Global Geographic Information Management: Some Institutional and Data Sharing Issues in Integrating Geospatial and Statistical Data

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1. The Context

In October 2009 Resolution VII: Global Geographic Information Management was adopted at the Eighteenth United Nations Regional Cartographic Conference for Asia and the Pacific in Bangkok. It stated:

"*The Conference*,
Recalling the recommendations made in Economic and Social Council resolution 131 (VI) of 19 February 1948, entitled "Coordination of cartographic services of specialized agencies and international organizations", and subsequent resolutions,

Taking note of the rapid development of and increased demand for geographic information infrastructure in all countries in past years, which has made geographic information an invaluable tool in policy planning and decision-making,

Bearing in mind that global issues, such as climate change, food and energy crises, peace operations and humanitarian assistance, all require strong support for geographic information management on a global scale,

Acknowledging with appreciation the work of the United Nations regional cartographic conferences and the significant role that they are serving in the Asia and Pacific and Latin America and the Caribbean regions, as well as in Africa, and recognizing the important role and contribution of regional organizations in Europe,

Also acknowledging the important contribution of other regional and international organizations and of global initiatives and projects,

Recognizing the absence of a United Nations consultation process led by member States, which deals with global geographic information management, coordinates regional efforts, promotes global norms on geographic information and brings such information to bear on global issues,

Also recognizing the requests of member States for a global mechanism, the work to develop common frameworks and tools and a process of standardization, for which the United Nations has a key mandate, to address the need and the necessity for experience exchange and technology transfer on geographic information tools and infrastructures, with specialized, regional and international organizations,

Requests that, by 1 November 2010, the Secretary-General and the United Nations Secretariat initiate discussions and prepare a report, for a future session of the Economic and Social Council, on global coordination of geographic information management, including consideration of the possible creation of a United Nations global forum for the exchange of information between countries and other interested parties, and in particular for sharing best practices in legal and policy instruments, institutional management models, technical solutions and standards, interoperability of systems and data, and sharing mechanisms that guarantee easy and timely accessibility of geographic information and services." (Eighteenth United Nations Regional Cartographic Conference for Asia and the Pacific, Bangkok, 26-29 October 2009, ECONF.100/9.

This was followed up by Decision 10 of the Forty-first Session of the United Nations Statistical Commission which states:

"The Statistical Commission:

(a) Expressed appreciation to Brazil for having prepared a report and brought this important topic to the attention of the Commission;
(b) Recognized the importance of the integration of geographic and statistical information and the opportunities offered in this context by the fast development of information technologies; noted that national statistical offices are playing an increasing role in the integration, especially in the area of census management;
(c) Called upon all national statistical offices, in partnership with relevant national authorities, to further develop national geographic information capacity, in the context of spatial data infrastructures, taking full advantage of information technology and focusing special attention on the area of improving statistical and geographic metadata compatibility;
d) Requested the Secretary General to prepare a report outlining a global vision for Geographic Information Management to be presented to the Economic and Social Council, reviewing the existing mechanisms and exploring the possibility of creation a global forum;
e) Requested the Statistics Division to convene and international expert group meeting, consisting of statisticians and geographical information specialists to address the global geographic information management issues;
f) Requested the Secretariat to report back to the Commission on the work of the expert group and the preparation for a possible global forum.
(Forty-first session of the United Nations Statistical Commission, New York, 23-26 February 2010)

2. The Importance of Locational or Placed Based Information

2.1 In the digital era location, or place, is assuming increasing importance making the efficient and effective management of such information a priority in both the public and private sectors and, increasingly, even at the personal level. Over eighty percent of existing digital databases have a locational component. "Everything is Somewhere" and location can be used as an integrator for both quantitative and qualitative information. Society is increasingly using location-based information in everyday life including GPS, Google Earth and related spatially referenced databases. Increasing amounts of such information can be accessed on mobile devices.

2.2 Governments are using location or place in planning and budget. A good example of this is the Obama administration budget memorandum issued in August 2009 which is entitled "Developing Effective Placed Based Policies for FY 2011" (M-09-28). This memorandum was for the heads of executive departments and agencies and was issued jointly by the Director of the Office of Management and Budget, the President's Domestic Policy Advisor and the Director of the White House Office of Urban Affairs, and the Director of the

White House National Economic Council. The memorandum outlines policy principles meant to advance the administration's domestic and fiscal priorities and to increase the impact of government dollars by leveraging place-conscious planning and place-based programming.

