GIS Standardization: The American Experience

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요 약 이제 GIS 표준은 국제적으로 공인된 과정을 거쳐 제정되고 있다. 이러한 과정과 표준자체의 중요성은 물론이며 표준 개발을 의한 GIS 표준 하부구조 즉 범 세계적 공간 정보 하부 구조 (the Global Spatial Data Infrastructure: GSDI) 의 개발도 아주 중요한 것이다. 기술이란 한상 변하고 있는 것이기에 GSDI등 표준 하부구조가 구축되면 새로운 GIS 표준은 이러한 하부 구조에 의해 쉽게 개발 되게 된다. 본 논문에서는 지금까지 구축된 공간 정보 표준 하부 구조는 어떠한 것이 있고 또 앞으로의 GIS 표준 개발 방향은 어떻게 나아가야 할 것인지 살피고자 한다.

Introduction

GIS standardization has become a commonly accepted process internationally. Beyond this acceptance, the acknowledgement and recognition for the process of GIS
standardization represents a level of maturity for the GIS community. During the emergence of technology, propagating the waves of innovation along with its diffusion and progress are paramount. At this early phase, integration in a common and sustainable way is usually a secondary consideration. As technology stabilizes, there is the need to preserve developed and superior technological functionality for integrating and extending these capabilities in a consistent manner. Rather than continually reinventing the same or similar specifications, standards are developed for widespread acceptance and deployment.

While the GIS standardization process and GIS standards are valuable and beneficial, the GIS Standards Infrastructure for developing GIS standards and the Global Spatial Data Infrastructure (GSDI) for deploying GIS standards are equally important. Because technology constantly changes, new GIS standards can be developed and deployed accordingly with these infrastructures appropriately in place. The focus of this discussion is on how we got here, what is being done, and where are we going with GIS standardization.

Internationally, the beginnings of GIS standardization occurred at different points in time and varied in their rates of development. This resulted from the differential spread of GIS knowledge and technology globally. Historically, standardization advanced civilization in regulating time, money, languages, weights and measures, and in many other useful ways. The modern era of standardization began with the establishment of the International Organization for Standardization in 1947. More recently, the standardization of information technology with the formation of the Joint Technical Committee 1, Information Technology of the International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) in 1987 [Cargill, 1989]. JTC1, Information Technology is responsible for approximately one third of all ISO standards. These standards are primarily for computer and related technology. Hence, GIS standardization and its foundation are relatively recent phenomena.

GIS Standards - A Definition

GIS standards refer to information technology

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standards and/or spatial data standards (Figure 1). A GIS standard may result from the adoption or adaptation of an information technology for GIS applications. The use of the Structured Query Language (SQL) is an example of the adoption of an information technology standard. The modification of SQL with a GIS extension represents an adaptation of an information technology standard. A GIS standard may also be a spatial data standard. Spatial data standards are standards developed for defining, describing and processing spatial data. The Spatial Data Transfer Standard (SDTS) and the Content Standard for Digital Geospatial Metadata are examples of spatial data standards [United Nations, 1998].

