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Maps and the Internet: Polarizing Contrasts in Development

M. P. Peterson
Department of Geography / Geology
University of Nebraska at Omaha
mpeterson@unomaha.edu

ABSTRACT

The era of maps and the World Wide Web spans less than a decade and a half and yet it is already characterized by widely divergent, almost polarizing, areas of development. These sharp contrasts are evident in the available file formats for online maps, server/client relationships, commercial vs. open source software, desktop vs. mobile Internet access, and the widely divergent savvy of the user audience. To better understand how maps are being transformed for the Internet, and what future developments might be, it is necessary to recognize these sharply contrasting areas of development.

INTRODUCTION

Maps as a form of communication have benefited dramatically as a result of the introduction of the World Wide Web in the early 1990s. Millions of maps are now being distributed to Internet users on a daily basis. People now look to the Internet to find all manner of maps. The Internet has clearly become the new medium for cartography.

An interesting aspect of Internet cartography is the widely divergent methods of map distribution. Such stark contrasts in technology are inevitable in any immature technology but the differences are important to examine, both to understand the advantages and disadvantages of each approach as well as to envision future needs and developments.

Five areas of Internet cartography are examined here, along with the contrasts inherent in each. These areas include file formats, server/client relationships, software, Internet access, and differences between users. The purpose is to provide a better understanding of the current status of maps and the Internet and develop a better understanding about possible future developments.

2.0 File Formats

Internet cartography is largely dependent on the available graphic file formats. Of the available formats, both raster and vector, each has unique characteristics for maps.

2.1 Raster

The long-standing contrast between GIF and JPEG is an example of the online polarization. GIF, introduced in 1987, uses a palette of only 256 colors and the loss-less LZW compression method. A patent controversy limited the use of the format for a number of years. Now 20 years old, the format is still widely used. Google returns 32.7 million GIF files for the keyword “map”. These are all either scanned paper maps or produced directly by a computer program. There are many more GIF format maps on the web that are not listed under the “map” keyword.

The introduction of JPEG coincides almost precisely with the World Wide Web in 1994. Designed specifically for pictures and supporting up to 16.7 million colors, JPEG uses a lossy compression method that results in some loss in visual quality. The complicated form of compression is particularly noticeable with lines that become “washed-out” with compression artifacts visible around the line. The designers of the format clearly were thinking of pictures and not maps with lines. Nevertheless, the format is widely used for maps. Google returns 35.7 million hits for this format with the "map" keyword. Each language would have its own set GIF and JPEG maps. The German version of Google returns 3.5 million hits for "karte" – the German word for map.

To solve some of the limitations of both the GIF and JPEG formats, a third format was developed – PNG. The format supports a lossless compression scheme and 16.7 million colors but can be 10 times the size of a comparable JPEG file (Wikipedia 2007). Released in 1996, the format is not as widely used as either GIF or JPEG. The "map" keyword returns only 4.7 million results in Google although the format is clearly superior to JPEG for linework and can display more colors than GIF.

2.2 Vector / Combined Formats

In comparison to common raster file formats, specifications that support vector graphics are multipurpose in that they can display both vector and raster graphics. The three common online vector file formats – PDF, SWF, and SVG – have similar contrasts.

Like GIF, Adobe's Acrobat Page Description Format (PDF) precedes the World Wide Web. Introduced in 1993, the format was designed for encoding documents – including 2-D and later 3-D graphics. Slow to be accepted at first, Adobe eventually made the Acrobat PDF reader available for free, has become the de facto standard for printable documents – even official documents distributed by governments. Based on PostScript, the format was specifically designed for high-resolution, PostScript-enabled printers. The text-based format produces large files, and viewing the files requires the initiation of a large plug-in. One common reaction of users to PDF files is to click the "Back" button because the process of starting the plug-in and displaying the file is too time-consuming.

In sharp contrast to PDF is Macromedia Flash – now Adobe Flash – originally introduced in 1996. The SWF (ShockWave) format that Flash uses is compact and specifically designed for delivery through the Web. Comparable files are 1/4th to 1/10th in size to PDF. Although it also requires a plug-in, the initial installation is effortless and subsequent loading is much faster than Adobe Acrobat. The ease in installation has made Flash the most widely distributed browser plug-in in the world with over 95% penetration. While its success in creating annoying animated advertising banners has also given it a bad reputation, it is still the most compact way of distributing vector graphics, and animations, through the web. One lesson of Flash are that users prefer a clean and simple user interface, but developers prefer open, free, standards-compliant tools. That brings us to SVG.

The third point in the online vector graphics triangle is Scaleable Vector Graphics (SVG), an open-standard endorsed by the World Wide Web consortium (W^{3}C). Based on XML, SVG generated considerable interest by cartographers and even a dedicated website (http://www.carto.net) that includes example applications. It is similar to Flash in that it offers anti-aliased rendering, pattern and gradient fills, sophisticated filter-effects, clipping to arbitrary paths, text and animations. Initially, the format also required a plug-in that Adobe supplied at no cost. Adobe announced in 2006 that it would no longer support the plug-in. At the same time, Firefox, an open source browser that has gained wide acceptance, supports SVG natively without the need for a plug-in. Unfortunately, the level of SVG support is not the same as Adobe's plug-in. Also, SVG files can be very large – larger even than PDF. For these reasons, the format is not widely accepted although SVG is clearly superior from a graphics perspective to both PDF and Flash SWF. Interest in SVG has stagnated even among the most loyal adherents in the open source community.

3.0 Server/Client Contrasts

All Internet maps are based on some sort of client/server interaction. In the simplest case, the server responds to the client with a static file, such as a scanned map. The next level of client/server interaction involves a spatial database on a server. In the case of a map server, the query might lead to the return of a user-specified map, usually in raster format, that is embedded within a web page. Finally, there is a different kind of server/client interaction based on a new amalgam of technologies called AJAX (Asynchronous Javascript and XML).

3.1 Polarized Servers

A major contrast in map servers is between those that implement AJAX and those that don't. The purpose of AJAX is to make web pages feel more responsive by sending small amounts of data to the client behind the scenes so that the entire web page does not have to be reloaded each time the user requests a change. This is intended to increase the interactivity, speed, functionality, and usability of the web page. Implemented by Google Maps and a number of other sites, this technology has resulted in much faster map updates speeds and levels of interaction. But, special software is required on the server to facilitate AJAX server/client interactions – and the spatial data must also be reformatted to the appropriate "chunks" to be downloaded in the proper way. It will take many years to transform all existing map servers to AJAX.

3.2 Polarized Clients

In addition to different capabilities on the part of the server, the client can be configured in thin and flat variations. A "thin client" is a browser that has not been augmented with plug-ins. A "fat-client" will have a number of added plug-ins – some that may even be proprietary and require a license. A basic consideration in any online mapping project is whether a thin- or flat-client will be required in order to view the maps.

4.0 Polarized Software Development

4.1 Open Source

The Web has also fostered polarization in software development. While companies have been active in creating programs for the Internet, the Internet has cultivated an open source community of programmers around the world that contribute their time to the development of free software. Open source has vociferous private sector critics who suspect that any software written by "idealistic nerds, and made available for free to anyone who wants to download it," must be a plot against western business (The Economist/Technology Review 2007). Zealous believers in the open source movement, meanwhile, envision open source triumphing over the "evil empires" of commercial software. The clash is often depicted as an "epic struggle for supremacy between Linux and Microsoft's proprietary Windows operating system" (The Economist/Technology Review 2007).

4.2 Development

The beginnings of the open source concept can be traced to the confrontation between Netscape and Microsoft in the mid-1990s. After Microsoft introduced its Explorer browser in 1996, the company made it very difficult for the Netscape browser to be installed under the Windows operating system. Eventually, Netscape, which had nearly 100% of the browser market share before 1996, rapidly lost its market share to Explorer and decided to release its source code as free software. The term "open source" was suggested to avoid the connotations associated with the word "free."

Open source software is based on the work of small groups of people from around the world working tirelessly together for little or no monetary benefit to create products that are ultimately provided for free to anyone who is able to download them. The installation procedure is usually not the easiest, the user interface is often not well-developed, and updating the software is usually problematic but the products are generally stable and work well once installed. A classic example in the mapping world is Minnesota MapServer, a product that has been implemented in all parts of the world. It implements a user interface that is now seen as clunky in comparison to Google, Yahoo and MSN map services.

In the last decade, most of the important online applications that have been introduced are open source – including the Apache web server software used by nearly 60% of all web servers (Netcraft 2007). Many online developers refuse to use any commercial applications – including commercial file formats like Flash SWF and Adobe PDF.

5.0 Polarized Displays

5.1 Miniature Displays

A major transformation of the World Wide Web is occurring with the further integration of mobile devices to browse the Internet. Already a fixture in many Asian countries, especially Japan and South Korea, the cell phone is changing how people access the Internet. Virtually all new users of the Internet are accessing the World Wide Web through cell phones. New users to the Internet are no longer starting by using a computer.

Although many believe that the cell phone represents just another type of display, the size of the display is a major limitation it is clear that the small display will change how people use the Web – particularly graphic displays like maps. Although devices have been proposed with fold-out displays or with small projectors, it is unlikely that any of these devices will find their way into the pockets of most cell phone users. In some ways, the cell phone interface to the Web forces us to contemplate a non-graphic Internet. Small maps on small displays may generate some interest but they are unlikely to be useful to many people.

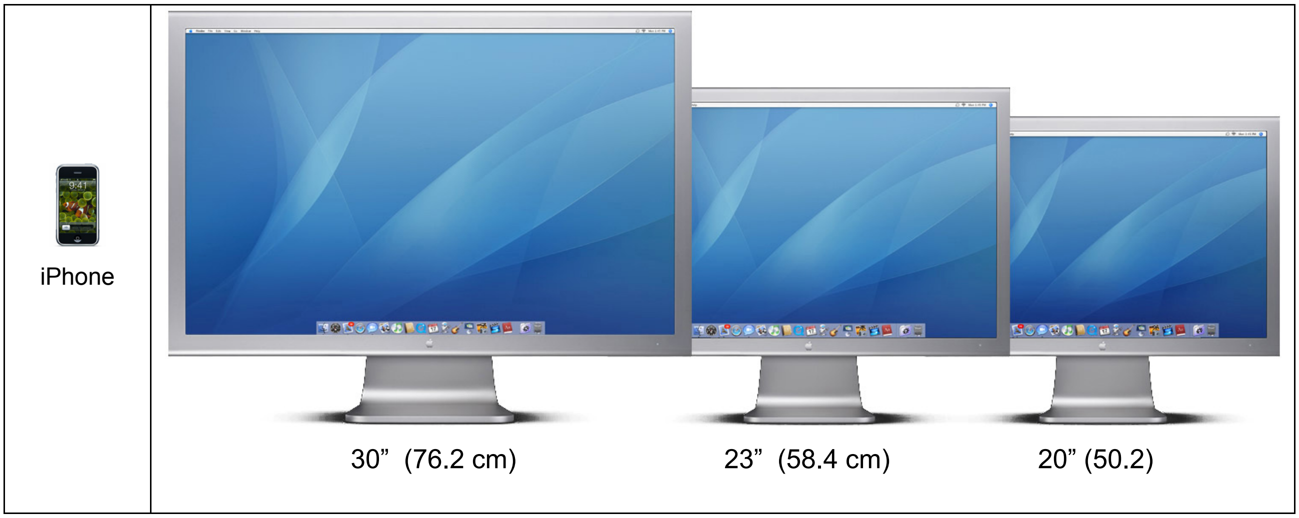

Figure 1. Apple iPhone in comparison to increasingly larger monitors

5.2 Massive and Multiple Desktop Displays

While cell phone displays are getting smaller, desktop displays are getting bigger (see Figure 1). In 2007, 19-inch displays are predicted to dethrone 17-inch monitors as the predominant size of choice. Many users are choosing 23” and 24” displays and even 30” displays. The largest current LCD display is NEC's 57-inch MultiSync LCD5710. The $15,000 display, which is targeted at the digital-signage, has a resolution of 1,920-by-1,080, a contrast ratio of 900-to-1 and a horizontal and vertical viewing angle of 178 degrees (Solheim 2007).

Another trend in desktop displays is conformance to the aspect ratio of HDTVs. Display manufacturers can save money at manufacturing plants by cutting desktop-display panels in the same wide format as LCD TV panels (Solheim 2007). New operating systems such as Vista from Microsoft and OS X from Apple are adapting to the wide space by adding buttons and control bars on the sides of the displays.

Multiple displays are also gaining favor. The market expected to see a drop-off of monitor sales with the move to laptops but this has not occurred. Not only are people buying larger displays for laptops, they are also buying a second display for desktops. This may be helped in part by a 2003 study conducted by NEC, ATI Technologies and the University of Utah, titled “Productivity and Multi-Screen Displays.” It found that multimonitor setups increased errorless productivity by 18 percent (Solheim 2007). Many desktop PCs now include dual outputs for multiple monitors as a standard feature.

6.0 Polarized Users

In addition to polarization in the development of hardware and software, people are also becoming increasingly polarized when it comes to the Internet. This is not only true when comparing people in different parts of the world, but also within the same area. The level of knowledge about the Internet and its use varies widely.

6.1 Digerati

The term “digerati,” from digital literati, is used to refer to people who are “highly skilled in the processing and manipulation of digital information; wealthy or scholarly techno-geeks” (Wikipedia 2007). Although sometimes used to refer to a select group of visionaries, the term is being increasingly used to refer to individuals who are simply more adept at keeping up with changes on the Internet. In the modern sense, a digerati would be up-to-date on the use of various aspects of the web, including blogs, vblogs, mashups, and other aspects of Web 2.0.

6.2 Falling Behind

In contrast to digerati are people who are increasingly alienated from the Web. They might use the Internet for email and web searches but are largely oblivious to the new developments and are conflicted about their predicament. On the one hand, they look down upon the digerati for wasting their time to keep up with all of the changes in technology when few of these will develop into mainstream applications. On the other hand, they feel like they are increasingly falling behind and will not be able to catch-up.

Whether for reasons of disinterest or lack of time, some people are skeptical of the value of learning the latest trends on the Internet. Technology changes quickly and one can usually skip a stage of development and still stay current – although this may become increasingly difficult. It is clear, however, that many people, even in the developed world, are losing the battle with technology – while others thrive in an environment of constantly changing communication tools.

7.0 Summary

The Internet is relatively new and it may be no wonder that the development has been so polarized. One vision of the Internet is that it would bring people together in a common online community. While this has certainly occurred to some extent, the Internet has also fostered increasing levels of polarization, both in politics and in technology. It may be that people in the age of the Internet are looking for some level of attention and recognition and the only way to accomplish this is to take increasingly polarized positions. While outliers are given more attention, progress may come more from building consensus, and this is always easier in the middle.

Maps are now closely tied to the Internet, and major developments in cartography will take place within this new medium for map distribution. While developments at the periphery may catch our attention, they may give little indication as to the direction we should be taking. Polarization shows us the extreme possibilities but not what the Internet will become.

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Problems and State of the Art of Ubiquitous Cartography

Georg Gartner
Vienna University of Technology
Vienna, Austria
georg.gartner@tuwien.ac.at

ABSTRACT

This presentation deals with current efforts at the Technical University of Vienna to analyze methods of wayfinding support for pedestrians in mixed indoor and outdoor environments. It is assumed, that methods of ubiquitous cartography in terms of a combination of active and passive systems with various presentation forms can support the wayfinding process. In this context the term ubiquitous cartography follows the definition of Ota (2004), who stated "ubiquitous mapping is that people can access any map at anywhere and anytime through the information network", incorporating also Morita's perspective (2004): "includes not only map making but also map use and map communication considering the interaction between map, spatial image, and the real world".

The main research question include the modelling of the behaviour of pedestrians and the possibility of meeting the needs/behaviour by a combination of active and passive systems. The use case includes therefore the usage of mobile devices in combination with short-range sensors and public displays. The main aim is to make the environment "smart", so that adaptively the "smart" environment delivers customised and location-dependent information for a particular user, instead of trying to permanently track and send information from centralized systems.

Results of using active landmarks and concepts of cartographic route communication in ubiquitous environments will be given and further developments will be discussed.

1 Introduction

Smart environments demand a different approach to the cartographic route communication than conventional systems. Location based services in the form of navigation systems usually require a mobile device on which several types of multimedia presentation forms inform the user about his environment. Ubiquitous environments, on the other hand, actively supply the user with information that is adapted to the current situation. Communication does not necessarily need to be conveyed via a personal device, but could also be provided on a public display or with the help of virtual personalities, called avatars. It is presumed, that a combination of active and passive systems with various presentation forms, that are harmonized with each other, support the wayfinding process best. Yet it is unclear, which presentation forms actually are valuable and effective within smart environments and which combinations are reasonable presenters of location based information without leading to an information overload.

When different hot spots are interconnected with each other, the walking direction of the pedestrian and the purpose of his visit can be found out better than in conventional navigation systems. Furthermore special interests could be transferred between the stations and could be considered in route communication. Additional to the route presentation, landmarks and points of interest, which are tailored to the user's preferences could be individually displayed.

The personal mobile phone, a public display or even an avatar could additionally inform the user about bargains in his favourite shops (in a shopping street or shopping centre), new exhibits of an artist of interest (in a museum), remaining time until the required flight takes off (in an airport), lunch break time of a colleague (in an office), etc. In case the user knows something, that could be of interest to other people, he should be able to leave geotagged bookmarks in his environment which could afterwards be used and supplemented by everyone who passes the area. Methods on how to interact with a smart environment have yet to be explored in order to enforce practicability.

The paradigm shift from passive navigation systems to route guiding within smart environments leads to new approaches and challenges to cartography. It seems like the sky is the limit, but the exhaustion of all thinkable possibilities could easily make us lose track of the original target, namely the effective route communication to individuals, which is why ontologies have to be established to specify constraints.

2 Ubiquitous Cartography

The basic assumption in this context is, that a harmonized combination of active and passive systems with various presentation forms supports the wayfinding process in indoor and outdoor environments best. A detailed investigation of the following topics is necessary to get knowledge about the context.

2.1 Analysis and development of cartographic methodology for ubiquitous route communication

Compared to outdoor environments, where maps have shown to be the most effective and favoured presentation form for navigation (Reichl 2003, Kray et al. 2003, Ortag 2005), the visualisation of indoor environments has mostly been neglected so far. Different presentation forms are imaginable when visualising a building, but their potential as route finding aids that lead a user from one room to another have not been investigated in detail. Properties and characteristics of indoor environments require different cognitive abilities than navigation in an outdoor environment (Raubal & Egenhofer 1998), which is why it is not possible to adapt outdoor navigation principles to buildings. As shown in a test by Radoczky (2003), where 22 people were guided to a special room at a university and none of the participants could immediately find the way out by themselves, orientation is the main problem within buildings.

Werner & Long (2003) suggest overcoming this problem by ensuring access to a global reference system, like a global landmark or an atrium, but unfortunately this is not always possible. Without any established knowledge about information absorption in indoor environments, most systems instinctively use floor plans as a presentation form (Long et al. 1996, Heidmann & Hermann 2003, Habel 1998). Probably these depictions are picked because of their similarity to traditional outdoor maps or because floor plans are mostly used in sciences like architecture or civil engineering. Nevertheless Radoczky (2003) tested three different presentation forms (floor plan, 3D-animation, birds-eye view) with the help of a simulation, which showed a clear preference for the visualisation of a floor plan and in some situations for a simplified 3D model of the building. Unfortunately there are no regulations concerning the design of indoor maps and 3D presentations concerning navigation. Legend symbols and colour management are often randomly defined or similar to the symbolisation of CAD-programs, like the visualisation of windows, doors, sewers, elevators, different types of walls etc. Another more innovative method to present routes to users is the visualisation of avatars, virtual persons that appear in the sight of the user any time help is needed. They seem completely detached from conventional presentation forms, yet they are more complex in design. The required functionality of avatars, that guide the user along the desired way as a navigation systems is yet unclear and needs further investigation.

2.2 Annotating and interacting with the environment

One of the great advantages of ubiquitous systems is the potential to directly interact with the environment. Information may not only be received by the user but can also be added to the smart environment by individuals. The idea originally evolves from Wikipedia, a free online encyclopaedia, which can be updated and complemented by everybody who considers himself an expert on the subject. Recently this concept was adapted to a spatial context and the term was changed to geowiki. In geowiki systems, individuals can add information about visited locations to a universally available map. Landmark information can be added, interesting spots can be highlighted and personal preferences or experiences can be annotated.

The Camineo guide (Raper 2005), a multimedia location based service which is used in national parks, includes this type of geo-bookmarking tool, where users can place timed and located bookmarks while using the service. That way the system can constantly be updated by the users themselves without any time-consuming and cost-intensive processes.

The implementation of geotagging functions in smart environments is based on similar considerations but yet opens different questions on how to interact with ubiquitous environments.

2.3 Specification of Indoor Landmarks and Emotional Landmarks

The importance of landmarks for wayfinding has extensively been discussed in several publications (e.g.: Michon & Denis 2001, Foltz 1998, Lynch 1960, Golledge 1999). A

landmark is understood as something of importance with some outstanding characteristics, for example visual characteristics, its location, its contrast to the environment and its distinctiveness (Raubal & Winter 2002, Elias 2002). Undisputedly they are not only important but even necessary features in pedestrian navigation. Yet the derivation of landmarks is a very individual process that can change from one person to another (Gartner et al. 2006). Rooms or shops where the user has been before, or even places that he immediately recognises because he has read or heard about it before, can act as so called Emotional Landmarks. Some outstanding features, though, can act as universal landmarks that are distinctive to almost everybody and thus should be included as orientation points in the guiding instructions.

Since it is more likely to lose orientation within a building than outside (Hohenschuh 2004, Radoczky 2003) and changes in direction happen more frequently, it is possible that the user demands a higher density of landmarks indoors than outdoors. Unfortunately it is expected that buildings dispose of a smaller choice of landmark categories. Potential candidates for indoor landmarks could be elevators, escalators, stairs, doors, plants, information boards, signs, fire extinguishers, etc. Even though they might not be highly remarkable they could still be essential aids for way descriptions.

Beside the substantiated selection of objects as indoor landmarks, another important topic needs to be investigated: the presentation of landmarks. In case a graphic representation is used, the visualisation should be adapted to the function of the landmark. A shop or a restaurant could be represented by its individual label, whereas features that are significant for the respective building could be visualised with the help of pictograms. The user should also be able to define his own landmarks by placing symbols or the system itself could remember start or destination points of previous routes and place flags automatically.

2.4 Adapting a guiding model to behaviour classes

Ongoing work on monitoring the navigation behaviour of pedestrians (Millonig & Gartner 2007) intensively deals with the classification of mobility styles. Based on these findings the consequences of different behaviour classes on the guiding model need to be investigated in more detail. Some users prefers to take the direct path from A to B, whereas others like to stroll around on more zigzag-like paths, therefore route calculation needs to be adapted. Moreover the correlation of presentation forms with behaviour classes is yet unspecified.

2.5 Combination of outdoor and indoor navigation

Most concepts of pedestrian navigation either deal exclusively with indoor or outdoor navigation. Even though a complete division in real life is unlikely, an integration of both versions into one single system has hardly been considered. A first step into this direction was realised by Baus, Krüger & Wahlster (2002), who worked on the construction of a pedestrian navigation system that should work within buildings with the help of Bluetooth and IrDA as well as outdoors with GPS and telecommunication techniques. The main objective of this project was the switch of the different positioning techniques, whereas the visualisation problem was hardly been taken into account. Obviously both navigation areas must use different presentation forms. The scale of an indoor map is naturally larger than the scale of an outdoor map and therefore a noteless switch is highly impossible. The question remains how this switch could be realised without an abrupt visual switch that leaves the user disoriented. A possible solution could be a dynamic zoom that changes the scale of the floor plan and automatically morphs into the outdoor map. Techniques on how this concept could be realised are under investigation currently.

3 Conclusion

This paper deals with ubiquitous cartography, location-based services and wayfinding. It comments to the status of developments and research and identifies major elements of research direction within cartography.

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RSS Feed for Open Access Web Mapping Service

Rex G. Cammack
Department of Geography / Geology
University of Nebraska at Omaha
rcammack@mail.unomaha.edu

ABSTRACT

Web Mapping Services (WMS) is nurturing technology that is being used within and between large organizations. To move this technology to the mainstream for map users and developers, some method of distributing services, web locations, and content of WMS needs to be developed. Currently access to these WMS can be found at several locations with ESRI's geographic network being one of the best known. This research looks at different methods of distributing this information to the public. In this prototype project two services will be constructed for public participation in WMS. The first of these two services is a service that allows the public to create entries into a database containing the connection information to existing WMS. The second of the services is a RSS feed that distributes this WMS connection information. Between the two services is a middleware application that will validate entries in the database and create the updated RSS feed. The result of this prototype will be a collection and dissemination environment that allows the public the ability to add information into the collective database and also have a means of distributing that information across the Internet.

INTRODUCTION

The ability of the World Wide Web (WWW or Web) to link people to place is a development framework used by WWW citizens. One group of WWW citizens interested in this framework is the professional geospatial science community. One can become a member of this group through several paths: formal education, job training, personal development or other means. There appears to be two specific characteristics that make one a member of this group. The first characteristic is generating some form of income from working with geospatial information. The other characteristic is having some basic understanding of maps either from formal education or personal experience. This group of WWW citizens has developed numerous means of linking people to places. Yet the work of this group is only a small part of the plethora of means to link people to place.

A much larger group of developers has been using the people to place framework. This group is much harder to label since they seem to come from all kinds of different backgrounds. Lets look at two examples. One is Apple, Inc. With the development and release of the IPhone, Apple is clearly using the people to place framework to entice individuals to buy this product. On the front screen, two of the 12 default concepts (Maps and Weather) are place to people framework elements (Figure 1). Apple, Inc is not a part of the geospatial science community, it's a technology and lifestyle company. The second example is Dartmaps (Figure 2). Dartmaps is a Google mashup that gets the latest train locations for the Dublin Area Rapid Transit and overlays them on Google Maps. The mapping application applies a thematic concept to the Google Maps base-map.

Figure 1. This IPhone illustration showing that place, (Maps and Weather) is a part of the default configurations (Apple Inc, 2007).

iPhone and Dartmaps are just two examples of this large group of WWW citizens that use the people and place framework to drive interest in their products or ideas. One should note that what gives both groups power is the fundamental need for individuals to understand place. One can compare the power of understanding place to human communication.

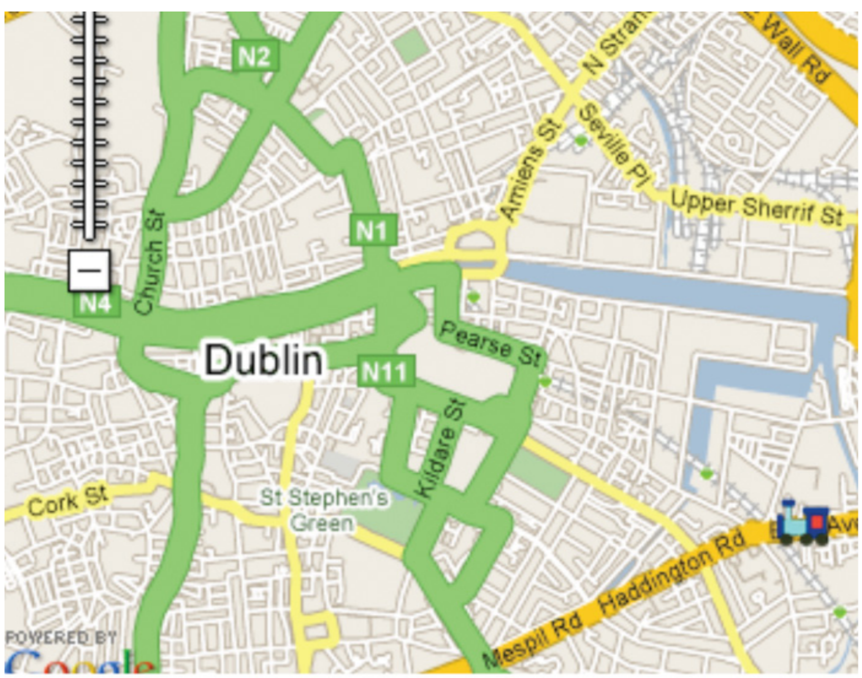

Figure 2. Snapshot of DARTmap (http://dartmap.mackers.com 2007)

This research examines how anyone can get access to open geospatial Internet Services (IS) through the development of a method for collecting and syndications linking information to WWW users. The goal of this research is to develop an open website that allows users to add geospatial IS's to syndication channels that will be freely available to the public. The website will add, test, verify, and maintain current information about all submitted geospatial IS's. The justification for this research is to broaden the list of available geospatial IS's used by the WWW community to develop their content driven websites.

INFORMATION SERVICES DESIGN

Many of the professional geospatial services being done today focus on the development of map based Information Services. These services can come in all different types based on the type of information being served. The Open Geospatial Consortium (OGC) has published several standards for different types of geospatial ISs (Open Geospatial Consortium, 2007).

- Web Mapping Services (WMS)
- Catalogue Services (CS)
- Grid Coverage Service (GCS)
- Location Services (LS)
- Web Coverage Services (WCS)
- Web Feature Services (WFS)

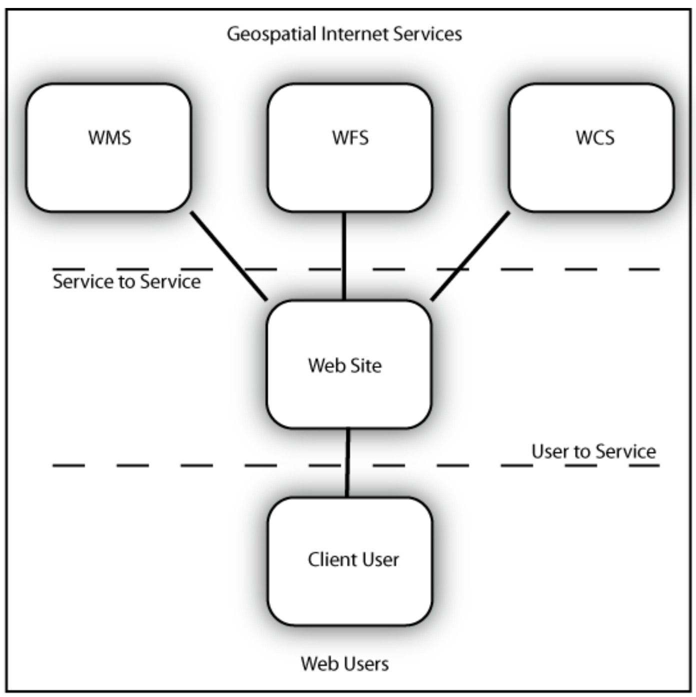

Figure 3. Server-Side Internet Services Model

From these OGS standards mapping agencies have developed all kinds of IS's for use both internally and externally. Once an individual agency constructs a geospatial IS it can be used in basically two ways. Figure 3 illustrates a service side model where all communication is done between services. In this model all requests to the geospatial IS's are passed through an intermediate Web Site. A second model is shown in Figure 4 where direct requests are being made to the geospatial IS by the user. This model is called a Client side service. Many times from the WWW user perspective there is no difference in the user experience, but for the developer the task involved in designing such web sites are quite different.

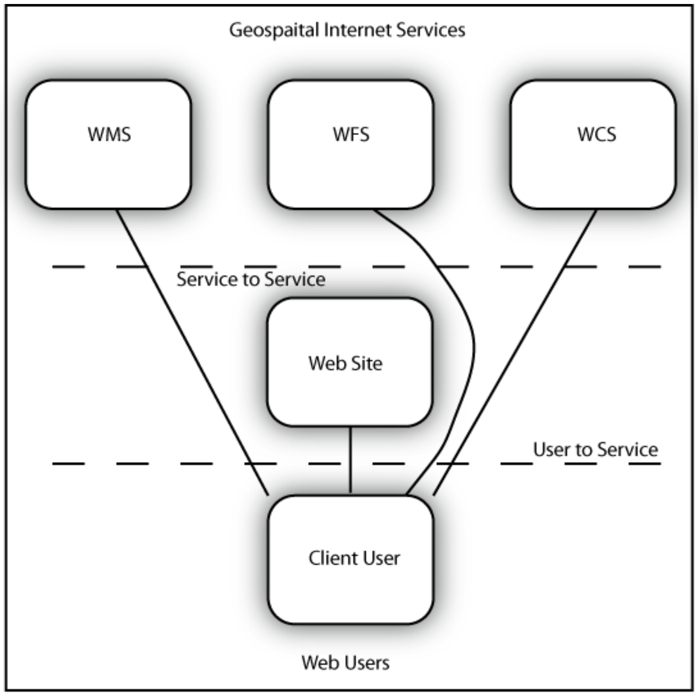

Figure 4. Client-Side Internet Services Model

One can use the service side and client side model as examples of both Web programming and Web 2.0 programming. The server side model can be considered a simpler style of web design equated to early web development. The client side model maybe more similar to the concept of Web 2.0 programming. One problem exists for using this association; Web 2.0 lacks a standard definition and some consider it just a jargon word that has little meaning. One way to define Web 2.0 is: to integrate numerous mature web technologies into a new and innovative way (Vlist, Ayers, Bruchez, Fawcett and Vernet, 2007). This definition will be main tenement to the development of Web Site for this project.

In order to design this Web Site and select the appropriate technologies one needs to consider what is the essence of the project. For this project we are concerned with making a Web Site that can assist WWW community in adding Geospatial ISs to a known list and then passing the information to the WWW community through a syndicated channel of information. Figure 5 identifies three critical steps for this project: finding geospatial ISs, determining content of service, and how to access such content. By identifying the three tasks a Web Site is constructed to achieve this task.

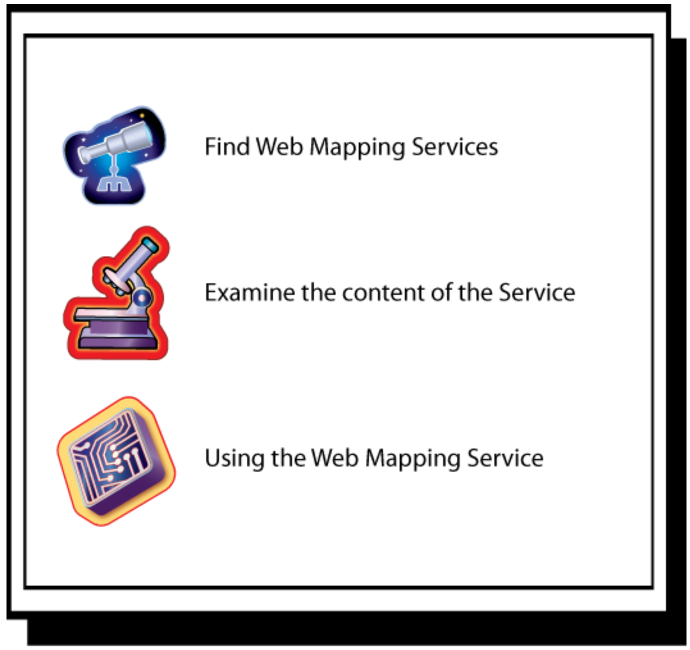

Figure 5. Public Participation Web Mapping Task

For this project it was decided to break it in two parts. The first part being the creation of a user WWW page that allows users to add new geospatial IS's to a database of such services. The second part was to create a process for generating a syndicated information channel those users could subscribe to and retrieve all geospatial ISs. The next two sections describe these parts in more detail.

GEOSPATIAL INTERNET SERVICES DATABASE

Most of the best Web 2.0 applications involve some type of social layer for the user community. In the first version of the web, users had little direct input into web content. One can equate this to the differences between read only (newspaper) to a read/write (Blog) environment. Web 2.0 developers allow the user community to become active in the content creation process. So in this example the community will create the list of available geospatial IS.