2.3 The use of location in planning by governments at all levels is, of course, not new as GIS has been in use for over four decades and spatial data infrastructures have emerged, and continue to emerge, at local, regional, national and global scales. In the text of the Obama administration memorandum discussed above, however, there is no mention of the words GIS, geospatial or spatial data infrastructure and it can be argued that the memorandum is an important step in making location much more central to government planning than ever before.

2.4 Location is also related to the rapidly growing public-participatory ICT infrastructure in which individual citizens are playing an important role through "crowd sourcing" activities such as Open Street Map. Here, the use of mobile devices for both data input and data access is increasing exponentially.

2.5 We may well be witnessing the emergence of the Age of Location

3. Semantics

One of the challenges in the management of geographic information is the use of the words we use to describe the field. The terms "spatial information", "geospatial information", "geographic information systems", "spatial data infrastructures", "spatially enabled government" and others are all used sometimes interchangeably. There is a refreshing simplicity in the terms "locational" or "place-based" information used, for example, in the Obama budget memorandum. These latter terms are ones that everyone can easily understand, which cannot be said of the former terms and other jargon we have created to describe the field. A major challenge of geographical information management is agreeing on semantic descriptions and definitions

4. Spatial Data Infrastructures: Some Institutional Models

4.1 The term "spatial data infrastructure" (SDI) emerged in the 1990s. Richard Groot and John McLaughlin, and Ian Masser have given good descriptions of this process as well as some good examples of best practices (Groot and McLaughlin, 2000; Masser, 2005). Countries like Canada, through its GeoConnections program, were in the forefront of developing such coordinating structures. In August 2002 the US Office of Management and Budget issued Circular A16 establishing the National Spatial Data Infrastructure of the United States. This was described as "…the technology, policies, standards, human resources, and related activities to acquire, process, distribute, use, maintain and preserve spatial data." This is one of the most comprehensive definitions of a spatial data infrastructure. By 2010 the recognition that countries should develop and implement policies for the efficient and coordinated management of their spatial data and services has become almost universal with SDIs at the national, regional and global levels evolving with increasing resolve and commitment. Many of the NSDIs, such as that of Korea, are at advanced stages of implementation. The Government of Korea has invested very substantial resources into developing and implementing the NSDI with over two billion dollars already invested. Some NSDIs, such as that of Brazil, have been created by legislation while others, such as that of Canada where the Canadian Geospatial Data Infrastructure is at an advanced stage of implementation, are being created through innovative partnerships between federal, provincial and local governments in cooperation with the private and academic sectors. In many nations the national mapping organization is the main coordinator of the NSDI. In others a special agency, such as SNIT in Chile, has been established for this

purpose. In all nations, regardless of the management model being used, the national mapping organization is a key player.

4.2 The European Union's INSPIRE Directive for a Europe-wide SDI came into force in 2007 and by the end of 2010 many European Union member states have passed this Directive into law. The implementation of INSPIRE will take several years. Details of INSPIRE are given in another background paper for this meeting and on their Web site at www.inspire-geoportal.eu.

4.3 Global Map, which was formally established in 1996 with United Nations support, is an example of an operational global spatial data infrastructure at the 1:1 million scale with eight data layers, four vector and four raster, designed to aid in environmental and sustainable development decision making. Formal establishment was preceded by several years of wide consultation and planning. The Global Map initiative is managed by the International Steering Committee for Global Mapping (ISCGM). Currently there are 164 nations and 16 regions, including Europe and Antarctica, involved in Global Map and nations are represented by their national mapping organization (NMO). The Chair of ISCGM is independent of any NMO. Global Map receives substantial support from the Government of Japan which hosts the secretariat. Nations which participate in Global Map sign an agreement to make their data available at low, or no cost for non-commercial purposes and to follow the standards and specifications arrived at by mutual consent. Each nation is responsible for its own coverage. Global Map Version I was released in June 2008 and in 2009 new ISO compliant standards and specifications were approved. Global Map is now entering Phase III of its existence. Details of Global Map are given in another background paper for this conference and can be found online at www.iscgm.org.

