearance process and outlined the security involvement in pre- and post- aerial survey activities for image scrutiny and clearance through an inter-departmental committee. He also commented on RSDP and mentioned that images of 1m are to be cleared through a High Resolution Committee for non-government users and outlined the process adopted of image scrutiny, user agency scrutiny and the clearance process adopted. He also outlined some of the forth-coming policy initiatives in government – especially, Vetting of Image and Geospatial Information for National Security Bill, 2012 (VIGIL); establishment of apex committee under Chair of Cabinet Secretary; vetting images for national security and need for licensing mechanism. In recommendation to National GI Policy, he suggested:

- National GI Policy to take into consideration of existing map/image/ aerial data policies
- A committee to decide security aspect in defining scope of projects involving map/data usage; decision at an appropriate level be taken to allow exploration survey by alternately providing security arrangements when required and a MOD Member, as an advisory, be involved in DST project at NIAS in formulating the policy

9.8. Dr PK Srivastava made a presentation on the Delhi Geospatial act and mentioned that the Act mandates every agency providing public services should use, contribute and share the Geo-Spatial data infrastructure to enhance the quality of their services in a cost effective manner. The Act involves the GSDL – a jv created by Delhi State government, Delhi State agencies (Municipal Infrastructure, Planning, Education, Social Welfare, Health Care Services) and citizens and commits to generate/use/share/update GI data and services. He mentioned how the access to GI data is provided, a revenue model is being attempted, how updation of data over time is envisaged, access by private agencies/contractors through SLA terms, how departments update and own their process-data and how value-addition is envisaged.

9.9. Dr Mukund Rao (referring to ***PERSPECTIVES FOR A NATIONAL GI POLICY – Draft discussion document Ver 1.0; NIAS Draft Report of June, 2012)*** then presented how the NIAS tem had studied on Critical issues for National GI Policy and building a National GI Policy. He outlined the policy scenario in India in 1990s and now in 2010s – especially addressing key issue related to GIS in Image Access; Image coverage; Image resolutions; GIS Technology maturity; Positioning; Mapping; GIS databases organisation; GI dissemination status; ease of access; cost issues; HR in GI; threat perception from national security point of view; user-base and how the Policy matured over past 20 odd years. He clearly brought out that in past 20 years, while Policy provisioning has made progress the gap of user demand to policy serviceability has remained wide and a "denial" regime still persists, though quite less. He also compared the Policy development in GI and Telecom in the same 20 odd years period in India (by analyzing/comparing the respective environments, licensed operators, maturity/advancement in technology/equipment, established/practiced operational procedures, user base, verification and compliance processes, operator and user liabilities, government control and regulation, ease of user access to services, level of value-addition being provided, financial returns to government and the ability/check mechanisms to detect misuse or abuse). He clearly brought out that telecom as an industry has matured quite well and telecom services are nationally and commercially well-

entrenched. But the same is not seen in GI – which is still lacking the thrust and growth that it has potential for. THE KEY ISSUE FOR THIS IS DUE TO FOCUS OF GI NOT BEING ON USER BUT ON PROVIDER – this needs to change and focus of GI Policy must be towards the user and enabling provisions for making this happen (just like in telecom).

Dr Rao mentioned that NIAS team had identified 7 major parameters that are critical in defining GI Policy - Imaging Capability – providing for nation to be assured of long-term, continuous imaging satellites; encouraging auctioned/ licensed private sector owned imaging satellites and image data acquisition/ dissemination; Precise Positioning Capability – indigenous, seamless, satellite-ground positioning capability and service and encouraging an Indian positioning equipment base; Advanced Surveying Capability – a liberalized aerial survey policy for large-volumes of aerial data acquisition; encourage private sector investment and operations; Mapping capability – long-term, continuous and updated topographic mapping availability and encourage private sector thematic and topographic mapping; National (Large area) GI content – establish National GIS as a GI data (images/maps/aerial data) and GIS application service; GIS Capability – reliability based technical competence GIS, indigenized GIS software and applications software and GIS applications in public domain; GI Policy Capability - a constant "holistic: development and updation of GI Policy that positions excellence in GI in India and also makes India a leader globally in GI and GI Knowledge Capability – a large-sale effort at multi-tiered GI knowledge force development. Dr Rao also identified key cross-cutting issues – national security –registration/licensing and security audits for GI activity and thus has knowledge of who is legitimately using and isolate misuse or abuse of GI data.

Dr Rao mentioned that NIAS team had analysed all these issues and had drafted a text of a National GI Policy and this was presented. The main goal is to establish National GIS that will enable national benefit from GI and enhance national GI capability to be in fore-front of global leadership.

9.10. Ms Ranjana Kaul gave a detailed perspective of the legal founding required for National GIS and INGO. She mentioned that the main aim of INGO should be acquiring/generating, processing/organising, distributing/sharing, using/ promoting use, maintaining/updating and preserving/archiving GI data and urged that towards this the constitutional Charter of INGO must contain legal provisions that enables it to perform its role – this, she mentioned is crucial and important. She mentioned that some of the challenges that GI would face (like any other information) is its coverage under Copyright at, Liability and use of GHI in justice

delivery systems. She outlined the Indian Copyright Act and how government had modified the Act for coverage of web-related information. She urged that National GI Policy should contain liberal copyright policy provisions to provide information in the public domain freely to citizens, and with clear indication of material that is protected and thus constitutional charter of INGO must contain user friendly 'right to access' provisions, in respect to public information. She commented on Right to Access and how existing RSDP fails on this issue by a denial mode for 1m images to its own non-government (and citizens) and also fails to cover access from outside India. She mentioned that Access must not be denied in any manner – especially in light of RTI – which would be applicable to GI. She also commented on Official Secrets At which is colonial and how RTI would prevail over OSA in case of conflict between RTI and OSA (referring to 2002 Ífftekar Gilani case) and cautioned that technological safeguards has to be built into National GIS for unauthorized access and subsequent action of being able to detect any such access. She mentioned that National GIS would be "liable" for services provided and thus must address accuracy and reliability of data that can be proven and established by law – such provisions must be built in. She also foresaw that GI would be used as evidence and this must be catered to – and even urged that INGO should consider preparing a register of expert witnesses, suitably qualified and trained to assist the court, when required. In summary, she mentioned that a long-term vision and leadership would be required in space imaging, mapping, GIS usage, legal provisions et for National GIS to be successful and urged that legal community be involved in discussions and sharing of knowledge.

