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Topic (iii): Internet and Intranet solutions

USING THE INTERNET TO MAXIMISE YOUR GIS INVESTMENT

Submitted by Statistics Canada[1]

Invited paper

ABSTRACT

Many statistical organisations have made significant long-term investments in creating a GIS infrastructure required for census purposes. These investments include the purchasing of computer hardware, GIS software and the human resources to create the spatial databases. Usually, this GIS infrastructure is only accessible and used by a small group of GIS professionals. This paper reviews Statistics Canada's experience in creating a Corporate Geographic Infrastructure and in developing Internet-based GIS tools and applications to maximise the access and use of the Spatial Data Infrastructure.

I. BACKGROUND

1. The use of GIS in statistical organisations is primarily for census purposes. Traditional cartographic techniques were used in the delineation of census boundaries (pre-census), household assignment (collection) and dissemination of census results (post-census). Statistical organisations benefited from the use of GIS by reducing their costs and timeframe to collect, process and disseminate census data through the automation of mapping processes.

2. The shift from traditional cartographic methods to digital GIS techniques requires a significant investment. There are initial short-term costs, which are very high and ongoing long-term expenses. Short-term costs include the conversion of analogue information to digital data, the purchasing of computers, GIS software and other spatial data, and the hiring and training of staff. Longer-term costs include ongoing operational expenses such as system maintenance and upgrades, spatial database updating and staff training. A GIS infrastructure must be viewed as a long-term investment to maximise its benefits.

3. The benefits of a GIS are both tangible and intangible. Efficiency gains can be measured through cost savings and increased productivity through automation of production processes, such as the production of maps and the creation of census boundaries. While intangible benefits, which cannot be measured quantitatively, include the capacity for spatial analysis and the integration of data sets for improved policy formulation.

[1] Prepared by Phil Fong.

II. CORPORATE GEOGRAPHIC INFRASTRUCTURE

4. At Statistics Canada, the Geography Division provides the geographic and cartographic base requirements for the census. GIS activities and funding have been linked to support the census on a five-year cycle. However, it was recognised that continual on-going maintenance and updates on the spatial database and GIS technology would be necessary if the Division were to broaden its role and meet the requirements of other clients within the organisation.

5. Consequently, the Division embarked on a new strategic plan to create a Corporate Geographic Infrastructure (CGI) that would support the geographic requirements of Statistics Canada's collection, dissemination and analytical activities, not only that of the census. The CGI focussed on three major components: 1) the development of the Spatial Data Infrastructure (SDI), 2) a partnership with Elections Canada to increase and update the digital spatial database1 and 3) the development of new web based GIS tools to allow users to access and use the SDI.

6. A new improved spatial data model developed for the SDI is based on the street layer, which is used as the building block for census boundaries. The SDI consists of a spatial database and an integrated attribute database that includes the address register, postal code and other geographic area variables. New tools were built to automate procedures and to improve the efficiency of maintaining and updating the spatial database.

7. For the 1996 Census, the spatial database consisted of digital files in urban areas and analogue data (paper maps) for the remainder of Canada. The digital files covered approximately three percent of Canada's land area but approximately 65% of its population. In partnership with Elections Canada, a project was formed to create a full national digital coverage for the 2001 census. National Topographic Database (NTBD) digital files from National Resources Canada were purchased at 1:50,000 and 1:250,000 scale. Over 1,200 map sheets were joined or rubbersheeted together with the road layer updated with road names and address ranges. At completion, there will be a seamless digital spatial database for Canada with a completely integrated attribute database.

IV. ENTERPRISE GIS

8. Geography Division has built a mature GIS infrastructure environment, which is used primarily for the census activities. A few other sophisticated GIS users within Statistics Canada use the spatial database created by the Geography Division for their own specific applications. For other areas, the costs of creating a GIS section have been an impediment in utilising this technology.

9. The Enterprise GIS project began in 1997 as a research and development project to explore ways in which GIS capability and access to spatial data could be made available to as many users in Statistics Canada as possible. The vision was to have users access spatial and subject matter data using a geographic interface to display and analyse information through customised applications.

10. The Enterprise GIS project team envisioned the Internet to be the ideal platform to provide maximum usage of our corporate spatial database. The Internet was an emerging distribution technology that was being used widely and rapidly by many people. Users were accustomed to searching and accessing information through Web-based applications. This trend was recognised by GIS software vendors and they began developing their products to operate in this environment.

