CHAPTER 1

Some Recent Developments in the Theory and Practice of Cybercartography: Applications in Indigenous Mapping: An Introduction

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1. SOME RECENT DEVELOPMENTS IN THE THEORY AND PRACTICE OF CYBERCARTOGRAPHY

1.1 INTRODUCTION

This book is a substantial update of *Cybercartography: Theory and Practice* published in late 2005. In the last paragraph of that book the following statement appeared. ‘…the chapters in this book suggest that we are at a breakthrough point in the development of cartography and that the paradigm of cybercartography is well worth further exploration. There are, however, many questions still to be answered, and much further research is required if cybercartography is to reach its full potential’ (Taylor, 2005:558).

Several challenges and directions were identified for future research:

- The need for more practice;
- and for more rigorous theory;
- design challenges;
- relationships with the arts and humanities;
- the utility of cybercartography;
- the need for multisensory research; and
- the challenges of preservation and archiving.

Since the first edition of this book was published substantial changes have taken place in both the theory and practice of cybercartography and many of these are the results of extensive new practice, especially in cooperation with indigenous communities in Canada. The interaction between theory and practice is a major facet of cybercartography and practice creates a new theory that in turn leads to improved practice. Cybercartography is essentially an iterative process and is holistic in nature. This chapter will outline some of the new theoretical and applied directions of cybercartography since the publication of the first edition.

1.2 THE ELEMENTS OF CYBERCARTOGRAPHY

In the first volume, seven elements of cybercartography were identified as follows:

- Cybercartography is multisensory using vision, hearing, touch, and eventually, smell and taste;
- uses multimedia formats and new telecommunications technologies, such as the World Wide Web;
- is highly interactive and engages the user in new ways;
- is applied to a wide range of topics of interest to the society, not only to location finding and the physical environment;
- is not a stand-alone product like the traditional map, but part of an information/analytical package;
- is compiled by teams of individuals from different disciplines; and involves new research partnerships among academia, government, civil society, and the private sector (Taylor, 2005:3).

In general terms, these seven elements are still in place but have been refined, modified, and expanded around six key ideas. These six key ideas, which are a reflection of the original seven elements, are:
1.3 Definition of Cybercartography

In 2003 cybercartography was formally 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, 2003:406). This captures some of the elements of cybercartography but has to be read with the major elements and ideas described in Section 1.1 and 1.2 in mind.

- Individuals use all of their senses while observing what is around them: cybercartography is therefore exploring the possibilities of using all five senses in its representations in order to make cybercartographic atlases as reflective as possible of sensory realities.
- Individuals have different learning preferences and prefer teaching and learning materials in different formats. Cybercartographic atlases have great potential in both formal and informal education and they provide the same information in multiple formats allowing users the freedom to choose which format or combination of formats and modalities they wish to use.
- Educational theory suggests that individuals learn best when they are actively rather than passively involved. This applies both in formal and informal learning situations. Engaging the user requires carefully thought out interactive engagement strategies including the design of effective user interfaces.
- The social media revolution has given people the power to create their own narrative and cartography is challenged to respond to individual and community needs in ways that previously did not exist. The Nunaliit Cybercartographic Atlas Framework is a software platform that provides a mechanism for people to enter their own data into cybercartographic atlases. Cybercartography provides a means for people to tell their own stories as part of a holistic information package. The Framework is open source, provides a metadata structure for the information, and is designed with an interface that does not require special knowledge in order to enter information.
- Many topics of interest to society are complex and the same set of ‘facts’ on topics such as climate change are open to a variety of representations. Even when there may be an agreement on the facts, there can often a wide variety of interpretations. There are often no simple ‘right’ or ‘wrong’ answers to many questions. Cybercartography allows the presentation of different ontologies or narratives on the same topic without privileging one over another. The user can consider the various narratives presented and have a greater understanding of the complexities and uncertainties surrounding many topics. Traditionally, the map was an authoritative source. Cybermaps are much more nuanced.
- Traditional cartography was supply-driven. National mapping agencies supplied the definitive and authoritative maps, which the public used. Technological change allowed for a much more demand-driven approach and cybercartography takes this one step further and empowers individuals and communities to create their own maps including the choice of what to represent and what not to represent. Individuals are new ‘prosumers’ rather than simply ‘cybercartography is consumers’ and, as a result, democratizing mapping in new ways. Indigenous people, for example, have often been largely ‘invisible’ on maps or have been represented by others. Cybercartography gives voice to indigenous people and other community groups both literally and metaphorically.
It is the combination of these elements and ideas in a holistic manner and the iterative interaction between theory and practice, which defines cybercartography as well as the processes by which cybercartographic atlases are created, which sets cybercartography apart from other approaches. Pyne has recently described cybercartography as a distinctive critical cartographic approach and as ‘a set of concepts and tools...that provides an effective atlas building framework for approaching complex social, political and economic phenomena...’ (Pyne, in press).