9.11. Dr TP Singh presented on Gujarat's GIS and how it has been built/developed as a seamless state-wide GIS. He also outlined how GI impacts society in a positive way and showed specific examples of GIS based DSS for MNREGS, forests right act implementation, sustainable agriculture production, disaster management, irrigation management, village-level amenities planning etc that has been developed and used in Gujarat. Discussions were held on GIS based DSS and it was emphasized that focus of National GIS must be to meet the GIS applications need of users – stressing the aspects of affordability, acceptability and adoptability of GI.

9.12. Dr Vinod Bothale made a presentation on User application needs and GI requirements - Inputs for National GI Policy. He highlighted how states look at GI and mentioned that states requirements of GI need to address ground implementation level; GI usage is closely connected to implementation and that larger scale and higher accuracy requirements are essential and also that higher levels of accountability are essential for GI availability. Some of the

state sectors that are important are Rural Development, Urban Development, Infrastructure development, Facilities development and Utilities development. He stressed that GI data not accessible as good as not generated. He briefly touched on NMP, RSDP and NDSAP and mentioned that policy making is a long-drawn process and will take time but the immediate need is - CLEAR Do's and Don'ts relating to Policies. He also felt that Policy FAQs to be made considering the existing policies, rules, guidelines, directions etc that will guide users for not committing mistakes rather than action on after mistakes are made and stressed that this principle must drive the new National GI Policy. He called for use of GI for bringing Transparency, Accountability and effective utilization of resources without hampering the national interests – as the major goal of National GI Policy. He mentioned that emphasis of GI Policy must be on content generation/ updation and data sharing as most of the state departments know about GIS and would readily use if easily available and usable – thus GI data sharing among the agencies must be a 'Minimum Needs'.

9.13. Dr Ashok Sonkusare mentioned that India very much needs National GIS and an overall endorsement and acceptance for National GIS has been achieved. He stressed that the development of National GIS is very much dependant on National GI Policy and felt that efforts must be towards integrating existing policy under one National GI Policy framework which would enable National GIS to become a reality, as outlined in the Vision of National GIS. He also stressed that standards must be embedded into the Policy framework so that all GI in the country is shareable and usable and inter-operable. He also felt that a good legal foundation will be required for National GIS as RTI and other instruments will demand openness and transparency.

9.14. Dr Dipak Sarkar talked on dissemination of soil information and the policy imperative for this important GI. He mentioned that state wise soil information (1:250,000 scale); degraded and wastelands database (1:250,000 scale); district level soil information for 45 districts et are all available. He mentioned some of the nitty-gritty issues of making the soil GI available – especially related to need for re-classification of soils data to meet NDSAP requirements; soil content standards are yet to be developed; technical framework for seaming soil data to state and national level soil GIS database; copyright and IPR provisions that organizations need to develop and implement and need for financial support to organizations to comply to Policy needs.

9.15. Mr Sushil Kumar outlined the Panchayati Raj (PR) institutions grappling with GIS and highlighted how GIS DSS is one element of larger Panchayat Enterprise Suite

(PRS) DSS as a symbol of modernity, efficiency, accountability & induce mass ICT culture. He clearly brought out the GI content that PR agencies would require – going on to clearly identify the need for geo-tagging large volumes of PR assets data. He identified the following challenges for the National GI Policy:

- Methodology to be adopted for preparing National level GIS backbone of Panchayats
- Level of mapping to start with.
- Responsibility of preparing GIS database and their Ownership. Central/state? (Panchayat being a state subject)
- Ministry of Panchayati Raj to team up with different line Departments, Ministries and Organizations/Institutions to come to a conclusion on how to approach a mapping activity on a village and panchayat level.

9.16. Dr Prithviraj talked on need for thrusting R & D and Capacity Building in Geo-Information Science & Technology as part of the National GI Policy. He specifically highlighted how under NRDMS Programme, KSCST has focused on some grass-root and fundamental research in GIS – especially on application aspects.

9.17. Mr Rajesh Mathur made a presentation of Industry Viewpoint on National GI Policy as a collective view of Indian GI industries under auspices of AGI and FICCI. He mentioned that industries envisage geospatial technology to become an integral part of government, public and private enterprises to develop the economy and drive efficiency thereby improving the quality of the lives of billion plus citizens of India. He mentioned that the 2 key enablers need to be - Policy framework and National level programmes which can promote inclusive growth, transparency, responsive governance and awareness. He mentioned that GI industry see 2 challenges - Data Availability (issues of data creation, data access, IPR, licensing, data sharing and collaboration, supply-chain, data standards and certification) and Geospatial Ecosystem (as niche technology, usage is sporadic and fragmented, aappropriate scoping in National Programmes, adoption of new geospatial technologies, bbusiness model for dissemination of data and services and trained manpower). He suggested 4 elements for focus for the National GI Policy:

- Content – requiring clarity on geospatial data creation policy, engage industry to invest in data creation, contour data allowed to be used by industry for Infrastructure/Utilities, need for supply side to be streamlined and importance of standards

- Deployment – needing GIS to be a part of the work flow and mandating use of geospatial technology in major national programmes and consultation with AGI and FICCI on such scope. This also requires strengthening GI Project Management and the urgent need for National and State GIS. Industry calls for building PPP as delivery model for citizen centric GI services. Appointment of CGO in government ministries, departments and PSUs would also help.
- Regulatory – having a single agency to regulate geospatial content creation and dissemination with mmechanisms for mandatory sharing of GI by NMOs. Accepting geospatial content as legal entity for documentation is required and industry calls for customs regulations on GPS and giving geospatial industry 'Infrastructure' status.
- Capacity Building - strengthen the existing institutions through Infrastructure development and curriculum development that is Industry Oriented and to make geospatial tools a part of training as a know how for all the government officials.

9.18. Ms Bhanu Rekha talked on a 2-speed world and highlighted the 2-speed characteristic of an emerging market and developed markets. She brought out the differences in land cadastres and land administration in 2-speed world and specifically mentioned that in NRLMP policy on GPS data not clear; there are gaps in aerial survey policy; 0.5 m resolution RS data used makes the cadastral dataset restricted; while use of cadastral data in G-G is okay but for industry, NGO and individual users it is not clear. She suggested some of these aspects to be covered in National GI Policy.

9.19. Mr Bal Krishna gave a satirical perspective of how GIS has not-evolved in India in past 10 years. He mentioned that policies are construed as a "paper-instrument" and hardly implemented. On the other hand GI technology has advanced so much. He stressed the need for an "out-of-box" passionate approach and a dynamic leadership in making National GIS and National GI Policy successful. He called for a GI Policy with direct linkages to economic development and making it mandatory fund allocation on spatial component in infrastructure project.

9.20. Mr Vishal Bargat called for National GIS to be implemented and stressed the need for content availability, standards and common frameworks at national level and also need for mandating local bodies for using GI.

10. During the presentations and in the discussions, the following important points were highlighted and discussed for the National GI Policy:

10.1. A holistic National GI Policy that will establish National GIS, promote/mandate use of GIS in governance/citizens and also maintain leadership of India in GI technology is essential.

10.2. Considering Policy in a fast changing environment, need to build in and evolve a long-term commitment to GI Policy

10.3. Government must provide leadership and facilitate a GI Policy that mandates National GIS data service and number of GIS apps DSS deployment to be positioned and maintained by government and accessible to any Indian group/citizens.

10.4. There should be no shying away from regulations and adhering to procedures in GI – all users/generators/providers must subject themselves to an open and transparent regulation process – including registration/audits/scrutiny etc in the national interest.

10.5. Learning from NMP experience, the GI Policy must bring clear Do's and Don't's and also simplified operational procedures foe policy implementation.

10.6. There should not be denial to any Indian of publicly generated GI – rather the foundation must be on open-access (RSDP was discussed in detail in this regard).

10.7. GI Policy making/revising must be an open and transparent and inclusive process involving government users, industries, academia and experts in the country.

10.8. It would be better to have arms-distance between policy-maker and policy implementer and not to co-locate them – with a view to position the best interest of GI. To this end, the suggestion of Secretary, DST to have existing NSDI Secretariat to make policies and INGO/National-GIS as implementer was discussed and broadly endorsed.

10.9. GI Policy must be driven towards users – with generators/providers meeting the needs. The focus must be on what users or nation wants and meeting that need. The demand side must dictate policy and national needs.

10.10. Central and state government agencies must be mandated to use and embed GI in their work process and decision-cycle and towards this National-GIS must provide all technical and managerial support.

10.11. Aerial data (images, Lidar etc) have immense potential and GI Policy must make the wide use of this technology possible in urban areas, land records, disaster management etc. India must make concerted efforts to make aerial data widely collected and utilized – and promote private sector investment and participation in this.

10.12. Indian satellite imaging availability (at <1m pan and xs; highly temporal XS) must be assured/continuous and the characters of this must be in drawn up in consultation to users. Else foreign imaging capability will dictate and cater to national GI demand.

10.13. Immediately position an open and inter-operable National GIS Standard (as per

National GIS Vision) and ensure that all national GI is on this standard.

10.14. Allow and encourage private sector GIS generation and ingest to National GIS and private sector GIS Apps publishing on National GIS.

10.15. GI Policy must stress on the aspects of affordability, acceptability and adoptability of GI

10.16. Carefully consider provisions of Copyright Act, Liability and use of GI in justice delivery systems, RTI etc in framing GI Policy.

10.17. GI Policy should aim to strengthen the existing educational/university institutions and to make geospatial tools a part of training as a know how for all government officials.

11. In the concluding session:

11.1. Dr Mukund Rao mentioned that the NIAS team will consider all the inputs and discussions. He requested delegates to send any further inputs or even comments on the draft NIAS report in next 2 weeks. After considering all inputs, the NIAS team will finalise the GI Policy Report and take it up for submission to DST and make the report available on public domain. Dr Rao thanked all delegates for the 2-day intense involvement and helping the NIAS team with valuable inputs. He also thanked DST for sponsoring such a unique policy research project and assured that NIAS would submit a quality report that would be of great relevance to National GIS activities.

11.2. Dr Sivakumar thanked the NIAS team and all delegates for the very intense discussions and suggested that NIAS team must submit the report quickly to DST. He also suggested that NIAS could take on a subsequent task for a Ministerial-level Working Meeting on GI Policy by taking the NIAS report for discussions – first, at a wider-circle of Secretary-level meeting and then presentation/consultation to a group of Ministers – Home, Defence, S&T, Planning Commission Dy Chairman, IT and others. This exercise is crucial for wider consultation in government and to start the process of adopting and implementing the Policy.