In this section and the next a general interaction process will be described and explained. This will not be a technical document covering all the different Internet technologies used and review of code segments. This work explains how the information moves through the different technologies in a generic form.

The simplistic view of this process is that a user will add a record to a database, however as can be seen from Figure 6, there are four steps to this process. Once a user has entered the Web Site and chooses to add a geospatial IS, the user will begin the add process. Step one is to complete a form where they will provide the connection information to the new geospatial IS. The connection information must conform to the OGC specification for posting a request to map service. This information is then submitted to Web Site for a server side processing of the information. The information must be processed twice before being sent back to the user. The first process is submitting an OGC getCapabilities request to the geospatial IS. The second server side process will be submitting a query to the geospatial IS database to determine if it already has a record for the submitted geospatial IS in the database. The results of the two processes are bundled together and returned to the user. If either of the two processes is negative, then the user will receive information saying that either the geospatial IS failed to respond or it is already in the database. It should be noted that like many tasks a client side process could be created using AJAX (Asynchronous JavaScript and XML) that would do the same thing. Step 3 is a major part of the social layer of the project. Users can evaluate the results and provide information regarding data quality and server performance that will be added to the database record. Once this information is added by the user, the verification of the record is complete and it is submitted to the database. The next section describes the information flow from the database to a syndication channel.

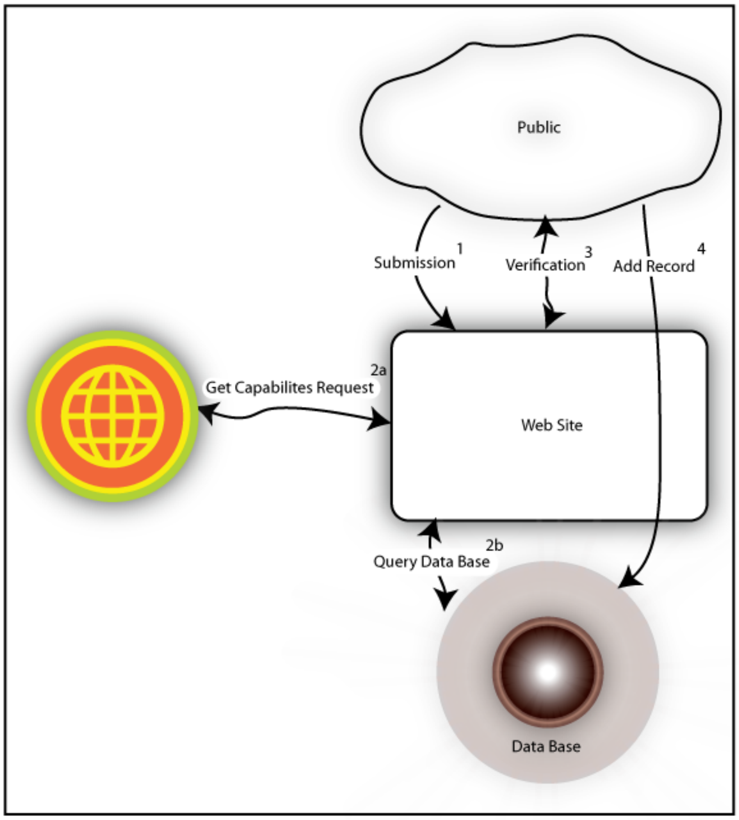

Figure 6. Geospatial Internet Services Data Development

SYNDICATION OF GEOSPATIAL INTERNET SERVICES

The database design for the project is to store information about each geospatial IS submitted to the database by the user community. Once a record is added several items must be maintained. Three attributes are shown in Figure 7; connection information, GetCapabilites response, and the converted XML data from the response file. All three of these items and several other items discussed in the previous section are maintained by the database.

Each time the syndicated channel is updated, three server side processes are completed. The check connection process and applying the XSLT are completed for each record in the database. So starting with record one the connection information is used to request the getCapabilities request. Once the XML response is returned to the server it is reformatted using and eXtensible Stylesheet Language (XSLT) (Cammack, forthcoming). XSLT is part of the eXtensible Markup Language (XML). Cammack (forthcoming) discusses how a XSLT can be used to convert a getCapabilities response into an item/entry element in a Really Simple Syndication (RSS) or Atom syndication channel. The resulting item/entry data for each geospatial IS will be stored in the database. When all the records are checked and converted, the final process will create the final RSS/Atom document. This document is validated and placed in a common location so individuals can subscribe to it.

There are other types of syndications that involve location. The most common form of spatial syndication is the Simple GeoRSS schema's (GeoRSS.org , 2007a). This method allows users to tag the location of points, lines, areas, and boxes onto other content. It is supported within Google Earth API and other web mapping technologies. For more complex spatial encoding tasks GEORSS.org (GeoRSS.org, 2007b) created GeoRSS GML. This method allows for a more complex form of tagging location information to items/entries in a RSS channel. Currently the OGC has a discussion paper outlining GeoDDS Mass Market (OGC 2007). It should be noted that discussion papers at the OGC are not standard and OGC has no official position on this paper.

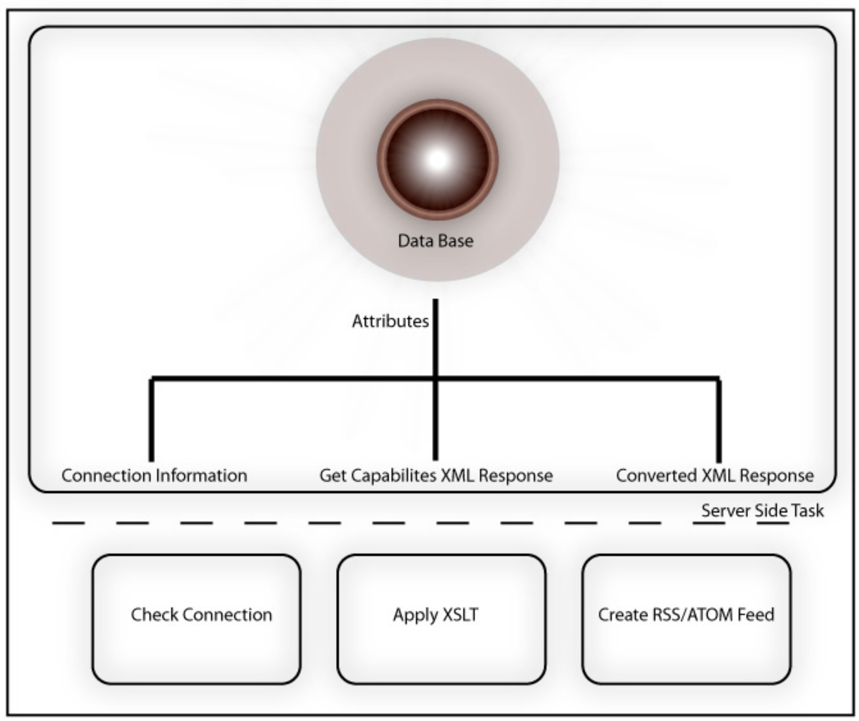

Figure 7. Building RSS/ATOM Feed

CONCLUSION

This research shows that a Web 2.0 social layer concept can be combined with web technologies to create a Web site that allows users to build a public database of geospatial ISs. As a part of the database maintenance process a server side application will check all records and generate a RSS/Atom syndication channel that other information aggregators can use. In the future special feed readers could be created that take advantage of the special type of data contained in this syndicated channel.

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Testing the use of Web maps in the retrieval and dissemination of regional statistical data

Corné P.J.M. van Elzakker
ITC, Department of Geo-Information Processing
Enschede, The Netherlands
elzakker@itc.nl

Pieter J. de Graaf
Statistics Netherlands
Voorburg, The Netherlands

Duncan J.D. Beeckman
Statistics Netherlands
Voorburg, The Netherlands

ABSTRACT

Increasingly, regional statistical data collected by National Statistical Organizations are made available to users through the WWW. When retrieving these data, users may make use of Web map displays in various ways. This is also demonstrated in the StatLine database of Statistics Netherlands, which is accessible through the Web. This paper reports on the results of a number of test sessions, carried out in December 2005, with various categories of users of the StatLine Web pages. These users were asked to carry out a number of tasks and it was investigated in which ways map displays functioned in the execution of these tasks. For these investigations, use was made of the think-aloud method. The results are used to improve the functioning of Web maps in the retrieval of regional statistical data. But one of the outcomes is also a plea for increasing the users' awareness of the potential roles of map displays in the retrieval of statistical information.

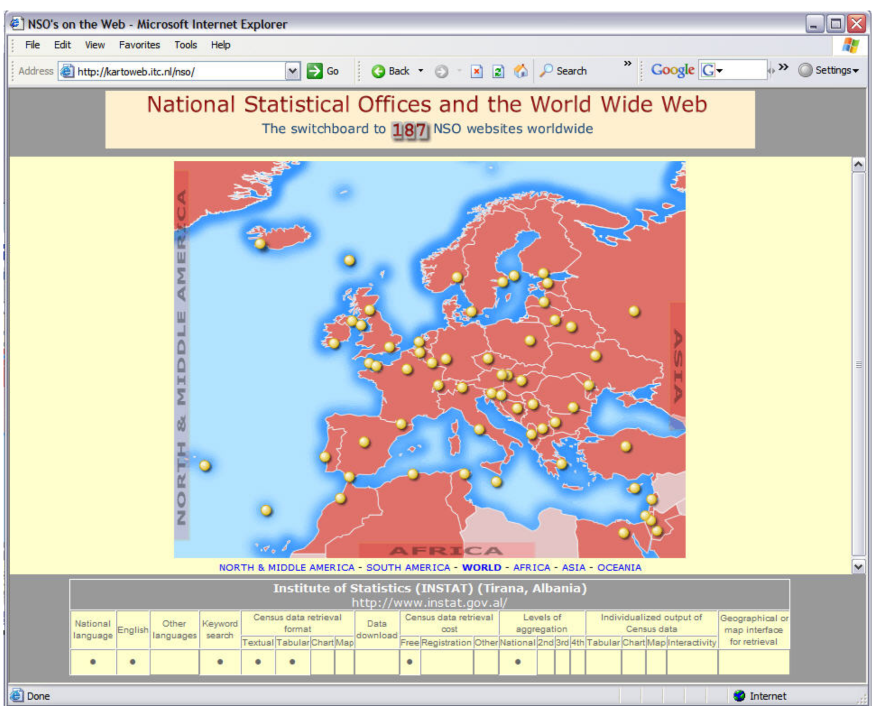

Figure 1: One of the regional interfaces to NSO websites on [URL1]

Dissemination of regional statistical data through Web maps by National Statistical Organizations

In almost every country in the World there is an organization with the task to execute a census and/or to collect and disseminate statistical data at national and lower aggregation levels. These organizations may have different names in different countries (Census Bureau, Central Bureau of Statistics, National Statistical Office, etc.). In this paper, the generic abbreviation NSO will be used to denote these kinds of organizations.

Because of the potential dissemination advantages of accessibility and actuality, more and more NSO's are making available their data through the World Wide Web. For the production of a chapter in the first edition of the ICA Commission's textbook on *Maps and the Internet* (Peterson, 2003) an extensive inventory was made the World's NSO websites and their functionality (Van Elzakker et al., 2003). The inventory also resulted in an accompanying Web portal to the World's NSO websites [URL1] which has been kept up to date as much as possible (Figure 1).

There has been an increase in the number of websites of NSO's from 126 in 2003 to 187 in 2005. Besides, more and more NSO's are discovering the potential usefulness of cartographic functionalities on their websites:

- in 50% (2003:40%) of the sites data can be retrieved in the form of a preconceived thematic map
- 23% (2003: 17%) of the sites allow on-line access to a database to prepare individualized output
- 19 (2003: 6) websites allow individualized output in the form of a thematic map and/or interactive cartographic visualization
- 25% (2003: 24%) of the sites have a map interface to find and select geostatistical data

Another clear development in the past years is that more and more Web maps have become interactive. In this respect, a distinction may be made between three potential roles of interactive Web maps in geostatistical data dissemination (Van Elzakker et al., 2003):

- geographical interfaces for finding and retrieving data
- Web maps as a means of presentation
- Web maps for on-line analysis and exploration

To some extent, these roles have also been implemented on the website of the NSO of the Netherlands.

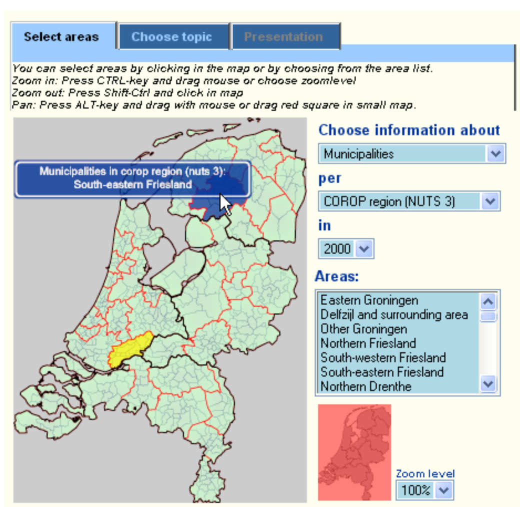

Figure 2: StatLine interface for finding and retrieving data [URL2]

StatLine database of Statistics Netherlands

The cartographic entry on the website of Statistics Netherlands was introduced in 2003. It is not an isolated application, but forms an integrated part of the on-line statistical database StatLine [URL2]. Of course, it contains a helpful cartographic interface for finding and retrieving the regional statistical data (Figure 2).

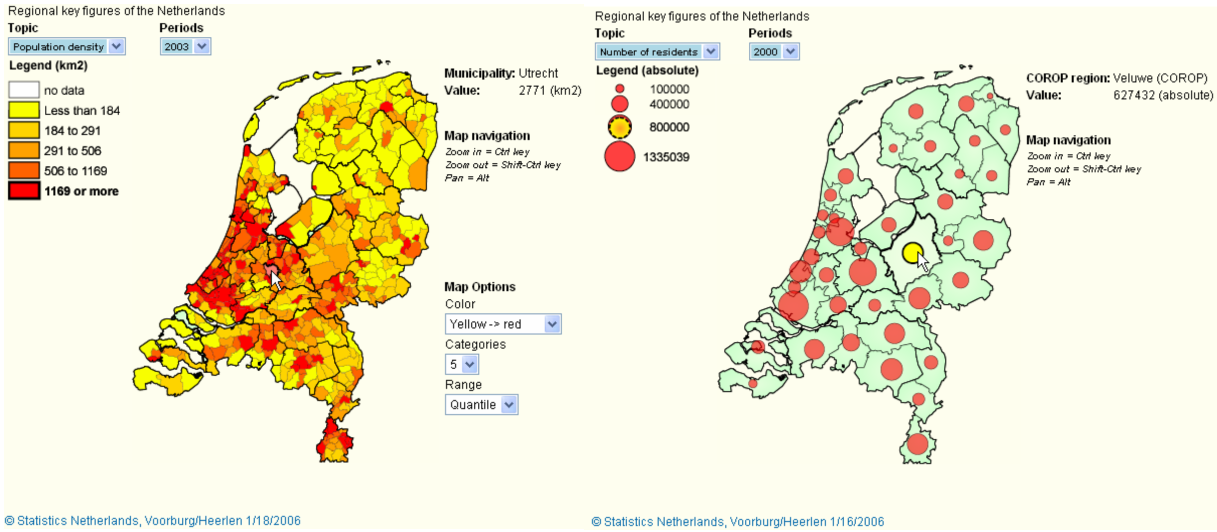

Figure 3: Choropleth and proportional point symbol map generated with StatLine

The data may be presented to the users in the form of tables, charts or diagrams but also in the form of cartographic output. The map displays that are generated (Figure 3) are interactive in several ways. This interactivity, or cartographic functionality, is made possible by the application of server-side generated SVG (Scalable Vector Graphics, a standard open Internet format based on XML for static and dynamic vector representations). It is possible, for instance:

- to view data values per administrative unit and highlight the corresponding legend box (through mouse-overs);
- to change the date to which the data pertain (through a pull-down menu);
- to change the topic represented (through a pull-down menu);
- to select one of the standard colour schemes (through a pull-down menu);
- to select the quantitative data classification method (quantiles or cluster), as well as the number of classes (2, 3, 4 or 5) (through a pull-down menu);
- to zoom or to zoom out (with mouse and keyboard keys);
- to pan (with mouse and keyboard keys); and
- to select an area of interest (by mouse clicks or drawing a bounding box)

At a certain moment, the question was raised whether all this increased cartographic functionality actually helped the users of the StatLine database in practice.

Research project into the usability of StatLine interactive Web maps

Pieter de Graaf took up this challenge during his internship with Statistics Netherlands as part of his MSc studies in Geographical Information Management and Applications (GIMA) (De Graaf, 2006). The following overall research questions were formulated:

- What is the use and effectiveness of the cartographic functions on the StatLine website?
- Which problems do users come across when using these functions?
- What functionalities are missing according to the users?

These questions were further subdivided into a number of sub-questions which were tackled with a combination of research methods and techniques:

- Quantitative research was executed by measuring the amount of hits or requests for information per month over a period of more than 3 years. The requests for information were split up on the basis of the ways in which the information is presented to the user: by way of tables, graphs, downloads thematic maps and print tasks. Filtering was applied by counting only once per hour every request by the same user for a specific output.
- A comparative study was made of the cartographic functions on the websites of 7 other NSO's (Germany, India, Israel, New Zealand, Sweden, United Kingdom, United States of America).
- The major part of this user research project was executed with the help of qualitative research, centred around the so-called think aloud method (Van Elzakker, 1999). There different user groups were distinguished: general interest users, business interest users and scientific interest users. They all had to execute geographical tasks of different complexity with the help of the StatLine website. Examples of such tasks are: "Which part of the province of Overijssel was most densely populated in 2003?" and "For each COROP-region in the western part of the Netherlands, present in a map the area of farming land per 1,000 inhabitants".

Figure 4: Two-room usability laboratories in Voorburg, Heerlen and Enschede

The subjects were asked to think aloud during their execution of these tasks in 3 different usability labs which were similarly equipped (Figure 4). The thinking aloud, as well as the changes on the screen and the images of the test persons interacting with the system was recorded on video simultaneously. Besides, two researchers were observing the test persons in real time in rooms next-door (Figure 4d). And, finally, the test persons were asked to complete questionnaires before and after the test sessions. These questionnaires plus the resulting video recordings were the valuable research materials that were used for analysis. In total, 19 subjects took part in the think aloud sessions, split over the three user groups (5-7-7 respectively). This is sufficient for obtaining valid results (Nielsen, 1994).

Results of the user research

Quantitative analysis first led to the conclusion that only a very small share of the total number of requests was for thematic maps: the mean total over the period 2002-2005 is only 4 per mille (Figure 5). One possible explanation for this low share may be the fact that StatLine was originally intended for the exchange of statistical data (also data without a geographical component) in "raw" tabular format. Therefore, many of the users may not yet be familiar with map displays and cartographic functionalities or simply do not need a geographical differentiation.

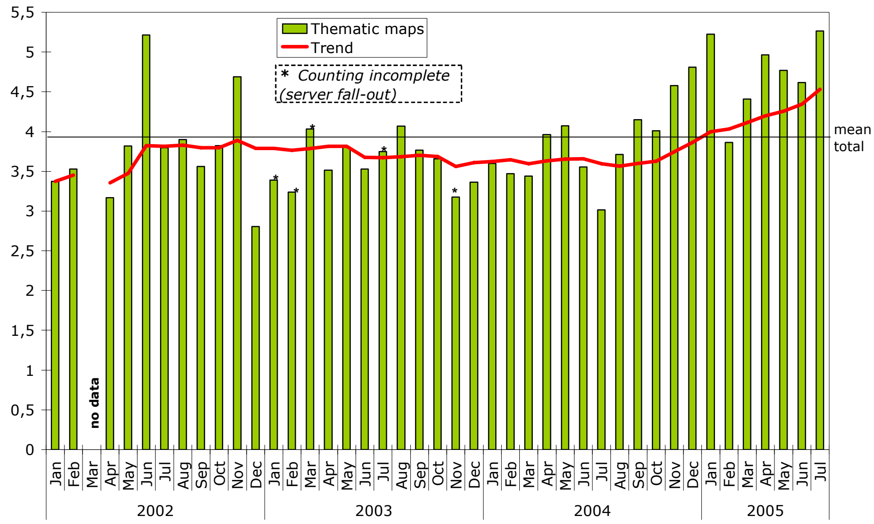

Figure 5: Requests for thematic maps as a permillage of the total amount of requests for StatLine output

On the other hand, the absolute number of requests for thematic maps is constantly increasing over the past few years (Figure 6). In fact, thematic map use is increasing at a faster rate than the overall use of StatLine.

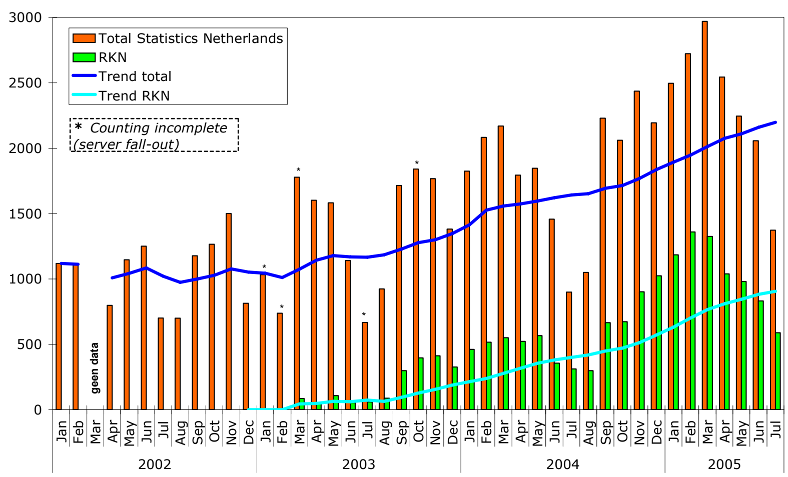

Figure 6: Absolute number of requests for thematic maps

The materials resulting from the qualitative part of this research project provide a valuable and almost infinite source of information. The analysis led to some general conclusions with respect to the functioning of interactive Web maps in the retrieval of regional statistical data, as well as to results which specifically apply to the StatLine website.

In general, users positively assess the cartographic functions offered at the website. However, they do not seem to be very familiar with them. In this research project, the subjects preferred to use tables, most likely because they are used to that for a long time already. Another conclusion is that sufficient help and instructions should be provided for the use of the cartographic functions. The users were often struggling with the interfaces. An important conclusion, that has also been confirmed in other research (see e.g. Van Elzakker, 2004), is that users are not very critical: they take for granted what is presented to them on the screen, even when there are mistakes in the display or when it does not provide an answer to the geographical question posed. Users are also not very tempted to make adjustments to the resulting map displays. In some cases this is because they are not aware of the nature and effects of the parameters (e.g. the different statistical data classification methods).

As far as the StatLine application is concerned, there were specific comments for both the cartographic interface for finding and retrieving data and the interactive Web maps that were used for the dissemination of the requested information. Both appeared to suffer from a lack of instructions, explanations or help functions and there were complaints about the sizes of screen text and map displays.

As far as the cartographic interface is concerned, the selection of areas of interest appeared to be simple, but users did not find it logical to first select a region and then a topic. Subjects were also struggling with the drop-down menus with which they could select both the region of interest and the geographical aggregation level. They also missed an orientation map, as well as descriptions of the attribute data. Finally, it was found awkward that years with no data could be selected.

With respect to the interactive thematic map displays for analysis, exploration and presentation, the research results were of a very varied nature, depending on the test person concerned. General conclusions that can be drawn are that the test persons are positive about the cartographic functionality in general and specifically, for instance, about the possibility to directly alter the year of the data presented and the possibility to only look at a selected region. There was only limited interaction of the test persons with the map displays. Therefore, all users did not immediately discover what additional information was provided with mouse-overs. Users also complained that it was not possible to print or download the map generated.

Conclusions and recommendations

More and more NSO's are discovering that interactive Web maps can play useful roles in the retrieval and dissemination of regional statistical data and, therefore, they are implementing these cartographic functions on their websites more and more. The user research project executed on the StatLine on-line database did not only lead to lots of specific recommendations for the direct improvement of the effectiveness and efficiency of this part of the website of Statistics Netherlands, but also proved that a cartographical interface is indeed useful in general for the retrieval of regional statistical data. But, on the other hand, it seems that more research is required regarding the availability and functionality of interactive Web maps for the exploration, analysis and presentation of regional statistical data. In this respect, the potential is not fully employed yet and we will have to find out more about the reasons for that. In any case, it is recommended that potential users should be better informed about the availability of cartographic functions on a website and we should increase their awareness of the potential effectiveness of interactive Web maps in the retrieval and dissemination of regional statistical data.

URLs

URL 1: Switchboard to NSO websites worldwide *http://kartoweb.itc.nl/nso/*

URL 2: StatLine: online database of Statistics Netherlands *http://statline.cbs.nl/*

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The Use of Internet/ Website as an Effective Media in Promoting Maps and Geo-spatial Products

Sukendra Martha
National Coordinating Agency for Surveys and Mapping
BAKOSURTANAL, P.O. Box 46/CBI
Cibinong, Indonesia
sukendra@bakosurtanal.go.id

Heru Warsito
National Coordinating Agency for Surveys and Mapping
BAKOSURTANAL, P.O. Box 46/CBI
Cibinong, Indonesia
heruwarsito@bakosurtanal.go.id

ABSTRACT

As a media, the internet is very effective to use for retrieving and downloading maps and geospatial products. Since the launch of the internet in 1997, several products like topographic, thematic maps, atlases and related data generated by the National Coordinating Agency for Surveys and Mapping (BAKOSURTANAL) Indonesia, have been significantly promoted. The web has performed a gradual improvement with significant increases in the number of visits. In September 2006, about nine years after launching the number of web visits was still less than 5 thousand (4,184) peoples, and became nearly 150 thousands (147,832 visitors) within one year (February 2007). This media will possibly improve the total numbers of maps being sold out. Even though there is no surveys available for knowing the relationship between the role of internet and the total numbers of maps sold, we believe that the better role of internet with best performance particularly in the 'front page' design, the better or more users/ visitors to browse our map information will be. The promotion and socialization activities for mapping products has regularly done in order to make people better understood and well public informed. This article describes the use of such media for maps and geo-spatial promotion. It also presents the problems of geographic location for the people to access the internet in Indonesia; therefore, establishing map outlets as one of the alternative solutions to help in socializing and selling BAKOSURTANAL geo-spatial products is needed. So far, only some outlets located in universities having a Geography Department or other Earth's Science study programs have contributed better revenues on map sales.

INTRODUCTION

Geographically, Indonesian comprises 17,508 islands covering 2,027,087 km2 of land area and 3,166,163 km2 of sea territorial waters. All the country areas are covered by topographic maps (34 sheet numbers of 1:1,000,000; 323 numbers of 1:250,000; 4,045 numbers of 1:50,000; and 14,200 numbers of 1:25,000 nominal scale). Due to such condition, topographic mapping in the whole area of Indonesia has not been completed yet (70 – 85%). This will influence the socialization and distribution of map for the public. One of the potential tool to promote and socialize such maps/ geospatial is the use of internet technology.

A commitment to make internet and information and communication technology (ICT) available and affordable as reported by Asia Pacific Regional Internet Conference on Operational Technologies (APRICOT) in Bali, 26-27 February 2007, the use of internet in Indonesia needs to push and improve because of low access or penetration. Based on data from the Indonesian Association for Internet Services/ Asosiasi Penyelenggara Jasa Internet Indonesia (APJI), the internet users in 2006 were 20 million people or about 8% of the total population (Kompas, 2007).

We realize that there is still in the low percentage internet user in Indonesia; however, we understand that the power of internet to socializing and promoting our products is very powerful and promising. Internet is like the biggest trade / business centre in the world, while website is a shop or kiosk in such business. http://www.hendrawan.com/003.html

Internet sites (website) can be used not only as on line space exposition for all business activities, but also as a media for on-line transaction. This type of media will build business image, and to catch new clients to joint and transaction with us. Consumers or consumer candidates don't have to spend valuable time to search about our business/ company, products and services available offered by internet with real-time.

A website can save time, place and cost. It can be as global network to effectively promote our products and to efficiently market the media. http://www.trijayaonline.com/solusi/web/

There is something to declare that how important maps for planning and regional development. However, the information on such existing maps and types of geo-spatial data is considered as something that cannot be fully accessed to the public. The public demand for surveys and mapping products today is improved. This is because of the improvement of public concerns and needs. Surveys and mapping products published by BAKOSURTANAL can be generally used and obtained so that all information related to such product need to be socialized and promoted to the public.

Based on BAKOSURTANAL's selling data, it indicates that 80% of buyers are generally come from the area of Jakarta-Bogor-Depok-Tangerang and Bekasi (Jabodetabek) and the rest are the users come from other area. Geographic and archipelagic condition of Indonesia creates problem for people to access the existing survey and mapping product.

Some effort to distribute and socialize the use of map have been continuously done. One of such efforts is to improve the numbers of outlets in the whole Indonesian territories. By outlets distribution and other function people / map users will be easier to access and obtain such maps. Other thing to improve map understanding of people, various activities like education and training, technical guidance, map workshop, and exhibition have been done.

PROBLEMS ENCOUNTERED

There are at least four problems related to BAKOSURTANAL website:

a. Generally slow people access to our internet because of the existing low band with (max 100 kbps).
b. On-line display with specific application become difficult to access (need a quite long time to wait) due to the band with limitation.
c. Problem of develop in one application program because the existing products consist of various format.
d. Lack of infrastructure and internet knowledge limitation makes people cannot optimally open internet in general and BAKOSURTANAL's website in particular.

BAKOSURTANAL WEBSITE DEVELOPMENT

BAKOSURTANAL started establishing a website: www.bakosurtanal.go.id in1997. During the year 1997 to 2001 it can be said as the beginning period of website establishment. It was still as linear information with capacity of 2 MB uploaded by the assistance of CBN provider (PT Cyberindo Adhitama) in Jakarta. Up to the year 2001 there was no development or changes, keeping in the same condition. It started having data improvement and changes in cover page display and operating systems in 2002. Within four years time (2002-2006), the website had more improvement for *on-line* application tool. Later, in the middle of 2006 it changed in display performance and management, as shown on Fig. 1 (a) and (b).

(a)

Website Display on Page of On line Map

Multi Hazard Mapping

(b)

Fig. 1. The display of website cover page (a) and thematic content: Multi-Hazard Mapping (b).

BENEFITS OF INTERNET USE

Several benefits of using internet for promoting and socializing BAKOSURTANAL's geo-spatial products are as follows:

1. Public Services
2. Selling geo-spatial products of BAKOSURTANAL in various regions
3. Education and training surveys and mapping
4. Technical consultation on surveys and mapping for human resources in local government.

5. Workshop on map socialization for geographic teachers and students.
6. Map drawing competition for children.
7. Welcoming technical visit for various agencies.

1. Public Services

Using internet, the benefit can be obtained for the purpose of services to the public. BAKOSURTANAL as a governmental institution responsible for national surveys and mapping has duty to provide services to the public. For public services, internet can be effectively used as communicating and promoting our geo-spatial products. FAQ can also be conducted as interaction between BAKOSURTANAL and the public. All user needs and complaints related to map and geo-spatial products can also be communicated through e-mail.

BAKOSURTANAL
WEBSITE VISITORS

		2006				2007			
		September	October	November	December	January	February		Average/ month
Unique visitors		2309	5123	5909	6546	7353	7375		5769.17
Number of visits		4184	9560	11572	13785	15135	14654		11481.67
Pages		50022	187578	244072	192525	133658	147832		159281.17
Hits		245422	463014	519891	486546	453196	515939		447334.67
Bandwidth (Gb)		2.09	5.59	6.31	6.97	8.28	9.27		6.42

Source: Pusjasinfo BAKOSURTANAL, 2007

Table 1. Visitors in BAKOSURTANAL Website during 2006 – 2007.

Based on available data, the most visited pages in 2002- 2006 were related to the products of Atlas, topographic maps and toponimic document. While in 2007, the most visited pages of our internet are asking about digital library, topographic maps index, road maps and thematic maps of natural resources. As shown on Table *"BAKOSURTANAL Website Visitors",* it tends to be improving numbers of visits, pages and hits. In more detailed information, during 2006 – 2007, the number of visits and the number of hits can be compared as seen in Figure 2.

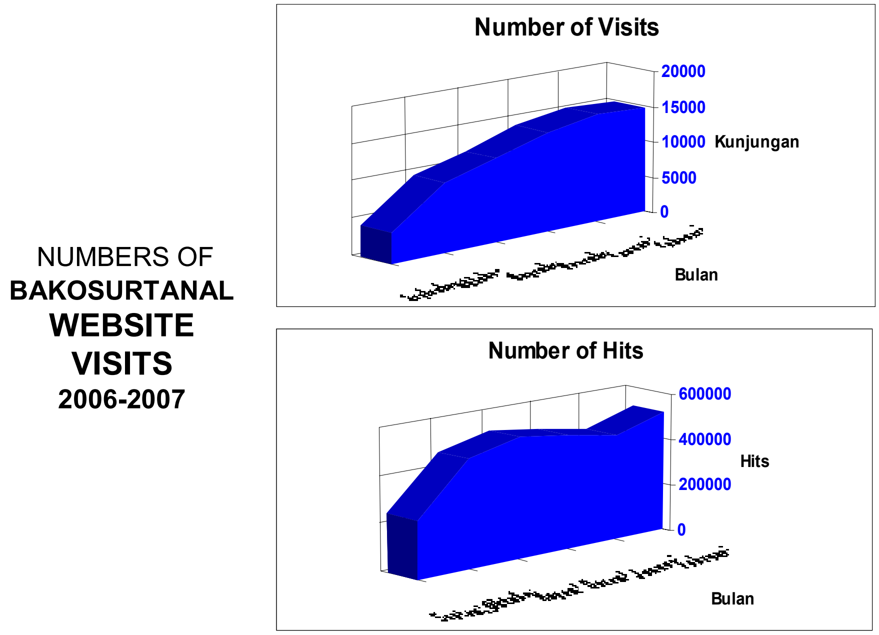

Fig. 2 Numbers of BAKOSURTANAL Website Visits and Hits during 2006 to 2007.

There are at least four types related information asked through e-mail in BAKOSURTANAL Website as follows:

1. Map index, procedure to access data, products and services (aerial photos, topographic maps and cost of products).
2. Topographic maps and other geo-spatial data availability for particular administrative area and research/ study area.
3. Procedure for students who want to do their field work and in job training.
4. Recruitment of new BAKOSURTANAL personnel's.

2. Selling geo-spatial products of BAKOSURTANAL in various regions

Internet can be useful to assist in selling geo-spatial products, together with outlet operation. Through internet, information about product and services can be disseminated and socialized all over the country. This could be directly or indirectly affects the increased product selling points. The improvement of selling geo-spatial products of BAKOSURTANAL in various regions may be caused by the promotional assistances through internet establishment.

3. Education and training surveys and mapping

Through internet, information of education and training for surveys and mapping can also be disseminated, so that we can serve widely to train people in the field of surveys and mapping.

4. Technical consultation on surveys and mapping for human resources in local government.

Internet in BAKOSURTANAL as media can effectively promote and offers some services related to technical advices of geo-spatial application for many specific applications. How to use and to check the quality of digital data are the important advices required by users. Technical consultation on surveys and mapping for human resources in local government can also be provided. Again, without internet using post mail and other media to inform the technical people in provincial, district and city governments is not effective due to geographic condition. There are 33 provinces, 456 districts and city governments where leaflet and other printed materials are going to be sent by post mail. If there is a proper infrastructure available, the old method may be replaced by electronic internet mode to disseminate information.

5. **Workshop on map socialization for geographic teachers and students.**
Internet can be a media for communication among the organizers and participant of workshop. The workshop is designed to have participants (geographic teachers and students) understand about maps and geospatial information. Then workshop itself becomes well known as map socialization forum.