And it has also been more simply described as ‘the application of geographic information processing to the analysis of topics of interest to society and the display of the results in ways that people can readily understand’ (Taylor, 2013:4). Cybercartography will continue to work in an iterative fashion as a result of the interaction between applications, technology, and theory. Each new practical application brings new theoretical insights as well as new technological developments and the results of each application are used as building blocks for the next.

1.4 NEW PRACTICE

The first edition of the book reported on the application of cybercartography under the Cybercartography and the New Economy Project (Taylor, 2005:7). As part of that project, two cybercartographic atlases – the Cybercartographic Atlas of Antarctica and a Cybercartographic Atlas of Canada’s Trade with the World – were created. These were, however, both primarily supply and technologically-driven atlases, which contain some of the elements of cybercartography described earlier in the chapter but by no means all. The user was involved in their creation but primarily from the human–computer interaction aspects of use and usability and the research reported on in the book included substantial input by human factors and cognitive psychologists. This volume is based largely on an entirely new practice developed since 2007 in cooperation with indigenous groups in Canada hence the sub-title of the book ‘Applications in Indigenous Mapping’.

A Social Sciences and Humanities Research Council of Canada (SSHRC) major grant, helped fund the research on cybercartography upon which much of this book was based. SSHRC has also supported the research described in this second edition, especially in relation to the creation of the Lake Huron Treaty Atlas (Chapter 17) and the work on Views from the North (Chapter 13). This has been supplemented by substantial support from the Government of Canada. International Polar Year (IPY), which provided major funding of over $1 million for the Inuit Sea Ice Use and Occupancy Project, which created the Inuit Siku (sea ice) Atlas (Chapter 14) as well as support for the development of the Nunaliit Cybercartographic Atlas Framework (Chapter 9) and related data-management issues. Both the Kitikmeot Place Names Atlas (Chapter 15) and the Gwich’in Atlas (Chapter 16) have been developed using funding from the Kitikmeot Heritage Society and the Gwich’in Social and Cultural Institute. The Arctic Bay Atlas (Chapter 20) was developed using funding from the Inuit Heritage Trust and Nunavut Arctic College after an initial investment by the Inukshuk Wireless Foundation. Although the amounts involved were not at the same scale as SSHRC and IPY funding, they were especially significant as indigenous communities and institutions were investing their own funds in atlas development.

This new practice has required a consideration of traditional knowledge (TK) and its representation in cybercartographic form. We have worked mainly with Inuit communities and with First Nation groups such as the Anishinaabe and the Gwich’in. The atlases that are
created as a result of our partnership with these communities are described in several of the subsequent chapters of this book but the interaction with indigenous people has had a profound effect on the thinking surrounding cybercartography.

1.4.1 The Nature of TK

Oguamaman, in his recent book on traditional knowledge, defines traditional knowledge as ‘...an aspect of ecological management and environmental stewardship, sustainable development, economic empowerment, self determination, human rights, culture, arts, craft, music, songs, dance and diverse creative repertoire: religion, lifestyles and innumerable aspects of social processes that undergird a people’s worldview’ (Oguamaman, 2011:46).

The nature of cybercartography lends itself well to the representation of this multifaceted concept but in creating cybercartographic atlases with indigenous groups a major challenge is not only to effectively represent the TK involved but also to consider the processes involved. Kitchen and Dodge have argued that in cartography the processes by which the map is created (ontogenesis) is as important as the ontology, the map itself (Kitchen and Dodge, 2007). Kitchen and Dodge do not explicitly consider legal and ethical aspects of the processes involved but at the Geomatics and Cartographic Research Centre (GCRC) we have found these to be of central importance to our work. The importance of process is central to the creation of products such as the Inuit Siku (sea ice) Atlas (Chapter 14), the Views from the North Atlas (Chapter 13), the Kitikmeot Place Names Atlas (Chapter 15), the Gwich’in Atlas of Place Names (Chapter 16), the Arctic Bay Atlas (Chapter 20), and the Lake Huron Treaty Atlas (Chapter 17). The creations of these are fully described in the chapters listed above. The equally important legal and ethical issues and processes in atlas creation are explicitly considered in the Chapters 18 and 19.

