Canadian Geospatial Data Infrastructure

Infrastructure canadienne de données géospatiales

UNDERSTANDING USERS' NEEDS AND USER-CENTERED DESIGN

Developed by GeoConnections GéoConnexions Canada

Making Canada's geospatial databases, tools and services available online

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GeoConnections is a national partnership program led by Natural Resources Canada to evolve and expand the Canadian Geospatial Data Infrastructure (CGDI). The CGDI provides Canadians with on-demand access to geospatial information (e.g., maps, satellite images) and related services and applications in support of sound decision making.

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1 Introduction

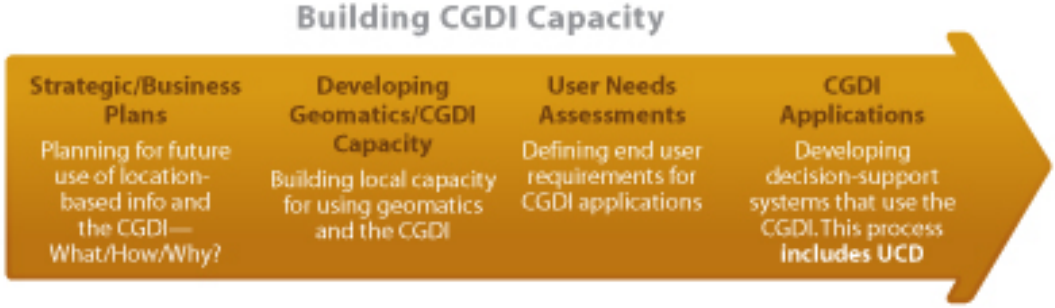
1.1 Purpose of this guide

The purpose of this guide is to assist organizations in understanding approaches for user-needs assessments and user-centered design, which are required for some projects that GeoConnections funds.

User needs influence several aspects of GeoConnections: they drive the development of decision-support applications and systems, and of Canadian Geospatial Data Infrastructure (CGDI) technology and content. For example, as GeoConnections continues to maintain and expand national framework data, a key part of this process is consulting data users to determine what data enhancements are required, and to determine the themes for new framework data layers. As well, regional atlases being developed in partnership with GeoConnections rely on the input of the end-users to produce relevant products that will be useful and sustainable over the long term.

GeoConnections is continuing efforts to make more data available to the CGDI, or at least searchable through the CGDI, particularly in relation to GeoConnections' four priority areas (public health, public safety and security, environment and sustainable development, and matters of importance to Aboriginal Peoples).

The Building CGDI Capacity figure illustrates that user-needs assessments occur after an organization has developed a strategic plan and/or business plan and has geomatics capacity. They are used as a preliminary guide to focus development of a system, an interface and/or the content to be provided. User-centered design occurs later, when a CGDI decision-support system, application or interface is being developed.



1.2 Background on GeoConnections and the CGDI

GeoConnections is a national partnership initiative led by Natural Resources Canada to build the Canadian Geospatial Data Infrastructure (CGDI). The CGDI is an online resource that enables Canadians to use and combine geospatial information (e.g., maps, satellite images) to gain new insights into social, environmental and economic issues. The goal of GeoConnections is to increase the use of the CGDI among decision makers.

According to Treasury Board of Canada guidelines for the renewed GeoConnections program, "user needs should drive program priorities to ensure the infrastructure serves requirements." Additionally, the guidelines mandate that a "user-centric design process will be employed for future infrastructure development."

Between 1999 and 2005, in its first phase, GeoConnections established partnerships with technology companies and content suppliers, which then developed content, tools and standardized services through the CGDI. In June 2005, the Government of Canada announced $60 million in renewed funding for the second phase of GeoConnections from 2005 to 2010.

The renewed GeoConnections program is addressing the needs of users in four priority areas:

1. public health
2. public safety/security
3. environment and sustainable development
4. matters of importance to Aboriginal Peoples

The need for a user-driven approach to develop the CGDI was first identified in 2003 during an internal evaluation midway through the first phase of the GeoConnections program. This recommendation was strengthened during national consultations of geomatics stakeholders, led by the Geomatics Industry Association of Canada (GIAC), which recommended that CGDI users be consulted on technology, content and policy priorities for the CGDI to ensure the infrastructure serves user requirements.

GeoConnections works with users at all stages of technological readiness. For organizations with limited use of geomatics, the program helps to increase their capacity to use the CGDI. For those ready to use the CGDI, GeoConnections enables them to customize applications and/or information systems. Through user-needs assessments

these user communities identify the content (data and services), technology and policies they need to address their issues, and through user-centered design they determine the required functionality and design of an application or system.

GeoConnections has undergone a user-needs assessment to identify the needs of the four priority areas for sharing and applying geospatial information, which include identifying content (data and services), technology and infrastructure and policy needs for the CGDI. Through nation-wide focus groups and a survey, GeoConnections found that there are several common data needs among the four priority areas. Results of the 2006 Survey of geographic information decision-makers can be found at: http://www.geoconnections.org/en/resourcelibrary/keyStudiesReports

1.3 GeoConnections/CGDI stakeholders

GeoConnections/CGDI stakeholders represent all levels of government (federal, provincial, territorial, municipal), academia, industry, Aboriginal organizations, and non-profit organizations. These stakeholders may be suppliers, developers, marketers, enablers/ facilitators, and/or end-users.

1.3.1 Suppliers

Suppliers provide geospatial data and web services to the CGDI. They are at the core of the CGDI, providing the building blocks necessary to develop applications.

For example, a federal government department may supply soil information to the CGDI through a CGDI-endorsed standard called a web map service (WMS).

1.3.2 Developers

Developers create web-based applications that allow users to interact with the CGDI.

For example, a company may develop an application that uses the WMS to visualize soil information.

1.3.3 Marketers

Marketers sell or otherwise promote geospatial applications to end-users.

For example, marketers may sell or promote an application that allows users to analyze soil information.

1.3.4 Enablers/Facilitators

These are typically government agencies and programs that facilitate the use of geospatial information by a larger group.

For example, a federal government agency that manages geospatial information may produce a web-based application that enables users to access the most current information on soil types across Canada.

1.3.5 End-users

End-users utilize geospatial data in decision making or in business and rely on applications to produce usable outputs. GeoConnections is currently focusing on end-users in four priority areas of the CGDI: public health, public safety/security, environment/sustainable development, and matters of importance to Aboriginal peoples.

For example, end-users for a CGDI soil application could include farmers, gardeners, researchers, scientists, municipal government officials, and staff responsible for preparing soil reports.

1.4 Using research professionals

GeoConnections highly recommends that an independent research professional be hired to conduct the user-needs assessment or user-centered design. Research professionals are recommended in order to:

- provide guidance and assistance;
- ensure impartiality in the assessment process;

- ensure that the research methods are appropriate for the type of results that are sought;
- ensure research questions are well worded; and
- identify participants, conduct interviews and provide facilities, when required.

1.4.1 Credentials for hiring a usability researcher and User interface designer

The **usability researcher** should have experience using all of the research methods typically used in application or systems development research and should be familiar with all aspects of UCD: task analysis, usage scenarios, storyboards, workflows, and user interface design and should have experience developing research instruments to identify key information to support user interface design.

A **user interface/interaction designer** must have experience in the field of human-computer interaction with a specialization in user interface design and should have a minimum of 2 years experience doing UI design within a UCD process or have their work directed by a senior UI designer with 5 or more years experience doing UI design within a UCD process

A qualified user interface/interaction designer should have the following knowledge base:

- Aware of all aspects of User Centered Design and related fields (such as cognitive psychology, ethnography and industrial design)
- Vast knowledge of User Centered Design methodology (such as prototyping, user interaction, visual design, user needs analysis (UNA), task analysis, and usability testing).
- Knowledge of industry standards (such as Microsoft Web Design Guidelines, and the Java Style Guide) and best practices in UI Design (such as Jacob Neilsen's Usability Heuristics, and Constantine and Lockwood's Usability Guidelines).
- Knowledge of usability methodologies, techniques, and tools (such as usability testing, interviews, job shadowing, focus groups, and card sorting).

A qualified user interface/interaction designer should have experience in the following:

- Full product user interface and interaction design specification (from concept to implementation)
- Prototyping and presenting UI Designs, specifications and concepts
- Analysis of business client requirements
- Working closely with all stakeholders (including business clients and system developers)
- Delivering UI designs within technical constraints, timelines and according to established business goals
- Quickly iterating UI designs based on results of applicable research activities
- Assessing risk inherent in different UI design options and approaches
- Creating UI designs from business use cases and task analysis

- Prototyping with tools such as Dreamweaver, HTML and JavaScript.

2 User-Needs Assessment (UNA)

2.1 What is User-Needs Assessment (UNA)?

A **user-needs assessment** (UNA) is a process of discovering and assessing the needs of users by taking into account their ideas, attitudes, wants and preferences on a particular issue. A UNA can help organizations set priorities and make decisions about a program, application or system, or the allocation of resources.

One of the challenges is determining who or what constitutes a "specified user" and "specified needs"; hence the following *strategic* questions must be answered:

- Do the project team's assumptions and hypotheses about the target audience hold true?
- Do members of the target audience see any value in the application?
  - If so, are the drivers of value what the application sponsors had assumed?

In order to answer these strategic questions, the project team needs to conduct a **User Needs Assessment (UNA)** to answer the following questions:

- Who is your audience in reality?
  - Is it best to segment them by:
    - Profession/field of work (e.g., activists, researchers, farmers, doctors)?
    - Geography (e.g., rural versus urban, by province, etc.)?
    - Attitude (e.g. "trusts technology, mistrusts government;" "trusts Government, mistrusts technology," etc.)?
    - Level of comfort using technology?
    - A combination of the above?
  - Which segment is dominant in terms of:
    - Numbers/segment size?
    - Similarities with project objectives?
  - Are they:
    - Highly computer savvy and prefer downloading malleable data?
    - Do they primarily prefer processed information in flat formats?

- Will they most likely access the system/application from:
  - An office with high-speed Internet connectivity?
  - A mobile wireless device with limited display capability?
  - A dial-up connection with low bandwidth and slow connections?

The same types of questions are asked in UCD (See section 3).

To be truly user-driven and to ensure the long-term sustainability of projects, any proposal submitted to GeoConnections for an application or system must incorporate the needs, profiles and preferences of the user group/community and not merely reflect the hypotheses of a supplier, developer or marketer.

Benefits of a UNA:
UNAs increase the chances for success and sustainability of a project. In addition, UNAs help: • define the users of, and the demand for, a new product • ensure that the new product will meet the needs of its intended users • define, explore and solve users' problems • ensure priorities and opportunities are based on user requirements • ensure accountability in the allocation of public resources.

An example of a UNA can be found in Appendix 3, Case study on information requirements for environmental assessment.

2.2 Types of UNA

Although several types of UNAs are used in various settings, GeoConnections projects are usually based on a combination of two types:

- **program and workplace needs assessments**, which examine what should be changed to make a program or workplace more effective; and

- **organizational needs assessments**, which examine what groups need services, what groups are not receiving the services they need and the most relevant solutions.

Regardless of the type of UNA undertaken, the process has three phases:

1. planning the assessment
2. conducting the assessment
3. interpreting and reporting the results

2.3 Planning a UNA

Whenever possible, GeoConnections recommends establishing a steering committee to oversee the UNA and to provide feedback throughout the process.

GeoConnections recommends the following steps in the planning process:

1. Set objectives
2. Profile users
3. Examine existing material
4. Determine location and timeline
5. Determine research methods
6. Determine costs and set budget

2.3.1 Set objectives

Objectives are needed to help guide the research and keep it within scope. This step involves:

- Identifying the priority area(s) (for GeoConnections' purposes, these are specific issues within the areas of public health, public safety/security, environment/sustainable development, or matters of importance to Aboriginal People); and

- Establishing the project plan (purpose and goals of the UNA, including specific tasks that will be carried out).

2.3.2 Profile users

This step identifies the main end-users of the application or system, either by user type or job function. This step could also include developing a list of people to be contacted for the research. End-users profiles range from those using the application to those who will use and benefit from the information it provides.

2.3.3 Examine existing material

In this step relevant user feedback is examined. User feedback could include comments on existing web sites, studies, correspondence, policies, practices and other documents. Pertinent material is identified and provided to the research professional, who may then do a more in-depth review.

