35 Future Directions for Multimedia Cartography

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35.1 Introduction

In the previous edition of this book Taylor addressed the future of multimedia cartography. The central argument was that the major challenges for the future of cartography, of which multimedia cartography is an integral part, were not primarily technological. It was argued that technological challenges exist but that these were much more likely to be resolved than the other challenges such as: the need for a greater awareness by cartographers of the opportunities presented to the discipline; for more imaginative cartographic representations; to improve the quality of the content of multimedia cartography; and to respond to the entertainment and education markets more effectively. In addition the challenges were: to ensure that multimedia cartography responds to the needs of the user; the organizational and commercial aspects of multimedia cartography; and to involve all the senses. It was also argued that the ultimate challenge was that of dealing with human emotions and values as qualitative elements for cartographic expression and as part of the process of doing cartography.

Forecasting the future is hazardous, especially when an updated chapter is required for a second edition to appear six years after the first! Although the technological context has changed and continues to change, as several chapters in this book discuss, the basic thrust of the arguments made about future directions for multimedia cartography in the first edition remain valid today.

35.2 Multimedia and Cartography: New Opportunities

In the first edition of this book (Taylor, 1999) the concept of cybercartography was introduced to highlight the need for a new paradigm for cartography. Cybercartography was first formally introduced in 1997 and was 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" (Taylor, 1997). Since that time the concept has been further developed as described more fully elsewhere (Taylor and Caquard, 2006; Taylor, 2003, 2005). The main elements of cybercartography include some of the key issues identified as important for the future of multimedia cybercartography and some of these will be revisited here.

Technological change is creating new opportunities. The most exciting at the moment are the emergence of the mobile telephone and associated locative media technologies, private sector initiatives such as Google maps and the growth of open source technologies. Mobile devices, especially cell phones, are a rapidly expanding consumer market which currently is larger than the market for television sets and computers combined (Thompson, 2005). Keltie (2005) has argued that the future of cartographic visualization, a key aspect of multimedia cartography, will be driven by mobile devices. Nixon (2005) sees the multimedia industry as being about "what" whereas the spatial industry as being about "where", although this is probably more of a continuum than a clear distinction between the two. Multimedia cartography has the opportunity to present information on computer screens and mobile devices in multimedia formats and to integrate "what" with "where" in new ways. Wireless location-aware devices, global location services, online geodata repositories, Radio Frequency Identification (RFID) are making digital information accessible in situ and in real time. The physical landscape we move through is becoming "deep" with vast amounts of digital information—in text, images, and other sensory forms (Institute for the Future, 2004). Structures, artifacts and objects in the environment are becoming location aware which provides both opportunities and challenges to cartographers. The Voices of Oakland project for example, integrates Augmented Reality (AR), game consoles, hand held devices, head phones and GPS technology to provide visitors to the Oakland Cemetery a real and virtual historical audio tour. Visitors point to a grave stone or a building to hear the stories of the individual buried there or to discover architectural facts (Augmented Environment Laboratory, 2005). Gartner (2005a) discusses the use of intelligent glasses developed by Gerhard Reitmayr that broadcast route instructions in the lenses and cues onto the environment as the wearers are walking to their destinations.

The private sector, through initiatives such as Google Earth and Microsoft Virtual Earth, both introduced in 2005, has introduced online maps to the mass market (Goodchild, 2005). The reactions to these developments by cartographers and GIS specialists has been mixed with some seeing these as threats but as Thompson (2005) points out, initiatives such as Google Earth presents the user only with an online image. Users however enjoy the ability to add their own data and to see themselves on that map. There are great opportunities for multimedia cartographers to enter the marketplace and add value and increase the quality of these images in innovative new ways. The private sector has already begun to do this. The consumer in the information era is looking for a personalized on-screen response. In the first edition it was argued that "… despite the potential of multimedia as an analytical tool the field is most likely to grow in the areas of communication and presentation rather than spatial analysis, although these are not virtually exclusive" (Taylor 1999:315). This is now even more likely. As Goodchild (2005) has commented, more people became aware of Google Earth in a matter of weeks than GIS which has been in existence for decades! Alternatively, participants in open source movements, not necessarily the same community doing open source mapping, have created emergent knowledge repositories such as the Wikipedia, and have adopted practices to tag and label multimedia objects using GeoTagging techniques and services such as Geocoder.ca, Flickr or BlogMapper to name a few. These initiatives are popular culture representations of how communication technologies and digital objects are being mapped and spatially enabled. BlogMapper for example enables the georeferencing of a blog's content or the blogging of a map itself, in essence this community is creating a new qualitative geographic narrative about space and place. Cartographers will want to use the new technologies being made available to them to better communicate spatial information where people are, will want to collaborate with the private sector to increase both the quality and reliability of map content and representation, and to learn how to better enable users to add their own content. Further, cartographers need to be aware of initiatives in open source communities and popular culture Web initiatives to understand how people want to be able to participate in the creation of their own mapped stories and to learn from that culture. The challenge of accurate and reliable map content remains, as does the debate between the perfect open source code vs. the perfect cartographic map product and intellectual property.

