

The Atlas of Canada Web Mapping: The User Counts

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Imagine if...

A student searches the Internet to get information for a project on Victoria for a grade nine geography class. He uses Google to search for "Victoria" and "geography". First on the list of search results is The Atlas of Canada. He quickly selects this and arrives at the home page of the Atlas. He sees that he can search for a place and he does so for Victoria. He finds there are many places named Victoria in Canada and is able to find the one in British Columbia for which he is looking. He then sees that he can link from the location map to combine themes with the place. The thematic material includes all the types of information he is required to put into his project. Not only can he see the maps, which he decides to use as the basis for his project, but also the background data used to make the map. He notices an audio button that he clicks on to get a description of the map and a video button, which brings up an interesting video clip. He then finds that a full description is available that also provides links to other sites that may be of interest. Everything he needs is in this one great Web site. From now on, The Atlas of Canada is where he will start all his assignments.

INTRODUCTION

"The Atlas of Canada's goal in mapping on the Internet is to provide the most interesting, dynamic and comprehensive collection of maps and related information about Canada with effective and intuitive tools to the general public."

The advent of the Internet has broadened the scope of The Atlas of Canada. An atlas has traditionally been seen as a collection of maps and has been described by Kraak and Ormeling as maps related to one another that achieve specific objectives (1996:183). The atlas on the Internet can do much more. Web-based systems for mapping are powerful tools for providing public access and visualization of complex information (Warren and Bonaguro, 2000).

The Atlas of Canada's goal in mapping on the Internet is to provide the most interesting, dynamic and comprehensive collection of maps and related information about Canada with effective and intuitive tools to the general public. To accomplish this goal, the Atlas of Canada must provide authoritative, current and accessible geographic information and tools that users want and are able to use. This has resulted in the Atlas being available on the Internet.

Being available on the Internet, indeed in any electronic environment, demands that the user have a level of technical proficiency. To use any atlas the user 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, 1996:186). 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). User-centered design and testing engages the user in the process of development, leading to more useful mapping.

This paper will provide a brief description of the history of the Atlas of Canada. The methodology and results of a user-centered design process is then described, and the resulting Web site outlined. The importance of this work and its continuation in the development of the Atlas is explored in the concluding section.

Era of Assumptions and the Lure of Technology

The Atlas of Canada has published five printed editions since 1906 (http://atlas.gc.ca/site/english/about_us/). Each volume represents an evolution of information, format and media. The five printed editions of the Atlas are collections of maps, graphs and tables that provide an overview of the geography of Canada at a given time.

The printed editions were produced without significant consultation from users. For example, map librarians disliked the Fifth edition of the Atlas because the sheets were loose leaf and disappeared from their collections. Decreasing sales indicated that users' needs were not being met. As a result of the low sales and the high cost of printing, the decision was made to end the paper editions of the Atlas and move towards digital solutions.

Early prototypes included an Atlas on CDROM. Users were required to purchase additional software to view the maps, so the product was not popular. With the Internet gaining acceptance, Atlas staff recognized the power of an Internet solution. The Atlas of Canada moved to the Internet and the journey towards today's on-line version of the Atlas began.

Atlas staff created The National Atlas on the Net in 1994, one of the first instances of using the Web for interactive maps. After proving the concept of interactive mapping on the Internet, the Atlas was contracted to develop geography content for the Industry Canada initiative, SchoolNet (<http://www.schoolnet.ca/>). This Atlas evolved from having the few layers of data needed to prove that the technology worked, to having hundreds of available layers.

Content and information access tools were developed in consultation with the educational community through a Teacher Advisory Group, representing teachers from across Canada. This group provided invaluable insight into what teachers needed in the site. This was the first real attempt to gather direct feedback in an organized fashion. As a result the Atlas site soon included a quiz about Canadian geography, a resource section for teachers, and much more textual background information on the maps. The seeds of the idea of user feedback may well have been sown through these interactions.

Despite the teachers' feedback, the traditional attitudes of "government knows best" and "if we build it, they will come" still prevailed. The creation of tools during this period was dependent on the developer's insights and data providers' comments. The general feeling was that since we were the developers and cartographers, we knew what would be best.

In 1998, the Government of Canada authorized an ongoing program for an Internet-based National Atlas. This led to the launch of the sixth edition of the Atlas of Canada at the International Cartographic Association (<http://www.icaci.org/>) conference in Ottawa, in August 1999. This new on-line edition offered the very latest interactive mapping technology on the Internet. Users could browse interpreted information and interact with the data being made available through the Atlas, as well as access the data sources.

The Atlas staff recognized that on-line mapping technology had matured. The focus, therefore, shifted to content and development of the information for the user. To achieve this, the Atlas looked to commercial, off-the-shelf software to provide an "out-of-the-box" solution. However, the Atlas was still attempting to focus on the very broadest audience, trying to serve all needs with a single window.

The great error in this phase of development was not asking users what they really needed. There was little understanding of the how users

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interacted with the Atlas and the importance of understanding what types of tasks they perform (Scanlon and Percival, 2002). Earlier feedback from the Teacher Advisory Group had provided the insight to focus the development of the Atlas on Canadian issues, but further user testing was not explored. Since the site was trying to address the needs of the basic user (access to general information) and the sophisticated user (cartographic manipulation and database queries) at the same time, the challenge of providing simple access to complex information was not met.

Introduction of the User

Many of the attempted modifications to the site were based on what was thought to be user input. Since the birth of the Atlas on the Internet, user input had been sought and received through e-mail via the site. This input was the basis of many changes following the Sixth Edition launch but it was never really known how representative this feedback was. For example, feedback indicated that the table of contents was difficult to use. Several changes were introduced, but these did not improve the situation. The Atlas staff was at a stand still, no longer sure of what changes could be implemented to improve the site.

Internal discussions revealed the answer was to better understand the Atlas users. Many questions arose as to who the users were, what they were coming to the site to find and whether they found what they wanted. The users could only provide answers to these questions. This led 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.

The user-centred process, adopted by the Atlas, consists of three main stages prior to launching a new or revised product. The first two stages include an examination of the Atlas' business needs and the users' requirements. This is followed by a series of usability tests where the product is refined. The value of this approach is one that saves effort and cost due to the quality of the end result and the reduction of design errors (Nielson, 1994).

To analyze the issues and problems with the Atlas, site comprehensive research encompassing both design and functionality, was conducted. The high-level objectives were:

1. Identify and profile the Atlas of Canada's user community,
2. Measure overall satisfaction with the site, focusing on the interactive and static mapping,
3. Assess the content, functionality, structure and usability of the site,
4. Understand users' behaviour when interacting with the site,
5. Determine the users' needs not being met with the existing site.