2.3.4 Determine location and timeline

This step determines where the UNA will take place: city, province, region or in multiple locations across Canada. The duration of the project should be estimated (start and end dates). When possible, the research should take into account users' schedules, vacations and holiday periods, in order to increase response rates.

2.3.5 Determine research methods

In this step, the project proponent should work with the research professional to determine whether qualitative or quantitative research methods will be used.

The selection of research method should take into consideration the type of questions to be asked and the type of information required. Interviews and focus groups are best used to understand attitudes and feelings (qualitative), while questionnaires, surveys or interviews are appropriate for answering specific questions (quantitative). Consideration should also be given to the type of person being surveyed and the time and costs involved in each method. Response rates will vary widely depending on the method chosen and the type of people surveyed.

Determining the "appropriate" research methods to meet information needs can be challenging. The table that follows outlines the different quantitative and qualitative research methods best suited for collecting data regarding attitude and behaviour.

	Qualitative	**Quantitative**
Attitude **(Preference)**	Focus groups Interviews	Surveys (online, telephone, mail)
Behaviour **(Performance)**	Usability walkthroughs Ethnographic research Job shadowing	Usability test Benchmark test

For examples of various types of survey questions, such as open- and close-ended questions, see Appendix 1, Sample Survey Questions.

2.3.5.1 Qualitative research methods

Qualitative research is a set of research techniques in which data are obtained from a relatively small group of respondents and not analyzed with statistical techniques. The goal of qualitative research is to discover participants' views on a particular subject. Qualitative research methods are more intuitive and subjective than quantitative methods, and information is grouped into categories rather than numerically. Analysis of records and documentation, observation, interviews and focus groups are examples of qualitative research.

The table below outlines some commonly used qualitative research methods:

Type of method	**About the method**	**Uses**
Analysis of records and documentation	Examination of existing reports or documentation, such as web usage, phone inquiries, sales figures and user feedback from a web site, workshop or evaluation form.	Documentation can reveal whether the users' needs are being met, and may also reveal user preferences.

Observational techniques (ethnographic research) i.e. job shadowing, in-home/work observations, field studies	To provide a view of the "real world" conditions in which the user operates with the product or service to provide a context around the use of the product. Use when you need to know: the environmental factors that may impact how the product is used; e.g. barrier to adoption or understanding operational problems in the field. Individuals are observed as they operate in a specific environment. The tasks they complete, interruptions, the order and flow of work are all noted and recorded as unobtrusively as possible. A series of questions may be asked before, during or after the observation period.	Used to gather information on work processes. Hierarchical task analysis, workflows, or use cases may be developed as a result of the observations.
Interviews	Provides qualitative data regarding a user, such as user characteristics, user goals, and motivations. Interviews allow the researcher to solicit unbiased opinions and handle sensitive issues. Begins with a series of questions. Individuals are interviewed by a qualified interviewer (face-to-face or by telephone), at the convenience of the interviewee. May involve up to three interviewees.	Used to gather attitudes and in-depth information from respondents. Use early to help guide development. Can also use when other people might negatively influence a response. Interviewer can probe for more information if necessary. Suited to open-ended questions. Data is also used to build and create user profiles, personas and usage scenarios.
Focus groups, community group forums	To explore and get feedback on new ideas for product design; to understand why existing problems or issues occur. Usually involve 6–12 participants, each of whom has the opportunity to express their opinions. A facilitator asks questions and guides the discussion; usually in facilities with one-way mirror for viewing. A quick cost-effective way to get qualitative information on a range of design options; to uncover hidden issues that may affect user behaviour. Focus groups do not provide independent opinions or quantitative data.	Used to gather participants' attitudes on a specific topic. When you are exploring a variety of options and want feedback quickly. Can be used to address all sides of a topic. Variation: Combine discussion with a survey or questionnaire.

2.3.5.2 Quantitative research methods

Quantitative research typically involves the construction of questionnaires and scales. People who respond (respondents) are asked to complete the survey. The sample size is large enough to allow the generalization of results across an entire population (e.g., the ability to say, with a certain measure of confidence that 85% of the target audience of a particular site use Internet Explorer 5). The data are analyzed using statistical methods, including statistical tests of significance. Quantitative research is structured and logical, and can be measured. The following table outlines some commonly used quantitative research methods:

Type of survey method	About the method	Uses
Questionnaires (written surveys)	A series of questions are formulated by a researcher to get information on specific topics, taking into consideration interviewer bias and respondent drop off. Use when you need numbers to support a business case. Generally less expensive than other survey methods since there is a standardized set of questions	Can be used to gather information on many alternatives. Best for asking specific questions. Not suited to measure deep attitudes and feelings. Variation: Electronic voting methods and online panels.
Telephone surveys	Expensive because of increasing refusal rates.	Used to survey respondents who cannot be reached online or lack an email or mailing database through which to send out invitations to participate in a survey. Cannot be used for visual representations.
Mail surveys	Helps to eliminate interviewer bias. Respondents remain anonymous. Responses may take longer than requested, resulting in delays.	Need to enter data which increases costs and timelines. Not suitable for complex issues.
Online surveys (Web and email)	Inexpensive to administer. Easy to modify. Helps to eliminate interviewer bias.	Yields rapid results.

Card Sorting	A method for determining how people sort and group items. Researcher asks users to write elements or items on a card, group the cards, and then name the resulting groups. Captures user's mental models with respect to how they may access or search for items. Identifies user's language as well as items that are likely to be difficult to categorize or find and terminology that is likely to be misunderstood.	Use to help define information architecture. Variations: Open Card Sorting – participant names the groups/categories. Closed Card Sorting – Group/category names are provided and the participant must group items within the pre-defined categories.

2.3.5.3 Keeping qualitative and quantitative research separate

In the course of conducting qualitative user research the temptation to quantify results (i.e. to use percentages to say that x% of respondents expressed a preference for Item A, or to use mean scores to say that the average level of satisfaction with a prototype was 2.5 out of 5) often exists. Such results are unreliable and can produce false results, for the following reasons:

- Research approach: Qualitative research has a fundamentally different approach from quantitative research in that the techniques used in qualitative research require researcher intervention, albeit unbiased. For example, in a one-on-one interview or in a focus group, the researcher (interviewer, moderator) will use a discussion *guide* and not a questionnaire; the guide will outline points of enquiry. The researcher may frame the same questions somewhat differently for each group of participants, based on any number of criteria, ranging from participants' language abilities to their particular interests and preferences. Moreover, based on the participants' responses, the researcher will ask follow-up questions, or probes, to uncover further details that better explain an initial response. These probes may vary significantly between research sessions. Consequently, the actual context of the conversation plays a very important role in a qualitative discussion or interview. This is very different from a quantitative online survey, for example, where every respondent interacts with the same, impersonal research instrument – the online survey – and has, at their disposal the same list of closed response categories (scales) to answer each question. Even in a quantitative telephone interview using Computer Assisted Telephone Interviewing (CATI) software, the interviewer is instructed never to interpret questions. The actual questionnaire is identical to that of an online survey in its use of structured questions, closed responses and pre-programmed skip patterns; if a respondent asks the interviewer to explain the meaning of a question the interviewer is instructed to simply repeat the question.

- Sample size: The sample size used in qualitative research is typically small. If a focus group comprises 10 participants, and if four focus groups are conducted, then the total sample size is 40. Assuming that these 40 research participants were surveyed using an actual, impersonal research instrument (e.g., an online survey) that eliminated

researcher and environmental bias, the margin of error would still be large enough to eliminate the possibility of statistically reliable results. Specifically, the margin of error for a sample size of 40 is +/-15.5%, 19 times out of 20; while the margin of error for 15 respondents, participating in one-on-one, lab-based usability tests is +/-25%, 19 times out of 20. Thus, to use 15 one-on-one usability tests to *understand* the performance of a site or prototype – understand the enablers of, and barriers to, usability, etc. – is extremely useful; but to use the same 15 qualitative interviews to *measure* performance – measure satisfaction using scales, etc. – is completely inappropriate.

2.3.6 Determine costs and set budget

In this step, costs of the assessment are determined and a budget is set. The cost of a UNA will depend on several factors: the complexity of the assessment, sample size and distribution, available resources, and how much work is contracted out to a research professional.

Experience has shown that user-consultation, if done properly, costs no more than about 10% of the total project budget. Given the tremendous benefits of consulting users (and the potential for failure in not using such an approach), spending 10% of the total project budget is money well spent; it helps manage risk and refine a product.

In setting a budget, elements of a UNA that should be taken into account include:

(a) For all research methods:

- preparing an introduction to the research questions
- developing a screener guide (to ensure the right type of person is contacted)
- developing the research tools (questions, guide, observation sheet)
- revising all documents, guides and tools
- pilot testing the tools
- photocopying (time and paper)
- contracting a moderator/interviewer/observer
- costs of contacting participants (recruiting)
- project management
- travel costs (transportation, hotel, meals and incidentals). If GeoConnections is contributing towards project costs, travel costs must not exceed the current travel costs in the Treasury Board Travel Directive.
- hospitality
- interpreting results
- preparing a report
- presenting the results

(b) For questionnaires and interviews:

- envelopes and postage, if questionnaire is mailed

- long-distance phone charges, if conducted by telephone

(c) For focus groups:

- facilities to host the focus group(s)
- participant incentives/honorariums

2.4 Conducting the UNA

Once the planning of the UNA is complete, the research tools will be developed and the research conducted.

To ensure impartiality, GeoConnections recommends that a research professional be hired to conduct the UNA. However, GeoConnections also recommends that project proponents stay involved and provide input into the UNA process. A research professional will have expertise in how to conduct opinion research but will not necessarily have the subject matter expertise to deal with questions that come up from interviewees.

While conducting a user-needs assessment, it is useful to remember that requirements are gathered. However, these may still be general in nature. Therefore, when a decision-support system is being developed, user-centered design process should be applied.

2.5 Evaluation criteria for UNAs

Before funding a geospatial decision support system, regional atlas, or thematic data projects, GeoConnections will evaluate UNAs following the evaluation criteria below. GeoConnections recommends that project proponents use these criteria when planning and conducting their UNA.

Focus on User;
The UNA:

- clearly focuses on one of the issues within the four priority areas of the CGDI:
  1. public health
  2. public safety/security
  3. environment and sustainable development
  4. matters of importance to Aboriginal Peoples
- clearly describes the business rationale for the application or system
- identifies content and/or services which must be provided
- identifies user requirements for key functionality or data properties
- identifies technology requirements to support user needs
- identifies any policies needed to resolve user issues
- demonstrates awareness that business goals/requirements may need to be adjusted

based on outcomes
- identifies specific intended user group(s)
- identifies user characteristics which will (or are hypothesized to) impact use of an application or system
- lists sources of relevant user feedback
  - and provides description of relevant sources
- lists data required (not applicable for content)
  - and provides its sources (data providers)

Research Methods

The UNA:
- includes clear and specific research objectives
- research issues/questions are clearly identified
  - research questions provide information on user groups (what they do, how they think)
  - research questions provide information on user tasks/activities
  - research questions provide information on user context of use
- participants correspond to the identified users or managers of the product
- research results are communicated in terms of inputs for design
- research results have been communicated back to key users/stakeholders with the opportunity to provide clarification to the researcher/presenter

Usage;

The UNA:
- identifies key activities or tasks performed by users
  - captures task information in a form easily used and understood by designers /developers
- identifies any context of use for users
  - describes what is known about context of use and impact on application/ service use

3 User-centered design (UCD)

3.1 What is user-centered design?

User centered-design (UCD) involves the input of users at various stages in the design of a system or application or web site or portal to ensure that it is easy to use and meets the needs of its users. UCD involves measuring usage: ease of use, ease of learning, and satisfaction as well as iterative design in which a product is designed, tested and modified repeatedly throughout the product lifecycle.

The **goal** of UCD is to concurrently improve the usability of applications; and the usefulness/ utility of applications by intuitively making the purpose, scope and target audience clear to the user by integrating the user into the design and development process. Consequently, the UCD process examines:

- how an application or system is used
- how people go about doing their work, and how they want or need to work
- how they think about their tasks
- how often they do particular tasks

While the International Standards Organization (ISO) defines usability as the "extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use," (ISO DIS 9241-11), the challenge on the Web is to determine who or what constitutes a "specified user," "specified goals" or a "specified context of use."