35.3 The Nature and Quality of the Content of Multimedia Data

Good content continues to be important for the future of multimedia cartography. This is, of course, not a problem confined to cartography as it affects all online information. Keltie (2005) has argued that the user needs "ubiquity and authenticity". Ubiquity is primarily a technological issue and a great deal of attention is being paid to the technological developments required to make information available in new forms and with increased speed as described in some of the other chapters in this book. The trade off between private information and ubiquitous technologies is however an important ethical consideration. Indeed, many multimedia cartographers give more attention to the "bells and whistles" of their products than to the quality and nature of their content or its implications and these remain as major challenges for the future.

Good metadata informs the user of the sources and quality of the data being used in a multimedia product. Developing more useful and effective metadata descriptions for multimedia data is important and this is a challenging task as Zhou (2005) outlines. Multimedia cartography requires new approaches to metadata descriptions. Metadata for geospatial data is developed through the initiatives of the International Standards Organization (ISO) such as the ISO Technical Committee (TC) 211 for geomatics and geographic information series including ISO 19115 for Geographic Information Metadata. These, however, need to be extended and linked to information object metadata standards for photographs, videos, imagery, text and other elements used by multimedia cartography. This often requires the creation of new application profiles such as that developed by Zhou (2005) using XML and much more attention to this issue is required beyond the issue of intellectual property. Multimedia metadata standards will increase access and discovery of multimedia content and ensure its reliability, accuracy and authenticity for both fit for use decisions and archival purposes. In many instances multimedia cartography is produced with inadequate metadata or, in the worst instances, no metadata at all! Producing quality metadata can be a time consuming business but it is important to indicate the reliability, accuracy and authenticity of the information used in multimedia products to the user. This is especially important given that the information used is often in a variety of different formats from a number of different sources. Automatic generation of metadata can help to re-

duce the time and effort required to produce them and Zhou (2005) has pointed to some important research directions to visualize metadata to help users understand it more effectively than is the case at present. Metadata descriptions and related cataloguing tools must be made easier to use and more transparent to the user. Folksonomies are emerging cooperative classification and communication practices, are social classification systems or a community based controlled vocabularies to describe multimedia objects. Their increasing popularity means they are getting more precise, but have not yet evolved to a point where a search will reliably find an object. There is however potential for communities (e.g. indigenous communities) to develop their own folksonomies to describe their own digital artifacts and stories in a language more familiar to them.

The restrictive policies of access to spatial data described in the first edition continue to be a challenge. Stuart Nixon (2005) observes that much of the mass of information available from remote sensed imagery, for example, remains "locked up" and that a large volume of potentially useful Landsat data is "rotting unused". He argues that higher resolution information is often more readily available for Mars than for many part of the earth and that a major reason for this lies in the control and pricing policies of spatial data custodians which are restricting the utilization of spatial information. Google Earth and Microsoft Virtual Earth are making spatial information available online free. The opportunity to add value to these datasets discussed earlier will be reduced if related spatial information is not made more readily available to producers and consumers alike. The custodians of data are mainly governments at various levels and the "cost recovery" mode currently in use in many instances needs to be re-examined, as do restrictive policies in the name of confidentiality and national security. Both confidentiality and national security are important issues but can be used as excuses for restricting access to information when this is not justified. The debate in India over this issue has been especially interesting (Tarafdar, 2005). Copyright and related intellectual property regulations and law are also challenging to multimedia cartographers Multimedia cartography often draws together information from a variety of sources and also in a variety of different media forms including music, photographs and videos. Increasingly this is done online and in real or near real time. Copyright and intellectual property law on the Internet remains a contested area. It is often unclear whether material can be freely used or if copyright permission must be sought. In addition to the absence of adequate metadata on many images it is often not certain if these Web versions are originals or have themselves been compiled from other online sources. Multimedia cartographers may find themselves in jeopardy of legal action if they use information from the Web, even when the sources are acknowl-