A contractor, that satisfied the Atlas team's requirements, proposed an integrated research methodology. It proposed a review of existing server log analysis reports, a quantitative on-line survey of a minimum of 1,000 visitors to the Web site; four follow-up focus groups and 12 in-depth observational interviews with members of selected user groups. The research would identify successes, problems, concerns and users suggested solutions, using both quantitative and qualitative research.

The purpose of the server log analysis review was to obtain an understanding of visitor behaviour to help form research hypotheses and on-line surveying strategies. Specifically, the findings outlined usage volume,

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traffic patterns, entry points and referring pages. This assisted in the on-line survey placement and timing, as well as aided in developing hypotheses around use and preferences.

The on-line survey resulted in 1,059 respondents. The invitation to complete the survey was programmed so that every fifth visitor, to one of 16 entry points within the site, would receive it. These entry points were selected based on the analysis of server log data and in consultation with the Atlas project team. To encourage response, survey participants were eligible to enter a draw for one of ten map sets, each containing nine thematic maps of Canada.

In order to maximize the number of completed surveys, respondents were asked to answer questions about their overall experience with the Atlas site and on one randomly selected area of the site, based on where they spent time. The contractor designed the survey in full consultation with the Atlas team and ensured that it was thoroughly pretested. The survey was branded with the contractor's logo and was located on their Web server. This ensured that those taking the survey knew the research was being conducted independently and with complete confidentiality.

The final stage of the study consisted of four focus groups and 12 in-depth usability interviews with site users. The purpose of the groups and interviews was to gain insight into navigation and usability issues identified with on-line survey, as well as to understand in detail the content needs of users and related improvements and additions to the site. Participants who used the site primarily for personal reasons were recruited into sessions that were separate from those who used the site primarily for educational purposes. The students for the in-depth interviews were recruited from local schools and had experience using maps and/or related materials for school.

“... respondents were asked to answer questions about their overall experience with the Atlas site ...”

What Did We Learn? The Quantitative Results

Little previous research, in general, had been done on how Web-maps are accessed and used, how they should be organized, how efficient and useable they are and for what purpose they are being used (van Elzakker, 2000; Harrower, Keller and Hocking, 1997). The results of the research were revealing and illuminating to say the least. The research results that follow will focus on the site as an atlas product and do not deal with content or the particulars of the content in The Atlas of Canada.

User Profile

The user profile offered, for the first time, a quantitative view of the Atlas' user audience. Visitors were evenly distributed among age groups, with the exception of those 55 or older. They represented only 10% of visitors, compared to all other age groups where proportions of visitors ranged from 18% to 24%.

Table 1 compares the demographic distribution of visitors to the site with the overall distribution of Canada's population, based on Statistics Canada's population data for the year 2000 (<http://www.statcan.ca/english/Pgdb/demo02.htm>).

Seventy-three percent of visitors were from Canada, followed by 16% from the U.S.A. The remaining 11% were other international visitors.

The largest proportion of visitors to the site was employed in professional services (consultants, engineers, marketing, etc) at 40%. Following this, the educational sector represented 32% of visitors of which 19% were students and 13% were teachers. There were very few in the elementary

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Geographic Area	Proportion From Survey	Proportion of Actual Population for the Year 2000
Eastern Provinces	7%	7%
Quebec	18%	24%
Ontario	39%	39%
Western Provinces & Northern Territories	36%	30%

Table 1. Demographic distribution data is from The Atlas of Canada Public Opinion Research Report, March 2000 and the Statistics Canada Web site (URL referenced above).

school grades, one to six. The remaining 28% were visitors that could be identified as the general public.

User Behaviour

The previous figures above are more revealing when compared with reasons for visiting the site as shown in Table 2.

User Group	Reason for Visiting the Atlas				Percentage by User Group
	School	Work	Personal	Total	
Students	128	9	63	200	19%
Teachers	56	54	30	140	13%
Professional	55	127	244	426	40%
General Public	52	21	220	293	28%
Totals	291	211	557	1059	100%
Percentage by Reason	27%	20%	53%	100%	

Table 2. "Reason for visiting the Atlas" data is from The Atlas of Canada Public Opinion Research Report, March 2000.

When asked how they got to the Atlas site, over 68% indicated that they linked to The Atlas of Canada from another site. Interestingly, only 11% indicated that they had used the site in the past and bookmarked it or knew the URL. Sixty-six percent of visitors typically accessed the site from home, followed by 25% who accessed it from work, and 8% who accessed it from a library. Most educational users cited lack of convenience, speed and availability as impediments to accessing the Internet at school. Most users classed as general public participants indicated that they primarily accessed the Internet from work.

Table 4 shows the percentage of visitors visiting the various sections of the Atlas Web site.

The Atlas site was not attracting a large proportion of repeat visitors. The majority of visitors to the site (79%) visited it for the first time. Only 18% had visited the site two to nine times in the past year, and only 2% had visited it ten times or more. Table 5 shows the amount of time visitors typically spent on the site.

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Type of Information Wanted by Users	Percentage of Respondents
Cities, provinces, political maps, etc.	44%
General facts about Canada	26%
Maps of lakes, rivers, physical regions, geographic formations	14%
Specific geographic information (e.g. latitude/longitude, elevations, etc.)	8%
Road map/directions	6%
Educational material to use in a classroom	6%
Population figures	5%
Aboriginal/Indian map	2%
Interactive maps	1%
Satellite images	1%
Other	8%

Table 3. "Type of information wanted by users" data is from *The Atlas of Canada Public Opinion Research Report, March 2000*. Users were allowed to select more than one type.

Areas of the Site Visited	Percentage of Respondents
Quick Maps (static maps)	59%
National Atlas Mapping Tool (interactive maps)	53%
Facts about Canada	36%
Quizzes	21%
Teaching Resources	19%
Canadian Communities Atlas (educational project)	15%
Products and Services (paper maps)	12%

Table 4. "Areas of the site visited" data is from the *Atlas of Canada Public Opinion Research Report, March 2000*.

Interestingly, visitors were spending large amounts of time at the site, especially considering that the majority of them were visiting for the first time. Users were sufficiently interested in the site and its content that they were willing to spend the time exploring it. These numbers showed the Atlas team the significant value of the Atlas to its user groups.