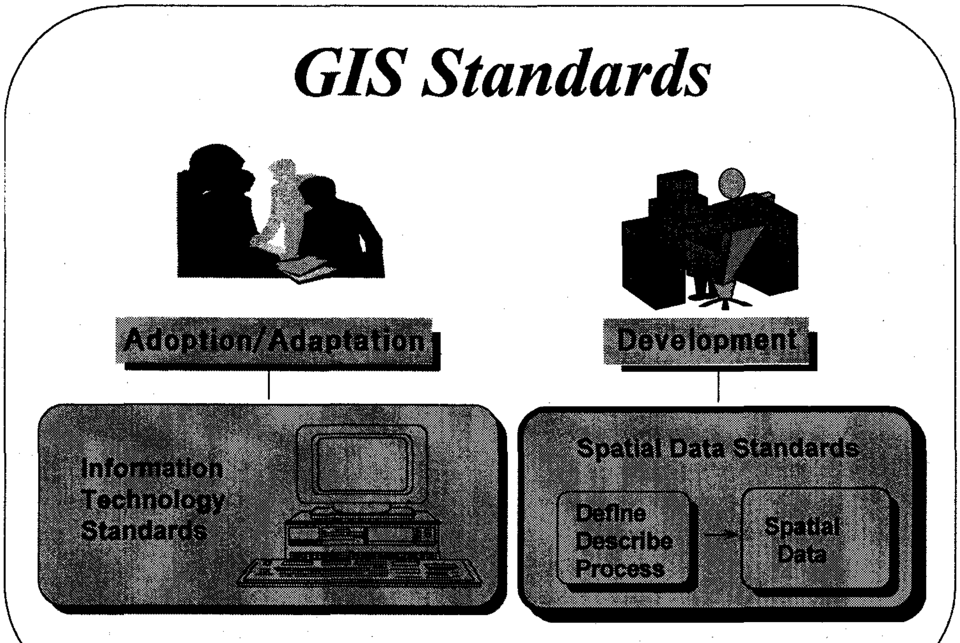

Figure 1

History – How we got here

In the United States, the origin of GIS standards began as Federal Information Processing Standards (FIPS). The FIPS program began in 1960's as a mandatory standards program for US government agencies using computer technology. GIS standards originated as standards for geographic code sets. FIPS –5,6,8, 9, 10, and 55 were geographic code sets for US states, US counties, US Standard Metropolitan Statistical Areas (SMSAs), US congressional districts, countries, and US named populated places and related entities respectively. Five of the first ten FIPS were geographic standards attests to the recognition, at the very outset, for the importance of standardizing geographic codes for relating social, economic, and demographic data geographically.

In 1980, the National Bureau of Standards (NBS), now known as the National Institute for Standards and Technology (NIST), assigned US Geological Survey (USGS) the leadership role for developing earth science data standards for the US government [NBS, 1980]. Two resulting FIPS from this agreement were FIPS 70, Geographic Point Locations and FIPS 173, Spatial Data

Transfer Standard (SDTS). Over the years, various FIPS were adopted as American National Standards Institute (ANSI) standards and FIPS 70 eventually became an International Organization for Standardization (ISO) standard, ISO 6709: Standard Representation of Latitude, Longitude, and Altitude for Geographic Point Locations.

Traditionally, ANSI is the national organization for certifying various standards development organizations (SDOs) in the United States. ANSI also represents the United States within the international standards community. Organizationally, ANSI did not have a GIS standards technical committee until recently. Geographic FIPS were adopted within existing technical committees such as X3 and Z39. X3 and Z39 were accredited standards committees. X3 focused on information processing systems while Z39 concentrated on the library sciences.

In anticipation of the rapid emergence of GIS standards at the national and international levels, a technical subcommittee, X3L1, Geographic Information Systems (GIS) for GIS standardization was established in 1994. Recently, X3, Information Processing Systems changed its name to the National Committee for Information Technology Standards (NCITS) and the designation for the GIS technical committee is now L1, GIS. L1 is responsible for GIS standards at the national level within the United States. L1 also serves as the technical advisory group (TAG) for ANSI within the ISO/TC 211, Geographic Information/Geomatics technical committee.

The Federal Geographic Data Committee (FGDC) is an interagency organization that organizes the use of spatial data by US Federal agencies. In 1994, President Clinton issued Executive Order 12906, which gave FGDC the responsibility for coordinating the development of a National Spatial Data Infrastructure (NSDI) and also the ability to develop US Federal standards for spatial data [Clinton, 1994]. The FGDC Standards Committee has been very active in coordinating the development of spatial data standards.

The year 1994 also saw the formation of a GIS industry consortium, Open GIS Consortium (OGC) for developing software specifications to advance geoprocessing interoperability across the GIS industry. OGC began as an American based organization, but has now evolved into an international organization. Currently, its membership has almost reached two hundred members with representation from the most important spatial organizations within industry, governments, and academia. Traditionally, the GIS vendor community was very ruthlessly competitive. The OGC managed to forge an organization that was industry-wide and it provided an open forum where competing GIS companies could discuss industry issues and actually form alliances and work together cooperatively for the advancement the GIS industry as a whole.