For example, users of the CGDI may be as diverse as environmental analysts, emergency management personnel, public health practitioners or Aboriginal band members. Each of these groups of users has different uses and motivations for using the Internet and geospatial information. It follows that their expectations of an application/system would be different as their context of use, level of satisfaction and resultant actions are different.

An example of how UCD is applied can be found in Appendix 3, Case study on information requirements for environmental assessment.

Benefits of UCD
If a UCD process is applied to a particular project, then the key benefits are: • Effective time and cost management • Enhancement of user-productivity

- Increased user-satisfaction
- Achievement of project/application objectives.

A UCD process allows the project team to gather user feedback at the very start of the project. This feedback can then be matched against project objectives so that the project team has an opportunity to prioritize or modify objectives to best leverage the points of convergence between the original project vision and user-response, while seeking ways to reconcile the points of divergence between the project team's objectives and users' expectations. An exercise such as this results in an application that is both more relevant to the user and in keeping with the strategic and tactical objectives of the project.

Since UCD takes into account user feedback, the application incorporates design elements – navigational schema, visual design, screen layout – that significantly enhances user-satisfaction; in addition, the application/system incorporates features, functionality and attributes that are most likely to enhance user-productivity.

A UCD process that is built into the entire development cycle of a project (refer to the section on "The UCD Process" below) ensures that any weaknesses in the application are minimized or eliminated at early stages since users are consulted at the projects' inception. Weaknesses in design, concept or strategy and changes to coding and prototyping are minimized thereby saving costs and keeping within budget and timelines.

There is nothing more futile than conducting user-tests with a site or application that has already been built – if there are serious problems with it, then changing it is more expensive than if a UCD approach had been used. UCD does *not* extend timelines or significantly affect budget *if*:

- The various phases of UCD are laid out in synch with the project timeline;
- The cost of user-consultation is accommodated in the overall budget;
- The cost is further managed by *not* introducing code until the UCD plan has been tested through cheaper, lower-fidelity formats with users; i.e. by the time coding begins, you are sure of what you are coding.

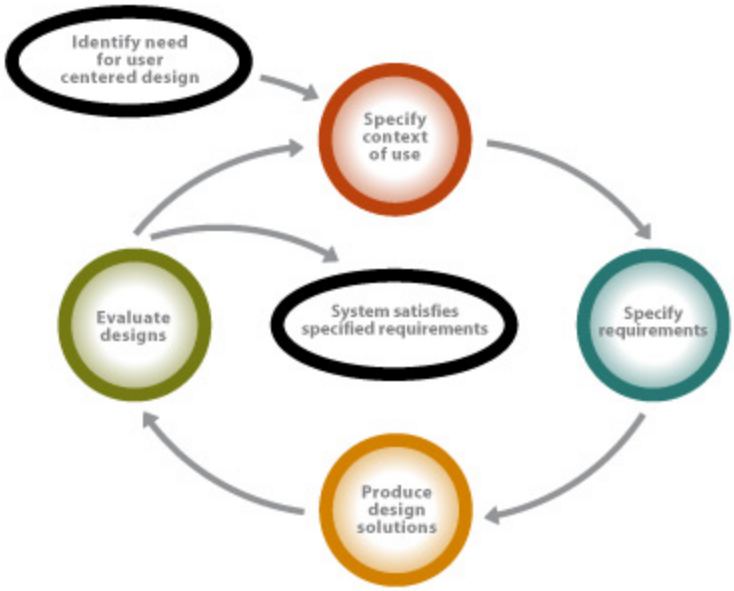
3.2 The UCD Process

There is an international standard that is the basis for many UCD methodologies. This standard, ISO 13407: Human-centred design process, defines a general process for human-centered activities such as UCD, throughout a development lifecycle, but does not specify exact methods (figure from the Usability Professionals' Association web site, www.upassoc.org/usability).

The UCD process is composed of four main activities:

1) Specify the context of use

2) Specify requirements
3) Produce design solutions
4) Evaluate designs



3.2.1 Specify the context of use

The first step in a UCD process involves understanding user context. This involves answering the following *strategic* questions:

- Do the project team's assumptions and hypotheses about the target audience hold true?
- Do members of the target audience see any value in the system/application?
- If so, are the drivers of value what the user groups of the system/application had assumed?

In order to answer these strategic questions, the project team needs to conduct research to answer the same type of questions as a UNA as seen in section 2.1, What is a UNA?

The purpose of this stage is to identify the people who will use the application/system (existing/expected users), what they will use it for, their key requirements, and under what conditions they will use it.

- If they have an existing application/system, how are they using it? Does it meet their needs?
- What is their interest in the particular system/application? What would motivate

them to use the system/application?
  - How does this relate to their current interests and activities?
  - What sort of information (or interaction) do they seek?
  - What are their goals and expectations? What do they need to accomplish?
  - What problems or issues have they identified?
- What is the most likely context for their use of the system/application?
  - How would the use of this system/application fit into their workflow[1]?
- If there is more than one user group, then:
  - What are the similarities and key differences between them?
  - If the differences between the two groups outnumber the similarities, how does one prioritize between the different groups? On what basis does one identify the focal, secondary and tertiary groups?

Outcome: A document that clearly identifies key user groups, their key points of interest in the system/application, and their most likely use contexts

This step is also part of User Needs Assessment (UNA).

3.2.2 Specify requirements

The requirements specification stage involves specification of both business and user requirements.

3.2.2.1 Business requirements

In order to specify **business requirements,** the following analyses can be conducted:

- Product opportunity analysis: assesses the value of a new product by identifying opportunities for improvement and barriers to success.

- Product value analysis: assesses the value of existing products (which can then be used to assess the value proposition of a new product).

- Business and customer value analysis activities seek to:
  1) identify the business values and goals and the value the product/service delivers to the organization,
  2) identify what the customer expects and needs from the product/service and what they value most, and
  3) bridges the gap between businesses and customers to ensure that the business balances their organizational goals with those of the needs of their customers.

[1] Workflow is the operational aspect of a work procedure: how tasks are structured, who performs them, what their relative order is, how they are synchronized, how information flows to support the tasks and how tasks are being tracked. Workflows may involve more than one user, tasks or systems.

- Stakeholder value chain analysis: identifies the stakeholders and the perceived product value. Section 1.3 outlines GeoConnections stakeholders.

OUTCOME - Success Metrics: a clear statement of the business value of the proposed system and what it will take to achieve it.

3.2.2.2 User Requirements

In order to specify **user requirements,** together with a research professional, conduct field studies using qualitative or quantitative research methods. For sample survey questions, see Appendix 1, Sample Survey Questions.

- User groups: identify user groups and characteristics (UNA).

- Context of use: The context of use may impact how users interact with the application or system (e.g., job characteristics, physical and organizational environment).

- Workflow and task identification: Identify a high level user interface roadmap which defines the product concept, tasks, constraints and design objectives. This involves understanding a typical workflow into which the application will be integrated. Break the workflow down into the various individuals involved, as well as the various tasks involved. Understand the key points of pain in the current workflow, and alternatives preferred by the user. Assess how these points of pain can be addressed by your application.

- Task analysis: An example output of a text based high-level task analysis is provided below.

[task]- Finding map area
    [subtask]Find web site,
    [subtask]Locate province/area
    [subtask]Begin zooming
    [subtask]Zoom to adequate scale
[task]- Interpreting map
    [subtask]Interpret map entities
    [subtask]Measure distance
    [subtask]Measure elevation
[task]- Manipulating Map
    [subtask]Zoom to area of interest
    [subtask]Pan/tilt to area of interest
    [subtask]View whole mapsheet
    [subtask]Switch between topographic and orthographic maps
[task]- Printing/Downloading map
    [subtask]Locate the desired map area

[subtask]Locate the desired map sheet
[subtask]Save it into a graphics program
[subtask]Save it into a word processor
[subtask]Print several sections
[subtask]Change dimensions of the image
[subtask]Piece several images together electronically
[subtask]Insert grids or other features onto the map
[subtask]Laminate the map after printing.

[task]- Using Map
[subtask]Fold printed map
[subtask]Store map
[subtask]Read it in the field
[subtask]Download map
[subtask]Upload it to a PDA

[subtask]Use with 3rd party PDA software or GPS…

Note: A task analysis may also be represented graphically.

- Usability goals: establish usability goals. Usability goals are used to determine the level of performance that is acceptable. It also helps researchers and designers establish when they have conducted enough iterations (revisions). Usability goals will vary depending on the business goals, safety issues and frequency of use or importance of the feature to overall success.

  A *usability test plan* describes how the product will be tested, what issues will be addressed, how the issues will be examined, and the required resources. The test plan is a means of ensuring that all stakeholders are on the same page about what will be tested and provides a focal point for the test and the product. In addition, it ensures that other researchers can replicate the study, if need be. The following are the main components of a usability test plan:
  - Revision history
  - Purpose
    - what is being addressed by this test
    - issues being examined.
  - Research Methodology for Usability Test
    - how the problem will be tested
    - user profiles and goals (participants)
    - scenarios and tasks that test participants will attempt to fulfil through your application; these scenarios and tasks will frame their interaction with the application and allow the researcher to identify enablers of, and barriers to, usability
    - prototype/product description
    - research roles
  - Plan for data capture and reporting
  - Description of final deliverables (e.g. report, presentation)

A *usability test report* serves as a communication tool and reference point for internal stakeholders. While report formats will vary from one researcher or organization to another, the main components of a usability report include the following:

- Executive Summary
  - overall findings and high-level recommendations.
- Methodology for usability test
  - purpose of test and usability objectives
  - participants
  - tasks
  - set up and environment
- Results
  - describes the data that was collected
  - detailed list and attendant description of:
    - key enablers of site effectiveness
    - key barriers to site effectiveness
      - prioritization of key barriers (issues) by:
        - their degree of impact on site effectiveness
        - the ease of remedy
- Findings and Recommendations
  - outlines the major findings based on the results.
  - recommendations should be prioritized (e.g., critical, major, minor).

The following elements should also be present in a usability test presentation/report:

- screen shots with notes highlighting where the problems occurred
- quotes from participants to illustrate their frustration or their delight in specific aspects of the product

In addition, wherever possible, the report could include video clips from the test to further illustrate findings

OUTCOME - Design and develop information architecture, navigation model and interaction mechanisms, based on an understanding of use context (including typical goals, scenarios and tasks). Establish usability goals and start testing the prototypes at an early stage (low-fidelity such as paper prototypes)

3.2.3 Produce design solutions

Based on findings from the previous stage, create renditions of the applications/system. These renditions can range from a sketch of the rough concept to a complete design (mock-up and prototype).

Prototyping is the process of creating models in order to test concepts/design ideas, interactions, or features to gather early user feedback. It is common practice to create and test multiple prototypes in sequence – each one building on the test results or user

feedback gathered from the previous prototype. The two most common types of prototypes are low-fidelity or paper prototypes and high-fidelity prototypes.

- ***Low-fidelity prototypes,*** sometimes referred to as ***paper prototypes***, usually consist of pencil and paper or PowerPoint mock ups of screens or tasks that are sketched at a high level. These types of prototypes are not "working models"; rather they require a researcher to present pieces of paper in front of test participants to mimic a progression of steps or screens. Respondents use their fingers as a mouse. Increasingly, low fidelity prototypes involve bitmapped images, hyperlinked to each other, and displayed in an HTML browser to simulate a higher fidelity environment.

- ***High-fidelity prototypes*** are generally more sophisticated in nature in which the design "appears" to be a working model of a product task or feature. These could be bitmapped images - shown on an HTML browser (with some buttons and links hyperlinked to other pages) where users tell the researcher where they might click or what they would do (or expect to do) in order to perform various tasks. High-fidelity prototypes allow designers to gather more detailed user interaction feedback and examine potential usability issues/questions in detail.

Typically, the production of design solutions, takes into account the following requirements:

3.2.3.1 Technical requirements

Technical requirements involve making decisions about the key technical aspects of the application. The most common are:

- Screen resolution: e.g., 800 x 600 or 1024 x 768, or other?
- Device adaptability: e.g., all desktop computers, or some desktop or wireless devices, or other?
- Accessibility:
  - Adherence to all or select W3C guidelines?
  - Access by assistive/adaptive technologies catering to visual, motor or cognitive limitations?
  - Minimum version of assistive technology to which the application or system would conform.

