UNIT 69 - GIS STANDARDS

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A. INTRODUCTION

- this unit is based largely on information from Exler (1990) and Tom (1990)
- standards are needed as GIS users attempt to integrate their operations with other hardware, GISs and data sources
- challenge is to get industry, government and users to implement and promote the use of standards
- many standards are set simply through common use, though major attempts are currently being made to develop broad ranging national and international standards

Reasons for standards

1. Portability of applications
   - need the ability to move developed applications to new hardware platforms in order that development efforts are not duplicated and can be shared

2. Data networks
   - need ability to access digital data which is distributed through various offices, agencies, states and even countries

3. Common environments
   - if applications use similar operating environments, learning curves are reduced and productivity is increased

3. Cost of program development
   - standards are important to software developers as they reduce the need to develop interfaces for many different data formats, operating systems, plotters, etc.

Standards organizations related to GIS

overhead - Standards Organizations

- the following is from Exler (1990)

ANSI - American National Standards Institute

- approves standards for US industrial and commercial sectors

DCDSTF - Digital Cartographic Data Standards Task Force

- combines FICCDC-SWG and NCDCDS for digital cartographic standards

FICCDC-SWG - Federal Coordinating Committee on Digital Cartography - Standards Working Group
- formed by the Interagency Coordinating Committee - Office of Management and Budget to serve as a focal point for the coordination of digital cartographic activities

FIPS - Federal Information Processing Standards
- official source of information processing standards for federal departments and agencies

IEEE - Institute of Electrical Electronics Engineers
- develop standards for a broad range of subjects, including information processing

ISO - International Standards Organization
- approves standards for the international community through national standards bodies such as ANSI

NCDCDS - National Committee for Digital Cartographic Data Standards
- formed by ACSM (American Congress on Surveying and Mapping) and funded by USGS

NIST - National Institute of Standards and Technology
- formerly the National Bureau of Standards
- oversees standards activities for the government
- recently opened a GIS laboratory

OSF - Open Software Foundation
- a vendor consortium of IBM and Digital Equipment Corporation

UNIX International - a vendor consortium of AT&T and SUN

X/Open - a nonprofit independent consortium of 19 computer manufacturers representing 160 software developers from 17 countries attempting to define standards for a complete computing environment

B. TYPES OF STANDARDS FOR GIS

Operating system standards

- for micro-computers, most GIS use the DOS operating system, though applications are being written for OS/2 and Macintosh
- UNIX appears to be the current popular operating system for the powerful workstations and mainframe computers, though there are several other well accepted and newly developing options

User interface standards

- affect the "look and feel" of GIS programs
- windowing is becoming popular as a standard in GIS and as well as most other applications
- at the micro-computer level:
  - for PC computers, Presentation Manager available under the OS/2 operating system and as Microsoft Windows in DOS is becoming the standard
  - Macintosh operating system has always been a windowing environment
- X-Windows is the de facto windowing standard for UNIX and other mainframe and workstation operating systems
  - this allows different vendor's hardware to support a common interface in a networked environment

Networking standards

are critical to allow communications between remote computers
    - networked environments are increasingly popular for GIS as the technology and data becomes widely used within organizations

Database query standards

- SQL (standard query language) is emerging as a standard across the data processing spectrum, though in its current form it is limited in its ability to handle spatial queries

Display and plotting standards

- several standards have emerged in this area simply as a result of the popularity of specific hardware devices

- these include:
    - CalComp and HPGL - line plotter formats
    - Postscript - raster, page oriented graphics

Data exchange standards

- the largest standardization effort is currently being directed at this area

- US Federal government has recognized the need to exchange data between different agencies (see Unit 68) and has formed committees to examine aspects of this
    - note work done by NCDCDS, FICCDC and DCDSTF
    - current efforts are directed towards the development of the Spatial Data Transfer Specification (SDTS) (see Tom (1990) for more details on SDTS)
    - the Defence Mapping Agency's digital cartographic data standard DIGEST is part of an effort to establish standards within the international defense community, e.g. NATO

- however, there are several common data exchange formats currently in use (see GIS World, 1989)

- these include: overhead - Spatial data exchange formats

  USGS DEM- Digital Elevation Model

    - format used by the USGS since early 1980s for gridded elevation data
    - allows a single attribute per cell

