InterPARES 2 Project

International Research on Permanent Authentic Records in Electronic Systems

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A. Overview

The Cybercartographic Atlas of Antarctica (CAA) Project[1] aims to develop an online atlas using primarily open source technologies portraying, exploring and communicating the complexities of the Antarctic continent for education, research and policy purposes. The CAA will highlight the global importance of Antarctica as the continent of science and peace.

Data from a number of international sources will be incorporated in the CAA. In collaboration with experts from different fields of science, these data will be used to develop theme-specific modules for use by the general public to facilitate knowledge sharing in multi-disciplinary science.

Project research is focused on Human interaction with geospatial information, a topic that has been recognized but perhaps not well addressed by industry and major standards initiatives. The project includes collaborators from a number of disciplines including Cartography, Geography, Psychology, International Studies, English, Cultural Mediation, Music Studies, Industrial Design and Computer Science. The CAA will act as a key object of research for this case study.

Data Collection

It is not the intention of the CAA Project to collect substantive new data but to bring together selected existing datasets in a new multimedia form including experimental work with virtual reality and render these in a dynamic and engaging fashion. Distributed data will be rendered on the fly in maps, charts, tables and text.

A variety of data sources will be used:

- Framework data layers will include remote sensing data such as those collected as part of the Radarsat Antarctic Mapping Project.
- Primary Topographic data will be provided by the Antarctic Digital Database (ADD) project. This vector database, compiled under the direction of researchers at the British Antarctic Survey, is constructed from source maps with scales primarily between 1:100 000 and 1:1000 000.
- A number of other databases will be made available from sources such as: the United States Geological Survey (USGS) Atlas of Antarctic Research, the King George Island GIS (KGIS), Australian Antarctic Division, Wuhan University (People's Republic of China) and many others.
- A number of multimedia objects will be created and included (e.g., video, animation, sound, etc.).
- Refer to Appendix K for a complete list of data sources.

Data Connectivity

Recent specifications proposed by the Open Geospatial Consortium (OGC) (see Appendix N) and the International Organization for Standardization (ISO) (see Appendix P) are enabling the development of the "spatial Web" (Moses, 2003). This spatial Web is making it possible for users to easily find, access and process digital geospatial data over the Internet. The CAA is

[1] For additional information refer to the CAA Project Internet site at http://www.carleton.ca/gcrc/caap/. For additional overview information refer to the case study 06 proposal at http://www.interpares.org/display_file.cfm?doc=ip2_cs06_proposal.pdf.

being built to OGC and ISO specifications, mapping Antarctic data in real time from distributed and remote data sources (see Appendix L).

The CAA is based on the Web services architecture that underpins the spatial Web. In keeping with the project's cybercartographic framework, text and multimedia content will be delivered using the same architecture (see Appendices L, M and O).

The ability to search for and discover data resources is integral to developing CAA content modules. To improve access to data, the Geomatics and Cartographic Research Centre (GCRC) has recently agreed to help develop the Antarctic Data Directory System (ADDS), a project initiated by the Joint Committee on Antarctic Data Management (JCADM). This directory system can facilitate data sharing between the CAA Project and the global Antarctic science community. In addition all data and multimedia information objects on the project will include metadata (see Appendix P).

For details, refer to Section D, below.

Analysis

The analytical capacity of the CAA will be developed through the use of cartographic visualization. In this context, cartographic visualization refers to the use of new map forms that provide dynamic visual representations within the sciences for which geo-referenced representations are critical (geography, geology, ecology, hydrology, meteorology, and others). These new map forms may include cartographic animation, three and four dimensional simulations (i.e., Virtual Reality) and the use of sound, text, hypertext, etc.

Applications

Research and development will include three user groups: the general public, policy makers and scientists. For a general public audience, a preliminary analysis has established a focus on the development of CAA modules for pedagogical purposes. Learning modules incorporated into the CAA will provide a thematically based synthesis of information. To develop this component, a partnership has been established with an Ottawa-area group of educators, Students on Ice. Human Oriented Technology Laboratory (HOTLAB) researchers are working with staff at Students on Ice to evaluate user needs.

The *Protocol on Environmental Protection to the Antarctic Treaty* calls for the capacity to assemble and display:

- information on environmental characteristics;
- past, current or proposed activities and their impacts;
- a means of monitoring and displaying changes; and
- the results of response actions and assessment of impacts for management of liability decisions.

The methodology proposed for developing the CAA has the potential to support these requirements. The CAA also aims to meet the needs of scientists who require a tool that can acquire, integrate and analyze geospatial information on Antarctica in a context of multidisciplinary and collaborative science. The lead researcher at GCRC is developing a module to evaluate effectiveness of a cybercartographic method in this context.

B. Statement of Methodology

The primary information-gathering tool for this case study has been the InterPARES 2 case study questionnaire, comprised of 23 questions. A copy of the Interview Protocol, questionnaire and the consent forms are available in appendices A, B and C. Two sets of semi-structured interviews at two different development stages of the CAA Project were conducted. The first set of interviews took place in November 2003, in Ottawa at the Geomatics and Cartographic Research Centre (GCRC), Carleton University. The respondents were the primary investigator, a technical specialist, a researcher on the CAA and a researcher involved in other aspects of research CANE project. The second set of interviews was conducted in the spring of 2005. The same group was interviewed. Respondents also reviewed the final responses to the 23 questions included in this report.

Two interviewers were involved in data gathering, Yvette Hackett, Library and Archives Canada and Tracey P. Lauriault, PhD Candidate, GCRC. The first set of interviews was digitally recorded using a hand-held Sony IC Recorder Digital Voice and associated Sony Editor Software. These interviews were subsequently transcribed. The second set of interviews was for clarification and follow-up only and was not recorded.

During the interviews, respondents referred to documents to clarify concepts. These are included in the appendices and will be referred to where appropriate in the body of this report.

C. Description of Context

Juridical-Administrative context[2]

The CAA Project is subject to the rules and procedures governing SSHRC grant recipients. As well, the project operates within the jurisdiction of Carleton University and its rules and regulations.

The CAA Project is being led by the Geomatics and Cartographic Research Centre (GCRC),[3] an organized research unit (ORU) in the Department of Geography and Environmental Studies at Carleton University, Ottawa, Canada. The CAA is a key deliverable of a larger research project entitled *Cybercartography and the New Economy* (CANE). D.R. Fraser Taylor is the primary investigator of the CANE project. This 4-year project commenced in January, 2003 and is funded by the Social Sciences and Humanities Research Council (SSHRC) of Canada under the Initiative on the New Economy (INE) program. A significant portion of the CAA Project infrastructure is funded by the Canada Foundation for Innovation (CFI).

Key legal issues include intellectual property and copyright. Antarctic Data fall under the Antarctic Treaty system and can be used, at no cost, for non-commercial research purposes. The data and related research can be used in the CAA with full acknowledgements and references. Most datasets are accompanied by metadata and these are included in the CAA. Digital multimedia information objects (e.g., video clips, photos, audio, Web cams, etc.) would also be fully referenced and include metadata embedded into the object and/or accompanying the object and/or referenced as a caption and acknowledged in the bibliography of each content module.

[2] The juridical-administrative context can be defined as the legal and organizational system in which the creating body belongs, as indicated by laws, regulations, etc. belongs. *InterPARES 1 Template for Analysis, Appendix 2, Final Report of the Authenticity Task Force,* http://www.interpares.org/display_file.cfm?doc=ip1_template_for_analysis.pdf.

[3] See http://www.carleton.ca/geography/geography/Taylor_research.html#Geomatics.

The CAA is primarily for educational purposes and poses no health or safety risks to the user. The accuracy and reliability of the content and how it is represented are reviewed according to typical academic and professional criteria of the disciplines and individuals involved (see Appendix P for a list of standards adhered to the project and Appendix T for data quality).

The CANE project has a commitment to an open source philosophy, interoperability and the adoption of and adherence to standards.

Provenancial context[4]

The GCRC's research focuses on Geographic Information Processing (GIP), Multimedia Cybercartography, Visualization and Remote Sensing, and the application of information and communications technologies in an international context. It has capacity in a broad range of activities in the GIP field in addition to its main research focus, including consulting expertise.

The research and development of the CAA is being carried out in partnership with a number of research laboratories at Carleton University and in collaboration with an international team of Antarctic scientists and multimedia visualization experts who will share their expertise, laboratories, human resources and data with the project.[5]

In addition to Dr. D.R.F. Taylor, thirteen collaborators and an Advisory Board guide the project. At any given time, approximately twenty doctoral and master students, with two Post Doctoral Fellows are actively engaged in the management, research and development of many aspects of the project. In addition, the project hires technology specialists and cooperative students. The project also has a Project Manager and an Assistant Office Administrator. Other departments at Carleton University also collaborate informally by providing research opportunities to their students (e.g., the School of Industrial Design's 4th year project). The project operates according to a flexible matrix structure composed of task/theme-based cluster groups (see Figure 1).

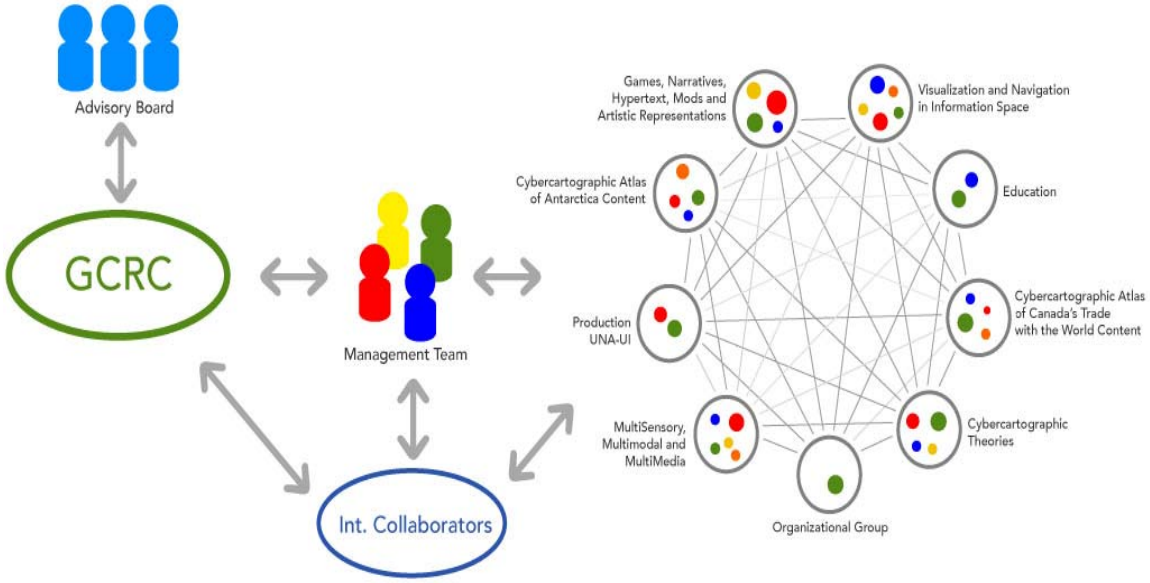

Figure 1. Cybercartography and the New Economy Organizational Chart

[4] The provenancial context is defined as the creating body, its mandate, structure, and functions. Indicators include organizational charts, annual reports, the classification scheme, etc. *InterPARES 1 Template for Analysis, Appendix 2, Final Report of the Authenticity Task Force,* http://www.interpares.org/display_file.cfm?doc=ip1_template_for_analysis.pdf.

[5] See the project proposal at http://www.carleton.ca/geography/geography/Taylor_research.html.

Additionally, the CAA Project involves numerous stakeholders, data providers and partners from industry, government and non-governmental organizations both in Canada and a number of other countries (see http://gcrc.carleton.ca and Appendices K - List of Data Sources and M - Atlas Framework). The CAA Project involves the following partners:

- Argentina – CENPAT
- Australia – Data Centre and Atlas, Australian Antarctic Division
- Canada – Canadian Committee for Antarctic Research
- China – Chinese Antarctic Center of Survey and Mapping
- Germany – IPG, Universite Freiburg
- United Kingdom – British Antarctic Survey
- United States – Scientific Committee on Antarctic Research (SCAR); SCAR Geoscience Standing Scientific Group; Atlas of Antarctic Research and Joint Committee on Antarctic Data Management (JCADM)

The CAA will be a dynamic, interactive, Internet-based, open source product to prototype the concept of Cybercartography. The historical evolution of the project highlights its collaborative nature beginning with the Canadian Committee for Antarctic Research (CCAR), which discussed and approved the CAA Project in 1999. The CAA concept was later presented to the SCAR Working Group on Geodesy and Geographic Information (SCAR WG-GGI) meeting in Tokyo, in July 2000. The project was also presented to the Antarctic Treaty's Committee for Environmental Protection (CEP) in Amsterdam in September 2001. Finally, two Cybercartographic Antarctic Workshops, held in Argentina (November 2001) and Ottawa (May 2002), were attended by leading members of SCAR, particularly scientists from the domains of biology, geodesy, geology, and geo-visualization expertise from Australia. The project was officially re-endorsed as a SCAR project in July of 2002. Since then a number of workshops, conferences and meetings with SCAR members and other partners have taken place.[6]

Procedural context[7]

The CAA is a cybercartography proof of concept online product. The development of formal guidelines and procedures is an important aspect of the project itself. The Lead Researcher (Peter L. Pulsifer, a PhD student at GCRC) creates content modules and coordinates activities with the MA students, the post doctoral fellow and between and among external research partners and collaborators. MA students also create content modules for the CAA. Research, requirements, and specifications are communicated to the technology specialists, and together with content creators they are developing the projects architecture and framework. The CAA user interface (UI) was developed in collaboration with the Human Oriented Technology Laboratory as part of the iterative User Needs Analysis, interface design and human factors testing process. The final UI design was done by a student from the School of Industrial Design and its implementation is being carried out by the technology specialists. Within the project, procedures are discussed in the GCRC online forum, the project wiki and in meetings (see Appendices U, V, W and Y). For additional process and technological information on how the CAA works, see core research questions 4, 5, 6 and 8 in Section D, as well as Appendices M, L and O.

[6] See workshop documentation at http://www.carleton.ca/gcrc/caap/meetings.htm or papers at http://www.carleton.ca/gcrc/caap/documents.htm.

[7] The procedural context includes the business procedure in the course of which the digital entity is created, as illustrated by workflow rules, codes of administrative procedure, classification schemes, etc.

Documentary context[8]

The CAA falls within the Carleton University fonds, as part of the Department of Geography and Environmental Studies series, and GCRC sub-series. It is possible, upon completion of the project that the CAA will be transferred to SCAR.

Technological context[9]

The CAA is, to the extent currently possible, an open source and standards-based interoperable Internet product. It also includes some proprietary format multisensory, multi-media, multimodal and interactive technologies. Additional details are available in Section D.

D. Narrative Answers to the 23 Core Research Questions

1. What activities of the creator have you investigated?

We have examined all aspects of a project that is developing a CAA. Cybercartography is a new theoretical construct in cartography that uses spatially referenced information on a wide variety of topics of interest and use to society and expresses them within online digital mapping conventions and newly developed multisensory, multimedia, multimodal and interactive innovations designed to improve searching and learning outcomes for users.

First, the project generates a wide range of traditional record forms using office automation tools such as word processing for minutes and reports; databases for bibliographies; spreadsheets for financial or time management planning, etc.

Second, the CAA is a Web-based product that will use the full extent of Internet technologies available today. The project gives preference to open-standard products and formats, and to develop procedures, practices and tools that will minimize the loss of data to technological obsolescence.

Both these activities occur within a technical infrastructure developed specifically to support the project.

2. Which of these activities generate the digital entities that are the objects of your case study?

The creation of the Cybercartographic Atlas of Antarctica (CAA).

3. For what purpose are the digital entities you have examined created?

The purpose is to inform and educate users about Antarctica and its relationship to the global environment. The CAA allows the integration of georeferenced data sources from a variety of scientific and cultural disciplines. This organizes the information by location, allowing the user to visualize, hear, touch, and potentially smell patterns of change across time and space. The

[8] The documentary context is the fonds to which the digital entity belongs and its internal structure, as illustrated by classification schemes, record inventories, indexes, registers, etc.

[9] The technological context includes the characteristics of the digital environment in which the record is created and maintained.

project aims to extend digital mapping conventions to improve searching and learning outcomes for users.

To quote Respondent #1: "...taking the information, organizing it through space, looking at patterns, location, movement, process and modeling in order to make this scientific information more understandable and useful to a variety of different audiences" (Interview, November 2003).

4. What form do these digital entities take? (e.g., e-mail, CAD, database).

For the purpose of this case study, the overall digital entity is a multimedia cybercartographic atlas, constructed using primarily open source Web-based technology including some proprietary multimedia information objects. It is constructed from a wide variety of digital components.

4a. What are the key formal elements, attributes, and behaviour (if any) of the digital entities?

The information expressed is primarily cartographic, according to the functionality of each of the file types below.

- Text
  - HTML
  - XML with XSL style sheets
  - Feedback / comment forum or blog
- Databases
  - PostgreSQL - open source
  - PostGIS (e.g., polygons, etc.) - open source
  - Excel spreadsheet (scientific numeric data, e.g., local databases)
  - ESRI EOO (e.g., Antarctic Digital database)
  - Flat binary (e.g., National Snow and Ice Data Center (NSIDC) at NASA)
- Graphics (e.g., remote sensing data, terrain models, Digital Elevation Models (DEM), Radar data, pictures, etc.)
  - 2-dimensional - BMP
  - 2-dimensional - GIF
  - 2-dimensional - JPEG
  - 2-dimensional - TIF
  - 2-dimensional - PNG
  - 2-dimensional - GEOTiff
  - 3-dimensional - VRML and the viewer(s) required to access it (e.g., Cortona or other that works with Firefox and Mozilla Browsers)
- Sound
  - OGGVorbis - open source
  - WAV
  - AIF
  - AU
- Moving images
  - Quicktime
  - MPEG4
- Animation
  - SVG (Scalable Vector Graphics) - open standard

    - Flash
- Virtual reality fly-through
    - VRML or video
- Games
    - Online quiz
- Programming languages and technical specifications
    - Javascript
    - Java
    - SVG
    - DHTML
    - XML (schema files)
    - GML (Geographic Markup Language)
- VRML (Virtual Reality Modeling Language)
- Haptics (e.g., a vibrating mouse, shaking chair, force feedback devices) feasible if creator wishes to do so
- Operating System, Middleware
    - Linux Redhat Enterprise V4
    - Apache Server - open source
    - TomCat - Java - open source
    - PROJ - open source
    - GEOS - open source
    - GeoServer - open source
    - Deegree - open source
    - Java SDK - open source
    - XML Libraries - open source
    - WFS
    - WMS/WCS

For additional details about the digital entities in use, please consult the following appendices:

- Appendices H and I - Software and hardware lists
- Appendix J - Mime Encoding of Project Software
- Appendix K - List of Data Sources for the CAA
- Appendix M - Atlas Framework, Model and File Types - Freiburg Paper and Presentation

4b. What are the digital components of which they consist and their specifications?

Given the complexity of the CAA, it is not possible to list all the digital components or their individual specifications. The diagram below (Figure 2) illustrates the overall technical architecture of the CAA. See Appendices O and Q for additional information on how the CAA works and its development.

4c. What is the relationship between the intellectual aspects and the technical components?

The technical components generate the interactivity specified within the content modules. For example, a map can be associated with text, another map, a chart, a timeline, a legend or

any combination of the above. Components can be hyperlinked to other components of the module.

Interactivity can involve dragging a handle across a timeline that is associated with a map or a diagram, to see change over time, such as the path of a journey and its duration, boundary shifts or changes in ice extent. A mouse-over can activate music, sound effects, narration, highlight associated colour and text, or change the background. Sound levels can be adjusted and turned on and off. By right clicking on the map, you can carry out a number of operations such as Zoom In, Zoom Out, and Original View. Two-dimensional (2D) fly-throughs enable users to access more information not expressed in the basic map animation. Users can click onto the map and "fly" over land and ocean. Similar functions can be performed with some maps and 3D objects.

Maps (graphics) are designed in Illustrator or in ESRI (based on shapefiles) and a working prototype was done in Flash, while the current version on the CAA was produced with SVG. The SVG plug-in supports the use of interactive Web-based graphics. A SVG viewer (such as Adobe SVG Viewer (ASV)) or a VRML viewer (Cortona) is required to support interaction with 3D objects. In addition, graphics are generated automatically by the Atlas Framework using WFS and WMS, which are OGC compliant protocols. To view graphics, one must use the SVG-enabled Mozilla browser.

4d. How are the digital entities identified (e.g., is there a [persistent] unique identifier)?

There are no unique and/or persistent identifiers, and there is no formal ID lookup system

- The digital objects are identified by a unique combination of a file name and a location in the system
- Some objects are identified in databases, with location information included with other metadata (see question 22 below).
- There are also some metadata embedded within some digital objects. The modules are associated with metadata. Within a module, metadata are available to reference any entity via a citation.
- Some of the maps will have embedded Geographic Markup Language (GML) to link to and describe related geo-referenced objects such as images or sounds.
- A multimedia metadata schema is being developed. Some of the elements will be embedded within the information objects themselves and some will be linked to the object. This will become a part of the Authors Toolkit, which includes a template of the XML schema that is completed by the content creators.

4e. In the organization of the digital entities, what kind of aggregation levels exist, if any?

Content creators aggregate at the module level. Each module is an XML-tagged document validated against a schema developed by GCRC. The CAA's technical specialists aggregate by file type (HTML, SVG, etc.). See Appendix R for a detailed description of this process.