6. **Map drawing competition for children**

Map drawing competition for children, as annually done in BAKOSURTANAL either for the national purposes or for international competition, is also helped by the role of internet. We can promote and advertise such activity by posting information in the internet.

7. **Welcoming technical visit for various agencies.**

As confirmation whether the visit will be conducted or not, internet can be used as media for communication. Various agencies, Universities, geography students visit BAKOSURTANAL to see what's going on, and to see the activity of surveys and mapping. The visitors can usually learn about from there.

WEB IMPACTS TO MAPS SELLING REVENUES

There is question whether website can influence map selling's revenue or not. There might be a correlation between the two. The method is to compare the development of internet establishment in BAKOSURTANAL and the product selling and its revenue.

PRODUCT SELLING
2001 - 2006

	2001	2002	2003	2004	2005	2006
Base Data	355	724	840	1,251	1,434	565
Digital Maps	279	809	1,584	1,549	1,182	1,346
Print-out Maps	10,827	48,431	64,254	71,136	82,269	83,183
Others	24	15	93	190	249	265

Source: Pusjasinfo BAKOSURTANAL, 2007

Table 2. Maps Product Sold at BAKOSURTANAL in the period of 2001 - 2006.

Based on Table 2 above, selling of BAKOSURTANAL products had generally increased for period 2001 to 2006. The total numbers of map sheet sold for products like digital maps, printed-out maps and others had increased. While for product like basic data was decreasing from 1,434 numbers into 565 numbers in 2006.

In line with the development of website in BAKOSURTANAL and the product selling for the same period of time (2001-2006) the increase of selling products had been probably affected by the impact of website roles.

CONCLUSION

Generally, internet can be used as an effective media for promoting maps and geo-spatial products. Based on data of website, e-mail and selling products, some indication can be concluding as follows:

a. Users are still concentrated in Java Island.

b. The use of maps bought is still for the location in Java Island with big cities around.
c. The increase of outlets indicates the improvement of map selling's.
d. The majority of website access is still in Java Island because of the infrastructure, quality and the quantity of human resources.
e. Majority of map users are dominated in the areas of Jakarta, Bogor, Depok, Tangerang and Bekasi (Jabodetabek), as a result of infrastructure and supported by the universities.
f. Based on the input from the seminar, workshop and other meeting related to geo-spatial data, it indicates that there are still many people have not understood surveys and mapping field.
g. Geographic condition causes the limitation of access to get BAKOSURTANAL data.

RECOMMENDATION

In line with the website roles, some recommendations to implement the efforts can be drawn as follows:

a. To improve workshop on map socialization for geographic teachers.
b. To establish technical consultancies for local governmental offices as a part of human resources development in the field of surveys and mapping.
c. To improve the role and performance of education and training in BAKOSURTANAL.
d. To increase the numbers of outlet and its technical and management personnel's.
e. To improve the quality of BAKOSURTANAL website and its management.
f. To develop social activities/ promotion through various events.
g. To improve quality and quantity of cooperation with various parties for the shake of map public understanding.

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http://www.trijayaonline.com/solusi/web/

http://www.hendrawan.com/003.html

Interaction with Maps on the Internet – It's All about the User

R. Eric Kramers
Senior Project Officer
Natural Resources Canada
e-mail: kramers@nrcan.gc.ca

ABSTRACT

The Government of Canada's Atlas of Canada has, for over 100 years, produced maps of Canada's geography and history reflecting its social, environmental and economic diversity. Its scope has always been national, focusing on small scale thematic and reference maps. The current 6th Edition offers interactive and static thematic, reference and topographic maps. Initial interactive mapping user interfaces contained tools that were based on the developers GIS experience. They permitted users to explore the maps and go beyond the surface of the map to access feature attributes, data and other information. The initial level of success was low. To resolve this, the Atlas undertook considerable user and usability research initiatives and adopted and integrated a user-centred development (UCD) process. This resulted in considerable success. This paper will look specifically at the methods used by the Atlas to offer interactive features within the maps and the types of tools developed to access them. In addition, this paper will look at the issues encountered, the solutions achieved, trends over time and a look to the future. Some comparisons will be made to other popular Web mapping sites. As the Atlas of Canada prepares for the future, the need to properly understand how users apply their Internet interaction experience with online maps will only become more important. Through user and usability research, the Atlas of Canada Program, is committed to developing the most usable and intuitive tools for online interactive atlas maps.

Introduction

Natural Resources Canada's Earth Sciences Sector celebrated 100 years of The Atlas of Canada's cartographic excellence in 2006 (see Figure 1). The Atlas' maps reflect Canada's rich social, environmental and economic geography and history. Its role is to present topical and issue-based information, relevant to the Government of Canada and Canadians, in a geographical context. Its scope has always been national, focusing on small scale thematic and reference maps.

The current online 6th Edition of the Atlas has three main types of interactive maps: thematic, archive and topographic. They are all displayed within interactive mapping User Interfaces (UI). The initial UIs contained tools that were based on the developers Geographical Information System (GIS) experience; the level of success with these was low. To investigate and resolve this issue, the Atlas undertook considerable user and usability research initiatives and adopted and integrated a User Centred Design (UCD) process. This resulted in considerable success.

This paper will present the UCD methodology and some of the research done to establish a comprehensive user profile, determine those users' map interaction requirements and details of some of the tools developed to meet users' needs. In addition, the specific issues encountered and the solutions achieved will be presented.

Figure 1: The evolution of the Atlas of Canada, 1906 to 2006

Understanding the Map User

Being available on the Internet, indeed in any electronic environment, requires that users have a basic level of technical proficiency. To use any atlas, an individual must be able to "…have a clear idea of its overall possibilities and structure, of the way to access the information they want and of the way to get back to the starting point" (Kraak and Ormeling 1996). The complexity of the systems used to visualize the information can create a barrier to access to information rather than enhance it (Warren and Bonaguro 2002). Some highly used Web mapping sites such as Google Maps are offering new map interaction paradigms. It is widely noted that their popularity is an example of changing user expectations.

While realizing those needs existed, the experience of the development team was the base line from which the first online mapping UI and tools were made in 1999. This team had considerable GIS experience. There was little understanding of how users interacted with the tools and the importance of comprehending what types of tasks they performed (Scanlon and Percival 2002). This led to a product that was efficient and useful for the developers but not the users.

The solution was to better understand the Atlas users by researching who they actually were, how they interacted with maps and for what they used the maps. This lead to a new era of user centred design. At the outset, the immense difference that this paradigm shift would make was barely conceived. Today, user consultation is deemed essential in the development of the Atlas (Williams, O'Brien, and Kramers 2003).

User Centred Design Methodology

The UCD methodology, adopted by the Atlas, consists of three main stages prior to deploying additions or changes to Website components. The first stage is an examination of business requirements, followed by detailed user requirements research in the second stage. The third stage involves the product and systems design (Kramers 2006). This approach saves effort and cost due to the quality of the end result and the reduction of design errors (Nielson 1994).

Including effective user requirements research, before moving to product design, has resulted in much increased levels of success. This entire methodology can be applied in whole or in part to any product or service. The level of research in each stage can be tailored to the amount of personnel, time and financial resources available.

The Atlas has used UCD for Web-based, data and printed products, and development activities such as requirements gathering, prototyping and product validation. The value of a user-centred development and design can be summarized as follows:

1. Reduces the affect of poor and inaccurate assumptions - informed decision making

2. Balances business and user requirements
3. Separates developers from evaluating their own designs
4. Increases user satisfaction and product effectiveness
5. Produces the right product, for the right reasons, for the right users

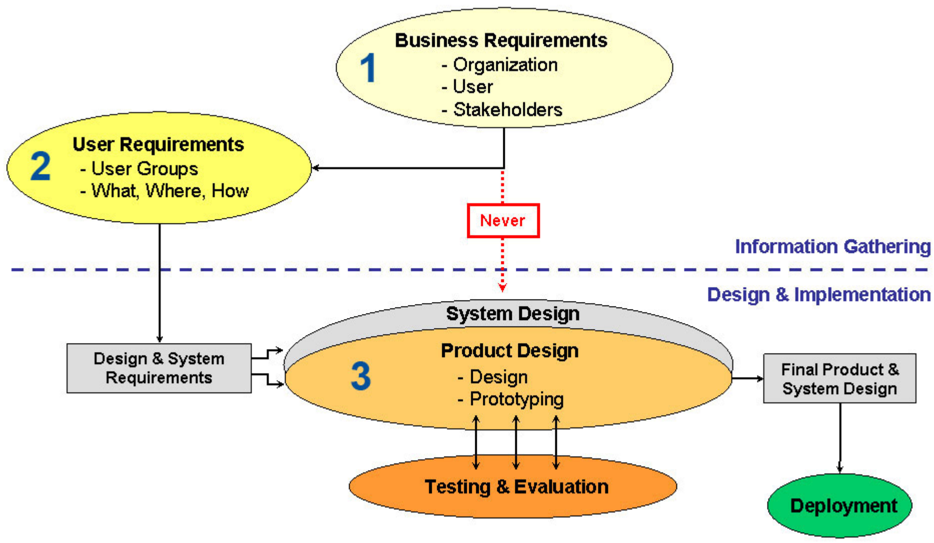

Figure 2: The user centred design methodology.

User Profile

Key in being able to design an effective mapping user interface is understanding who the Atlas of Canada's users were. The first online survey in 2000 revealed the first representative user profile. This was validated and updated in 2003, 2004 and 2007. In addition, a User Profile Analysis (March 2005) furthered this research by interpreting the data from various survey questions such as how and why maps were used. The analysis was applied to all survey periods and an example showing user groups is shown in Table 1. While each groups' proportion of Atlas users is expressed as a percentage, there is a small overlap between them. This accounts for the total being greater than 100%.

User Group	2007 Survey	2004 Survey	2003 Survey	2000 Survey
Personal Interest	48%	36%	19%	27%
Students	22%	21%	21%	19%
Work related	20%	21%	12%	17%
Browsing	10%	11%	26%	19%
Teachers	7%	9%	8%	13%

Table 1: User Groups - Data is from the Atlas of Canada User Profile Analysis, March 2005 and Online Survey Reports, 2003 and 2000.

By correlating the user groups with the type of use, a clearer profile is created of individual user groups, as shown in the table below.

Use of Atlas Information	Personal Interest	Students	Work Related	Browsing	Teachers
Personal project / recreation	78%	19%	12%	46%	15%
Own school assignment	----	56%	1%	4%	11%
Work assignment or report	2%	5%	64%	7%	7%
Develop / support curriculum	1%	11%	13%	7%	54%

Table 2: Use of Atlas Information by User Group - Data is from the Atlas of Canada User Profile Summary Report, March 2005.

The Atlas of Canada is not typically a site where users return daily or weekly, but rather on an as needed basis. The 2007 online survey showed that the number of repeat visitors is 40% and 17% of all users returned to the Atlas 10 times or more during the preceding year. Most visitors continue to report that they stayed on the site from 1 to 20 minutes. Between 2001 and 2007, the average increase in the number of user visits per year was over 35% resulting in nearly 9,300,000 user visits in 2006. The majority of visitors access the Atlas from home, 65%, while a quarter are accessing the Atlas from work, 24%, as shown in Table 3.

Location of Use	2007 Survey	2004 Survey	2003 Survey	2000 Survey
Home	65%	51%	66%	66%
Work	24%	36%	24%	25%
School	7%	10%	7%	8%
Library / public access	1%	2%	1%	2%
Other	2%	1%	1%	1%

Table 3: Location of Use - Data is from the Atlas of Canada Online Survey 4 Report, March-April 2007.

By combining all of these factors, along with many others, typical Atlas users are interested and committed map users who access the site mostly from home for personal use. There is both strong educational and "at work" use of Atlas maps and information for assignments and reports. Atlas users have average Internet experience with minimal to moderate amount of online mapping but not GIS experience. While these descriptions are generalized, the value of the details allows the development team to design a user interface and map interaction tools based on a known user profile. This avoids unsuitable options and focuses efforts on the most usable design models.

Map Interaction Requirements

The first Internet-based version of the Atlas of Canada was launched in 1999. The map interaction tools developed for the thematic maps were an assortment that the development team thought would sufficiently allow users to explore the interactive maps (Figure 3). Their functionality was based on similar GIS tools and the team expected that users would understand the behaviour of the tools. The results of the first survey indicated that users came with different expectations and understanding of how tools would function. In many cases they had little previous on-line mapping experience to guide them. Their understanding of mapping and interacting with online maps was considerably less than what was assumed by the design team. The result was that many users could not effectively use the tools to explore the Atlas' maps. The two biggest oversights were first, not understanding what tools were needed and secondly, how the tools should function to be effective and usable.

The UCD methodology (Figure 2) guided the Atlas team by incorporating user requirements research. It determined what features and functions users needed and expected to be available with maps in the Atlas. This was done with a series of in-depth interviews and a series of focus groups. User expectation for these functional needs has not changed over time. The results revealed that the following primary functions, in order of priority, were needed:

1. Zooming in and zooming out
2. Printing a map
3. Viewing a legend
4. Moving about the map
5. Selecting a specific feature on the map and obtaining information about it

Having first determined what users needed to do with the online interactive maps, the response was to develop tools and their associated behaviour to meet these specific needs.

Interactive Tool Development

Tools that allow users to perform specific tasks on maps are used in all mapping software and interactive online maps. They are mostly located within a mapping UI, above, below and/or beside a map and can be displayed in many ways such as buttons, images, check boxes and radio buttons. Their behaviour can vary from automatic responses once a tool is selected, to multi-steps to activate a change in the map, to a combination of actions between various tools and no actual action on the map. To add further complexity, many of the different Web-based mapping UIs use similar tools, for identical functions and they all behave differently. To make sense of all this, the Atlas' development team started from the beginning, without the bias of existing design models.

While icons are a common and usually intuitive means for identifying tools and their use, they did not prove to be the sole solution. Figure 3 shows the icons used in the original Atlas UI tool bar. The general results of usability research revealed that all participants, regardless of user group, responded better to a label accompanying an icon as icons alone can mean different things to different people. With the Atlas' broad range of users, clarity was paramount to avoid any confusion.

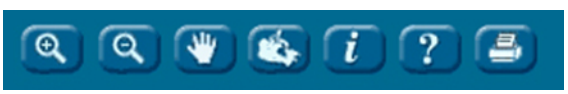

Figure 3: The tool bar from the Atlas of Canada's 1999 thematic mapping user interface.

Figure 4 shows two mock-ups used in the usability tests to evaluate the use of combined icon and text tools. Usability testing revealed that users responded best to a label beginning with a verb. In addition, some form of instruction, such as a mouse-over, tool tip or alt tag, worked best where the function of a tool was not intuitive. All usability testing on UI tools between 2002 and 2006 continually validated these design principles regardless of the changes and improvements to functionality of UI tools.

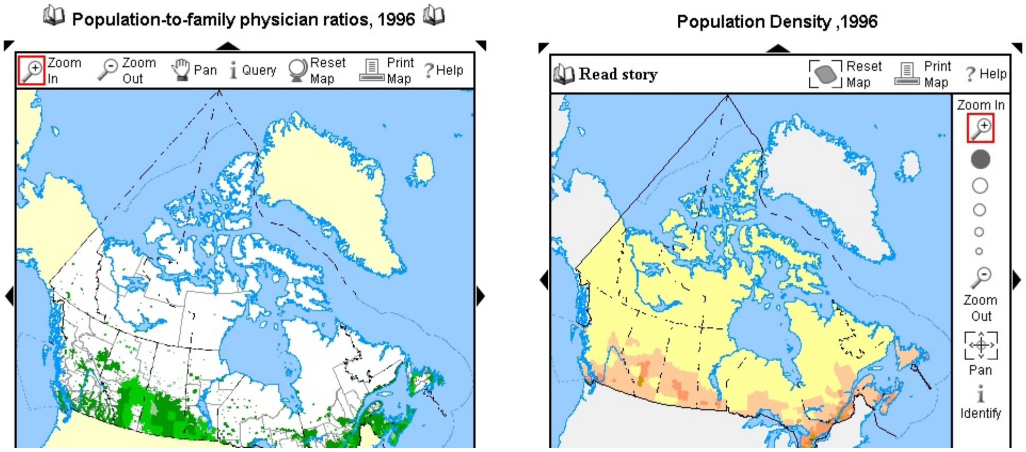

Figure 4: The prototype mapping user interface mock-ups used during the iterative usability testing of the Sixth Edition of The Atlas of Canada, Version 2, 2002.

Zooming In and Zooming Out

The Zoom In and Zoom Out tools were initially designed to work as a two-step operation. The first step was to select the tool making it active and a second step to click on the map to invoke the zoom in or out action. When attempting to zoom in, testing participants intuitively clicked on the map to zoom in without first selecting the zoom in tool. They also did not notice any highlighting or change to the tool button, such as a change in colour or "pressed in" appearance indicating it was active. In addition, there was no expectation of a user-defined zoom behaviour such as drawing a square on the map to define the map extent. When attempting to zoom out, testing participants surprisingly clicked the tool expecting something to happen, but did not think of clicking on the map to invoke the action.

The zoom in behaviour was modified so that it was active by default when a map first appeared (Figures 5 and 6). Users could then click on the map and see the expected zoom in results. The Zoom Out tool was changed to a one step operation, so that when the tool was clicked, the map would automatically zoom out one level, keeping the same map centre. These changes have worked very well in all UI usability testing scenarios between 2003 and 2006, where the zoom tools were used but not the subject of testing.

Figure 5: The tool bar from the 2002 thematic mapping user interface.

A zoom level indicator, shown in the right image of Figure 4, used five different sized circles. This was tested but not used by any of the participants in usability tests. Several printed mock-ups, using other shapes, such as thin rectangles and squares, were shown. Most indicated that the shape made no difference in their decision not to use it. This was surprising as this type of feature is commonly used in well-known commercial Web mapping sites. This type of feature has not been further evaluated or considered for use.

Figure 6: The tool bar from the 2005 thematic mapping user interface.

Viewing a Legend

The challenge with map legends is to show enough information regarding the features and symbology on maps without making the legend tool long, requiring the user to scroll down away from the map. The legends used in the Atlas range from thematic maps having varying numbers of layers and symbols, to topographic maps showing up to 126 feature layers in 14 groups. Initial usability testing with thematic maps showed that participants responded best to legends with only the thematic layers. The shorter legend showed the most needed information and prevented users from scrolling down resulting in the tool bar and some or all of the map disappearing. More concise legends were developed but did not work with all maps. Pop-up windows are not option for legends as Government of Canada Web design requirements generally do not support their use (http://www.tbs-sct.gc.ca/clf-nsi/index_e.asp).

With the large number of features in the topographic map legend, two additional solutions were found to deal with a long legend: collapsible legend groups and a scrolling legend. The legend groups contain common feature types and vary in size; the auto-redraw functionality is applied to these and when checked off, the legend group collapses with only the group title visible. The opposite occurs when a layer group is checked on. Users found this arrangement both functional and intuitive.

The scrolling legend was evaluated along with a short legend that contained a "View more detailed legend" button. It was thought that the latter may satisfy users who would use one or the other. The only users who had difficulty scrolling were those that were not frequent Internet users. Compared to the "View more detailed legend" button, the scrolling legend proved to be more intuitive and easier to use. The scrolling legend will be adopted in the thematic mapping UI later in 2007.

Atlas legends also allow users to customize their maps by allowing individual or groups of layers to be turned on and off. There were two initial types of behaviour permitting this, as shown in the older thematic map legend in Figure 7. One was an automatic update of the map when a user clicked the "radio" button box next to the layer or layer group name. The second was a combination of a check box and a "Redraw Map" button when different combinations of map layers could be selected prior to the map being redrawn. The use of "radio" buttons and check boxes, as described, is common across the Internet. However, usability testing revealed that participants had difficulty applying this standard behaviour to the legend. The functionality of the check boxes was changed to allow for an auto redraw of the map and the "Redraw Map" button was removed. This same behaviour was tested during the development of the more complex topographic mapping UI legend, with the same success.

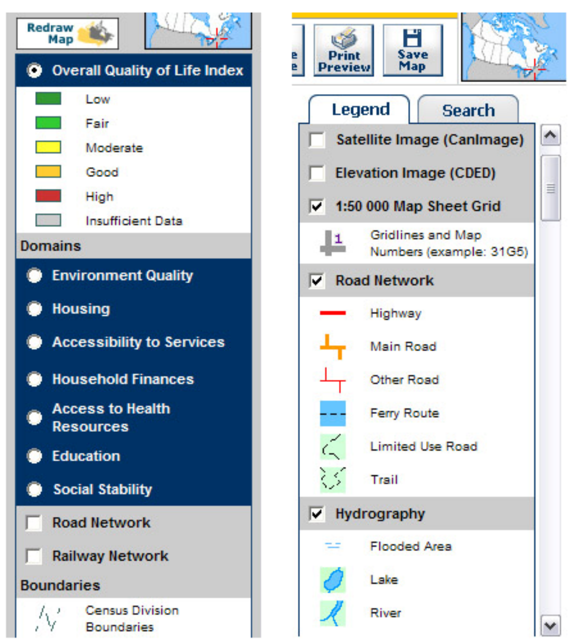

Figure 7: The older thematic legend (left) and scrolling topographic map legend tab (right)

Selecting a Specific Feature on the Map

All interactive Atlas thematic and topographic maps contain more information than appears in the map window. Thematic maps contain varying numbers of attributes adding considerable value beyond the polygon or symbol displayed on the map. These attributes can include quantitative data, textual information and links to other related Atlas and partner data and information. Topographic maps offer various coordinate information and topographic map sheet numbers. Developing an effective tool for users to access this information has been a significant challenge. The first thematic UI tool bar (Figure 3) contained an Identify tool, represented by an "**i**" symbol. It was interpreted as a help symbol such as in a visitor information centre on a paper road map. As a result, participants did not think of using it to get information from the map. The two step process of selecting the tool, then selecting a feature or location on a map also caused some confusion as with the zoom tools. The solution that brought some initial success was to create a new icon and rename the tool Get Statistics (Figure 5). There was limited success with this solution, but resources at the time did not permit further development.

A subsequent evaluation of this tool was completed at a later date during another series of usability tests. Two new labels were tested: "Get Information" and "Identify Feature". In addition a cursor change was evaluated. It changed from the standard arrow to a cross-hair, once the tool had been selected. Participants generally did not notice the changing cursor; those who did, misinterpreted it. The testing revealed that the "Get Information" name better communicated what the tool was meant to do. This incremental improvement was implemented.

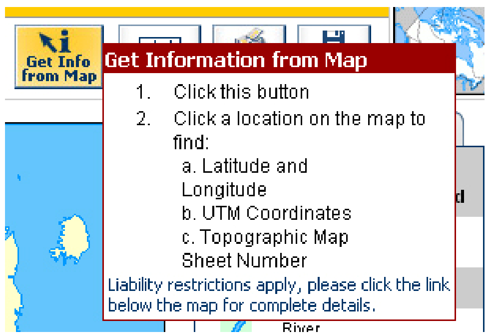

Figure 8: The Get Info from Map tool

Later during the development of the topographic mapping UI, there was another opportunity to further develop and refine this tool. The issue remained that users did not clearly understand what the tool could be used for and the behaviour of the two step process of selecting the tool and then selecting a location on a map. The "Get Information" label was evaluated along with a new "Get Info from Map" label. The usability testing showed that some form of explanation, such as a mouse-over or tool tip, was expected by users when the behaviour of a tool, such as this, was not intuitive. The "Get Info from Map" label, a new icon and an effective tool tip proved to be a very effective solution (see Figure 8). Once users had gone through the process of using it once, even those who struggled with it in previous tasks were able to complete the subsequent tasks quickly and efficiently. The success rate of participants using the tool tip was significantly higher and the error rate noticeable lower. The tool tip is only used for this and the Measure Distance tool, therefore allowing these tips to stand out and be more evident to the user. The new tool is currently being used on both thematic and topographic mapping UIs.

Conclusion

The three stages of the User Centred Design methodology work together as a unified process. They have brought focus and clarity to the development and design of the Atlas of Canada. The lessons learned on how to involve users in determining requirements and in testing are, in the long run, more important than the specific results that have been learned to date (Williams, O'Brien, and Kramers 2003). What is really needed is a clear understanding of who the target audience is, and what they need. This then leads to a clear definition of what can be done to support those needs. Since it is impossible to do all things for all users, it was necessary to first concentrate on specific high priority objectives.

Once the goals and objectives are known, prototypes are built and testing begins. Without testing, any assumptions, whether they deal with site organization, labelling or functionality, are nothing more than speculation. This is not a one-time step as any proposed solution needs to be tested (Daly-Jones, Bevan and Thomas 1999). When designing map interaction tools, as well as any product or service, those for whom the end product or service is intended must be part of the design process, from beginning to end. The underlying lesson behind all the interface tools' issues and solutions is that the perspective and experience of a development team is very different from that of a user and cannot replace them. That difference must be understood, respected and applied (Kramers 2007). The Atlas has made significant advancements in recent years by taking users into consideration. This has led to an Atlas that is more useful, relevant and ultimately more valuable to all map users.

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"I am going to visit Warsaw", that is to say what is a better choice: a traditional paper city map or an Internet city map?

T. Opach
The Chair of Cartography, Faculty of Geography and Regional Studies, University of Warsaw
Krakowskie Przedmieście 30, 00-926 Warsaw, Poland
e-mail: topach@uw.edu.pl

ABSTRACT

It seems that fast growth of the number of web pages containing city maps, would result less interest in traditional paper city maps. However, the symptoms of that recession are difficult to observe. On the contrary, traditional city maps are still very important part of cartographic publishing houses' offers (e.g. in Poland). Warsaw could be a good example. There are almost twenty paper street maps of the city, in various scales and with various range of thematic information.

When we want to justify the causes of constant interest in traditional paper city maps, we could present the following reasons:

- In spite of Internet cartography progress, traditional city maps are still characterised by more reliable obeying of traditional cartographic and graphic principles,
- Generally, there are more thematic and topographic details on papers city maps,
- It seems that papers city maps are irreplaceable during visiting places, it is possible to take a look on the any part of area thanks to them, and finally – they do not need any source of power,
- A significant part of users is accustomed to use papers city maps.

In my opinion, nowadays Internet city maps of Warsaw as well as maps of other cities are not alternative for paper ones. However, in many situations Internet city maps, interactive, with a lot of very practical functions – are simply more useful. A good example where it is possible to find address, compare time levels, make a measurement of distance, modify range of thematic information: about tourist infrastructure, culture institutions, buildings or well-known places are Internet maps e.g. "Google Earth – 3D_Warehouse".

Introduction

The fast growth of the number of Warsaw Internet city maps leans towards reflection, whether this kind of city maps are rivals of traditional paper maps. What is important – this problem does not refer only to Warsaw, but also to cities from all over the world. City maps of many world's cities can be found in the resources of World Wide Web.

It seems that free access to the Internet city maps could result in smaller interest in traditional Warsaw city maps. But, making observations of offers of domestic cartographic publishers, we may see a different trend – the number of available titles is still increasing. There are one-sheet city maps as well as multisheet ones in the form of atlases.

In the present article I will try answer the question if the Internet city maps are competitive to traditional city maps – on the case of Warsaw study.

Traditional paper Warsaw city maps

Warsaw, with almost two millions of inhabitants is a very important market for cartographic publishing houses. Prestigious and promotional reasons and over two millions of foreign visitors each year also influence the cartographic publishing houses' interests in Warsaw market. Because of considerable dynamics in the group of Warsaw paper city maps, it is currently difficult to determine precisely the number of titles which are available in bookshops and the number of their publishers. We may estimate that there are about 10 cartographic publishing houses that offer about 25 maps.

A high interest of Polish cartographic publishing houses in Warsaw affects the cartographic market in a positive way as well as negative one. On the one hand a bigger competition means that the quality of maps could be higher, on the other hand publishers reduce costs and they often neglect reliability of maps. This problem manifests itself in omitting conscientious proof-reading and field verification.

Because the literature about elaboration of traditional city maps is very extensive and also because the analysis and evaluation of paper city maps is not the main aim of this study, the paper is limited to the most important observations.

The content-related quality of Warsaw paper city maps could be assessed positively. Their scale usually oscillates around 1:26 000, but beside main maps there are also second maps in almost all of them, which present centre of the city in a larger scale. In figure 1 we can see fragments of selected Warsaw paper city maps with centre presented in larger scale (references at the end of the article).

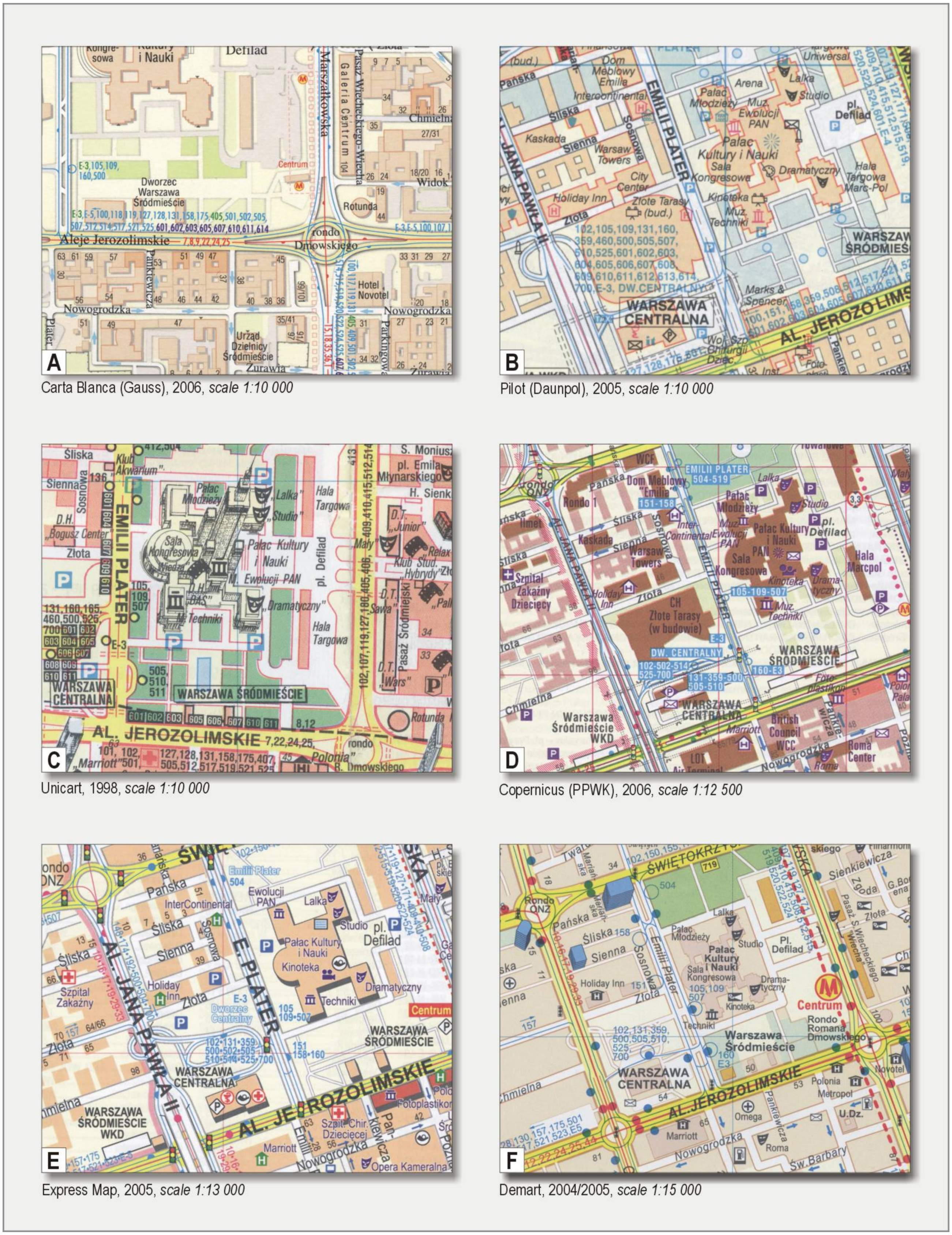
Warsaw paper city maps are characterised by the broad scope of content. This is typical for city maps published in Central and Eastern European countries (P. Martyński, W. Ostrowski, 2003). On these maps the information is presented in a detailed way, what is important for moving in the city – street network, buildings (usually with distinction between residential, shopping and industrial buildings), parks, squares and hydrographic objects. There is also broad thematic content in Warsaw city maps. It includes public utility buildings, city transport network, cultural places, historic monuments, addresses of buildings and the others. We could not have reservations as well about the layout of Warsaw paper city maps. In most cases they are legible and they retain typical features of maps which graphically catalogue real world – that is "maps for reading" (S. Bonin, 1989). Among these features one especially important is the proper adaptation of visual importance of maps signs (B. Medyńska-Gulij, W. Spallek, 2002). In my opinion visual importance of cartographic signs in most Warsaw paper city maps was adapted in a proper way, i.e. important objects (e.g. railway stations) were presented in "aggressive" way and second-rate objects (e.g. residential buildings) with lesser visual importance.

Aesthetic values of city maps are important from the point of view of map's buyers. Graphic methods such as "building shadowing" (Fig. 1 A and Fig. 1 E) and "small illustrations" of main buildings (Fig. 1 C), used in a skilful way, significantly influence aesthetic and usable values of Warsaw city maps. City map elaborated by Gauss Publishing House and published by Carta Blanca Publishing House is a good example of high aesthetic quality (Fig. 1 A). Graphically optimised, very legible and aesthetic, could be a model of proper and skilful application of visual variables.

In general, Warsaw paper city maps are an example of reliable, traditional cartography. We also could not have reservations about their content-related and graphic level. Regardless of quality of cartographic design, in many cases using Warsaw paper city maps is inconvenient. Searching for specific addresses (especially when family dwellings are dense), searching for specific tourist objects, using the large sheet of a map – these tasks are often very difficult, particularly when we use paper city maps. In these causes, we reach out for electronic Warsaw city maps (among other things) delivered via World Wide Web.

Internet Warsaw city maps

There were about 15 websites with Warsaw city maps in May 2007 (a list at the end of the article). Three groups of maps can be distinguished among them – maps with low level of interactivity, with "standard" interactivity and with high level of interactivity. Maps from the first group are nearly the same as traditional paper maps – usually they are electronic versions of paper city maps. Maps from the second group exemplify an attempt to combine traditional maps with a new medium, the last group assembles maps, with regards to usefulness, are often similar to GIS applications.