Status - What is being done

Currently, there has been much progress by all major GIS standardization efforts individually and collectively. Each has made considerable progress and this includes the important coordination and cooperation across all efforts. During the past 6 years, the various organizations and processes involved in GIS standardization have evolved into a cohesive, stable, and coordinated infrastructure.

American National Standards Institute (ANSI)

Nationally, the L1, GIS, technical committee has advanced the adoption of FIPS 173, Spatial Data Transfer Standard (SDTS) as ANSI / NCITS 320-1998. This also includes the Topological Vector Profile (TVP). With the rescinding of the FIPS Program, the US government is now supporting the adoption of ANSI and ISO standards for use as US government standards. Thus, the approval of FGDC developed spatial data standards is now directed at becoming ANSI standards instead of FIPS. L1 is currently working with FGDC in developing the policy and procedures for the approval of FGDC standards as both ANSI and ISO standards, as well as, for the migration and approval of ISO developed standards as ANSI and FGDC standards. This work is being done in anticipation of the emergence of a considerable number of FGDC and ISO standards. As the US TAG to ISO/TC 211, L1 is directly responsible for 7 of the 20 standards under development by ISO/TC211. These include: Framework and Reference Model, Spatial Operators, Temporal Subschema, Metadata, Quality Principles, Cataloguing Methodology, and Positioning Services. In addition, the US is providing the project leadership for the Technical Specification for Projection Codes and Parameters.

International Organization for Standardization (ISO) Technical Committee 211, Geographic Information/Geomatics

ISO/TC 211 was established in 1994. ISO/TC 211 has the following work groups:

WG 1- Framework and Reference Model
WG 2 - Geospatial Data Models and Operators
WG 3 - Geospatial Data Administration
WG 4 - Geospatial Services
WG 5 - Profiles and Functional Standards

The original programme of work consists of an integrated set of standards, ISO 15046-Parts 1-20. Part 20 has now been combined with Part 7. Also, there are several technical reports being written.

ISO 15046-Parts 1-20

15046-1	Reference Model
15046-2	Overview
15046-3	Conceptual Schema Language
15046-4	Terminology
15046-5	Conformance and Testing
15046-6	Profiles
15046-7	Spatial Subschema
15046-8	Temporal Subschema
15046-9	Rules for Application Schema
15046-10	Cataloguing Methodology
15046-11	Geodetic Reference Systems
15046-12	Indirect Reference Systems
15046-13	Quality Principles
15046-14	Quality Evaluation Procedures
15046-15	Metadata
15046-16	Positioning Services
15046-17	Portrayal of Geographic Info.
15046-18	Encoding
15046-19	Services
15046-20	Spatial Operators

Technical Reports

Functional Standards Technical Report
Imagery and Gridded Data Technical Report
Projection Codes and Parameters Technical Report
Qualifications and Certification of Personnel Technical Report

The approval of this ISO standard and various parts will occur during year 2000.

Open GIS Consortium (OGC)

The Open GIS Consortium (OGC) has made significant progress to date. Selected OGC specifications that become industry standards will seek additional approval as ISO standards. The OGC has also submitted a new work item proposal for standardization that will be jointly developed by ISO/TC 211 as an ISO standard. Similar to ISO, the OGC also operates on a consensus process. Recently, the OGC has established the OGC Integration Laboratory for integrating technology. OGC has also developed and administers an industry-wide conformance and testing capability to validate compliance to OGC specifications. It has also established a WEB Mapping TestBed for developing geoprocessing functionality specifically for the Internet. Many OGC members are participating in this avant-garde initiative. Moreover, the OGC has been working very closely with ISO/TC 211 in identifying the overlap and division of labor in mutual work programs. The formation of the ISO / TC 211-OGC Coordination Group is a result of such efforts. As an international consortium, the OGC strives to work, as a neutral organization, with ISO/TC 211, as opposed to working with any particular national body. Thereby avoiding the perception that the OGC represents or supports a specific national position.