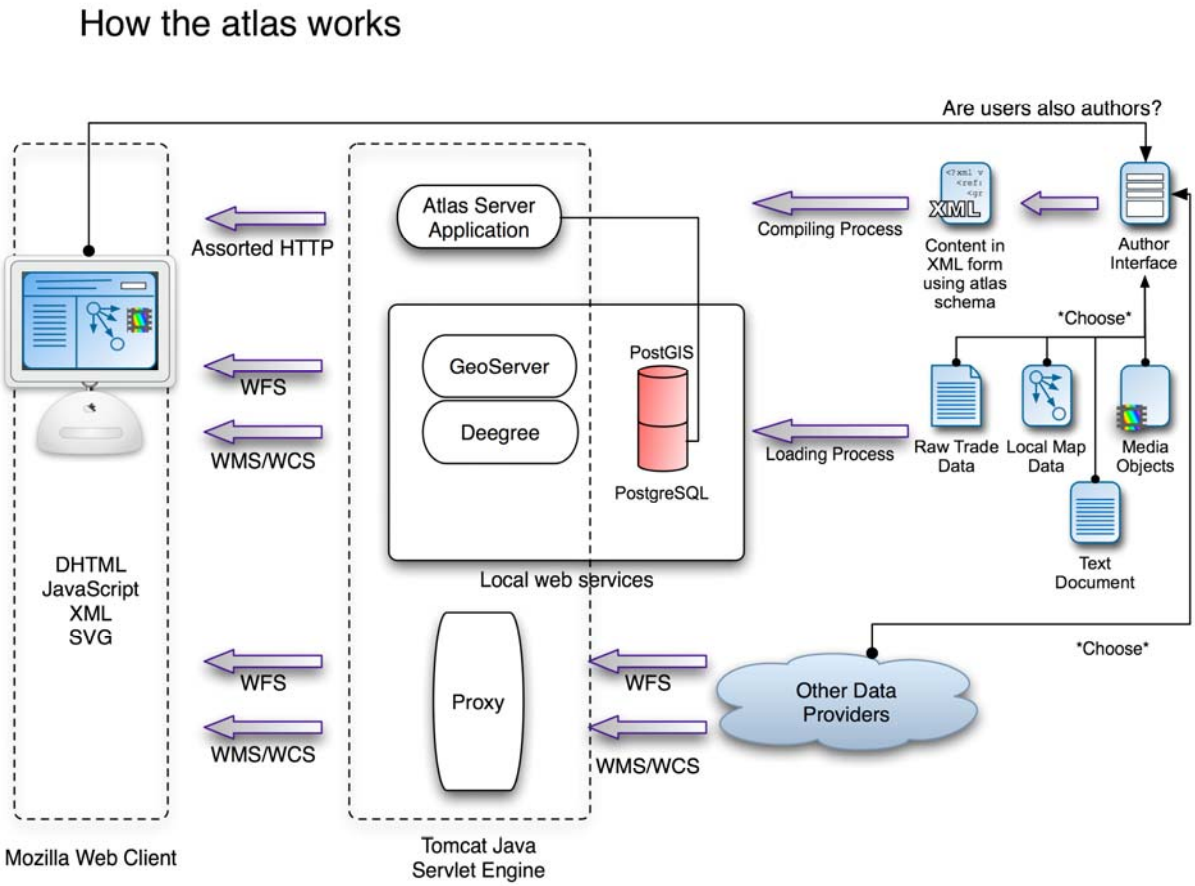

Figure 2. How the Atlas works
Diagram created by Amos Hayes, GCRC, 2005

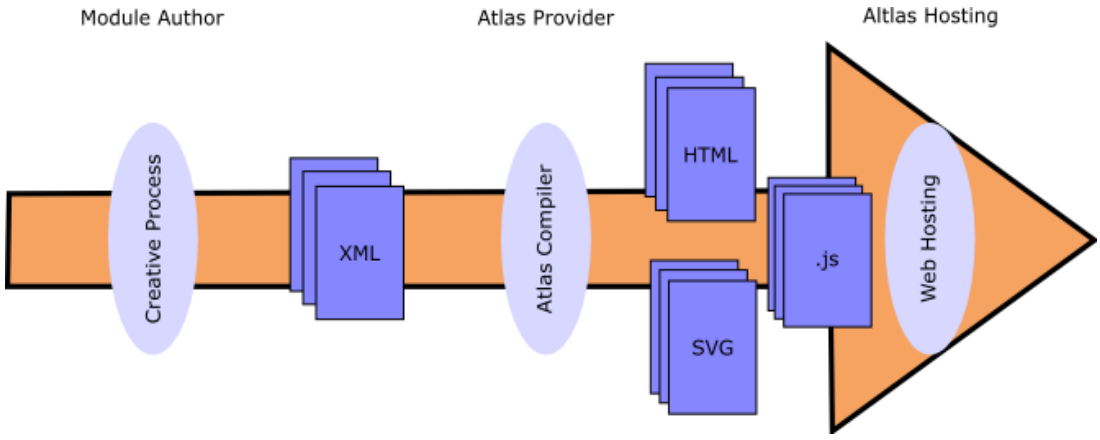

Figure 3. Process diagram
Image created by J.P. Fiset, GCRC, 2005

4f. What determines the way in which the digital entities are organized?

The content creators determine how the content modules are organized in their personal work environments. Creators also submit instructions that explain the intended functionality and how the data are to be represented (e.g., colour, font, lines, etc.) or a working model in the creator's chosen software is provided. Currently these are shared verbally with the CAA's technical specialists, posted on the project's wiki or in the GCRC online forum.

The CAA's technical specialists organize the compiled modules within the structure/ architecture of the CAA, which is based on technological issues that drive how the various entities are rendered. At the moment the project does not have either the financial or human resource capacity to write a specification or technical manual. A process is in place to seek resources to do so.

5. How are the digital entities created?

In the creation of the CAA, the intellectual aspects of content creation and the technology that renders the creators' intent are separate. CAA content modules are developed by content creators in such a way that the linkages between the information objects, their functionality and associated metadata are described in an XML document (created within the specified XML project schema), where the mark-up language indicates what to display.

The XML document is processed by a compiler operated by one of the CAA's technical specialists. They also create other programs or "widgets"[10] that are part of the CAA's functionality. They are also responsible for integrating all digital components into the Web-based product, including data from external sources (e.g., Antarctic Digital Database).

Also see Appendix S.

5a. What is the nature of the system(s) with which they are created? (e.g., functionality, software, hardware, peripherals, etc.)

Overall, it is a Web-based, or Web-enabled environment, using primarily open source software. See question 4a above for a list of the major digital entity types used in the CAA. In addition, Appendices H and I list all hardware and software being used in the CAA.

Some examples of specific functionalities include:

- Flash, which enables dynamic multimedia
- ARCGIS, which enables the creation of maps and related base map layers
- VRML, which enables the creation of 3D objects

A number of viewers exist to render VRML created objects.

5b. Does the system manage the complete range of digital entities created in the identified activity or activities for the organization (or part of it) in which they operate?

No. External data sources exist outside the system. Open Geospatial Consortium (OGC) specifications enable access to data held by outside institutions (see Appendix M for specifications for other institutions and Appendix N for OGC information). Content modules, although they are still under the control of the content creator, also exist outside the system.

[10] In Web mapping, examples of "widgets" are: interactive timelines, map legends, a sound activator, etc.

6. From what precise process(es) or procedures, or part thereof do the digital entities result?

Content creators work on personal computers that can be hooked up to a network environment developed to support project work. This offers shared storage space and access to specialized software, hardware and data.

Content files are often initially developed in a software environment selected by the creator. For the content to enter the CAA, it must be normalized within the parameters of a special XML schema designed for the project, which consistently contains content, embeds metadata and includes links to additional content generated in "project-approved" file formats.

If approved for inclusion in the CAA, there is a formalized process to get geospatial data into a standard Open Geospatial Consortium (OGC) framework. Content modules are provided to technical specialists who run the content of an XML schema file through a compiler to convert it to language that meets the technical parameters set for the project.

It is hoped that future module creators will be able to select data, send specifications, etc. in OGC compatible formats. Also, an Authors Toolkit is in production that will enable external, authorized content creators to add content directly to the online CAA.

7. To what other digital or non-digital entities are they connected in either a conceptual or technical way? Is such a connection documented or captured?

In addition to the content creators' design documents, there is also an overall relationship between the CAA Project and operational records, but it is conceptual in nature. This includes standard administrative documents such as contracts and correspondence, as well as minutes, reports and other documents that direct the intellectual and technical framework of the CAA. Proof of concept products also exist to inform design and functionality.

There is another body of records being generated by the Human Oriented Technology Laboratory (HOTLab) that supports developments in the navigation and user interface design of the Web-based product (requirements and specifications).

Material is also being digitized (e.g., scanned material) for use in the CAA. The hard-copy source material would be cited, as a requirement of copyright.

8. What are the documentary and technological processes or procedures that the creator follows to identify, retrieve and access the digital entities.

Individual content creators define their own processes and procedures to the point that they need to integrate their content module into the CAA (e.g., integration into the XML schema). Content in non-digital formats or external to the project are fully referenced.

Any digital object that forms part of the CAA must be described by the creator, using metadata standards adopted or developed by the project. See question 20, below and Appendix P, which includes the project's metadata standards.

Retrievability of, and access to, the digital objects are based on a number of adopted OGC interoperability specifications (see Appendices P and N).

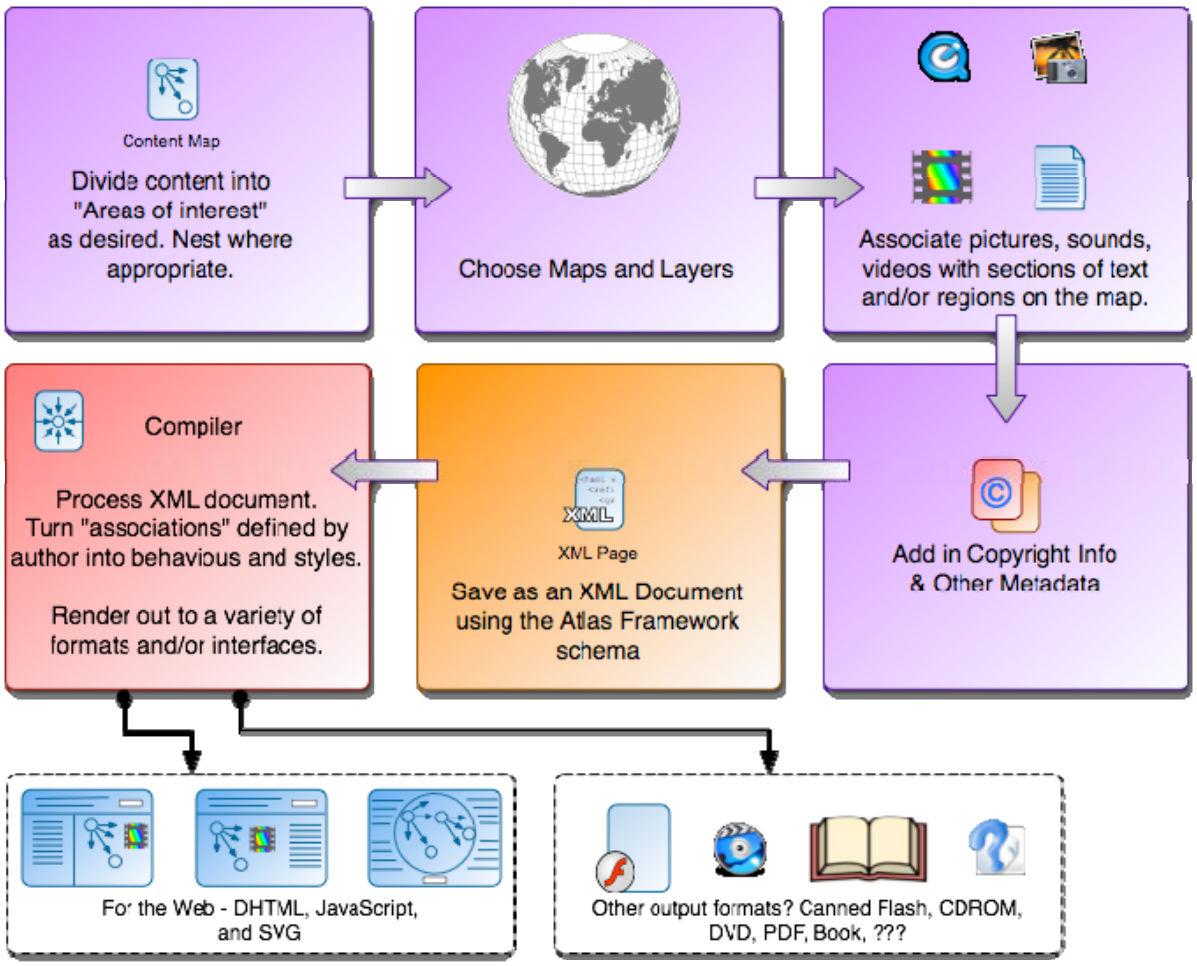

Figure 4. Atlas content flow diagram
Image created by Amos Hayes, GCRC, 2005

9. Are those processes and procedures documented? How? And in what form?

Official standards are fully documented; see questions 20 and 23 for details.

The project itself is in the process of developing a number of processes and procedures to govern the project such as:

- The Author's Toolkit
- A Designer's Manual (planned; see Appendix O as a working example)
- Training courses (e.g., Appendix Q - Presentation)
- Draft and final documents captured on the GCRC online Forum (Appendix V), or the project's wiki (e.g., minutes of content or production meetings) and on the GCRC communication Web site (Appendix Y).
- Shared practices

Finally, subject specialists (e.g., geologists, musicians, biologists, etc.) and technical specialists (e.g., programmers, security, etc.) would, to the extent applicable, follow procedures

and practices defined by their disciplines and professions and also adhere to the standards therein.

10. What measures does the creator take to ensure the reliability and authenticity of the digital entities and their documentation?

Data are acquired from authoritative sources and are peer-reviewed (e.g., British Antarctic Survey, Scientific Committee on Antarctic Research, scientific and academic journals and books, etc.). Each would have been assessed against the Elements of Spatial Data Quality, which include:

- lineage
- positional accuracy
- attribute/thematic accuracy
- completeness
- logical consistency
- semantic accuracy
- temporal information

See Appendices T and K for the list of data sources.

Authenticity in geography is captured in standard metadata as data lineage. Quality measures are dependent on the type of data and their function (e.g., the acceptable margin of error for the precise location and size of a particular ice flow to inform tourist ships is smaller than fish counts to inform fisheries and ecological modeling). In addition, each scientific domain is governed by their particular data quality standards, measures and assurances and these are included in the metadata. Appendix P includes a list of such standards).

Within the geomatics profession, certain data management practices have been adopted that ensure quality, reliability and authenticity of geospatial datasets. Key elements in the metadata identify characteristics such as scale, accuracy, age, limitations on use and other important facts about the dataset. Furthermore, as defined in question 9 above, other disciplines and professions represented in this project also have established procedures and practices to ensure data quality, reliability and authenticity.

The online CAA production environment is protected by security measures such as physical security and password protection. Access to the CAA itself is restricted to the CAA's technical specialists (see question 8 for a description of the creation and production processes).

Some metadata will be embedded into information objects; additional metadata will be linked to the objects at the module level (see questions 4d and 23).

The CAA will have its own domain name and a trademark with branding. GCRC researchers oversee the modules, providing additional checks and balances.

11. Does the creator think that the authenticity of his/her digital entities is assured and if so, why?

Yes, because of the various measures described in this section (questions 6, 8, 9 and 10). In the future, the formalization of module approval will further ensure the authenticity of the CAA's content, as will the implementation of the SCAR's proposed editorial function.

12. How does the creator use the digital entities under examination?

The CAA's creators use some of the digital entities to continue to build and update the Atlas. The balance of digital entities, which comprise the Atlas itself, are made available to those consulting the CAA.

13. How are changes to the digital entities made and recorded?

Once something is integrated into the CAA, only the CAA's technical specialists can add or modify online content. New material would generally be provided by content creators. Modifications could also be related to the correction of technical problems identified on the site.

Changes to the code are captured in Subversion, a source repository system used by the project. Subversion maintains all code, and all versions of that code are tracked. Subversion is from Tigris.org—it is an open source content versioning system (CVS) for use with the most popular operating systems. The Subversion database is backed up regularly. Other digital objects that form part of the CAA are not captured by Subversion.

The Authors Toolkit will eventually allow changes to associated metadata to be tracked as well.

14. Do external users have access to the digital entities in question? If so, how? And what kind of uses do they make of the entities?

External users have no access to the production environment in which the CAA is created. External users have access, via the World Wide Web, to the CAA. Access to the raw data used to create content such as maps, bar charts, etc. may be restricted by the original data provider through copyright or use agreements. Much of the data that goes into creating maps is available world-wide via WFS, is described in the metadata and may be accessible via a variety of data portals / catalogues and directories (see Data Sources in Appendix K and question 6).

Scientists, students, educators, politicians and Web users would access the CAA to learn about Antarctica. The Web site allows users to:

- Search
- Follow hypertext links
- Construct a view of a map by selecting layers & features, time periods, themes, etc.
- View live webcam feeds
- Navigate virtual reality and terrain models
- Play games
- Listen to audio content, view videos, etc.

In future, users may be able to replicate any of the code used because of the open source philosophy of the project.

15. Are there specific job competencies (or responsibilities) with respect to the creation, maintenance, and/or use of the digital entities? If yes, what are they?

Content creators and CAA's technical specialists have specific job competencies related to the technology or to their subject specializations.

Short-term maintenance during the production phase is primarily the responsibility of the technical specialists at the GCRC.

The CAA is designed to be accessible to all World Wide Web users, with no special skill sets required.

16. Are the access rights (to objects and/or systems) connected to the job competence of the responsible person? If yes, what are they?

Yes. Access to the production environment is currently limited to the CAA's technical specialists. Access to the CAA is unrestricted.

17. Among its digital entities, which ones does the creator consider to be records and why?

The creator considers every digital object connected to the CAA, its creation, its funding and its dissemination activities to be important. These include all the items listed in question 4a and the operational records and related research records described in question 7.

Of particular importance to the long-term viability of the CAA are the XML-tagged content modules created by the content creators. These are considered the "master" content element. They are processed via a compiler to make them Web-ready. Should the technology platform of the CAA change, the content of the Atlas would be re-built by re-accessing the XML content modules and processing them anew through a new compiler. Although this method will not protect all information objects included in the CAA (e.g., sound, video, Flash, etc.), it should facilitate forward migration of the essential content, presentation information and intended functionality. Proprietary problems remain with some multimedia formats used in the CAA.

18. Does the creator keep the digital entities that are currently being examined? That is, are these digital entities part of a recordkeeping system? If so, what are its features?

Yes, the creator keeps the digital entities under examination but they are not part of a recordkeeping system. They are currently kept in the production environment for the CAA, which has no useful recordkeeping features beyond version control and backup capability (see question 13). The backup is done completely every six weeks, and only changes are backed up daily. The backup copy is kept onsite.

A new open source "enterprise wiki" called Confluence is being implemented to improve access and collaboration.[11] Given this functionality however, this product is not likely to improve the recordkeeping practices of the project.

The related operational records described in question 7 are on a shared server in a recordkeeping system.

18a. Do the recordkeeping system(s) (or processes) routinely capture all digital entities within the scope of the activity it covers?

Not applicable.

18b. From what applications do the recordkeeping system(s) inherit or capture the digital entities and the related metadata (e.g., e-mail, tracking systems, workflow systems, office systems, databases, etc.)? digital entities?

Subversion captures the CAA code (see question 13). Backup procedures capture digital objects other than code at timed intervals. Backup is costly, as it takes time and tapes are

[11] Wikis are named after the Hawaiian word for "quick.". As described on the Confluence Web site (http://www.atlassian.com/software/confluence) "a wiki is a Web site that makes it easy for anyone to contribute pages, and link them together. A wiki makes it as simple to edit a page as it is to read it, and thus makes for the perfect online collaboration tool."

very expensive. Confluence will probably also be backed up at regular intervals, once operational.

18c. Are the digital entities organized in a way that reflects the creation processes? What is the schema, if any, for organizing the entities?

There is no information at this time about how the digital objects are organized within Subversion, or within Confluence.

18d. Does the recordkeeping system provide ready access to all relevant digital entities and related metadata?

Not applicable. Digital objects for which metadata have been captured are easier to re-access (see questions 8 and 9).

18e. Does the recordkeeping system document all actions/transactions that take place in the system re: the digital entities? If so, what are the metadata captured?

Not applicable.

19. How does the creator maintain its digital entities through technological change?

Use of open source software will make the CAA more sustainable than if proprietary products were being used. If, for example, PostGIS becomes obsolete, its open source nature requires that future specifications and standards include earlier versions. Migration should be easier since the technology evolves but does not become obsolete

Also, content modules can be re-compiled. The use of XML for the content modules should make the CAA easily translatable (via new compilers) into any future mark-up languages (see question 13 and 17).

19a. What preservation strategies and/or methods are implement, and how?

Beyond what has previously been discussed (see questions 13 and 17), the Carleton University Library is working with the project to attempt to archive the CAA, as it exists at the end of the project, as per SSHRC requirements.

19b. Are these strategies or methods determined by the type of digital entities (in a technical sense) or by other criteria? If the latter, what criteria?

Specific strategies or methods are to be determined. It is expected that SCAR will take over responsibility for the long-term maintenance and future development of the CAA at the end of the SSHRC project. The limitations are human, financial and institutional resources, as well technical capacity.

20. To what extent do policies, procedures, and standards currently control records creation, maintenance, preservation and use in the context of the creator's activity? Do these policies, procedures, and standards need to be modified or augmented?

Previous answers have referred to the project's open source philosophy. A number of policies, procedures and standards have been adopted by the project, are in development by the project or will be adopted by the CAA's technical specialists as time permits. For example:

- Creator content modules: see questions 5 and 9

- Backup procedures: see question 18
- Technical manual: see questions 4f and 9
- Metadata standards adopted or developed by the project: see questions 4d and 22, and Appendix P
- Open GeoSpatial Consortium (OGC) Interoperability specifications (see Appendices N and O) (e.g., to access datasets from external servers, see list of datasets in Appendix K)
- User interface: Structured Query Language (SQL)

Given the innovative nature of the project, these policies, procedures and standards are in constant need of review and modification (e.g., introduction of the wiki Confluence).

21 What legal, moral (e.g., control over artistic expression) or ethical obligations, concerns or issues exist regarding the creation, maintenance, preservation and use of the records in the context of the creator's activity?

All standard intellectual property concerns apply. They are being primarily addressed by metadata. These include license agreements, use rights to objects and data, and copyright.

The CAA itself includes use caveats and disclaimers (e.g., the CAA is intended for information, not navigation purposes).

Professional competencies dictate a wide range of sound academic ethical practices related to content creation and maintenance of the technological environment (see questions 8 and 9).