Carta Blanca (Gauss), 2006, *scale 1:10 000*

Pilot (Daunpol), 2005, *scale 1:10 000*

Unicart, 1998, *scale 1:10 000*

Copernicus (PPWK), 2006, *scale 1:12 500*

Express Map, 2005, *scale 1:13 000*

Demart, 2004/2005, *scale 1:15 000*

Fig. 1 Fragments of selected Warsaw paper city maps

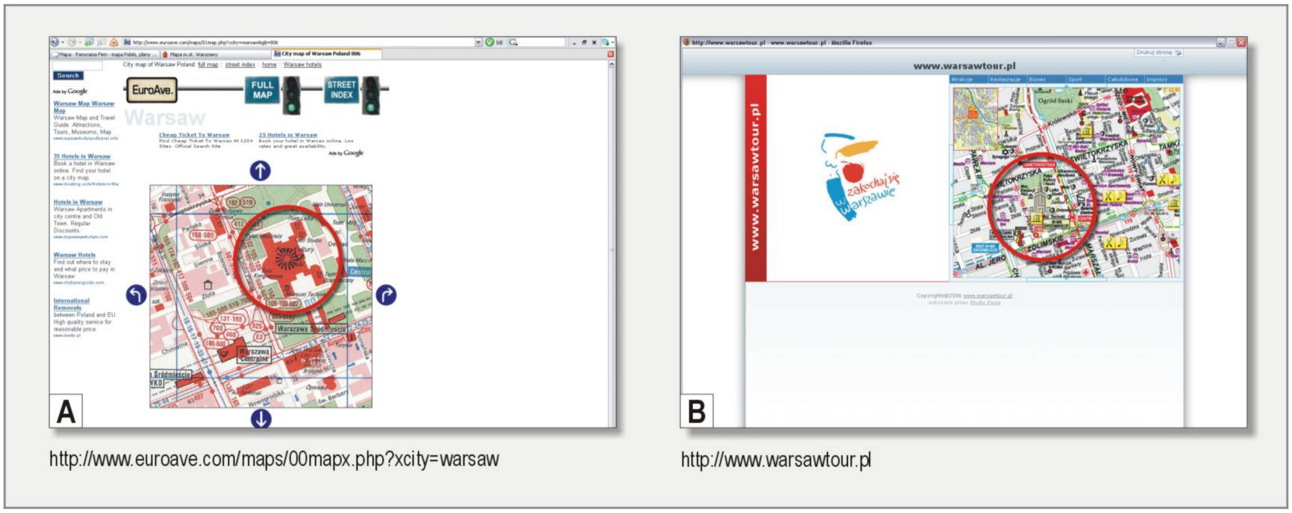


Fig. 2 Electronic versions of paper maps which were saved as a raster image and delivered via the Internet

Three from 15 analysed Internet city plans can be classified into the first group. Two of them are electronic versions of paper maps which were saved as a raster image (Fig. 2 A and 2 B), one of them was saved as a vector graphic and published in the Internet as a swf file (Macromedia Flash) (Fig. 3 C). The usefulness of city maps from this group does not significantly depart from usable values of paper city maps (apart from the basic difference which is an information carrier, that is the medium). For instance in the city map from the website www.warsawtour.pl it is possible only to display selected point symbols from the set of tourist objects. Also there are no significant differences between layouts of these city maps and traditional paper city maps. Usually graphically they are similar.

Maps with moderate interactivity are the second group of Warsaw Internet city maps. It is possible to see examples of such city maps in figure 3 B, D, E, F, H (references at the end of the article). A list of available functions in city maps with moderate interactivity is presented below:

– possibility of map zooming with changing map's details level, "Panorama Firm" Fig. 3 F; "Targeo" Fig. 3 B; "www.zumi.pl";
– possibility of searching for addresses, "citmap.com" Fig. 3 E; "Panorama Firm" Fig. 3 F; "Targeo" Fig. 3 B; "www.zumi.pl"; "www.mapquest.com";
– possibility of modifying range of thematic information: about tourist infrastructure, culture institutions, buildings or well-known places,"Targeo" Fig. 3 B; "citmap.com" Fig. 3 E;
– possibility of searching for city transport connections,"ztm.dojazd.pl" Fig. 3 D;
– possibility of searching and calculating the route length,"Panorama Firm" Fig. 3 F; "Targeo" Fig. 3 B.

The second group of maps are usually aimed at specific function. This function depends on the kind of website where city map has been published. The second group of maps are published in the Internet as vector graphic images. Reliability of their elaboration and aesthetics are diverse. Among them there are city maps elaborated fairly reliable (e.g. "Targeo" Fig. 3 B) as well as city maps of low quality (e.g. "Warszawska Mapa Urody" Fig. 3 H).

Products from the third group have a variety of interactive functions. It is difficult to characterise maps from this group as classical city maps. I have rated two types of presentations in the third group – global web mapping services ("Yahoo Local Maps" Fig. 3 G; "Google Maps" Fig. 4) and municipal information systems ("http://mapa.warszawa.um.gov.pl/" Fig. 3 A and Fig. 5). It is necessary to add that maps from "www.targeo.pl" and "www.zumi.pl" mentioned earlier are very similar to global web mapping services. The difference lies in the fact that "www.targeo.pl" and "www.zumi.pl" apply only to Poland.

Undoubtedly, global web mapping services have radically changed reasoning of Internet maps, and of course Internet city maps. The quantity of data available in these products is huge, because they are data-bases combined maps (Fig. 4 A) with satellite imageries (Fig. 4 B) and other kinds of geographic data, e.g. 3D terrain models or 3D buildings' models. Global web mapping services give users revolutionary possibilities and they are the most promising not only from a point of view of city maps. As a matter of fact we could have reservations about accuracy of drawn – roads' details, buildings' details etc, but their most important trump is not graphics but functionality. Furthermore cartographic data representation in these web services is still adjusted and enriched by new data.

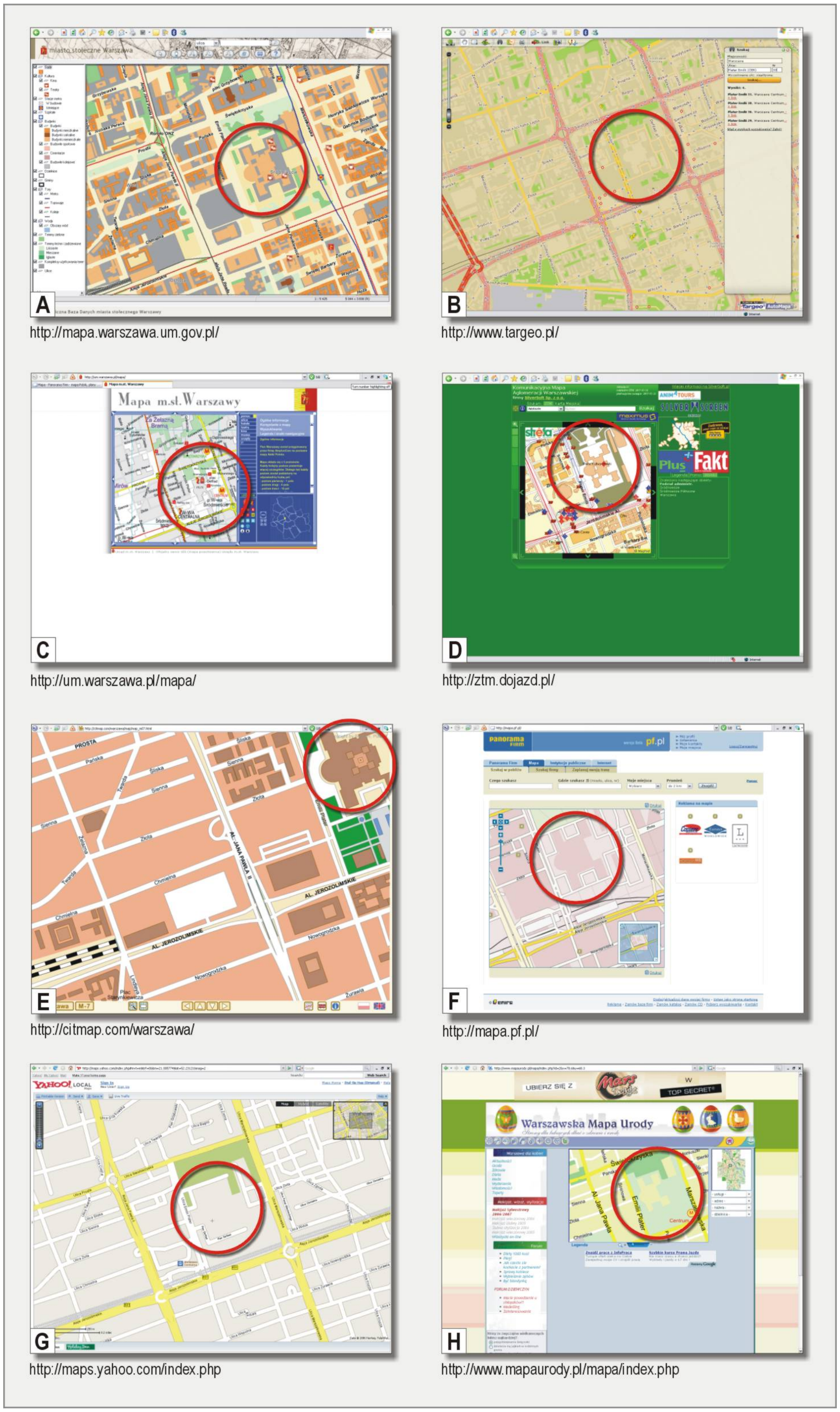


Fig. 3 Fragments of Warsaw city maps available in the Internet as vector graphics images

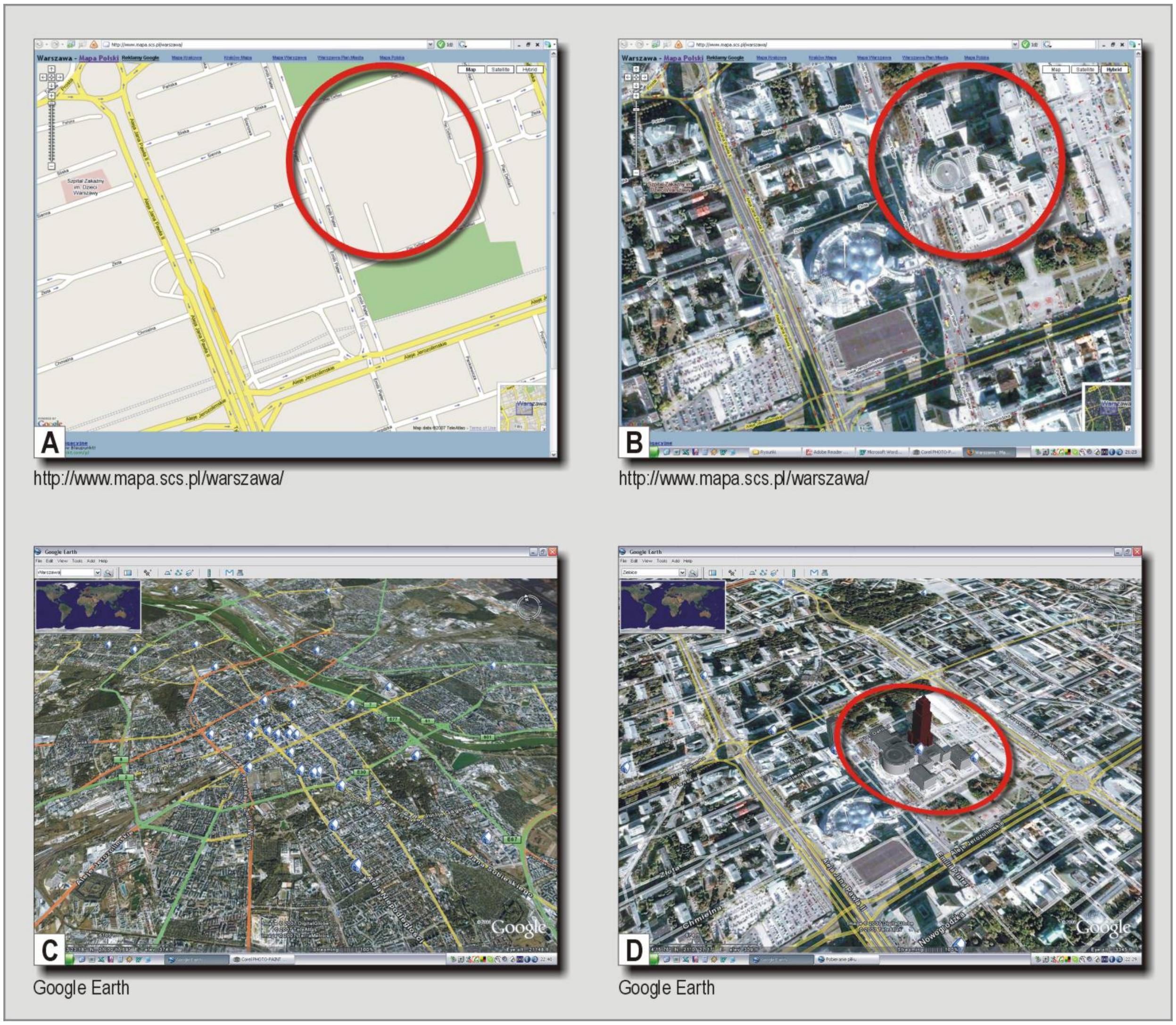


Fig. 4 Examples of global web mapping services (products of Google)

Among global web mapping services the Google products are worth to out of the ordinary note. They are available as Google trademark, e.g. "Google Maps", as well as products of others companies e.g. "Wikimapia", "www.mapa.scs.pl/warszawa/", "mapy.eholiday.pl/mapa-warszawa.html". In a sense, among Google trademark global web mapping services we could include "Google Earth" application. Admittedly it is not a typical website but this is free software and that is used with the Internet connection. It allows to display on the globe: imageries of Earth from space, aerial images and miscellaneous types of geographic data (e.g. urban 3D models). In this application data could be displayed in various scales. The degree of details available is based on the points of interest but most land is covered in at least 15 meters of resolution imageries.

Among the group of maps with high level of interactivity I have rated city map from the Warsaw City Hall website. This is the example of municipal information system delivered via World Wide Web. The map described here was prepared by means of Autodesk MapGuide software, which allows preparing maps especially for delivering via Internet. Examples of maps are shown in Fig. 3 A and Fig. 5. This map has a wide range of functions, among them it is possible to display orthophotographs: made after Second World War (Fig. 5 A) and contemporaries (Fig. 5 B).

Internet city maps, interactive, sometimes very complex, require different design and production approach (W. Cartwright, 2003, M. Peterson, 2003, V. Voženílek, 2005). Assessment of maps delivered via Internet also requires a different approach. In case of Internet city maps the most important is not precision of drawing and layout but utilitarian advantages. Nowadays Internet map use is the one of the most important research problems of Wide World Web cartography. This topic was mentioned in website of Commission on Maps and the Internet ICA: “how are maps being used?”, “who uses which maps for what reasons?” (*http://maps.unomaha.edu/ica/*).

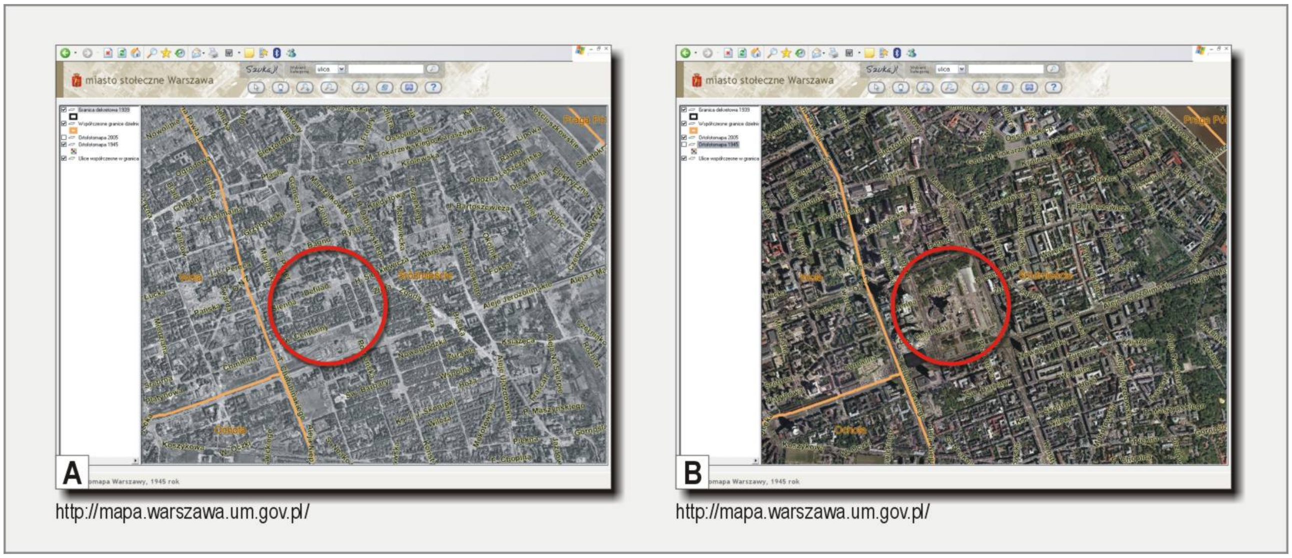


Fig. 5 Orthophotographs made after Second World War (A) and contemporaries (B) published in the website of Warsaw City Hall

Warsaw Internet city maps differ from one another for the sake of available functions. In most cases they are used on personal computers, but it is possible to use them by means of Personal Data Assistants (PDAs). Of course we could print a map displayed on the screen, but then quality of this map is low because it is graphically adjusted to watching on computer screen.

In spite of progress of Internet cartography, traditional city maps – among them, Warsaw city maps – are still characterised by more reliable obeying of traditional cartographic and graphic principles and more well-thought-out layout. It is well shown in figure 3. Fragments of Warsaw city maps available in the Internet as vector graphic images, were set together in this figure. They were put in order of quality of details presentation. Because almost everybody knows The Palace of Culture and Science in Warsaw, therefore I have chosen fragments of maps with neighbourhood of this building. Combination of these fragments in Fig. 3 clearly shows unreliable digitalisation and omission of conscientious proof-reading.

Conclusions

Differences between using paper and Internet Warsaw city maps make it difficult to recognise these two groups of maps as rivals. It is also difficult to answer the question, which of them are better. In my opinion in this situation a better chosen expression is “complementary maps”. With regards to utilitarian advantages, paper and Internet city maps complement one another. The first ones are irreplaceable during visiting places, it is possible to take a look on the any part of area thanks to them, and finally – they do not need any source of power. It is also important that a significant part of users is accustomed to the use of paper city maps. However the second ones turn out to be very useful as a home-use municipal information system.

To sum up, in my opinion the more numerous Internet city maps of Warsaw as well as maps of other cities are still not – and also for some time will not be an alternative for traditional paper city maps. However, with time Internet city maps, interactive, with many of very practical functions and with possibility of screen map’s high cartographic quality printing will often compete with paper city maps.

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   – City Hall of Warsaw
3. http://www.mapa.scs.pl/warszawa/
4. http://citmap.com/warszawa/
5. http://www.euroave.com/maps/01map.php?xcity=warsaw&glj=806
6. http://www.mapaurody.pl/mapa/index.php?id=2&x=78.6&y=68.3
   – Warszawska Mapa Urody
7. http://mapa.warszawa.um.gov.pl/
   – City Hall of Warsaw
8. http://mapy.eholiday.pl/mapa-warszawa.html
9. http://www.targeo.pl/
   – Targeo
10. http://maps.yahoo.com/index.php
    – Yahoo Local Maps
11. http://ztm.dojazd.pl/
    – ZTM
12. http://www.warsawtour.pl/index.php?id=3&
13. http://www.zumi.pl/
    – Zumi
14. http://www.mapquest.com/maps/main.adp?formtype=address
    –MapQuest

Application of a Hybrid Model in the Visualization of Reference Data

Andrzej Głażewski
GIS Laboratory, Department of Cartography
Warsaw University of Technology
a.glazewski@gik.pw.edu.pl

ABSTRACT

Among digital models used in geovisualization, we can distinguish three important categories: database model, known as DLM, cartographic (sign) model, known as DCM, and image model. Nowadays we can observe inclination to integration of these categories into complex models of geographic reality, which make it possible to analyze or visualize spatial data more effectively. Such models have been called hybrid models. And the integration here can refer to each case (database model and cartographic model, database model and image model or cartographic model and image model).

In the first case as a result we can consider a map as a visual model with database elements (using DLM) limited to chosen features (feature classes). It's known, the newest application of visualization in GIS enable writing in database number of sing-representation of features. The database-driven symbology can be used independently of exact-place representation of feature. In second case it's possible to use the result of integration to spatial analyzing, and visual form of model is double: it can be an image of terrain with small number of database features or it can be database model with small parts of image (e.g., aerial photo or satellite scene).

In geovisualization, we can use hybrid model consisting of cartographic and image models which were overlaid. Up to date in this integration the base has been always image model and cartographic model was used only to add some more precise information about narrow range of features of terrain.

In my research I propose change the rules. The map – sing model really can be the base, and the additional information may be provided by image model. Both classes of this visualization (map and image) have to comply with row of requirements, to be integrated into clear for user hybrid model of reality.

1. HYBRID MODEL OF GEOGRAPHIC REALITY

Among many different models which inform us about geographic reality the most interesting are these expressed graphically, as we consider their information capacity and facility of perception. These models transfer information in the form most approximated mental map – model of geographic reality functioning in mind of each person.

It is possible to classify such geo-reality models from the point of view their form and employment in three groups:

- database models – known as Digital Landscape Models (DLMs),
- sign model – known as Digital Cartographic Models (DCMs),
- image model – remote sensing models – called here Digital Image Models (DIMs).

Database models (DLMs) transfer information (on geographic phenomena) in a way appropriate for tools processing spatial data (e.g. performing data analyses) like GIS software. This form is not easy for perception by human senses, there it is introduced no perceptual improvements (because this model is not for reading), but it is possible to see it, using visualization software. This model of geographic reality, spatial database built in vector data model, finds the widest employment in modelling this reality in geographic information systems, and – among their other functionalities – in fundamental one: performing of spatial analysis.

Sing models (typically cartographic), which are built with direct application of cartographic visualization principles, always use formalism (sign system) for transferring information of geo-reality. The recipient of this communication is human with its senses, so facility of reception of information is the most important deal here. Maps and atlases (contemporary – digital, as well as traditional – analog) are the best examples of such models. (Fig.1.)

Image models (DIMs) transfer information of geographic reality by image – remote sensed and recorded in different wave ranges: light (visible wave range), radar (microwave sensing) and laser (e.g. aerial scanning LIDAR). This models comprise records of appearance of object "visible" only for sensors of given types. They can be successfully used in geovisualization, as we can observe in case of photomaps last time, which are so popular in internet services, where often main carrier of geoinformation are satellite images of Earth. Image models often present base for evaluation other categories models, although there is necessity of local topographic works in process of elaboration precise database model.

Integration of above-mentioned models can have three forms, but two of them have meaning: 1) creating geodatasets for evaluation integrated spatial analysis and simple geovisualizations (DLM + DIM), and 2) hybrid visualization (DCM + DIM).

Common, integrated presentation of two models DCM and DIM, called hybrid visualization here, connects advantages (and defects) taken images, and also it reveals new qualities.

Using in compilation of geovisualization two models DLM and DIM, always leads to strictly limited map content, most often thematic, such as navigation maps or mapping emergencies.

In advanced visualization of reference data it is advisable to use for presentation sign model (DCM) in integration with image model (DIM). Then, it is possible to complete the cartographic image (generalized and properly compiled) with photographic image of Earth. Such presentation are being called here the hybrid visualizations. Word *hybrid* refers to features of model but not to functionality of used applications. GIS software since long time can perform data acquisition, management, analyzing and visualization – data recorded in both – vector and raster categories of data models.

Such integrated visualization of spatial data is based on interaction between pictorial form objects (remotely sensed) in DIM and vector signs (DCM) corresponding with feature-classes of database. The fundamental differences among cartographic and image models (table 1.) makes this models in presentation complementary to one another, such common visualization characterize:

- keeping unambiguity of cartographic presentation,
- communication more associative with real landscape.
- strong connections with mental map (functioning in reader mind),
- object discrimination of image contents by discretization of DIM,
- improvement of cartographic model (classified and generalized) with tonal image, which is seen better in free fields of face map (without vector sings),
- increasing of information capacity of visualization.

Table 1. Features of cartographic (sign) model and image model

Feature	Sign Model – DCM	Image Model– DIM
basic element	vector sign	pixel
objects representations	referred to DLM feature classes, points, lines, areas, multipatches, annotations	pixel matrix, not related to objects
data sources	DLM, field, DIM, other DCMs	field
generalization	data generalization	image of all sensed objects

	graphic generalization	
accuracy	depending on data sources, stated by scale	depending on sensors type and conditions, stated by dimension of field pixel
visualization	vector	raster
perception	easy (clear sign system applied)	depends on individual features of user

Fig. 1. The examples of cartographic and image models (visualization of TOPO and ORTO TDB components)

2. REFERENCE DATABASES AVAILABLE IN POLAND AS DATA SOURCES

Reference data is kind of spatial data modeling basic elements of topography. As a model it may be a base for modeling and visualization other kinds of geo-data.

Reference database should assure logic classification of concerned topographic objects, topological correctness (expressed by geometric cohesion of data and faithful modeling of topological relations), high localization correctness (ensured by using cartometric sources of data and using known methods and technologies of data interoperability), and it should characterize its structure properly designed from logical point of view.

Many products exists in Poland, which pretend now to name of complex reference database on different accuracy levels. Let's mention only ones built by State Geodetic and Cartographic Service:

- Topographic Database (TBD) – product of the highest accuracy, MRDB, filling all the features of reference data set;
- VMap Level2, VMap Level2+ are the military databases: VMap Level2 is kind of DCM, and VMap Level2+ is database model (DLM);
- General Geographic Database (BDO) – database consisting of 3 components, which are referred to 4 accuracy levels (the most accurate is 1:250000). Modules of database are: GIS (DLM), WEK (vector DCM) and RAS (raster DCM);

- State Borders Database (PRG) – spatial database containing borders of administrative units in Poland (geodetic accuracy);
- State Geographic Names Database (PRNG) – toponymic database of whole country.

The most important problem, in accordance with development of thematic spatial databases, now becomes the harmonization of conceptual models of above mentioned data packages, as well as topological integration. [11], [13]

Poland, despite big area (as on European conditions) – 314.000 sq. km, owns topographic data resource in scale 1:10000, concerning whole the country. Building of this resource was initiated in 1957-1974, and now part of it is submitted of periodic modernization. Since 2003 new way of developing this resource has been assumed – building national Topographic Database (TBD). There is the only product covering so big areas with so accurate data, which can be a spatial base of other databases. It fills all the criteria of correctness of reference databases, and first of all, it has been constructed with logical correct conceptual database model.

TBD consists of 4 components:

- TOPO – vector database (DLM)
- ORTO – georeferenced orthophotomaps (DIM)
- NMT – DTM (EOP = 1,0 m – on open and flat areas)
- KARTO – cartographic visualization of TOPO 1:10000 (vector DCM)

Two components: vector TOPO (modeled as DLM) and raster ORTO – orthophotomap (DIM) are the best, available now in Poland, products modeling reference data. It is possible to use them in hybrid visualization with success.

Basic component of TBD includes topographic objects (coordinates of WGS-84 datum) with its attributes (about 230 features classes related with different accuracy levels), which were differed on base of 1:10000 topographic map classification and thematic classifications. This component is multiresolution database (MRDB), so for each data visualization always is selected part of all feature classes. It has managed in this solution to distinguish land cover layer (42 feature classes) – being the partition structure, and land use layer (49 feature classes) – modeling objects like schools, universities, hospitals, harbors and so on (which consist of many topographic objects, but are important in managing and using). Land cover layer in direct visualization of TOPO component is face for visualization of next feature classes, and creating the DCMs.

Component ORTO is pictorial database of orthophotomaps, in national coordinate system “1992” (WGS-84 datum projected by Gauss-Krüger method). Its field pixel is equal 0,5 m, and standard error of position is 1,5 m.

Independently on slow realization of TBD (until 2006 full database has covered c.a. 5% of country area), digital orthophotomap is available for all country. It is possible to differ 3 fundamental standards of this product:

- standard I (25 % area) – field pixel 0,25 m, base: aerial photos 1:13000;
- standard II (70 % area) – field pixel 0,50 m, base: aerial photos 1:26000;
- standard III (5 % area) – field pixel 1,00 m, base: VHR satellite images;

It is planned five-year cycle of database modernization, so 20 % country area will be covered every year with new images. [12]

3. HYBRID VISUALIZATION MODES

It is possible to distinguish several cases of hybrid visualization of DCM and DIM, in which the models fulfill different roles:

- using tonal image of selected feature classes for creation the raster patterns (as graphic components of cartographic signs) or for photo rendering 3D models;
- improvement of image model contents (not modified) with vector signs, object names and marginal information;
- joint visualization cartographic and image models with graphics modification in both of them:

- simple – raster modified as a composite unity (georeferencing, building sub-image pyramid, resampling, orthorectifying, mosaicking, correction of brightness and saturation etc.)
- integrated – raster, besides complex corrections, is processed by discretization to distinguish visualization fields – done with extents of feature classes presented in DCM.

Vector map is effect of the first solution (vector mode of DCM), where for chosen elements are employed tonal components (raster patterns) of cartographic signs. Such approach allow to increase the associations of graphics with real landscape and makes easier interpretation of contents. In 3D visualization images of objects are used for photo-realistic rendering, often applied in 3D graphic modeling – from simple block diagrams to multimedia dynamic model using VR environment.

Second solution gives in result an image model improved with vector elements necessary in proper image interpretation. An example of such product is classic polish orthophotomap (Fig. 2.) Vector signs are overlaid on photographic image and they occupy independent, the highest perceptual plan. Bright colours (including white) are used here for vector signs in accordance with strong tonal discrimination of image model contents.

Third solution leads different results, depending on manner of graphic modification of image model. In each case vector graphics respects accepted conventions (in visualization of reference data this conventions are usually official), and may be very easy changed in visualization process, dependently on scale level and designation of the visualization.

The result of simple hybrid visualization is always read as a tonal image, which has been completed with selected feature classes of vector model. Examples of this type images are being used in web services, eg. GoogleMaps, OS MasterMap – Fig.3.) The image models used here are the base of visualizations, and their graphics dominates in perception of integrated models.

When the discretization of DIM is processed and different fields of image are graphically distinguished, the integrated hybrid visualization can be performed. Chosen feature classes, symbolized in DCM, are used as masks of photo-image and they differentiate graphics of DIM (in places taken by this feature classes). In the result the fields of image model occupy different perception plans, the same related to vector graphics (because of common reading of this models). Such kind of visualization reference data will be percepted as a cartographic model, completed by implemented set of fields of image model.

Fig. 2. Orthophotomap of Poland (field pixel 0,5 m), edited according to GUGiK's guidelines (an example of second solution – read as a DIM with vector elements)

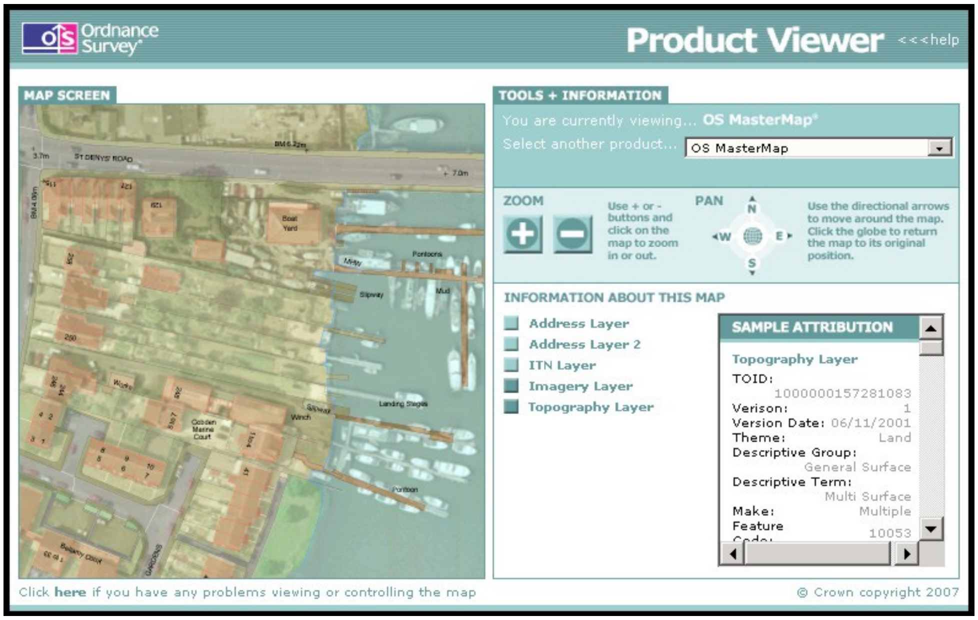

Fig. 3. Web browser of Ordnance Survey MasterMap (an example of simple hybrid visualization)

4. PROPOSAL OF HYBRID VISUALIZATION OF REFERENCE DATA

The key in suggested approach of hybrid visualization is assuming the cartographic model to be a graphic base of visualization, and discretization process of image model, which contains complementary graphic elements – changing form of cartographic signs in chosen areas.

Both, cartographic and image models, for hybrid visualization, have to fulfill mentioned below conditions.

Image model has to have:

- proper georeferencing, in keeping with legal guidelines, performed with precision enough for reference data,
- orthogonal geometry, obtained with using DTM for orthorectifying imagery, requiring the resampling and new mosaicking as well,
- acquisition date according with date of revising the cartographic model. More often the DIM is more up-to-date then DCM, what is natural, but the difference should not be bigger then several years,
- performed the discretization by vector feature classes,
- adjustment of brightness and saturation general levels according to saturation of colours used by signs of DCM. The accepted levels places the imagery in background of visualization, but also enable easy perception of tonal image.

Sign model has to:

- have proper georeferencing, related with referencing of DIM, the best conditions for transformation are when both models are using the same datum,
- be approximately consistent in degree of up-to-dateness. In practice it means several years delaying of revision DCM date from date of acquisition imagery,
- group vector objects in groups differentiating perceptual plans of DIM,
- use cartographic sign systems considering presence of image model. Visual variables used by graphic components of signs should be adjusted to general levels of brightness and saturation applied for DIM graphics.

In discretization of DIM, there were employed mainly two visual variables: *colour* and *transparency* for differentiation of reading levels of imagery. Feature classes belonging to land cover and buildings categories (implemented in conceptual model of TBD) were used for discretization process. There were accepted 3 reading levels of DIM, according to 3 groups of DLM features (visualized by DCM):

- Level I – open area, low plants area, cultivation area, forest – in these areas reading quality of DIM is the best, almost unlimited, and the transparency of colour fillings for all signs representing mentioned objects is close (or equal) to 100%. These are the areas in which official maps [5] proposed area signs delimited to marker patterns (like in *grass* sign) or which were not presented at all (like *ploughland*). Here the photo image is of the most importance, especially in improvement of visualization with additional information (directions of parcels' configuration, fields dissagregation, kinds of cultivation, boundary directions).
- Level II – build-up areas, other green areas – in these areas reading quality of DIM is not very good, but its perception is possible, and the transparency of colour fillings for all signs representing mentioned objects is close to 60%. For some of fields in this group the role of DIM is to improve the DCM, and some of them (especially *plants*) are visualized with signs for which are used additional raster patterns – created from natural image of this areas.
- Level III – buildings areas, water areas – in these fields reading quality of DIM is strictly limited (transparency of colour fillings for area signs here is close to 30%). Slight increasing of information capacity of DCM is possible here (can see differences in heights of buildings, disclosure of sandbanks and shallows).

Apart from that visual plans, there in each hybrid visualization are places where tonal image is impossible for seeing – these are areas of point and line symbols, and lettering and its masks.

Mentioned reading levels of DIM allow to distinguish 3 perception plans of tonal image: first level is related to the perceptive plan closest to reader, the easiest for reading. In fields of low accumulation of contents details (in sign model) the role of IDM is increasing, and opposite: in places where is seen big number of vector signs, an image model is slight readable.