edged in their products. The multimedia industry is very creative but multimedia cartography remains somewhat conservative as argued in the first edition of this book. Some National Mapping Agencies (NMOs) have adopted multimedia approaches and Geosciences Australia is a good example of this but the emphasis is on presenting existing information in new ways rather than on looking at innovative new topics which have previously not been "mapped" (Beard et al., 2005). The Creative Commons (creativecommons.org) is another initiative stemming from creative multimedia content creators and publishers (e.g. musicians, Web artists, etc.). Creative Commons provides a spectrum of possibilities between full copyright "all rights reserved", a voluntary "some rights reserved" or public domain "no rights reserved". Access, discovery and copyright policies remain as challenges while new initiatives and proposals are emerging to address these and multimedia cartography must respond more effectively to the needs and capabilities of the user.

35.4 The Centrality of the User

In the first edition it was argued that "Multimedia cartography like all cartography, will have to respond to user demand but if cartographers confine themselves to traditional markets then the full potential of multimedia cartography is unlikely to be realized. The reality for the future is that multimedia cartographers will have to seek new markets and new niches in existing markets for their products and their talents…." (Taylor, 1999:318, 319). This continues to be the case today. More fully understanding consumers and increased awareness of market trends is important for the future of multimedia cartography. For example, teenagers are very comfortable with communication technologies such as text messaging, and are accessing multimedia content on hand held devices or game consoles. Further, it can be argued that visual and navigation literacy in Virtual Environments is very high resulting from the experience of this group with computer gaming. Therefore, education and entertainment and the intersection between them – "edutainment" – as identified in the first edition remain as key market segments. Multimedia cartographers will want to ensure their products communicate to these growing market segments. These and new developing market areas will be considered later in this chapter.

Seeing the user as a consumer is important but the future of multimedia cartography also depends on a much deeper understanding of the user in term of both use and usability issues. Here multimedia cartography has much to learn from human factors psychology, cognitive science, and from human-computer-interaction (HCI) research in general. Many of the new consumer market opportunities lie in taking multimedia cartography to

where the user is taking advantage of the new developments in mobile technology and context as outlined earlier and in several other chapters in this book. A greater understanding of use, usability and context of use of these new technologies as well as existing multimedia products is increasingly important for the future.

Before producing new multimedia maps cartographers need to more carefully and systematically assess the needs for such products (Parush et al., 2005, Wealands, 2005). Use and usability are two separate but related concepts. "Use" deals with the need to establish the demand and expectations for a product. "Usability" explores a variety of factors involved in using a product including cognitive and contextual issues. Of special importance is testing and more fully exploring the assumption made by almost all multimedia cartographers that presenting cartographic information in a multimedia format is superior to other approaches. There is overwhelming evidence in the psychological literature that interaction between the user and the map is advantageous. The evidence of other advantages of multimedia presentations is more mixed. Fabrikant (2005), for example, draws attention to the fact that cognitive science has been unsuccessful in identifying the advantages of dynamic over static display. Research dealing with multimedia cartographic products in human factors and cognitive psychology is limited and much more research in this area is required (National Research Council, 2003). This topic is a major focus of research by a team of cognitive and human factors psychologists working as part of the interdisciplinary team involved with the Cybercartography and New Economy (CANE) project supported by the Social Sciences and Humanities Research Council of Canada (SSHRC) at Carleton University (http://gcrc.carleton.ca). The research results obtained so far are reported by Lindgaard et al. (2005), Roberts et al. (2005), Trbovich and Lindgaard (2005), DeStefano and LeFevre (in press 2006).