The project must also adhere to the requirements of the funding agency and Carleton University.

22. What descriptive or other metadata schema or standards are currently being used in the creation, maintenance, use and preservation of the recordkeeping system or environment being studied?

- ISO 19115 GeoSpatial Metadata standard
- GCRC Multimedia Metadata standard (developed by the project—Y. Zhou, Master's thesis on this topic entitled: "Profiling and Visualizing Metadata for Multimedia Information in a Geospatial Portal"). An abstract of Zhou's thesis is available in the Description Cross-domain Research Questions in Section E, below.
- Federal Geographic Data Committee (FGDC) metadata standard
- British Antarctic Survey DIF or Directory Interchange Format for the Antarctic Digital Database

23. What is the source of these descriptive or other metadata schema or standards (institutional convention, professional body, international standard, individual practice, etc.)?

- International Standards Organization (ISO)
- Open Geospatial Consortium (OGC)
- Scientific Committee on Antarctic Research (SCAR)
- Geomatics and Cartographic Research Centre (GCRC)
- DIF Format (see http://gcmd.gsfc.nasa.gov/User/difguide/difman.html for details).

- The CAA Project itself: Y. Zhou, Master's thesis on this topic entitled: "Profiling and Visualizing Metadata for Multimedia Information in a Geospatial Portal"). An abstract of Zhou's thesis is available in the Description Cross-domain Research Questions in Section E, below.

E. Domain and Cross-domain Research Questions

Many questions are difficult to respond to in their entirety as most would be best answered by domain researchers or archivists. In addition, Domain responses are best developed within domains in comparison with other case studies. Keeping these limitations in mind, the following are partial responses based on the responses to the 23 questions, the case study context or comments related to the geomatics sector in general.

An Excel spreadsheet that mapped the Domain questions to the case study questions was produced by InterPARES 2 researchers. This spreadsheet accompanies this report. Although useful, it should only be used as a rough guide, as in this case study, some of those mapped responses are less relevant than the references provided along with each question as follows. The following responses include suggested references to what are thought to be the relevant case study answers and appendices.

Domain 1 Research Questions

Domain 1, Question 1: What types of documents are traditionally made or received and set aside (that is, created) in the course of scientific activities that are expected to be carried out online?

The history of cartography is very long, complex and multifaceted. The following are useful references that present its evolution:

- *The World Through Maps: A History of Cartography*, by John Rennie Short (Toronto: Firefly Books, 2003).
- NCGIA Core Curriculum 1990 Version History of GIS Module, available at http://www.geog.ubc.ca/courses/klink/gis.notes/ncgia/u23.html#UNIT23.
- *The History of Geographic Information Systems: Perspectives from the Pioneers*, edited by Timothy Foresman (Upper Saddle River, NJ: Prentice Hall PTR, 1998).
- *Multimedia Cartography*, 2nd edition, edited by William Cartwright, Michael Peterson and Geog Gartner (New York: Springer-Verlag, 2007).
- *Maps and the Internet*, edited by Michael Peterson (New York: Elsevier, 2003).
- *Cybercartography: Theory and Practice*, edited by D.R. Fraser Taylor (New York: Elsevier, 2005).
- *Cartographica: Special Issue on Cybercartography* 41(1) (2006).

For archival and library cataloguing descriptions and management of traditional maps (i.e., analogue) and some digital environments, please refer to the following:

- Canadian Committee for Archival Description, Rules for Archival Description, *Chapter 5: Cartographic Materials Chapter 5*, (http://www.cdncouncilarchives.ca/rad_ch5.pdf).
- *Cartographic Materials: A Manual of Interpretation for AACR2, 2002 Revision, Second Edition*, which includes digital maps.

- Information Management at Library and Archives Canada, see: *Managing Cartographic, Architectural and Engineering Records in the Government of Canada* (http://www.collectionscanada.ca/gestion-information/0625/0625020315_e.html).

The following is a very brief outline of how cartographic materials have developed, from the analogue era through several generations of digital technology:

1. With paper maps, an atlas was self-contained.

2. Geographic Information Systems (GIS) were first created in the 1960's in Canada by Roger Tomlinson. GIS became common desktop computer platforms and in some cases enterprise systems (e.g., municipal government systems). In the GIS era, multiple maps with multiple layers (e.g., points, lines, polygons, demographics, etc.) could be created with databases that required metadata and viewers. GIS enabled the modelling of complex environmental and social systems. GIS eventually became more interactive and expanded to include multimedia. Initially GIS file formats and their viewers were proprietary. The lack of inter-institutional standardization of file formats, metadata and viewing technology made data sharing difficult to impossible.

3. Early in the Web-mapping era, maps generated from a GIS were converted into image files (i.e., JPEG, TIFF) and viewed as static objects.

4. Along with Internet innovations, Web-mapping technologies both proprietary and open source also emerged. Today, Web mapping involves generating maps from distributed datasets in real time. There is also increased interactivity and increased use of multimedia objects. This led to the development of interoperability standards, open source standards and specifications, more metadata elements for both information objects and their relationships.

5. Cybercartography is a term coined by D.R. Fraser Taylor and is defined as "the organization, presentation, analysis and communication of spatially referenced information on a wide variety of topics of interest and use to society in an interactive, dynamic, multimedia, multisensory and multidisciplinary format." In a cybercartographic context the data, how the data are represented (e.g., in the map, chart, user interface, etc.), data in multimedia formats, design, user requirements, the process of organizing the data, how it is structured, who works on it and its implementation are considered important.

References:

- Core research questions 1, 2, 3 and 12 for context
- Core research questions 5 and 5 for how the CAA works and its entities
- Core research questions 6 and 9 for processes and procedures
- Appendices O and Q for additional information regarding the CAA Model and the creation process
- Appendix R to gain a better understanding of the changing role of the cartographer and how cartography is evolving in a cybercartographic context

Domain 1, Question 2: What are the nature and the characteristics of the traditional process of document creation in each activity? Have they been altered by the use of digital technology and, if yes, how?

With paper maps, an atlas was self-contained. In the GIS era, multiple maps with multiple layers could be created with databases that required metadata and viewers. Both the GIS file formats and the viewers were proprietary. The lack of inter-institutional standardization of file formats, metadata and viewing technology made data sharing impossible.

At the beginning of the Web-mapping era, maps generated from a GIS were converted into image files (i.e., JPEG, TIFF) and viewed as static objects. Today, Web mapping involves generating maps from distributed datasets in real time. There is also increased interactivity and increased use of multimedia objects. This led to the development of interoperability standards, open source specifications, and more metadata elements for both information objects and their relationships.

References:

- Core research question 4c for interactivity
- Core research questions 5, 5a, 6 and 19 for the creation process
- Appendices O, Q, R and S

Domain 1, Question 3: Specifically, what is the manifestation of authorship in the records of each activity and its implications for the exercise of intellectual property rights and the attribution of responsibilities?

Regarding Intellectual Property Rights and Authorship:

Much of the data used in the creation of the CAA—a non commercial research product—can be used at no cost as part of the Antarctic Treaty System. The project also includes typical intellectual property issues such as license agreements, use rights to objects and data, and copyright. The CAA itself includes use caveats and disclaimers (e.g., it is intended for information, not navigation purposes). Professional competencies dictate a wide range of sound ethical practices related to content creation. The data are fully referenced in the CAA within modules, within the metadata or embedded within the digital objects.

Some data are remotely accessed on the fly when a map is created. Access to these datasets is part of the Open Geospatial Data Consortium Standards (see Appendices L and N) and formal agreements have been made with data providers to call these data (see Appendix L).

Module content creators are identified when their content is discussed in numerous academic papers, presentations and reports and also on the Project's Communication Internet Site (see Appendix P).

The CAA itself bears the following attribution of responsibilities:

> The Cybercartographic Atlas of Antarctica, its technology, content, and theory is the responsibility of the Geomatics and Cartographic Research Centre. The Atlas is formally endorsed as a Scientific Committee on Antarctic Research (SCAR) project.

References:

- Core research question 4d for identifiers
- Core research questions 8, 9, 22 and 23 for description

Domain 1. Question 4: Does the definition of a record adopted by InterPARES 1 apply to all or part of the documents generated by these processes? If yes, given the different manifestations of the record's nature in such documents, how do we recognize and demonstrate the necessary components that the definition identifies? If not, is it possible to change the definition maintaining theoretical consistency in the identification of documents as records across the spectrum of human activities? In other words, should we be looking at other factors that make of a document a record than those that diplomatics and archival science have considered so far?

The Glossary of the InterPARES 1 project defines a record as follows: any document made or received and set aside in the course of a practical activity.

This CAA Project does produce traditional records in its administrative activities, but these were not the object of this case study, which focused solely on the CAA and its production environment. The research revealed four generations of digital objects:

1. Creators' content modules
2. Creators' XML-schema for submission to the CAA technical specialists
3. Compiled content modules
4. The CAA itself

Creators' content modules do not formally come under the control of the Project. The XML-tagged module is submitted by the *Content Creator* to the CAA's technical specialists is set aside and maintained once it is validated and successfully compiled. These digital objects form the core of the preservation strategy developed by the project, which is to maintain as much content, presentation information and functionality in a technology-independent format such as XML.

The compiler creates the version used on the Web site. The compiler will change to meet the requirements of changing technology required to present the CAA on the Web.

The strategy is imperfect because the content modules continue to contain proprietary file formats for certain types of content (e.g., audio, video, 3D animation, etc.), which cannot be converted to a non-proprietary file format. Finally, the *CAA itself* is subject to ongoing, continuous content update, as well as occasional technological upgrading.

References:

- Core research questions 5 and 6 for creation process
- Core research question 17 for what the identification of records within the CAA
- Core research question 20 for the project's policies and procedures

Domain 1, Question 5: As government and businesses deliver services electronically and enter into transactions based on more dynamic Web-based presentations and exchanges of information, are they neglecting to capture adequate documentary evidence of the occurrence of these transactions?

The transactions for the user's of the CAA are primarily to view and interact with the content for educational purposes. In this context, there is no legal obligation to maintain a record of these transactions. Disclaimers and caveats on the Web site are intended to limit the responsibility of the Creator in this area.

From a historical perspective, there is an interest in preserving the entire CAA at different points in its development.

References:

- Core research question 4d for identifiers
- Core research questions 8, 9, 22 and 23 for description
- Appendix P - List of Standards Adhered to on the Project

Domain 1, Question 6: Is the move to more dynamic and open-ended exchanges of information blurring the responsibilities and altering the legal liabilities of the participants in electronic transactions?

The validity of disclaimers and caveats remains to be tested in Court. Although the educational purpose of this atlas reduces the risk, the accuracy and reliability of online maps in other contexts is a disputed area (e.g., in car navigation maps or Emergency Preparedness, etc.).

Domain 1, Question 7: How do record creators traditionally determine the retention of their records and implement this determination in the context of each activity? How do record retention decisions and practices differ for individual and institutional creators? How has the use of digital technology affected their decisions and practices?

The research environment of this case study is not a traditional recordkeeping environment. In the analogue and stand-alone digital past, individual academics made retention decisions relating to their own research records. The digital age and the era of Big Science have driven the development of team projects and multidisciplinarity, requiring the development of a more coordinated approach to record retention decisions and practices, a trend being strongly encouraged by the funding agencies.

Interoperability, open source standards and specifications, and metadata can all support improved record retention decisions and practices.

Domain 2 Research Questions

Domain 2. Question 1a): What does record reliability mean in the context of scientific (geographical) activities?

Each spatial dataset has associated data quality measures and most organizations have particular data quality assurances. Users of the CAA can refer to the metadata to assess data sources. Module creators accept that the data are reliable as they are acquired from authoritative data sources (e.g., Antarctic Digital Database).

Data quality elements are:

- lineage
- positional accuracy
- attribute and thematic accuracy
- completeness
- logical consistency
- semantic accuracy
- Temporal information.

These are explained in Appendix T.

Data quality standards are quite specific and those adhered to on the project are listed in Appendix P. In addition, each scientific domain is governed by their particular data quality standards, measures and assurances and these are included in the metadata.

References:

- Core research questions 6, 8, 9, 10, 11 for reliability and authenticity
- Appendices P and T

Domain 2. Question 1b: To what extent can the electronic records created in the course of scientific (geographical) activity be considered reliable and why?

The degree of reliability attributed to scientific (geographical) records would depend on whether the creator could demonstrate adherence to the data quality standards described above (Domain 2, Question 1a).

Domain 2, Question 1c: What requirements on their form and controls on their creation would make us presume that they are reliable?

See Domain 2, Question 1a.

Domain 2, Question 2a: What does record accuracy mean in the context of each scientific (geographic) activity?

Six of the seven data quality elements listed above measure accuracy. Only "lineage" does not apply.

Domain 2. Question 2b): To what extent can the electronic records created in the course of scientific (geographic) activity be considered accurate and why?

The datasets used in the CAA are presumed accurate and fit for use based on the information contained in their associated metadata, which reflect the seven elements of data quality listed above. Key elements in the metadata identify characteristics such as scale, accuracy, age, and limitations on use. Within the geomatics profession, certain data management practices have also been adopted (e.g., documentation of source data rendered, how these have been modified and rendered, etc.). The reputation of the institution or scientist is also a factor. The academic peer review process is also considered a method to assess accuracy.

The content of the CAA will be reviewed by an editorial group to ensure thematic accuracy.

References:

- Core research questions 4c and 5 for the creation process related to accuracy
- Core research questions 8 and 9 for documentary evidence
- Core research question 10 for accuracy

Domain 2. Question 2c: What controls on their creation would make us presume that these records are accurate?

See Domain 2 question 2b.

Domain 2. Question 3a: What does authenticity mean in the context of scientific (geographic) activity?

Data are acquired from authoritative sources and are peer reviewed (e.g., British Antarctic Survey, Scientific Committee on Antarctic Research, scientific and academic journals and books, etc.). Authenticity in geography is captured in standard metadata as data lineage.

"Lineage," a mandatory metadata element, includes the history of a geographical dataset. Information regarding the production of the data is also mandatory. In some cases data source material is also provided.

In addition, the CAA production environment is protected by security measures such as physical security, password protection, and careful control of access depending on type of user.

The analysis ISO 19115, the geographic metadata standard by the Description Cross-domain should highlight how authenticity, reliability and accuracy are expressed in geospatial metadata.

References:

- Core research questions 4c and 5 for the creation process related to accuracy
- Core research questions 8 and 9 for documentary evidence
- Core research question 10 for accuracy
- Appendices P and T

Domain 2, Question 3b: To what extent is the definition of record authenticity adopted by InterPARES 1 relevant to the records resulting from scientific (geographic) activity and from the use of increasingly complex digital technology?

The InterPARES 1 definition of authenticity: The quality of being authentic, or entitled to acceptance. As being authoritative or duly authorized, as being what it professes in origin or authorship, as being genuine.

This definition would be considered relevant for this case study as discussed in Domain 2 question 3a, and would be addressed in the metadata as lineage.

Domain 2, Question 4: On what basis can the records created in the course of scientific (geographic) activity be presumed authentic? How, in the absence of such presumption, can their authenticity be verified?

See response to Domain 2 question 3a, namely authoritative sources, metadata, accepted professional practices, security measures, peer review, domain name, etc. In the absence of such presumptions, peer review journals, reports, presentations, developer's guidelines and other related documentation could be used as proxy information to assist with verification. In this case study, much information is captured in the Project wiki, GCRC forum and Project Communication Web site.

Domain 2, Question 5a: How is the authenticity of these records affected by their transmission across space and time?

- For datasets brought to the CAA - metadata
- For data called by the CAA - the interoperability protocols, open standards technology and the authenticity of the data provided by the data providing institution as stated in their metadata
- For content - verification by team
- For the XML files - verification by CAA technical specialists after compilation
- For the CAA - The GCRC Team, and the Scientific Committee on Antarctic Research

References:

- Appendices L, O, P, S and T

Domain 2, Question 5b: What controls on the process of transmission would ensure that these records will continue to be recognized as authentic?

Uncertain.

Domain 2, Question 6: Are the conceptual requirements for reliability and authenticity developed by the UBC-MAS project [Duranti and MacNeil, 1999] and InterPARES 1 for administrative and legal records generated within databases and document management systems applicable to the records studied by InterPARES 2?

The requirements listed in *Requirements for Assessing and Maintaining the Authenticity of Electronic Records* are applicable.[12]

In this case study, for example:

- Req.A1 - Expression of Record Attributes and Linkage to Record—identity and integrity are addressed with metadata. For geographic data, some elements may differ.
- Req.A2 - Access Privileges—access to the CAA is restricted to authorized technical staff. In future, this may be expanded to content creators.
- Req.A3 - Protective Procedures: Loss and Corruption of Records—a backup system is in place. Though not perfect, a recent backup process failure was detected.
- Req.A4 - Protective Procedures: Media and Technology—considered, but a process is not yet in place.
- Req.A5 - Establishment Documentary Forms—Articulated in content creator guidelines and manuals, and eventually in the Author's Toolkit.
- Req.A6 - Authentication of Records—Yes, not by a judicial system but in professional practice in the lab.
- Req.A7 - Identification of Authoritative Records—this has been discussed; Subversion is the system in practice, though it is inadequate.
- Req.A8 - Removal and Transfer of Relevant Documentation—this has not yet been determined but will be required when the CAA is transferred to SCAR. The project has not yet considered a process for Authentic Copies.

Domain 2, Question 7: Do the participants in electronic transactions have shared access to reliable and accurate information about the terms and effects of the transactions? What would constitute reliable and accurate records of transactions in current electronic service delivery initiatives?

The transaction for users in this case study is viewing and accessing CAA content modules. No metadata about the transactions themselves are currently collected or kept.

References:

- Core research question 20 for policies and procedures
- Core research question 21 for legal, moral and ethical obligations
- Core research questions 22 and 23 for descriptive information or metadata

Domain 2, Question 8: What would be the consequence of issuing guidelines for record creation on the nature of the records of each activity?

A limited set of guidelines for the CAA currently exist. Enhanced guidelines would ensure coherence of practice, while user friendly tools would ensure implementation. In addition, these would provide methodological information for new content creators outside the project.

Guidelines must not limit forms of expression or a world view. The technology choices made on the project affect broad-based accessibility (e.g., the Mozilla browser is not yet commonly

[12]See http://www.interpares.org/display_file.cfm?doc=ip1_authenticity_requirements.pdf.

used, and disability guidelines have not yet been taken into consideration). In addition, from a cartographic perspective, open source technologies provide a new way to organize cartographic data but provide technological limitations to creativity.

Domain 2, Question 9: How can cultural differences, freedom of expression, freedom of inquiry, and right to privacy be reflected in those guidelines?

Not applicable in the CAA. However, if disciplinary culture is considered, the warrant for record management and good metadata needs to be more formally articulated and understood in the scientific community, particularly in the realm of multimedia data (e.g., pictures, sounds). Currently the pain of metadata is perceived to outweigh the gain. Incentives need to be put in place, as well as user friendly tools. The CAA has a commitment to standards and will not include material that is not accompanied with metadata.

Domain 2, Question 10: What technological and intellectual tools would assist creators to generate records that can be authentically preserved over time?

In this case study, metadata, a source repository system (Subversion), classification systems, standards and a commitment to archiving were the tools, processes and culture in place to address preservation.

User-friendly tools to effectively and efficiently capture metadata; a multimedia metadata set that meets both archival requirements and geospatial standards; and a greater understanding of where current geospatial metadata standards fail with regard to archival benchmarks would all be useful. Greater institutional support and understanding of these archival issues are required within GCRC, as is additional funding from outside institutions and the University.

Currently, state-funded research projects (e.g., SSHRC, NSERC, NRC, etc.) in Canada do not formally request budget lines for long-term preservation. Also, at the moment, there are no institutions capable of archiving SSHRC supported project data and results. Best practices, guidelines, resources and expert advice in this area would be valuable for funding agencies and universities.

Refer to the following documents:

- Archiving of Research Data SSHRC only - http://www.nserc.ca/professors_e.asp?nav=profnav&lbi=f1
- National Data Archive Consultation. Phase One: Needs Assessment Report (May 2001) http://www.sshrc.ca/web/whatsnew/initiatives/da_phase1_e.pdf
- National Data Archive Consultation. Final Report: Building Infrastructure for Access to and Preservation of Research Data (June 2002) http://www.sshrc.ca/web/whatsnew/initiatives/da_finalreport_e.pdf
- National Consultation on Access to Scientific Research Data [Web site] http://ncasrd-cnadrs.scitech.gc.ca/about_e.shtml
- Archive, Management and Preservation of Geospatial Data Summary Report and Recommendations (January 2005). By David L. Brown, Electronic Records and Development Division, Library and Archives of Canada; Grace Welch, University of Ottawa and Christine Cullingworth for GeoConnections Policy Advisory Node submitted to the: Working Group on Archiving and Preserving Geospatial Data

Domain 2, Question11: What legal or moral obligations exist regarding the creation, use and preservation of the records under investigation?

All standard intellectual property concerns apply. These are being primarily addressed by metadata. These include license agreements, use rights to objects and data, and copyright. The CAA itself includes use caveats and disclaimers (e.g., the CAA is intended for information, not navigation purposes). Professional competencies dictate a wide range of sound ethical practices related to content creation and maintenance of the technological environment. The project is legally obliged to deliver the CAA and related products to SSHRC as mandated in the awarded proposal. GCRC has responsibilities to Carleton University to deliver as promised.

Domain 3 Research Questions

Domain 3, Question 1: How do the appraisal concepts, methods and models developed by InterPARES 1 for the administrative and legal records created in databases and document management systems apply to the appraisal of the records of scientific - geographic activities resulting from the use of the technology examined by InterPARES 2?

Possible References:

- Core research questions 17 and 18 for what the creator considers to be records
- Core research questions 19, 19a and 19b for preservation strategies

Domain 3, Question 2: How do the preservation concepts, methods and models developed by InterPARES 1 for the administrative and legal records created in databases and document management systems apply to the preservation of the records of scientific - geographic activities resulting from the use of the technologies examined by InterPARES 2?

These preservation concepts, methods and models (e.g., digital components, chain of preservation, etc.) seem to apply. However, preservation issues in this case study such as distributed access to data provided by external institutions (see Appendices M and K for a list of data sources), integrated multimedia, interactivity, and their representation (e.g., map colour, layers, line width, sound levels, etc.) of those data to meet the creator's intent do not seem to be fully addressed.