12. This record issues with approval of Director, NIAS.

(Mukund Rao)
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&
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June 28/August 17, 2012

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39. Prof R Sivakumar, Professor, SRM University (sivakumar.r@ktr.srmuniv.ac.in)
40. Mr MS Mohan Kumar, Scientist, KSCST (office@kscst.iisc.ernet.in)
41. Mr Sanjeev Trehan, Manager, Trimble India (sanjeev_trehan@trimble.com)
42. Mr Vadivelan, Consultant, KSRSAC (vadivels46@gmail.com)

AGENDA FOR ROUNDTABLE MEETING

DATE: June 19/20, 2012

Venue: IISc Faculty Hall, IISc Campus, Bangalore

DAY-1: June 19, 2012

0900 – 0930 **Registration (Tea and Coffee)**

0930 -1100 hrs **Inaugural Session**

- Welcome – Dr V S Ramamurthy, Director, NIAS
- Inaugural Address - Dr T Ramasami, Secretary, DST
- Keynote-talk: Mr Sudhir Krishna, Secretary, Ministry of Urban Development
- Message from Dr K Kasturirangan
- Message from Dr Shailesh Nayak
- Expectations Setting and Scope definition – Dr Mukund Rao, Principal Investigator, NIAS Team

1130 – onwards **Session – 1: Present Scenario of National GI Policy**

Co-Chair: Mr Sudhir Krishna, Secretary, Ministry of Urban Development
Co-Chair: Dr NL Sarda, Professor,IIT-B

- Profile of GI Policy Initiatives in GOI (Dr R Sivakumar) – 15 mts
- EO and Image Distribution Policies (ISRO/NRSC) – 15 mts
- National Map Policy – Present and Future perspectives (Maj Gen RC Padhi, Dy SG, SOI) – 15 mts
- International Scenario of GI Policy and Analysis of Indian GI Policy Eco-system – Findings from NIAS Study (Dr Mukund Rao, PI NIAS GI Policy Project) – 30 mts
- Discussions – 30 mts

Session – 2: Perspectives of a National GI Policy

Co-Chair: Mr Sushil Kumar, JS (EPRI), MOPR
Co-Chair: Dr M P Narayanan, Geospatial Media and Communications

- GIS data and app services – Policy perspective and NIC experience (Dr Vandana Sharma, DDG, NIC) – 15 mts
- Critical Security safeguards required for GI Policy (Maj Gen SV Chinnawar, DDG, MOGSGS, MoD) – 15 mts
- Delhi Policy for Geospatial Data (Dr P K Srivastava, MD-GSDL) – 15 mts
- Critical Issues for a National GI Policy and Building a National GI Policy – Steps and directions (Dr Mukund Rao, PI NIAS GI Policy Project) – 30 mts
- Discussions – 15 mts

DAY-2: June 20, 2012

0930 hrs onwards

Session – 3: Perspectives of a National GI Policy (Continued) - Including Social and Legal issues

Co-Chair: Dr Deepak Sarkar, Director, NBSSLUP
Co-Chair: Maj Gen Chinnawar, DDG, MOGSGS

- Legal Perspectives of GI (Ms Ranjana Kaul, Dua Associates) – 15 mts
- Social Benefits of GI and Policy Expectations (Dr TP Singh, Director, BISAG) – 15 mts
- How Maharashtra is addressing dissemination of GI (Dr Vinod Bothale, MRSAC) – 15 mts
- Key interventions/statements by some user agencies of centre, state and National GIS – 30 mts
  - Planning Commission
  - ICAR
  - MOPR
  - KSCST
  - IIT-B
  - . ….Others
- Discussions – 15 mts

Session – 5: Industry Perspectives for a GI Policy

Co-Chair: Dr Vandana Sharma, DDG, NIC
Co-Chair: Mr PG Diwakar, Director, EOS

- Perspectives of GI Policy of AIG and FICCI GIS-Task Force (Mr Rajesh Mathur) – 20 mts
- India in a two-speed world: A media perspective of GI Policy (Ms Bhanu Rekha, Geospatial Media and Communications) – 10 mts
- Coordinates (Bal Krishna, Editor) – 10 mts
- Intergraph Perspective for National GI Policy (Kaushik Chakraborty, MD, Intergraph India) – 10 mts
- Rolta Perspectives of GI Policy (CD Murthy, Rolta) – 10 mts
- Cybertech experience in GI project – Policy issues (Vish Tadimety, Cybertech) – 10 mts
- India-wide Maps – what MapMyIndia did (Rakesh Verma, MapMyIndia) – 10 mts
- …..Others
- Discussions – 15 mts

1400 – 1430 hrs **CLOSING SESSION and WRAP-UP**

Co-Chair: Dr R Sivakumar, COE, NSDI
Co-Chair: Dr Mukund Rao, NIAS

ANNEXURE-II: DRAFT NATIONAL GI POLICY

PREAMBLE

Recognising that in the newer paradigm of Governance which aims at transparency and inclusivity, the nation needs to adopt spatial planning, area-based development assessment, spatial assessment of disparity and gaps, goal-based performance monitoring – all of which will bring focus on scientific and rational developments in various sectors, viz. agriculture, infrastructure, rural development, urban areas, health, education, industries development etc;

Recognising that Geographic Information (GI) is critical for furthering inclusive and transparent governance activities and also to bring greater technological benefit to the nation;

Taking into consideration that over the years, India has developed successful GIS-based activities in Imaging (from satellites, aerial platforms), Mapping (topographic and thematic), surveying, positioning and GIS (databases and applications) – both in government and private sector and also that policies for Open Series topographic Maps; Remote Sensing Data; Aerial Survey flight permission guidelines and Data Sharing have been serving the national needs;

Noting that a National GIS is to be established as a "new GIS regime" supporting good governance, sustainable and inclusive development and citizen empowerment through an operational GIS-based Decision Support service for governance, private enterprise and citizens for the nation.