Use of Maps and Mapping-Related Information

Teachers typically used maps from the Internet to support their lessons, as well as to supplement the maps found in out-of-date texts. Some used Geographical Information Software (GIS) to manipulate maps, such as adding layers to create a complete picture of a region. High school students used maps that their teachers gave or referred them to, for classroom work. The general public used maps for a wide range of reasons, mostly travel/interest, locating specific locations for a wide variety of reasons, and some thematic (e.g. topographic maps for personal interest)

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Length of Visit on the Site	Percentage of Visitors
Under 1 minute	3%
1 to 5 minutes	27%
6 to 10 minutes	33%
11 to 20 minutes	21%
Over 20 minutes	16%

Table 5. "Length of visit" data is from the Atlas of Canada Public Opinion Research Report, March 2000.

maps. This led the Atlas team to develop specific parts of the site for different user groups.

What Did We Learn? The Qualitative Results

The overall role and user audience of the site was not clear to visitors. To clarify this, it was necessary to identify the primary user groups and their needs. The original design and content of the site had not been designed with specific audiences in mind. The site design and style was inconsistent, the graphics were too large and did not always serve a purpose. The inconsistent menus and style of navigational aids made moving around the site difficult because users did not know if they were in the appropriate section for their information needs. The site pages were generally slow to load.

The overall organization of the site was complicated and confusing, and led to user frustration. The organization of the home page was a key problem. Most felt there was no clear indication of how to navigate the site or what would be found behind each label. One of the fundamental problems was that there were four mapping related labels on the home page. For example, if a user was looking for a relief map, he or she would have to go to three different sections to find the three relief maps. This caused considerable confusion as users had to explore each of these areas in order to understand what they contained. In many cases a user would review and exit an area of the site, and still not appreciate what the area contained.

The vast majority of the static maps were contained in a section called "Quick Maps". The intention of this section was to offer these maps quickly and easily. As with other parts of the site, the labels did not accurately describe the contents within each section of Quick Maps and visitors had to visit numerous subsections to determine if the contents were appropriate for their needs. There was also confusion about the difference in the content of this section and the interactive map section, "Make a map".

The Interactive Maps' Table of Contents

Most users were unable to find or access what they were looking for in the interactive mapping table of contents. Selecting maps was a time consuming process. It was designed to emulate Windows Explorer but did not have all of its elements. They did not find it intuitive to click on the 'plus' boxes to "drill down" deeper. The maps and their related textual information were not differentiated; they both appeared as underlined labels. Users expected to click on an underlined word and get a map. When they

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"The overall organization of the site was complicated and confusing, and led to user frustration."

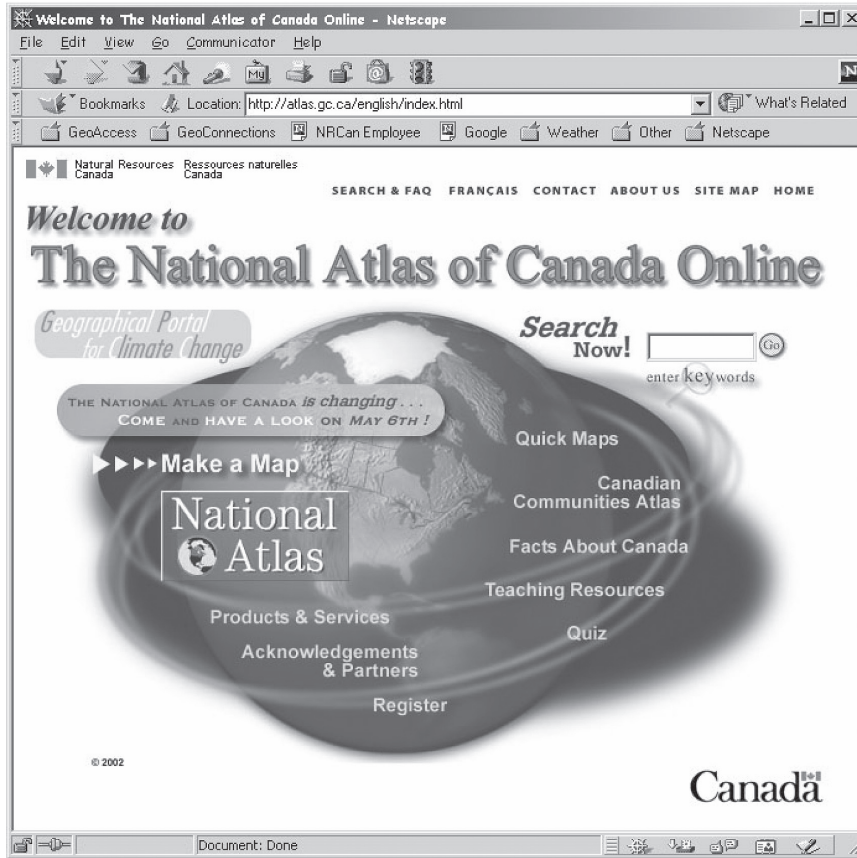


Figure 1. The home page of the Sixth Edition of the Atlas of Canada, Version 1.

selected one and was presented with text, they thought that was all there was, text and no maps.

The Mapping User Interface

The initial map displayed was at scale of 1:60 M. Users could not see the entire map, tool bar and legend at the same time. Users typically scrolled down to see the entire legend and the bottom of the map. When this was done, the tool bar was forced upwards and when out of view, it was forgotten. With the apparent absence of the tool bar, users did not realize they could zoom in and would think that the very generalized national view was all there was to see. Due to this, users did not realize they could manipulate maps. The mapping user interface's (UI) tools were shown as buttons with an unselected and selected state and used standard GIS icons. Many users did not understand what most icons meant and how to use the tools.

The links to maps' related text, its subtopic and overall topic were not seen in the upper left corner. Only the primary thematic and relevant base layers were shown in the legend. The others were behind the main legend and were accessible using a tab. This was not intuitive.

Responding to the User – A New Atlas Web Site

The need to redesign the Atlas of Canada was clear based on the research and recommendations. A first and most important step was to define the primary user groups (Scanlon and Percival 2002). Based on the results of

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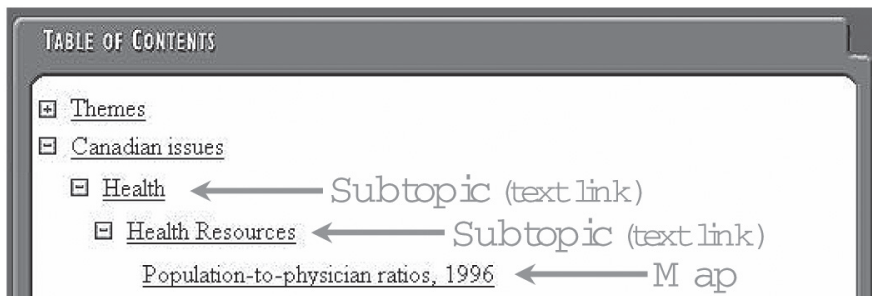


Figure 2. The interactive mapping table of contents of the Sixth Edition of the Atlas of Canada, Version 1.