Federal Geographic Data Committee (FGDC)

The Standards Committee, Federal Geographic Data Committee has also been quite prolific in their standards development activities. It is currently involved in the processing and development of a considerable number of spatial data standards and the status of FGDC standards as of May 1999 is:

FGDC Endorsed Standards

Cadastral Data Content Standard
FGDC-STD-003
Classification of Wetlands and Deep Water Habitats
FGDC-STD-004
Content Standard for Digital Geospatial Metadata (version 2.0)
FGDC-STD-001-1998
Content Standard for Digital Orthoimagery
FGDC-STD-008-1999
Geospatial Positioning Accuracy Standard, Part 1, Reporting Methodology
FGDC-STD-007.1-1998
Geospatial Positioning Accuracy Standard, Part 2, Geodetic Control Networks
FGDC-STD-007.2-1998
Geospatial Positioning Accuracy Standard, Part 3, National Spatial Data Accuracy Standard
FGDC-STD-007.3-1998
Spatial Data Transfer Standard (SDTS) FGDC-STD-002 (a modified version was adopted as ANSI NCITS 320:1998)
Spatial Data Transfer Standard (SDTS), Part 5: Raster Profile and Extensions
FGDC-STD-002.5
Spatial Data Transfer Standard (SDTS), Part 6: Point Profile
FGDC-STD-002.6
Soils Geographic Data Standard
FGDC-STD-006
Vegetation Classification Standard
FGDC-STD-005

Draft Standard Review Stage

Completed Public Review

Biological Data Profile of the Content Standard for Digital Geospatial Metadata, Biological Data Working Group
Content Standard for Framework Land Elevation Data, Base Cartographic Subcommittee
Facility ID Data Standard, Facilities Working Group
SDTS Part 7: Computer-Aided Design and Drafting (CADD) Profile, Facilities Working Group
Utilities Data Content Standard, Facilities Working Group

Out for Public Review

Content Standard for Remote Sensing Swath Data, Standards WG (Closes May 20, 1999)
Geospatial Positioning Accuracy Standard, Part 4: Architecture, Engineering Construction and,
Facilities Management, Facilities Working Group (Closes May 20, 1999)

In Review by SWG Prior to Public Review

Encoding Standard for Geospatial Metadata, Clearinghouse Working Group

Draft Standard Development Stage

Address Content Standard, Cultural and Demographic
Content Standard for Digital Geospatial Metadata: Extensions for Remote Sensing Metadata, Standards Working Group Imagery Subgroup
Digital Geologic Map Cartography, Geologic Subcommittee
Earth Cover Classification System, Earth Cover Working Group
Environmental Hazards Geospatial Data Content Standard, Facilities Working Group
Geologic Data Model, Geologic Subcommittee
Geospatial Positioning Accuracy Standard, Part 5: Standard for Hydrographic Surveys and Nautical Charts, Bathymetric Subcommittee
Governmental Unit Boundary Data Content Standard, Cultural and Demographic,
Hydrographic Data Content Standard for Coastal and Inland Waterways, Bathymetric Subcommittee,
Metadata Profile for Cultural and Demographic Data,

Cultural and Demographic
Metadata Profile for Shoreline Data, Bathymetric Subcommittee
NSDI Framework Transportation Identification Standard, Ground Transportation Subcommittee

Standard Proposal Development Stage

Biological Nomenclature and Taxonomy Data Standard, Biological Data Working Group
Transportation Data Content Standard, Facilities Working Group
Universal Grid Reference System, Public X-Y Project

GIS Standards Infrastructure

The GIS Standards Infrastructure, a specific subset of the global standards infrastructure, provides an institutional structure and process for coordinating and integrating the development of GIS standards [Figure 2]. Figure 2 denotes an infrastructure comprised of formal and informal organizations doing GIS standardization at government, national, regional, and global levels.

In the American experience, the organization traditionally responsible for the development of standards for US government organizations is the National Institute of Standards and Technology (NIST), former the National Bureau of Standards (NBS). The reason why the Federal Geographic Data Committee (FGDC) in Figure 2 at the government level is in both the Standards Organization and the User/Industry Organizations columns is because in 1994 FGDC was also assigned a standards development role by Executive Order 12906.