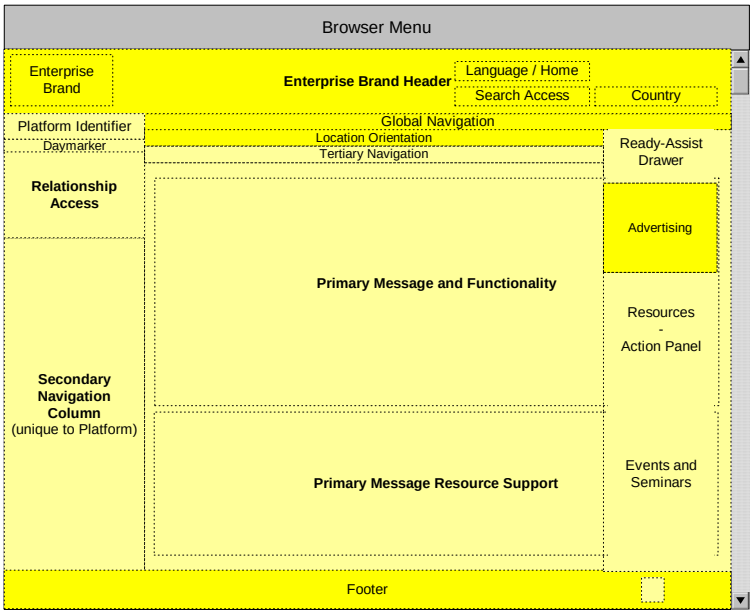
3.2.3.2 Design requirements

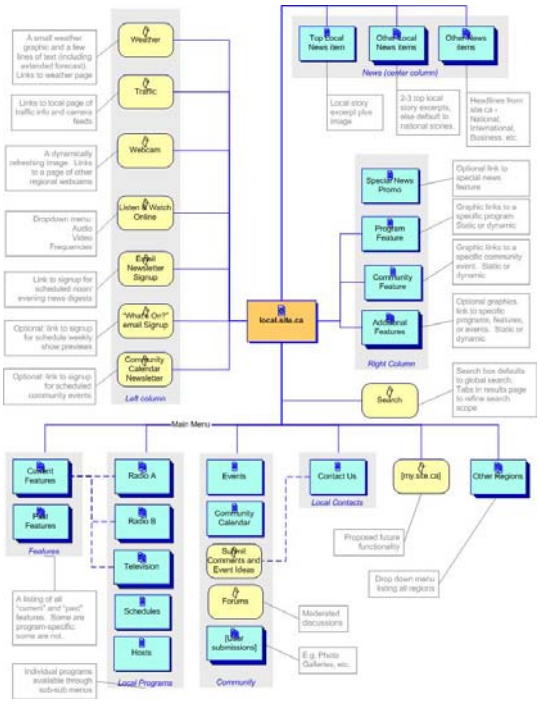
The two key components of design requirements are web site information architecture and screen topography:

- **Web site information architecture (IA):** shows how the information is organized, how different groups of information relate to each other, and how they are labeled. IA includes the following aspects:
  - Taxonomy: grouping different kinds of content and functionality;

- Nomenclature: labeling format for the different groups of content and functionality;

- **Screen topography**: a decision about how to divide the screen into panels (Left Hand, top, Right Hand, etc.); and subsequently, where to place various elements (links, buttons, etc.). Site wireframes illustrate screen topography.





3.2.3.3 Navigational schema

In his book, The Elements of User Experience: User-Centered Design for the Web, Jesse James Garrett outlines a navigational framework based on the following 6 elements:

- Global – persistent main menu;
- Local – hierarchy of parent, children, and siblings nodes;
- Supplementary – navigation that shifts focus based on facets;
- Contextual – "inline" navigation embedded in content of page;
- Courtesy – links that are not regularly needed, but are offered for convenience; and
- Remote – site maps, help, search, etc.

Setting the navigational schema requires deciding on the various navigational elements – based on user feedback – and then deciding on their:

- **Look-and-feel**: e.g., links versus buttons; font-size; colour, etc.
- **Operability**: static menus or expanding menus; mouse-over displays of sub-menu items (fly-outs), etc.

When someone is new to user-centered design it is difficult to know good design advice from bad advice. For this reason, characteristics of good design decisions/advice are outlined below.

Good design decisions/advice:

- takes into account both business goals and priorities and user context and behaviours;
- is backed up by experimental data; and
- considers other UI design decisions.

For example: Provide users/stakeholders with basic, reliable geospatial data which help the Earth Sciences Sector (ESS) to play a leadership role in Sustainable Development (SD) (characteristic 1 = organization goal). Interviews indicate that data continuity of high spatial resolution of Canada land mass is a significant issue (characteristic 2). A raster product of Canada should be produced at regular intervals, preferably every 5 - 10 years (characteristic 3), and the raster product should be able to be cross-calibrated with previous raster products for change detection and trend analysis (characteristic 4).

Bad design decisions/advice:

- break a standard or guideline; i.e. have the system process information (load an application for instance) without any feedback;
- claim to be very generally applicable, yet has very specific design solution characteristics; i.e. "make all information 3 clicks away on a web site". There is no reference to context and no example of extensible experimental data that supports this notion.

3.2.4 Evaluate designs

Have users test the application/system to see if they can easily find desired information. Modify product iteratively throughout the product lifecycle based on user feedback. Specifically, this stage involves:

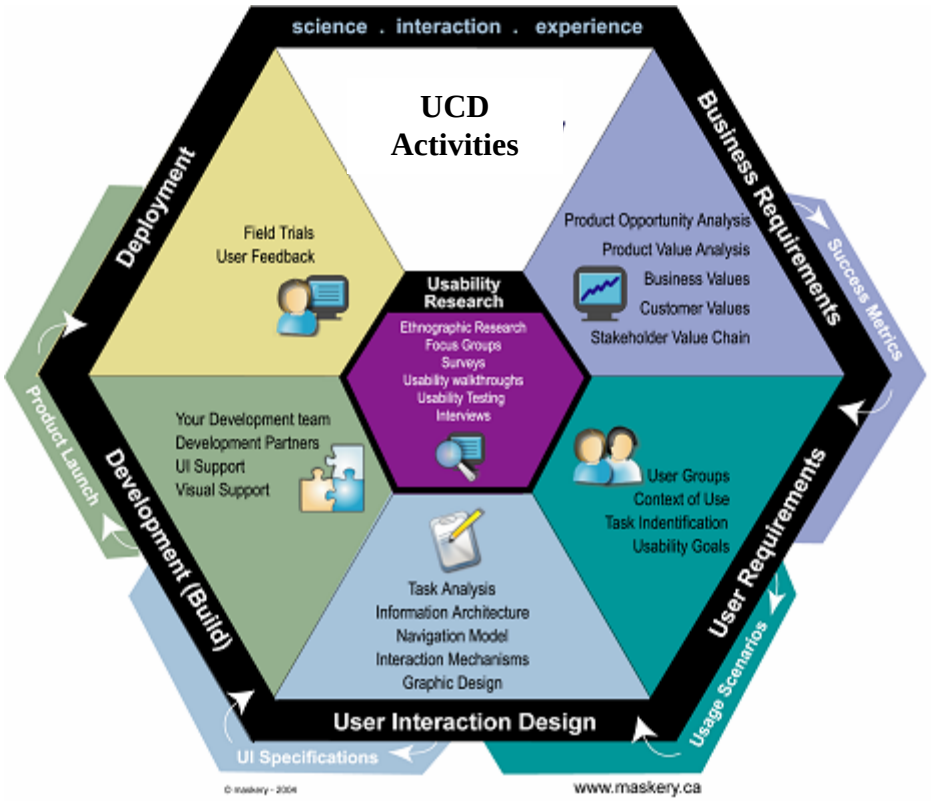
- Testing the design/plan with a controlled group of users to uncover enablers of, and barriers to, usability and effectiveness (utility);
- Making modifications to design;
- Further (iterative) testing with a group of users consistent with the first group. Repeating the process throughout the development cycle i.e. introducing code progressively to move the prototype from low-fidelity images to higher-fidelity functionality, and finally into an alpha or beta version, to eliminate barriers to the application's effectiveness.

3.3 The UCD Toolkit by stage

Several research methodologies can be employed to complete a UCD process. This section discusses the UCD toolkit of qualitative and quantitative research methods by the various stages in a project.

The following diagram describes the five stages – Business Requirements, User Requirements, User Interaction Design, Development and Deployment - of a successful UCD project.

The 5 stages of User Centered Design



The following table summarizes the UCD toolkit of qualitative and quantitative research methods by each of the five stages in a project and questions that need to be answered for successful deployment of the project:

Stage	Key Questions	Approaches	Outcomes

Stage	Key Questions	Approaches	Outcomes
Business Requirements/ Analysis	• What do I want my online application/ system to do?	• Facilitated planning sessions • Internal interviews	• Objectives and key initiatives (linked to corporate objectives) • Measurement framework • Business/ strategic plan
User Requirements	• Is my target audience who I think it is? • How likely are they to use my online application	• Surveys (online and traditional) • Behavioural data • Contextual enquiry and other qualitative approaches	• Audience segmentation and prioritization • Needs identification • Behavioural profile • Channel role • Context of use • Reports
User Interaction Design	• How can I ensure that my application resonates with the cognitive, substantive and functional expectations of my target audience?	• Focus groups • Card-sorting exercises • Topography exercises	• Architecture • Usability plan
Development (Build)	• Now that I have a concept, how do I ensure that it's working?	• Paper prototype testing • Wire-Frame testing • Usability testing • Accessibility testing • Traffic impact assessment	• Refinement of product concepts • Detailed preferences with respect to layout, nomenclature, functionality
Deployment	• Now that I have launched my online application how do I measure its effectiveness?	• Online surveys and visitor tracking	• Performance measurement process • Identification of performance issues and areas for improvement

Once you have decided which UCD activities to conduct, assign timelines, deliverables and milestones. The UCD activities should be reflected and integrated into your product development cycle alongside activities such as developing functional specifications, use cases, and coding deliverables.

3.4 Project Considerations

3.4.1 Determine location and timeline

As users' approaches may vary across the country, it is important to consult users from different cities, provinces or regions (if applicable).

Response rates may improve if research is timed to take into account users' schedules, vacations and holiday periods. The duration of the project should be estimated (start and end dates).

3.4.2 Determine appropriate research methods

Several methodologies describe how to complete a UCD process. Refer to section 2.3.5. "Determine research methods" for information on different research methods.

3.4.3 Determine costs and set budget

The cost of a UCD process will depend on several factors: the complexity of the design, sample size and distribution, available resources, and how much work is contracted out to a research professional.

In setting a budget, elements of a UCD process that should be taken into account include:

(a) For all research methods:

- preparing an introduction to the research questions
- developing a screener guide (to ensure the right type of person is contacted)
- developing the research tools (questions, guide, observation sheet)
- revisions of all documents, guides and tools
- pilot testing the tools
- photocopying (time and paper)
- contracting a moderator/interviewer/observer
- costs of contacting participants (recruiting)
- project management
- travel costs (transportation, hotel, meals and incidentals). If GeoConnections is contributing towards project costs, travel costs must not exceed the current Treasury Board Travel Directive
- hospitality
- interpreting results
- preparing a report
- presenting the results to GeoConnections and other appropriate audiences, such as management, members of the organizations involved, the people who were consulted in the research, and any user communities affected by the research.

(b) For questionnaires and interviews:

- envelopes and postage, if questionnaire is mailed
- long-distance phone charges, if conducted by telephone

(c) For focus groups:

- facilities to host the focus group(s)
- participant incentives/honorariums

In addition to the cost of research, the budget for UCDs should also include methods that may be used by the professional to visualize the new application or system.

Experience has shown that user-consultation, if done properly, costs no more than about 10% of the total project budget. Given the tremendous benefits of a UCD-approach (and the potential for failure in the non-employment of such an approach), the allocation of 10% for risk-management and product-refinement is good practice. The 10% includes the development of the UCD plan – so it actually overlaps with the requirements specification phase.

3.5 Conducting the UCD

The UCD should be conducted according to the research methods determined at the planning stage. GeoConnections recommends consulting with or hiring a research professional to conduct the user-centered design.

Benefits of hiring an external expert include:

- lack of bias which brings objectivity to the process, especially when there are contradictory stakeholder opinions or pre-suppositions.
- professional and academic experience in UCD which allows for a very focused approach to the UCD process.