The Government of India adopts the National GI Policy (NGIP) - *201x* detailing goals, actions and broad procedures for GI related activities to be conducted and organised in the nation

Indian National GIS Organisation (INGO), Ministry of …….. the Government of India shall be the nodal agency for coordinating and implementing all actions under this policy, unless otherwise stated.

A. GOALS AND BENEFITS

1. The goal of the National GI Policy is to enable the establishment of National GIS and its operationalisation so that:

    1.1. benefits of GI is available as a g-Governance service in the form of customised GIS-DSS applications meeting the needs of governance, citizens and enterprises

1.2. real-time availability of seamless and updated GIS Asset for the nation is assured.

1.3. leadership in GI technology and applications is maintained to bring knowledge and competitive edge in the national and international arena

B. DEFINITIONS

2. "GI" means Geographic Information that refers to any information that has a geographical or locational context. The GI includes satellite images, aerial images, maps, survey data, Positioning data, geo-tagged attributes/tables etc and also the derivatives from their processing – all of which are amenable to visual display as maps/images in the spatial domain.

3. "GIS" is the system related to Geographical Information (and known as Geographical Information System) and meaning "system of infrastructure, data/information, software/ processing, services, human resources, policies etc" that generates, archives, processes and serves GI to users.

4. "National GIS" is the system being developed/positioned to provide GIS Decision Support services for governance, private enterprise and citizens by maintaining a nation-wide, standardized, seamless and most current GIS Asset for the nation.

5. "Mapping" means the process of information generation in map format and derived from survey data (on ground or aerial and other platforms), from satellite images, from computer-rendition of data etc

6. "g-Governance" means governance and decision-making that is founded on use of GI (meaning satellite images, aerial data, maps, GIS DSS applications etc) and which will provide a scientific and rational basis to making decisions

7. "Images" means pictures that are obtained from imaging satellites (like Indian Remote Sensing satellite etc), aerial platforms or on ground using an imaging camera/sensor.

8. "Surveying" means the process of colleting basic "raw" data in a systematic manner either on the ground or aerial (and other) platforms and using specific instruments (like Total Station, GPS devices, Ground Penetrating Radars (GPR), Lidars, Imaging Camera etc) or by enumeration/inventory/tabulation of different parameters (like population, consumers, market etc)

9. "Topographic Maps: means the nation-wide topographic maps that are generated by Survey of India and which authoritatively depict the national/state/district and other

boundaries, elevation, cultural and physical features at an appropriate scale (as of now 1:50k)

10. "Thematic Maps" means the specialised maps that depict some theme – say, forests, landuse, soils, land degradation etc or GIS-derived maps of any feature – say, population maps, integrated theme maps, urban maps etc. (that are very different from topographic maps).

11. "Aerial Survey" means the survey carried out using airborne platforms and specialised instruments (like aerial cameras, Lidars, airborne geophysical instruments etc)

12. "Ground Survey" means the survey carried out on the ground by field/ground visits and using either specialised instruments (like GPS devices, Total Stations etc) or enumeration/ inventory/tabulation of different parameters (like population, consumers, market etc)

13. "GIS Decision Support System" means the key GI based applications and services that provide user-required processed GI or solutions that help user to take a decision. Typically. such GIS DSS can be visualised as GIS-based answers to user-questions for taking decisions. The GIS DSS has to be customized and developed as an applications software tool which when "used" by user provides him the "answer".

14. "RSDP" means Remote Sensing Data Policy, 2011.

15. "NMP" means National map Policy, 2005.

16. "NDSAP" means National Data Sharing and Access Policy, 2012.

17. "Government" means the national government responsible through the nodal Ministry for the National GI Policy.

C. NATIONAL GIS

18. Implementation of the National GIS will be taken up in a Mission mode whereby GIS DSS for various government users, citizens and enterprises would be available and a nation-wide, seamless, regularly updated and GIS-Asset would be developed.

19. Indian National GIS Organisation (INGO) will be established as the nodal agency for National GIS (till such that INGO is established, the National GIS Mission Directorate will play this role). INGO will also be responsible for the development and growth of the GI sector so that a systematic and coordinated development is ensured amongst government, private, academia and others and ultimately benefitting the nation.

20. National GIS, including the National GIS Asset and appropriate GIS DSS, would be available and accessible to all government agencies (central and state), citizens of India, Indian private/public enterprises, Indian universities/institutions and Indian non-governmental agencies on "non-discriminatory" and "need to access" basis. For this, transparent and easy procedures and terms and conditions will be established.

21. Technical standards and Protocols for National GIS would be established that will allow easy access, guidelines for surveying, mapping, GIS database organisation, ingest of GI to GIS Asset, publishing GIS applications on National GIS DSS service, sharing of GI and credits/value for GI and applications and any other related procedures required for GI generation, sharing and usage in the larger context of National GIS. These standards procedures and protocols should enable government, private and individuals to "contribute" to GIS Asset and provide GIS applications services.

22. As a national service, INGO (in collaboration with the national mapping agency – Survey of India) will develop and release a open and freely available National Spatial Foundation Dataset (consisting of the spatial framework of India with national/state/district boundaries, major roads, major cities and other broad features) as a National GIS Template. This template can be used by any user to build GI and participate in National GIS.