Domain 3, Question 3: What preservation paradigms can be applied across activities and technologies? What preservation paradigms are required for specific types of records resulting from each activity?

There does not seem to be a contradiction between the preservation paradigms discussed in InterPARES 1 and this case study. However, as discussed in Domain 3 question 2, the ability to re-create dynamic records as found in the CAA, CAA components involved in generating interactivity, distributed data access and the ability to recreate the CAA as intended by the creators and etc. remain unclear.

Domain 3, Question 4: What metadata are necessary to support appraisal and preservation of authentic digital records resulting from each activity?

An assessment of how geospatial metadata standards stand up to archival requirements are required. As previously discussed the Description Cross-domain Registry work should yield specifications.

Requirements for this case study are:

- Metadata guidelines for content creators.
- Access to the code in Subversion (e.g., chronology and versioning).
- Process metadata and the creator's intent on data representation.
- Hardware dependencies need to be evaluated and discussed.

General requirements are:

- Metadata, multimedia metadata standards, the embedded metadata and how these are organized in the system.
- An understanding of adopted standards and known practices.
- Mapping of geospatial metadata language regarding appraisal, preservation, accuracy, reliability and authenticity are required.
- In the sciences, portals/catalogues and repositories are the access and dissemination tools for scientific data, these are driven by geospatial metadata. An extension of these metadata to meet archival requirements would be a step toward preservation policies. The research work in Focus 2 is looking into these issues.

References:

- Appendices P and T

Policy Cross-domain Research Questions

Policy Cross-domain, Question 1: To what extent do policies, procedures, and standards currently control records creation, maintenance, preservation and use in each focus area? Do these policies, procedures, and standards need to be modified or augmented?

***Possible References*:**

- Core research questions 4 and 5 for entities, how the atlas works, and creation
- Core research questions 20, 21, 22 and 23 for policies, procedures and standards.
- Domain 2 question 8 for guidelines for record creation
- Domain 2 question 11 for moral and legal obligations
- Appendices O, P and Q

Policy Cross-domain, Question 2: Can an intellectual framework or frameworks be developed to facilitate the translation of policies, procedures, and standards into different national environments, sectors, and domains?

Frameworks to facilitate the preservation of online national atlases and spatial data infrastructures are generally (see references provided in Domain 2 question 10). Some for GIS exist but these are simple compared to the CAA.

As seen in Domain 3 question 4, the geospatial science community relies heavily on national and international data portals/repositories and catalogues, a framework to assist these initiatives would be new and helpful.

National mapping agencies (NMOs), Defence Mapping, and municipal, national, regional and global geospatial data infrastructures currently have little or no policies, standards and procedures in place when it comes to preservation. Frameworks, technology, resources and a cultural shift toward the receptivity to preservation practices and policies are required.

Data creators have few preservation incentives beyond meeting scientific and professional requirements and the peer review process.

Research funding agencies need to include preservation as part of their award structures and also need to provide institutional support and also require policy frameworks.

Policy Cross-domain, Question 3: How can enhanced control over and standardization of records creation, maintenance, preservation, access and use be balanced against cultural and juridical differences and perspectives on issues such as freedom of expression, moral rights, privacy, and national security?

This question is best answered by the Policy Cross-domain.

Policy Cross-domain, Question 4: What legal or moral obligations exist regarding the creation, maintenance, preservation, and use of the records of scientific - geographic activities?

In this case study, intellectual property issues apply as discussed in Domain 1 question 3, in Domain 2 question 11, and in core research questions 4d, 8 and 21.

The CAA must meet the rights and obligations of the Antarctic Treaty System. Long-term access to the CAA and enabling legislation regarding data (i.e., collection, sharing, access and metadata), funding, and national atlases, framework data and remote sensing data are also required.

Privacy and security issues also need to be taken into consideration (e.g., sub metre resolution for remote sensing data, addresses, location of vulnerable infrastructure, emergency preparedness data, defence mapping, etc.).

Policy Cross-domain, Question 5: What principles should guide the formulation of policies, strategies and standards related to the creation of reliable, accurate and authentic records in the digital environments under investigation? What principles should guide the formulation of policies, strategies and standards related to the appraisal of those records?

The following is a list of ideas:

- Creation and preservation strategies, the process needs to begin at the point of creation.
- Strategies regarding copies
- Incentives from funding organizations.
- Prioritizing the archiving of scientific data at a national institutional level.
- Work with creators as each discipline and sub-discipline have their own cultural practices
- Adherence to open source and other standards, specifications and technologies
- User friendly approaches

References:

- All Domain 2 questions
- Appendices P and T

Policy Cross-domain, Question 6: What principles should guide the formulation of policies, strategies and standards related to the long-term preservation of those records?

- The data and their representation are important (e.g., interactivity, colours, line width, and etc.).
- An understanding of the content creator's environment and their intent.
- Cost benefit analysis

References:

- Policy Cross-domain question 6

Policy Cross-domain, Question 7: What should be the criteria for developing national policies, strategies and standards?

Understanding the creator's unique environment is important.

Policy Cross-domain, Question 8: What should be the criteria for developing organizational policies, strategies and standards?

Understanding the creator's unique environment is recommended.

Description Cross-domain Research Questions

Description Cross-domain Question 1: What is the role of descriptive schemas and instruments in records creation, control, maintenance, appraisal, preservation, and use in traditional record-keeping systems in the three focus areas?

The role of technical, descriptive and process metadata are very important in this case study and extending these to meet preservation requirements would be welcomed by the geospatial community.

***Possible References*:**

- Core research questions 4d, 5, 6, 8, 10, 13, 14, 17, 18d, 18e, 20, 21, 22, 23 for metadata and description
- Domain 1 question 1 and all Domain 2 questions
- Appendices N, O, P and T

The analysis of ISO 19115, the geospatial metadata standard by the Description Cross-domain group may lead to some new initiatives for the geospatial community.

Description Cross-domain Question 2: What is the role of descriptive schemas and instruments in records creation, control, maintenance, appraisal, preservation, and use in emerging record-keeping systems in digital and Web-based environments in the three focus areas? Do new tools need to be developed, and if so, what should they be? If not, should present instruments be broadened, enriched, adapted?

These issues are very important in this case study and to the geospatial community in general. Please refer to the response Description Cross-domain question 1. Also, the results of the study on scientific portals and archives conducted in Focus 2 by Craig and Lauriault will yield additional information in this area.

Description Cross-domain Question 3: What is the role of descriptive schemas and instruments in addressing reliability, accuracy and authenticity requirements (including the InterPARES 1 Benchmark and Baseline Authenticity Requirements) concerning the records investigated by InterPARES 2?

See all Domain 2 responses.

Description Cross-domain Question 4: What is the role of descriptive schemas and instruments in archival processes concerned with the long-term preservation of the records in question?

The results of the study on scientific portals and archives conducted in Focus 2 by Craig and Lauriault may yield additional information in this area.

Description Cross-domain Question 5: Do current interoperable frameworks support the interoperability of descriptive schema and instruments across the three focus areas? If not, what kinds of frameworks are needed?

This case study notes that descriptive metadata for multimedia information objects fall short of interoperability of schemas and do not measure up to standards found in the geospatial data community. It is also uncertain how interactivity is best described. Yuchai Zhou at the GCRC has just produced a Master's thesis on this topic:

> *Profiling and Visualizing Metadata for Multimedia Information in a Geospatial Portal*
>
> ABSTRACT
> With more and more applications of multimedia data emerging in geospatial contexts, researchers have recognized that the combined use of multimedia data and geospatial data can offer good solutions to solve problems in both social and physical science domains. A new concept "cybercartography" has been proposed in the geography community to integrate digital cartographic products with multimedia data such as photographs, videos, still images, audios, texts, virtual reality and even multisensory data on the Internet. This study will present research methodology and key findings on profiling metadata for geo-referenced multimedia data in a geospatial context.
>
> The Cybercartography and New Economy project is developing two atlases based on the concept of "cybercartography." An OpenGIS compliant catalogue will be developed to enable the access, sharing and reuse of large amounts of multimedia data, through metadata. Since multimedia data is a relatively new scientific data type in the geography community, there is no metadata standard that is readily available for describing it. This paper will introduce a new approach of developing a metadata profile by a combined use of different metadata standards for the purpose of making multimedia data more manageable, accessible, shareable and reusable in a geospatial context. Metadata information visualization of a geospatial Web portal will also be discussed as an efficient means of facilitating efficient data access and retrieval.

Description Cross-domain Question 6: What are the implications of the answers to the above questions for traditional archival descriptive standards, systems and strategies? Will they need to be modified to enable archival programs to meet new requirements, or will new ones need to be developed? If so, what should they be?

Archival specifications will probably be required in the geospatial community. It is recommended to explore the well established geospatial data community methods.

Description Cross-domain Question 7: To what extent do existing descriptive schemas and instruments used in the sectors concerned with the focus areas addressed by this project (for example, the geo-spatial data community) support and inform requirements such as those developed by InterPARES 1? Will they need to be modified to enable these sectors to meet these requirements, or will new ones need to be developed? If so, what should they be?

The results of the study on scientific portals and archives conducted in Focus 2 by Craig and Lauriault may yield additional information in this area.

***References*:**

- Appendices N, O, P and T

Description Cross-domain Question 8: What is the relationship between the role of descriptive schemas and instruments needed by the creator and those required by the preserver to support the archival processes of appraisal, preservation and dissemination? What tools are needed to support the export/import/exchange of descriptive data between systems?

Possible reference:

- Description Cross-domain question 7

Description Cross-domain Question 9: What is the role of descriptive schemas and instruments in rights management and in identifying and tracking records components, versions, expressions, performances, and other manifestations, and derivative works?

The study by the Description Cross-domain Registry may lead to some new initiatives for the geospatial community.

Possible references:

- Core research questions 4d, 5, 6, 8, 10, 13, 14, 17, 18d, 18e, 20, 21, 22, 23 for metadata and description
- Domain 1 question 1 and all Domain 2 questions
- Appendices N, O, P and T

Description Cross-domain Question 10: Is it important to be able to relate the record of scientific activity to the associated expression, performance, product, work, or other manifestation of it, and, if so, in what ways can descriptive activities facilitate it?

Yes, in the context of this case study.

Possible references:

- Description Cross-domain question 9
- Core research questions 4, 5, 6, 7, 8, 9, 10, 11, 13, 15, 17 and 18
- All Domain 2 questions

F. Preliminary Case Study Model

References:

- Core research question 4
- Appendices L, M, O and Q for the Project's models

Appendix A: Interview Protocol

Interview Introduction

My name is Yvette Hackett, and I am an InterPARES 2 institutional member from the National Archives of Canada and a researcher on the InterPARES 2 Project. Tracey P. Lauriault is a Ph.D. Candidate in the Department of Geography and a Research Assistant at the Geomatics and Cartographic Research Centre. Today we would like to ask you some questions about the records you create and maintain as part of your work on the Cybercartographic Atlas of Antarctica Project being carried out at the Geomatics and Cartographic Research Centre (GCRC) to inform a case study being conducted for InterPARES 2 under the Scientific Focus and the Creation and Maintenance of Electronic Records Domain.

Let us briefly explain to you the aims of InterPARES 2. The InterPARES 2 Project is an international research initiative that involves national archives, various government agencies working together with industry representatives and an interdisciplinary team of academic researchers to address important issues related to the permanent preservation of authentic electronic records. We are particularly interested in identifying what systems designers, records creators, records managers, archivists, and policy developers need to do to ensure that records produced in new digital environments as part of artistic, scientific, and government activities to address issues of reliability, accuracy and authenticity from their creation through permanent preservation. We are conducting case studies of activities and implementations within new digital environments in order to better understand the nature of their records, and the business, research, and information processes they support.

If you would like to learn more about the project, there is a Web site that you can go to that contains project reports, organizational structure, and so forth. The URL is http://www.InterPARES.org/ip2_index.cfm.

Are there any questions we can answer for you at this moment about InterPARES 2 Project before we move on to talk about the case study?

[Wait for respondent to reply. If there are no questions, move on. If there are Questions, either try to address them or refer the participant to background materials and Project reports on the Web site.]

InterPARES 2 research efforts aim to address issues of reliability and accuracy in addition to issues of authenticity. The research will focus on records produced in new digital environments that are experiential, dynamic, and interactive. Further, the objective is to address them throughout the records' lifecycle (from creation to permanent preservation).

The Cybercartographic Atlas of Antarctica (CAA) was selected as a Case Study for InterPARES 2 and now we are conducting interviews with people who are part of the record creation and maintenance process of this CA Atlas so that we can learn as much as possible about it and its constituent records.

We will go through a series of questions with you about the Cybercartographic Atlas of Antarctica and would like you to try to answer us as fully as you can. It would be helpful if you could go into more detail than a simple yes or no. Please don't worry if we ask you any questions that you do not know how to answer, although it would be helpful if you were able to indicate anyone else who might be able to answer them so that we might also talk to them or to provide us with a time when you believe the project will be at a stage of development when we can ask you again. Also, we would welcome copies of any appropriate documentation or records related to the Cybercartographic Atlas of Antarctica that you think might assist the InterPARES 2 researchers in understanding the system or records.

We will be taking notes as you talk, and we would also like to use a voice recorder to help us with note-taking and subsequent data analysis by the InterPARES 2 researchers. Do you mind if we record our conversation?

[Wait for respondent to reply. If he or she replies that they do not mind being tape recorded, move on. If he or she has questions about the purpose or subsequent use of the voice recording, explain that the recording is purely voluntary and that audio records will be kept strictly confidential and will only used by the researchers analyzing the data in order to assist them with data analysis. Further, portions of the audio recordings may be used in presentations without releasing the respondent's identity. If he or she says he or she is not comfortable being recorded; for example, in a situation where the respondent's supervisor is an InterPARES 2 team member - say that is fine and move on. Remember that in the latter case, you will need to take much more detailed notes of the participant's responses.]

Do you have any questions that we can answer for you at this point about how the case study will be conducted or what we will be asking you?

[Wait for respondent to reply. If he or she replies that they do not mind being voice recorded, move on. If the respondent has questions, try to address them based on your training in the conduct of this protocol]

Once we have interviewed you, we will give our notes, recordings, and any documentation we have gathered to the InterPARES 2 researchers who will also be responsible for analyzing the case *study data without releasing your identity. We and they will keep these data in a secure place and personally identifiable data or sensitive system configuration information will not be released to anyone beyond the InterPARES 2 Project researchers. The data will be coded for anonymity and then used to assist with the research objectives previously mentioned.*

Can we answer any other questions for you at this point?

[Wait for respondent to reply. If he or she replies that they do not mind being audio recorded, move on. If the respondent has questions, try to address them based on your training in the conduct of this protocol]

Human Subject Consent

Before we progress any further with this interview, we need to go over your rights and what you can expect from us as individuals participating in this research study. We would like to reassure you that your participation is completely voluntary and that you have the right to withdraw from the case study at any point. We are now going to give you a human subjects consent form that outlines what we have just gone over with you. We would like you to take a few minutes to read it over, and then, if you don't have any questions, to sign it.

[Give the respondent the human subjects consent form and give him or her time to read it over.]

[Ask the respondent if he or she has any questions. If no, ask the respondent to sign the human subjects consent form, then set it aside in your folder for making a copy to return to the respondent, and then filing of the original with other human subjects' clearances. If yes, try to address the questions based on your training in the conduct of this protocol. If the respondent is reluctant to sign, you will not be able to continue with the case study; thank the respondent for his or her time and conclude the interview.]

Identifying Information

We would now like to move ahead with the case study questions and we are going to switch on the audio recorder

[Switch on tape recorder and briefly test it to make sure that it is recording. Skip questions in the *Identifying Information* section for which you already have an answer (i.e., organization name)]

Appendix B: Consent Forms

Signed Consent forms available upon request.

Appendix C: Questionnaire

Original Interview Questions **June 21, 2002** **Amended Feb 20, 2003** *(italicized questions were not part of the original 18)*	**Authenticity (A) & Modeling (M) Sub-Questions** **(in lay language)** **Feb 19, 2003**	**Re-worded Questions and Cross-Domain Questions** **(framed for investigators)** **June 26 and Sept. 17-21, 2002**	**Modeling Sub-Questions** **(framed for investigators)** **Feb 8-14, 2003**
<u>Words to listen for as clues to authenticity, reliability, and accuracy:</u> Genuine, original, authentic, forgery, fake, fraud, unaltered, corrected, verified, accurate, dependable, counterfeit, bias, slant, quality, precision, realistic, integrity, legitimacy, manipulated, contrived, artistic license, intellectual property, historical integrity.			
0. Describe what you do and what you create. *00. Do you consider it "interactive"? In what way?*	A10. How do you know when your work is finished? That it has enough information to meet the goals for which the work was created? [or] What do you consider the definitive version of your work? Why? A17. In 100 years, how would someone know that a document/work is yours? Does	1. What activities of the creator are you investigating?	

	this matter, and in what sense?		
		2. Which of these activities generate the digital entities that are the objects of your case study?	
1. What are the purposes of the information you record or create?		4. For what purpose(s) are the digital entities you are examining created?	
2. What information do you create to meet these purposes?			
3. What methods and paradigms inform your work?			
4. What forms does your information take?	M3a. What do you want to express in your work (e.g., behaviour, form, structure)? What do you want people to experience, learn or know from your work? M3b. What kinds of computer files do you create (e.g., text,	3. What form do these digital entities take? (e.g., e-mail, CAD, database)	3a. What is the structure, form, behaviour (if any) of the digital information entity? 3b. What are the specifications of the digital components of which they

	image, spreadsheet, e-mail, database, CAD, etc.) to accomplish the goals you've just described? M3c. Do some of the files contain the intellectual content, while others contain technical specifications? M3d. Do you have a standard way to name the various files? Do your file names ever change? M7b. How do you organize them into directories and sub-directories? M7c. How did you decide on that structure?		consist? 3c. What is the relationship between the intellectual aspects and the technical components? 3d. How are the digital entities identified (e.g is there a (persistent) unique identifier)? 7b.What kind of aggregation levels exist, if any? 7c. What determines that?
5. What processes do you follow in creating information?	M5a. Do you create all your files on the same system, or do you use more than one? M5b. What operating system are you using?	5. How are those digital entities generated?	5a. Does the system manage the complete range of digital entities created in the identified activity or activities for the organization (or part of it) in which they operate?

	M5b. What software packages do you use (type, name and version) M5b. Do you need special equipment connected to your computer?		5b. What is the nature of the system(s) with which they are created? (e.g., functionality, software, hardware, peripherals etc.)
6. What are the key processes in creating the information?	A8. Does the document/work reflect your activity? How do you evaluate this? How does this influence the status of the document/work?	6. From what precise process(es) or procedure(s), or part thereof, do the digital entities emerge?	
	M7a. Do you create paper files as well? *M7b. How are they connected to the computer files?*	7. To what other digital or non-digital entities are they connected? Is such connection documented or captured?	
7. How do you record and identify the information, the methods and the technologies you have followed?	M7a. How do the files and the technology interact to produce the results you want? Name all the software you need to have running on your computer to work and discuss what they do.	8. What are the documentary and technological processes or procedures that the creator follows to identify, retrieve, and access the digital entities?	7a. Are the (created) information entities related both on a conceptual level (i.e., the art entities) and a technical level (i.e., the digital components).

8. How do you document the processes and procedures you use?	A6. Does your document/work follow rules that are laid down by someone else? Do you need authorization to carry out your activity? What is the status of a document/work that was made in breach of these rules? A7. Is it important for you to follow a specific procedure in creating a document/work? Is there something distinctive about how you create a work that distinguishes it from other people's works of a similar nature? Are there steps that you go through that influence the final product in such a way that skipping a step would be noticeable?	9. Are those processes and procedures documented? How? In what form?	
9. What are the key elements of the information you create?		10. What are the key elements, attributes, and digital components of the entities under examination?	
10. What measures do you take to ensure the quality and reliability of the information you create or	A5. Does anyone need to give you permission or authority to create documents? Do you have some official capacity that gives	11. What measures does the creator take to ensure the quality, reliability and authenticity of the digital entities and their documentation?	

information sources that you use?	your documents/work a credibility that would be lacking in the work of someone without such capacity? *(The latter use of capacity might be academic degrees or experience to distinguish an amateur from an academic.)* A11. Does anyone ever critique or audit your documents/work? What standards do they use to evaluate your documents/work? A12. Which aspects of your documents/work are influenced by accuracy? What does it mean to describe your documents/work as accurate? A13. What is the relationship of your documents/work to 'reality'? To what extent is it important that any facts in your documents/work be accurate? How would one assess the truthfulness of your documents/ work?	If no specific measure is taken, does the creator think that those qualities are to be assumed for its digital entities? *(Note overlap with question 16.)*	

	A15. Does it matter to you if your documents/work might contain an error?		
10. (continued)	A18. How would someone know that one of your documents/works has not been altered over time? That it remains true to the form and content in which you created it? What is the status of a document/ work that has been altered? A19. Do you take measures to ensure that your documents/work are not altered over time, or that you can detect any changes (intentional or environmental)?		
11. How do you use the information you create?		13. How does the creator use the digital entities under examination?	
12. How are the changes made to your information and how are these recorded?		12. How are changes to the digital entities made and recorded?	

13. How do others use the information you create?	A14. Would it be possible for someone to criticize your documents/ work as inaccurate? How might someone correct your documents/work? A16. How would someone verify your documents/work? How would they be able to tell that it is by you? That it was created (at least roughly) at the time it is dated?	14. Do external users have access to the digital entities in question? If so, how, and what kind of uses are made of the entities?	
14. Do others add to your information to create new information?	M14a. Do you work alone, or do you collaborate with others? Do you have staff? M14b. Do these others have access to your files? M14c & d & e. Can you describe who has what type of access to your files, at which points in the process, and the		14a. Are there specific job functions (or responsibilities) with respect to the creation, maintenance, and/or use of the digital entities? 14b. Are the access rights (to objects and/or systems) connected to the job function of the responsible person? 14c. What is the job function of the responsible person?

	nature of the work they do with the files?		14d. What are the access rights of this person? 14e. What are the responsibilities of the person in relation to creation, and/or maintenance, and/or preservation, and/or use, and/or other identified processes?
15. What do you conceive of as a record?	A1. After you publish your [work], let's say drafts, notes, letters, or other things are left over. Do you want them to survive intact as long as your [work] lasts? *(Key distinctions between product and by-product.)* A2. Do you label or mark your work in any way to show that they are yours? *(Re reliability)*	15. Among its digital entities, which ones does the creator consider to be records and why?	
16. What do you conceive of as an authentic record?	A4. Explain what meaning the following words have, if any, in the context of your work:	16. Does the creator think that the authenticity of his digital records is assured, and if so, why?	