Figure 3. The interactive mapping user interface of the Sixth Edition of the Atlas of Canada, Version 1.

the research, they were found to be the general public, teachers and students in their late elementary and high school years.

The role of the Web site required clarification. The selected user audiences identified who the site would be designed for but did not identify what it would contain. Poor and inaccurate labelling, throughout the site, and inappropriate supporting graphics caused confusion about the previous site's role and contents. The project team decided that the role of the site would be to "Discover Canada Through Maps and Facts" and that this would be reflected in all new labels and graphics.

The new site was designed using iterative user testing. A redesign based only on the results of the initial study would have resulted in some improvements, but not many. To ensure real and validated improvements, the site redesign would include a contract for three iterative usability-testing stages, based on time and budgetary considerations. This approach

"The new site was designed using iterative user testing."

was used for a companion program developed in the GeoAccess Division. Using simple mock-ups, representative tasks with small numbers of users were key to the testing success of this program (Szeredi and McLeod, 2000). The objectives of the site redesign were to:

1. Develop new site architecture and improved navigation,
2. Develop a new site design and style with consistently applied specifications,
3. Apply the Government of Canada's Common Look and Feel requirements,
4. Implement a gazetteer service,
5. Assess the Atlas' interactive mapping user interface (UI) requirements and implement a new UI,
6. Deliver all maps faster,
7. Improve the site's search functionality,
8. Assess and implement content management software,
9. Assess map server requirements, and implement a replacement.

The interactive maps' textual and ancillary documents were not tested due to time constraints. This component has been undertaken in a different phase of development.

Methodology

The three user-testing sessions were composed of 12 observational usability interviews. Conducting research at three separate stages throughout the re-design process ensured that changes accurately reflected user needs. The user-testing sessions were equally divided between students, teachers and the general public. The number of users required for usability testing was minimal. Typically four to six users per user audience is sufficient to reveal usability issues or provide proof of success (Nielsen, 1994).

The usability interview approach was well suited to collecting information on users needs and navigation related the Atlas Web site. The interviews were conducted using a think-aloud, task-based testing methodology (Szeredi and McLeod, 2000). It required participants to interact with the Atlas site and conveyed a user's detailed impressions and reactions to the site, navigational behaviour, search strategies and issues with the user interface.

The research in the first testing session focused on identifying the role of the site and the design and labelling of the homepage and second level pages. This was based on two site architecture models reflected in the two functional prototypes. It did not specifically probe on the interactive mapping tool, but participants were asked about the features they expected. Organization of content was tested as well as variations of design and labelling. Participants were asked to find content based on several retrieval scenarios.

The second testing session focused on a single prototype, which included a combination of elements from the two prototypes tested in the first session. The research in this stage included an overview of the homepage, probing comments on its design, labelling and organization. A number of scenarios were conducted to fine tune navigation. The interactive mapping tool was tested to evaluate the appearance and layout of selected features. A new gazetteer section was introduced in this stage, focusing on how users would navigate through a place name search and what they expected to find.

"Using simple mock-ups, representative tasks with small numbers of users were key to the testing success of this program."

Building on the recommendations from the second stage of research, the third testing session focused on fine tuning specific elements of the homepage design and labelling. Navigation was refined. Further usability issues with the interactive mapping and the gazetteer sections were dealt with. Some home page labels and some features of the interactive mapping user interface still proved to be problematic. These issues will be addressed in future usability testing sessions.

It is worthwhile to examine some of the specific solutions found during the iterative usability testing. In the section that follows, specific findings dealing with site design, labelling, navigation and architecture and the mapping user interface are presented.

“Easily readable pages . . . were found to be more important than the colours used.”

Site architecture and design

A new site architecture was developed to offer consistency missing from the previous site. It separated maps and their related textual resources from other textual content. The interactive and static maps, along with their related textual resources, are the Atlas' primary content and they were combined into a single mapping section. This section also included a new gazetteer service titled "Find a Place". The remainder of the site's content was combined in a new secondary section called "More Than Maps", which contains: "Facts about Canada", "Quizzes", "Learning Resources", "Glossary", "Data and Services" and "Useful Links".

Consistency was introduced to the mapping user interface as well. In the previous version of the Atlas, up to four different mapping UI's were used with up to three different map servers. Iterative testing demonstrated that users experienced a great deal of difficulty understanding and using the most basic interface tools. The new Web site used variations of the same interface to avoid confusion for the user.

The format of the site's pages was mainly formulated by following the specifications in the Government of Canada's Common Look and Feel (CLF) standards (http://www.cio-dpi.gc.ca/clf-upe/index_e.asp). Specific higher-level navigation that appears across the top of each page was required to comply with this standard. A vertical navigational panel was also required to appear along the left side of every site page. The remainder of the page was available for site content. The CLF guidelines were followed with the exception of the width of the mapping user interface, which extends slightly beyond the designated right margin. Easily readable pages, with high levels of contrast between the text and the background, were found to be more important than the colours used.

“. . . most users wanted descriptive but simple labels . . .”

Navigation – Labelling

Labels used on the home page and within the site are important to help users identify the content within various sections of the site. When deciding on labels or categories for maps, terminology that is easily understood by users is essential. The previous table of contents, shown in Figure 2, initially grouped all interactive maps in one of two categories, themes or issues. Below these, the Atlas used category names such as physical, economic and human. Many of these labels performed poorly with all three user groups involved in the testing. The images in Figure 5 show the evolution of the left navigational panel labelling through the three testing iterations to the final menu.