A key element is understanding ‘the people’s worldview’ mentioned in Oguamaman’s definition above. This is not easy to articulate as it involves ‘...understanding of the human place in relation to the universe [and] ...encompasses spiritual relationships, relationships with the natural environment and the use of natural resources, relationships between people; and is reflected in language, social organizations, values, institutions and laws’ (Legat, 1991:1). The task is made even more difficult by the fact that descriptions are often written by outsiders rather than the indigenous people themselves. For the Inuit, the term Inuit Qaujimajatuqangit (IQ) or the Inuit ‘way of knowing’ was developed in 1997 and Shirley Talalik, an Inuit herself, described IQ as follows:

*Inuit Qaujimajatuqangit* (IQ) is the term used to describe Inuit epistemology or the Indigenous knowledge of the Inuit. The term translates directly “that which Inuit have always known to be true.” Like other Indigenous knowledge systems, *Inuit Qaujimajatuqangit* was formally adopted by the Government of Nunavut; however the descriptors used to capture the essence of *Inuit Qaujimajatuqangit* are recognized as being consistent with Inuit worldview as it is described in various Inuit circumpolar jurisdictions. Inuit Elders in Nunavut have identified a framework for *Inuit Qaujimajatuqangit* which is grounded in four big laws or *maligait*. All cultural beliefs and values are associated with the implementation of these *maligait*, ultimately contributing to ‘living a good life’ which is described as the purpose of being (*Tagalik, 2001 as quoted in Sullivan, 2013*).

The major principles of IQ are:

- **Inuuqatigiitsiarniq**: the concept of respecting others, building positive relationship, and caring for others;
- **Tunnganarniq**: the concept of fostering good spirit by being open, welcoming, and inclusive;
• *Piliriqatigiingniq*: to develop collaborative relationships and working together for the common good;
• *Avatimik Kamattiariniq*: to show environment stewardship;
• *Pilimmaksarniq*: to be empowered and built capacity through knowledge and skills acquisition;
• *Qanuqtuurungnarniq*: to be resourceful and seek solutions through creativity, adaptability, and flexibility;
• *Ajiijiqatigiingniq*: consensus decision-making; and
• *Piijitsirarniq*: to contribute to the common good through serving and leadership (McGregor, 2010:173–174).

The approach to TK of First Nations people is similar to that of the Inuit in terms of the deep relationship between humans and the environment and the TK Working Group of the Northwest Territories described it as follows:

...knowledge that derives from, or is rooted in the traditional way of life of Aboriginal people. Traditional knowledge is the accumulated knowledge and understanding of the human place in relation to the universe. This encompasses spiritual relationships with the natural environment and the use of natural resources, relationships between people; and is reflected in language, social organization, values, institutions and laws (Legat, 1991:1).

### 1.4.2 Cybercartography and TK

Cybercartographic atlases have the technology to represent the multifaceted nature of TK and in the atlases described in subsequent chapters of this book almost all of the aspects of TK appear in a variety of ways and forms. The processes by which the atlases are created are empowering and often involve an explicitly post-colonial, decolonizing approach, for example the *Lake Huron Treaty Atlas* (Chapter 17) and the *Arctic Bay Atlas* (Chapter 20). Indigenous people use the atlases as one of the means of reclaiming their cultural heritage, for example the *Kitikmeot Atlas* (Chapter 15) and *The Gwich’in Atlas* (Chapter 16). The reclamation of cultural heritage through the use of indigenous names of course predated the atlases but the atlases have been adopted by indigenous peoples as a way to further exert their cultural ownership and expression. All of these atlases involve the inclusion of narratives, often by Elders in their own language. These narratives capture the essence of an ‘indigenous way of knowing’ and both preserve and represent this concern in new ways. To the Inuit, for example, a journey is not simply represented on a map by a line indicating origin and destination. Each journey is a narrative and even where the route taken is the same the narratives are different (Aporta, 2009). The *Inuit Siku (sea ice) Atlas* (Chapter 14), for example, presents the narratives of several Elders and communities and each Elder and community is identified by name. It is possible to look at the collectivity of routes but at the same time to isolate each narrative by individual Elder. This is important because the quality and authenticity of information to Inuit communities is determined not by locational accuracy or the data quality elements usually used in mapping but by who provided the information. We are dealing here with ‘living metadata’ (Chapter 14), which is quite different from the metadata usually associated with digital maps.