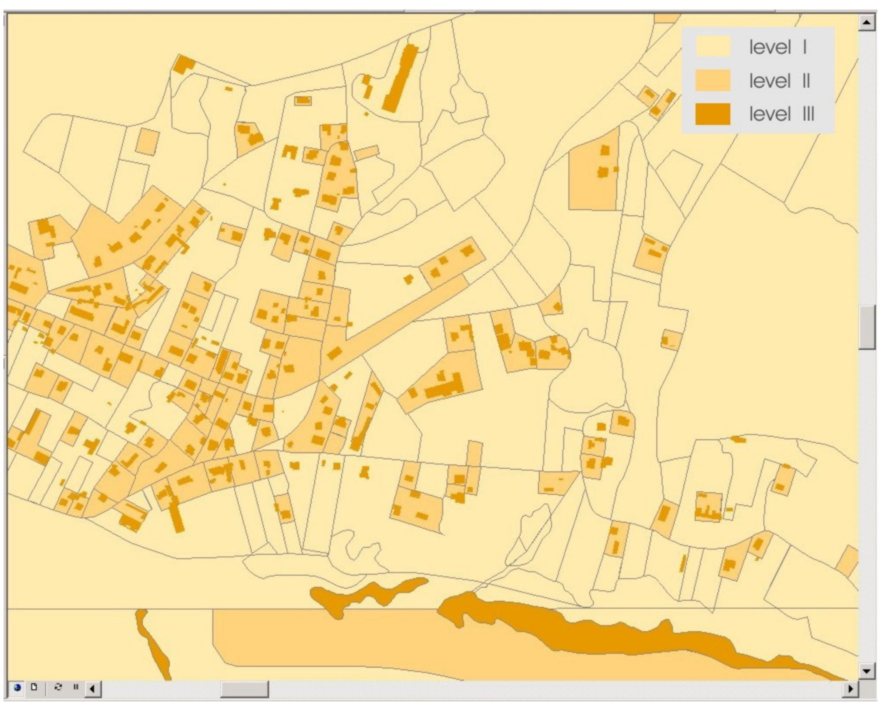

Fig. 4. Fields used in discretization process – 3 reading levels of DIM (with borders of DLM feature classes added)

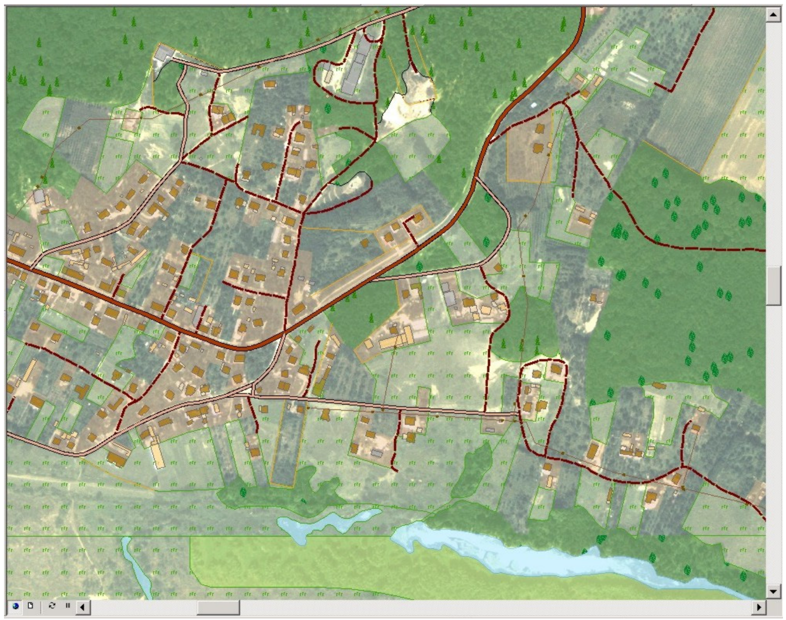

Fig. 4. Example of integrated hybrid visualization of reference data

5. CONCLUSIONS

Proposed integrated mode of hybrid visualization is suggesting to use DCM and DIM together with modifications each of them. Performing the visualization is the best when prepared DCM is overlaid on DIM. In result it will be done visual integration both of images, with regionalization of DIM.

It is possible to employ such integrated hybrid visualization of reference data as perfected version of topographic map, with success used in digital applications, in WMSs, e.g. in polish geoportal [15], as well as print such maps in paper form. This visualization may be an image layer for rendering of DTM and creating 3D model, where more important will be additional changes of image features (e.g. correction of natural shades). Such layer can be used as a base for dynamic visualization and be integrated with other types of geo-models (like DTM mentioned).

Hybrid visualization in case of reference geo-data makes the map “filled”, eliminate white fields in its face – places with minimal number of vector details or without signs. In integrated visual model the number of element for reading is big over all the map, and its perception depends only on observer and his or her possibilities and intensions. Here strongly increases information capacity of map, with keeping unambiguity of presentation.

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Deployment of Interactive Web-Atlases using Scalable Vector Graphics, C# and ASP.Net: the example of the *Atlas of the Aboriginal Communities of Québec*

Philippe Apparicio
Spatial Analysis and Regional Economics Laboratory *DIALOG* – Le réseau québécois d'échange sur les questions autochtones
INRS Urbanisation, Culture et Société
3465, rue Durocher
Montréal (Québec) H2X 2C6 CANADA
Philippe_Apparicio@UCS.INRS.Ca

Carole Lévesque
Spatial Analysis and Regional Economics Laboratory *DIALOG* – Le réseau québécois d'échange sur les questions autochtones
INRS Urbanisation, Culture et Société
3465, rue Durocher
Montréal (Québec) H2X 2C6 CANADA
Carole_Levesque@UCS.INRS.Ca

ABSTRACT

In Canada, access and adequate use of data on aboriginal communities is an important issue. In this context, Atlas of aboriginal communities of Quebec (Canada) was developed by DIALOG cluster — Le réseau québécois d'échange sur les questions autochtones — and Spatial Analysis and Regional Economics Laboratory to provide information for communities members, social policy makers and researchers. This atlas which contains 120 web-maps is based on customized compilation of data from Statistics Canada and from Indian and Northern Affairs Canada.

Recent developments in interactive and dynamic cartography and development of Internet technologies are largely contributed to increase the number of interactive atlases on Internet. With client/server technologies and vector formats for Internet, it's now possible to deploy rapidly interactive web-atlases. For example, with Scalable Vector graphics (SVG), it's possible to quickly develop interactive and dynamic mapping functions and thus high quality and interactive web maps. Moreover, advantages of Web-Atlas are today well known: "cost efficiency, flexibility and timeless, opportunities for active learning and World-wide connectivity" (Torgerson and Blinnikov).

The aim of this paper is to describe a simple and effective approach based on C#, ASP.Net and SVG to product interactive atlases on Internet such as Atlas of aboriginal communities of Quebec. This approach is very useful for two reasons: the cartographic production is very simple and fast, and the development of interactive and dynamic mapping functions is facilitated, almost unlimited, and can be adapted according to needs and knowledge of the user.

INTRODUCTION

For the past ten years or so, we have been seeing more and more electronic atlases on the Internet—whether national, regional, metropolitan or thematic in focus (Kraak, 2001; Richard, 1999)—that is, sites including a series of maps with some degree of interactivity. Recent developments in interactive and dynamic cartography and advances in Internet technologies have largely fostered this increase in the number of atlases on the Internet, which are thus responding to the growing demand for geographic information on this medium (Taladoire, 2003; Van Elzakker, 2001 a and b).

On the technological point of view, many Internet mapping solutions are today available to deploy web-atlases: commercial Web GIS server products[1], open source Internet map servers such as MapServer which works with

[1] ArcIMS (Esri), Push'n'See for MapXtreme and Envinsa (MapInfo), Maptitude for the Web, Bentley Geo Web Publisher (MicroStation), etc.

PostgreSQL and PostGIS; Google Maps, Yahoo! Maps and MSN Virtual Earth Map APIs; and vector formats for Internet (Flash and Scalable Vector Graphics – SVG). There is also some commercial products to deploy Flash or SVG web-mapping applications (GéoClip, HyperGIS, GeoReveal, SVGMapMaker).

The aim of this methodological paper is to describe a simple approach that uses C#, ASP.Net and SVG to produce interactive atlases on the Internet such as the *Socioeconomic Atlas of the Aboriginal Communities of Québec* (http://www.reseaudialog.ca/rub5.asp?rub=5). In particular, we focus on the objectives of this atlas, the deployment model on which it is based, and the interactive mapping functions that it includes.

1. OBJECTIVES OF THE SOCIOECONOMIC ATLAS OF THE ABORIGINAL COMMUNITIES OF QUÉBEC

The *Socioeconomic Atlas of the Aboriginal Communities of Québec* is the result of a close collaboration between two Québec research groups: the *DIALOG* cluster—Le réseau québécois d'échange sur les questions autochtones—and the Spatial Analysis and Regional Economics Laboratory (SAREL). *DIALOG* is an interuniversity, inter-institutional, cross-disciplinary and international cluster created in 2001 and based in Québec (Canada). This cluster brings together more than one hundred and fifteen people—researchers, students and collaborators—from universities and Indigenous organizations and communities, who carry out their work in Québec, Canada, the Americas, Europe and Asia. These diverse actors share the objectives of promoting, disseminating and renewing research relating to Indigenous peoples. In this context, a web-atlas is clearly a tool that is especially well adapted to the sharing and dissemination of information relating to all of these 54 Aboriginal communities of Quebec.

Although there are today many different technological solutions facilitating the deployment of atlases on the Internet, the development of a web-atlas on the Aboriginal communities of Québec was still a significant challenge, as it had to satisfy the following objectives:

- it had to be possible to include varied and at times unavailable data sources for all 54 communities;
- the content of the atlas had to be easily extensible, in terms of the themes, data and number of maps;
- most users are not geographers or cartographers[2], so that interactive functions had to be implemented to make it easier to interpret the maps;
- users' profiles vary widely: members of Aboriginal communities, representatives of Aboriginal organizations, public decision makers, researchers and students in the DIALOG cluster coming from very different disciplinary fields. The atlas's navigation and exploration functions thus had to be adapted to these different profiles so that each user could properly make use of the atlas's analytical potentialities.

2. THE DEPLOYMENT MODEL FOR THE ATLAS

The deployment model for the *Socioeconomic Atlas of the Aboriginal Communities of Québec* presented here is based on C# programming language, in order to use three technologies: SVG, ADO.Net and ASP.Net.

2.1 Use of SVG, ASP.Net and ADO.Net with C#

SVG is a well-known 2D vector format for the Internet based on XML. Recently, many authors have demonstrated that SVG is a very effective solution for the deployment of dynamic and interactive mapping applications and thus of web-atlases (Boulos et al., 2005; Danzart et al., 2003; Neumann and Winter, 2003). Indeed, SVG standard has many advantages, on both the design and graphic levels (Danzart et al., 2003; Neumann and Winter, 2003).

In terms of design, SVG is a free language developed by the W3C consortium (http://www.w3.org/TR/SVG); in other words, it can be used without charge unlike Flash. It is also a standard that takes into account other W3C methods (CSS, DOM SMIL, XSL and XLST), and that is supported by the most common Internet technologies (HTML, ASP, ASP.Net, JSP, PHP, etc.). This interoperability thus makes it much easier to develop SVG-based applications.

On the graphic level, SVG integrates three types of objects: drawing elements, images and text. SVG elements can be grouped, transformed (rotation, scaling, etc.) and animated. Finally, thanks to DOM (*Document Object Model*),

[2] For example, the researchers come from the following disciplines: anthropology, archaeology, communications, criminology, law, economics, education, environmental studies, tourism studies, geography, management and administration, history, linguistics, social and preventive medicine, psychology, political science, sociology and social work.

SVG files can integrate internal or external script (JavaScript), so that one can quickly and effectively develop the interactive functions associated with the SVG elements. One can also generate graphic elements using these scripts.

C# language, which operates with the Microsoft .Net platform, has many similarities with C++ and can be used to rapidly deploy Windows and Web applications (Watson, 2001). The Web applications are based on ASP.Net (client/server technology) and ADO.Net for access to data on a server. The coupling of C#.Net and ASP.Net makes it easier to set up client/server web sites for several reasons. First, ASP.Net includes Web forms that are very similar to classic Windows forms, so that one does not have to use the at times very fastidious HTML. The most obvious advantage of ASP.Net is that it represents a real object programming language generating HTML, DHTML or XHTML pages.

2.2 Deployment model

The deployment model for the interactive web-atlas is shown in Figure l. It includes two phases: Data Preparation and C# Web Application, that is, the computer programming of the site as such.

The first data preparation task is to structure and integrate all of the data needed to build the maps within a database software (Access, MS SQL Server, Oracle, etc.). This information is of two kinds: attributive data associated with spatial entities; and the map features, that is, map and legend titles, name(s) of the variable(s) used, types of cartographic representation (proportional circles, graduated symbols, graduated colour, etc.), class boundaries and colours, and the analytical text associated with the map. To make it easier for the cartographer, a data entry form has been created for this purpose (figure 2). In others words, with this form, adding or modifying a map is very simple.

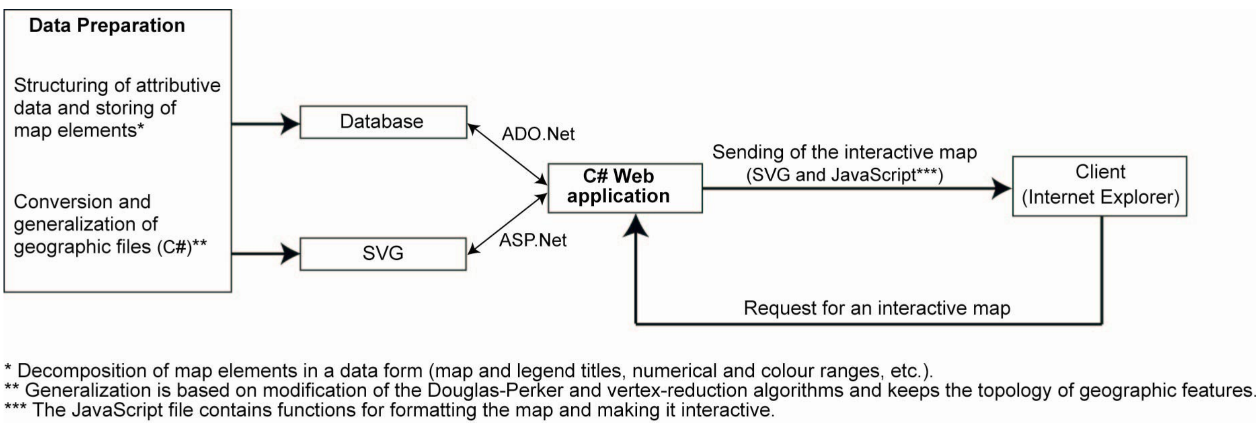

Figure 1. Deployment Model

Still in the data preparation phase, the geographic file has to be converted to SVG format. Therefore, we developed a C#.Net application for the conversion of *shapefile* (ESRI) to SVG format by applying (or not applying) a level of generalization of the geographic information (Petkevitch and Apparicio, 2006). This generalization process is an often necessary process to make the SVG file a reasonable size that does not limit the speed of Internet navigation. Douglas-Peucker (1973) and vertex-reduction generalization algorithms (Hershberger and Snoeyink, 1992) are implemented in *SVG Convertor* (figure 3), which can be downloaded free of charge from the SAREL web site (http://laser.ucs.inrs.ca/). The cartographer supervises, of course, the generalize process: he chooses a good level of generalization that allows the production of a small size SVG map with acceptable quality.

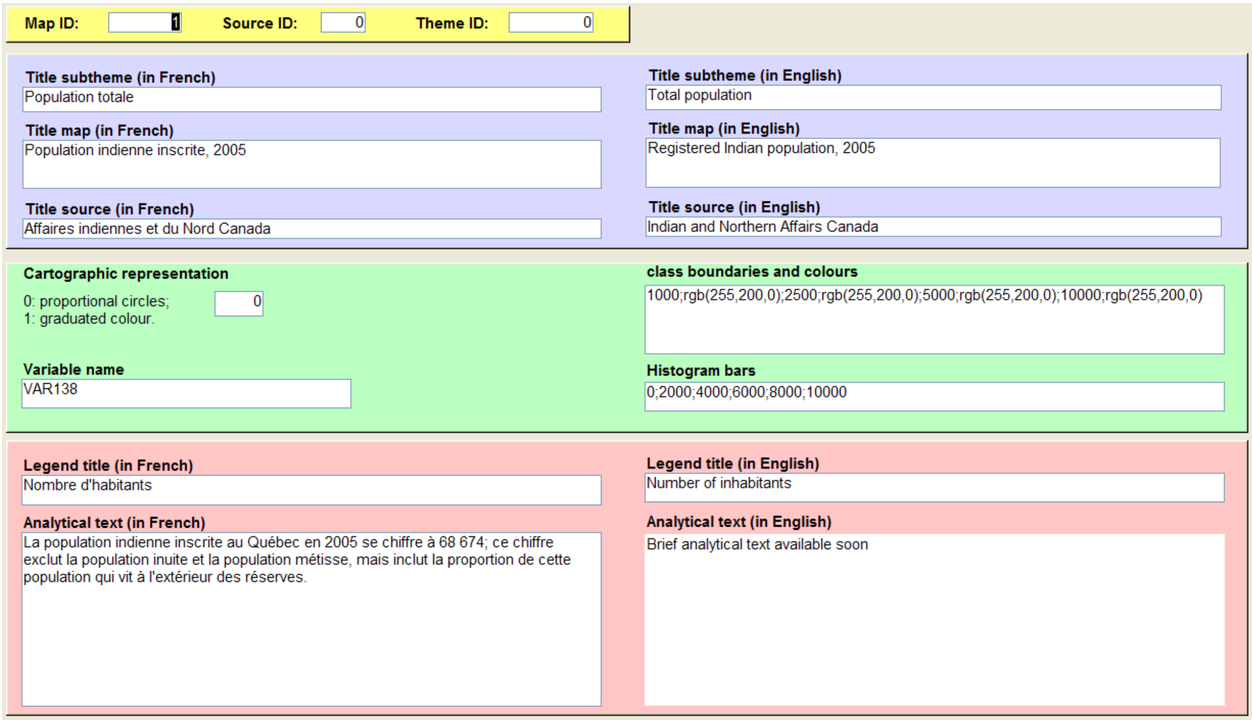

Figure 2. Data Map Entry Form

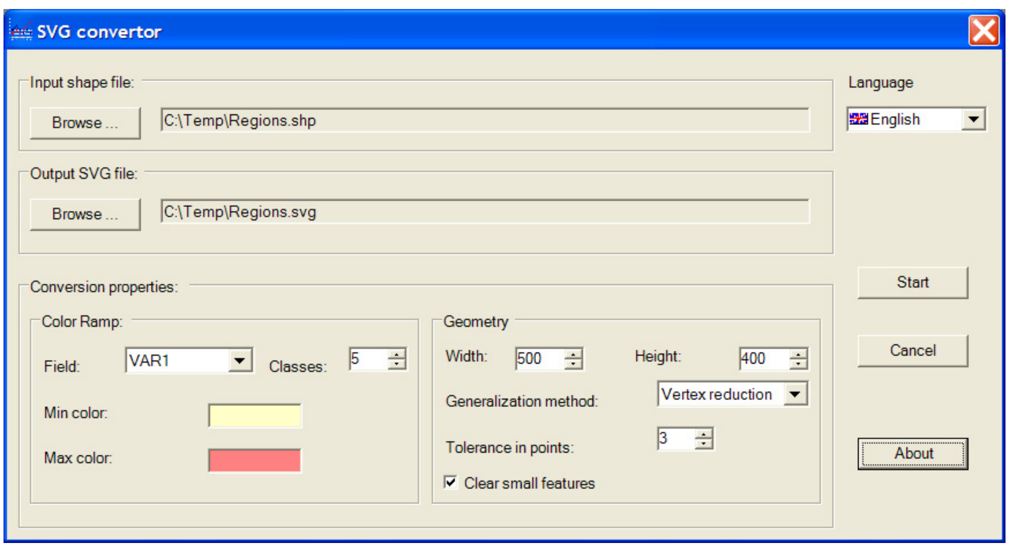

Figure 3. Screenshot of the SVG convertor C# Application

Figure 4. Generalization and SVG conversion examples

The second phase of the deployment model—programming of the site—is carried out in C#.Net and is based on ADO.Net technology for access to and querying of the database, on ASP.Net technology for the creation of web pages, and on JavaScript code for formatting the map and making it interactive. More concretely, when the client requests an interactive map, the C# web application accesses and reads the attribute and geographic data from the database using ADO.Net. Then, the application uses ASP.Net to write a series of global variables in the JavaScript file, which contains formatting and interactive mapping functions, and finally, it sends the JavaScript file and SVG file to the client.

3. ATLAS FUNCTIONS

The *Socioeconomic Web-Atlas of the Aboriginal Communities of Québec* includes 121 maps grouped by themes and according to the two data sources used (Indian and Northern Affairs Canada and Statistics Canada). Due to the very diverse profiles of the atlas users that we mentioned earlier, we developed two navigation modes: a simple mode and a second, more advanced mode that includes more interactive functions (Figure 5).

The atlas is made up of three types of elements: elements for navigating through the atlas, map formatting elements and interactive mapping functions.

With the first navigation element identified by the symbol ① in Figure 5, the user selects and activates the various categories of the atlas using the dropdown menus. The content of these menus is generated automatically with

ASP.Net, using information entered in the database. This makes it easier to modify and extend the content of the web-atlas. For example, to create a new category in the atlas, one simply has to add a record in the database, and then enter the title of the category and the information for the corresponding map in the Data entry form described previously. The menu bar (② in Figure 5) can be used to activate a number of functions: viewing of the analytical text or a table accompanying the map, printing or saving the map in *jpeg* and changing from French to English or vice versa.

Still in Figure 5, symbols 3 to 6 correspond to map formatting elements: ③ map title, ④ legend building, ⑤ attribution of proportional circles or graduated colours, and ⑥ building of a table linked to the map. In the advanced navigation mode, one also finds a histogram and descriptive statistics linked to the map (⑦ and ⑧). It is important to note that this formatting is done from the client's workstation with *JavaScript* code external to the SVG file and not by using the server's resources, which makes the application even faster (figure 6).

To make it easier to analyze the maps, several interactive mapping functions have also written in the *JavaScript* file, including navigation functions on the map (*zoom in and out*, *predefined zooms, full extent, pan*, *distance between two points*) and an *information tool* (see symbols ⓐ and ⓑ in Figure 5). Other functions are designed to facilitate exploration of the data: ⓒ dynamic links between the map and the graph and legend, ⓓ displaying of the name of the community and the value of the corresponding variable in a table as well as the First Nation to which the community belongs by placing the mouse on the community in question.

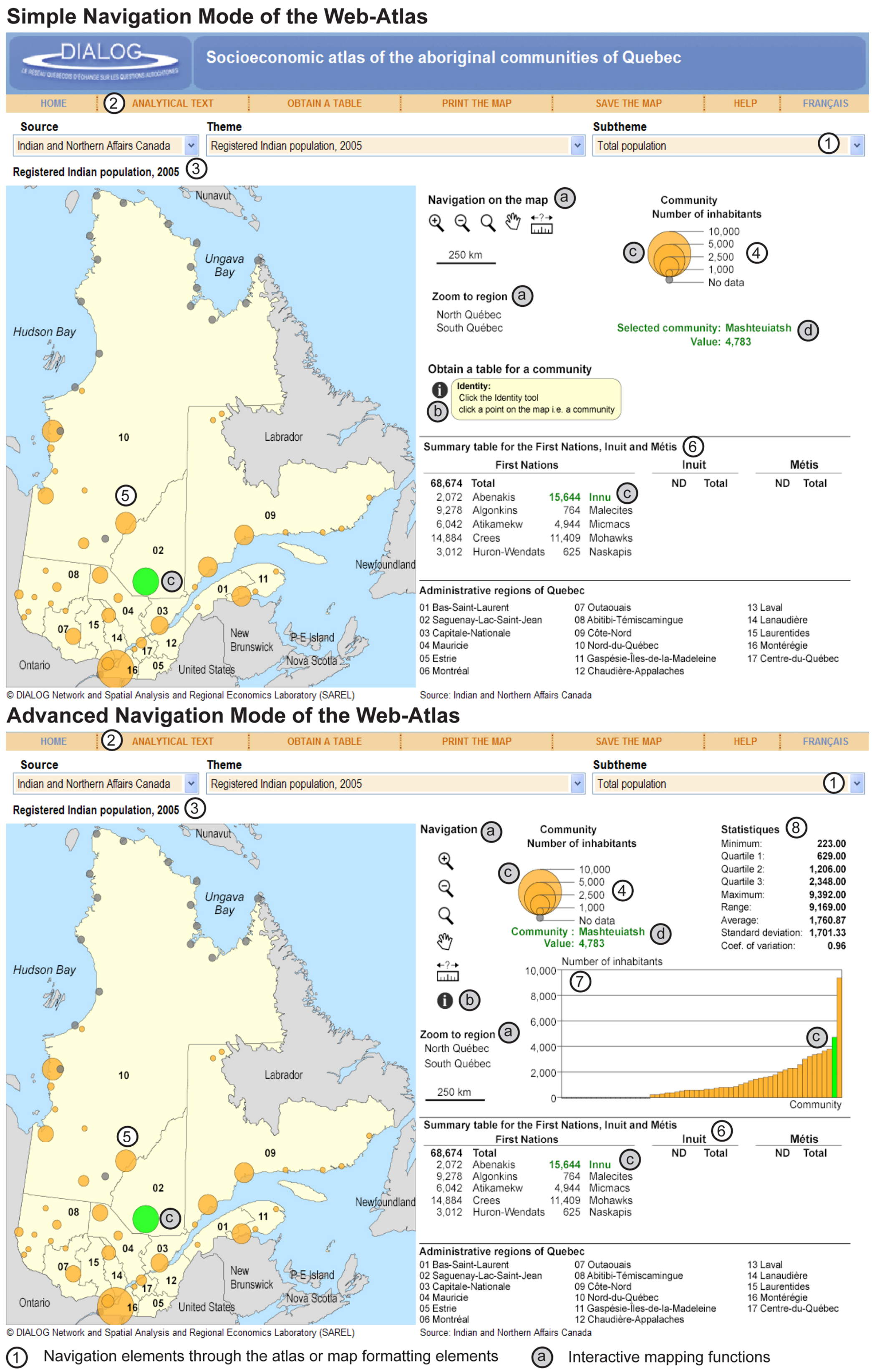

Figure 5. Socioeconomic Web-Atlas of the Aboriginal Communities of Québec

```
//Legend variables: legend title, class labels and color classes
LegendName="Percentage";
Classes=new Array("0.34 to 9.99", "10.00 to 19.99", "20.00 to 49.99", "50.00 to 100", "No
data");
colorCL=new Array("rgb(255,255,50)", "rgb(255,180,180)", "rgb(250,100,100)", "rgb(150,0,0)",
"rgb(150,150,150)");

Tip1Str="Community:";
Tip3Str="Value:";
CommunData=new Array(83.83, 68.16, 14.61,…, 6.4);
CommunautesNames=new Array("Odanak", "Wôlinak", "Hunter's Point", … ,"Kawawachikamach");


function CreateLegend()       //FORMATTING THE MAP: Building the legend
{
        var x=140,y=23;
        T=CreateText("", x, y, LegendName, "");
        T.setAttribute("font-weight", "bold");
        Legend=svgControls.getElementById("Legend");
        Legend.appendChild(T);
        y+=6;
        for (i=0; i < colorCL.length; i++)
        {
            Legend.appendChild(CreateCircle("CR"+i, x, y+8, 4, colorCL[i], ""));
            Legend.appendChild(CreateText("", x+20, y+11, Classes[i], ""));
            y+=13;
        }
}


function CC(Over, idCommun)   // INTERACTIVE MAPPING FUNCTIONS: dynamic link between the map
and the histogram; displaying of the name of the community and the value of the
corresponding variable in a table
{
        CommunCir=svgMap.getElementById("cir"+idCommun);    //Community spatial unit (circle)
        bar=svgControls.getElementById("bar"+idCommun);     //Histogram Bar
        TIP=svgControls.getElementById("ZoneTip");
        Tip1=svgControls.getElementById("TIP1");
        Tip2=svgControls.getElementById("TIP2");
        Tip3=svgControls.getElementById("TIP3");
        Tip4=svgControls.getElementById("TIP4");

        if (Over == 1)
        {
               TIP.style.setProperty('visibility','visible');
               Tip1.getFirstChild().setData(Tip1Str);
               Tip2.getFirstChild().setData(CommunautesNames[idCommun]);
               Tip3.getFirstChild().setData(Tip3Str);
               Tip4.getFirstChild().setData(CommunData[idCommun]);
               CommunCir.style.setProperty('fill', DefaultColor);
               bar.style.setProperty('fill', DefaultColor);
        }
        else
        {
               CommunCir.style.setProperty('fill', color[idCommun]);
               bar.style.setProperty('fill', color[idCommun]);
               TIP.style.setProperty('visibility','hidden');
        }
}
```

Figure 6. Examples of JavaScript functions for formatting the map and making it interactive

CONCLUSION

Vector formats like the SVG standard represent the most recent and most successful solutions for the deployment of interactive and/or dynamic atlases (Danzart et al., 2003). Our deployment model for interactive web-atlases based on a vector format for the Internet (SVG) and on client/server technologies (ADO.Net and ASP.Net) is very effective for two main reasons. On the one hand, mapmaking is made much easier because the maps are automatically formatted by programming and by using information entered in a database (map and legend titles, numbers, colours and boundaries of classes, etc.). These functions give mapmakers flexibility in modifying existing maps or adding new maps. On the other hand, with SVG, one can easily operationalize certain interactive web-mapping concepts such as functions for data exploration, for navigation or personalization of the map and, finally, for designing several modes of navigation and interactivity based on the types of atlas users.

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Mashup cartography: cartographic issues of using Google Earth for tag maps

Aidan Slingsby
giCentre, School of Informatics, City University London, EC1V 0HB, UK
a.slingsby@city.ac.uk

Jo Wood
giCentre, School of Informatics, City University London, EC1V 0HB, UK
jwo@soi.city.ac.uk

Jason Dykes
giCentre, School of Informatics, City University, London, EC1V 0HB, UK
jad7@soi.city.ac.uk

Keith Clarke
Geography Department, University of California, Santa Barbara, CAUSA
kclarke@geog.ucsb.edu

INTRODUCTION

'Mashups' are the results of combining Internet-based tools and data to produce new content (Merrill, 2006). They are facilitated through widely available and usually free tools with published APIs, XML-based feeds and dynamic scripting languages. The latter two are collectively known as AJAX ("Asynchronous JavaScript and XML") which facilitate dynamic content within web pages in response to changes in input data and user interaction (Garrett, 2005). Geographical (map-based) mashups which use a spatial framework as the basis for data integration have become hugely popular and widespread[3]. The ease of combining data from different sources, the dynamic user interfaces and user-driven content is increasingly having an influence in geographical information science (Miller, 2007). Google Earth[4] is a downloadable geographical browser (of which there is a free version) with impressive functionality which has been closely associated with the growing interest in and the development of mashups. It offers better data handling and user interaction functionality than is currently offered by web-based versions.

We have been exploring the use of mashups for the exploratory visual analysis of large spatiotemporal datasets, in which we combine a set of specialist tools and use Google Earth for visual output and user interaction. We have found this approach is very suitable for our purposes and it has enabled us to better understand the structure of our data and the phenomena that they describe (Wood *et al,* 2007).

In this paper, we focus on a number of cartographic issues identified using our use of Google Earth for producing tag maps (Slingsby *et al,* 2007). Although Google Earth and tag maps are a very specific combination (and Google Earth has frequent updates), the issues we describe have a wider relevance to mashup cartography and may inform others using geo-browsers to develop innovative mashups for visualisation. Although it is possible to access a small number of functions of Google Earth directly using an API (Google, 2007a), we use the standard method of encoding our visual output and interaction through the XML-based KML (Google, 2007b), which can be delivered over the Internet and will work with Google Earth (we are using KML v2.1 and the free version of Google Earth v4.1) without further customisation.

TAG MAPS

'Tags' are free text labels widely used for marking-up Internet content to help with its organisation; for example, photographs (e.g. Flickr[5]) and video clips (e.g. YouTube[6]).

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[3] http://www.programmableweb.com/mashuplist/

[4] http://earth.google.com/

[5] http://www.flickr.com/

We are not concerned with tags themselves, but with the most common way in which they are visually summarised, namely, 'tag clouds' (Hassan-Montero and Herrero-Solana, 2006). A tag cloud is a group of the most prominent tags in a collection, each of which are sized according to their importance. They are usually arranged alphabetically, in order for tags to be found quickly. Tag importance is usually assessed as a measure of the number of times a tag has been used to tag content. For example, the Flickr website has a tag cloud of the most frequently used ('popular') tags[7].

Tag clouds have recently diversified in use and are now widely used for summarising words in other contexts, such as documents, speeches and keywords. The Tag Crowd[8] website is an example of a service that facilitates this.

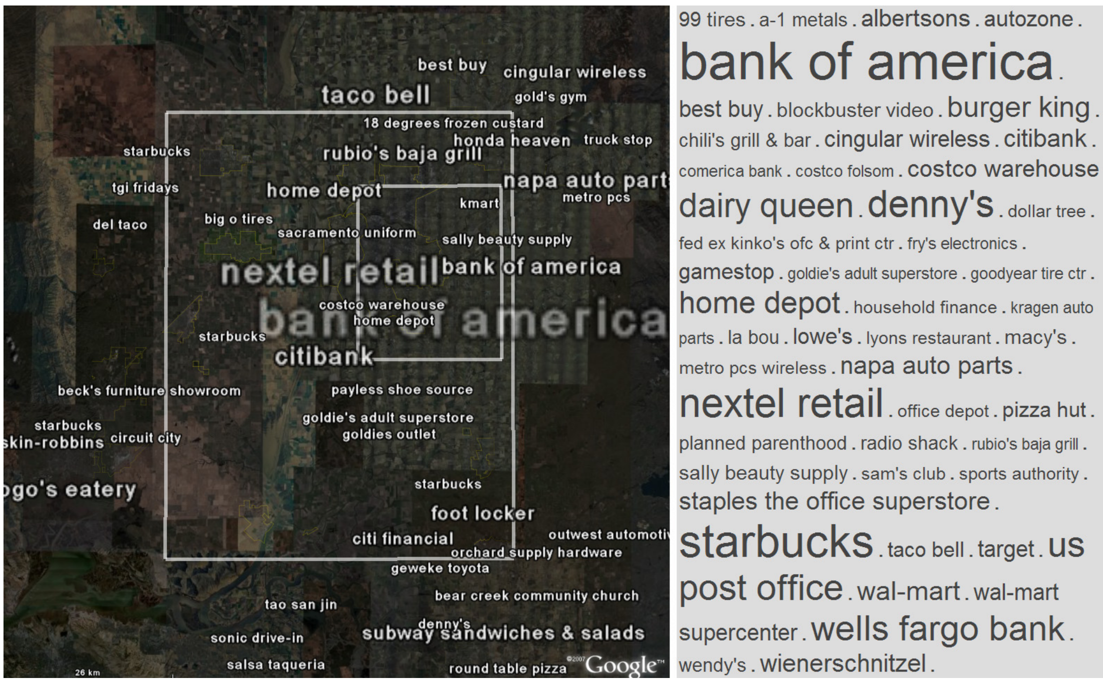

Figure 1: Tag map (left) showing the local importance of words and tag cloud (right) showing the 50 words of most overall importance for the geographical area. The smaller bounding box is 'bank of america'; the larger is 'starbucks' (more spatially diluted).

A tag map (Jaffe *et al*, 2006; Ahern *et al*, 2007; Slingsby *et al*, 2007) is a spatial version of a tag cloud. Instead of words' sizes being related to their global importance within a collection of words, they are related to their local importance in relation to a word's position on the map. Tag maps can be generated from a set of georeferenced words at a variety of different spatial scales.

GENERATION AND DELIVERY

We have developed tag maps to explore the spatio-temporal structure of words, therefore the phenomena they represent. We use MySQL[9] to store and retrieve georeferenced text. PHP[10] is employed to query the database and generate output. These technologies allow us to generate tag maps by gridding the area under study into cells and outputting the sized and positioned words in KML[11] for display in each cell in Google Earth. Google Earth provides

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[6] http://www.youtube.com/

[7] http://www.flickr.com/photos/tags/

[8] http://www.tagcrowd.com/

[9] http://www.mysql.com/

[10] http://www.php.net/

[11] http://code.google.com/apis/kml/documentation/kml_tags_21.html

a means for interactively selecting an area – and therefore a spatial scale – for which an interactive tag map can be generated at an appropriate scale for the selected area, and which can be visually synthesised with Google Earth's ancillary data and that of third-parties.