The process revealed that most users wanted descriptive but simple labels identifying the content within. Categories that had meaning to the Atlas team were in many cases meaningless to those tested. When a user

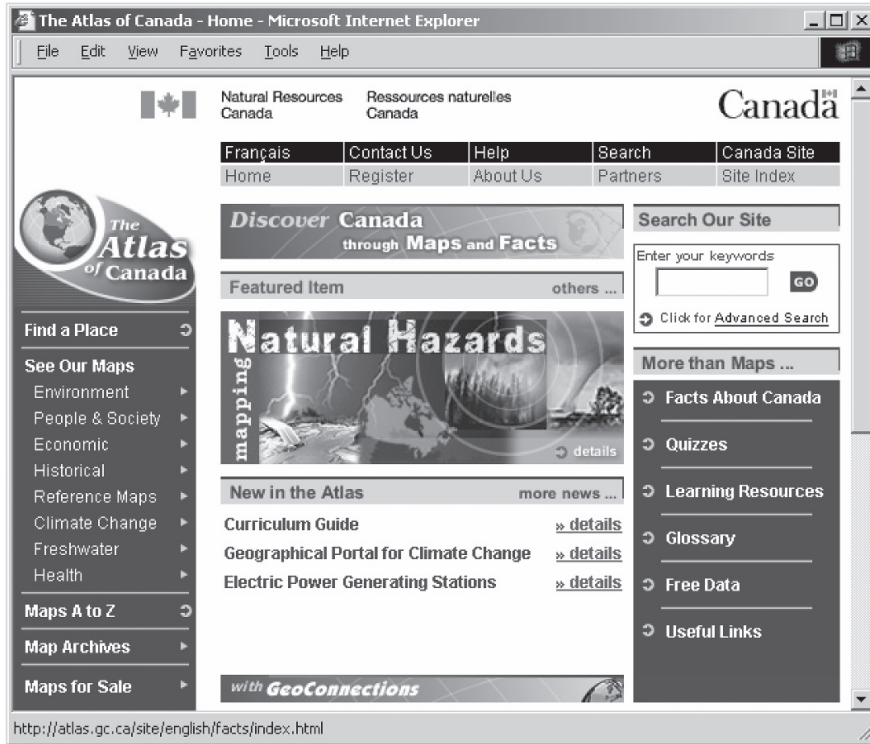


Figure 4. The home page of the Sixth Edition of the Atlas of Canada, Version 2.



Figure 5. The iterative stages of the pop-out menus developed for the Sixth Edition of the Atlas of Canada, Version 2.

did not know what to expect with a particular label, effective navigation working together with the labels assisted users to easily discover what was contained in each section. A complete consensus was never achieved. The practical solution was to get the “best possible fit”.

Navigation – Finding Maps

Testing revealed that users expected easy and consistent navigational aids allowing them to move effectively through the site. As previously men-

“A complete consensus was never achieved. The practical solution was to get the ‘best possible fit’.”

tioned, some of this was addressed by implementing the Government of Canada's Common Look and Feel standards. However, access to content is not covered in these guidelines. The architecture models regrouped the Atlas map content by theme, such as "Historical", rather than by type, such as static or interactive. Maps are accessible through the left navigation panel and secondary, textual content is made accessible from the home page in a panel on the right side.

A vital user preference was the ability to find and display a map quickly. With about 250 interactive and 70 static maps to choose from, a solution was needed to provide this access. It was found by using mouse-over activated pop-out menus.

"A vital user preference was the ability to find and display a map quickly."

Two mock-ups were used in the first testing session. They offered the user two options (Figure 5). The first mock-up displayed map categories, such as "Themes" on the home page, and pop-out menus of topics, such as "People and Society", and sub-topics, such as "Population". The user would click a sub-topic name and then a list of all the maps in the sub-topic would be displayed in a refreshed window. The second mock-up displayed both map categories and topics on the home page. The pop-out menu listed the subtopics only. From the sub-topic list, offered in both options, the user would select a map or its supporting textual documentation and the window would be refreshed with the selection.

Those tested preferred the second mock-up since the map topic names on the home page offered more upfront navigational information. The grouping of maps in to "Themes" and "Canadian Issues" was confusing; the preference was for all maps to be grouped under descriptive topic names. Those tested also found the sub-topic lists of maps useful but indicated a preference to go directly to a map or a page with more information about the map.

The second testing session used a third prototype that offered the user a revised list of topic names on the home page and pop-out menus of sub topics and map titles. When a map title was selected, a preview map would appear in a refreshed window with a number of viewing options. These options included, as before, the interactive or static map and the supporting textual documentation. Most tested preferred this but some issues remained over users clicking on the preview map image expecting to see a larger version.

The third testing session explored providing the same level of pop-out menus to a map title, but instead of giving the user a new page with a preview map and viewing options, they were given the interactive map. This solution resulted in the most positive responses from all three testing sessions and was incorporated into the final product. The static maps continued to use the viewing options page since they have a number of file format viewing options.

"The iterative testing process allowed the Atlas to do some testing on every component: the legend, map window, access to related text and tools."

The pop-out menus proved to be an intuitive and easy to use method and the response to them was overwhelmingly positive in all three testing sessions. The current pop-out menus require an initial, one time, download of about 300Kb. This is slightly high but the benefits of navigational ease outweigh the download time.

Mapping User Interface

The fault of previous mapping user interfaces, as discovered in the initial usability testing, was that they were not very usable. The usability issues that were uncovered showed the importance of a user-centred approach in interface design (Miller and Pupedis 2002). The iterative testing process allowed the Atlas to do some testing on every component: the legend,

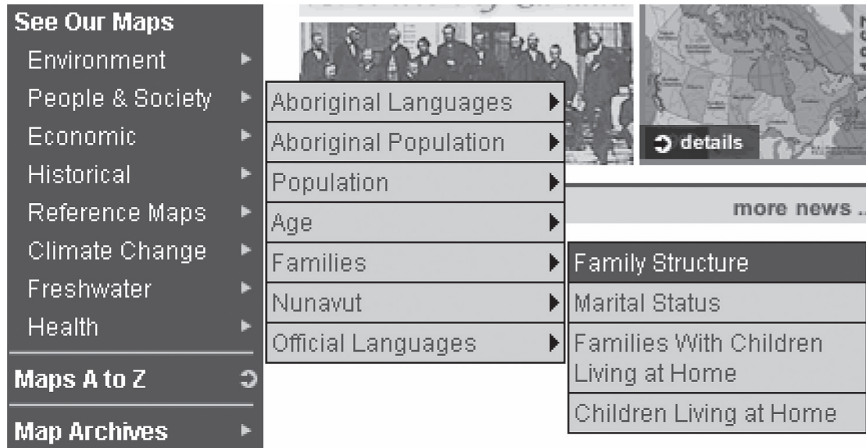


Figure 6. The pop-out menus of the Sixth Edition of the Atlas of Canada, Version 2.

map window, access to related text and tools. The results allowed the Atlas to develop its first mapping user interface that users could adequately relate to and use with greater ease. In the first iterative testing session, users were asked what features or functions they expected to be available with maps on the Atlas site. In order of priority they expressed the following:

- Zoom in and out;
- Print a map;
- View a legend (overwhelming consensus to view the entire legend with the map);
- Move about; and
- Select a specific feature and get information on it.