	"reliable," "authentic," "accurate." A3. If someone damages your documents/work in saving them, or if you left mistakes in them, would you want those damages or errors noted? *(Re authenticity and accuracy)*		
17. How do you preserve this authentic record?	M17a. Do you have a standard procedure when it is time to preserve them for the long-term? M17b. Do you keep the files in the same system that you created them in, or do you move them to another system? If yes, what do you move them to? M17c. Do you save everything, or just selected files? M17d. If you are saving files in a second system, does this	17. Does the creator keep the digital entities that are currently being examined? That is/are these digital entities part of a record keeping system? If so, what are its features?	17a. What processes exist for maintaining the digital entities? 17b. Is there 'recordkeeping' functionality built into the systems, or a separate dedicated RK system? 17c. Do the recordkeeping system(s) (or processes) routinely capture all digital entities within the scope of the activity it covers? 17d. From what business

	system inherit or derive any information from the system you used to create the files originally?		systems do the recordkeeping system(s) inherit or capture the digital entities and the related metadata (e.g., tracking systems, workflow systems, office systems, databases, etc.)?
17. (continued)	M17e. Do the files stay organized the same way as when you were using them, or do you organize them differently when you are finished? M17f. Have you ever had trouble retrieving something you had created earlier, due to passage of time? M17g. Once the files are "stored," is there any record of people accessing them, or modifying them later? What kind of information is collected?	17. Does the creator keep the digital entities that are currently being examined? That is/are these digital entities part of a recordkeeping system? If so, what are its features?	17e. Are the digital entities organized in a way that reflects the creation processes? What is the schema, if any, for organising the digital entities? 17f. Do they provide ready access to all relevant digital entities and related metadata? 17g. Does the recordkeeping system document all actions/ transactions that take place in the system re: the digital entities? If so, please provide an overview of the metadata captured.

18. How do you preserve this through technological change?		18. How does the creator maintain its digital entities through technological change?	18a. What preservation strategies and/or methods are implemented and how? 18b. Are these methods determined by the type of digital entities (in a technical sense) or by other criteria? Please specify.
19. Have you had to make rules, or adopt standards to help you in your work? Do you find you have to update them regularly?	A9. Are there professional standards or best practices that you rely on to ensure that your document/ work is acceptable by your colleagues?	19. To what extent do policies, procedures, and standards currently control records creation, maintenance, preservation and use in the context of your activity? Do these policies, procedures, and standards need to be modified or augmented?	
20. Do any legal or ethical issues arise from your electronic work?		20. What legal, moral (e.g., control over artistic expression) or ethical obligations, concerns or issues exist regarding the creation, maintenance, preservation and use of the artistic records in the context of your activity?	

21. Did you create or adopt a standard list of information which you try to record about each file, or work?		21. What descriptive or other metadata schema or standards are currently being used in the creation, maintenance, use and preservation of the recordkeeping system or environment being studied?	
22. Where did you get it? Do you know if others use the same one?		22. What is the source of these descriptive or other metadata schema or standards (institutional convention, professional body, international standard, individual practice, etc.?)	
Comments			

Appendix D: Transcripts - Respondent 1

Available upon request.

Appendix E: Transcripts - Respondent 2

Available upon request.

Appendix F: Transcripts - Respondent 3

Available upon request.

Appendix G: Transcripts - Respondent 4

Available upon request.

Appendix H: Project Software List

Status	Product	URL	Purpose
Architecture?	Maya by Alias	http://www.alias.com/eng/press/press_releases/20030729_alias_leads_3d_industry.shtml	Gaming/3D Prototyping & Animation
Delayed	PCI E-Cognition	http://www.pcigeomatics.com	Data Analysis
Delayed	LizardTech Express Server	http://www.lizardtech.com	Image server
Delayed	LizardTech GeoExpress	http://www.lizardtech.com	Image converter
Handed off	ErgoBrowser by ErgoSoft	http://www.ergolabs.com/resources.htm	User Analysis
Library	SAFE Software FME for ESRI	http://www.safe.com	Data conversion
Library?	Idrisi Kilimanjaro	http://www.clarklabs.org	Data Analysis
Received	Adobe Creative Suite Premium	http://www.adobe.com	
Received	Macromedia Studio MX	http://www.macromedia.com	
Received	VMWare Workstation 4 (Win)	http://www.vmware.com	
Received	Virtual PC for Mac	http://www.microsoft.com/mac/products/virtualpc/virtualpc.aspx	
Received	MS Office X Mac	http://www.microsoft.com/mac	
Received	OmniGraffle 3 Pro for Mac	http://www.omnigroup.com/applications/omnigraffle/pro/	
Received	Colour Printer (HP CLJ 5500dtn)	http://www.hp.com	
Received	Designer Workstation (Mac)	http://www.apple.ca	
Received	Remote Sensing Workstation (Dell)	http://www.dell.ca	
Received	Kingston Memory KTDWS450E/2G	http://www.kingston.com	
Received	Gigabit Switch (3C17400 3Com Superstack 3 Switch 3824 24 port)	http://www.3com.com	Improved Networking
Received	HP Scanner 4670	http://www.hp.com	Digital Image Acquisition
Received	UPS for server (Back-UPS Pro 1000)	http://www.apcc.com	Power Protection
Received	UPS for Special Workstations (Back-UPS CS 500)	http://www.apcc.com	Power Protection
Received	UPS for General Workstations (ES 500)	http://www.apcc.com	Power Protection
Received	Pinacle Systems MovieBox DV	http://www.pinnaclesys.com	Movie Conversion
Received	Shuttle Pro v.2	http://www.contourdesign.com/shuttlepro/	
Uncertain	MediaMapper Elite v. 5.0 by Red Hen Systems	http://www.redhensystems.com	GPS hookup for camera
Uncertain	GeoSmart.net by MoosePoint	http://www.moosepoint.com/products/	
Uncertain	RedSpiderWeb	http://www.ionicenterprise.com	
Uncertain	Cognos Visualizer	http://www.cognos.com	Data Analysis
Uncertain	Oracle	http://www.oracle.com	
Uncertain	Visio	http://www.microsoft.com/visio	

Appendix I: Project Hardware List

Cybercartography and the New Economy - Canada Foundation for Innovation List, Feb. 2004

Equipment Type	Category	Item	Details
Hardware	Accessories	Camera tripods+bags (n/a)	Optex T465 or equivalent
Hardware	Accessories	Adapter	SmartDisk Airline Power Adapter for PowerBook G4
Hardware	Accessories	Battery	Extra Battery - PowerBook (17" TFT)
Hardware	Accessories	Cables	miscellaneous cables
Hardware	Accessories	Carrying case	Professional 17 Shoulder Case by Brenthaven
Hardware	Accessories	Carrying case	TC1000 carrying case
Hardware	Accessories	Carrying case	Versa Litepad Carrying Case
Hardware	Accessories	Ethernet cable	Belkin Retractable Ethernet Cable - 7 Feet
Hardware	Accessories	minijack cables	standard minijack cables, various lengths & types
Hardware	Accessories	Palmtop styluses	extra styluses
Hardware	Accessories	Power bars	surge-protected power bars
Hardware	Accessories	RCA cables	standard RCA cables, various lengths
Hardware	Accessories	Uninterrupted Power Supply	Back-UPS Pro USB
Hardware	Accessories	Uninterrupted Power Supply	UPS 1440 (uninterrupted power supply)
Hardware	Accessories	USB Adaptor	Belkin 10ft A to B USB Cable
Hardware	Accessories	USB Extension Cable	Belkin 10ft A to A USB Extension Cable
Hardware	Audio	1/4" audio plugs	standard 1/4" audio cables, various
Hardware	Audio	Audio Cassette Recorder	audio cassette recorder
Hardware	Audio	Audio mixing board	MACKIE 1202-VLZ audio mixing board
Hardware	Audio	Audio Mixing Board	Mackie 1202 VLZ Pro Mixing Board
Hardware	Audio	audio recorder w/ foot pedal	Panasonic RR-930
Hardware	Audio	Audio system	TEAC microamps w/ wall-mounted speakers
Hardware	Audio	Digital audio recorder	Miniature digital audio recorder
Hardware	Audio	Foot controller	Roland FC-7 Foot Controller
Hardware	Audio	headphone	Sennheiser HD280PRO or equivalent
Hardware	Audio	Headset	Plantronics M-110 or equivalent
Hardware	Audio	Headset microphone	Logitech USB Headset. Digital USB
Hardware	Audio	headset microphone	headset microphone
Hardware	Audio	Headset microphone	Sidewinder Game Voice 1.0 95/98/WME/NT
Hardware	Audio	Intercom System	
Hardware	Audio	keyboard synthesizer	Roland XV-88 keyboard synthesizer
Hardware	Audio	Microphone	Shure SM 57 Microphone
Hardware	Audio	Microphone	Shure SM 58 Microphone
Hardware	Audio	Microphone	AKG C1000 Microphones (Twin Pack)
Hardware	Audio	Microphone	AKG C414 Microphone
Hardware	Audio	Microphone	Sennheiser attachable shotgun mike
Hardware	Audio	Microphone	SONY clip-on mike
Hardware	Audio	Midi digitizer	Infusion Systems I-CubeX
Hardware	Audio	Midi interface	MOTU Fastlane USB MIDI interface
Hardware	Audio	midi keyboard	low end w/ midi in/out
Hardware	Audio	Minidisc recorder	SONY Net MD Walkman Recorder

Hardware	Audio	Music Player	Apple 40 GB iPod
Hardware	Audio	Speakers	PC speakers
Hardware	Audio	Speakers	Z340 33WATTS 3pc Speaker System
Hardware	Audio	Speakers	Tannoy Series 800 Active Near Field Loud Speakers
Hardware	Audio	Speakers	JBL Creature - Silver (PC/Mac)
Hardware	Audio	Speakers	3pc 2.1 Console Gaming Speaker System (Black)
Hardware	Audio	Speakers	Z640 5.1 Speaker 50W includes Game Console Adapter (PC/Mac)
Hardware	Audio	Subwoofer	BOSE subwoofer
Hardware	Audio	Subwoofer	Tannoy Series 800 Active Subwoofer
Hardware	Audio	USB Microphone	iVoice USB Digital Microphone
Hardware	Audio	USB Microphone	M-560 Super Directional USB Microphone
Hardware	Audio	Wireless headphone	Sony MDR-RF945RK 900MHz Wireless Headphone System
Hardware	Cameras	Digital camera	6-Megapixel digital still camera
Hardware	Cameras	Digital camera	3-Megapixel digital still camera
Hardware	Collaboration	72" Smartboard	SmartTech 72" Digital Smartboard (biggest)
Hardware	Collaboration	smart board	smart board for plasma display
Hardware	Computers	Wearable computer	Xybernaut Mobile Assitant V - MA V
Hardware	Computers	Workstation (Special)	Alienware Martian Red Area-51 Pentium4 @ 3.0GHz 512MB DDR PC3200 NVIDIA GeForce FX 5900 Ultra 256MB
Hardware	Computers	Apple Workstation	Apple Dual 2Ghz PowerPC G5; 8GB SDRAM, SuperDrive, NVIDIA GeForce FX 5200 Ultra videocard, Airport Extreme Card, Digital Audio option
Hardware	Computers	Apple xServe	2 CPU, 2GB RAM, Fibre Channel, 520GB disk
Hardware	Computers	Dell PowerEdge 1650 Server	Dual CPU, 2GB RAM, 520GB disk
Hardware	Computers	Remote Sensing Station	Dell Precision 450, Dual 19" LCD display, 2x120GB SATA HD, FW
Hardware	Computers	Workstation	standard PC workstation *
Hardware	Computers	Workstation (Special)	Alienware Cyborg Green Area-51 Pentium4 @ 3.0GHz 512MB DDR PC3200 NVIDIA GeForce FX 5900 Ultra 256MB
Hardware	Gaming Accessories	i-Link 6 Port Hub (PS2)	
Hardware	Gaming Accessories	Console stand	Playstation 2 horizontal stand
Hardware	Gaming Accessories	Controller	Sony Playstation Dual Shock 2 controller
Hardware	Gaming Accessories	Controller	Pelican FREEDOM SHOCK 2 Controller
Hardware	Gaming Accessories	Controller	Playstation Dualshock 2 Analog Controller
Hardware	Gaming Accessories	Controller	Nintendo GameCube Controller
Hardware	Gaming Accessories	Controller	Bass Champion 2 Fishing Controller PS2
Hardware	Gaming Accessories	Controller	Mad Catz Blaster (PS2)
Hardware	Gaming Accessories	Controller	Mad Catz Blaster (Xbox)
Hardware	Gaming Accessories	Controller	SHOCKHAMMER DUAL SHOCK GAME PAD FOR SONY PLAYSTATION
Hardware	Gaming Accessories	Controller	X-Arcade Authentic Arcade Controller
Hardware	Gaming Accessories	Controller Hub	Sony Playstation 2 Multitap
Hardware	Gaming Accessories	Controller hub	Playstation 2 Multitap

Hardware	Gaming Accessories	Extension Cable	Extension Cable (XBox)
Hardware	Gaming Accessories	Force feedback joystick	'Microsoft 656-00105 Sidewinder Force Feedback 2 Joystick'
Hardware	Gaming Accessories	Force feedback Touch Pad	'Logitech WingMan Rumble Pad'
Hardware	Gaming Accessories	Force feedback wheel controller	'Thrustmaster Force Feedback Racing Wheel , Branded by Ferrari').
Hardware	Gaming Accessories	Haptic controller	Freestyler Board (XBox)
Hardware	Gaming Accessories	Haptic controller	Thrustmaster FreeStyler Board
Hardware	Gaming Accessories	Haptic glove	Essential Reality PS Gaming Glove
Hardware	Gaming Accessories	Iogear 6PORT ILINK BATTLEHUB FOR PLAYSTATION 2	
Hardware	Gaming Accessories	Joystick	MAJS USB Programmable AIRSTICK Joystick for Mac
Hardware	Gaming Accessories	Joystick	Naki G-Shock Flightstick
Hardware	Gaming Accessories	Joystick	Logitech 963152-0403 WingMan Interceptor 9-Button Joystick
Hardware	Gaming Accessories	Joystick	Saitek J45 Cyborg 3D Force Stick (USB)
Hardware	Gaming Accessories	Linux adapter	Linux Kit (for PlayStation®2)
Hardware	Gaming Accessories	Memory Card	MS X-box memory card
Hardware	Gaming Accessories	Memory Card	Playstation 2 memory card (8 Mb)
Hardware	Gaming Accessories	Memory Card	Nintendo Memory Card 251
Hardware	Gaming Accessories	Memory Card	Sony Playstation 8 Mb memory card
Hardware	Gaming Accessories	Network Adapter	Nintendo GameCube Broadband Adapter
Hardware	Gaming Accessories	Network Adapter	Playstation 2 network Adaptor
Hardware	Gaming Accessories	Network Adapter	Sony Playstation 2 Network Bundle
Hardware	Gaming Accessories	Network Adapter	Xbox Live Starter Kit
Hardware	Gaming Accessories	Pedal controller	CH Products Pedal Controller
Hardware	Gaming Accessories	Pedal input	Kinesis 3-Pedal input
Hardware	Gaming Accessories	Remote controller	Playstation 2 DVD Remote Control with IR Receiver Unit
Hardware	Gaming Accessories	SynthaGram Player	Stereoscopic Enabler
Hardware	Gaming Accessories	SynthaGram StereoEnabler	Stereoscopic Enabler
Hardware	Gaming Accessories	System Adapter	Nintendo GameCube Game Boy Player
Hardware	Gaming Accessories	Touch Pad	Belkin Nostromo n50 Speed Pad
Hardware	Gaming Accessories	Touch Pad	Gravis G42021 PC Gamepad Pro
Hardware	Gaming Accessories	Touch Pad	Logitech 963188-0403 Wingman Gamepad Extreme
Hardware	Gaming Accessories	Touch Pad	Macally ISHOCK USB Game Pad Programmable for Mac/iMac
Hardware	Gaming Accessories	Touchpad	Fingerworks iGesture Pad
Hardware	Gaming Accessories	Touchpad	Seiko SmartPad
Hardware	Gaming Accessories	Video Adapter	Nintendo Component Video Cable
Hardware	Gaming Accessories	Video Adapter	Playstation 2 Component AV Cable
Hardware	Gaming Accessories	Video Adapter	Playstation 2 S Video Cable
Hardware	Gaming Accessories	Video Adapter	Ultra AV Kit xbox MC
Hardware	Gaming Accessories	Video Adapter	Xbox DVD Movie Playback Kit
Hardware	Gaming Accessories	Wearable computer accessories	Xybernaut Accessory Vest with battery, CPU, FPD, Mini Port Replicator Holsters, and Cable Sleeves (Black)
Hardware	Gaming Accessories	Wearable feedback	Imeron IGS560 Intensor LX 350 Gaming Seat

			and Vest Combo
Hardware	Gaming Accessories	Wheel controller	Mad Catz MC2 Racing Wheel
Hardware	Gaming Accessories	Wheel controller	Universal MC2 Wheel
Hardware	Gaming Consoles	Console computer	Microsoft Xbox Video Game System
Hardware	Gaming Consoles	Console computer	Sony Playstation 2
Hardware	Gaming Consoles	Console computer	Nintendo Game Cube Console
Hardware	Handhelds	Palmtop computer	Garmin iQue
Hardware	Handhelds	Palmtop computer	HP iPAQ h5555 pocket pc
Hardware	Handhelds	Palmtop computer	Sony Clie (high end)
Hardware	Handhelds	Palmtop computer	Handspring Visor (high end)
Hardware	Handhelds	Palmtop computer	Compaq iPaq
Hardware	Handhelds	Palmtop computer	RCA eBook Reader (REB1200)
Hardware	Handhelds	WiFi card for iQue	
Hardware	Input Devices	3-D Trackball	Kensington Microwave Ltd. Turboring 3-D trackballs
Hardware	Input Devices	Audio-Visual hub	OmniView SOHO Series 4-port KVM Switch with Audio
Hardware	Input Devices	Cordless controller	Logitech Cordless Controller
Hardware	Input Devices	Cordless keyboard	Cordless Elite Duo Keyboard & Mouse (PC/Mac)
Hardware	Input Devices	Drawing tablet	ACAD INTUOS2 9x12 Serial Tablet w/INTUOS2 Grip Pen 4D Mouse & SW
Hardware	Input Devices	DVI KVM	MoniSwitch Pro DVI
Hardware	Input Devices	Force Feedback mouse	Logitech iFeel™ MouseMan
Hardware	Input Devices	force-feedback mouse	force-feedback mouse
Hardware	Input Devices	Graphics tablet	Wacom graphics tablet ($1200.00)
Hardware	Input Devices	Graphics tablet	Wacom Intuos 2 12x18 graphics tablet
Hardware	Input Devices	KVM switch PS2	Keyboard/Mouse/Monitor/Sound switch
Hardware	Input Devices	KVM switch USB	Keyboard/Mouse/Monitor/Sound switch
Hardware	Input Devices	lightpen	lightpen
Hardware	Input Devices	Mini Keypad	USB Ultra Mini Keypad
Hardware	Input Devices	Mouse	Kensington StudioMouse Wireless
Hardware	Input Devices	Portable Keyboard	Stowaway USB Keyboard
Hardware	Input Devices	Portable keyboard	SmartTech portable smartboard
Hardware	Input Devices	Portable keyboard for palmtops	Palm Portable Keyboard
Hardware	Input Devices	Portable keyboard for palmtops	Compaq iPAQ STOWAWAY Portable Keyboard
Hardware	Input Devices	Portable keyboard for palmtops	Sony Clie STOWAWAY Portable Keyboard
Hardware	Input Devices	Projection keyboard	Canesta Keyboard
Hardware	Input Devices	RF Remote	KEYSPAN Presentation Remote RF PowerPoint Remote w/Laser/Remote
Hardware	Input Devices	Trackball	Kensington Turbo Mouse Pro Wireless Trackball
Hardware	Input Devices	Trackball	Logitech 904286-0403 Marble Mouse Trackball
Hardware	Input Devices	Video control switch	VGA 8-in 2-out
Hardware	Input Devices	wireless keyboard	
Hardware	Input Devices	wireless mouse	wireless mouse
Hardware	Monitors	17” LCD Touch monitor	3000 Series Elo Entuitive 1725L 17” LCD