4.4 OneGeology is an initiative to create a global spatial data infrastructure for geological information (www.onegeology.org). OneGeology is creating a geological map of the world at the 1:1 million scale with the aim of making geological map data for the earth accessible. The initial meeting to establish OneGeology was held in 2007 and by April 2010 one hundred and sixteen nations were involved represented by their geological surveys. The management structure and organization of OneGeology has similarities to Global Map and the two initiatives cooperate with each other. The Chair of ISCGM acts in an advisory capacity to OneGeology. Special efforts are being made to ensure that the datasets of the two initiatives are interoperable with each other.

5. Some Limitations of Existing SDI Models

5.1 Considerable progress has been made in managing geospatial information through existing or planned SDIs. These models, however, have many limitations. These have been discussed in a series of articles by Jackson, Schell and Taylor and the titles of these papers are provocative. They include "National Spatial Data Infrastructures: Coordinating Framework or Battleground for the Management of Geospatial Data? (June 2009), "Revising the Concept of National Spatial Data Infrastructures" (October 2009) and "2010 – The Year to Celebrate Success for NSDI's or the Year to Return to the Drawing Board" (2010 forthcoming).

5.2 One of the weaknesses of the existing models is that they are predominantly supply-driven rather than demand-driven and are rarely oriented to respond directly to high priority societal policies or problems. It is assumed that these infrastructures will provide the information required to respond to problems and the creators of such infrastructures provide comprehensive national data layers to do this. Rarely, however, do they consider the nature of the problems that the information is supposed to address. This often leads to a serious "disconnect" between national needs for the management of geographic information and current SDI approaches.

5.3 A serious drawback in this respect is that most SDIs do not include adequate socio-economic data, yet these data are key to the effective management of geographical information. Many SDIs are, as a result, isolated from the mainstream information management of location-based data, which is often carried out by agencies and organizations other than the NMO, many of which are not part of SDI efforts. The integration of geospatial and statistical information, which is the major theme of this meeting, would be a very positive step forward in this respect.

5.4 The management challenge is compounded by the rapid technological developments in the commercial and mass-market sectors. A dynamic new "geoweb" is emerging and at present SDIs are not an integral part of this emerging location-based ubiquitous computing environment. Many SDIs are stand alone creations isolated from the ICT management mainstream.

5.5 There is a need to create new models, what have been called the "new SDI-2" (Jackson, Schell and Taylor 2010) which will assume Web.2.0 characteristics. Geospatial information in these emerging models will be more ubiquitous, more dynamic, and not confined to the traditional geospatial applications.

6. Institutional Relationships between NSOs and NMOs

6.1 The existing situation in most nations is that the national statistical organization and the national mapping organization tend to act independently of each other. Even in situations where the two are legally part of the same institution, for example in Brazil and Mexico, effective integration is limited and the geography divisions in INEGI (Mexico) and IBGE (Brazil) are, in practical terms, often isolated from the various statistical divisions. This situation is beginning to change in Brazil as outlined in a recent paper by IBGE given in February 2010 at the Forty-first sessions of the United Nations Statistical Commission (E/CN.3/2010.13). This paper was the basis for Decision 10 described earlier and a major stimulus for this meeting.

6.2 A Major reason for this separation is that NSOs, in almost all countries, are governed by formal legislation on national statistical activities, especially, but by no means exclusively, related to censuses. This legislation is often in the form of a national statistical act which defines and constrains the activities of an NSO.

6.3 NMOs have quite different legal and policy mandates and these differences constrain the effective cooperation between the two organizations.

7. The Importance of Data Sharing

7.1 It is widely recognized that a major problem in geographic information management is ensuring effective data sharing among the stewards of location-based data in both the public and private sectors.

7.2 One of the most comprehensive studies of this complex challenge in geographic information management has been carried out under the auspices of the Group on Earth Observation (GEO) and the related activity of creating a Global Earth Observations System of Systems (GEOSS). Although the study and related reports deal with earth observation data, the barriers identified to data sharing apply to all kinds of geographical data. A full consideration of these issues is beyond the scope of this paper and the reader is referred to the article by Paul Uhlir, et.al (June 2009) and the GEOSS Data Sharing Task Force Report entitled "Implementation Guidelines for the GEOSS Data Sharing Principles" (November 2009).

7.3 There are many barriers to the sharing of data including technical, legal and administrative/political barriers. The technical barriers include the important topic of interoperability which is considered in another background paper for this meeting. Although the technical issues are significant they are perhaps much easier to resolve than the legal, administrative and political ones. The next section of this paper will consider the topic as it relates to data sharing between NSOs and NMOs.