Subject to word culling:

```
<Style id="style1">
  <LabelStyle>
    <color>ffffffff</color>                    (1)
    <scale>1</scale>                           (2)
  </LabelStyle>
   <IconStyle>
    <scale>0</scale>                           (3)
   </IconStyle>
</Style>

...

<Placemark>
  <styleUrl>#style1</styleUrl>
  <name>Word</name>                            (4)
  <Point>
    <coordinates>
      -93, 27, 0                               (5)
    </coordinates>
  </Point>
  <description>
    Count=45                                   (6)
  </description>
</Placemark>
```

The word (4), is positioned (5), has a description (6), is coloured opaque white (1) and has a specific size (2). The icon is suppressed (3).

Not subject to word culling:

```
<Style id="style2">
  <LabelStyle>
    <scale>0</scale>                           (1)
  </LabelStyle>
   <IconStyle>
    <scale>1</scale>                           (2)
    <Icon>
      <href>
        http://.../word.png                    (3)
      </href>
    </Icon>
   </IconStyle>
</Style>

...

<Placemark>
  <styleUrl>#style2</styleUrl>
  <name></name>
  <Point>
    <coordinates>
      -93, 27, 0                               (4)
    </coordinates>
  </Point>
  <description>
    Count=45                                   (5)
  </description>
</Placemark>
```

The word is an image (3), is positioned (4), has a descriptions (5 and has a specific size (2). The label is suppressed (1).

Box 1: The KML used to describe the words of the tag map. The method on the left is subject to Google Earth's word culling and the method on the right is not.

Google Earth takes KML as its input, a fully-documented XML-based language which allows geometry and text to be described in geographical space (Google, 2007b). This is interpreted by Google Earth and displayed with the aerial photography and other suppied contextual information. In this paper, we use the Placemark element (a geographical feature) to describe each word. A Placemark has a position, an icon (graphical image), a text label and a description (see the KML reference for complete documentation). The visual appearance of placemarks is controlled by the Style element in KML, which can be in the same or a separate KML file.

We found that where words were specified as text labels of Placemarks (Box 1, left), Google Earth automatically removes those which would otherwise overlap and make that map less legible. As is demonstrated in the following section, this 'word culling' is significant and greatly affects the resulting tag maps. It is very helpful, in the sense that where there are too many words specified in the KML, only those that can be shown legibly according to users' screen and zoom settings will be shown. However, in order to evaluate the impact of this algorithm, we found that we could prevent words from being subject to this by suppressing the text labels in Placemark, using a graphical image of the text instead as a Placemark Icon (box 1, right).

In this paper, we use two data sources. The first is data from go2[12], a mobile telephone service provider which allows users to search for nearby businesses and services. Go2 kindly provided one month of usage logs, in which every query is accompanied by the location and time at which it was made. The second data source is from the 1:50,000 Ordnance Survey Gazetteer (supplied by Edina[13]), from which we have extracted common British placename prefixes and suffixes[14]. In each case, the individual georeferenced words are held in a MySQL database and tag maps are generated when required.

The two main cartographic issues we face are as follows:

- where to position words on a map – each word represents a spatially-aggregated summary of many;
- how to deal with the situation where words overlap, a particular issue in areas where there are more important words

These issues are explored in the following section.

CARTOGRAPHIC ISSUES FOR STATIC MAPS

Text placement

The issue of text placement has always been of great importance in traditional cartography and the automated label placement is an active research area. For example, van Dijk *et al* (2002) review some of the methods for doing this and develop a framework for evaluating the results of such methods. They identify four categories within which to evaluate text placement: aesthetics, label visibility, feature visibility and label-feature associate. Aesthetics do not relate to the position of text, rather to the manner it is displayed (van Dijk *et al* cite text angle, curvature and letter spacing factors). The features which are labelled on tag maps are not features in the traditional mapping sense – instead they are local summaries of 'features' (individual georeferenced words).

As stated above, the two most challenging cartographic problems of tag maps, is how to place words at representative positions and how to prevent the map from becoming too overcrowded. Van Dijk *et al*'s (2002) 'label-feature associate' and 'label visibility' (respectively) relate to these. These problems are strongly related, because representative positions for two or more local word summaries may be spatially coincident, thus reducing each others' visibilities (through overplotting). An approach to dealing with this situation is to adjust the positions of the words in order to try and achieve a balance between the representativeness of position (label-feature associate) and the legibility of the word (label visibility). Where there are many words, it may not be possible to display them all and some words cannot be shown. Selecting which words to display is a balance between the local importance of the word and its legibility.

Figure 2 shows two tag maps in which the words are placed at the cell centres for which they are locally important (the cells are generated by the gridding procedure, section 1.2). All the important words were supplied in the KML for both maps and all of these can be seen in the illegible tag map in Figure 2 (right). Figure 2 (left), however, is legible because the majority of words are not displayed, having been removed by Google Earth's word culling.

The words in Figure 2 have been specified using the two different methods shown in Box 1. Both methods use exactly the same input data and both describe the words in KML Placemarks. However, in Figure 2 (left), words are specified in the Placemark through the name element, with the Icon element suppressed in the IconStyle element. Google Earth centres the word on the position of the Placemark (specified by the Point element of Geometry) and formats the text according its LabelStyle (if the Scale element has a value of 1, it is of 'normal' size). For Figure 2 (right), a graphical image and size of the word is specified in the IconStyle, and no text is specified for the name element. Google Earth centres the image of the word at the IconStyle size at the required position.

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[12] http://www.go2.com/

[13] The data is Crown Copyright/database right 2007. An Ordnance Survey/EDINA supplied service (http://edina.ac.uk/digimap/).

[14] The extracted placename elements are taken from http://en.wikipedia.org/wiki/List_of_generic_forms_in_British_place_names

Figure 2: Tag maps in which words are placed at cell centres with GE word culling (left) and without GE word culling (right).

As stated, Google Earth deals with words specified using these two methods in different ways. In the latter case, Google Earth will display all the words it is supplied with (Figure 2, right), which result in poor 'label visibility' in van Dijk *et al*'s (2002) definition. In the former case, Google Earth employs an algorithm for culling all the words that would make the map illegible. As can be seen in Figure 2 (left) this is very helpful from a label visibility perspective. The way in which the cull achieved is undocumented, leading to concerns about a possible and unknown bias in the sample of words chosen for display by Google Earth that would ultimately affect the interpretation of the datasets being explored. We will refer to these two methods as "with GE word culling" and "without GE word culling", and compare both methods for a number of word positioning experiments to try and understand Google Earth's culling algorithm and also to explore issues of word placement for tag maps.

In Figure 2 (left), it is apparent that a small amount of word overlap is allowed – it appears that there is a geometrical area overlap threshold, below which word overlap is allowed. In this Figure, there is a bias in selection of the words that Google Earth has selected for display. The largest longest words and the smallest shortest words (e.g. the large "domino's pizza" superimposed with the small "ihop") are favoured. Words between these two extremes are not shown. This bias is for geometrical reasons, and is problematic on two grounds. Firstly, word length should not affect its likelihood of being displayed and secondly, some of the smaller (less important) words are displayed at the expense of larger (more important) words.

In Figure 3, words have been placed at random positions within the grid squares in which they are important. The most striking difference from Figure 2 is that many more words are visible, because there is more space. Figure 3 (left) has fewer culled words, but Figure 3 (right) shows that in fact, the majority of words have still been culled. Worryingly, it appears that some of the most prominent words have been culled in Figure 3 (left) – see the large 'ihop' near the bottom right of Figure 3 (right). Note also that there are words in the ocean, due to the sampling affect of the grid. Artefacts of the grid can be seen in Figure 3 (right), which again shows the sampling affect of the grid, but also that words are spatially variant – in Florida, there appears to be a higher distribution of words, even though the land-to-ocean ratio of the cells is smaller.

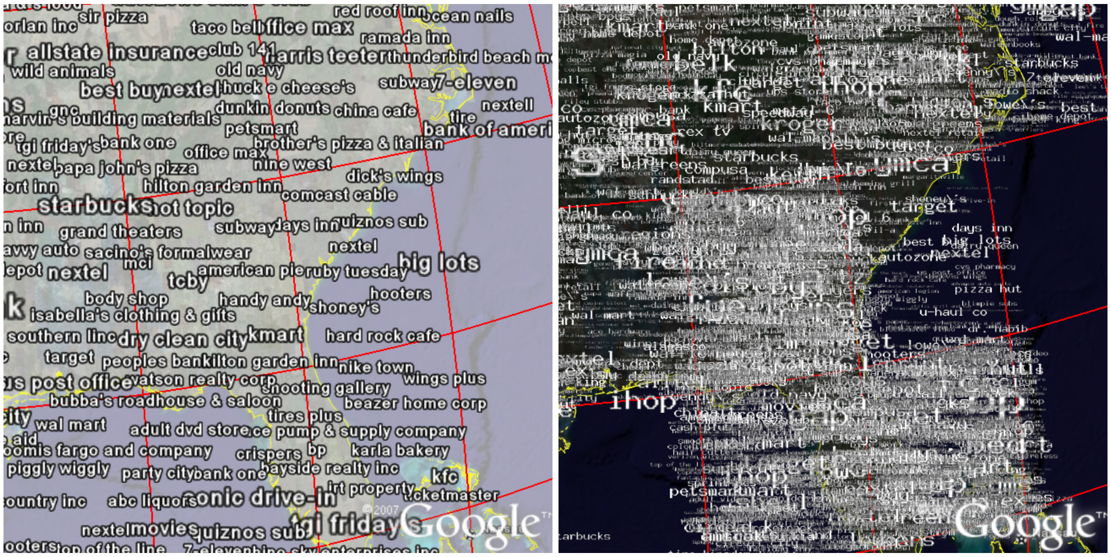

Figure 3: Tag maps in which words are placed at random locations within the cells in which they are important, with GE word culling (left) and without GE word culling (right).

Figure 4: Tag maps in which words are placed at random locations within the cells in which they are prominent with a Gaussian distribution around the cell centres, with GE word culling (left) and without GE word culling (right).

Figure 4 also uses a random distribution, but ensures that there is a Gaussian distribution around the cell centres (this is more obvious in Figure 4, right). This reduces the likelihood of words appearing on cell boundaries, reducing the potential for words to be positioned too far from the original position of the phenomena that they represent – improving the likelihood of a better label-feature association. A word on a boundary of a cell may belong anywhere in the two surrounding cells (four, if a grid intersection).

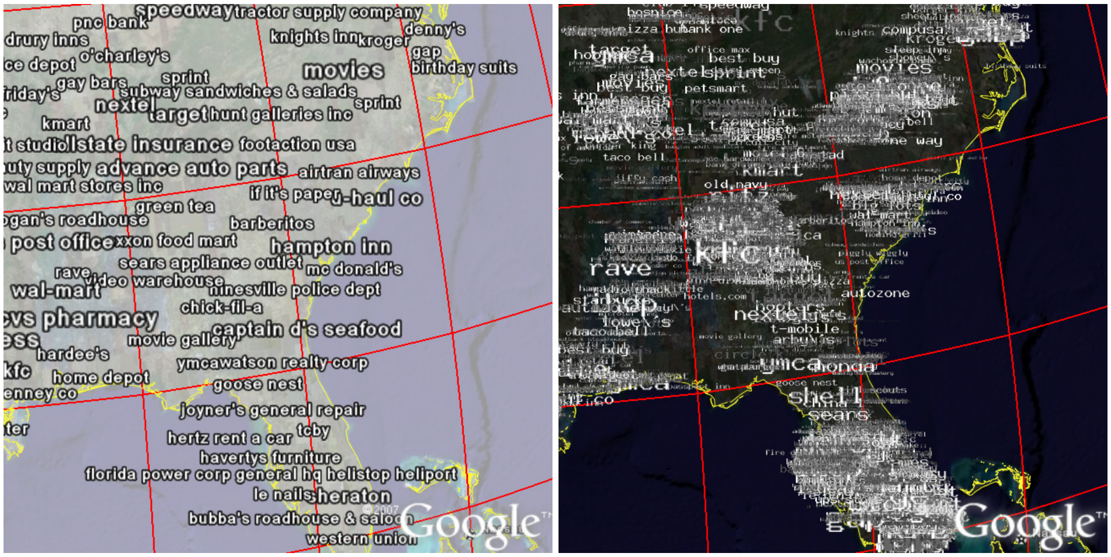

Figure 5: Tag maps in which words are placed at the average positions of the original georeferenced words in the cells in which they are important, with GE word culling (left) and without GE word culling (right).

Figure 5 shows the final text positioning experiment, in which locally-prominent words are positioned at the average position of the contributing georeferenced words in the cell. The most obvious advantage is that words are more likely to maintain a better label-feature association (for example, there are few words in the ocean). Since the available area for words has been reduced (by excluding the oceans), inevitably, more words have been culled. In the trade-off between feature-label association and label visibility, this method favours the former. As is the case in our other examples, the version without GE word culling gives a better indication of the overall distribution, showing where there are higher densities of words. Even though positions are more representative, words tend to be placed towards the centres of cells, due to edge effects. Additionally, where there is a high concentration of many georeferenced words, these are unlikely to become spread out, in the way that was achieved with the random distributions.

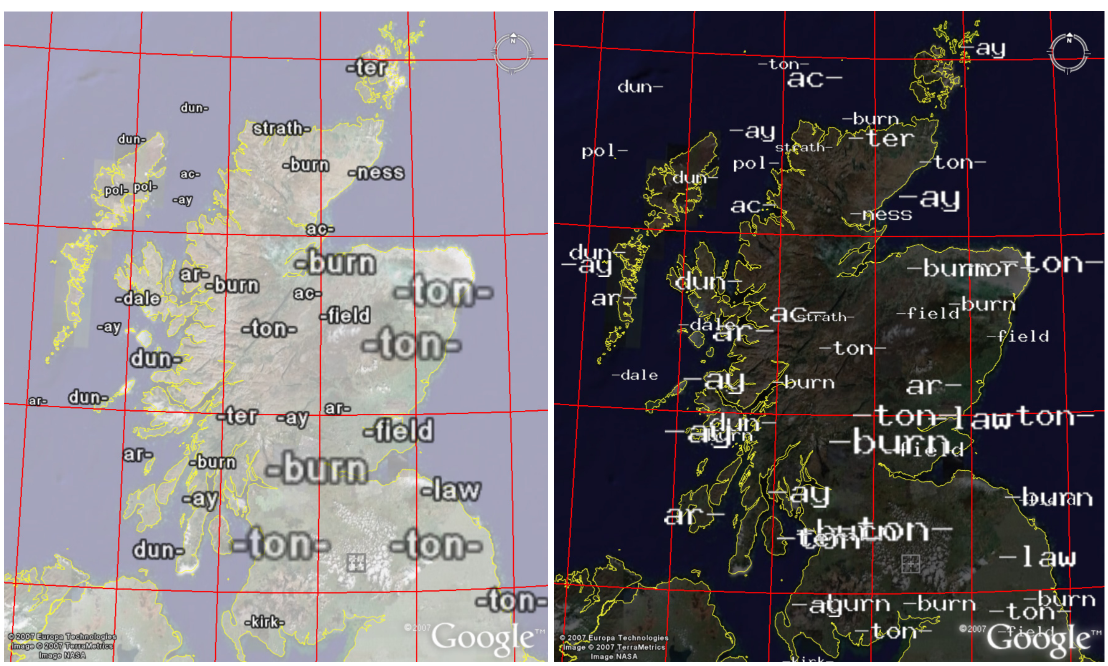

Figure 6: Scottish placename prefixes and suffixes. The top four in each cell have been supplied with GE word culling (left) and without GE word culling (right).

Google Earth's word culling algorithm made for much more legible maps, but did not necessarily result in appropriate words (in terms of their local importance) being selected for display. Avoiding GE's word culling algorithm gives us more control for producing static maps. Whilst largely illegible, they helped reveal spatial structures. Legibility can be improved in a number of ways. The following section shows how interactive zooming and panning is one such way. Alternatively we can limit the words supplied for each cell to the most important – this can result in legible tag maps. Figure 6 shows Scottish placename prefixes and suffixes, in which only the four most prominent words for each cell have been supplied (for this example and at this zoom level, four words produced good results). In Figure 6 (left) it is clear that some have been culled. In Figure 6 (right) the maps remain quite readable, even though some of the words overlap.

Visual interference with background imagery

Google Earth contains a wide range of geographical contextual information including aerial photography and coastal outlines (both of which can be seen in many of the Figures in this paper). The colours and contrast in aerial imagery may interfere with overlaid graphics.

Figure 7: Visual interference with background imagery. From left to right: the clouds on the aerial photograph make the overlaid text hard to read. Overlaying the imagery with translucent white, translucent black and opaque white and opaque black may make the text easier to read.

In Figure 7, the white clouds on the aerial photograph make the white text difficult to read. The black overlays make the text much more legible. Where the text is outlined in black, as in Figures 2, 3, 4 and 5 (left), both a black and a white overlay are suitable – white was used because it reproduces better in greyscale.

CARTOGRAPHIC ISSUES FOR INTERACTIVE MAPS

Interactive maps offer further opportunities for presenting detailed information without overloading the map with information.

Panning and zooming

Google Earth's word culling algorithm operates dynamically on the input KML files, in response to zooming and panning. As the user zooms in on regions that contain culled words, these words will be gradually be reveal as space becomes available.

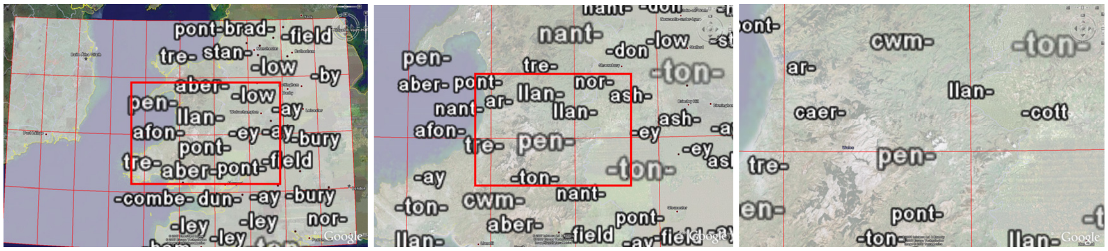

Figure 8: Welsh placename prefixes and suffixes (using GE word culling), at various zoom levels from zoomed out (left) to zoomed in (right) according to the red box. Each screenshot uses exactly the same KML (and the same spatial grid resolution).

Figure 8 shows the same KML file (of Welsh placename prefixes and suffixes), at three different zoom levels. At each zoom level increases from left to right, more words are revealed as space becomes available (for example, the 'caer-' prefix has been revealed at the highest zoom level). Note that all three screenshots use the same KML file, thus the same grid resolution – differences in the words displayed are entirely a result of Google Earth's word culling.

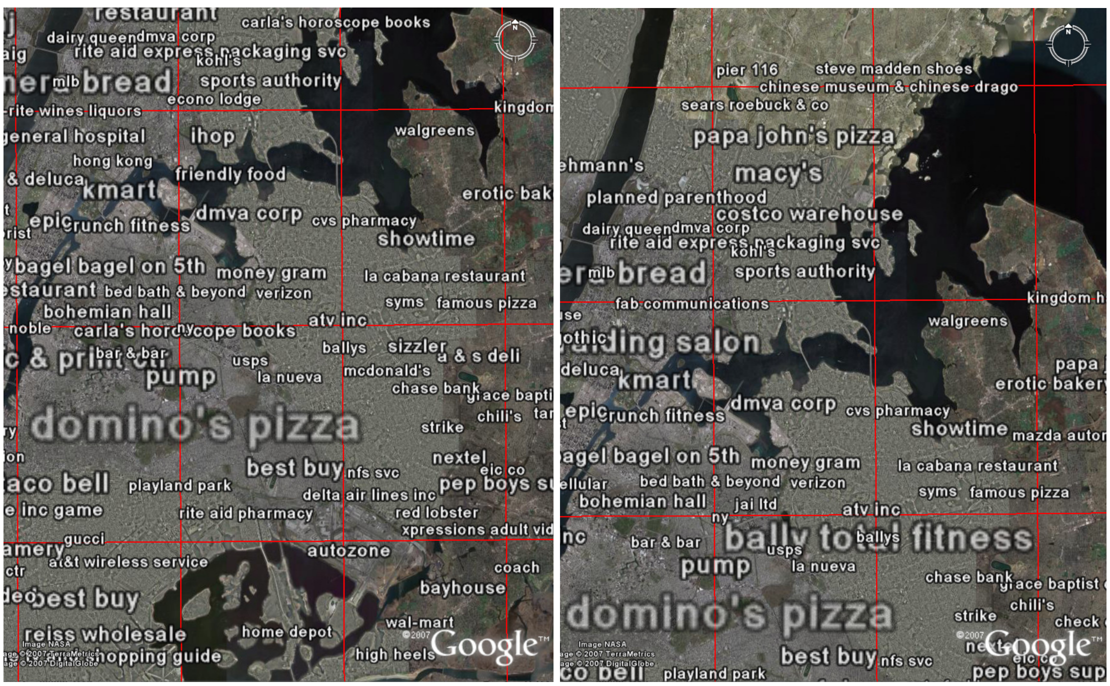

Figure 9: Two views of the same tag map (using GE word culling). The left view is panned North with respect to the view on the right.

Google Earth's culling algorithm is also highly sensitive to panning. Figure 9 shows the same tag map (using exactly the same KML), but the tag map on the left has been panned northwards compared to that on the left. 'Domino's pizza' and '-bread' is consistent between views, but 'bally total fitness', 'kmart' and '-salon' are examples of important tags (large text size) that are not visible in the leftmost view.

The fact that the culling algorithm is sensitive to panning suggests that by panning, one can see many different subset collections of words. Exploring the dataset by both panning and zooming allows the user to reveal many more words than are visible on a static map. This may overcome some of the limitations of the static map.

Toggleable layers

Google Earth is organised around hierarchically-nested layers of information which can be turned on and turned off (apart from the aerial imagery which cannot be turned off, only obscured). Each user-specified KML file appears as a separate layer, which can themselves contain layers (Folders) and items (Placemarks), each of which can be turned on and turned off.

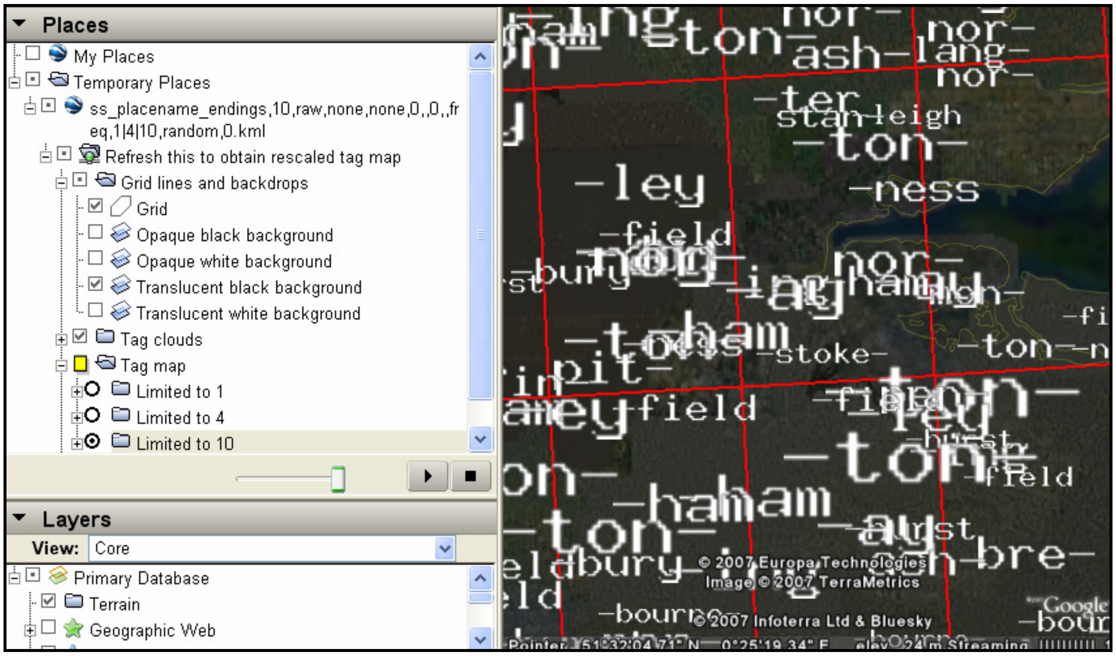

Figure 10: Toggleable layers in Google Earth. Notice the user-defined layer from a KML file "ss_placename…", containing a NetworkLink (labelled "Refresh this…", the grid (visible), backgrounds to reduce impact of aerial imagery and "Tag map" folder, and with the "limited to…" layers. At the bottom as layers containing Google Earth ancillary data.

This allows cartographic representations to be organised into groups (Folders) which can be shown or hidden, as shown in Figure 10. In Figure 6, we limited the words to the top 4 in each cell. In Figure 10, we have provided the top 1, 4 and 10 words in three separate folders in the same KML, which allows us to easily compare the effects of restricting the words to these numbers. Notice also that we can easily show or hide the grid and the opaque and translucent background images. It is also possible to load multiple KML files, showing and hiding as many as required.

Triggering spatially-constrained aware queries from within Google Earth

Google Earth's NetworkLink, provides the capability to instigate further queries from within Google Earth. It allows a particular section of KML (within the NetworkLink) to be replaced with a new version, which can be based on the current geographical extent. This is used to generate a resampled tag map, appropriate for the new geographical extent.

Figure 11: Exactly the same geographical area, but with tag maps at different sampling resolutions, generated by refreshing the NetworkLink at two different zoom levels. In the right image, a bubble containing the Placemark description is showing, for a specific localled important word ('-combe'). Notice the link, which will trigger a tag map containing only '-combe'.

The gridding procedure used to produce tag maps, sets the cell widths to a proportion of the visible geographical extent, so the action of, zooming in and regenerating the tag map through the NetworkLink, results in a resampled tag map in which word importance is assessed over smaller geographical areas (Figure 11). Google Earth is thus a means of conditioning data by geography and selecting (and varying) the spatial scale at which to study the phenomena under consideration.

An alternative way to instigate new queries from within Google Earth is to embed URLs into a Placemark's free-text description (HTML), as shown in Figure 11 (right). Clicking on the Placemark will result in the appearance of a 'bubble' containing the description text, which, in this case, contains a URL link. This link (labelled "Click for tag map of –combe" in Figure 11, right) triggers the generation of a new KML file of a tag map for the current geographical extent, which only contains the '-combe' placename ending.

A by-product of regenerating tag maps which employ the randomised word placement method and GE's word culling, is that that every regenerated map will show a different sample of words because of the word positioning dependence of the algorithm. This represents an alternative way to explore different word samples.

Inspection

Where KML Placemarks with icons are spatially coincident, Google Earth will collapse the Placemarks into a single icon. Where the name element has been supplied, Google Earth will fit as many labels as it can around the icon. Again, there may be geometrical bias in choice of words shown, as can be seen in Figure 12 (left). As in Figure 2, all the words have been supplied and positioned at the cell centres – the only difference between Figure 2 (left) and Figure 12 (left) is that the Icon has not been suppressed (see Box 1, left, line 3). Figure 12 (right) shows that clicked upon, all the collapsed words are revealed. This approach is similar to that of 'excentric labelling' described by Fekete and Plaisant (1999).

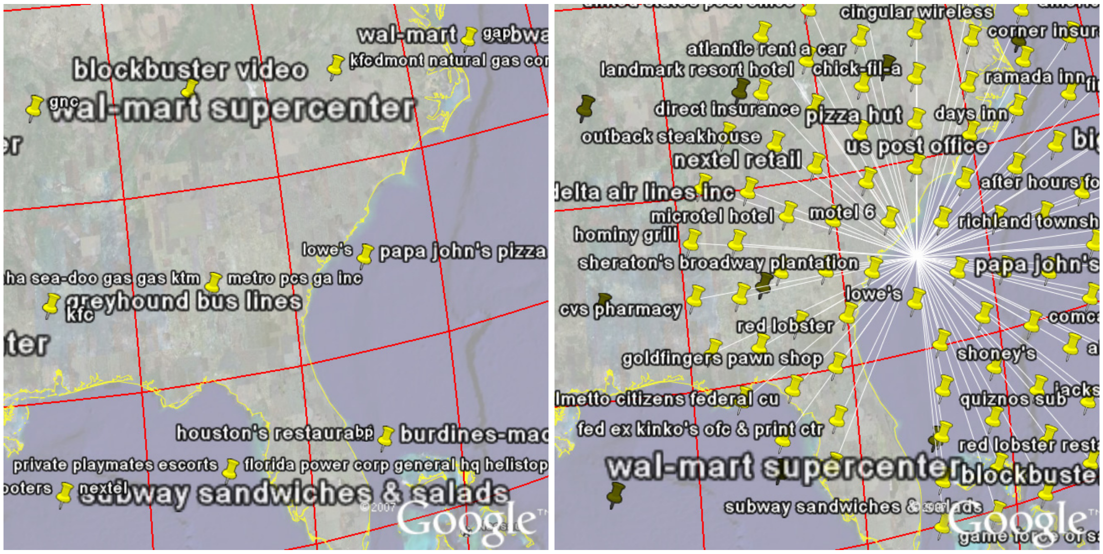

Figure 12: Placemarks have been collapsed into the centres of cells (left). When one is clicked upon, it will 'explode' revealing all its contents (right).

The description element of Placemarks and the 'bubble' which pops up when the Placemark is clicked upon allows the details of individual words to be inspected (Figure 11, right).

DISCUSSION

The work on generating usable tag maps for exploration draws attention to a number of characteristics of Google Earth in its current guise that may have an effect on the static and interactive cartography that we generate from it. We structure our discussion of these issues into five sections: the visual interference of background imagery, text placement, text culling, map interaction and the mashup approach.

Visual interference of background imagery

The increasingly common use of aerial photography requires careful thought about how it will affect overlaid information. We used translucent ground overlays to reduce the visual impact of the aerial imagery supplied in Google Earth. If colour is used – to distinguish the language origin of the placenames, for example – colours must be chosen which can be seen easily against the background imagery. Alternative pictorial visual encodings may have other issues in this regard.

Text placement

Since the words on a tag map represent summaries of words in entire cells, there is more than one approach to choosing a precise position for words. Using the cell centres was not visually appealing and was problematic because of the overplotting of words. Using a function to spread the words around the cell was more visually appealing and allowed many more words to be displayed. Using a random function worked well, but it was possible that words could be displayed up to a cell's distance away from the whereabouts of the phenomenon being represented. For this reason, we experimented with a random function that ensured a Gaussian distribution around the cell centres. This reduced the edge effects of the cells, but also reduced the number of words that were visible and results in a grid pattern that might be considered less visually appealing and less aesthetically satisfactory than the other solutions. An interesting combination of the random positioning and Google Earth's word culling is that it gives a different sample of words each time, though whether or not this is a biased sample is not something that we have determined as yet. Using the average positions of words within the cell is likely to provide the best feature-label association (subject to the edge-effects of the grid sampling), but it often does at the expensive of label-visibility because the words are not usually distributed as widely as with the random positioning technique.

Text culling

We greeted Google Earth's undocumented but effective text culling with mixed feelings. It made our maps legible without us having to intervene, but we were concerned that the method it used may cause bias in the output results. This was partly confirmed by the precedence it gave to large long words and small short words in Figure 2 (left). We were impressed by the dynamic nature of the algorithm though: that when the map was zoomed in, words which were not previously visible, appeared as soon as space was available. The sensitively of the algorithm to panning at the same zoom level was initially disconcerting, but on reflection and with a working knowledge of the effects of this behaviour, we began to use it as a way in which different samples of words could be interactively explored. In a static context, we have demonstrated that the effects are less positive, due to the fact that only a single snapshot sample is shown. We need to understand the word culling algorithm in more detail to know whether the sample was biased in any way.

Standard KML provided us with a way in which to bypass Google Earth's word culling (by using the graphical images of words as icons in Placemarks) and given us control over what to show and what not to show. Where *all* the important words were included in the KML (as in the left of Figures 2, 3, 4 and 5), the maps were unsurprisingly illegible. However, if we limit the words to the *n* most prominent in each cell as we did in Figure 6 (where *n*=4), we can produce a legible map, even though there is some word overlap. Using this technique, we can produce tag maps of the most important words. In Figure 10, we illustrated how toggleable layers could be used to limit the number of words in each cell to different amounts, at a click of a button. Section 3.3 also showed that it is possible to provide the means for dynamic queries to be triggered from with Google Earth.

Map Interaction

The ability to interact with the map provides a number of opportunities to further explore tag maps. Where GE's text culling is in operation, zooming in on the tag map will reveal more words as space becomes available. Both zooming and panning actions apparently allow the user to see a different sample of words. Where positioning is randomised and GE's word culling is in operation, the action of regenerating the map from Google Earth will produce a different sample of words.

Where GE's word culling is not in operation and where most words overlap (right of Figures 2, 3, 4 and 5), the map is illegible. However, by zooming into the most crowded areas, they will become less overcrowded as more words leave the field of view.

Interactive maps allow information to be summarised, such that the user can obtain more information in selected areas. The use of Google Earth's 'exploding Placemarks' (Figure 12) are a good example of this. In addition, further information about specific words (such as their importance score) can be added to the description element of Placemarks, so that the user can inspect the Placemark, using a pop-up window showing this further information.

Mashup approach

We used Google Earth within a 'mashup' approach in which a number of tools are selected and combined. Google Earth is an example of a geographical information viewer, of which are others available. The functionality and behaviour of Google Earth is specific to Google Earth (in its current implementation of v4.1.7076.4458, beta). However, some of the techniques and findings presented here are likely to be more widely applicable in other applications, mashups and geobrowsers.

An advantage of using the mashup approach is that developers of the components often respond to user opinion on Internet discussion boards, and updates tend to be more rapid than traditional software products. Since they are usually well-used, there is much help available on the Internet. The file structures for data input and output (often XML-based) are usually simple, because the components are designed to be used alongside other similar components in a system. This makes it relatively easy to substitute a component in a system, because of the loosely-couple architecture. The simplicity and flexibility of KML is demonstrated by our work, which has allowed us to generate useful maps and interfaces to our data with acceptable levels of label visibility and feature-label association, without the need to delve into the lower-level APIs.

There are also disadvantages to using the mashup approach. As we found, aspects of Google Earth's behaviour were undocumented. The authors have not found any questions, concerns or articles about the algorithm Google Earth employs for text culling, so it is likely that this is highly effective for most Google Earth users. Through experimentation, we have found ways to achieve some of the behaviour we require using standard KML in order to generate static and interactive cartography to meet our requirements.

We cited rapid updates as an advantage to using the techniques and methods employed here. However, this may also be a disadvantage. There is no guarantee that functionality and behaviour will be retained between software releases, particularly where behaviour is undocumented. For standalone applications like Google Earth, legacy versions of software can be retained (unless they are designed to time-out, or become incompatible with new operating system versions). For applets hosted on the developers site, this is more problematic, though Google Maps allows users to specify the particular version of the API they are using. However, the widening choice of components suitable for mashups and the general simplicity of combining information make it relatively easy to substitute mashup components.

APPLICATIONS AND FUTURE WORK

Although tag maps are a new and a very specific cartographic representation, we have shown that many of the cartographic issues we discuss are applicable to cartography in general (as illustrated by our use of Dijk *et al*'s (2002) terminology for the quality of standard cartographic text-placement). Our experiences of dealing with large datasets in cartography, using spatial selection, different scales of spatial sampling and map interactions are also more widely applicable. In other work (Wood *et al*, 2007), we have shown that that these characteristics make this approach extremely suitable for finding structure in large datasets by facilitating the (relatively) easy generation of novel cartographic representations at different spatial scales.