23. As National GIS is established using public funds, INGO would coordinate for sharing of GI as per NDSAP provisions and establish specific National GIS service procedures for serving GI and Applications.

24. Ministries/Departments of government (central/state/local) will be encouraged and steered to use National GIS (and state-level GIS) for all planning/fund allocation/monitoring/reviews and also warranted to base their decisions/governance activities on the National GIS, in an appropriate manner, to bring a scientific rationale and transparency in governance.

25. State governments will be encouraged and promoted to build further on National GIS to establish linked State-level GIS that will enable usage of GIS for state-level and local-level governance, decision-making, planning, monitoring and provision of citizen services.

26. With a view to participatory approach, a national forum will be convened every year where all National GIS users/providers can exchange information and suggest/participate in further developing National GIS. INGO will consider all recommendations and plan any improvements/modifications in development of National GIS.

D. SATELLITE IMAGES

27. Government recognizes that it is not possible for any nation to "contain" or "restrict" use of satellite-based images/data as global imaging satellite services are available that provide commercial imaging/data services across all nations. Thus, any limiting-factor within any nation can be easily overcome from use of images/data outside the nation. Government recognizes that Indian users must not be in-denial with satellite images/data that are currently (or would be in future) available globally/commercially and, thus, will ensure that what images/data services are available globally are appropriately also accessible/available to Indian users, under similar conditions and to users under a process of registration.

28. Satellite images/data will be available "as is" (without resorting to masking) for registered users and for National GIS activities.

29. Licensing of privately-owned and operated Remote Sensing Satellites and licensing of satellite image acquisition and distribution will be governed by Remote Sensing Data Policy for which Department of Space (DOS) is the responsible agency.

30. Specific steps would be taken to encourage and position a regime of private ownership and operations of Indian registered RS satellites and private acquisition/distribution of RS images/data. This will, over time, enable emergence of privatization of imaging satellites operations services and image distribution services.

31. Immediate steps will also be taken to revitalize the revenue-based model for global marketing/distribution of precious government-owned Indian RS satellites data/images (that have been funded by public funds) so that global revenues defraying costs of satellites is maximised.

32. A long-term strategy (say, 25 years strategy) for government's Indian RS satellites would be evolved (and regularly updated/rolled-over) by DOS that will meet national needs and needs of National GIS. In doing so, DOS will seek inputs/suggestions and consult user community, citizens, private sector agencies and government agencies in arriving/reviewing the strategy.

33. Satellite images and data from non-Indian RS satellites will also be considered to contribute, augment and complement the national RS systems so that user needs and needs of National GIS are always met and are not "deprived" of globally available data.

34. RSDP licensing terms and services provision (even for NRSC) will embed a service-level guarantee condition - in terms of committed time-lines for delivery of images/data and quality of images/data. This will enabled higher-accountability and improved services to Indian users.

35. All efforts will be made to modernize and improve performance/efficiency of Indian RS Satellite services by state-of-art e-enablement of the Indian RS satellites images/data acquisition/holdings, search and preview, user order system and delivery system.

36. With a view to participatory approach, a national forum will be convened every year where all image/GIS users/providers can exchange information and suggest/participate in further development of RSDP. DOS will consider all recommendations and plan any improvements/modifications in development of RSDP.

E. POSITIONING SERVICES

37. A nation-wide Positioning Service will be established which will provide real-time precise coordinates of a national network of reference points. This will be based on integration of Indian Regional Navigational Satellite System (IRNSS) with Positioning satellite systems of other countries. Such a service can be used by users for obtaining real-time correction for positioning of hand-held and other devices – thereby enhancing precision of position anywhere in the country. This implementation of Positioning-As-A-Service concept an be of great use for navigation, transportation, logistics, location-based services, location content generation and other applications.

38. Availability and accessibility of Positioning data to citizens of India, Indian private/public enterprises, universities/institutions, non-governmental agencies and central/state government agencies on “non-discriminatory” basis subject to multi-level registration.

39. Encourage and promote indigenization of industrial capability in Positioning by way of involving Indian industries in developing, owning and operating Positioning technology elements – satellite and ground systems, ground devices etc.

40. With a view to participatory approach, a national forum will be convened every year where all Positioning/GIS users/providers can exchange information and suggest/participate in further development of Positioning policy elements. INGO will consider all recommendations and plan any improvements/modifications in development of the segment.

F. SURVEYING

41. Every city in India will be surveyed, preferably every 5 years, from aerial platforms for obtaining ultra-large scale images, maps and elevation data. This aerial data/ image content will be used to make city plans, city infrastructure development and city management. Every city administration, through Ministry of Urban Development, will be issued guidelines for undertaking this activity. INGO will coordinate this with MUD/ States. Similarly, the needs of Land Records sector and Disaster Management sector would also have to be met. These would be huge requirements for aerial survey.

42. Procedures for conduct of aerial survey, aerial image/data security clearance and aerial data sharing/usage will be streamlined and simplified so that it will become easy for city administration to undertake this activity in quick turn-around time.

43. An industrial capability for providing such aerial services would be encouraged and positioned in a licensing mode so that a few licensed serviced providers can undertake this large activity for more than 5000 urban areas, land records market and supporting disaster management needs. With proper market development, private sector can develop a good business opportunity to service these need under license fee/royalty terms and service level guarantees. Details of these would be worked out by INGO, in consultation with Ministries of Finance, Urban Development, Land Records, NDMA and others.

44. Aerial images/data and the derived maps/products would be available and accessible to registered users without any limitation to use. Sharing of aerial images/data and derived products would be governed by National GI Sharing guidelines.