This research has revealed that the presentation of information in multimedia formats certainly engages and can entertain the user but whether this leads to longer-term learning and retention of the information being presented is less certain. Great care must be taken when designing multimedia cartographic products to consider cognitive models and learning processes and their design implications and to develop an iterative process of testing and design on use and usability. Research so far in the Cybercartography and New Economy project has led to the development of a number of design guidelines and an increased understanding of interface design and navigation issues (Trbovich and Lindgaard, 2005; Roberts, Parush, and Lindgaard, 2004) but more research in this area is required.

One of the difficulties facing multimedia cartography in terms of taking a greater "user-centric" approach is determining who the users are in situations where material is being developed for transmission over the Web as Cartwright (2004) has pointed out. Ideally a multimedia product should

have a clear purpose worked out before production and design process begin, in consultation with the users, and utilizing well established tools such as User Needs Assessment. Delivery on the Web is much less of a problem when the multimedia product is being designed for a particular purpose such as education (Baulch et al., 2005) but the particular age group and the curriculum is a variable. Multimedia cartography is also a social product and must respond to the societal context in which it is produced, regardless of its purpose. The educational needs of multimedia products for Ontario schools described by Baulch et al. (2005) are different, for example, than those described by Quinn (2005) for Australia. The general arguments of the need to actively involve the students in the learning process, the value of presenting materials to suit different learning styles, and the importance of new forms of engagement and learning still, of course, apply.

35.5 Education, Entertainment and Edutainment

It was argued in the first edition of the book that "the major market for multimedia products is the entertainment market in which interactive games are an important part. Education and training are also growing markets. 'Edutainment' is a process by which interaction technology is used to both entertain and educate" (Taylor, 1999:319). It was argued that multimedia cartography had the potential to penetrate this market in its own right. This is still very much the case today and Cartwright (2004, 2005a, 2005b) has explored some of the issues involved. Contemporary mapping, although providing timely and accurate products, may still be using formats which disallow them to be fully utilised. If one was to make a very general observation, the conclusion could be made that the formats and types of presentations used for the depiction of spatial data do not fully exploit the plethora of other information delivery devices in common usage. Telephones, television, faxes, computers, email, Web browsers, radio, newspapers, magazines, films and interactive mediums are all used to keep us informed in our own everyday lives. Maps can also adapt these other devices and media to enhance the communication of spatial information.

Computer games are more than just a game, designed well they are also a means to educate a certain segment of the population. The Games cluster of the Cybercartography project argue that computer games, especially character-based role-playing games can be designed to stimulate critical thinking through the process of presenting multiple points of view (Dormann et al., 2006). This multidisciplinary group has created a proof of concept modification of Neverwinter Nights (NWN) with Antarctica as the setting and climate change as the topic. The games include role-playing in a geospatial Virtual Environment, numerous characters (e.g. scientists,

wizards, and penguins), points of view, emotion, and experiences. They have demonstrated that players can be stimulated to learn in an emotional and imaginatively reconstructed reality and now this group is exploring ways to push students to think about their game playing and environmental issues more deeply. Multimedia cartographers may want to consider more fully the narrative possibilities of games and their related technologies to model complex realities in a way that is both engaging and educational to the user.

35.6 Commercial Aspects of Multimedia Cartography in the Experience Economy

It was argued in the first edition of this book that "Multimedia cartography will have to find its way in an increasingly competitive commercial world and cartographers interested in the emerging field will have to form new partnerships which will have to include the private sector" (Taylor, 1999:324). In the previous section of this chapter the development of a new cybercartographic educational game within the CANE project was described. This game was developed by modifying an existing game produced by the rapidly expanding game market. Millions of dollars can be spent on developing a popular game and multimedia cartographers rarely have the resources to compete with the large players in this marketplace. Modifying existing games as described above is one route forward and the opportunities exist to do this. The market for educational gaming is expanding but multimedia cartographers have played only a limited role in these developments. To enter this marketplace multimedia cartographers will have to form new partnerships with private sector firms and with educational authorities and more clearly demonstrate the value of their products. Computer gaming draws heavily on spatial concepts and there are several computer games, such as SIMCITY, which draw on the map for their structure and content.