The second testing session focused on two interactive mock-ups to compare preferences for the presentation of various features and functions within the mapping user interface. The information retrieval exercises directed participants to the two interactive mock-ups and required them to use only the zoom and panning tools. Due to time constraints, the rest of the tools were only discussed. These would be tested in the third session.

The participants intuitively clicked on the map to zoom in without making reference to the zoom tool and did not notice that it was highlighted indicating it was active. The “Zoom Out” tool worked in a standard two-step operation, one step to select the tool and a second to click on the map invoking the zoom out action. Participants, however, expected it to work in a one step operation, invoking the zoom out action immediately upon clicking on the tool icon.

The “Pan” tool was less understood. When asked, participants preferred the icon in mock-up two. When required to perform a panning action in the exercises they intuitively clicked the “arrows” surrounding the map.

When participants were required to move from one zoomed in location to another, they did not find or think of using the “Reset Map” tool. They would either pan using the arrows surrounding the map or want to zoom out and then zoom in. The confusion over a two-step zoom out remained and the participants required instruction on how it worked. When the “Reset Map” tool was described, participants felt it would be good to keep

“The participants intuitively clicked on the map to zoom in . . .”

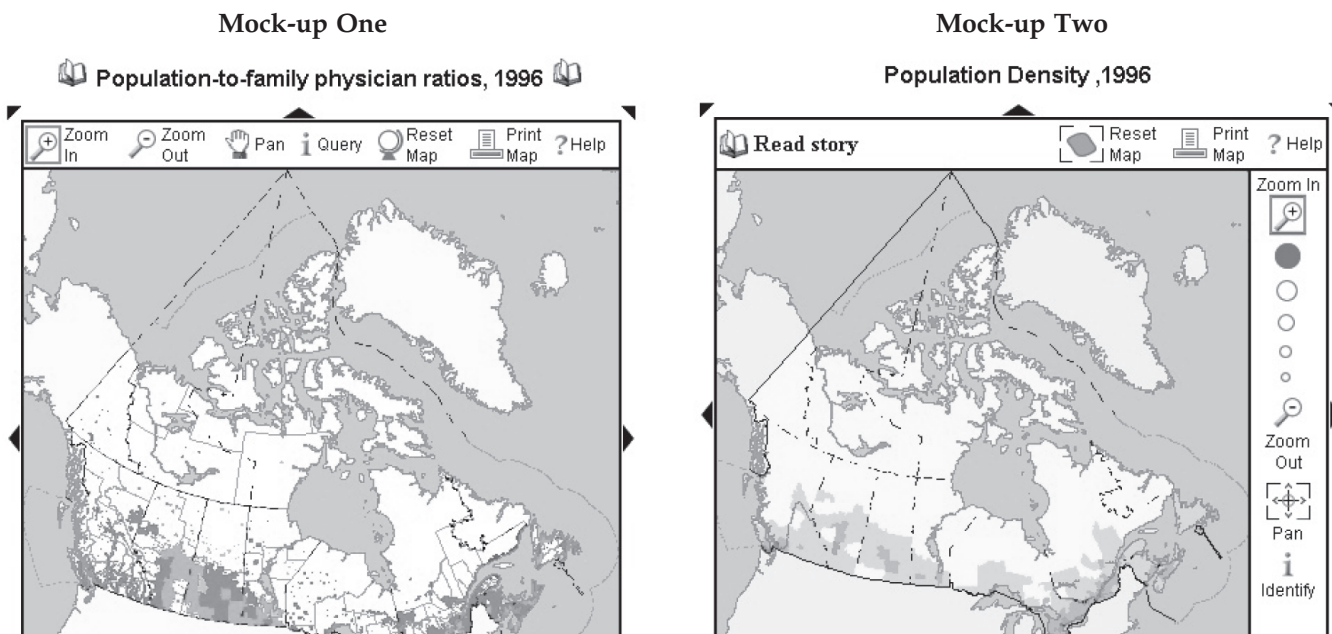


Figure 7. The prototype interactive mapping user interface used during the second iterative testing session of the Sixth Edition of the Atlas of Canada, Version 2.

“The zoom level indicator in mock-up two . . . was not used by any of the participants.”

“. . . text pages should appear in a separate window so that it could be read while viewing the map.”

even though they did not use it. The icon of choice was the globe in mock-up one. Another unexpected option to fully zoom out to a full extent was the use of the menus to redisplay the map. The main pop-out menus were so intuitive and easy to use that some used them to reselect the map and get back to the full extent zoom level and they would then zoom into the new location.

The zoom level indicator in mock-up two, which used five different sized circles, was not used by any of the participants. Several printed mock-ups, using other shapes such as thin rectangles, were shown to those tested. 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 by some well-known commercial Web mapping sites.

The “Query”/“Identify” tool was discussed and most participants felt that it would be useful feature to have. The icon of choice was the arrow icon in mock-up two.

An important component of every interactive map is the supporting textual documentation. This material describes the map’s theme and interprets the patterns appearing on it. Mock-up one provided a link to this material via the map’s title and mock-up two via an icon with a “Read story” label on the left side of the upper tool bar. Both were intended to be more prominent than the other tools. Most users did not easily find this tool as it was presented. In probing for further feedback, it was found that users preferred that it appear in the menu bar with a book icon. Also, it was suggested that the label be changed to “Read about the map”. Participants also felt that the text pages should appear in a separate window so that it could be read while viewing the map.

All participants felt that the toolbar in mock-up one was more visually appealing as it was cleaner and less cluttered; the split toolbar did not appeal to anyone.

The third and final testing session used a single mock-up with the icons representing the tools as previously described. When all the tools were placed on a single row, it was too crowded to also place labels with the icons. Since the supporting textual documents are important for interpret-

ing the map, its icon was the only one to have text beside it. The tool bar for the fourth mock-up appears in figure 8.



Figure 8. The prototype interactive mapping tool bar used during the third iterative testing session of the Sixth Edition of the Atlas of Canada, Version 2.

Many participants commented that the toolbar was not eye-catching or visually appealing. In addition, as soon as participants began to scroll down to see the entire legend, the toolbar disappeared from their view. This coupled with the fact that the toolbar was not eye-catching caused some to give it less attention and subsequently miss the available interactive features.