At the national level, which includes the government, public and private sectors, and academia, the formal organization for coordinating and certifying standards organizations is the American National Standards Institute (ANSI). The Open GIS Consortium (OGC) and the National States Geographic Information Council (NSGIC) operate at the national level. NSGIC is an organization of state GIS representatives and has a GIS standards committee. Other professional societies such as the Urban Regional Information Systems Association (URISA), American Congress on Surveying and Mapping (ACSM), American Society of Photogrammetry and Remote Sensing (ASPRS), and

GIS Standards Infrastructure

Standards Organization	Standards Scope of	User / Industry Organizations
National Institute of Standards and Technology (NIST) Federal Geographic Data Committee (FGDC)	Government	Federal Geographic Data Committee (FGDC)
American National Standards Institute (ANSI)	National	Open GIS Consortium (OGC) National States Geographic Information Council (NSGIC)
European Committee for Standardization (CEN)	Regional	Digital Geographic Information Working Group (DGIWG) European Umbrella Organization for Geographic Information (EUROGI) Permanent Committee on GIS Infrastructure for Asia and the Pacific
International Organization for Standardization (ISO)	International	International Cartographic Assoc. (ICA) International Hydrographic Bureau (IHB) Open GIS Consortium (OGC)

Figure 2

Mapping (ACSM), American Society of Photogrammetry and Remote Sensing (ASPRS), and Association of American geographers (AAG) also have GIS standards committees and representation on ANSI/NCITS L1, GIS Technical Committee. L1, GIS also has members from academia, industry, and the government. The reason why OGC is also at the national and international levels is because OGC started in the US but later became international. OGC is still a member of L1, however, it maintains only an observer status. In order to maintain a neutral and international position, OGC will not involve itself in establishing a US position in matters of international GIS standardization.

Regionally, the US experience does not include GIS standardization at the regional level. Hence, the best example is the European Committee for Standardization (CEN). CEN Technical Committee 287, Geographic Information has representation from the 16 countries comprising the European Union. Unlike, voluntary standards such as ANSI or ISO standards, CEN standards are mandatory and take precedence over national standards when there is a conflicting circumstance. User groups at the regional both develop and adopt GIS standards. The Digital Geographic Information Working Group (DGIWG) is comprise of North Atlantic Treaty Organization (NATO) countries but is not an official part of NATO. DGIWG does develop GIS standards. The European Umbrella Organization for Geographic Information (EUROGI) and the Permanent Committee for GIS Infrastructure for Asia and the Pacific adopt GIS standards developed by standards organizations.

Internationally, the International Organization for Standardization (ISO) serves as the formal standards body. ISO/TC 211, Geographic Information/Geomatics has approximately 40 member nations along with observers, internal and external liaison organizations. At the global level, the International Hydrographic Bureau (IHB) and organizations such as the International Cartographic Association (ICA) will adopt ISO standards. At the global level, OGC does develop interoperability specifications for geoprocessing software. A simplistic way to differentiate the work between ISO and OGC efforts is: ISO is comprised predominantly by users developing spatial data standards, while in OGC, GIS vendors are developing industry software standards.

21st Century - Where are We Going

During the dawn of the 21st century, GIS standards will be under going implementation and deployment. The major mechanism for this deployment will be the evolving Global Spatial Data Infrastructure (GSDI). The basic component of the GSDI is the spatial data infrastructure.

Spatial Data Infrastructures (SDI)

The establishment of spatial data infrastructures at the national, regional, and global levels is the international response to the challenges of organizing and using geographic information. Spatial data infrastructures (SDI) at the national and regional levels are collectively stimulating the emergence of the global spatial data infrastructure. A spatial data infrastructure for a country is considered the national spatial data infrastructure (NSDI), which can vary by country. A regional spatial data infrastructure (RSDI) is comprised of several NSDIs and/or by a number of countries, in which a NSDI may or may not be present. Accordingly, linking national and regional spatial data infrastructures forms the global spatial data infrastructure (GSDI).