The parts of UCD that particularly benefit from an external expert are:

- understanding user context (UNA), and
- iterative evaluation and refinement of design.

3.6 GeoConnections UCD Evaluation Guidelines

The following evaluation guidelines will be used by GeoConnections to evaluate how well you have incorporated UCD (and previously conducted user needs assessments) in your proposal submitted to GeoConnections.

The guidelines are divided into the following 8 sections:

- **User Requirements**: how you plan to conduct research that will identify user goals and users needs based on use and behaviour.
- **Research Methods**: activities and practices you plan to conduct to gain an understanding of the users (such as, context of use and tasks), and how you plan to communicate the research results to project stakeholders to ensure results are successfully incorporated into the design.
- **Usage**: evaluates your plan to capture task information that conveys how users typically use the product.
- **User Interaction Design**: how you plan to integrate user and task information into the process through practical design techniques.
- **Design Assessments**: evaluates how well you plan to assess and test your initial design concepts as you work on the information architecture, navigation model, and interaction mechanisms of the product.
- **UCD During Development**: evaluates how you plan to integrate usability testing and issue tracking during development to further mitigate project risks
- **UCD During Deployment**: evaluates how you plan to continue to gather product and user information after it has been deployed in order to better understand it's use in the field. This section also focuses on how you plan to incorporate the field research in subsequent releases.
- **Overall UCD Approach**: whether you've identified the appropriate resources to conduct research and design the UI. The section also evaluates whether you have adequately considered the budget/costing associated with research and design.

User Requirements

The UNA:

- clearly focuses on one of the specific issues within the four priority areas of the CGDI:
  1. public health
  2. public safety/security
  3. environment and sustainable development
  4. matters of importance to Aboriginal Peoples
- clearly describes the business rationale for the application or system
  What are the business requirements that must be met for the application or system to be successful? Are these requirements clearly stated? The business requirements may be stated as goals to be achieved by the application or system or as benefits that it will deliver to the users. Does the UNA address any changes to the business requirements as a result of identifying new user requirements? An example of a business requirement could be: 'This application will provide users with higher resolution Geospatial data
- identifies content and/or services which must be provided
- identifies user requirements for key functionality or data properties
- identifies technology requirements[2] to support user needs
- identifies any policies needed to resolve user issues

[2] e.g. the user requirement to have satellite data at different resolutions for various parts of the country may imply a specific technical solution to stitch together data sets to provide a consistent view across the country.

- demonstrates awareness that business goals/requirements may need to be adjusted based on outcomes
- identifies specific intended user group(s)[3]
  Broad generic terms like 'general public' are non-specific and should be given a '0' score. User groups may be identified by job categories or by usage variables or a combination of both. Managers of geospatial data for provincial governments would be an example of a job category; while people who use geospatial data for planning purposes would be an example of a usage category.
- identifies user characteristics which will (or are hypothesized to) impact use of application or system.
  User characteristics could include any of the following requirements to use the application or system:
  - *skills (e.g., requires GIS skills, familiarity with online mapping tools)*
  - *knowledge (e.g., working knowledge of similar mapping applications)*
  - *physical attributes (e.g., user must be able to enter data in application while wearing gloves in a cold environment)*
  - *cognitive attributes (e.g., users with limited sight or colour-blind users must be able to use application)*
  - *job characteristics (e.g., employee performs administrative functions for the application therefore needs to access all functionality)*
- lists sources of relevant user feedback
- provides summary of relevant sources
- lists data required
  - *and provides its sources (data providers)*

Research Methods

- include clear and specific research objectives.
  Research objectives should identify the type of user information that is collected. This could include any or all of:
  - *data to develop user profiles*
  - *data to identify key tasks or uses of the application or system*
  - *data to identify the context of use of the application or system*
  - *data to identify technical requirements as a result of user needs*
- research issues/questions are clearly identified
  a. research questions provide information on user groups (what they do, how they think)
  b. research questions provide information on user tasks/activities

[3] GeoConnections defines a "user group" as a group of users who share common concerns or problems and who might have common requirements of the CGDI.

   c. *research questions provide information on user context of use*
      The context of use may impact how users interact with the application or system. Factors to consider in context of use include: physical environment, job characteristics, organizational environment[4]
- participants correspond to the identified users of the product
- research results are communicated in terms of inputs for design

Will indicate understanding by the type of questions asked in the research as well as the outputs from the research. Outputs should be crafted to focus on key issues which designers will need to consider. Ideally outputs will include or at the very least lend themselves to be easily turned into: user profiles, task analyses or workflows, usage scenarios. A generic research report which does not focus on these key elements would not provide adequate information to direct design and development decisions. The UNA serves as the primary reference to develop a project and indicates the users' view to the developers. It is a clear picture of what the end users expect once the project is completed, and provides developers with a basis for estimating the resources required to build the solution

- overall research results have been communicated back to key users/stakeholders with the opportunity to provide clarification to the researcher/presenter
- the proposal identifies the % of total project costs related to UCD and user consultations

Usage

<u>The UNA:</u>

- identifies key activities or tasks performed by users
  - *captures task information in a form easily used and understood by designers / developers. Ways to capture tasks include: a workflow diagram (demonstrating the order of tasks or activities in completing a process), a hierarchical task analysis (demonstrating the relationship between higher order tasks and sub-tasks), listing key tasks or activities.*
- identifies any context of use for users
  - *describes what is known about context of use and impact on application/ service use*

User Interaction Design

<u>The proposal:</u>

- includes a plan to create usage scenarios[5]?
  a. *indicates they will use user profile data*
  b. *indicates they will use task analysis data*
  c. *indicates they are planning to incorporate the usage scenario into the design process?*
- includes a plan to create use cases[6] and/or storyboards[7] and or workflows[8]?

[4] e.g. an application may be developed for users in the field under various lighting conditions and limited input options. Another application may require limited access to some functionality for some users who do not have security clearance to use higher level functions (organizational environment).

[5] Usage scenarios capture a view of how users typically use the product.

[6] A use case is a technique, used by system developers, for capturing functional requirements of an application or system.

   a. *indicates they will use task analysis data to create use cases?*
   b. *includes a plan to create story boards and/or workflows based on tasks analysis and usage scenarios?*
   c. *includes a plan to test and validate storyboards using the appropriate research methods (e.g., one-on-one interviews or usability walkthroughs)?*
- includes a plan to create prototypes[9]?
- includes a plan to create a UI Design Specification
   a. *The proposal indicates that the UI Design Specification is based on documented test results.*
   b. *The proposal indicates that the UI Design Specification is based on UI Designer Credentials.*
   c. *The proposal indicates the UI Design Specification is basis for creating prototypes during Development phase.*

Design Assessment

The proposal:

- includes a plan to test a concept(s).
   a. *indicates an intention to test iteratively (more than one cycle) throughout the design phase?*
   b. *includes a plan to test with representative end users (4-6 users)?*
   c. *the plan indicates an intention to assess and test the information architecture i.e. structure of the application for example by using card sorting? An effective information architecture allows users to find information quickly and incorporates terms and labelling that are familiar and easily understood by the target audience.*
   d. *the plan indicates an intention to assess and test the navigation model?*
   e. *the plan indicates an intention to assess and test interaction mechanisms (i.e. hyperlinks, buttons, menus, right-click actions)?*
- includes appropriate assessment techniques (see table Determining Appropriate Research Methods), including one or more of the following: card sorting, usability walkthroughs, and assessment tests with interviews?
- a plan/process is clearly articulated for turning research results into achievable design recommendations?

Recommendations should be crafted to focus on key issues. The researcher must extract across tasks (when analyzing findings) and look for common issues or patterns of use. Ideally recommendations will focus on information architecture, navigation and buttons and labels A generic research/test report which does not focus on these key elements would not provide adequate information to direct design and development decisions.

- overall research results will be communicated back to key users/stakeholders with the opportunity to provide clarification to the researcher/presenter?

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[7] Storyboards are a series of illustrations that capture information in a wire frame format for the purpose of quickly checking an initial draft at workflow and organization.

[8] Workflows show the flow of tasks in a larger process to meet an end result.

[9] Prototyping is the process of creating models in order to test concepts/design ideas, interactions, or features to gather early user feedback.

UCD During Development
The proposal:

- outlines a plan to conduct usability testing as the product is being developed?
  a. *indicates a plan to conduct usability testing to answer specific questions that come up during development for which user data does not exist?*
  b. *indicates a plan to conduct testing with representative end users (4-6)?*
- outlines a plan to establish usability goals before they start testing?
  - *outlines a plan to capture, track and resolve usability issues to meet the usability goals?*

UCD During Deployment
The proposal:

- includes a plan for conducting usability research using appropriate research methods to gather product feedback?
  a. *plan to conduct validation usability testing with users working with the deployed product?*
  b. *plan to conduct an ethnographic study, which includes one or more of the following: observations, job shadowing, contextual interviews.*
  c. *plan to create and deploy product surveys to collect user feedback and satisfaction ratings on an ongoing basis?*
- indicates how they will capture and review user data captured in the field after product deployment?
  a. *indicates establishing a process or database/repository for storing and tracking feedback from the field?*

Overall UCD Approach
The proposal:

- identifies an appropriate resource to conduct the usability research.
  - *The research credentials of the proposed Usability Researcher are clearly identified.*
- identifies an appropriate resource to assess and design the UI.
  - *The credentials of the proposed UI Designer are clearly identified?*
- accounts for all steps to conduct effective UCD research in the budget/costing.
  a. *Budge/costing accounts for recruiting participants?*
  b. *Budget/Costing accounts for developing research instruments?*
  c. *Budget/costing accounts for conducting research?*
  d. *Budget/costing accounts for analyzing results?*
  e. *Budget/costing accounts for reporting results?*
  f. *Budget/costing accounts for developing recommendations for design?*
  g. *UCD costs are distinct from technology development costs*

4 GeoConnections requirements for UNAs and UCDs

4.1 Limits on GeoConnections funding

Given the importance of user-driven systems, interfaces and content to the success and sustainability of the CGDI, GeoConnections has chosen to provide financial support to UNAs and UCD processes. GeoConnections funds only cost-shared projects in which the project proponent and its partners provide at least 50% of the total project cost through cash or in-kind contributions. The dollar amount of GeoConnections funding towards UNAs and UCD projects (as part of the development of an application or system) varies according to the announcement of opportunity.

An agreement must be signed with the project proponent and GeoConnections must provide written authorization before GeoConnections will cover any incurred costs.

Competitive funding opportunities are listed on the Opportunities section of the GeoConnections web site.

Opportunities target different groups of stakeholders. Project proposals must be submitted by targeted stakeholders identified in the announcement of opportunity.

4.2 GeoConnections reporting requirements

All projects that receive GeoConnections funding for a UNA or UCD must submit their research results to GeoConnections in a written report. If a steering committee is overseeing the UNA or UCD, it should review the final report before the results are presented to an audience**.**

It is important to present the research results to the people who were surveyed or consulted in the UNA or UCD to help them accept and understand the reasons for decisions. This is key to obtaining commitment and understanding. Research results should also be presented to:

- management, or whoever requested the research; and
- members of the organizations involved; or
- communities impacted by the research.

Research results can be presented, either by the research professional or the project proponent, in several ways:

- written reports
- presentations
- discussions in meetings
- debriefing sessions

The report must include the following elements:

- title page
- executive summary/key findings
- table of contents
- introduction
- description of the methodology used and why
- problems encountered
- research results
- copy of moderator's guide, interview guide, survey or questionnaire
- financial accounting of the use of GeoConnections funds

4.2.1 GeoConnections review of UNAs

Before approving funding for a system, application or content for which a UNA has been completed, GeoConnections will evaluate the UNA. An example of a UNA can be found in Appendix 3, Case study on information requirements for environmental assessment.

In evaluating a user-needs assessment, GeoConnections ensures that the following questions are answered, at a minimum:

1. To which GeoConnections priority area does the UNA correspond?

    - Public Health
    - Public Safety/Security
    - Environment/Sustainable Development
    - Matters of Importance to Aboriginal Peoples

2. Who led the UNA? Was it a contractor or in-house? Include name and other information.

3. Where did the UNA take place? Identify cities, regions, provinces.

4. When did the UNA take place? Include dates.

5. Who are the users? List the different user types.

6. What existing material was examined? if applicable

7. What were the objectives of the UNA?

8. What research methods were used?
9. What questions were asked?
10. What were the research findings?
11. What priorities/decisions resulted from the UNA?