8. Barriers to Data Sharing between NSOs and NMOs

8.1 National statistical organizations have very strict requirements to protect personal privacy and confidentiality which are often governed by legal and policy frameworks. This makes the sharing of this data with NMOs within the framework of SDI challenging. SDIs are based on the principle of open access and sharing of datasets. NSOs have constraints on what data can be shared and in what form.

8.2 The two organizations deal with very different types of data, very different data collection techniques and very different data collection timelines. Collection of data through remote sensing techniques allowing data update in almost real time, for example, is very different from the methods used to collect information for a decennial census.

8.3 The two agencies have different standards, specifications and data collection units making interoperability between their datasets difficult.

8.4 None of these barriers is insurmountable but the challenges to sharing, let alone integrating, geospatial and statistical information should not be underestimated.

9. Some Possible Ways Ahead at the National, Regional and International Levels

9.1 At the national level a first step might be the creation of a formal memorandum of understanding to share location-based data between the national mapping organization (and/or the organization responsible for the NSDI) and the national statistical organization. This memorandum would be specific to the administrative, political and legal situation in each country.

9.1.1 This would be followed by the creation of a joint working group to establish the management structure for the resulting enhanced geographic information. A formal structure should be established for this purpose and should be agreed upon in each nation according to its own circumstances.

9.1.2 In nations such as Brazil and Mexico where a formal institutional structure is already in existence, existing institutional procedures should be examined to improve their functionality at the working level.

9.1.3 It is unlikely that existing NSDI models will be adequate for this purpose and new models will be required. Building on the existing or planned NSDI, each nation should create a National Geospatial and Geostatistical Infrastructure (NGGI). This should be designed to respond to priority national demands and policies and as an integral part of a holistic location-aware computing environment, not as a stand-alone isolated system. This will require the creation of new standards, specifications and regulations to facilitate the integration and interoperability of relevant datasets.

9.1.4 In creating an NGGI special attention will be required to deal with the legal constraints on NSOs, especially those related to the issues of personal privacy and confidentiality.

9.1.5 Each nation should document the approach it develops and prepare a brief report on this process.

9.2 At the regional level the European Union is in the process of implementing the INSPIRE Directive which came into force in 2007. This directive will be passed into national law by most European Union members by the end of 2010. The legal process is far advanced. Further integration of statistical information will have to be done on an ad hoc basis in the short term. The European Union should be asked to consider how this might be done. Individual European Union member states should be encouraged to take the action outlined in section 9.1 to 9.1.5 outlined above.

9.3 At the international level two actions are suggested.

9.3.1 The United Nations Statistical Division should create a global forum to discuss the results of the actions discussed above.

9.3.2 That global forum should also formulate a resolution for consideration by ECOSOC on the role of the United Nations in facilitating the management of geographic information at the global level.

9.3.4 In this respect consideration should be given to building on existing management models such as Global Map. This management model has many strengths:

- It is an existing global spatial data infrastructure
- Wide consultation and planning took place in advance of formal action
- It is built from the "bottom up" with each nation being responsible for its own contribution
- Some nations (e.g. Kenya and Brazil) have used Global Map as a building block for their national spatial data infrastructure
- Each nation is represented by its national mapping organization and the vast majority of the world's NMOs are already members
- Global Map policies and implementation are guided by the International Steering Committee for Global Mapping (ISCGM) which has 20 representative NMOs as members
- ISCGM is linked to all major organizations involved in geographic information management which are either liaison organizations or invited observers at ISCGM meetings
- ISCGM meets once a year with larger Global Map forums being held every two or three years with much wider participation
- Standards and specifications have been agreed on by mutual consent and are designed in a pragmatic manner so that every nation, including those less technologically advanced, can use them
- A new set of ISO compliant standards and specifications were approved in November, 2009.
- Each nation signs an agreement when joining Global Map to make its data freely available for non-commercial use
- There is a strong capacity building component in Global Map to help less technologically advanced nations participate
- Global Map has already released coverage online for 59.8% of the world's land surface by area and 52.3% by population
- Global Map already has one demographic layer. Additional data layers can be added

- Global Map is a fully operational global geographic information management initiative with a secretariat supported by the Government of Japan

10. Conclusion

The resolution adopted by the Eighteenth UN Regional Cartographic Conference for Asia and the Pacific and Decision 10 of the Forty-first Session of the United Nations Statistical Commission provide new opportunities to integrate geospatial and statistical data and create new approaches to global geographic information management.

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