National Spatial Data Infrastructure (NSDI)

A national spatial data infrastructure formalizes the structure and process for organizing, using and sharing spatial data common to a broad spectrum of applications and users within a country. The concept of a spatial data infrastructure is not new. The need was recognized several years ago. In 1990, the Federal Geographic Data Committee (FGDC) in the United States of America began such an initiative. This effort received substantial visibility when President Clinton issued Executive Order 12906, April 11, 1994 to formally

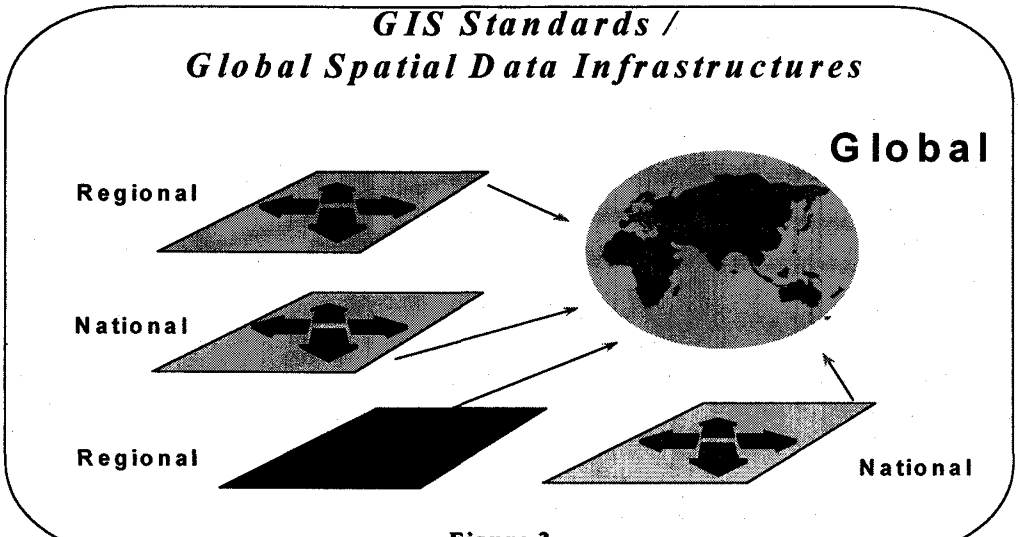

Figure 3

establish the National Spatial Data Infrastructures (NSDI) and the Secretary of the Interior, a member of the President's Cabinet, personally chaired the FGDC. Other countries such as the United Kingdom, Australia, New Zealand, Japan, Korea, and Canada have also established their own NSDI recently.

Regional Spatial Data Infrastructure (RSDI)

Currently, there are three emerging regional spatial data infrastructures (RSDI). The European, Asia and the Pacific, and Americas regions are actively engaged in coordinating the development of an RSDI in their own region.

The European community, under the leadership of the European Umbrella Organization for Geographic Information (EUROGI), established the European Geographic Information Infrastructure (EGII). EUROGI serves as the umbrella organization for 16 national geographic information associations, six pan European organizations, and includes a number of observers.

The Permanent Committee on GIS Infrastructure for Asia and the Pacific is developing the Asia and the Pacific Spatial Data Infrastructure (APSDI). The Permanent Committee has made progress in approving the Statutes and Rules of Procedure and organizing its working groups and their work plans. The formation of the Permanent Committee on GIS Infrastructure for the Americas, modeled after the Permanent Committee on GIS Infrastructure for Asia and the Pacific, is expected in early part of 2000.

Spatial Data Infrastructure Components

Standards, technology, data policy, and institutional framework are emerging as the four major components of a spatial data infrastructure, common to the national, regional, and global spatial data infrastructures. For standards: GIS standards are also based on information technology standards and the GIS standards infrastructure needs to be understood, adopted, and utilized within the broader structure of a spatial data infrastructure. For technology: there is acknowledgment that GIS technology is also founded upon generic information technology, which accentuates the need for GIS technology to be fully integrated with the emerging Global Information Infrastructure (GII). For policy: many policies need to be developed, with an international viewpoint, regarding all aspects of digital spatial data. For institutional framework: agreements must be ratified for coordinating the formation and linking of national and regional spatial data infrastructures to form the global spatial data infrastructure.

Another important aspect of the global spatial data infrastructure is the concept of framework data. Framework data are those basic datasets upon which most other datasets could be built. Some of the basic datasets identified include: geodetic, cadastral, hydrography, transportation, boundaries, elevation, and digital orthoimagery datasets. It is recognized that the underlying dataset for framework data is the geodetic network, which provides consistent global geo-referencing for spatial datasets that are created or derived.