Further modifications were required with the “Query”/“Identify” tool represented by the “globe” icon. Participants did not notice it in the tool bar and were confused about what it offered. The “i” symbol was interpreted as a help symbol as in a visitor information centre on a paper road map. The process of selecting the tool and then selecting a feature on the maps caused confusion, as it did initially with the “Zoom Out” tool. The “Query”/“Identify” tool, however, could not be converted to a single step tool. Even so, most participants felt that it was a useful feature. A clearer icon and label were needed as well as visible instructions to help users.

The “Zoom In” and “Zoom Out” tools worked very well. They were modified so that zoom in was active by default when a map appeared. The “Zoom Out” tool was changed to a one step operation so that when it was selected, the map would automatically zoom out one level, keeping the same map centre.

Since most participants used only the side navigational arrows to “pan” to different areas of the map. The “Pan” tool was removed from the tool bar.

The “Reset Map” tool was not intuitive to users. Most associated the globe icon with international maps and did not immediately connect the globe with resetting the map to the national level. It was removed from the tool bar and a “Zoom to Place” feature was added. The “Zoom to Place” has a drop-down menu that includes Canada, the provinces and territories, and major cities. While this was not tested, it was successfully used on other mapping UIs developed for the Atlas’ federal election results maps and the Canadian Communities Atlas project database search results (http://www.atlas.gc.ca/site/english/learning_resources/ccatlas/ccgallery/).

All participants, regardless of audience group felt that a textual description should accompany an icon. They also indicated that some form of explanation must appear (e.g. a mouse-over). Consequently the mapping UI icons have a label as well as an instruction for their use in the form of a small mouse-over window. This was the final testing session so other options for the tools were not tested.

Participants preferred legends that showed only the thematic layers. The shorter legend prevented users from scrolling down a long legend resulting in the disappearance of the tool bar.

“. . . zoom in was active by default when a map appeared.”

“The ‘Pan’ tool was removed from the tool bar.”

The current tool bar incorporates all the refinements resulting from the usability research and is shown in Figure 9.

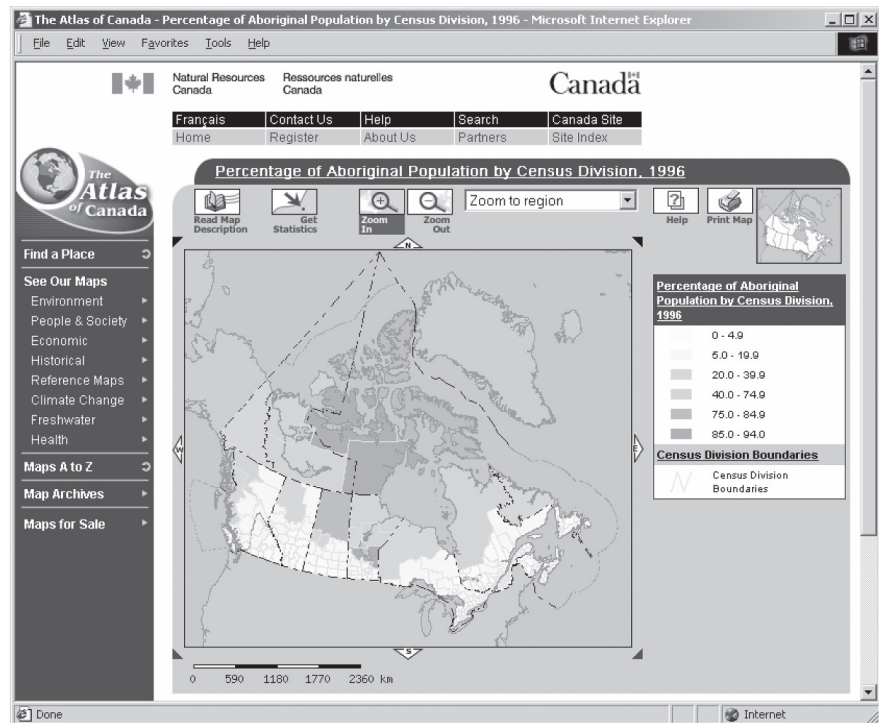


Figure 9. The current interactive mapping user interface of the Sixth Edition of the Atlas of Canada, Version 2.

“The impact of a user-centered approach has been an unqualified success for The Atlas of Canada.”

The impact of a user-centered approach has been an unqualified success for The Atlas of Canada. The result is an Atlas Web site where users can find and use what they want easily and quickly. The Atlas team would have been unable to solve the issues identified in the initial research as effectively without focused and well-planned usability testing. Usability testing does require some additional cost and time but the return on the investment makes it worthwhile (Souza, 2001). However, similar time and money would have been spent on the less valuable approach of untested assumptions.

The following are some recommendations to those interested in user-centred Web site development:

“Usability testing does require some additional cost and time but the return on the investment makes it worthwhile.”

- Define the audience and mission,
- Never assume anything about your users, let them tell you and test, test, test,
- Do as many iterations as time and money allow,
- Remove everything that is not needed,
- Function is more important than aesthetics,
- Page layout is more important than aesthetics,
- Clean, clear, uncluttered aesthetics are essential,
- Fast direct access to primary content is paramount,
- Have a clear hierarchy of content,
- Users easily default to site search engines, so it better be good,
- Spend time, but not too much, on labels: you cannot please everyone.

- Don't assume users know what you mean - avoid jargon, select words users would understand,
- Make the site usably dynamic.

What's Next – The Immediate Future

The lessons learned from iterative testing and development are demonstrated in the plans for the Atlas. A series of improvements are foreseen that extend over the coming months and years. These include content updates, efficient production processes, revised navigation and new functionality, which will be supported by ongoing user research and testing.

Other components are being updated because of the new Web site and related tools. The new web mapping server software requires the use of different tools for the map authoring and publishing process. This in turn necessitates a new production process involving the proper checks and controls. These requirements have been identified and further refinements and enhancements will be identified as the first maps are produced using the new tools and process.

Map production was interrupted during the redesign as all resources were brought to bear on that challenge. Following the redesign and launch, map production is slow as the new tools and processes are put into place.

There are several known issues with the new pop-out menu navigation, despite the fact that they work well and are a central component of the users' goal to go immediately to a map. These issues are in the areas of accessibility, scalability and maintenance. The implementation of the menus does not allow universal accessibility to serve the broadest possible audience. This ranges from access technology to assistive devices and emerging technologies according to the Government of Canada's Common Look and Feel requirements. The scalability of the menu system is also a concern as the number of interactive and static maps grow from the current 320 at a rate of 100 new maps every year. Finally, initial user testing involving text and other content associated with interactive maps indicate that a complete navigation paradigm for maps, text and other content must be consistent. This suggests that the menus may need to be adapted to support more than just maps if a map-centric approach cannot be found.