45. Standards for Ground Survey data collection and Quality assessments need to be developed so that they become the basis for survey data collection for National GIS. Professional bodies in Surveying and experts must be involved in this standards development. They can also take up wide publicizing in the survey community for adoption so that quality certified survey content is available for National GIS.

G. MAPPING

46. Government recognizes that it is not possible for any nation to contain mapping of its territories as global satellite imaging satellite images/data are available that can be used globally to prepare maps of any nation. Thus, any limiting-factor within any nation can be easily overcome from maps prepared from outside the nation. Government recognizes that Indian users must not be in-denial with mapping information and what mapping

can be prepared/is available globally must be also available/preparable by Indian users, under similar conditions and with process of registration.

47. Topographic Mapping is and will continue to be be the responsibility of Survey of India. The distribution of updated topographic maps will be governed by National Topographic Map Access Policy (till now National Map Policy).

48. The topographic mapping of the nation will be undertaken with a update cycle that will be notified, keeping in mind the national requirements, technological developments and also user needs.

49. Government will ensure that a basic set of topographic features, including elevation, will form a part and parcel of the topographic map of the nation and these topographic map features would be available in digital form to all users, as per National Topographic Map Access Policy.

50. All other maps (other than topographic maps) – be they thematic maps, GIS derived maps, simulated maps etc will be governed by following National Thematic Mapping Policy provisions, hereunder.

    50.1. Mapping for National GIS Asset will be licensed by INGO as per transparent terms and conditions. Maps so created would be ingest to National GIS as per ingest guidelines and with compliance to standards.
    50.2. Theme-based mapping (like geological maps, forest maps, soil maps etc) will be generated by the respective thematic agencies (like Geological Survey of India, national Bureau of Soil Survey and Landuse Planning, Forest Survey of India etc)
    50.3. Any thematic map of the nation will be accessible/available to registered users and INGO would define these registration guidelines, in consultation with generating agency.

51. Thematic mapping activity in the nation will be based on National Spatial Framework (NSF) dataset as a base and will adopt National GIS Mapping Standards. This will ensure synergy of maps from different sources.

52. With a view to participatory approach, a national forum will be convened every year where all Surveying/Mapping users/providers can exchange information and suggest/ participate in further development of National Mapping Policy elements. INGO will consider all recommendations and plan any improvements/modifications in development of the segment.

H. GIS APPLICATIONS AND SERVICES

53. Promote and encourage national/state planning/fund allocation/monitoring/reviews to be based on use of National GIS DSS applications.

54. GIS Applications from any government, private sector, academia group and complying to National GIS Applications service standard will be made available/hosted on National GIS, on agreed terms and condition with applications provider. A licensing approach will be adopted for allowing such GIS Applications hosting. This will encourage large number of applications to be developed and provided and would encourage applications business.

55. With a long-term goal of strengthening "indigenous" technology base for National GIS, Indian technology products and applications services that meet quality and proficiency levels for National GIS would be encouraged. Indian IT industry must meet the challenge of indigenizing and supporting the needs of National GIS on a long-term basis through design, development, deployment, and maintenance/support and upgrades proficiency of high-level. INGO would work on specific programmes for this with Indian IT sector, academia and others.

56. With a view to participatory approach, a national forum will be convened every year where all GIS users/providers can exchange information and suggest/participate in further development of National GI Policy elements. INGO will consider all recommendations and plan any improvements/modifications in development of the segment.

I. SAFE-GUARDING AND SECURITY

57. Any GI and Applications service available through National GIS would be security-screened and devoid of any sensitive material. INGO would work out procedure for identifying and screening such features with Ministry of Defence and Ministry of Home Affairs.

58. To safe-guard and for knowing what GI and GIS Apps are being generated, used, required etc, a easy process of registration and licensing would be adopted – this would identify all genuine and verifiable users/generators/holders of all GI. As required, specialised screening, background checks and audits would be conducted and use-reports generated. All registered and licensed users will be obliged to file a safe-guard/compliance report for their licensed/registration activities.

59. A National GI Transaction Registry of all licensed/registered transaction related to National GI and GIS Apps would be maintained. These registry entries would be subject to audit and inspection for verification on need-basis. Independent Registry Analytics,

Transaction Audit, security scrutiny etc would be adopted to ensure compliance and detect any violations/non-compliance/un-licensed activities.

60. Any violation of license terms and registration procedures will be dealt with under appropriate provisions of existing laws.

J. GI ECO-SYSTEM DEVELOPMENT

61. Efforts to encourage, promote and position a high-quality industrial GI capability will be taken up so that, over time, private sector can be licensed specific tasks and roles of National GIS and by way of which government can reduce its further investments in National GIS and revenue from Indian industries market development could contribute in a large manner to operations and services of National GIS.

62. Quality and culture of excellence will be paramount for National GIS and it is essential to bring a 2-way discipline of excellence amongst government agencies and private sector for making National GIS successful. Training, orientation programmes in government and private sector will be essential for this.

63. INGO would work with Ministry of Human Resources Development to position the national Geospatial Education Strategy for human resources development in GIS. It is important and essential to implement the 4-pronged approach of the strategy – at school-level to 'ignite the first spark'; at university level to build 'GI knowledge capacity'; training and outreach to 'make professionals up-to-date in GIS'; and creating a knowledge culture for GI and applications through an institutional mechanism.

K. GENERAL ASPECTS

64. Recognizing that use of GI as legal evidence can bring rationality in judicial activity, the legal fraternity and courts/judges would be made aware of the use of GI and also training/orientation provided for them to benefit from National GIS.