			Desktop Touch monitor
Hardware	Monitors	19” flat screen monitor	
Hardware	Monitors	19” flat screen monitors	
Hardware	Monitors	19” NTSC monitor	
Hardware	Monitors	21” colour TV Monitors	
Hardware	Monitors	23” HD Display	Apple Cinema
Hardware	Monitors	20” flat screen monitor	Apple
Hardware	Monitors	Portable monitor	Mobile Monitor (PS2)
Hardware	Monitors	Stereoscopic monitor	SynthaGram 222 Monitor
Hardware	Monitors	Stereoscopic monitor	SynthaGram 422 Glasses-Free 3DTM monitor
Hardware	Monitors	Touch screen	Wacom 18sx Cintiq
Hardware	Monitors	Wearable monitor	BV-3 Binocular Viewer
Hardware	Monitors	Wearable monitor	DV-1™ Wireless Digital Viewer
Hardware	Monitors	Wearable monitor	MicroOptical SV-9 PC Viewer
Hardware	Monitors	19” monitor	LaCie Electron Blue 19” Monitor
Hardware	Networking	AirPort Extreme Base Station (without modem and antenna port)	
Hardware	Networking	Bluetooth Access Point	
Hardware	Networking	Cisco Catalyst 3750 Switch	Part no. WS-C3750G-24TS-E
Hardware	Networking	Cisco Catalyst 3750 Switch	Part no. WS-C3750G-24T-E
Hardware	Notebooks	Apple Notebook	Apple 17” PowerBook G4 w/ 1GB RAM
Hardware	Notebooks	Docking station	TC1000 docking station
Hardware	Notebooks	PC Notebook	standard PC notebook
Hardware	Other (special)	3 Dimensional Mouse	Mouse that supports interaction with 3 dimensional virtual models. For use with a PC using the Windows XP operating system (and possibly Linux) and a USB Interface.
Hardware	Other (special)	eye tracker	LC Technologies Eyegaze Development System
Hardware	Other (special)	Facsimile machine	FAX machine w/ memory
Hardware	Other (special)	Flexcomp Infinity	Flexcomp Infinity (hardware & software) 7555M Sensors T9305Z SA9503M SA9306M SA9308M SA9309M SA9310M SA93011M Electrodes (200)
Hardware	Other (special)	Haptic device	A hardware device that provides force feedback to users. For use with a PC using the Windows XP operating system.
Hardware	Other (special)	Haptic glove	CyberGrasp Glove with CyberTouch
Hardware	Other (special)	Haptic glove	Infusion Systems TouchGlove
Hardware	Other (special)	Head-mounted tracker	Madentec Tracker 2000 (head-mounted tracker)
Hardware	Other (special)	Kettle	kettle
Hardware	Other (special)	Lafayette Instruments	LX 4000 Platinum Series Polygraph (No

		LX4000SW polygraph	computer) LX Version 9.0 Software PolyScore Polygraph Software Piezo Activity Sensor Model 7687US
Hardware	Other (special)	Microwave oven	microwave oven
Hardware	Other (special)	Minifridge	minifridge
Hardware	Other (special)	Motion tracker	InterSense IS-900 Precision Motion Tracker
Hardware	Other (special)	Motion tracker	JesterTek JestPoint 3D
Hardware	Other (special)	Motion tracker	InterSense InertiaCube2
Hardware	Other (special)	Neural interface	BioControl Systems Biomuse
Hardware	Other (special)	Noldus The Observer (hardware & software)	The Observer Video-Pro 5.0 Screen Capture Module
Hardware	Other (special)	photocopier	photocopier
Hardware	Other (special)	Stereo Vision System	A system that creates a 3D immersive environment. For our purposes, the system will be used in conjunction with Photogrammetric production software produced by DVP Canada (see www.dvp.ca - http://www.dvp.ca/produitsComplete.html)
Hardware	Other (special)	Tool box	Tool box
Hardware	Other (special)	Touch screen sharer	VOPEX 4-port Touch Screen Sharer (VOPEX-4MM-BI)
Hardware	Other (special)	usability lab** Portable	MiniDV_Ulab
Hardware	Other (special)	VGA -> NTSC Converter	
Hardware	Other (special)	Virtual Olfactory Display (VOD)	A device that can recreate odours based on a digital signature.
Hardware	Other (special)	VR projection system	Fakespace ImmersadeskR2 with all Standard and Optional Peripherals, Extended Support and System Support Options
Hardware	Other (special)	VR projection system	PHANTOM Desktop Premium 3.0
Hardware	Peripherals	Adapter	Mac ADB to PS/2 Adapter GM PS/2 to ADB Adapter for Mac
Hardware	Peripherals	Bluetooth adapter	D-Link DWB-120M Bluetooth USB Adapter
Hardware	Peripherals	Firewire Hub	Belkin 6-Port Mini FireWire Hub
Hardware	Peripherals	RS-232 Controller	RS-232 controller
Hardware	Peripherals	USB Adaptor	USB-to-serial converter
Hardware	Peripherals	USB hub	Keyspan USB HUB GRAPHITE 4 PORT
Hardware	Peripherals	Video Adapter	DVI to ADC Display Adapter
Hardware	Peripherals	Video Adapter	DVI to VGA Display Adapter
Hardware	Peripherals	Video adapter	Apple Video Adapter
Hardware	Printers	colour deskjet printer	HP colour deskjet w/ethernet (Mac compatible)
Hardware	Printers	colour laser printer	colour laser printer w/network (Mac compatible)
Hardware	Printers	Laser Printer	HP - LaserJet 2200 Printer
Hardware	Printers	Laser printer	1200 dpi basic laser printer
Hardware	Printers	Colour Plotter cartridges	Cyan, Yellow, Magenta, and Black
Hardware	Printers	HP CLJ 5500 Cartridges	Cyan, Yellow, Magenta, and Black
Hardware	Printers	Large format colour plotter	HP DesignJet 800 42” Colour Plotter, Mac compatible
Hardware	Scanners	3-D Scanner	Minolta VIVID 910 3-D Scanner

Hardware	Scanners	barcode scanner	hand-held barcode scanner
Hardware	Scanners	Pen scanner	C-Technologies C-Pen 800C Hand-Held Scanner
Hardware	Scanners	Pen scanner	Digital Ink N-Scribe
Hardware	Scanners	Pen scanner	IRISPen II Executive Handheld Multi-Language Scan...
Hardware	Scanners	Pen scanner	Logitech IO Personal Digital Pen (USB)
Hardware	Scanners	Pen scanner	READING PEN II HRES SCAN W/ TXT SPCH EN
Hardware	Scanners	Pen scanner	WizCom QuickLink Pen
Hardware	Scanners	Scanner	14” flatbed firewire scanner ($250.00)
Hardware	Scanners	Scanner	1200 DPI
Hardware	Scanners	Scanner	8.5” x 14” 48-bit flatbed firewire scanner with document feeder
Hardware	Sound cards	Soundcard	SB Audigy X-Gamer
Hardware	Storage	Apple xServ RAID	1.26 TB
Hardware	Storage	External firewire DVD-R CD-RW	DVD-R CD-RW
Hardware	Storage	External storage	LaCie 240 GB 7200 rpm or greater firewire drives
Hardware	Storage	PC Card hard drive	SimpleTech 10 GB PC Card Hard Drive
Hardware	Storage	Portable Storage	LaCie 60GB Pocket Drive
Hardware	Storage	Portable storage	LaCie Universal Media Drive (for flash cards)
Hardware	Storage	Removable storage	DiskOnKey - 256 MB
Hardware	Storage	SCSI Ultra 160 PCI adapter	For connecting to Autoloader
Hardware	Storage	SDLT 320 Autoloader	Quantum ATL SuperLoader 16+1 with barcode reader
Hardware	Storage	SDLT 320 cassettes	
Hardware	Supplies	Video, audio tapes, paper, etc.	Estimate
Hardware	Tablet PCs	Tablet computer	NEC VERSA LITEPAD TABLET PC
Hardware	Tablet PCs	Tablet computer	HP/Compaq TC1000 Tablet PC
Hardware	Tablet PCs	Tablet computer	Fujitsu Stylistic ST4121B
Hardware	Telecommunication	Telecom Bridge	
Hardware	Telecommunication	Telephone	telephone with speakerphone
Hardware	Video	4-port VGA video splitter	
Hardware	Video	A/V switching system	A/V switching system
Hardware	Video	Camcorder	Canon MiniDV Camcorder
Hardware	Video	Camcorder 3CCD	DV Camcorder with 3 CCDs
Hardware	Video	Camera	Logitech QuickCam for Notebooks Pro
Hardware	Video	Camera Case	Optex OPTC Kit
Hardware	Video	Camera Tripod	Miller tripod
Hardware	Video	Data projector	data projector, ceiling-mounted, 1024x768 (XGA) with DVI connector
Hardware	Video	Data projector	data projector, portable 1024x768 (XGA) with DVI connector
Hardware	Video	Data projector	Data projector
Hardware	Video	Desktop video camera	Canon VC-C4
Hardware	Video	DV Camera	SONY PD-150
Hardware	Video	DV deck	SONY DSR-40 DV deck

Hardware	Video	Equipment bags	camera & equipment bags
Hardware	Video	Headphones	camera headphones
Hardware	Video	Lighting kit	Arri (or Lowell) small lighting kit
Hardware	Video	Mobile device camera	Noldus Mobile Device Camera
Hardware	Video	vcr S-VHS Deck, rack-mounted	S-VHS deck, rack-mounted
Hardware	Video	VCRs	Toshiba W625
Hardware	Video	vcrs VHS deck	4 Head VHS deck
Hardware	Video	Video Accessories	Video access. Estimate
Hardware	Video	Video deck remote controller	Video Deck remote controller
Hardware	Video	Video hub	VEEMUX™ SM-8X8-15V-LCD (Front & Back) Video Matrix Switch
Hardware	Video	VIDEO MATRIX SWITCHES	
Hardware	Video	video monitor	RCA 9" ColorTrak or equivalent
Hardware	Video	Workstation Camera	Apple iSight camera
Hardware	Video Cards	Video capture cards	Videum 1000 Plus
Other	Service	Tech Support	1 year tech support: Online Solutions
Software	Audio	Cinewave RT 4.0 with Pro DA breakout box	
Software	Audio	ProTools Plug-in	Gallery Software "Library Loader"
Software	Audio	ProTools Plug-in	Native Instruments "Reaktor"
Software	Audio	ProTools Plug-in	Prosoniq "Orange Vocoder"
Software	Audio	ProTools Plug-in	Waves "Native Power Pack"
Software	Audio	Screen Reader Software	Digidesign "DIGI 002" (Digital Mixer/Interface) w/ Pro Tools LE recording software
Software	Audio	SoundEdit 16	
Software	Business	Adobe Acrobat 6.0 Professional (Mac)	
Software	Business	Adobe Acrobat 6.0 Professional (PC)	
Software	Business	Microsoft Office (Mac)	
Software	Business	Project 4.0 (PC)	
Software	Games	Media for MS Xbox	Various console cartridges
Software	Games	Media for Nintendo Gamecube	Various console cartridges
Software	Games	Media for PlayStation 2	Various console cartridges
Software	Graphics	Adobe Creative Suite Pro (Mac)	
Software	Graphics	Director 10 (Mac)	
Software	Graphics	Macromedia Studio MX 2004 (Mac)	
Software	Operating System	Carleton Standard lab Image	
Software	Operating System	Microsoft Office XP Pack for Tablet PC (Tablet Pack)	
Software	Other (special)	ATLAS.ti 5.0	
Software	Other (special)	Banxia Decision	
Software	Other (special)	ESRI Suite	

		(ArcView/ArcInfo v. 8.x)	
Software	Other (special)	Haptic device software development kit (SDK)	SDK to support development with above. For use with a PC using the Windows XP operating system (and possibly UNIX/Linux).
Software	Other (special)	Haptic software	Immersion VirtualHand Studio
Software	Other (special)	Haptic software	Sensable Technologies GHOST SDK
Software	Other (special)	Input software	Madentec MagicCursor 2000
Software	Other (special)	MindJet MindManager 2002 for Tablet PC	
Software	Other (special)	miscellaneous programs: $1000.00	
Software	Other (special)	Screen Reader Software	Software that Intelligently converts text to speech. Designed for people with special needs. JAWS is currently the industry leader and the most popular software used by our target user group (blind and visually impaired people). Request the latest version of the software for use on a PC with a Windows XP operating system.
Software	Other (special)	SPSS Statistical Package	
Software	Other (special)	StorySpace (Mac)	
Software	Other (special)	StorySpace (PC)	
Software	Other (special)	Tactile Graphic Designer package	A software/hardware package designed to support creation of maps for the blind and visually impaired. For use with a PC using the Windows XP operating system - prefer USB interface/serial acceptable.
Software	Other (special)	various plug-ins (Photoshop, After Effects production bundle)	
Software	Other (special)	Workstation Software	Site license for various hypertexts
Software	Other (special)	Workstation Software	Site license for various hypertexts
Software	Other (special)	Workstation Software	C-I-SAID
Software	Other (special)	Workstation Software	HyperRESEARCH 2.5
Software	Other (special)	Workstation Software	N6
Software	Other (special)	Workstation Software	NVivo
Software	Programming	Workstation Software	Visual Studio .NET Prof
Software	Utilities	Workstation Software	MacLinkPlus Deluxe
Software	Utilities	Workstation Software	Norton Antivirus (Mac)
Software	Utilities	Dictation software	MacVoice (Mac)
Software	Utilities	Dictation software	Dragon Systems Naturally Speaking
Software	Utilities	Roxio Easy CD Creator (PC)	
Software	Utilities	Roxio Toast Titanium (Mac)	
Software	Utilities	Workstation Software	Norton Utilities
Software	Utilities	Workstation Software	FileMaker Pro (Mac)
Software	Video	Adobe After Effects (Mac)	
Software	Video	Cinema Tools (Mac)	
Software	Video	Final Cut Pro 4.0 (Mac)	
Software	Video	Quicktime Pro (Mac)	
Software	Video	Quicktime VR Authoring	

		(Mac)	
Software	Video	Video matrix switch software	Matrix control software and for universal matrix Kym switches & RS232 control
Software	Video	Workstation Software	Media Cleaner

Appendix J: Mime Encoding of potential project software

The following was submitted to Bill Underwood for the Mime Encoding Survey.
Prepared by: Peter Pulsifer, Lead Researcher for the Cybercartographic Atlas of Antarctica, Geomatics and Cartographic Research Centre, Carleton University, July 28, 2003

Submitted by: Tracey Lauriault, IP2 CS06 Cybercartographic Atlas of Antarctica, Researcher, Geomatics and Cartographic Research Centre, Carleton University

Submitted to: Bill Underwood, Scientific Focus, Kevin Glick, Chair Scientific Focus, CS06 Case Study Team, and to be posted with CS06 Case study section of the IP2 Restricted Researchers Site, July 28, 2003

NOTE: Due to time constraints, it was not possible fill in the MIME Type column; most of these formats have MIME types. The Cybercartographic Atlas of Antarctica is currently under development and there may be additional file format included as part of the project and these will be added as the project progresses. There are over 100 geographic file types; however, this list is restricted to those that will likely be encountered in this project. Should you have any questions, please do not hesitate to communicate with Tracey Lauriault, tlauriau@connect.carleton.ca.

File Format Name/ Encoding Language	Name Extension	Vector/ Raster	MIME Type	Sample URL	Primary Function(s)	Comments
ESRI Shapefile	SHP/DBF /SHX	Vector		http://www.esri.com	Read/Write/Transfer/ Analyse/Display*	Key format used in the lab.
ESRI ArcInfo Binary Coverages	Multiple	Vector		http://www.esri.com	Read/Write/Display/ Analyse	Key format used in the lab.
ESRI Grid	Multiple	Raster		http://www.esri.com	Read/Write/Display/ Analyse	Key format used in the lab.
ESRI ArcInfo Geodatabase	GDB	Vector (Both)		http://www.esri.com	Read/Write/Display/ Analyse	Object Oriented relation data structure. Not what we would normally think of as a file format.
ESRI ArcInfo Export	E00	Both		http://www.esri.com	Transfer	Often used by data warehouse sites to distribute geospatial data.
ESRI ArcInfo TIN	NET	Vector		http://www.esri.com	Read/Write/Transfer/ Analyse/Display	A 3-dimensional format.
AutoCAD DWG	DWG	Vector		http://www.autodesk.com	Transfer	Large scale data (i.e., site plans,

						building plans, settlement data) often stored in this format.
AutoCAD DXF	DXF	Vector		http://www.autodesk.com	Transfer	Transfer version of DWG.
PCI Database	PIX	Raster		http://www.pcigeomatics.com/index.html	Read/Write/Analyse	Raster data format that can also hold vector segments and various other ancillary data related to Remote Sensing data analysis (i.e., satellite ephemeris data). Primary Software in GCRC Lab.
GeoTIFF	TIF	Raster		http://rockyweb.cr.usgs.gov/nmpstds/	Transfer/Display	GeoTIFF is a spatially enabled extension of the TIFF standard.
Spatial Archiving and Interchange Format	SAIF?	Both		http://home.gdbc.gov.bc.ca/fmebc/	Transfer	Still under review by GCRC.
Spatial Data Transfer Standard (SDTS)	DDF	Both		http://mcmcweb.er.usgs.gov/sdts/	Transfer	U.S. Government format.**
Geography Markup Language (GML)	XML	Vector		http://www.opengis.org/techno/docum	Transfer	(Open GIS Consortium / ISOTC.211).
USGS Digital Elevation Model (DEM)	DEM	Raster Surface		http://rockyweb.cr.usgs.gov/elevation/	Transfer	U.S. Government format.
USGS Digital Line Graph (DLG)	DLG	Vector		http://edc.usgs.gov/products/map/dlg	Transfer	U.S. Government format.
USGS Digital Orthophoto Quad	DOQ	Raster		http://mapping.usgs.gov/www/ndop/	Transfer	U.S. Government format, National Imagery and Mapping Agency/Defense.
Mapping Agency Digital Terrain Elevation Data (DTED)	DTED	Raster Surface		http://www.nima.mil/publications/spec	Transfer	U.S. Government format.
VRML	WRL	Vector		http://www.web3d.org/	Display	For Web display.
GeoVRML	WRL	Vector		http://www.geovrml.org/	Display	For Web display.
SVG	HTM/ HTML/ XML	Vector		http://www.w3.org/Graphics/SVG/Over	Display	For Web display.
Raw Binary Image Format	BIL/BIN/ RAW	Raster		http://www.pcigeomatics.com/cgi-bin/	Transfer	Raw binary transfer of data. Requires header information for import.
Joint Photographic Experts Group	JPG	Raster		http://www.jpeg.org/	Display	For Web display.

Portable Network Graphics	PNG	Raster		http://www.libpng.org/pub/png/	Display	For Web display.
CEOS	Multiple	Raster		http://www.ceos.org	Transfer	Used to distribute single and multi-band satellite imagery.
Excel Spreadsheet	XLS	Vector		http://www.microsoft.com	Read/Write/Transfer/ Analyse	Positional and attribute data often stored in this format.
Hierarchical Data Format	HDF	Vector (Both?)		http://hdf.ncsa.uiuc.edu/	Transfer	Still under review by GCRC.
Vector Product Format	VPF	Vector		http://164.214.2.59/publications/specs	Transfer	U.S. Government format.
IDRISI Vector/Raster	Multiple	Both		http://www.clarklabs.org/	Read/Write/Transfer/ Analyse/Display	Files created by the IDRISI GIS software package.
Hypertext Markup Language	HTML	n/a		htttp://www.w3c.org	Display	Used to create Web mapping sites.
Microsoft Video Format	WMV	n/a		http://www.microsoft.com	Display	Used for video and animation.
Motion Picture Experts Group (MPEG)	MPG	n/a		http://www.mpeg.org/MPEG/index.htm	Display	Used for video and animation.

Column-specific notes:

* Display refers to display to the end user.

** U.S. Government formats are important because much of the Project data come from U.S.G.S. sources.

Appendix K: List of Data Sources for the Cybercartographic Atlas of Antarctica

Cybercartographic Atlas of Antarctica Data Sources, as of 26 March 2005:

Module	Data Name	Data Format	Data Provider	Web Link of Provider
Southern Oceans, Xiuxia Liu	Southern Elephant Seals	Numeric data	Centro Nacional Patagonico	N/A
	Squid	Numeric data	Xavier, J.C., P.G. Rodhouse, P.N.Trathan and A.G. Wood	http://www.antarctica.ac.uk/staff-profiles/template.php?user=jccx
	Seal Track	Numeric data	McConnell, B. J. and M. A. Fedak	http://seamap.env.duke.edu/datasets/detail/68
	Sea Surface Temperature	GeoTIFF (Raster)	Jet Propulsion Laboratory, NASA	http://podaac.jpl.nasa.gov/poet
	Bathymetry	GeoTIFF (Raster)	National Geophysical Data Center, NOAA	http://www.ngdc.noaa.gov/mgg/fliers/01mgg04.html
	Antarctic Coastline	ESRI EOO	Antarctic Digital Database	http://www.add.scar.org/
	Sea Ice Concentration	Flat binary	National Snow and Ice Data Center (NSIDC), NASA	http://nsidc.org/data/nsidc-0051.html
Territoriality module, text and base maps by Peter Pulsifer based on the following, Multimedia Design by Peter Pulsifer and Sebastien Caquard, Implementation by Amos Hayes and JP Fiset		Book	McGonigal, David and Woodsworth Lynn, *The Complete Encyclopedia, Antarctica and the Arctic* (Willowdale, Ont: Firefly Books, 2001), 608 pp.	
		Book + CD-ROM	Berkman, Paul Arthur. *Science Into Policy: Global Lessons from Antarctica* (San Diego, CA: Academic Press, 2002), 252p Accompanying material: 1 CD-ROM	
		Book	May, Tom. *The Greenpeace Book of Antarctica: the New View of the Seventh Continent* (Toronto, Macmillan, 1989), 192 pp.	
		Internet Site	The Web site of the Council of Managers of National Antarctic Programs (COMNAP).	http://www.comnap.aq

	Flag Graphics	GIF?	Flag graphics used in the narrative for each claimant nation.	http://www.flags.net
	Geo-data pie slices for each territorial claim		P. Pulsifer, created manually using ArcGIS and coordinates obtained from the text of references 1 and 2 above.	
	BaseMap Layers		Basemap layer was obtained from the Antarctic Digital Database 1:10 000 000 scale coverage.	http://www.add.scar.org
Dry Valley Module, Birgit Woods	LIDAR elevation data and air photo drape.	30m_elev.tif dry_valleys.tif	LIDAR data from USGS: Credit the U.S. Geological Survey Polar Program funded by the National Science Foundation.	http://usarc.usgs.gov/antarctic_atlas Select Data Download LIDAR Elevation Data
Atmosphere and Ozone Module, Birgit Woods	Images of ozone over poles and whole Earth	24 BMP images of poles 4 BMP images of Earth	Total Ozone Mapping Spectrometer: Ozone Processing Team- NASA/GSFC Code 916.	Images from TOMS-Total Ozone Mapping Spectrometer: http://toms.gsfc.nasa.gov/ozone/ozone_v8.html
	Text and figure about the atmosphere.	Saved as: Atmosphere.gif	NASA Space Academy, Exploration, Earth's Atmosphere. Original Author: Shaun Phillips. Editor(s): Patrick Meyer. Responsible Official: Becky Bray. System Manager: Patrick Meyer.	http://liftoff.msfc.nasa.gov/academy/space/atmosphere.html
	Text and figures about the ozone	Saved as: DobsonGraph1950to2010.jpg DobsonSpectrophotometer.bmp StratosphericCloud.bmp	British Antarctic Survey (BAS): Natural Environment Research Council. 2004.	Key Topics. Ozone. http://www.antarctica.ac.uk/Key_Topics/The_Ozone_Hole/index.html
Antarctica & Geologic Time Module, Birgit Woods	Text and Paleogeographic and tectonic feature maps.	14 JPEG Images Representing time slices of earth history from Cambrian to Present.	Dataset Creator: Ron Blakey Dataset Title: Regional Paleogeographic Views of Earth History Dataset Publisher: Department of Geology, Northern Arizona University Data Presentation Form: Maps Found using the Global Change Master Directory- a directory of Earth science data and services -> Data Sets -> Solid Earth -> Regional	Time Slice, http://jan.ucc.nau.edu/~rcb7/global_history.html, all maps and globes of all regions by geologic time, and a brief narrative for each time interval.