  USGS DLG - Digital Line Graph

    - all features of the USGS quadrangle map series are supported by this format
    - is the most widely used format for exchange of digital cartographic data
    - used primarily for coordinate information though it does support alphanumeric attributes

  GBF/DIME - Geographic Base File/Dual Independent Map Encoding (Census Bureau)

original Census Bureau digital files developed in early 1970s
- allows both coordinate and attribute data

TIGER - Topologically Integrated Geographic Encoding and Referencing (see Units 8 and 29)

IGES - Initial Graphic Exchange Specifications (National Bureau of Standards)

- used extensively for the exchange of CAD and CAM data
- only one attribute per feature

SDDEF - Standard Digital Data Exchange Format (NOAA)
- primarily used to exchange data between NOAA, Defense Mapping Agency and the Federal Aviation Administration
- only supports point data

SIF - Standard Interchange Format (Intergraph)
- developed to support exchange of data between Intergraph and other systems
- popular data exchange format for many GIS packages

MOSS - Map Overlay and Statistical System (US Fish and Wildlife)
- originally developed as part of the MOSS GIS
- a non-topological format for vector data with translators to several common spatial data formats
- now used by several federal and local government agencies

DXF - Digital eXchange Format (Autodesk)
- developed by Autodesk, Inc. for AutoCAD
- like SIF is a popular data exchange format for many GIS packages

C. IMPLEMENTING STANDARDS

- several issues are related to the implementation of GIS standards

Start-up costs

- implementation of a standard can incur substantial costs in terms of money and time

- will be major short-term costs related to user training and reprogramming of software

Management support

- management needs to recognize the positive impacts of standards on productivity and system costs and be willing to commit short-term resources for retraining and reprogramming

Technical tradeoffs

- adopting of standards require tradeoffs between functionality and performance

- standards provide for broad functionality
  - e.g. adopting software that uses a standard data exchange format allows access to a broad range of data sources
  - e.g. adopting a standard operating system provides access to a large library of existing applications

- however, standards by their very nature, do not allow fine tuning to specific hardware or applications
  - e.g. plotter standards may not make the optimum use of the hardwired capability of your plotter

- some de facto standards are neither efficient nor the best available
  - many exist simply due to the original popularity of the hardware or software, even though they may no longer be the state-of-the-art

Potential for security risks

- wide availability of common operating systems allow for misuse and exploitation
  - e.g. the spread of computer viruses depends on common operating systems

Innovation

- broadly accepted standards make it very difficult to introduce innovations

D. WHAT TO STANDARDIZE?

- the majority of standards effort in GIS to date has concerned data formats

- standards such as DIGEST provide standard record layouts, coding schemes

- although formats are standardized, these efforts deal primarily with the structure of the data, and not with its meaning

- data may be written into a standard format for transfer, and thus be readable by some other system, but it may still be virtually meaningless without extensive documentation

- the SDTS goes well beyond format standards by defining standard meanings for terms
  - e.g. SDTS attempts to remove the confusion over the use of arc, link, edge, chain, segment in GIS by establishing a standard term for every type of object

- the USFS effort to establish a corporate database may similarly yield standards of meaning, e.g. standardized definitions of GIS layers, at least within this organization

- still missing is a standard of data models that would provide standard ways of representing geographic phenomena
  - e.g. for digital elevation data, should the standard include all of contours, DEMs and TINs?
    - should there be standard resolutions for DEMs?

        - should there be standards of vertical accuracy?

- also missing are standards of data accuracy for GIS
    - map accuracy standards deal only with cartographic features
    - e.g. a GIS standard for digital elevation data might specify the accuracy of elevation for any point in an area, not the accuracy of positioning of a contour

- such standards would provide the GIS user with expectations about the reliability of the database as a window on the world, rather than a window on source documents, or a window on transferred databases

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EXAM AND DISCUSSION QUESTIONS

1. Standards can be imposed from above, or emerge through consensus. Discuss the pros and cons of top-down and bottom-up approaches to GIS standardization.

2. How successful do you think DXF can be as a GIS exchange standard? What aspects of information exchange does it standardize?

3. Review the approach taken by SDTS to standardizing the use of the term "chain".

4. "SDTS is a standard for cartography, not GIS" - discuss.

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