As known concerns of the current Web site are addressed, the Atlas can also start looking forward to new features and functionality. Having an established structure to the Web site allows the Atlas to add new features such as multimedia. This will also contribute to the objective of increasing the percentage of repeat users to the Atlas. With an established base of users, it will be possible to begin introducing increasingly complex concepts and tools. An example of more advanced concepts is the ability for the user to create or customize maps by selecting layers and choosing symbology. This capability was removed during the Web site redesign because not enough was understood about the user needs. This capability can now be reintroduced in a way that is suitable for specific users. It is not yet predetermined how this capability will work, but it is thought that a step-by-step user interface may be best.

All future changes will be supported by ongoing testing. As mentioned, initial testing revealed problems with the discovery and navigation of map texts. All solutions must be proven by testing to ensure an improvement over past approaches. In addition to conducting user testing for

“... menus may need to be adapted to support more than just maps if a map-centric approach cannot be found.”

“All future changes will be supported by ongoing testing.”

specific aspects of the web site, the Atlas will re-conduct user research to gauge overall reaction to the new Web site and to update the user profile.

Reaching the Vision

The overall vision for The Atlas of Canada is more than simply a Web site. It also encompasses the underlying data, information and services. The Atlas currently focuses on map visualization. There will be new and different challenges associated with navigating large amounts of cartographic, textual, attribute data and other content as the number of maps and the amount of information made available through the Atlas grows. Other issues to be faced are associated with a distributed system where individual maps or layers may be drawn from remote partners' web applications to be viewed within, and as part of, the Atlas. The availability and presentation of data and information and the overall performance of the application in a distributed Web environment will add extra challenges in providing a high performance, usable service to users.

The vision also supports the Atlas reaching its users through more than just The Atlas of Canada Web site. Currently, the Atlas acts as a service for several other Government of Canada Web sites that link to specific Atlas maps relevant to their subject area. Increasingly, on-line services will provide maps and data directly into other Web based applications. In this context, the Atlas becomes a "back office" service that provides information through other Web sites. A current example of this is the Find a Place capability on the Atlas Web site. It can be reused by other Web sites, as can the underlying Gazetteer service that provides structured data to Web application developers. The Atlas will become an integral part of the Canadian Geospatial Data Infrastructure by using open, accepted standards and specifications such as the OpenGIS Consortium's Web Mapping Service and Web Feature Service (<http://www.opengis.org/>). In this way, the scope and influence of the Atlas will extend well beyond that of a simple Web site.

In the long run, a usable, relevant and well visited Web site along with a corresponding set of services for partners, will help the Atlas fulfill its role. Within the Government of Canada, this role is as a key communications vehicle for government science and policy, and within the Canadian Geospatial Data Infrastructure, it will be the most public window into the geography of Canada.

CONCLUSION

Imagine if... all students now start at The Atlas of Canada for their geography, history and social studies assignments on Canada. These students search for places and link off to a wealth of related information. They view maps, texts and other multimedia related to a wide range of issues important to Canadians. They visualize and download all the information that they need.

The Atlas of Canada is now in a position to begin supporting this "imagine if..." scenario. The Web site is focused on its target audience of the general public, teachers and students. Tools and functionality are in place to support their requirements, while superfluous and confusing tools were eliminated. The Atlas is usable, which means that users can now exploit its potential and receive the results that they want and need. This functionality is supported by rich and continuously expanding sets of maps, texts and other information.

Several specific lessons have been learned during the process of user research, focus groups and usability testing. User expectations of The Atlas of Canada may differ from the original ideas of the developers. In

"Increasingly, on-line services will provide maps and data directly into other Web based applications."

"The Atlas of Canada is now in a position to begin supporting this 'imagine if...' scenario."

the case of the Atlas, the desire of users to find information about specific locations was not planned, but the Atlas was able to respond to this need. The site architecture or the structuring of information is very important. Often developers separate things into unique sections that hold little meaning for a user. For example, the user research found that maps are maps, not interactive maps, static maps, quick maps or archive maps. Within an overall consistent architecture, the information must also be presented in a consistent fashion. Differing terminology, labels and presentation between different sections of a Web site merely cause confusion. The labelling of selections and links is very important. Labels must be presented in simple language, avoiding jargon, and ambiguity.

Several interesting lessons were learned with respect to the mapping user interface. In general, the tools represented by icons, which are generally familiar to the GIS community, are not well understood. When they are not understood, they are not used, as in the "Reset Map" tool and the "Pan" tool. These were removed from the mapping user interface. The remaining tools must be supported by help information. Finally, interactions with maps should be a one-step, or one-click operation, whenever possible. When two steps are required, there is uncertainty and what the user expects may not happen when they make a selection.

The lessons that the Atlas has learned on how to involve users in determining requirements and testing are, in the long run, more important than the specific results that we have learned to date. First, a clear understanding of who the target audience is and what they want from the Web site is needed. This then leads to a clear definition of what the Web site can do to support these users. Since it is impossible to do all things, it is recommended to concentrate on specific high priority objectives first.

Once the goals and objectives are known, then the testing begins. Without testing, any assumptions, whether they deal with site organization, labelling or functionality, are nothing more than assumptions. This is not a one-time step as any proposed solution needs to be tested (Daly-Jones, Bevan and Thomas, 1999).

This leads to the concept of iterative research, testing and development. User testing verifies or dismisses solutions that are proposed for an identified problem. In the Internet world, Web sites must continue to evolve or they quickly become stale. Only a certain amount of change can be accomplished in any given development cycle, so priorities must be set. Other changes or enhancements should be left to future development cycles where they can be properly tested. The resulting Web site will be much more effective in achieving its goal.

The Atlas has made significant advancements in recent years by taking users into consideration. This has led to an Atlas that is more useful, more relevant and ultimately more valuable to them. The "government knows best" attitude that existed during the era of the paper Atlas was initially carried forward into the digital era. At first, this took the form of a technology-push approach that led to innovative Web developments, which were feature rich but content and usability poor. Throughout this initial period on the Internet, some user needs were collected and unsuccessful attempts were made to address them. In the end, it took a structured process of research, definition, testing and iteration to be able to understand these requirements and translate them into the new Atlas of Canada Web site. The user does count!

"The lessons that the Atlas has learned on how to involve users . . . are . . . more important than the specific results . . . learned . . ."

"Without testing, any assumptions, whether they deal with site organization, labelling or functionality, are nothing more than assumptions."

"The user does count!"

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