4.3 Communicating project results

4.3.1 GeoConnections review of communications material

GeoConnections strives to support the communication of project results and to coordinate its own communications with those of its partners for maximum benefit. Before any project communication material is distributed, it should be submitted to GeoConnections for review to ensure that the program and the CGDI are both accurately represented and to allow GeoConnections to distribute the messaging and promote the project through its own channels.

All projects that receive funding from GeoConnections must publicly acknowledge GeoConnections on all project documentation and communications material.

If **text acknowledgments** are used, the text must state:

> With financial support from GeoConnections, a national partnership initiative led by Natural Resources Canada. GeoConnections and its partners are working to enhance the Canadian Geospatial Data Infrastructure, an online resource that enables decision makers to access, combine and share geospatial information over the Internet and gain new insights into social, environmental and economic issues.

If **logos** are used in acknowledgments, both the GeoConnections logo and the Canada wordmark must be used:

Other sizes of the logo can be downloaded from:
http://www.geoconnections.org/en/newsmedia/media

4.3.2 Project promotion by GeoConnections

GeoConnections will promote projects that receive funding in consultation with project proponents and collaborators. Promotion may include web site links to news releases and articles related to the project.

Appendix 1: Sample Survey Questions

Regardless of the type of research methods used, a professional researcher, facilitator or interviewer should be employed to provide guidance and assistance, ensure questions are well worded, identify participants, conduct interviews, provide facilities when required, and, most important, ensure the interviewer is not influencing the results.

This appendix provides an overview of various types of survey questions that could be used by the research professional to collect data for a user-needs assessment or user-centered design process.

Much of the information in this section is from *Enjoying Research? A 'How-to' Manual on Needs Assessment*, by Abby-Livingston and Abbey.

A.1 Types of survey questions

There are two types of survey questions: open-ended and close-ended.

A.1.1 Open-ended questions

In open-ended questions respondents answer a question in their own words. The researcher provides only the general topic without giving respondents any particular point of view. For example:

> What could GeoConnections do to improve its program?

In an argument type of open-ended question the researcher can find out respondents' opinions about both sides of an issue. For example:

> What do you think are the advantages and the disadvantages of the Canadian GeoSpatial Data Infrastructure (CGDI)?

Open-ended questions can be used to find out what people know or feel about an idea. For example:

> What does good data quality mean to you?

In open-ended questions researchers have less control over responses. In interviews or telephone surveys, interviewers can probe for more information or ask clarifying questions.

A.1.2 Close-ended questions

When a question is closed, respondents must choose the answer from the categories provided. There are several different ways of gathering information in closed questions:

- nominal scale
- checklist
- ordinal scale
- rating scale
- interval scale
- rank ordering

A.1.2.1 Nominal scale

A nominal scale enables classification of information into categories. It is generally used to gather factual information.

> Were you born between 1940 and 1980? (Please circle the number of the correct answer.)
>
> 1. Yes
> 2. No

A.1.2.2 Checklist

A checklist is a series of nominal scales. Respondents are asked to check off applicable answers; hence a checklist can be used when there is more than one correct answer:

> Which age groups are represented by the adults in your household? (Please check √ all that apply.)
>
> 1. age 18-29 ____
> 2. age 30-39 ____
> 3. age 40-49 ____
> 4. age 50-59 ____
> 5. over 60 years old ____

A.1.2.3 Ordinal scale

An ordinal scale ranks answers by order or groupings (but not necessarily in equal increments. See interval scale). Ordinal scale questions are used to gather factual information as well as to gather opinions by structuring the scale to measure degrees of intensity or feeling.

> Please indicate your age group. (Please circle the number beside the appropriate answer.)
>
> 1. Teenager (age 13 - 18)
> 2. Adult (age 19 - 39)
> 3. Middle age (age 40 - 59)
> 4. Senior (age 60 - 80)

The most widely used ordinal scales for assessing attitudes and opinions are called **Likert scales**. A Likert scale enables respondents to indicate their level of agreement with a statement. For example:

> How would you rate your success in accessing a CGDI Web Map Service? (Check √ one response.)
>
> _____ Very satisfactory
> _____ Satisfactory
> _____ Unsatisfactory
> _____ Very unsatisfactory

A.1.2.4 Rating scale

A rating scale is a method of assessing preferences or performance. It can be used to find out opinions on an issue or event. For example:

> How important is it to you that a policy for data sharing be developed? (1–Least important, 5–Most important)
>
> 1 2 3 4 5
>
> To what extent do you think online training on the CGDI will be used by your staff? (1–Not used very much, 5–Used very much)
>
> 1 2 3 4 5

A.1.2.5 Interval scale

An interval scale has categories of equal increments. For example:

> Please indicate your age group. (Circle the number beside the correct answer.)
>
> 1. 20 to 35 years
> 2. 36 to 50 years
> 3. 51 to 65 years
> 4. 66 to 80 years

A.1.2.6 Rank ordering

Respondents put items in order of priority to find out how they value those items. For example:

> Please rank the five types of geospatial information for your organization according to importance. (1–Least important, 5–Most important). Be sure to mark all five items.

_____ Satellite imagery
_____ Aerial photography
_____ Roads
_____ Hydrography
_____ Topography

A.1.3. Mixed-mode approaches

A combination of open-ended and close-ended questions is often used to compare what respondents will state spontaneously and what they will choose when given categories of responses. For example:

> What do you think are the top three barriers to your organization's use of geospatial information?

Further down in the questionnaire, the following multiple-choice closed question could be asked:

> In the following list of barriers, which two do you think are the most important for your organization? (Please circle TWO only.)
>
> 1. financial constraints or the cost of data
> 2. difficulty in locating or learning about data sources
> 3. human resources limitations and training capacity
> 4. politics

By comparing the two selected responses to the above question, the researcher can identify which issues people talk about when they have not been prompted, which are top priorities in a forced choice situation, and which appear on both lists.

Appendix 2: Literature review

***A Practical Guide to Needs Assessment,* Kavita Gupta**

This publication includes guidelines for launching and implementing four different types of needs assessments: strategic needs assessment, competency-based assessment, job and task analysis and training needs assessment. The book explores data-gathering tools such as interviews, surveys, questionnaires, observation and focus groups; and gives tips for preparing and conducting an interview. It includes a toolkit with worksheets, checklists and questionnaires.

***Conducting Needs Assessments,* Fernando Soriano**

This publication identifies the steps in designing a needs assessment and explores assessment methods, survey methods and sample size requirements, instrument development, data collection, data preparation and statistical analyses, reporting the findings, and social and cultural considerations.

***Enjoying Research? A 'How-To' Manual on Needs Assessment,* Diane Abbey-Livingston and David S. Abbey**

This publication describes the needs assessment process: collecting information; defining the purpose of your research; selecting a research method and sample; estimating time and costs; designing and administering questionnaires for surveys and interviews; conducting research on attitudes; and summarizing, analyzing and presenting research results.

GeoConnections would like to acknowledge the Lifestyle Information Network (LIN) for the use of content from this manual.

***Planning and Conducting Needs Assessments: A Practical Guide,* Belle Witkin and James Altschuld**

This guide examines a three-phase model to plan and manage a needs assessment. Phase 1 is the pre-assessment or exploration stage; phase 2 includes assessment or data gathering; and phase 3 is post-assessment or utilization. The book explores methods for conducting a needs assessment such as records and social indicators; surveys, interviews, and the critical incident technique; basic group processes; and specialized survey and group techniques; and addresses future-oriented needs assessment procedures.

***Rapid Contextual Design: A How-To Guide to Key Techniques for User-Centered Design,* Karen Holtzblatt, Jessamyn Wendell and Shelley Wood**

This is a hands-on guide that explains the contextual design process (part of user-centered design) and adapts it to projects. It includes information on structuring and planning the

project, planning contextual interviews, conducting inquiry interviews, running interpretation sessions, work modeling, sequence models, building an affinity diagram, writing personas, visioning, storyboarding and paper-prototyping.

***User-Centered Design: An Integrated Approach,* Karel Vredenburg**

This is a guide to introducing, deploying, and optimizing user-centered design. It focuses on methods and techniques to design a compelling "total customer experience" that will make both internal and external products (software, hardware, websites, and services) easy to buy, learn, and use.

Usability toolkit
Society for Technical Communication

This toolkit includes forms, checklists and other useful documents for conducting usability tests and user interviews.

Other recommended reading

User Centered Design

- Beyer, Hugh & Holtzblatt, Karen. *Contextual Design: Defining Customer-Centered Systems,* Morgan Kaufman Publishers Inc,. 1998
- Bias, R. & Mayhew, D. *Cost-Justifying Usability*, Academic Press, Inc., 1994
- Constantine, Larry L. & Lockwood, Lucy A.D. *Software for Use: A Practical Guide to the Models and Methods of Usage-Centered Design,* ACM Press., 1999
- Garrett, Jesse James. *The Elements of User Experience: User-Centered Design for the Web,* New Riders Publishing, 2002.
- Hix, D. & Hartson H. *Developing User Interfaces – Ensuring usability through product and process,* John Wiley and Sons, Inc., 1993
- Mayhew, D. J. *The Usability Engineering Lifecycle – a practitioner's handbook for user interface design,* Morgan Kaufman Publishers Inc, 1999.
- Nielsen, J. *Usability Engineering*, Academic Press, Inc., 1993
- Trenner, L. & J. Bawa. *The politics of Usability – a practical guide to designing usable systems in industry*, Springer-Verlag Ltd., 1998

User Requirements

- Hackos, JoAnn T. & Redish, Janice C. *User and Task Analysis for Interface Design*. John Wiley & Sons, Inc., 1998
- RESPECT User-Requirements Framework Handbook. Version 2.21. HUSAT, 1997

User Interface Guidelines

- Mayhew, D. , *Principles and Guidelines in Software User Interface Design*, Prentice hall., 1992
- Microsoft Windows guidelines: http://msdn2.microsoft.com/en-us/library/ms997431.aspx
- Sun Java look and feel guidelines: http://java.sun.com/products/jlf/ed2/book/index.html

- User Interface Design Patterns: http://www.welie.com/patterns/ and http://time-tripper.com/uipatterns/index.html
- More guidelines: http://usability.gov/guidelines/

Web usability

- Baxley, Bob. *Making the Web Work: Designing Effective Web Applications,* 2003
- Krug, Steve. *Don't Make Me Think: A Common Sense Approach to Web Usability,* 2001

Usability testing

- Dumas, Joseph & Redish, Janice. *A Practical Guide to Usability Testing*, Ablex Publishing Corporation, 1993
- Rubin, Jeffrey. *Handbook of Usability Testing*, John Wiley and Sons, Inc., 1994
- Nielsen, J. & Mack, R.L. (eds.). *Usability inspection methods*, John Wiley and Sons, Inc., 1994

Appendix 3: Case study on information requirements for environmental assessment

This case study provides an example of how a user needs assessment (UNA) and user-centered design (UCD) concepts were applied to inform and refine a particular decision-support application.

A3.1 Problem definition

The *Canadian Environmental Assessment Act* and its equivalent provincial legislation require an assessment of the environmental effects when particular development projects are proposed. An environmental assessment (EA) can be time- and cost-intensive and often requires the integration and analysis of a substantial amount of environmental, social and economic information from a broad range of sources. For project proponents, delays in acquiring and integrating this information can contribute to delays in securing necessary approvals for projects to proceed.

A3.2 The user-needs assessment

A3.2.1 Background

Environment Canada's Canadian Information System for the Environment (CISE) Secretariat profiled a number of use cases for environmental information – focussing on specific policy/legislative requirements. In the case of EAs, the Secretariat refined the user profile to cover the oil and gas community in Western and Northern Canada.

Westworth Associates Environmental Ltd., an Edmonton consulting company with experience in opinion polling and knowledgeable of the subject matter, was retained to conduct the needs assessment survey in the EA community. See the proposed workplan in section A3.6.

A3.2.2 Objectives

CISE and Westworth set two overall objectives:

1) to examine current availability and use of existing environmental information in the EA field; and

2) to investigate the type of environmental information system that would better meet the needs of the assessment community.

Nine specific objectives were further identified at this stage.