Geographical Information Processing (GIP), of which multimedia cartography is a part, has tended to develop in a somewhat isolated fashion from the information technology mainstream. As a result it is often under utilised. Geospatial Information (GI) must become part of the everyday Information Technology (IT) environment (Camateros, 2005; Thompson, 2005). Multimedia cartographers must work in a more interdisciplinary way to form new partnerships with industry, government and the Open Source community to ensure that their value is appreciated. These are two important non-technical elements of cybercartography (Taylor, 2005) and both require changes in attitude and perspective on the part of multimedia cartographers, and a more imaginative response to existing opportunities.

There are encouraging signs in this respect, especially in response to the rapidly growing market for cartography on mobile devices discussed earlier and as described by Klitzing (2005). Gartner (2005b) sees "telecartography" as a new means of geo-communication and several chapters of this book illustrate the kind of interesting and imaginative response required.

Thompson (2005) has argued convincingly that there is a need for those involved in various aspects of GIP to carefully follow emerging trends in the marketplace and how the private sector is responding to these. Paying attention to trends in the marketplace is certainly important to the future of multimedia cartography as mentioned earlier in this chapter and some recent trends will be discussed here.

Pine and Gilmore (1999) argue that post industrial societies are moving from the current services economy towards an experience economy. This development is not without its critics, not all who see the experience economy in a positive light but there is considerable evidence that it is continuing to expand. Pine and Gilmore argue that experiences are a distinct form of service and they describe these as interactive and multi-sensory experiences for the consumer. Two examples of this are The West Edmonton Shopping Mall that markets itself as the greatest indoor show on earth and the Southgate/Southbank, shopping and entertainment complexes along the Yarra River in Melbourne, Australia. These include a series of restaurants, shops, cinemas, galleries, indoor installations, and attractions. The Southgate/Southbank complexes include water and fire installations, restaurants represent all major national culinary traditions and the smells of these different cuisines are part of the ambience. The complexes are multilevel and walking through them requires multiple changes in direction, level and constantly changing vistas. They are designed to encourage serendipitous exploration rather than the functionality of quickly locating a store or service. There are few, if any, location maps. Sight, sound, touch and smell are combined to engage the consumer in an iterative way and spaces have been designed both to meet particular needs and to increase the emotional sense of "belonging" to a group. Australia has been described as a sports-mad nation and wall sized, high definition television screens allow the consumer to follow as many as six separate current sporting attractions at once. Overall the consumer is engaged, entertained and immersed and, as a result, the businesses involved in the complex increase their profits. Southgate/Southbank provides an "experience" which goes well beyond a service and it is this experience that draws people of all types to the complexes from families with infants and small children to senior citizens. It is an architectural simulation of reality that is designed to appeal to all of the senses in a one stop shopping environment, an experience that millions of people are seemingly looking for.

Cartography is still coming to terms with the service demands of the information economy but multimedia cartography in particular has the potential to meet some of the demands of the experience economy. It can also help to add an important locational element to that economy. This will require cartographers to go well beyond geographic and cartographic visualization and create a cartography that entertains, engages, educates, informs and immerses the user. Education and information are still central purposes of multimedia cartography and engagement, entertainment and immersion are a means to an end rather than an end in themselves. Multimedia cartography can, however, be used in a commercial sense in order to attract consumers to goods and services. "Free" online Web services depend on advertising for their services. If multimedia cartography is to enter the mainstream then it may have to follow suit.

35.7 Full Involvement of the Senses

The previous edition mentioned the importance of involving all of the senses in multimedia cartography. This continues to be a challenge today and it is interesting to note that involvement of all of the senses is one of the facets of Pine and Gilmore's "experience economy" described above. In addition, Marin Lindstorm introduced the concept of "brand sense" in a book published in 2005. The study on which the book was based covered more than twelve countries and looked carefully at how religions use the senses. Lindstorm developed a six-step program for companies to develop brands based on all five senses, not just sights and sound, and quotes numerous examples. Smell is of particular importance and Lindstorm's three top sensory brands are Disney, Apple and Singapore Airlines. His ideas are being embraced with enthusiasm by business worldwide. Unlike the experience economy this is not a development confined to post-industrial societies as it builds on religion and culture it can be situation specific. The use of all five senses was an element of the original concept of cybercartography in 1997 and continues to be developed.