The Global Spatial Data Infrastructure and the GIS Standards Infrastructure

The correspondence of levels between the GIS standards infrastructure and those of the global spatial data infrastructure facilitates the integration of spatial data. GIS standards can integrate horizontally across a spatial data infrastructure level and vertically integrate between various levels. GIS standards provide the horizontal integration of spatial data at each of the federal government, municipal, county, and state levels while providing the vertical integration of these levels to form the national spatial data infrastructure.

Similarly, GIS standards also provide the horizontal integration of spatial data across each of the national and regional levels, while providing the vertical integration of these levels to form the global spatial data infrastructure. Equally significant, the global spatial data infrastructure serves a major role in the development, deployment, and implementation of international GIS standards. The success of standards, in turn, determines the viability of the global spatial data infrastructure.

The GIS standards infrastructure, a specific subset of the global standards infrastructure, provides an institutional structure and process for coordinating and integrating the development of GIS standards. The levels of the GIS standards infrastructure correspond with the global spatial data infrastructure. This correspondence in levels reflects common coverage in organizational jurisdiction and applicability. At the government and national levels, there will be some variation depending on the political and cultural composition of a particular country. The term regional, in the context of the GIS standards infrastructure and the global spatial data infrastructure, applies to a grouping of countries. Regional can also be applied to a grouping of cities, counties, and provinces - depending on the country and its composition.

Conclusions

There have been three GSDI Conferences to date. The last one was held in Canberra, Australia in November, 1998. The theme for this last conference was institutional framework and policy. Most international participants feel that there has been some definite progress in the establishment of the GSDI. The next two GSDI Conferences will be held in South Africa and Colombia in years 2000 and 2001 respectively. The GSDI Conferences and the recent United Nations Regional Cartographic Conferences have endorsed the standards and efforts of ISO/TC211. The Global Mapping Project is adopting the ISO Metadata Standard and has also become a Class A Liaison to ISOTC 211.

The Global Mapping Project is an international effort to create the Global Map. The Global Map, a global group of geographic datasets of known and verified quality with consistent specifications, publicly available, and distributed at nominal cost, is vital for understanding global environmental problems, mitigating natural disasters, and realizing social improvement and economic growth within the context of sustainable development. The Global Mapping Project is administered by the International Steering Committee for Global Mapping (ISCGM) and the Geographical Survey Institute of Japan serves as the Secretariat for ISCGM.

While the Global Mapping Project represents an approach to implementing the GSDI, the actual GSDI implementation will probably be a virtual spatial database comprised of networks of spatial databases observing the policy, procedures, and standards endorsed and supported by GSDI participants.

In conclusion, GIS standards will become obsolete and change with the emergence of new technology. It is GIS standardization that will accommodate these changes and the development of new GIS standards - so long as the GIS standards infrastructure and processes are preserved.

Refereences

[1] Cargill, Carl F., (1989): Information Technology Standardization: Theory, Process, and Organizations, Digital Press.

[2] United Nations, Economic and Social Commission for Asia and the Pacific (1998): GIS Standards and Standardization: A Handbook, New York.

[3] National Bureau of Standards, (1980): Data Elements and Representations: Standardization; Automated Earth Science Systems Use (Memorandum of Understanding with U.S Geological Survey). Federal Register, Volume 45, No.77, Friday April 18, 1980 NOTICES, 26408.

[4] Clinton, W.J. (1994): Coordinating Geographic Data Acquisition and Access: The National Spatial Data Infrastructure. Federal Register, April 13, 1994, Vol 59. No. 71, Executive Order 12906, pp 17671-17674.

[5] Portions of the text for the sections on the GIS Standards Infrastructure and Global Spatial Data Infrastructures are from:

[6] Tom, Henry, (1997): Standards for the Global Spatial Data Infrastructure (GSDI), Fourteenth United Nations Regional Cartographic Conference for Asia and the Pacific, Bangkok, 3-7 February, 1997 and Sixth United Nations Regional Cartographic Conference for the Americas, New York 2-6 June 1997.

[7] Tom, Henry, (1996): Global Geospatial Information and Services: A Vision for the Future, Proceedings of the Emerging Global Spatial Data Infrastructure Conference, Bonn, Germany, 4-6 September 1996.