A3.3.3 Users

Primary users of environmental information, companies and other organizations that prepare or review EAs were targeted for the purposes of the needs assessment. These included consultants, industry/developers, regulatory reviewers, environmental non-government organizations (ENGOs) and academics.

In total, 100 possible respondents from these EA user groups were selected to participate in a survey.

A3.3.4 Examination of existing material

Existing material was reviewed including feedback from EA practitioners and policies and practices relevant to EA.

A3.3.5 Location and timeline

The survey was conducted in January–March 2002 in Calgary, Red Deer, Edmonton, Hinton and Fort McMurray (Alberta); Vancouver, Victoria, Fraser Lake and Prince George (British Columbia); Yellowknife and Inuvik (Northwest Territories); and Whitehorse (Yukon).

A3.3.6 Research methodology

Qualitative and quantitative research methods were used. First, a standardized set of 22 questions was asked of a cross-section of the user groups. From the original list of 100 possible respondents, 57 interviews were conducted: 49 by telephone and 8 through email. The survey involved both open-ended and closed questions.

The survey asked users how they use existing EA information and what problems and constraints they had experienced. Users were also asked for their opinions on the potential benefits of a coordinated environmental information system. To view the survey, see A3.7.

A3.3.7 Results: research findings

Respondents identified several major constraints in using EA information, particularly the time needed to access data and the inaccessibility of some data. Most respondents agreed that a coordinated environmental information system would improve the quality of EAs and save both time and money.

A3.3.8 Conclusions: decisions resulting from the UNA

There was broad support from the user community for a coordinated environmental information system established by government and an identification of which types of environmental information it should provide.

A3.4 The user-centered design process

The results and conclusions of the user-needs assessment were then used to design two successive prototypes of a coordinated environmental information system and helped identify which types of information should be delivered and in which manner. The following illustrates how users actively participated in every step of the three-year process.

The first (alpha) prototype was developed by the Miistakis Institute at the University of Calgary, in partnership with CISE. It provided interactive mapping tools and links to various databases, with a focus on southwestern Alberta.

Lynch-Stewart & Associates helped gather users' needs for the second (beta) prototype.

A3.4.1 Objective

The UCD process had one main objective: to further analyze the responses of the environmental consultants identified in the Westworth survey (user-needs assessment). These respondents had identified the need for a portal to quickly identify what research papers and datasets were available for a particular geographic area.

A3.4.2 Users

The results of the user-needs assessment helped refine the definition of users of the system: environmental consultants who conduct field studies and prepare reports.

A3.4.3 Location and timeline

Workshops held in Ottawa (Ontario) and Calgary (Alberta). Timeline: November 2002 (alpha prototype/regional portal) – November 2004 (beta prototype/national portal).

A3.4.4 Research methodology

The Miistakis alpha prototype was demonstrated in a hands-on classroom setting to a sample of regulatory officials, industry proponents, environmental consultants and industry association representatives, all from the petroleum industry, at the University of Calgary. These participants were asked whether the prototype was headed in the right direction, what tasks it could aid with, how it needed to be refined to support those tasks, what specific questions it should answer and which information needed to be provided to answer those questions. The participants identified specific requirements and noted that:

- the requirements for supporting EA of petroleum projects would be similar to requirements for EAs in other sectors in other areas of the country;

- user requirements vary depending upon the target audience (environmental consultants, regulatory officials) and the stage of EA at which the tool is applied (scoping an EA, conducting a screening, supporting a panel review, implementing a monitoring plan, assessing cumulative effects);

- the geospatial tools used in the prototype should be presented in a decision-support environment which also provides non-spatial functionality (e.g. keyword searches of document databases).

The CISE Secretariat initiated the second iteration of the EA decision-support system in mid 2002 to refine the prototype and to determine the context of use. A second consultant, Lynch-Stewart & Associates, was retained to guide this process. The CISE Secretariat worked with the consultants to make a preliminary determination of the target audience for the second portal. The audience was broadly defined to include industry, government, ENGOs and academic representatives.

In November 2002, 23 EA representatives from across Canada attended a two-day workshop in Ottawa to discuss their information requirements and explore how to improve the management of that information. Participants examined the alpha prototype, as well as other information management systems. Workshop participants agreed that two solutions, at different scales, would be required. First, a national scale, Internet-based EA portal, with both spatial and non-spatial query features, would best address information management needs common to EAs across the country. Second, local-scale portals, refined further from the Miistakis prototype, would be needed for EAs in specific geographic areas. These would need to be refined to address the particular users and stage for that EA.

Based on the results of these reviews of the alpha prototype by the EA community and other feedback from users, a national EA portal was developed in 2004 with GeoConnections funding support. The project team was led by Environment Canada and involved partners from both the public and private sectors. The Miistakis Institute and Lynch-Stewart & Associates collaborated in the development of a conceptual national EA portal. A national advisory team of EA experts was assembled to guide the portal design, which included a CGDI-compliant GIS/toolkit framework within the context of a broader non-spatial information environment. The national portal includes a national map interface that provides access to national and regional data, and a comprehensive EA toolkit that provides links to EA-related materials.

The portal provides built-in methods for continuing assessment and improvement by users: a feedback mechanism where users can provide comments and a separate mechanism for users to add their EA tools to the portal (www.eaportal.ca/).

A3.4.5 Results

Once the beta prototype was completed, Environment Canada, Miistakis and Lynch-Stewart & Associates demonstrated it at a national EA practitioner's conference in late

2004. They obtained feedback on the design of the national portal and further recommendations for its development.

Two prototypes exist since they support different end-users; one has a broad (national) focus while the other has a regional focus.

The next step for either prototype would be to further refine development by piloting the application in support of an actual EA scenario. Lessons learned from the pilot exercise would then be used to roll out an operational system. CGDI-supported operational systems are the desired end-points of GeoConnections-funded projects.

A3.5 Summary

This EA case study demonstrates the differences in application of a UNA and a UCD.

A UNA involves consulting users in advance of program, application or system development. It can be repeated, to further probe system requirements, but it is less rigorous than a UCD, which has several phases.

A UCD is an ongoing, iterative exercise that is used to continually refine an application or system to ensure it is relevant to users' needs. A UCD typically involves users responding to storyboards or prototypes. It provides a sense of system capabilities and is used to direct how those capabilities could be packaged. A UCD exercise may go through several iterations before an operational system is deployed.

A3.6 Proposed workplan

A Canadian Information System for the Environment and Biodiversity:
A Prototype Application for Environmental Assessment

Objective:
CISE aims to produce a biodiversity prototype product this fiscal year that engages the provinces and industry, while demonstrating how a distributed information system can support an industrial clientele.

Problem Statement:
The Canadian Environmental Assessment Act (CEAA) and equivalent provincial legislation require that environmental assessments (EAs) be conducted when a range of development activities are proposed. Whether they be screenings, comprehensive studies, panel reviews or cumulative effects analyses, these assessments require a range of environmental information to be analyzed in a short time. Delays in acquiring information either means costly project delays and/or disregard for appropriate environmental components given assessment deadlines.

Environmental information is generally scattered and poorly catalogued by those who hold it. Information that could be used in EAs is typically held by Conservation Data Centres, museums, provincial fish and wildlife databases, field naturalist and other non-governmental organizations (NGOs), Environment Canada, Agriculture and Agri-Food Canada, Natural Resources Canada and Fisheries and Oceans Canada. Additional information is collected continually through a range of citizen science, academic and consultant efforts. These databases will likely never be consolidated. A mechanism is needed by which distributed biodiversity databases can be linked in real time and queried using spatially explicit tools (given that developments triggering EAs almost always occur in a particular place).

Proposed Solution:
Throughout 2002, CISE will administer the development of a distributed biodiversity network, engaging a number of provincial, federal and NGO partners. Data from the network would be integrated with maps in real time to support EA queries. The system will be developed in close consultation with the provincial, federal and corporate EA community. Initial discussions with members of this community have indicated considerable interest (Westworth & Associates, 2002).

The pilot system would focus on the Rocky Mountains with a particular emphasis on the Eastern Front of Alberta. Discussions are under way with Shell Canada Limited to partner on development of the system. Broad consultations on user needs should be conducted in tandem with an existing CEAA-Environment Canada 'Sharing Good Practices' project led by Pauline Lynch-Stewart.

Workplan:
- initial user needs assessment (completed Mar 31, 2002)
- development of an alpha prototype to demonstrate system capabilities (due Sep 30, 2002)
- link content providers in distributed system focussing on birds and species at risk (due Dec 31, 2002)
- process design with CEAA/Environment Canada representatives through consultative workshops (Nov 2002)
- develop beta prototype of EA support system (due Mar 31, 2003)

Appendix A. Technical Details – Knowledge Integration System White Paper

The Need:
A number of barriers exist to consolidating environmental databases. Scientists who publish from data often do not want to release this professional wellspring. Field naturalists fear releasing information about their favourite observation sites, especially those involving sensitive species. Provincial and federal agencies use different formats in collecting data for various purposes. Often data managers simply protect

their 'turf' as their funding is reliant on the size of their holdings. Technical problems include differing data structures, variant data collection protocols and differing approaches to quality assurance. Finally, a lack of descriptive information or metadata hinders our collective ability to determine which databases are where.

As a result, we need a system that addresses both the technical and the political challenges around integrating data. Such a system ideally would:
a) provide an intuitive applied interface that serves the needs of a paying client group
b) provide the economic incentive for database maintainers to become involved
c) provide the standards-based mechanism that integrates participating distributed databases in real time and delivers it through the aforementioned interface
d) be easily replicated for other applications and clients nationally

The Structure:
A knowledge integration system comprises a number of distributed databases mounted online using a standard communications protocol (e.g., XML or Z39.50 – the same protocol used by libraries for literature searches). A database interoperability client resides with each database and allows it to be searched regardless of its structure. This client crosswalks database fields to a common format. For biodiversity data, Species Analyst was developed for this purpose by the University of Kansas in service to NABIN. Species Analyst crosswalks biodiversity data to the Darwin Core standard.

Various organizations can provide access to these databases through the use of customized portals. Each portal allows for customized searches online using a combination of tabular searches (e.g., for date, species, confidence rating) and spatial searches (for place). An EA portal would provide online map layers for land parcels; protected areas; wetlands/migratory bird sanctuaries; other developments (for CEAA scoping); and NGO/landowner areas of concern against which database information can be loaded and compared. Dynamic searching by drawing the footprint/region of the proposed development would allow a user to scope issues of concern, thereby focusing field efforts and streamlining the EA process.

Other portals can be created to develop customized views into the same data. A Species at Risk Compensation Evaluation portal might contain more landowner information and simply query for species of concern. A publicly accessible biodiversity education portal may show broad distribution patterns and coarse resolution data screened for security purposes. A biodiversity research system might provide for broader search tools but allow a user to collect and download data from participating institutions. Finally, a natural capital indicators portal might assemble a variety of geospatial and biodiversity data to report on indicators of ecological health as measured in a GDP-like index.

In other words, the system is designed to allow a number of customized views to access the same pool of distributed databases. Control over which information to provide at which resolution to which portals remains local as does the ability to update the database. Any organization can develop a portal by negotiating access with database holders.

For the system to be sustainable, an incentive is needed to ensure databases are engaged and continually updated. In these cases, an information brokerage would provide commercial functionality. The brokerage would collect subscriptions from clients wishing to access the EA Support Portal (e.g., petroleum, forestry, mining, tourism companies). The brokerage would deduct a service fee to fund its own operations then distribute the rest of the funds to database holders on a prorated system relating to successful queries. The more content, the more reward a database holder receives. Funds can then be reinvested to build content according to quality standards.

Results:
An EA portal accessing a larger biodiversity knowledge integration system can demonstrate the utility of CISE in a short period of time. The portal provides functionality that demonstrates the economic benefits of integrating environmental information. The system engages industry, ENGOs, universities, museums and both federal and provincial/territorial governments. It provides the means by which it can be self-supporting after it is built. Finally, it is entirely extendible to supporting other decision-making processes

through parallel portals.

A3.7 Environmental Assessment Practitioner Needs Assessment Survey

Hello……..,

I'm calling from Westworth Associates Environmental Ltd. We are conducting a needs assessment survey for Environment Canada relating to environmental information, particularly biodiversity. We are contacting individuals from various firms, companies or organizations that are involved with preparing and reviewing environmental assessments for their input. The survey will only take about 30 minutes. Could you please complete it and send it back (email or fax) in the next few days? Thank you very much for your time and assistance. Please contact XXX at Westworth Associates if you have any questions (phone 780 000-0000, fax 780 000-0000, or email xxx@xxx.net.