Humans perceive the world using their senses. The world is rich in sound, texture, and smell while cartography remains primarily a visual discipline, digital maps are mostly silent, all are odourless and are touched remotely with a mouse. Sensory media such as sound, haptics and to a lesser extent smell are becoming more prevalent in Virtual Reality, information visualization, gaming, new media art installations and advertising. The Cybercartography and the New Economy (CANE) Project has provided an opportunity for researchers to explore how other disciplines such as cultural geography, anthropology, film, music, psychology, art, food

and fragrance industries and marketing have studied the social, cultural and economic dimensions of how humans interact with the world using their senses. This has provided a better understanding of methods to incorporate sensory media into mapmaking. In addition members of the project are looking at both technological and conceptual methods to test and apply multisensory media in multimedia cartography proof of concepts.

Sound in particular is providing an added dimension to cartography and is being used to augment rather than replicate visual information and provides new insights into the subject matter of the map (Brauen, 2006). Brauen has created some proof of concepts in SVG and Java script programming languages and intends to experiment with Java Sound Application Programmers Interface as a possible replacement for the embedded audio components in the SVG language. He also encourages cartographers to "develop skills in the production of sound – training that is available in specialized acoustic design and multimedia curricula" (Brauen, 2006) and also recommends the development of interdisciplinary teams that include members with sound expertise to help "incorporate the consideration of the use of sound as part of the cartographic process" (Brauen, 2006).

The proliferation of relatively inexpensive handheld (e.g. portable game consoles) and multimodal devices (e.g. joy sticks) primarily designed for the gaming industry can provide an alternate method to interact with maps. As previously discussed this is being done with computer games and to a lesser extent in Virtual Reality, and these can be adopted and adapted by cartographers to provide a more interactive experience with map content.

Scented cartography is a new concept that has not been fully implemented yet scent as a medium is a growing multimedia industry. Scent is being incorporated into Websites, email, billboards, kiosks, museums, art installations, Virtual Reality, logos and some are sending scented email (Lauriault and Lindgaard, 2006). The marketing industry uses scent to brand products, subliminally persuade or to create an ambient experience of a space (Barbet et al., 1999). The food, fragrance and perfume industries are the obvious leaders in the creation and innovative uses of scent and are the experts who hold the ability to effectively use language to communicate the complex world of odours (Lauriault and Lindgaard, 2006). There are some smellscape studies (Dulau and Pitte 1998, Corbin, 1986 and Porteous, 1985), scent as a theme is making its way into cartography such as the Twin Cities Odorama: A Smell Map of Minneodorous and Scent Paul (Twin Cities Odorama Team, 2003) but there are only a few computer scented maps such as Les vins de Bourgognes - Balades Olfactives (France Telecom et al., 2005). A variety of scent broadcasting technologies exist and are primarily embedded chips or desktop machines connected via a serial or parallel port to a relay that activates a scent output

device for a designated time period (Kaye, 2004). Liquids can be sprayed using a supply of compressed air (e.g., British Telecom, inStink at MIT, France Telecom). The user would click a scented icon on their screen to activate the device on their desktop that in turn broadcasts the scent. Lauriault and Lindgaard recommend that cartographers experiment with scent broadcasting technologies and also adopt and adapt tools from other communities and disciplines such as wine scent wheels, fragrance industry database structures, perfumer catalogues and curricula or sommelier ranking schemes for their own purposes. This they argue will be how to develop innovative tools and methods for creating olfactory cartography.

Multimedia cartographers will find it difficult to incorporate sound, smell or haptics on their own at the moment and they will have to collaborate with other media experts or become hybrid specialists in a number of fields in order to best represent multisensory media into their maps. In addition, it is advisable that these new cartographers work with human factor psychologists to understand sensory perception. Other sectors and communities have effectively incorporated multisensory media into their applications and it will be up to cartographers to catch up and find new imaginative ways to communicate spatial information.

35.8 Preserving Multimedia Cartography

One of the earliest examples of multimedia cartography was the impressive *Domesday* Project completed in 1986 to commemorate the 900th Anniversary of the Domesday Book produced on the order of William the Conqueror. Cartwright comments that in terms of multimedia cartography this product "…has yet to be matched in terms of coverage and innovation" (Cartwright, 1997:449). The *Domesday* Project was well ahead of its time but its subsequent history has drawn attention to a major challenge for multimedia cartography – the archiving and preservation of the cartography being produced.