Although we have found KML to be very flexible, we have three implementation suggestions for KML and Google Earth (albeit, quite specific) which we would find useful. The most simple of these is to add a tag to KML which can turn word culling off, without us having to generate images of the words as Placemark icons. By using this in conjunction with restricting the number of words per cell, we can produce legible map with which we maintain control. To control word culling more effectively, when it is in operation, we would like to be able to set priority levels for individual Placemarks to control which are more likely to be culled, so that we can preserve the most important words be more likely to be preserved on the map. This would be useful for other cartographic representations; e.g. the names of larger places should take precedence over smaller places. The most complicated change we suggest is that word-culling be done alongside word position modification – we envisage that this would use some balance between moving the position of a word slightly and removing the word together. Words would only be culled, if they could not be moved anywhere such that the required level of label-feature association was met. This word positioning/culling algorithm would use new specific KML tags within individual placemarks to set moving or culling priorities and to specify the areas within which the label may be moved. Currently, words are culled when it might be more appropriate to adjust their positions slightly. We would, of course, require this behaviour to be fully documented.

Our work with mashups for the visual exploratory analysis of data is ongoing. We continue to work on new and novel cartographical representation which can be applied dynamically and in response to user actions. For example, we combine tag maps with tag clouds (Slingsby *et al*, 2007), which shows a geovisualisation view alongside an information visualisation view of the same data for the same geographical extent, revealing the effects of spatial variability. We are also using colour to distinguish words based on other attributes; for example, the language origin of the placename prefixes and suffixes, which form a spatial pattern. We have developed other novel cartographical visualisations using KML and Google Earth; for example, data dials (Wood *et al*, 2007) which are multivariate graphics showing multiple aspects of data at a particular location. We have also been using Google Earth and KML to explore temporal structure in data.

CONCLUSION

We have found the use of Google Earth within a mashup approach a positive experience. We found that KML offered the flexibility to generate dynamic and novel views for our data and to explore Google Earth's behaviour so that we could use it for our purposes – as the basis for a specific visualisation mashup. Its design and behaviour seemed to be robust and well thought out for the majority of users. However, one has to be careful when using it to analyse data, because some of its behaviour is poorly documented. We managed to avoid the automatic word culling that has been employed to improve legibility at the expense of retaining all associations between features and labels – as is the cartographic norm – by using of graphical images of words in Placemarks. In the context of visualisation, particularly in the case of interactive maps, we sought maps in which the relationship between feature in our dataset and the labels displayed was more consistent and comprehensive, sometimes at the expense of legibility and aesthetic quality. The flexibility of KML is demonstrated by our work.

Our specific example of a mashup using Google Earth to produce tag maps has revealed a number of issues which are more widely relevant. Firstly, it illustrates the – sometimes surprising – flexibility and opportunities offered by tools such as Google Earth. For example, the relative ease with which data can be dynamically resampled by using intuitive zooming and panning tools for spatial selection, is relevant for many visual representations of spatial data. Secondly, some of the problems with mashups are highlighted, for which users need to be aware. For example, we had concerns about Google Earth's undocumentated word-culling, and we have shown how if was possible to do a number of systematic experiments to help us understand more about this behaviour and so to produce results which were acceptable to us. The issue of word culling of particular importance for exploratory data analysis, because of the aim to reveal patterns which are not merely artefacts of the means of display; rather they should be patterns in the data which hopefully correspond to patterns in the underlying phenomena.

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Web-based Visualization of Cities of Northern Canada – Social Environmental and Economic Aspects

Eva Siekierska, Peter Williams, Jean-Pierre Dostaler
Canada Centre for Topographic Information, Earth Sciences Sector, Natural Resources Canada
siekiers@NRCan.gc.ca

Jessica Webster
Sustainable Buildings and Communities Group
Energy Technology and Programs Sector
Natural Resources Canada

Zoran Reljic
Laboratory for Applied Geomatics and GIS Science
University of Ottawa

Abstract

The value of positional data is significantly increased when combined with ancillary information to portray social, economic, or environmental issues facing the northern regions. The International Polar Year (IPY) initiated in March 2007 will address many of these issues. Natural Resources Canada has initiated several projects to address the issues facing northern communities. This paper will present results obtained in projects carried out to visualize issues related to the sustainable development of northern cities. The visualization of Iqaluit, Nunavut, portrays the historical and spatial evolution of this city. Visualization techniques to depict the evolution of the town focus on change representation. The City of Whitehorse, Yukon Territory, serves as an example of visualizations developed as a part of the Canadian Urban Archetypes Project. Selected neighbourhoods were studied to investigate the linkages between urban form, human behaviour patterns and energy consumption for the purposes of integrating energy-related information into urban planning decision making. Visualizations were developed in a Google Earth environment and the Scalable Vector Graphics based Dynamic Visualization System.

1. Introduction

The increasing economic development activities in the northern regions of Canada require large amounts of geo-spatial information. New types of maps and cartographic visualization need to be developed, not only for the management of natural resources, but also for the protection of wildlife and environment and for new economic activities such as eco-tourism. Digital mapping, visualization and Geographic Information Systems (GIS) are becoming basic tools used local authorities for the effective economic and socio-cultural development of the territories.

Northern communities use traditional knowledge while adapting to the global economyand modern technology (Alekseyev, 1997). Economic development has brought new occupations and with that change in wealth and income distribution and community and family patterns. The economic future of this region is firmly linked to its renewable and non-renewable natural resources: mining and petroleum development, commercial fishing and hunting and eco-tourism.

Natural Resources Canada, Department of the federal government is responsible for policies and science and technology that support the sustainable development. It aims to reduce the environmental impacts of emissions and waste; to find longer-term technologies that will protect the environment for future generations; and to ensure regulatory regimes are effective and efficient. The Natural Resources department plays a pivotal role in helping shape the important contributions of the natural resources sector to the Canadian economy, society and environment. Its sectors—forests, energy, minerals and metals, as well as related industries—are one of the most productive, high-tech sectors in the global economy. The projects presented in this paper have been conducted in partnership - the visualization of Iqaluit with the Territorial Government of Nunavut, Department of Culture, Language, Elders and Youth and the visualization of energy use within neighbourhoods in the City of Whitehorse in collaboration between the Energy Technology and Programs Sector and the Earth Sciences Sector of Natural Resources Canada.

2. Visualization of the city of Iqaluit, Nunavut

Nunavut is the newest northern territory of Canada. It was created in April 1999; the capital of the territory is Iqaluit (previously known as Frobisher Bay). To acknowledge the creation of the new territory the Canada Centre for Topographic Information produced a special commemorative topographic map of the capital city of Nunavut, Iqaluit and its environment (Iqaluit, parts of NTS 25N9,10,15 and 16). This map breaks with conventional portrayal of the country within the National Topographic Mapping System and positions the capital of the territory in the centre of the map. Furthermore, several projects have been conducted to develop new methods of cartographic visualization and geographic information handling suitable for web-based communication of geospatial information pertaining to northern communities (http://maps.nrcan.gc.ca/visualization). Within these projects experiments were conducted on how interactive hyper-linking techniques could be used to show the rapid urban development, which occurred in Iqaluit from its inception as a small fishing village, to the active port serving northern territories, called Frobisher Bay, to the capital of Nunavut.

2.1 Spatial and Historical Evolution of Iqaluit

The Canadian National Air Photo Library stores historical aerial photographs. These photographs are good data sources for examining previous distribution of land use and a realistic starting point for discussing potential future developments. A visualization of the evolution of Iqaluit was based on the aerial photographs taken at approximately ten-year intervals. The aerial photographs were assembled to portray the rapid growth of the city over 50 years (1948-2000). They served as a basis for the creation of historical city maps. The historical photographs and records provided additional information to reconstruct the development of Iqaluit, to discover factors influencing change explain patterns in development and provide cultural and social background. The techniques used to portray the change included interactive overlays of images with different opacity to illustrate the continuous change in the growth of the city based on aerial images. Another way to represent change is a discrete comparison between two consecutive periods based on historical maps (Armenakis et al., 2006). An innovative representation of change implemented in this project is a parallel flight over 3-D historical landscapes using animation. Figure 1 shows the 'parallel fly-over' of the historical landscape in two periods

2000 1969

Figure 1. Animation of 3-Dimensional historical landscapes - comparison between years 2000 and 1969.

The 3-dimentional animated visualization has broad range of applications. The passive or interactive animations, for example Canada Rover system (http://www.lunny.com) make it possible to 'fly-over' a given area to interpret it more effectively [Baulch, et al. 2005] The simulated landscapes have been extensively used in promotion of tourism and in urban planning (Al-Kodmany, 2002).

2.2 Historical Evolution of Iqaluit Web Site – Multi-lingual Edition

The web site depicting the historical and spatial evolution of Iqaluit was created to explain the background of the development of the city and to provide basic information for planning and sustainable development activities. The site was created in collaboration with the Government of Nunavut, Department of Culture, Language, Elders and Youth (CLEY- Nunavut), the City of Iqaluit and the Nunatta Sunakkutaangit Museum. At the present time the site is available in French and English (http://maps.nrcan.gc.ca/iqaluit).

To facilitate the use of the web site in Nunavut, the site has been translated into the native languages of the region, *Inuinnaqtun*, written in the Roman orthography, and *Inuktitut* written in syllabics (http://maps.nrcan.gc.ca/_dev.iqaluit). This site uses standardized, syllabic font called *Pigiarniq,* developed for the Government of Nunavut. Web site users need to download the *Pigiarniq* font package from the Government of Nunavut web site. Figure 2 shows an example of the implementation of the web site in *Inuktitut*.

Figure 2. Historical and spatial evolution of Iqaluit in Inuktitut – historical commentary

The development in the field of informatics and specifically electronic communications via Internet offers much flexibility in the design and distribution of versatile cartographic products. Not only conventional maps are available in a digital format for downloading http://apps1.gdr.nrcan.gc.ca/mirage/topo/mirage_index_e.php but we are moving toward an era of interactive cartography, in which user can produce their own classical or multimedia maps, to satisfy specific user requirements and preferences.

3. Visualization of the City of Whitehorse – Sustainable Use of Energy

The Canadian Urban Archetypes Project investigates the relationships between urban form and energy consumption within residential neighbourhoods. By synthesizing land use and infrastructure data, a survey of area residents and utilities data, the project aims to build general cases to provide energy-related information for urban planning decision making in participating municipalities. Although only one northern community, The City of Whitehorse, participated in the project, this research can contribute to climate change mitigation, by reducing energy consumption in residential neighbourhoods across Canada.

The Canadian Urban Archetypes Project is being carried out by the Sustainable Communities and Neighbourhoods Group within the Energy Technology and Programs Sector [http://www.sbc.nrcan.gc.ca]. In collaboration with the

Visualization Team of the Canada Centre for Topographic Information, Geomatics Canada, Earth Sciences Sector [http://ess.nrcan.gc.ca/2002_2006/sdki/visual/index_e.php], and LAGGIS (Laboratory of Applied Geomatics and GIS Science) research centre at the University of Ottawa, http://www.geomatics.uottawa.ca/index_e.html several visualization methods were developed to communicate project results. Systems evaluation and preliminary user feedback provide a basis for recommending appropriate visualization methods for effective communication of findings to targeted user groups, including urban planners and the general public.

Described in this paper are mapping applications developed for the City of Whitehorse. With a view to sustainable community design, the city planners were the first to integrate the archetypes project information into their urban planning decision making processes. The energy related information collected by the project was visualized using Google Earth and used in the City's Porter Creek Sustainable Community Design Charette, a workshop devoted to planning a new neighbourhood, held in Whitehorse in November, 2006 (http://www.city.whitehorse.yk.ca).

Part of the challenge associated with the diverse data collected within the archetypes project is the need to display both spatial and statistical information at the same time. An approach that employs cartographic visualization is therefore appropriate because it facilitates the holistic communication of features of urban form and relevant statistical data on resident behaviour, and energy consumption (Webster, 2007).

Community planning engages a wide variety of stakeholders with varying levels of experience working with maps. Urban planners for example can be considered expert map users whereas the general public are more likely to be novice map users. Because information resulting from the Urban Archetypes Project should be communicated to both of these groups, several different methods of visualization were investigated. Examples described in this paper include Google Earth and Dynamic Visualization System (DVS), an SVG based platform, suitable for on-demand interactive web based visualization.

3.1 Google Earth Based Visualization of Urban Neighbourhoods

Google Earth is a freely available virtual globe program that uses streaming technology to deliver imagery, maps and ancillary information over the Internet. It does not run in an Internet browser but is a downloadable application. The earth surface is represented using satellite and aerial imagery portrayed on a three dimensional globe. An efficient "pan and zoom" function, allows users to explore any area of the globe. Users can import their own data, such as vector or raster data, real-time GPS data, movie sequences or 3-D buildings with photorealistic textures. The system permits users to export their data in an XML based file format called KML (Boulos, 2005). A characteristic feature of Google Earth is effective search based on place name or on a previously added mark. Temporal data may also be portrayed in Google Earth for time based visualizations. Google Earth supports links to OGC Web Map Servers thus additional data may be integrated into the application. Google Earth has limited analytic functions and is not designed to replace professional GIS software, displaying information layers in Google Earth is relatively straightforward.

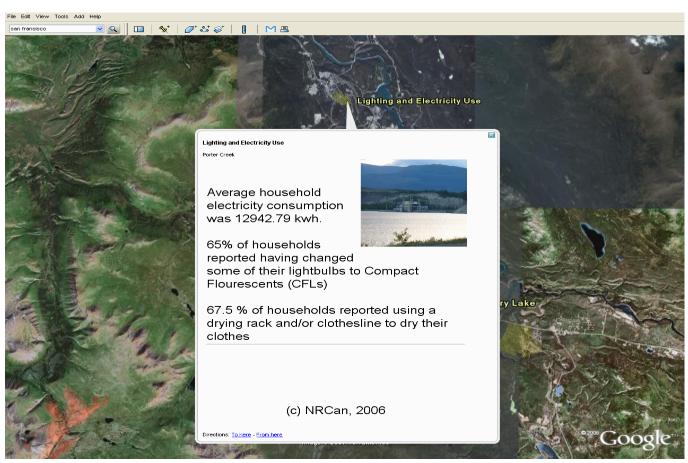

Figure 3. Whitehorse neighbourhoods with display of energy related information

A Google Earth environment was used to visualize energy-related information for presentation of the neighbourhood research at the charette. Figure 3 shows an image of Whitehorse with the neighbourhoods studied. The information 'bubble' displays information related to household electricity consumption in the neighbourhood of Porter Creek. This information was then compared to the values obtained in the other neighbourhoods examined in the project.

Overall feedback obtained from the Porter Creek Charette indicated that visualization methods enhanced the communication of energy-related indicators by providing the geographic context for effective urban planning. Participants also commented that the information would be more useful visualized in a comparative format, between neighbourhoods as well as between similar neighbourhoods in different communities. Subsequent to the charette, further Google Earth based displays developed included a 3-dimensional mock up of a local high school showing its electricity consumption and an interactive display of bus routes linked to the actual bus schedule web site.

3.2 Dynamic Visualization System - Visualization Created On-demand

Another Internet-based system used in the visualization of urban archetype data was the Dynamic Visualization System (DVS). This system was tested internally to demonstrate the applicability of Scalable Vector Graphics (SVG), a promising technology for real time interactive mapping with the potential to develop a web-based spatial decision support mapping environment. Using this system, geospatial information available at remote locations may be accessed and selectively downloaded by feature type or by attribute.[15] The implementation of DVS system is based on geo client open source SVG mapping environment (http://arcscripts.esri.com/details.asp?dbid=12679). This capability optimizes web mapping by permitting users to integrate information most relevant to their particular application online, thus avoiding excessive data processing and reducing the reliance on the speed of the Internet. The system could provide researchers, planners and decision makers real time access and on-demand display of geospatial information from distributed, web-enabled data sources (Williams, 2006)

The DVS-SVG system is in the development stage, and was not been presented in the urban planning session in Whitehorse. However, internal evaluations and presentations given to decision and policy makers of the mining sector at Natural Resources Canada indicated a strong interest in this upcoming technology. Figure 4 illustrates the functionality of the system: the interactive bar graph on the right shows the sample size of the neighbourhoods that were studied in Whitehorse linked to their location, while the table on the left shows user-selected values associated with energy-related variables.

In the future, when indicator databases of energy-related information are available in open-source servers, this type of visualization and exploratory data analysis of energy-related indicators can be performed in real-time. This functionality has potential for accessing information from distributed databases that exist or will be created relevant to an urban energy theme. Such databases must conform to standards of interoperability to create a fully integrated GIS environment and will be successful only in the context of collaborative institutional structures.

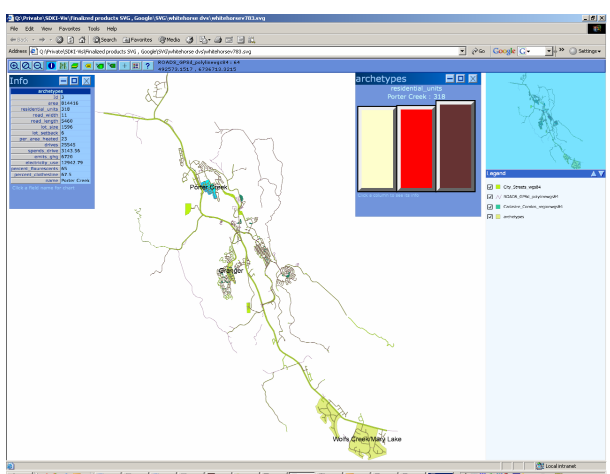

Figure 4. On-demand Web-based mapping using dynamic visualization system

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[15] Services for web based real time exploratory data analysis are currently being developed. See http://www.galdosinc.com

4. In Conclusion

Visualization methodologies implemented within the Urban Archetypes Project included interactive web based maps with various levels of detail and functionality that can satisfy the requirements of different user groups. During the project, two distinct user groups who would benefit from the visual synthesis of spatial and statistical energy-related information were identified, namely urban planners and the general public. The project team concluded that Google Earth or a similar web enabled browser could be effective platform for use by the general public, while analytical interactive mapping systems such as SVG based DVS would be better suited for expert users such as urban planners.

Visualization created for the City of Iqaluit focused on change representation. The clear advantage of portraying geospatial data using electronic media is the ability to display the change, to analyze the patterns of change and to model the possible future scenarios. The integration of ancillary information such as historical commentaries that explained the stages in the evolution of the city, facilitates understanding the evolution in development of urban regions. Representation of spatio-temporal change is particularly important for the decision making taken within the context of sustainable development.

Progress in technology allows cartographers to create advanced geospatial information representation. As a result, geospatial data handling process and visualization has dramatically improved by moving from static to dynamic, from passive to interactive electronic mapping. Consequently, more tools to support the establishment of a territorial management information infrastructure are being made available. With the end user able to interactively control map contents, decisive steps forward have been achieved in exploratory cartography and map use. Furthermore, for the effective use of visualization in northern regions, publication of information in native languages used by these communities is essential. The version of the web-site in a native language to the region will ensure that greater awareness and participation of the local population in the decision making concerning the future developments.

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Usability Evaluation of Web Map Sites

Annu-Maaria Nivala
Department of Geoinformatics and Cartography, Finnish Geodetic Institute, Finland
Annu-Maaria.Nivala@fgi.fi

Stephen Brewster
Department of Computing Science, University of Glasgow
UK
Stephen@dcs.gla.ac.uk

Tiina Sarjakoski
Department of Geoinformatics and Cartography
Finnish Geodetic Institute, Finland
Tiina.Sarjakoski@fgi.fi

Abstract

The aim of this multi-disciplinary study was to identify usability problems of commonly used public online map services. Four different map sites were evaluated: Google Maps, MSN Maps & Directions, MapQuest and Multimap.com. The purpose was to classify the typical problems, which were identified through different usability methods (usability tests and expert evaluations). Half of the evaluations were carried out with experts, during which eight usability engineers and eight cartographers examined the sites by paying attention to their features and functionality and wrote down all the problems encountered. Additionally, eight usability tests were carried out with ordinary users in a usability laboratory, where each of the participants performed a set of map use tasks with each of the services. The usability problems found were compared both quantitatively and qualitatively, and grouped according to their criticalness for the use situation. The paper gives examples of the usability problems found in the study. Most of the problems were related to the search operations the users performed to find out where different places were located, but also problems related to user interface and map visualisation and map tools were identified. The paper closes with a discussion and conclusions of some relevant future research topics.

1 Introduction

The need to consider usability approaches during product design is widely accepted. The ISO 13407 standard - human-centred design processes for interactive systems - gives instructions to achieve user needs by utilising a user-centred design (UCD) approach throughout the entire life cycle of a system (ISO, 1999). The purpose of usability engineering methods is to collect information in order to gain greater understanding of the users, and their tasks and environments and apply this to the product design.

Cartwright et al. (2001) emphasised that the technological changes involving cartography and computer graphics have made modern cartographic representation different: a wide range of maps can be made faster and less expensively, and interaction with visual displays in almost real-time is now possible. Koua and Kraak (2004) stated that the map use studies that have been carried out over a long time in the field of cartography are not fully applicable in new interactive visualisations, which may have new representational spaces and user interfaces. MacEachren and Kraak (2001) stressed that there is a lack of established paradigms for conducting cognitive or usability studies with highly interactive visual environments. Van Elzakker (2005) listed the usability research agenda for maps under main headings: user profiles and requirements, usability testing, UCD and research methods and techniques. MacEachren et al. (2005) stated that the development of more natural interfaces for computer systems has been part of HCI research for a while, and that this approach should also be incorporated into GIS applications in order to improve their usability.

Despite the fact that increasing number of usability evaluation methods are being used, Fuhrmann et al. (2005) stated that usability inspection methods are not widely used for geovisualisation at present. Nivala (2005) observed that usability studies have concentrated either on evaluating graphical user interfaces (GUIs) (of GIS or mobile guides) or evaluating different types of map visualisations. The studies have not included both; studies related to map visualisation, and studies related to the GUI of map applications. Possible reason for this may be that current map applications are evaluated by two different groups of researchers: 1) cartographers and GIS specialists, or 2) HCI engineers, and their results have also been reported in different conferences and journals.

In addition, the knowledge on how to execute the usability methods with map application development was observed to be sometimes almost non-existent (Nivala et al., 2007). Most of the companies would have liked to implement this approach, but the problem was the lack of resources, and lack of knowledge on how to implement it. As bringing the UCD concept into such a specific research area as geoinformatics seems to be problematic, research on how to apply these methods in map application design should be carried out. A more systematic comparison should be carried out of which methods should be used and in which way to suit the interdisciplinary nature of map application projects.

1.1 Objective of the study

The aim of the study was to give an insight into how usability engineering methods can be used in a multidisciplinary environment, which has long traditions for design and research. A usability evaluation of web map sites was carried out with two main objectives: 1) *to find out usability problems from current online map services*, and 2) *to compare the suitability of different evaluation methods for finding out usability problems of online map services*.

The results related to the first objective are discussed in detail in another paper (Nivala et al., 2007), which gives a qualitative view on the usability problems found. The present paper focuses on the preliminary results of the second objective. The aim is to compare different evaluation methods from the perspective of using them for the evaluation of web map sites. The study is still ongoing, and further analysis will be produced in the future to give suggestions for which type of the problems can be found with different evaluation methods.

2 Method

The usability evaluation methods can be classified according to whether the evaluations are done with real users or representational users, and with real computers or representational computers (Whitefield et al., 1991). Shneiderman (1998) calls the evaluations performed without users expert reviews, while Faulkner (2000) calls these methods analytical evaluations. The term ‘expert’ means that the design is evaluated either by a usability engineer, interface designer, or person who is knowledgeable in the application area, etc. If the evaluation involves a user, the methods are called empirical evaluations (Faulkner, 2000) or usability testing (Nielsen, 1993).

Four different online map services were evaluated in this study: Google Maps (abbreviated in this paper as GM, available at <http://maps.google.com/>), MSN Maps & Directions (MD, <http://maps.msn.com/>), MapQuest (MQ, <http://www.mapquest.com/>) and Multimap.com (MM, <http://www.multimap.com/>). These sites consisted of an interactive 2D map with zooming and panning options. Additionally, users were able to search for different locations and directions for routes.

2.1 Procedure

The evaluations were carried out following a use scenario *“A tourist is planning to visit London”*. Half of the evaluations were conducted as *usability tests* and the other half as *expert evaluations*. Usability tests were carried out in a usability laboratory, where each user performed predefined test tasks with two of the web maps. The expert evaluations were carried out by eight cartographers and eight HCI experts (or usability specialists), each of whom went through one map site. Altogether 24 participants were involved, and 32 different evaluations were carried out in the study. Each of the four map sites was therefore evaluated by eight separate participants (four test users and four experts) (Table 1).

Table 1. The methods, participants, number of evaluations and description of the test set up.

Method	Participants	Number of evaluations	Procedure	Duration
Usability test	8 test users	8 x 2 = 16	Users went through two different map sites with predefined test tasks in a usability laboratory.	1 hour
Expert evaluation	8 cartographers	8+8 = 16	Each expert carried out an evaluation for one site by him/herself.	≤1.5 hours
	8 HCI engineers			

2.2 Analysis

The video data from the user tests were analysed by writing down everything that the users had problems with and/or commented as being a problem in some way. Positive comments related to the web maps were also recorded. The same was done with the expert evaluations; the evaluation reports were examined carefully, and all the negative and positive findings were picked up.

Afterwards, problems were grouped under four different categories (1-4) according to the severity of the problem encountered (Nielsen, 1993) (Table 2).

Table 2. The usability problems were classified according to their severity to the use situation.

1	**A major usability problem**	Complicates the use a lot and/or hinders the use of the application.
2	**A notable usability problem**	Makes the use of the site significantly difficult.
3	**A clear usability problem**	Makes the use of the site somewhat difficult.
4	**A small usability problem**	Sometimes only a cosmetic problem that prevents the feeling of a finished design.

Following this, the problems encountered were compared both qualitatively and quantitatively.

3 Results

Altogether 403 usability problems were found with different evaluation methods (*Total** in Table 3). Some of the problems were found with several different methods. When counting only the individual problems encountered, altogether 343 problems were identified, from which 69 from Google Maps, 83 from MSN Maps & Directions, 92 from MapQuest and 99 from Multimap.com.

Table 3. The number of usability problems found with different methods.

	Usability Tests	Carto Eval.	HCI Eval.	*Total**	Total number of individual problems
Google Maps (GM)	38	17	25	***80***	**69**
MSN Maps & Directions (MD)	57	21	18	***96***	**83**

MapQuest (MQ)	50	26	32	***108***	**92**
Multimap.com (MM)	71	32	16	***119***	**99**
Total	***216***	***96***	***91***	***403***	***343***

3.1 Quantitative findings

In sum 53% (216) of the problems were found by usability tests, 24% (96) by cartographic and 23% (91) by expert evaluations (Table 3). As there were as many evaluations carried out with both of the methods (16 usability tests and 16 expert evaluations), it seems that in terms of numbers, the methods provided nearly equal amount of usability problems, usability tests been slightly more efficient.

3.1.1 Severity of the problems

Although the total number of usability problems gives an indication of the usability of the map site, it is obvious that the severity of the problem also plays an important role. From GM only one severe problem was found, where as MD and MM had the same amount of the most severe problems (13) (Figure 1). GM also had the smallest amount of the second severity problems category (21).

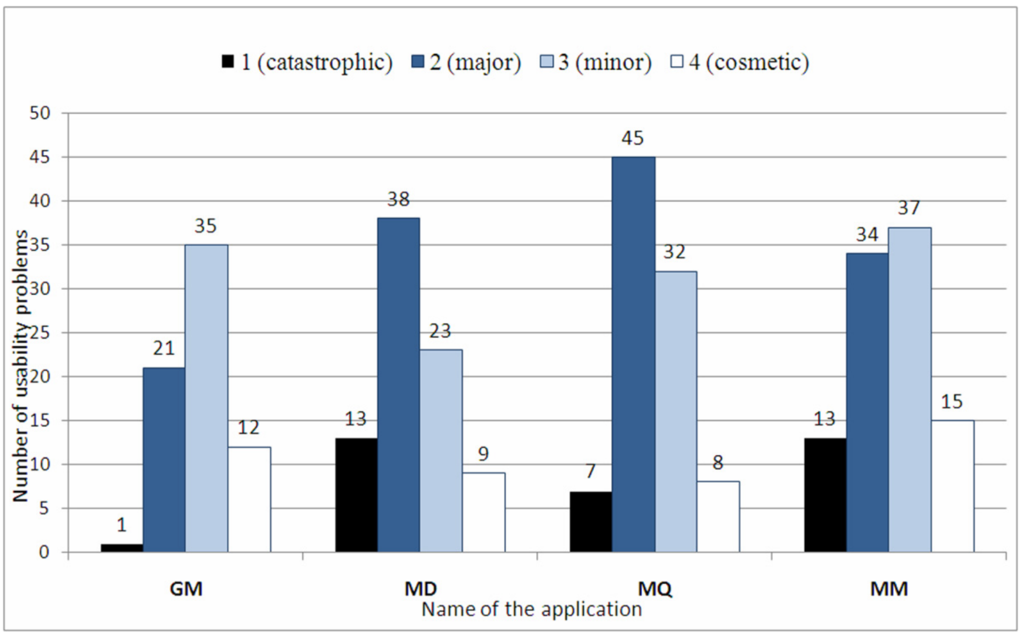

Figure 1. Distribution of the severity of the usability problems in each of the map site.

3.1.2 Method vs. severity

There was no big difference in terms of numbers of usability problems found with different methods. However, different evaluations identified different type of problems. The problems were identified more often by usability tests, especially the most severe ones: over 60 % of category 1, and over 70 % of the category 2 (Figure 2). The minor problems were identified almost equally (50% and 60%).

3.2 Qualitative findings

The usability problems were grouped also under four different categories according to which part of the site they belonged to: 1) *the user interfaces* (display, layout, and functionality), 2) *map* (visualisation and tools), 3) *direction, address and place searches* (search criteria/logics, default settings, search results, route searches and visualisation of the results), and 4) *help and guidance* provided to the users in an error situation. Problems are discussed in more detail in Nivala et al. (2007). Short summary is also given in the following paragraphs.

The first impression is relevant with the web map sites; it should be clear from the beginning of the use situation what the map site is designed for and how the user can use it. The users should also know what they did, are doing at the time, and will have to do in the future when using the map site. As map services are decidedly visual in their nature, distractive advertisements and messy user interfaces were observed to be particularly critical for these sites. This does not only refer to the user interface aspects of the site, but also the maps. Each map scale should be considered separately: attention should be paid to what information should be included and how it should be visualised in each of the scales. Using maps that are originally designed as paper maps, or even worse, maps that are in fact paper maps but have been scanned and put on the Web is no longer acceptable. Today's users are used to having access to a lot of free but well-designed services on the Internet, and if they are faced with a site that not only looks bad but is also difficult to use, they will rapidly start looking for a better alternative.

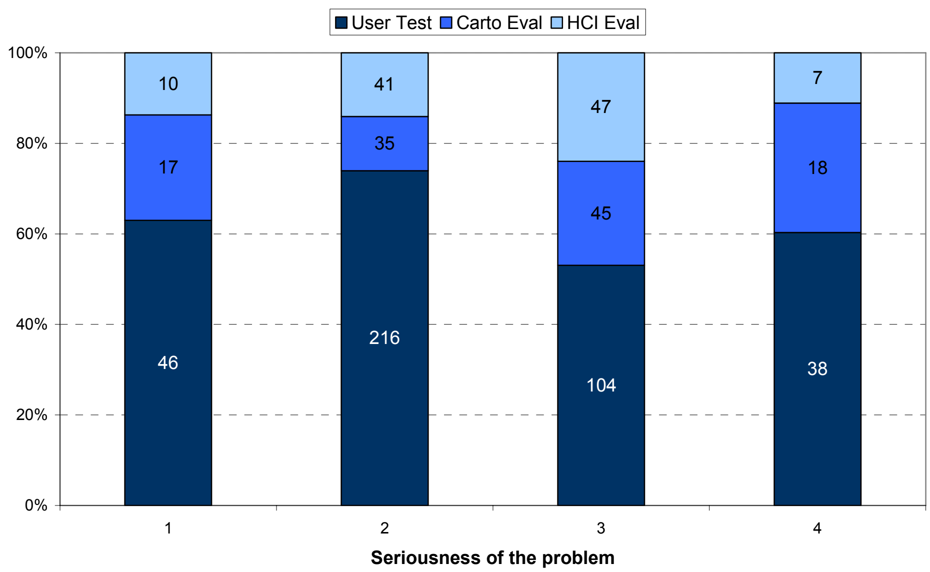

Figure 2. The percentage of the usability problems found with different methods grouped according to the severity of the problems.

Map tools have to be logically grouped (map operating tools together, links together, other functions together etc.). With current technology it is also easy to implement new tools such as a route measuring tool, an option to add markers on the map etc., from which the users could benefit. However, traditional tools, such as legends and north arrows, should not be forgotten either, although they seemed to be missing from many web maps. Tools in general should be distinctive, but not block too much information on the map. The level of detail is a critical aspect from the usability point of view; the steps in visualisations between different scales should not be too big and a continuous shift between different scales would allow users to follow a specific location while zooming in and out.

Among the most common tasks with web maps are different types of searches carried out by users to look for addresses, routes, etc. It is important that the map and the search box occupy a central role on the map site. Different people search things differently; some people are used to making web searches with search engines, and they also want to carry out map searches in the same 'free' manner. Others may need more structured/guided searches. As the most severe problems observed during the usability evaluation were related to the default settings of the map sites, it is critical to guarantee that the users know with what type of criteria the search is carried out. It should be also made clear to the users what the search results are based on and how they relate to the query. Visualisation of search results should take into account the scale of the map and the symbols that are already used on the map. Furthermore, help and guidance functions are a necessity with map sites.

4 Discussion

The need to consider usability aspects in map design is especially relevant today as maps are increasingly more often being used by private, non-professional map users. Consequently, map providers should be able to respond to the different levels of user needs and provide the users with flexible systems. The topic should be further studied. Further study is required also based on the observation that some of the participants had hardly used any types of maps at all, and the use of the maps was especially difficult for them. Some of the users did not realise that the map scale could be changed or that searches could be carried out for the different objects on the map. The challenge remains to design map sites that people can use and in which they can make meaningful search queries without getting frustrated or without facing a lot of problems in using them.

Map sites often offer links to different additional services (such as hotels and tourist attractions), but since these are links to their own web pages, they either had their own map interface, or no map at all. If a user wanted information on how to use the subway to get from one tourist attraction to a hotel, at least three different maps and services had to be opened at the same time: a subway route map, a map with hotels on it, a map with tourist attractions on it, and perhaps even a base map for combining all this information. If all of these have their own maps with different scales and visualisations, it is difficult for users to combine all the information. The best way would be to have all these embedded in the same map service. However, this might be quite difficult, so another way would be to have harmonised maps and UIs between different services. This aspect is one of the usability challenges for designing future web maps.

Bringing the usability engineering concept into such a specific discipline as geovisualisation raises many questions. In order to support map developers in adopting usability methods in their product development, further research is required on how to apply these methods in map application design. Methods need to be further developed to suit the interdisciplinary nature of mobile map projects. Established map use research is to some extent still applicable, but it should be developed to suit the purposes of today's interactive, dynamic and location-aware maps. Therefore, a more systematic comparison of which methods should be used, and in which way, should also be carried out. The study presented here still continues by analysing the different types of comments different methods bring out of the map visualisation and the map user interface.

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Mapping the Ideas – the Role of Cartography in Social Networks

Paweł J. Kowalski
Warsaw University of Technology
Department of Cartography
p.kowalski@gik.pw.edu.pl

Introduction

The idea of the Web 2.0 network has been materialising under our eyes. Experts stress significant technological changes based on the XML language and AJAX programming environment. The spectrum of web services is rapidly growing; their functionality may be easily combined, what leads to new quality in the web. More web applications appear, which may compete with their stationary equivalents and considerably change the utilisation of Internet.