1) What type of work do you do for your company?

2) What types of environmental assessments does your company prepare?

3) How much of your company' time is spent in preparing environmental assessments? (% of time)

4) In general, how much time of an assessment project is spent gathering existing information (% time)?

How much time is spent on collecting original data (% time)?

5) What sources of environmental information do you currently use?

- ❑ *Consultant reports*
- ❑ *Government reports/publications*
- ❑ *Scientific publications*
- ❑ *Private industry reports*
- ❑ *Knowledgeable individuals*
- ❑ *Government-operated databases (Conservation Data Centre, BSOD, ANHIC)*
- ❑ *Other privately run data services (Breeding Bird Atlas)*
- ❑ *Newsletters*
- ❑ *WWW or online sources*
- ❑ *Other – indicate*

6) Do you have any problems or concerns with existing government databases?

How do you access sources of existing environmental information?

- ❑ *Library*
- ❑ *Internet*
- ❑ *Subscribe/pay for reports*
- ❑ *Direct contact with individuals*
- ❑ *Other*

For Consulting Firms
Which data services or newsletters does your company use?

What is the method of payment? (e.g., pay per use, subscription)

What is the cost of these data services/year?

7) Do the sources of information you use meet your needs for existing environmental information?

8) Do you ever have problems finding important existing environmental information when preparing environmental assessments?

- ❑ *Yes*
- ❑ *No*

If yes, which types of existing information?

- ❑ *Biodiversity*
- ❑ *Species occurrence*
- ❑ *Status of species*
- ❑ *Indicators*
- ❑ *Species abundance*
- ❑ *Habitat/community associations*
- ❑ *Species distribution/movements*
- ❑ *Invasive or alien species*
- ❑ *Ecosystem integrity*
- ❑ *Local knowledge on ecosystem components*
- ❑ *Traditional knowledge on ecosystem components*
- ❑ *Other*

9) Do you feel that

- ❑ *The data exists somewhere?*
- ❑ *That information gaps exist?*

10) What would you say are the main constraints in obtaining and using existing environmental information?

- ❑ *Time required to access it*
- ❑ *Cost*
- ❑ *Accessibility of data sources*
- ❑ *Number and fragmentation of data sources*
- ❑ *Data not in a useable format*
- ❑ *Existence of some sources are not widely known*
- ❑ *Others*

11) In your opinion how often does missed data/information result in:
a) additional existing information requests by regulatory agencies being required to complete an assessment?

- ❑ *Rarely*
- ❑ *Occasionally*
- ❑ *Frequently*

b) redundant field work being undertaken?

- ❑ *Rarely*
- ❑ *Occasionally*
- ❑ *Frequently*

12) If a coordinated environmental information system were developed by the federal government for accessing and retrieving existing ecosystem information, from the standpoint of an EA practitioner:

a) What types of information should it contain to meet your needs? Examples below, please provide own input on other types or forms of data/information:

- ❑ *Biodiversity – species occurrence/abundance*
- ❑ *Rare and endangered species*
- ❑ *Indicator species*
- ❑ *Status of species*
- ❑ *Habitat/community associations*
- ❑ *Species distribution/movements*
- ❑ *Invasive of alien species*
- ❑ *Ecosystem integrity*
- ❑ *Local knowledge on ecosystem components*
- ❑ *Traditional knowledge on ecosystem components*
- ❑ *Bibliographic information – studies done in particular areas*
- ❑ *Other*

Would a database that tracks biodiversity information be of value for environmental assessments?

b) What would be the most important functional features associated with such a system. (examples, please provide your own input)

- ❑ *Easily accessed location (e.g., Internet)*
- ❑ *User-friendly*
- ❑ *Flexible – a variety of queries/keywords can be used to obtain information (e.g., legal description, ecosystem categories, species)*
- ❑ *Has interactive features*
- ❑ *Data is in a standardized format*
- ❑ *Can provide a variety of summary data*
- ❑ *Provides variable output formats – electronic, hardcopy – electronic output in various formats (Excel, Word, etc)*
- ❑ *Determine the source/credibility of the data*
- ❑ *Links to variety of databases*
- ❑ *A system that provides geo-referenced information*

c) What method of information delivery would suit your needs?

- ❑ *Internet*
- ❑ *Email*
- ❑ *Hardcopy*
- ❑ *Other*

d) How should this system differ from other databases?

13) Are there any concerns that you may have with such an information system that would influence your decision to use it? Examples only, please provide your own input.

- ❑ *Data/information integrity*
- ❑ *Completeness of data*
- ❑ *Format of the data*
- ❑ *Cost of the data*
- ❑ *Other*

14) If a coordinated information system containing data on ecosystem components were available, do you feel the quality of impact assessments would be improved?

- ❑ *Yes*
- ❑ *No*

If yes, to what extent?

- ❑ *Significantly*
- ❑ *Moderately*
- ❑ *Minimally*

15) If a coordinated information system containing data on ecosystem components were available, would it result in cost savings in conducting impact assessments?

- ❑ *Yes*
- ❑ *No*

If yes, to what extent?

- ❑ *Significantly*
- ❑ *Moderately*
- ❑ *Minimally*

16) If a coordinated information system containing data on ecosystem components were available, would it result in savings in time required to conduct impact assessments?

- ❑ *Yes*
- ❑ *No*

If yes, to what extent would the time currently required to obtain existing information be reduced?

- ❑ *Significantly*
- ❑ *Moderately*
- ❑ *Minimally*

17) Overall, how would you rate the usefulness of a coordinated information system in the overall conduct of environmental assessments?

- ❑ *Invaluable*
- ❑ *Very useful*
- ❑ *Of some use*
- ❑ *Little use*

18) Current databases are important to the function of a coordinated information system, and will reduce the probability of redundant work being undertaken. Would your organization be willing to contribute data in order to make information more accessible to the environmental assessment community?

- ❑ *Yes*

If yes, what types of information?

- ❑ *No*

If no, why not; what concerns do you have?

19) Who should fund/support the establishment and operation of an environmental information system?

- ❑ *Federal government*
- ❑ *Provincial government*
- ❑ *ENGOs*
- ❑ *Universities*
- ❑ *Consultants*
- ❑ *Proponents*

20) What form do you envision user support to take:

- ❑ *User-pay service by individual request*
- ❑ *User-pay service over a time period (i.e., subscribe to the services for a year or longer)*
- ❑ *A one-time member fee, in addition to fees for individual requests or subscription period*
- ❑ *Users who contribute data to the system get free use or reduced rates*

21) What would you be willing to pay to access information from a coordinated information system?

22) Are there any additional comments you would like to make regarding an environmental information

system?

Thank you for participating in the survey.

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Appendix 5: Glossary

Canadian Geospatial Data Infrastructure (CGDI): offers Canadians easy online access to geospatial databases, applications and services, enabling them to use, combine, analyze, and share this information in support of sound decision making.

Card sorting: method for determining how people sort and group items. Researcher asks users to write elements or items on a card, group the cards, and then name the resulting groups.

Developers: create web-based applications that allow users to interact with the CGDI.

Enablers/Facilitators: enable/facilitate the use of geospatial information by a larger group.

End-users: utilize geospatial data in decision making or business, and rely on applications to produce usable outputs.

Focus groups: groups of 6-12 stakeholders (users, decision makers, etc) are lead in a focused discussion by a moderator; usually in facilities with one-way mirror for viewing.

Framework data: the set of continuous and fully integrated basic geospatial data that provides context and reference information for the country.

GeoConnections: national partnership program led by Natural Resources Canada to evolve and expand the Canadian Geospatial Data Infrastructure (CGDI).

GeoConnections' four priority areas: public health, public safety/security, environment/sustainable development, and matters of importance to Aboriginal peoples.

Geomatics: is the collecting, managing, analyzing and integrating of geospatial data.

Geospatial data: is information that can be mapped or otherwise associated with a particular place, for example, the location of a river, crime statistics for a neighbourhood, or the spread of infectious diseases.

Information architecture: refers to the structure of information and specifically deals with the organization and labeling of content to optimize usability and findability. An effective information architecture allows users to find information quickly and incorporates terms and labeling that are familiar and easily understood by the target audience.

Interaction mechanism: means by which a user interacts with a product or site. An interaction mechanism is anything that allows the user to submit a request for an action to the software application. Examples of interaction mechanisms include; hyperlinks, buttons, menus, right-click actions.

Interviews: Individuals are interviewed by a qualified interviewer who builds trust in order to elicit sometimes sensitive personal or business information.

Marketers: sell or otherwise provide geospatial applications to end-users.

Navigation model: pathway people use to navigate through an application or website. A good navigation model allows users to access information easily and intuitively.

Observational techniques (ethnographic research) i.e. job shadowing, in-home/work observations, field studies. Individuals are observed as they operate in a specific environment. The tasks they complete, interruptions, the order and flow of work are all noted and recorded as unobtrusively as possible. A series of questions may be asked before, during or after the observation period.

Prototyping: process of creating models in order to test concepts/design ideas, interactions, or features to gather early user feedback.

Qualitative research: used to discover participants' views on a particular subject. This type of research is more intuitive and subjective than quantitative methods and groups information into categories rather than numerically. Qualitative research includes analysis of records and documentation, observation of work tasks, interviews, focus groups and community group forums.

Quantitative research: a structured and logical research methodology that can be measured. Includes surveys and questionnaires (telephone, mail or online).

Suppliers: provide geospatial data and web services to the CGDI.

Storyboard: a series of illustrations that capture information in a wire frame format for the purpose of quickly checking an initial draft at workflow and organization. The drawings in a storyboard may represent an interaction with the system, an interaction with another person or a manual step.

Surveys/Questionnaires: can be administered in many ways – independently using paper or comparable electronic means – by an interviewer. A series of questions are formulated by a researcher to get information on specific topics, taking into consideration the medium for administering the survey/questionnaire, interviewer bias and respondent drop off.

Task analysis: done to gain insight into the goals that should be achieved by end users. A task analysis identifies the key steps in a process, including primary and secondary tasks. The results of a task analysis are critical input for product design.

Treasury Board of Canada: a Cabinet committee of the Queen's Privy Council of Canada, responsible for accountability and ethics; financial, personnel and administrative

management; comptrollership; and approving regulations and most Orders-in-Council. The Treasury Board President manages the government by translating the policies and programs approved by Cabinet into operational reality, and by providing departments with the resources and administrative environment they need to do their work.

Usability testing: process of collecting empirical data based on the observation of representative users using the product to perform representative tasks. A facilitator and observer collect quantitative and qualitative data while minimizing interaction with the user.

Usability test plan: describes how the product will be tested, what issues will be addressed, how the issues will be examined, and the required resources. The test plan is a means of ensuring that all stakeholders are on the same page about what will be tested and provides a focal point for the test and the product. In addition, it ensures that other researchers can replicate the study, if need be.

Usage scenario: captures a view of how users typically use a product or service. The information presented in usage scenarios typically come from the user profile and task analysis data that is collected during the UNA.

User-centered design (UCD): involves the input of users at various stages in the design of an application or system to ensure that it is easy to use and meets the needs of its users. UCD examines how an application is used, how people go about doing their work, how they want or need to work, how they think about their tasks, and how often they do particular tasks.

User group: a group of people who share an interest in a topic (or an "issue domain"), who continually interact, and who accumulate and disseminate knowledge. GeoConnections defines a "user group" as a group of users who share common concerns or problems and who might have common requirements of the CGDI. For GeoConnections' purpose, users are equated with end-users - the people/organizations that will benefit directly from the project and use of the information it integrates in order to make informed decisions.

Use case: a technique, used by system developers, for capturing functional requirements of an application or system. Use cases typically capture the interaction between the system and users. Within a use case, users can be end users or other systems.

User interface (UI) design specification: a document that describes the high level or detailed design for the interface of a product. High level designs are documented early in the process and contain descriptions of design alternatives, design questions to be answered and general guidelines that will be followed. Detailed design descriptions tend to include more details with respect to window, screen or page layout and behaviour.

User-needs assessment (UNA): involves discovering and assessing the needs of users in order to meet those needs.

Workflow: shows the flow of tasks in a larger process to meet an end result. Workflows may involve more than one user, tasks or systems.