			Paleogeographic Views of Earth History (accessed on 2 Feb 2005).	
	Figure	Saved as: GeoTimescale.jpg	Stephen S. Gao, Associate Professor, Department of Geology, Kansas State University	http://earth.geol.ksu.edu/sgao/g100/plots/1017_timeline.jpg
	Text and Figures from USGS online book	Saved as: Baseball.GIF TectonicPlates.GIF RejoinedCont.GIF	USGS W. Jacquelyne Kious and Robert I. Tilling, 1996. *This Dynamic Earth: the Story of Plate Tectonics* (Online edition).	http://pubs.usgs.gov/publications/text/dynamic.html#anchor10790904
Climate Change & Global Warming Module, Birgit Woods	To be determined	To be determined	To be determined	To be determined
Multimedia Material			British Antarctic Survey (BAS) archives.	
King George Island GIS			Using OGC Web Map Services.	http://www.geographie.uni-freiburg.de/mapserver/kgis/kgis.phtml
Miscelaneous Data (DEMs, Satellite imagery, Multimedia)			USGS Antarctic Resource Centre Centre (USArc) Data Clearinghouse.	http://usarc.usgs.gov/
Miscelaneous Data			New Zealand (OGC Web Services access) Clearinghouse.	http://www.anta.canterbury.ac.nz/gis/
Topographic and Environmental Data			Australian Antarctic Division using OGC Web Services.	http://www.aad.gov.au/default.asp?casid=3812
Non-Geographic Data			Antarctic Treaty System.	http://www.ats.org.ar/
Non-Geographic Data			Committee for Environmental Protection.	http://www.cep.aq/
Framework Data	ETOPO2		World Data Center - Global Change Master Directory.	http://www.ngdc.noaa.gov/mgg/fliers/01mgg04.html, metadata record - http://gcmd.gsfc.nasa.gov/KeywordSearch/Freetext.do?KeywordPath=&Portal=GCMD&MetadataType=0&Freetext=ETOPO2

				And then choose item 2 (ETOPO2 2-Minute Gridded Global Elevations from NOAA/NGDC [NOAA_NGDC_ETOPO2])
Framework Data	Topographic		Antarctic Digital Database Project headed by the British Antarctic Survey (BAS).	http://www.add.scar.org
Xiuxia Liu, MA Thesis Data	Bathymetry		World Data Centre	http://www.ngdc.noaa.gov/mgg/fliers/01mgg04.html
Exploration Module, Sébastien Caquard	Text, Audio text, pictures, old maps, journeys	Book	McGonigal, David and Woodsworth Lynn. *The Complete Encyclopedia, Antarctica and the Arctic*. (Willowdale, Ont: Firefly Books, 2001), 608 pp.	
	BaseMap Layers		Basemap layer was obtained from the Antarctic Digital Database 1:10 000 000 scale coverage. Completed (text and ice extend) by S. Caquard	http://www.add.scar.org
	Exploration journeys		Drawn by S. Caquard based on McGonigal, David and Woodsworth Lynn, *The Complete Encyclopedia, Antarctica and the Arctic*. (Willowdale, Ont: Firefly Books, 2001), 608 pp.	
	Image Map “Island of Utopia”	Book	In Thomas Moore, 1518, Utopia – Modified by S. Caquard with Adobe Photoshop.	
	Sound		Voices of A. Hayes and S. Caquard based on McGonigal, David and Woodsworth Lynn. *The Complete Encyclopedia, Antarctica and the Arctic*. (Willowdale, Ont: Firefly Books, 2001), 608 pp.	

Appendix L: Antarctic Digital Data Web Feature Server Development Notes

CS06 - Antarctic Digital Data Web Feature Server Development Notes

Cybercartographic Atlas of Antarctica

British Antarctic Survey

Antarctic Digital Data Web Feature Server Development Notes

GeoServer (http://geoserver.org) was used to establish a combined Web Map Server and Web Feature Server. The Web Map Server outputs maps in JPEG, PNG and SVG image formats. The Web Feature Server delivers data in the form of OGCs Geography Markup Language (GML - Ron Lake et al. have been the key drivers of this initiative). In the end GeoServer was selected over MapServer as it seemed easier to implement and manage.

See the following document:

Pulsifer, P. L., J. McKenna and A. P. R. Cooper (2004). "ADD WFS Development Notes," British Antarctic Survey, Geomatics and Cartographic Research Centre, Carleton University. Available at: http://www.interpares.org/display_file.cfm?doc=ip2_cs06_APPENDIX_L.pdf.

Appendix M: Atlas Framework, Model and File Types - Freiburg Paper and Presentation

Modeling and File Types

See the following documents:

Pulsifer, P. L. and D. R. Fraser Taylor (2003). "The Cybercartographic Atlas of Antarctica: Towards Implementation," paper presented at the *2nd International Antarctic GIS Workshop (SCAR GI Technical Experts Meeting). Institut für Physische Geographie Universität Freiburg, Freiburg, Germany, April 7-11, 2003*. Available at: http://www.interpares.org/display_file.cfm?doc=ip2_cs06_APPENDIX_M_paper.pdf.

Pulsifer, P. L. and D. R. Fraser Taylor (2003). "The Cybercartographic Atlas of Antarctica: Towards Implementation," paper presented at the *2nd International Antarctic GIS Workshop (SCAR GI Technical Experts Meeting). Institut für Physische Geographie Universität Freiburg, Freiburg, Germany, April 7-11, 2003*. Available at: http://www.interpares.org/display_file.cfm?doc=ip2_cs06_APPENDIX_M_presentation.pdf.

Appendix N: OpenGIS® Reference Model

This is a document that explains the project's model. This document was referred to by Respondent #4.

Available at: http://portal.opengeospatial.org/files/?artifact_id=3836.

Copy also available at:
http://www.interpares.org/display_file.cfm?doc=ip2_cs06_APPENDIX_N.pdf.

Appendix O: How the Atlas Works and Instructions for Creators

See the following document:

Fiset, J.P. (n.d.). "Welcome to the Atlas 4 Windows Project." Available at: http://www.interpares.org/display_file.cfm?doc=ip2_cs06_APPENDIX_O.pdf.

This document is the first set of guidelines for creators created by Jean-Pierre Fiset.

Appendix P: List of Standards Adhered to on the Project

a) GML Standard Reference from Respondent 4 Transcripts.

ISO 19135
Geographic information -- Procedures for registration of items of geographic information

Edition:	1 (Monolingual)
Number of pages:	56
Technical committee / subcommittee:	TC 211; ISO Standards
ICS:	35.240.70
Status:	Under development
Current stage:	40.60
Stage date:	2004-12-10
Publication target date:	
Revision information:	None

b) GML Standard Reference From Respondent 4 Transcripts.

19107
Geographic information -- Spatial schema
(available in English only)

Edition:	1 (Monolingual)
Number of pages:	166
Technical committee / subcommittee:	TC 211; ISO Standards
ICS:	35.240.70
Status:	Published standard
Current stage:	60.60
Stage date:	2003-05-08
Revision information:	None

Abstract

ISO 19107:2003 specifies conceptual schemas for describing the spatial characteristics of geographic features, and a set of spatial operations consistent with these schemas. It treats vector geometry and topology up to three dimensions. It defines standard spatial operations for use in access, query, management, processing, and data exchange of geographic information for spatial (geometric and topological) objects of up to three topological dimensions embedded in coordinate spaces of up to three axes.

c) Spatial Data Transfer Document (SDTD) document referred to by Respondent #4.

Purpose of SDTS -- The purpose of the SDTS is to promote and facilitate the transfer of digital spatial data between dissimilar computer systems, while preserving information meaning and minimizing the need for information external to the transfer. Implementation of SDTS is of significant interest to users and producers of digital spatial data because of the potential for increased access to and sharing of spatial data, the reduction of information loss in data exchange, the elimination of the duplication of data acquisition, and the increase in the quality and integrity of spatial data. SDTS is neutral, modular, growth-oriented, extensible, and flexible--all characteristics of an "open systems" standard. (From the USGS)
http://data.geocomm.com/sdts/

Spatial Data Transfer Standard – USGS Page
http://mcmcweb.er.usgs.gov/sdts/

d) Open Geospatial Consortium (OGC) Standards and Specifications that the project would adhere to formally or may be referred to in general by the project as discussed by Responded #4.

Details, abstracts and specifications can be read and downloaded from the following site: http://www.opengeospatial.org/specs/?page=specs. Recommendation paper, discussion papers on this topic are also available at this location.

Type	Title	Version	Document #	Date	Description	Editor(s)
IS	Catalog Interface (CAT)	2.0	04-021r2	2004-08-02	Defines a common interface that enables diverse but conformant applications to perform discovery, browse and query operations against distributed and potentially heterogeneous catalog servers	Doug Nebert
IS	Coordinate Transformation Services (CT)	1.0	01-009	2001-01-12	for general positioning, coordinate systems, and coordinate transformations	Martin Daly
IS	Filter Encoding (Filter)	1.0	02-059	2001-05-01	A filter is a construct used to describe constraints on properties of a feature class for the purpose of identifying a subset of feature instances to be operated upon in some way	Peter Vretanos
IS	Geography Markup Language (GML3.0)	3.0	02-023r4	2003-01-29	The Geography Markup Language (GML) is an XML encoding for the transport and storage of geographic information, including both the geometry and properties of geographic features	Simon Cox, Paul Daisey, Ron Lake, Clemens Portele, Arliss Whiteside

IS	Grid Coverages (GC)	1.0	01-004	2001-01-12	This specification was designed to promote interoperability between software implementations by data vendors and software vendors providing grid analysis and processing capabilities	Louis Burry
IS	OpenGIS Location Services (OpenLS): Core Services [Parts 1-5] (OLS Core)	1.0	03-006r3	2004-01-16	OpenGIS Location Services (OpenLS): Core Services, Parts 1-5, which consists of the composite set of basic services comprising the OpenLS Platform. This platform is also referred to as the GeoMobility Server (GMS), an open location services platform	Marwa Mabrouk
IS	Simple Features - CORBA (SFC)	1.0	99-054	1999-06-02	The Simple Feature Specification application programming interfaces (APIs) provide for publishing, storage, access, and simple operations on Simple Features (point, line, polygon, multi-point, etc.)	Peter Ladstaetter
IS	Simple Features - SQL (SFS)	1.1	99-049	1999-05-05	The Simple Feature Specification application programming interfaces (APIs) provide for publishing, storage, access, and simple operations on Simple Features (point, line, polygon, multi-point, etc.)	Keith Ryden
IS	Simple Features – OLE/COM	(SFO)	1.1 99-050	1999-05-18	The Simple Feature Specification application programming interfaces (APIs) provide for publishing, storage, access, and simple operations on Simple Features (point, line, polygon, multi-point, etc.)	T.C. Chair
IS	Styled Layer Descriptor (SLD)	1.0	02-070	2002-08-19	The SLD is an encoding for how the Web Map Server (WMS 1.0 & 1.1) specification can be extended to allow user-defined symbolization of feature data	Bill Lalonde
IS	Web Coverage Service (WCS)	1.0	03-065r6	2003-10-16	Extends the Web Map Server (WMS) interface to allow access to geospatial “coverages” that represent values or properties of geographic locations, rather than WMS generated maps	

					(pictures	
IS	Web Feature Service (WFS)	1.0	02-058	2002-05-17	The purpose of the Web Feature Server Interface Specification (WFS) is to describe data manipulation operations on OpenGIS® Simple Features (feature instances) such that servers and clients can "communicate" at the feature level	Peter Vretanos
IS	Web Map Context Documents (WMC)	1.0	03-036r2	2003-06-12	Create, store, and use "state" information from a WMS based client application	Jean-Philippe Humblet
IS	Web Map Service (WMS1.3)	1.3	04-024	2004-08-02	Provides three operations protocols (GetCapabilities, GetMap, and GetFeatureInfo) in support of the creation and display of registered and superimposed map-like views of information that come simultaneously from multiple sources that are both remote and heterogeneous	Jeff de La Beaujardiere

Legend

ATB	Approved Technical Baseline
IS	OpenGIS Implementation Specification
RP	Recommendation Paper
DP	Discussion Paper
AS	Abstract Specification
RFC	Request for Comment
ATB-Draft	Technical Baseline - Draft
IS-Draft	Implementation Specification - Draft
RP-Draft	Recommendation Paper - Draft
DP-Draft	Discussion Paper - Draft
AS-Draft	Abstract Specification - Draft
IPR	Interoperability Program Report
RFC-Draft	Request for Comment - Draft
D-ATB	Deprecated Technical Baseline
D-IS	Deprecated Implementation Specification
D-RP	Deprecated Recommendation Paper
D-DP	Deprecated Discussion Paper
D-AS	Deprecated Abstract Specification
D-RFC	Deprecated Request for Comment

e) Standards related to geospatial data in general that the project would adhere to formally, or to which the data accessed by the project would adhere.

ISO/TC 211 Publications
Last updated 2005-02-14
International Standards and Technical Reports: http://www.isotc211.org/publications.htm

1. ISO 6709:1983 Standard representation of latitude, longitude and altitude for geographic point locations

2. ISO 19101:2002 Geographic information — Reference model

3. ISO 19105:2000 Geographic information — Conformance and testing

4. ISO 19106:2004 Geographic information — Profiles

5. ISO 19107:2003 Geographic information — Spatial schema

6. ISO 19108:2002 Geographic information — Temporal schema

7. ISO 19110:2005 Geographic information — Methodology for feature cataloguing

8. ISO 19111:2003 Geographic information — Spatial referencing by coordinates

9. ISO 19112:2003 Geographic information — Spatial referencing by geographic identifiers

10. ISO 19113:2002 Geographic information — Quality principles

11. ISO 19114:2003 Geographic information — Quality evaluation procedures

12. ISO 19115:2003 Geographic information — Metadata

13. ISO 19116:2004 Geographic information — Positioning services

14. ISO 19119:2005 Geographic information — Services

15. ISO/TR 19120:2001 Geographic information — Functional standards

16. ISO/TR 19121:2000 Geographic information — Imagery and gridded data

17. ISO/TR 19122:2004 Geographic information/Geomatics — Qualification and certification of personnel

18. ISO 19125-1:2004 Geographic information — Simple feature access — Part 1: Common architecture

19. ISO 19125-2:2004 Geographic information — Simple feature access — Part 2: SQL option

Final Draft International Standards

1. ISO/FDIS 19109 Geographic information — Rules for application schema

Draft International Standards

1. ISO/DIS 19104 Geographic information — Terminology
2. ISO/DIS 19117 Geographic information — Portrayal
3. ISO/DIS 19118 Geographic information — Encoding
4. ISO/DIS 19123 Geographic information — Schema for coverage geometry and functions
5. ISO/DIS 19128 Geographic information — Web Map Server interface
6. ISO/DIS 19133 Geographic information — Location based services tracking and navigation
7. ISO/DIS 19135 Geographic information — Procedures for registration of items of geographic information
8. ISO/DIS 19137 Geographic information — Core profile of the spatial schema

Appendix Q: The Cybercartographic Atlas of Antarctica Development Framework

See the following document:

Pulsifer, P. L. and D. R. F. Taylor (2003). "The Cypercartographic Atlas of Antarctica Development Framework," presented at the Cybercartographic Atlas of Antarctica Development Meeting, October 14-17, 2003, Carleton University, Ottawa, ON, Canada. Available at: http://www.interpares.org/display_file.cfm?doc=ip2_cs06_APPENDIX_Q.pdf.

Appendix R: Atlas Creative Process - Acte Cybercartographique

See the following document:

Pulsifer, P., S. Caquard, J.P. Fiset and A. Hayes (n.d.). "Acte Cybercartigraphique." Available at: http://www.interpares.org/display_file.cfm?doc=ip2_cs06_APPENDIX_R.pdf.

Appendix S: Cybercartographic Atlas Framework Presentation

See the following document:

Hayes, A. and J.P. Fiset (2005). "CyberCartographic Atlas Framework." Available at: http://www.interpares.org/display_file.cfm?doc=ip2_cs06_APPENDIX_S.pdf.

Appendix T: Geospatial Data Quality

See the following document:

(2002). "Excerpts from the Supplement to the Case Study – 6: Elements of Geospatial Data Quality." Available at: http://www.interpares.org/display_file.cfm?doc=ip2_cs06_APPENDIX_T.pdf.

Appendix U: Project WIKI

http://hot.carleton.ca/~wiki/cgi-bin/cybercat/wiki.pl?HomePage

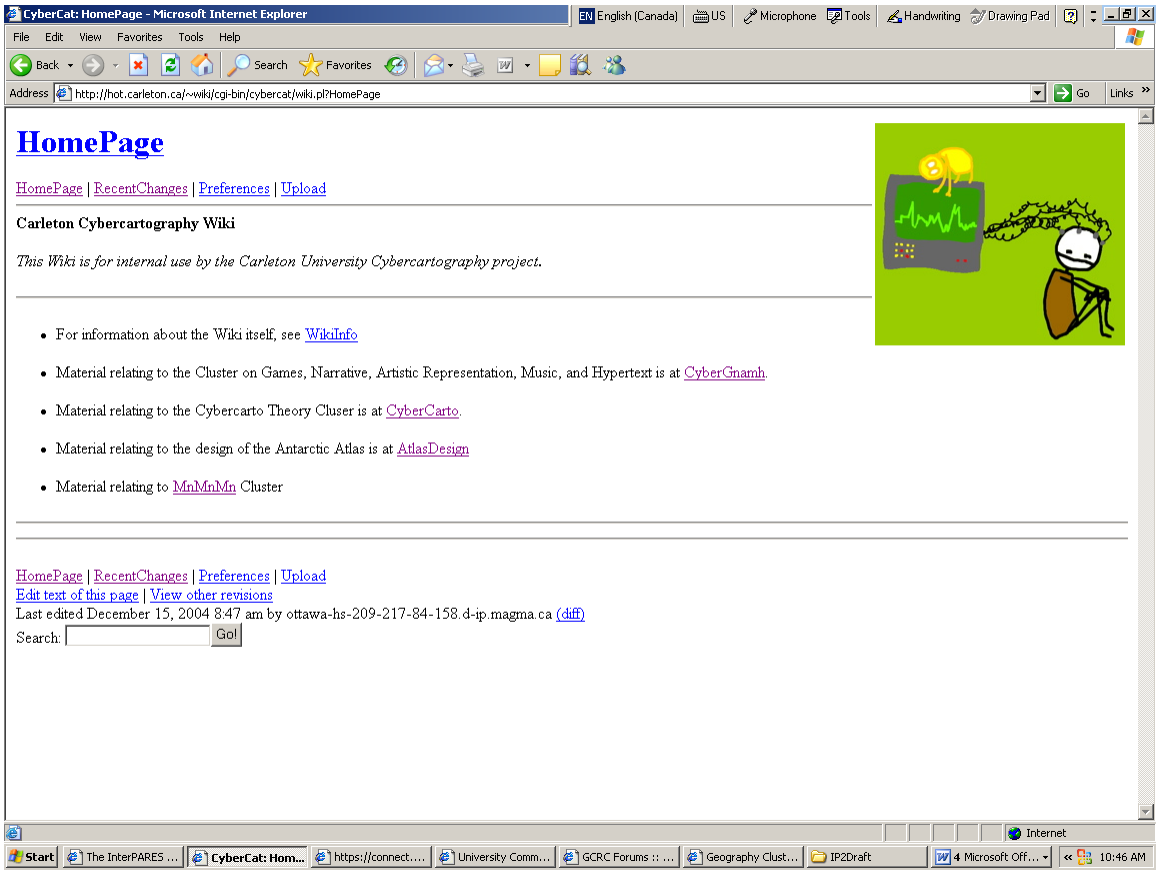

Figure 5. Project Wiki: Screenshot of home page

Appendix V: GCRC Project Forum

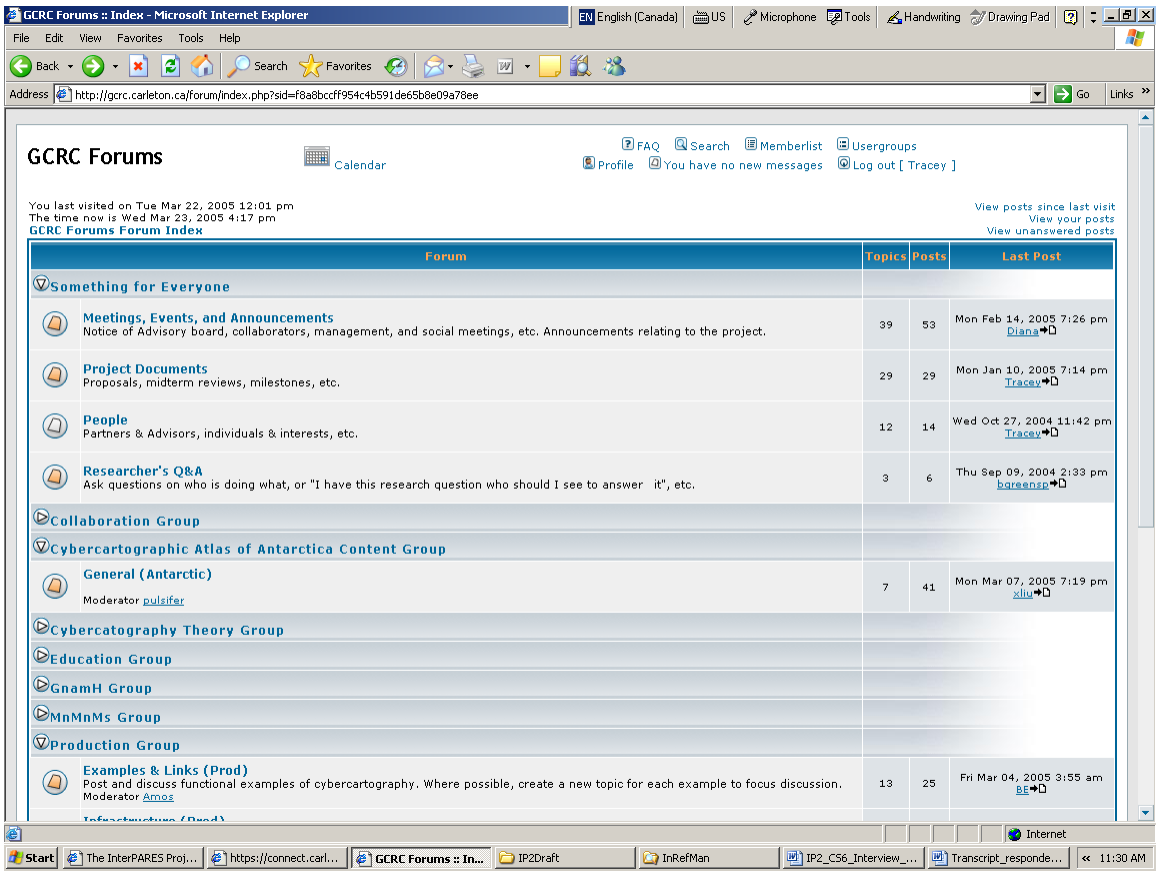

Figure 6. GCRC Project Forum: Screenshot of directory of documents relevant to all researchers