Multimedia cartography products are important cultural and technological artifacts that should be made accessible to future generations. The objects in and of themselves are important as is the process of how they were created. At the moment many of the objects are created in a record keeping vacuum, without metadata, often in proprietary formats and with hardware dependencies. The Domesday project discussed above and the first North American GIS project - the Canada Land Inventory (CLI) are classic cases of very important scientific artifacts that were lost and later partially recovered but not in their entirety and not necessarily in the way

the creators would have liked them to be. The CLI for example, was created in 1963 by Roger Tomlinson the father of GIS; it was a multilayer land-use with planning maps of Canada's inhabited and productive land (GIS World, 1996). In 1994 with government reorganization the project was shelved. Over time the magnetic tape upon which it was stored degraded and some files were completely lost. Eventually, the remaining files were translated into a modern GIS system through a 16 step data conversion process at a very high cost in time, human resources and data loss. Today much but not all of the CLI is now available on GeoGratis.ca.

Multimedia cartographers will want to take into consideration some very basic issues in the creation of their objects such as: technological obsolescence which includes the backward compatibility of software and hardware dependencies; interoperability between peripherals, software and file types; proprietaryship of both software and data; issues of data refreshing from one medium to another and the possible loss of functionality when doing so; data migration issues from one configuration to another, between computer generations and operating systems; the long term sustainability of data emulation; storage capacity and as previously discussed metadata (Bleakly 2002). It is important to distinguish data archiving from information preservation, the former includes strategies to maintain a record in a context while object refreshing and emulation are simply ways to preserve an object which may or may not reflect the creator's intentions. Finally, clearinghouses and portals are not archives they are catalogues or repositories that rarely have longterm preservation as their mandate. At the moment online atlases are not archived by the agencies that create them, geospatial data infrastructures world wide do not include the archiving of geospatial data as a policy and few archives are capable of ingesting the vast amount of scientific data collected by scientists or generated by national data collection agencies in both the natural and social sciences.

The International Research on Permanent Authentic Records in Electronic Systems 2 (InterPARES 2) is a multinational and multidisciplinary archiving research project that aims at developing the theoretical and methodological knowledge essential to the long-term preservation of authentic records created and/or maintained in digital form (InterPARES, 2002). InterPARES 1 has generated a number of reports that include benchmark requirements and strategies (http://interpares.org/book/index.cfm) for some electronic records while InterPARES 2 focuses on records produced in complex digital environments in the course of artistic, scientific and e-government activities. The Cybercartographic Atlas of Antarctica (CAA) is a case study in this project and preliminary results suggest that the open source technologies upon which the CAA is built, associated technology white papers and manuals

combined with the multimedia metadata standards being implemented should make the product robust and malleable enough for long-term preservation inclusive of all of its functionality in the same way the creators intended it to be. Some of the proprietary multimedia content (e.g. video and audio) in the CAA however may not stand the tests of time.

If multimedia cartographers want their artifacts accessible to future generations, they will have to include archiving at the beginning of content creation and not as an afterthought once a project is nearing completion as that may be too late. Archiving concerns need to be a part of the production process and need to be a policy formally adopted by the project with dedicated financial and human resources. Funding agencies who expect returns on their research investment are also advised to implement processes and build the infrastructures required to archive what they pay for. Funding proposals should also include a percentage of resources dedicated to the activity of archiving to ensure that the cultural and scientific multimedia content citizens are paying for are made available to them in the future. Multimedia cartographers also need to recognize that they are contributing to our collective cultural and scientific heritage that is of benefit to us all and future generations.

35.9 Conclusion

The major challenges for multimedia cartography remain primarily non-technological. Technological challenges continue to exist, especially in relation to the hardware and software required to develop the mobile, egocentric devices for which demand is increasing. These technological challenges are, however, much more likely to be quickly resolved than some of the other challenges discussed in this chapter. Over the last several decades geographical information processing has become increasingly “scientific” and “objective” in nature and, as a result, has lost its ability to deal with qualitative information and both the artistic and emotional aspects of human existence. Multimedia cartography can retain a strong scientific framework but more effectively portray and represent a world rich in colours, texture, sounds and smells. Our current digital cartographic world is emotionally stark, largely visual and often in black and white. Computer reality is no substitute for the real world but multimedia cartography can help to make it more interesting, engaging and effective.

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