Journalists argue, whether it is only evolution of the first generation Internet, or maybe revolution, or maybe we face … the anarchy. Since the most important feature of the Web 2.0 network is its availability and technical openness, what makes that the Man 2.0 becomes the participant and co-creator of virtual events – the Man 2.0 becomes the citizen of the cyberspace and organises Internet societies in a natural and obvious way.

The countable effect of socialisation of Internet is an increasing number of personal blogs, which supersede existing home pages, as well as thematic blogs within company and institutional pages. New communication channels occur, such as profiled RSS feeds or podcasts, which substitute existing mailing lists and newsletters. But rapid increase of users' influence on content published in the web is the most important issue. This happens directly, through co-editing of articles included in such services as Wikipedia, or indirectly, using the tagging system of marking and evaluating the documents. As the consequence, the popularity rankings of WWW pages become an interesting alternative for conventional hierarchically ordered catalogues.

Such phenomena organise the society in a new way and the attractive space for communication grows in the web. Geographic information plays a very important role in that space, which is called the blogosphere. Space-oriented behaviour is the natural behaviour of a man.

Geographic information in Internet

Development of network technologies: introduction of new standards, evolution of browsers and increase of the network capacity allowed to introduce advanced methods of cartographic modelling in Internet. Besides cartographic Internet publications (Kraak 2001) importance of geoinformation services is growing. They are the data-oriented systems, in which maps are generated on the user's request and following the user's need. It is worth to notice that in case of geospatial data, they could not be maintained without visual presentation; therefore the cartographic image is presented at the stage of reviewing, analysis, as well as at the stage of data transfer.

The present expansion of geoinformation services coincides in time with development of the social Internet, where the spatial location is an important, real and useful attribute of exchanged data. Characteristics of events, phenomena and objects, as well as the user, may be spatially referenced. Therefore, if the user obtains simple, intuitive tools for making such data accessible in the form of a map, they will be applied, and, maybe the user will also apply the map to perform on-line co-operation or just to have some fun.

Participation of geographical data in Internet resources has been significantly increased for the last two years. This has been mainly the result of activities performed by leading location services providers, i.e. Google Maps, Yahoo Maps, MapQuest and MSN Live Maps. Their basic task is to supply information on locations: searching for addresses, POI type objects, attractions for tourists, delineation of travel routes etc. If one is to believe statistical data presented in May 42% of the American users of Internet use maps. One service generates 16 million maps and routes per day (Greiner 2007).

Home servers: maps.google.com, maps.yahoo.com or www.mapquest.com are only the topic of an iceberg, which consists of uncountable mashup type services, which combines own thematic content with topographic, vector or raster background supplied by selected geodata providers. Functionality of various services is integrated as a result of utilisation of API programming libraries of various environments. Obviously, applets (like Google Mapplets) or applications which automate combination of services from various suppliers also exist, in order to make those operations which were performed by programmers in the past, available to wide groups of Internet fans.

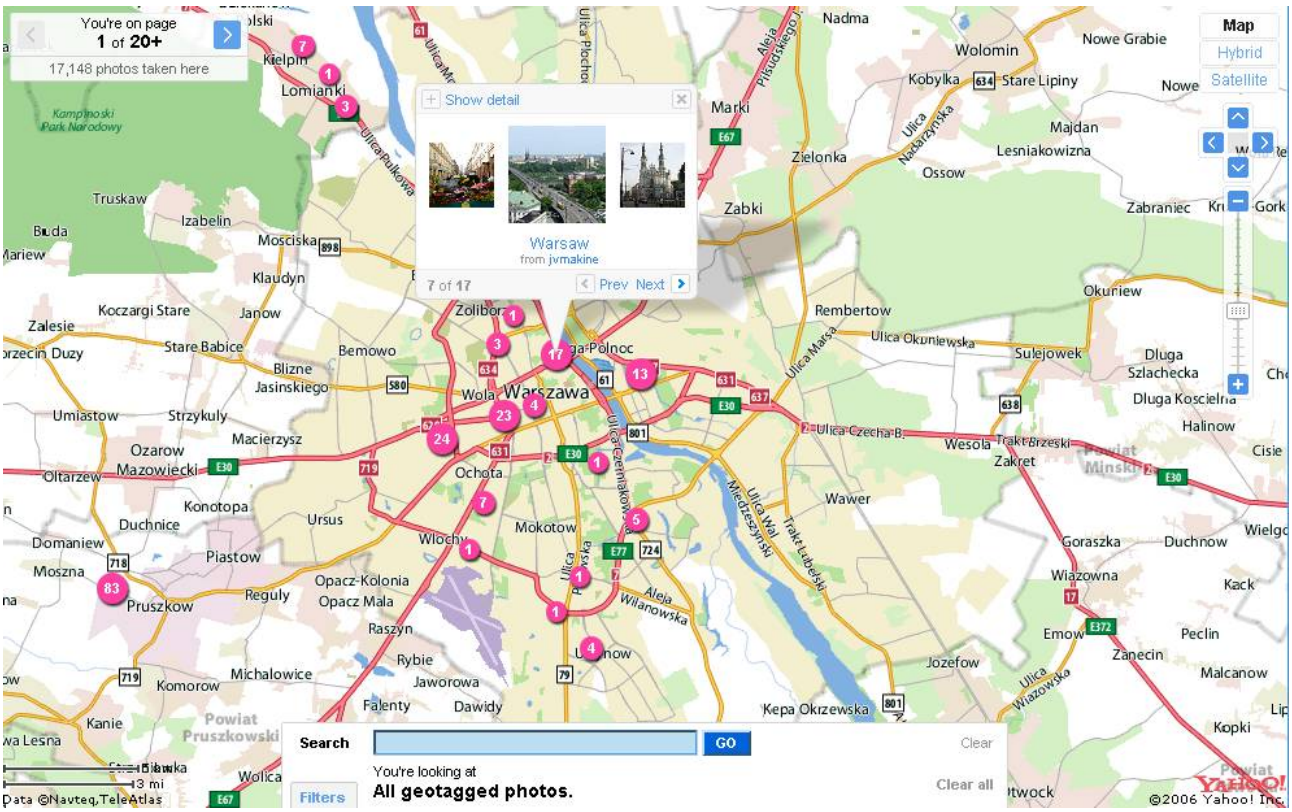

Fig. 1. One of the most popular online photo sharing service, Flickr, based on Yahoo Maps.

Besides map services, which are prevailing, photographic services (**Fig. 1**) are also very popular, as well as searching, travel, video, news and other services (ProgrammableWeb site). An example of one of the simplest mashup services, based on Google Maps data is Wikimapia – combination of the idea of Wikipedia and Google Maps resources. Among many examples of photographic warehouses, developed basing on map foundations, the following may be mentioned: Flickr as one of the most popular and Woophy – WOrld Of PHotographY. Other interesting solutions include: Atlas of Fiction showing real places imagined by great writers or Littourati Blog.

Those examples show completely new kind of products of social cartography: map of hobbies, artistic maps, maps of ideas, maps of group works etc.

Rapidly growing interest in new publication possibilities results from the fact, that such possibilities appeared, but also from their advantages. Obvious advantages of Internet map distribution, using the present Internet techniques, are:

- publication speed, which is expressed in shortening of time between the stage of editing and publication and reception of a map, as well as in shortening of time required for map updating (Peng, Tsou 2003),

- simplicity of integration of a cartographic image with various multimedia means (Cartwright, Peterson, Gartner 1999),
- interactivity, which combines advantages of hypermedia navigation and dynamic sites, which utilise script languages (Kraak 2001, Cartwright 2005).
- The attractiveness of cartographic transfer in Web 2.0 is influenced by strengthening each of the above features:
- publication speed – as a result of utilisation of the existing geoinformation resources and ready-to-use applications;
- simplicity of integration of a map and multimedia – as a result of specialised web services (Fig. 2);
- interactivity – as a result of XML applications on the map websites (Zaslavsky 2005).

And last but not least – findability. WWW services are used to find news, websites, photographs, videos or other resources. Every piece of information can be geographically enabled –geocoded by place names, latitude and longitude coordinates or postal address. That identification is called geotagging and can be found in GeoURL, GeoRSS or in metadata of images. Geotagging can help users find a wide variety of location-specific information.

Fig. 2. Interesting mashup Map.Moving360 with map and panoramic video (Müllenhagen, Zastrow 2006)

Cartographic analysis of geoinformation services

Evolution of Internet geographic services, for which a map is the basic form of presentation, results in the following question: what is the quality of cartographic presentations in regards to their form, scope of the content and usefulness? On the international forum cartographic issues are considered as less important. During such conferences as O'Reilly Where 2.0 or GeoWeb mainly technical and organisational issues are discussed, which delineate directions of Internet development with respect to geoinformation. Therefore, it is very important to continue research on the usability, symbolisation, generalisation and methods of cartographic visualisation in Internet, when it changes its image.

Functionality (usability) of the Internet services results from its equipment, quality and user friendly utilisation (Nielsen 2003). Therefore, it is the general evaluation of the number of advantages, which may be gained from the product with possibly low inputs of work and time. The basic component of that evaluation is usually the number of possible options and functions, which are included in the equipment of the particular tool.

The mostly implemented geoservices functions are:

- Searching for and address or a particular object;
- Searching for travel routes according to assumed criteria;
- Adding and describing new points and routes to a map;
- Sending the resulting map by electronic mail;
- Location of links to maps presented in services on own WWW pages;
- Presentation of location (access) maps on own WWW pages;
- Common creation of services by means of the system of comments.

It seems, that the available functionality of services is not fully utilised. Maybe, this happens due to lack of skills how to use the advanced options of services and due to lack of time required for familiarization with those options. The majority of users need to draw on a map the objects, addresses or routes which have been found. They often would like to send that map to friends. In fewer cases we need to amend particular location with our own photographs or another document. But we may be sure, that the awareness of possibilities which are brought by the Web 2.0, will permanently increase.

The Internet network is based on standards (World Wide Web Consortium). Without standards of data transfer, it would not exist at all, without standards of description of hypertext pages and multimedia, the worldwide WWW would not exist. Similarly – without standards of presentation, the review and popular cartography, based on recognisable symbols (signatures of a hotel, a railway line) and colour schemes (green – forests, blue – hydrography) would not be developed. Such commonly applied symbols are used by creators of location based services, who do not present legends and count on the knowledge (and intelligence) of the users.

An interesting aspect of visualisation are hybrid (i.e. image-and-symbol) images, which requires the definition of an alternative sets of symbols and patterns, which are displayed, when the user switches to the display of an aerial or satellite photograph (Fig. 3). Transparency is an important visual variable for such vector layers on tone images. Unfortunately, colour and brightness distortions are not always considered for semi-transparent symbols.

With respect to visualisation, besides the basic set of conventional symbols, at least several special symbols, are used in the process of interactive work with a map: they are used for marking the current selection – a selected point, part of a route, alternative section of a route, starting and ending points, intermediate points of a route an interactive, or (seldom) a selected area. Besides, at least one (point or line) signature must be reserved for marking objects (locations) introduced by the user. Mostly, each service uses the characteristic icon or a simplified logotype version.

Such characteristic signature is a drawing-pin, originating from the Google Maps service, which became a well recognisable and repeated motive by competitors, nevertheless its inconsistency with the map image. Marking special points is usually accompanied by information clouds, which may be modified by the user. It is the development of an idea of text labels, attached to the objects. An interesting solution is to place detailed maps, as city plans, in an information cloud, on the background of a small-scale map. It is a very useful way to avoid the problem of map generalisation, and, in particular, the problem of diversified accuracy of presentation required for various areas.

Effects of generalisation are usually obtained in the process of map displaying by means of automatic modification of the level of details for various levels of magnification. This also refers to names and descriptions on a map. Images of Internet maps at small scales seem to be the worst: areas of countries or regions of lower levels of details are very well visible. On the other side, names of objects are often selected randomly, and not according to a generalisation key.

Fig. 3. Hybrid display with transparent symbols in Wikimapia

Usability achieved by means of generalisation and symbolisation results in generation of a user-friendly map; the user looks for a particular, readable and well edited document; it such a document is found, the user will not more than several minutes to look through it. The need of the maximum generalisation of the content and form is confirmed by statistical data concerning visits: the average Internet user look through more than 1000 sites within a month and spend 20-30 hours working with the computer, what results in less than one minute spent for one site (Nielsen/NetRatings **Error! Reference source not found.**).

Evaluation of Cartographic Presentations in Internet

There is no doubt, that although some editorial and aesthetic defects exist in the majority of social services, the cartographic image fully meets the users' needs. The spectrum of developed services of the type "make a map for your friend" (such as Frappr or Wikimapia) is very wide, but it should be noticed that the majority of such services present the narrow scope of general geographic data – only those data which are required for spatial orientation. There are also many problems in the field of thematic cartography dedicated to public participation (discussed in Caquard 2005).

At the beginning of the revolution marked as the number 2.0 some threats are visible. The most serious of them is the expansion of mashup services, which utilise geospatial components (technology and data) from only one provider. Most of those services repeat the Google-like graphical and functional solutions, what promotes the de facto standard of data exchange and geopresentation (KML), but, on the other hand may lead to hermetic sealing of solutions.

Another observations originates from my own University. During practical sessions in multimedia cartography (Multimedia Warsaw project: http://zk.gik.pw.edu.pl/multimedia.html) more than 2/3 students decided to use the screenshot of the Google Maps service or Google Earth for the needs of illustration of the location of an object on a developed website. It happened although they independently edited a topographic plan in the geographic information system. It seems that the effectiveness of Internet publication was the deciding factor. Capacity of locally available applications (ArcGIS) and topographic database were somehow attractive for the minority of students. Maybe is it the effect of Googlemania?

The positive phenomenon is popularization of geographic information system by means of Internet applications, but the fact of absolute trust in the image presented in Internet may be distressing. Social networks may be a remedy in such situation. Thanks to systems of internal verification and evaluation they may support the beginning users of geoinformation in efforts to search for required data and maps. On the other hand, for those who publish own works, they are a kind of filters, which improve the quality of products which are finally delivered to wide groups of users.

Concluding remarks

A map is the classical form of presentation of the geographic space. Following the theory of communication; it is defined in cartography as the transfer of information between the creator and the recipient: Cartographer > Map > Map_User (Brodersen 2005). Fields of cartographic applications presented in this paper justify the needs for widening that theory and substitution of the above scheme with another one: Internet_User <> Map < > Internet_User. In this case, communication is performed in two directions and, besides, each map, as a communication node, may be read-out and edited for many users at the same time.

The condition required of successive editing of a map (co-mapping) is the utilisation of specified rules of projection of its content and symbols – similarly to the presentation cartography. Participation of cartographers in initiatives of Internet societies should be increased in this respect. Thanks to the universal graphical language, the map often becomes a platform of all data exchange; it often becomes just the communication interface, for which the spatial location is the basic information. At the same time, as each map, that cartographic interface plays an orientation, navigation, general information, touring or sightseeing role et al.

But: is the place on a map reserved for geographic objects and phenomena only? There are maps of genes, mind maps, language grammars maps and maps of websites. Together with development of the worldwide web, a new research discipline arose at the join of cartography and telecommunication; it is called cybergeography and it utilises methods of cartographic presentation for the needs of presentation of computer networks: technical infrastructure, topology, capacity ect. (Dodge, Kitchin 2000).

The Web 2.0 opens successive research areas for cartographers, for example visualisation of social phenomena at the level of individual experiences of the society members. In such projects, as "Else/Where Mapping – New Cartographies of Networks and Territories" such issues as mapping the impressions, emotions and experiences of humans occur. (Abrams 2007) Therefore such subjective cartography has all features of exploratory cartography, which utilises the full freedom of the content selection and unlimited visual means.

The above lists of tasks of cartography may be amended with humanistic and artistic functions. The importance of the idea of cartographic presentation of one's experiences and thoughts and sharing one's visions of the world with others becomes more and more important. Thus, in the times of deep technological transformations we face the renaissance of cartography as the art.

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Spatial Knowledge: Some considerations for Web Cybercartography

Carmen Reyes
Centro de Investigación en Geografía y Geomática
Ing. jorge L. Tamayo A.C. (CentroGeo)/ México City /México
creyes@centrogeo.org.mx

Elvia Martínez
Centro de Investigación en Geografía y Geomática
Ing. jorge L. Tamayo A.C. (CentroGeo)/ México City /México
emartinez@centrogeo.org.mx

1. Introduction

Cybercartography (CC) is our research subject. Within its boundaries, CentroGeo developed, in a first instance and following Taylor's vision, several computerized cybercartographic artifacts in the form of DVD or CDROM: the 'Cybercartographic Atlases' that have been previously described. These atlases were built by interdisciplinary groups that took the demands, needs, and priorities expressed by social stakeholders and integrated them into interactive digital artifacts. The artifacts, once inserted into diverse public and private organisms, have in its own turn evolved to better adapt to the organization's processes and needs. This spiral growth - denominated by Reyes 'the unfolding virtual helix' - has established a starting point to analyze the circular processes that derive from the atlas-society interaction.

Knowledge has been a central concept to the inquiry of these circular processes. Even during the development of the first artifacts, we have sought to support the organization of the atlas' messages with knowledge models. For instance, the Lacandona Region and the Chapala Lake Atlas were based on Zonneveld's Landscape Ecology model. The knowledge model to be used was initially selected from sufficiently robust models by expert authors; the challenge then was to use cybercartography language to articulate the atlas messages in such a way that they followed the guiding thread of the selected model. In other words, the knowledge model guided the navigation and the subsequent storytelling process resulting from the interaction with the atlas.

The theoretical conceptual framework of CC emerged from a second order activity: the inquiry of the construction and insertion processes of the atlas. Through this reflection, a possibility to orient the future development of research in the subject was glimpsed. The motivation to place geo-spatial knowledge in a more protagonist role in CC research is one of the main results of this conceptualization. In this sense, the interest has gone beyond the mere selection and implementation of already established models or schools of thought and to include the designing of knowledge models that capture the complexity of the issues and processes involved and allow for different theoretical, conceptual or ideological readings. These models have the capacity to evolve from the interaction between the artifact and the social stakeholders. The challenge now is to feed the knowledge model so that it maintains coherence while it evolves, without detaching it from the context and without loosing navigational effectiveness; that is without breaking the flow of the storytelling process.

Towards this goal, the evolution of the knowledge model from the insertion of the atlases in diverse conversations with relevant social stakeholders has already been accomplished. Through the participatory observation of these processes and following the second order cybernetics perspective of Pask's Conversation Theory (1975), the research group identified new concepts and perspectives that were then fed to the atlases. This has been possible within the framework of synchronic conversations - both in time and place- between the atlases and the social stakeholders. However, the insertion of these artifacts on Internet - which is crucial to the advancement of CC- raises a new challenge to the knowledge model evolution of each artifact since it radically changes the observational and knowledge managing roles that up until now the research group had been playing.

This has leaded us to explore subjects such as the exchange and management of geospatial knowledge, the creation of new geospatial knowledge and the technological base related to the distance support of these processes.

2. Exchange and management of spatial knowledge

The approach to the subject of knowledge exchange and circulation has drifted away from the models that favor discipline stalls and formal academic circles and forums; instead, it has opened up to the observation and analysis of the social networks through which knowledge flows by means of diverse mechanisms and in diverse forms. Gibbons (1994) highlighted that scientific knowledge is not exclusively produced in the confines of academy or through formal research; it also emerges from the communication networks of formal an informal organizations, and is interdisciplinary, context-driven and problem-focused

From this perspective, multiple authors place knowledge as the main asset for organizations and societies to generate economic value and increase productivity, and knowledge management (KM), as the required process to achieve a good performance in the emerging knowledge society.[16] The challenge is that every person must have the required knowledge available in the precise moment of making decisions, that is, he must efficiently relate the knowledge with its use.

Since 1967, Polanyi has made a distinction between the explicit knowledge, found in publications and presented in academic conferences, and easily shared and communicated- at least between peers- due to its systematic and formal nature; and the tacit knowledge , or 'know how', embedded in the individual's abilities and which is hard to communicate in its full extent. In Polanyi's words “we can know more than we can tell"”

Hildreth and Kimble (2002) stress the ambiguity of the term knowledge at the KM literature. They synthesize various dichotomy visions of knowledge: They quote Conklin’s proposal of a differentiation between ‘formal knowledge’ -expressed in books, manuals, documents, etc.-, and informal knowledge, which is applied in the process of creating formal knowledge. They say that for Rulke et al, knowing-what-you-know is the organization transactive knowledge while knowing-who-knows-what is its resource knowledge; that Kogut and Zander distinguish between information and know-how, while for Brown and Duguid the know-how is the ability to put the explicit knowledge or know-what into practice; and that Leonard and Sensiper view knowledge as a continuum – with tacit knowledge standing at one, explicit knowledge at the other-, and establish that most knowledge exists between extremes. In the KM literature these visions are seen as means for addressing the transformation of ‘less structured knowledge’ into more ‘structured knowledge’ which can be captured, codified, and stored.

From the management sciences point of view, renowned authors like Nonaka and Takeuchi (1995) have proposed a dynamic, non linear model of knowledge generation that considers that the knowledge assets of an organization are shared in a context of interaction between individuals; this leads to the conversion of tacit knowledge into explicit knowledge which is suitable for its further circulation and amplification. However, Hildreth and Kimble (2002) consider Nonaka’s vision of tacit and explicit knowledge, as mutually complementary entities that interact in a spiral ‘conversion process’, becoming a dichotomy while changing from one into the other; they also point out that some authors like Teece, consider the inherent difficulties to articulate tacit knowledge while others, as Shum, consider that tacit knowledge looses validity once it is captured and codified.

The hegemonic view of KM is based upon such dichotomy views and is focused in the management of explicit knowledge and in the conversion of tacit knowledge into explicit. Instead they propose a dual vision of knowledge in which, hard knowledge –or knowledge that can be codified and whose management is well established with tools and techniques of information resource management- is intrinsically articulated with the so called soft knowledge - which is less quantifiable, cannot easily be captured and stored and the management of which needs to be further explored as its sharing requires more than making it explicit. In this vision the tacit and explicit dimensions of knowledge are interwoven: all knowledge is to some degree hard and soft and some aspects of it can be codified and stored, while others cannot be formally externalized. (Hildreth & Kimble 2002)

In dealing with the geographic space, what is hard and soft knowledge? It is true that much of spatial knowledge, can be codified, for example in mathematic or cartographic models; spatial information can and must also be

[16] As an example one could mention that the Wikipedia entrance to the words “knowledge management” cites more than 50 authors (http://en.wikipedia.org/wiki/Knowledge_management)

adjusted to scientific norms and standards for its collection, classification, storage and retrieval. But, spatial knowledge also possesses a quite relevant tacit dimension: the apprehension of the space is constructed in a process that starts in early childhood; the comprehension of the spatial dimension present in social, political or cultural processes is an issue interwoven with context and culture, and people relates to space in their daily activities according to cognitive maps which construction involves personal, psychological and subjective dimensions.

Traditionally, the map has been the major medium to model and to communicate the geographic space; but map-making involves the hard dimensions of knowledge (measurements, scales, geometry, etc.) as well as the soft ones (the map-maker's worldview, her creativity or her ability to represent that which she wants to communicate). Spatial knowledge displays the three main elements of any knowledge: the dual character of its nature, in which tacit and explicit dimensions are interwoven; the social character of its construction, and the complexity or non-linear character of its generation. All three elements show to the need to find novel ways for spatial knowledge management in order to enhance its exchange and circulation and synergize the learning and knowledge creation processes.

3. Meaning and the Generation of New Knowledge

The evolution of cartographic production from paper to the digital format, the development of Geomatics and Information Sciences and the circulation of information in multimedia from and via Internet have implied a paradigm shift in the geographic space communication process. Not only has the number of users with access to geographic information increased, but also map-making - previously confined to the cartographer's expertise- is now, with the support of diverse technologies- within reach of other discipline's analysts and even the common citizen.

As the ITC's and the Internet permit the creation of an increasing volume of geographic information, its expression in different media and formats, and the increasing exposure of non-specialized users with it, the meaning that users draw from said information, and the contribution this has to improve learning and knowledge generation processes become subjects with many faces to explore. In this sense, Eddy and Taylor (2005: 37) ask "How might cybermaps serve to augment 'meaning' as a result of dialogical information processing and how does cybercartography enhance this process?" This question that could be extended to every knowledge field points back to Wiener's central issue of communication between humans, between humans and computers, and communication between computers (Wiener 1948).

From a second order cybernetics perspective (Von Foerster 1979) we have been observing the communication and feedback cycles resulting from the insertion of cybercartographic artifacts (developed by Centro Geo in CD and DVD-ROM) in diverse social contexts. These conversations, circumscribed to human-computer and human-human interaction, have been conceptualized, following Pask's principles, as a productive activity in which the participants get involved with the purpose of establishing a cognitive interaction through which they build meaning and discover new things that enable them to make decisions, solve problems or learn. (Scott 2001). As a participant of said conversation, the CC artifact relies on its knowledge model to imbue meaning to its messages; this model interacts with the knowledge model of its humans counterparts in the conversation

The human-computer interaction does not happen merely through the browsing activity, as it is guided by the artifact's narrative structure which permits to approach a subject from different perspectives and conceptual levels and in different languages and media that help to convey meaning in the message. We have previously sustained that new concepts that represent a mutual understanding of territorial processes emerged from the recursive exchange of messages between the stakeholders and the artifact and that they can be feedback both to the atlas' information stocks and to its knowledge model.

The knowledge and information embedded in the artifact's messages, and their semantic characteristics empower the individuals who participate in the conversation to generate new knowledge. It is through the circulation of information and knowledge in human cognitive processes that new knowledge about the space emerges as a new level of complexity. New knowledge is built by the participating social stakeholders as they are the ones capable to derive meaning from a message, to integrate and combine this meaning into their own knowledge models, to create new knowledge, and to introduce this new knowledge to the artifact. Hence we agree with Hildreth and Kimble (2002) when in their conclusions they assert that "..it is important …to re-emphasise the key attribute of knowledge: that it exists in people's heads. Once explicit knowledge is committed to paper, (or any other medium) it becomes information. The original knowledge remains in the mind of the author and (in an ideal world) is only transmitted to the mind of the reader trough this medium".

As far as computer-computer communication process is concerned, the main contribution comes from Artificial Intelligence and research on the automatic interactions of intelligent agents. The meaning that these software agents are able to transmit in their messages is limited to the knowledge representation in formal networks and the programmed decision rules that allow them to display a sort of intelligent reasoning. Based on ontologic and/or semantic network agents are instructed as how to see the world and how to reason about it. (Davis et al, 1993), Accordingly, while agents can search and deliver pieces of information or knowledge -both greatly valuable functions-, they lack the capability to generate or build new knowledge. Their intelligence does not reach the realm of creativity. The possibility to generate new knowledge, currently lies only in the human brain.

Research on semantic networks has in great measure followed this line of thought. For instance, semantic networks have a conception of memory guided by the metaphor of information storage and recovery, structured as clusters of independent or loosely connected facts. This 'memory' does not reflect in anyway neither the richness of the information interconnections of human memory, nor its intertwining with the cognitive process (Riegler 2005).

In contrast with reductionism approaches, cybercartography perspective on knowledge acknowledges the multiple and diverse actors that participate in the process of knowledge construction, the interactions and exchanges that occur between them, and the emerging of something new from these networks.

In our submission to International Perspectives on Maps and Internet, we have highlighted that in the Semantic Grid the subjects of meaning and knowledge in the computer-computer conversation are approached through descriptions in a suitable language to be automatically processed. These descriptions are, in fact, the metadata of information, resources and services that flow through the grid and that are represented using ontology or semantic network tools. Pulsifer and Taylor point out that the Geomatics community approaches the semantic heterogeneity in three ways: metadata, standardization and semantic translation. (Pulsifer & Taylor 2005)

These ways are considered to be the main tools to convey meaning in the computer-computer communication. Their usefulness lies mainly in the possibility to effectively search and deliver spatial information in order to allow collaboration, and their purpose is to achieve a high degree of automation in searches and deliveries. However, formal knowledge representations are limited when dealing with conversations in which participants need to analyze, share, and discuss the theoretical, conceptual, or methodological angles involved in spatial knowledge generation. Computer-computer communication does not attain the production of novelty the way conversations between humans or between human and computer do.

Looking at knowledge generation as a complex process imposes a new challenge to the design and development of information and communication artifacts. These need to be supported by open knowledge representation structures that guide the organization of the diverse cognitive elements and allow for their expression through the most pertinent means and languages for the communication process. In these models, notions and concepts need to be considered in each other context, knitting holistic structures; ways of transmitting both explicit and tacit knowledge need to be introduced in languages and media and ways for receiving feedback for the evolution of the models need to be incorporated.

The evolution of the knowledge model in a CC artifact requires that coherence be kept. The model openness allows its evolution by letting the users introduce new conceptual units. From these the narrative may derive in new avenues. But, in order to avoid chaos, it is an imperative that those new avenues find their place in the narrative's thread. Coherence does not mean that all lines have to obey a line of thought or a particular ideology; it rather means the possibility to identify in the narrative the school of thought or the ideology in course and the agreements or disagreements with others, so that users are able to discriminate the theoretical posture that guides de message weaving. This is possible if the model's evolution is steered by a holistic knowledge management model

4. The Cybercartographic Knowledge Grid

Up to date, the evolution of the CentroGeo CC artifacts knowledge model has been guided by the research group. Since these artifacts are in DVD or CD-ROM, they have been inserted in synchronic conversations in time and place. The research group members have acted as participants and observers of these productive processes, and the feedback to the knowledge model was selected by them. The research group has managed knowledge. The insertion of cc artifacts in Internet poses a challenge for research on asynchronic conversations and it is precisely through the knowledge conceptualization that we have outlined that we want to tackle what Reyes and Martínez (in press) have called the Cybercartographic Knowledge Grid (CCKG) .

Grid computing is a concept that emerged as a result of Internet. It proposes a distributed computation model with a scaling potential that goes beyond the power of supercomputers and that makes tasks that imply the use of large volumes of information possible. This concept has given way to new technology that, by facilitating the information access, exchange, and processing through expert networks, support complex research projects that involve many researchers located in different places, and allow them to share technological resources, results and observations. This concept has led to specific architectures that support complex research projects that cross organizational boundaries, as it is the case of the Knowledge Grid Center. (Zhuge et al 2006)

De Roure et al (2001) have pointed out that the e-science process requires, in addition to the computer and telecommunication infrastructure, information management and knowledge processing support. This more encompassing vision has been called in literature 'semantic grid' and is based '"upon the notion of various entities (represented as software agents) providing services to one another under various forms of contract (or service level agreement) in various forms of marketplace" (De Roure et al 2001:7). The word semantic preceding the concept of Grid points back to the issue of meaning that is central in the communication process.

Technology plays an important role in knowledge management. Most technology for KM has relied on the codification metaphor and has been centered on the management of information or structured knowledge. Grid architectures pose the need for technologies that address issues of knowledge processing support and that embrace a conception of knowledge in both its dimensions: tacit and explicit.

Although many authors emphasize proximity as a must for sharing tacit knowledge, we believe that current and future technologic innovations incorporated into the CCKG architecture will have the potential to manage softer aspects of knowledge, even if they cannot be codified in scientific formal languages. Cybercartography itself already contains this potential: in combining different languages and media, the language of cybercartography can transmit attitudes, feelings, preliminary ideas, opinions or values in a way similar to that by which an artist expresses his inner self through his work. Hence, some messages communicated by CC artifacts are expressions whose meaning may vary according to the observer rather than follow a formal codification.

Communities of Practice (CoPs) are groups of people that share a common domain of interest and collaborate with the purpose of learning from each other in the performance of a task. Through the process they exchange information and abilities and develop a shared repertoire of resources (Wenger 1998). From a knowledge generation perspective, one of the main advantages of the CCKG would lie on its potential to support the emergence and consolidation of CoPs and the management of the knowledge that may surge from conversations among its members. CoPs would be formed by networks of individuals that may or may not be in the same place but that share an interest in the subject matter of a CC artifact (as for example: competitive territories, soil degradation, social segregation, etc). These individuals would be willing to obtain or/and construct spatial knowledge to solve the problems that they may jointly define. The clue for achieving knowledge generation in these networks lies in the support the CCKG can provide to CoPs' members for expressing, sharing, working, and in general for synergizing the exchange of both dimensions of knowledge in their conversations.

CoPs are social structures able to share tacit knowledge in learning processes. It is through practice that the individuals involved learn from each other, and from practice surges meaning. For many authors, face-to-face contact is a must for tacit knowledge to be exchanged; however, appropriate technology may be developed in order to support the sharing of this knowledge by means of linking people and of providing them with forms of expression and communication that may reproduce the perception of attitudes, feelings and many of the spontaneous signals that people make in face to face contact. We view asynchronic conversations of these distant CoPs in Internet to be supported with technology that may allow, among other elements, communication by written words, but also by voice, drawings, images, maps or videos.

Technologies related to ontologies or semantic networks tend to focus in the packaging of knowledge as an object and in the sharing of explicit knowledge expressed in formal representations. Technologies related to the CCKG would also have the potential to help the exchange of softer aspects of knowledge, even if these cannot be captured, codified, and stored, and to manage the spatial knowledge surging from conversations of the individuals involved. The explicit dimensions of this new knowledge would be codified and fedback to the community's knowledge base, while its tacit dimension would be synergized by supporting networking and facilitating different forms of expressions.

In the CCKG, CoPs would organize their links around geo-spatial computerized artifacts, like cybercartographic atlases or systems supporting collaborative spatial decisions. To derive meaning from the information and knowledge embedded in CC artifacts, knowledge in the mind of the community's members is needed; these artifacts are geared towards building a spatial language among the community members, favoring the construction of knowledge about geographic space, supporting communication processes that help generate consensus and shared agreements, and helping steer social processes towards the enhancement of particular territories. (Martínez and Reyes 2005). Systems supporting collaborative spatial decisions aim at the collective definition and solving of particular complex and fuzzy problems in which the spatial dimension plays a major role. (Jankowsky et al 2006, Luscombe 1986)

The CCKG would play the role of connecting individuals in CoPs and of providing them with an architecture that supports knowledge exchange and management. Those artifacts would also facilitate communication across different communities. The CCKG architecture would be able to evolve. Some processes initially performed by the human agency could eventually be delegated to software agents if the advancements in KM permit to do so. Also, services previously confined to software agents can be re-structured for their delivery by the human agency. Hence, the CCKG architecture combines both men and computer in order to achieve a holistic KM process .

Conclusion

The motto of Moscow's AIG meeting: *Cartography for everyone and for you* is a fortunate one. It gives room to reflect about ways to exchange and generate geospatial knowledge. Knowledge dissemination and generation through Internet plays a relevant role for the incorporation of local dimension into the global culture. CC artifacts need to address relevant issues like environment preservation, biological and cultural diversity, the better use of natural resources, the competitive advantages of places, and other leading issues; and such artifacts need to be inserted in the hegemonic discourse of global networks. The challenge for spatial knowledge is that it should be shared, discussed and synergized in distant networks in order for the spatial dimension to be filtered in conversations that include everybody: cartographers, geographers, researchers from other disciplines, policy makers, interested citizens and social actors in general. Places and the social constructions expressed in territories should take an integral part in the construction of universal knowledge.

The CCKG tackles knowledge exchange and generation from a complex and dynamic systems perspective. Its framework includes the multiple and diverse actors that participate in the process, the interactions and interchanges among these actors, and the emergence of novel concepts within these networks that contribute to decision making, problem solving, and scientific theory furthering.

In its architecture, information and communication technologies support the activities of software and human agents; the services that it provides are differentiated between those related to hard knowledge management -that can be automatically performed by software agents- and those that require the human agency processing - related to a holistic knowledge management -where knowledge is approached both in its hard and soft dimensions. This first outline of the CCKG is an attempt to guide the building of a structure to supports knowledge management and generation processes, linking distant participants and using the language of CC in order for *geo-spatial knowledge to be for everyone and for you*.

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