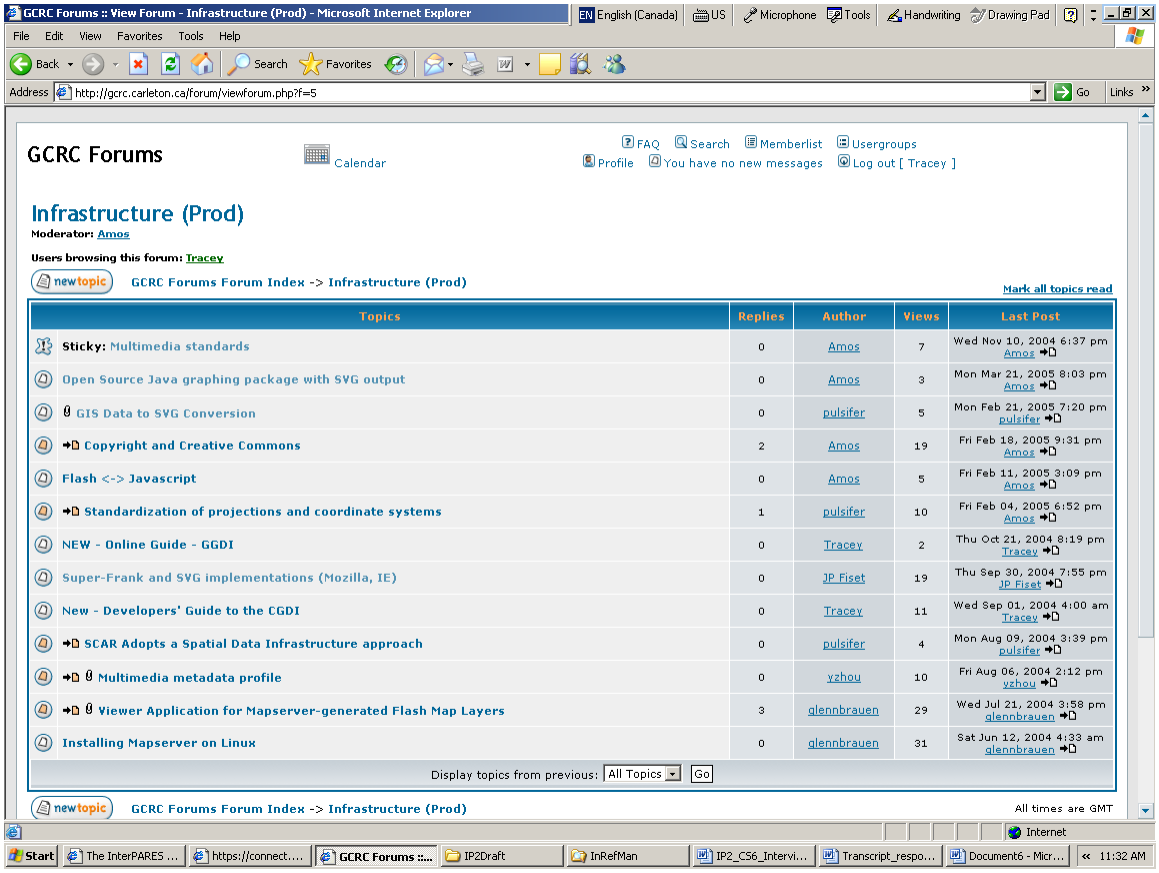

Figure 7. GCRC Project Forum: Screenshot of production infrastructure section

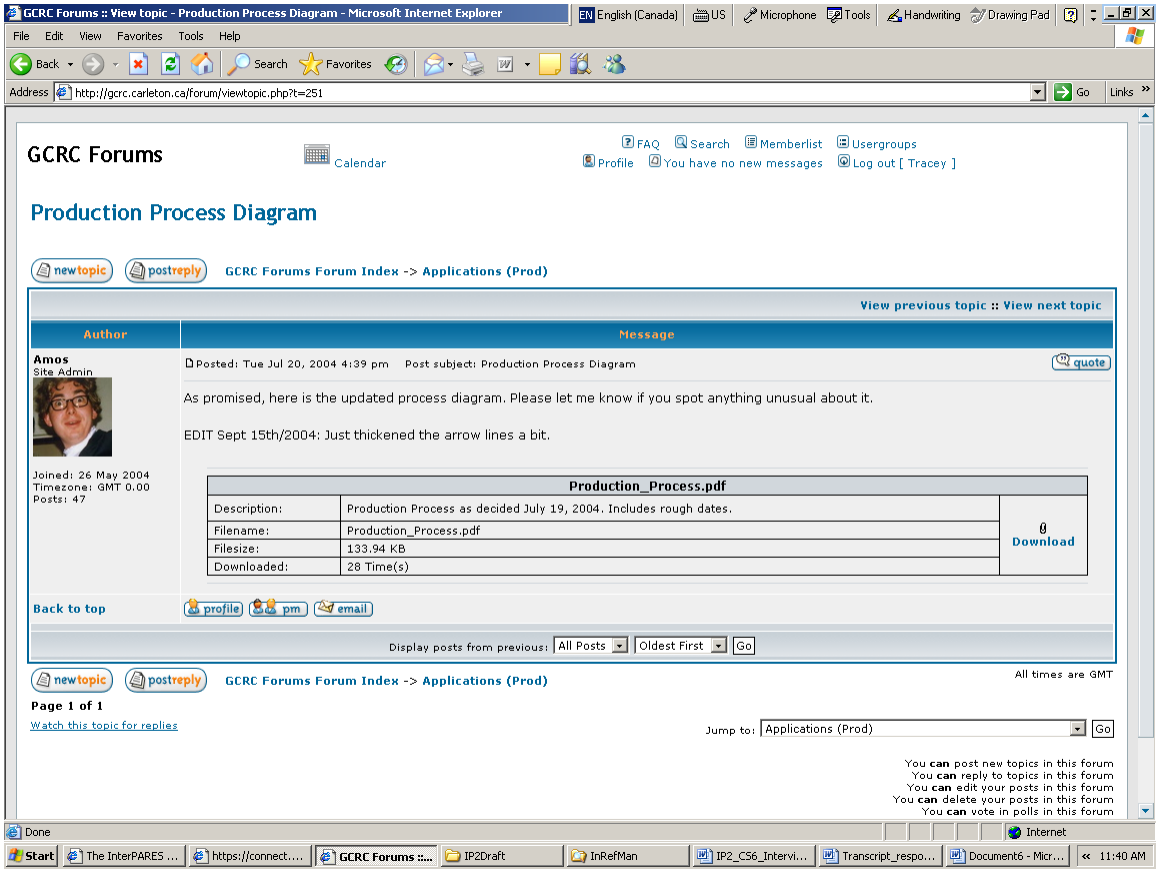

Figure 8. GCRC Project Forum: Screenshot of section with a posting and an attached document for review by the Production Team

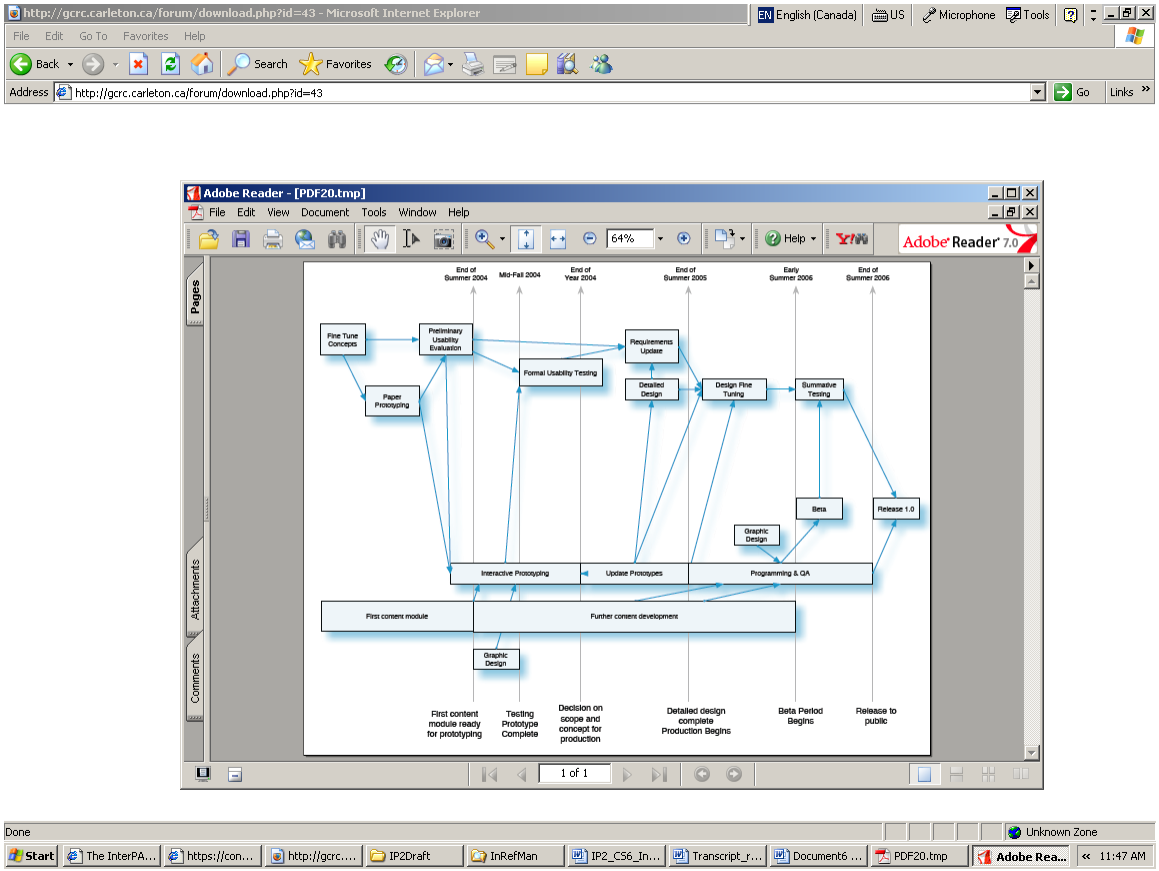

Figure 9. Screenshot of presentation of the document

Appendix W: Project Recordkeeping Directory

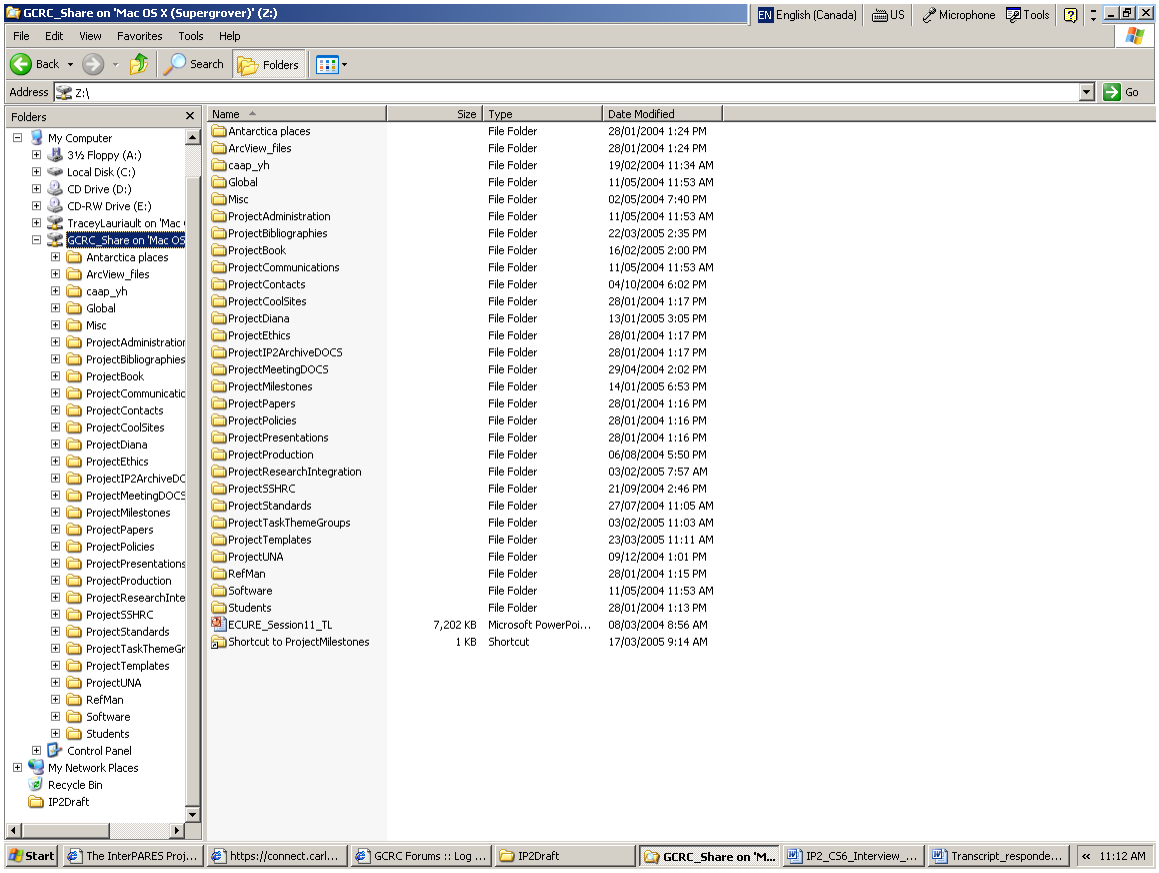

Figure 10. Screenshot of Project main directory

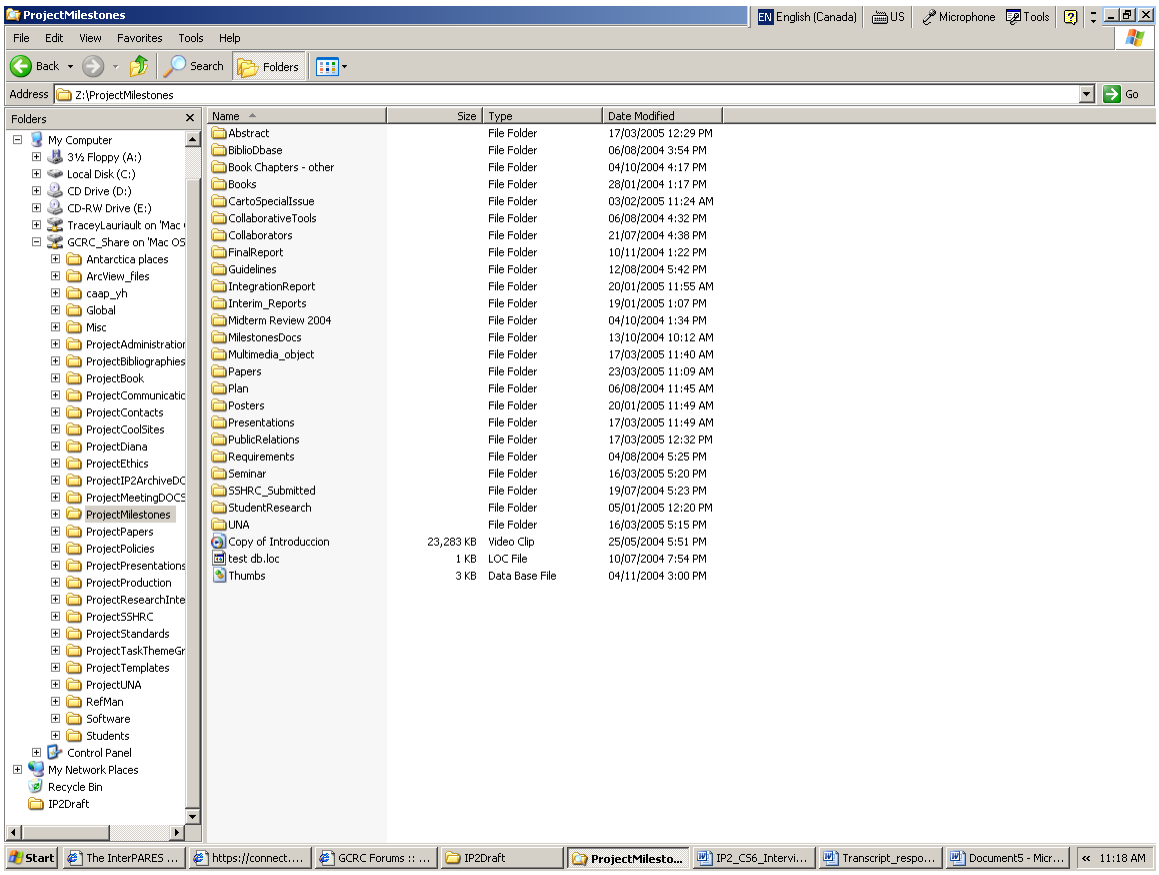

Figure 11. Screenshot of Project milestones sub-directory

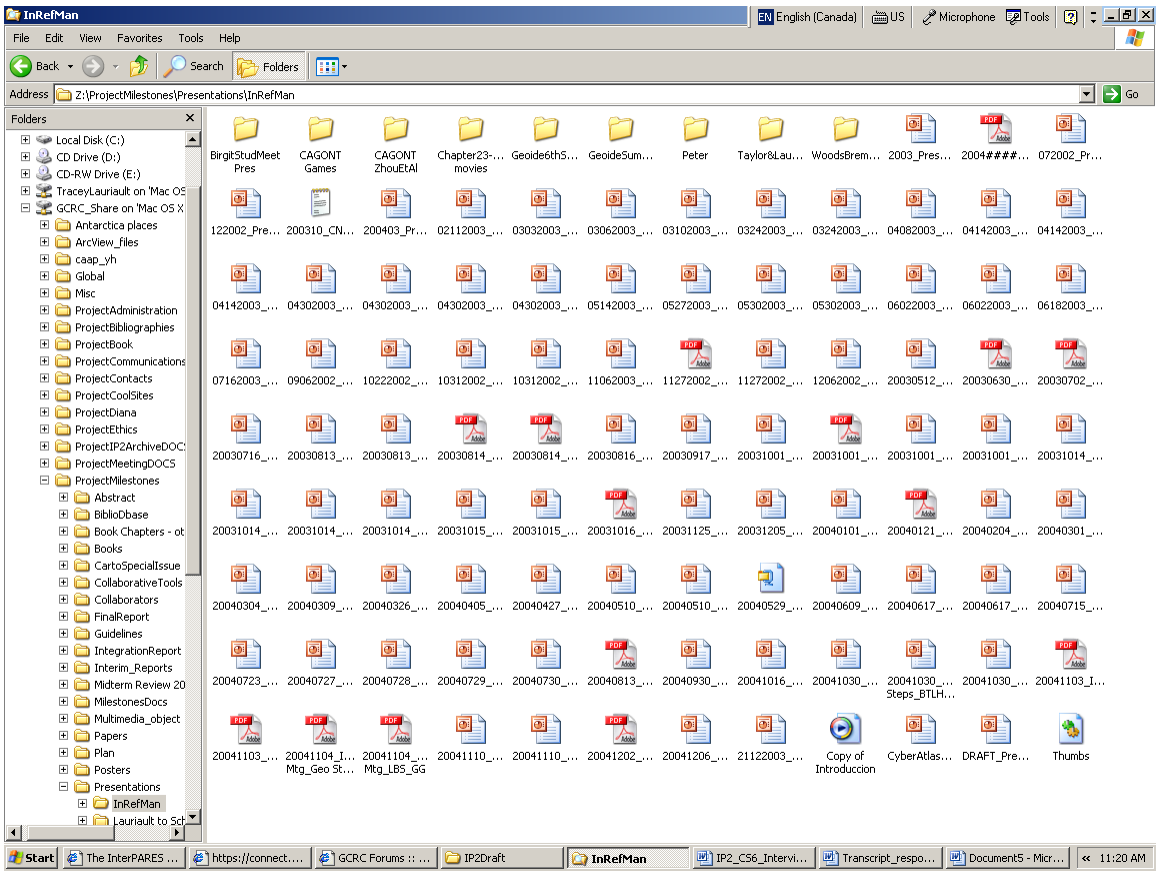

Figure 12. Screenshot of Project presentations sub-directory

Appendix X: Dublin Core Report Footer

In the event you need some help on filling in the document metadata in the footer refer to: Dublin Core Metadata Element Set, Version 1.1: Reference Description

http://dublincore.org/documents/dces/

If your document is appearing in a journal please put the full journal citation in the header and fill in the footer as for any other document

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Appendix Y: Project Communication Internet Site

Figure 13. Screenshot of GCRC communication Web site