65. It is also recognized that National GIS would be amenable to Copyright Act, RTI Act etc and thus INGO must involve Ministry of Law and other legal experts to comprehend legal implications of providing National GIS services and facilitate elaboration of existing legal frameworks in areas, such as Data Access, IPR, Liability, Privacy etc.

66. National GI has implications on society and social development – especially it would be important that this "resource" is equitably available to all regions in India. Further, the social aspects of GI assimilation must bring empowerment of society. It would be important

to measure these impacts and document the social benefits (and gaps) that accrue from National GIS. INGO would encourage and develop such research and educational studies involving social institutions, social science experts and universities/academia.

67. A technically robust and efficient private sector engagement needs to be encouraged and further developed – especially in support of GIS Asset generation, GIS DSS services and GI capacity-building activities. A pathway needs to be created for National GIS, one operational, in future, becomes amenable to a PPP model based on licensing/royalty – for which robustness and efficiency of GI industry is critical.

68. Benefit of GI in decision-making needs to be measured and quantified. This would justify the investments made and bring learning for further activities. INGO would encourage and develop such economic and social science research and cost-to-benefit studies with involvement of research institutions, finance experts and universities/academia.

69. The National GI Policy would be reviewed every year through an inclusive mechanism involving government, enterprises, academia, citizens and obtaining feedback and inputs. Based on these, the policy updates would be recommended for adoption. INGO will coordinate this review/change process.

About The Authors

Dr Mukund Rao is an Information technology professional with expertise in EO Space Systems and Spatial Technology and Applications. Presently, he works as an independent GIS Consultant in the national and international scene and is also Adjunct Faculty in NIAS.

Dr Rao is a well-known GIS expert and has been furthering EO and GIS in India for almost 30 years. He has the unique distinction of vast experience - both in government and industry, having served in ISRO for 24 years – where he worked in shaping the Indian Remote Sensing programme and its applications and establishment of India's National Natural Resources Management System (NNRMS). He has worked for India's first GIS programme on Natural Resources Information System (NRIS); National Spatial Data Infrastructure (NSDI) Strategy and Action Plan; National Urban Information System design etc. Later for 6 years he has been with GIS industry – where he was CEO of GIS business initiatives and acquired and delivered some of India's largest GIS projects. Subsequently, he worked for Planning Commission as Expert on National GIS and was key person in conceptualizing National GIS. Presently, he consults and advises to many GIS entities in government, industry and academia. He has vast experience in EO and GIS Policy and Regulatory aspects at national and international level.

Dr Rao is well-known in India and also in the world – he has contributed to many national and international initiatives – he was the founding and first President of the international Global Spatial Data Infrastructure Association (GSDI); Vice-President of the International Astronautical Federation (IAF); elected Member of International Academy of Astronautics (IAA); has been active in the international Committee on Earth Observations Satellites (CEOS) and other forum like International Society for Photogrammetry and Remote Sensing (ISPRS) and UN-Office for Outer Space Affairs and UN-ESCAP.

Dr Rao has been honored with many awards - GIS Professional of 2009 at the Map India, 2010 Conference; National Geospatial Award for Excellence of the Indian Society of Remote Sensing (ISRS) in 2009; Exemplary Service Medal from international Global Spatial Data Infrastructure (GSDI) association in 2009 and Hari Om Ashram's Vikram Sarabhai Young Scientist Award in the area of "Systems Analysis and Management" in 2002.

At NIAS, as Adjunct Faculty, he is germinating the seeds of a focused GIS research and policy activity. **Dr Rao was Principal Investigator at NIAS for the DST Sponsored project on GI Policy**.

Contact: Mukund Kadursrinivas RAO (Email: mukund.k.rao@gmail.com)

Mr K R Sridhara Murthi is a distinguished professional in the fields of space commercialisation, space policy and strategy management. He played key roles in India's Space programme for over three decades. He served as the Scientific Secretary of Indian Space Research Organisation (ISRO) and later as the Managing Director of Antrix Corporation. He extensively contributed to technology transfer and space industry development programmes in ISRO. Serving as a counsellor at Embassy of India in Paris, he provided thrust to many cooperative initiatives between space agencies and industries in Europe and their counterparts in India. He holds a degree in Mechanical engineering and is a post graduate from IIM, Ahmedabad. He is a Fellow of the Institution of Engineers (India).

Mr. Murthi is well recognized for his roles in promoting international cooperation in the peaceful uses of outer space. He was elected in 2011 as a Vice President of the International Institute of Space Law (IISL) and became the first Asian national to hold the position. He also served in past as Vice President of International Astronautical Federation and as a Trustee of the International Academy of Astronautics (IAA). He represented India as a delegate to the United Nations Committee on Peaceful Uses of Outer Space.

He has been the recipient of several honors including the Social Sciences Award of International Academy of Astronautics in 2003, the Astronautical Society of India award in Space Systems Management in 2004, the ISRO Merit award in 2007 for Commercialization and the Lifetime achievement award from the International Institute of Space Law in 2007.

His works on space policy, strategies and commercial developments is widely published in national and international journals and he was a co-editor of the book "Perspectives in Communications" published by World Scientific Publishing Company, Singapore.

Post his stint in ISRO, Mr Murthi served during 2011 as a Senior Expert in the Office of Adviser to PM on Public Information Infrastructure and Innovations in India. He was also a member of Interim Core Group set up by Planning Commission of India for evolving National GIS system. He serves as a member in the Board of National Design Research Forum of the Institution of Engineers(India). Currently as an Adjunct faculty at National Institute of Advanced Studies at Bangalore, Mr. Murthi is engaged in policy analysis relating to GI and outerspace matters.

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