11. It was the objective of the project to bridge the complex nature of GIS with an user friendly interface that would provide GIS capabilities to users in a clear and simple manner. From an end user perspective, the acquisition of PC or Unix-based GIS software and the computer hardware is expensive. But this is not the only cost. Skilled GIS trained technicians are also required to build, maintain and operate a GIS system.

12. Internet based GIS systems are ideal for dissemination activities. Most users want to be able to use GIS functionality to access and display information. Other sophisticated users want to have advanced spatial analysis capabilities. These GIS functions can be provided to all users through a Web browser because new Internet GIS tools have been developed by software vendors. A Web server centrally maintains a current spatial database that is accessed by web applications. These applications are typically customised to meet specific user needs or generic applications for accessing spatial and related data.

13. The Internet environment further allows for efficiencies in a distributed server model. Subject matter data can be housed in remote data servers and be related to a spatial data server by a common geographic key. This allows for the integration of subject matter data that is crucial for the spatial analysis needs of a statistical agency. Individual subject matter areas would be responsible for maintaining and updating their own data servers. The system allows for great flexibility and is seamless to the end user.

14. In order to provide a rapid application development environment, a mapping toolbox concept was developed. This toolbox contains specific GIS functions that developers use to build custom applications. A standard set of basic mapping tools include navigational (zoom in/out, pan), search (by place name, street, postal code, census geography, etc) and display (reference layers, identify, label, thematic map) capabilities. More advanced GIS functions include spatial analysis tools (buffering, overlays) and feature adding/updating (add new features, update feature fields). These tools provide much of the GIS functions required by a majority of GIS users within the statistical organisation.

IV.1 Web Applications

15. Internet and Intranet web servers have been created and are maintained at Statistics Canada. The Intranet server provides web-mapping services to internal Statistics Canada subject matter areas and the Internet server serves external federal government organisations. Access to these web applications varies from full access for the general public to restricted access for certain users. The Web mapping applications serve various purposes. The most common functions provide web applications with a geographic search tool and map display capabilities. Other more sophisticated applications include data entry and update functions to spatial analysis tools.

IV.2 Open Access Sites

16. Following are examples of Internet applications that illustrate the various uses and levels of sophistication of Web-based mapping services.

17. ***Statistical Profile of Canadian Communities*, Statistics Canada**
http://ww2.statcan.ca/english/profil

The Statistical Profile of Canadian Communities provides free 1996 Census data for four themes including, Population, Education, Income and Work and Families and Dwellings for close to 6,000 communities and for 137 large to smaller metropolitan areas in Canada. The mapping application displays the location of the community and navigational tools to select other communities.

18. ***The Great Canadian Guide to Museums and Galleries*, Canadian Heritage Information Network, Heritage Canada**
http://daryl.chin.gc.ca/Museums/English/index.html

The Great Canadian Guide is an on-line gateway to over 2400 museums and galleries in Canada. Users can search and identify by place name or museum and display the location of the selected museum.

19. ***Canadian Business Map*, Industry Canada**
http://strategis.ic.gc.ca/scdt/bizmap/nav.html

The Canadian Business Map is an Internet site, which provides quick and seamless access to international, national, provincial, territorial and municipal business information. The mapping application provides thematic mapping of population and dwelling data and display of user selected reference layers such as roads and airports.

20. ***Meal and Entertainment Expenses Search Map*, Revenue Canada**
http://www.ccra-adrc.gc.ca/tax/business/smallbusiness/searchmap-e.html

For business taxation purposes, the deductions of business meal and entertainment expenses are generally limited to 50%. However, if a site is at least 30 kilometres from the boundary of the nearest urban area that has a population of at least 40,000 people, 100% of the meal and entertainment expenses can be deducted. The search map calculates the distance between the user defined place name and the nearest urban area. The application displays a map and the calculated distance so the user can deducted the proper business expense.

IV.3 Closed Access Sites

21. The closed access web-sites are custom designed to provide specific GIS tasks for the clients. These sites use more sophisticated GIS functionality such as the edit and update tools and spatial analysis capabilities. The sites are used to add and update street information and their attribute fields, locate delinquent census households, assign place of work data and determine grant applications.

V. CONCLUSION

22. Statistical organisations invest significant resources in building and maintaining GIS systems to support census operations. The GIS system is usually used and accessed by only a small group of GIS professionals. To achieve the full benefits of a GIS system, more users must have access through user friendly GIS applications in their statistical activities. As well, the spatial database has to be designed in a method that supports the geographic requirements of other statistical areas and not just the census. New Internet GIS tools allow users to access and perform GIS functions directly through web browsers, largely eliminating the cost to the user of developing a GIS system. Internet mapping is important technology that will maximise the benefit of an organisation's GIS investment.