One way of ensuring that a ‘people’s way of knowing’ is adequately reflected is to give the power to the people concerned to choose what they want to represent. In the case of the
Gwich’in Social and Cultural Institute and the Kitikmeot Heritage Society, the content of the atlases is determined by these organizations. In the case of the *Atlas of Arctic Bay*, the same principle applies and often the choice of content encompasses things that would not have been chosen by outsiders. For example, the inclusion by Arctic Bay youth of a rap video entitled ‘Don’t call me Eskimo!’ ([http://www.youtube.com/watch?v=tS8RZcKQwBA](http://www.youtube.com/watch?v=tS8RZcKQwBA)).

No mapping technology can claim to represent TK in all of its complexity but cybercartography does this better than most, especially when the communities concerned take full ownership of the atlases. *Bonny and Berkes (2008)* considered this issue some years ago and although technologies have changed, many of their arguments remain valid. They were writing before cybercartography had been used to represent TK. The advantage of the Nunalit Cybercartographic Atlas Framework is that although it has been developed to enable the online representation of any form of knowledge, its flexible database structure allows it to deliver information in a variety of forms including CD-ROMs and print. This ability allows for broader distribution of the atlases in situations where a user cannot view them online, which is sometimes the case where a bandwidth is limited (see Chapter 9).

1.5 NEW THEORY

In the first edition of this book, the theory of cybercartography was not well developed and certainly was not nearly so well described as the practice. The same applied to the related concept of geocybernetics being developed in parallel by the research group at Centro de Investigación en Geografía y Geomática ‘Ing. Jorge L. Tamayo’, A.C (CentroGEO) in Mexico City, which was described in the first edition of the book. The Mexican research group has contributed two chapters (Chapters 2 and 3) to this book. Although the CentroGEO research team argues that geocybernetics encompasses cybercartography, there are striking similarities between the two concepts. As with cybercartography, geocybernetics was initially intuitive and empirical rather than theoretical as outlined in Chapters 2 and 3 but CentroGEO researchers have recognized the need to build a transdisciplinary theoretical framework. They are building new linkages between the hard and the social sciences by using holistic and transdisciplinary approaches. Geocybernetics uses Norbert Wiener’s concept of social cybernetics in terms of interaction with society and attempts to integrate community knowledge with specialist knowledge to form a ‘combined knowledge base’. ‘This triggers the creation of a network of stories describing the complex relationships involved’ (Chapter 2). They argue that geocybernetics encompasses cybercartography as well as other concepts such as the geomatics prototype, the Reyes method, and emerging knowledge networks with common theoretical building blocks such as chaos theory, complexity theory, and metamathematics. These are important theoretical developments that, like cybercartography, are based on the interaction between theory and practice and recognize the importance of narratives. CentroGEO is building on the experience of over 60 empirical projects, especially the key visual and; verbal expressions of these projects. Whether geocybernetics encompasses cybercartography or the other way around is open to debate but both concepts are based on the interaction between theory and practice and consider environmental and societal issues although in a very different physical and sociocultural context. They also use different language and theoretical constructs to describe this interaction with society.
The theoretical constructs, which have developed, that underpin cybercartography owe much to the interaction with indigenous peoples described earlier. This interaction has helped to clarify thinking about cybercartography in new ways that are quite different from the theoretical approaches described in the first edition of the book.

The macrotheory underlying cybercartography is a reflection of the author’s earlier work in Africa, which argued for a ‘development-from-within’ approach, building on the knowledge and wisdom of local people as a key element in socioeconomic development (Taylor and Mackenzie, 1992). Cybercartography also recognizes the importance of earlier work on traditional mapping described by Woodward and Lewis in their impressive volume on this topic in the *History of Cartography* series (Woodward and Lewis, 1998).

Woodward and Lewis (1998:1) argue that ‘maps are more than …ever-improving representations of the geographical world’ and point out that maps have to be thought of as part of a cognitive system as well as a social construct in addition to being part of material culture. In cybercartography all three aspects, the material, the cognitive, and especially the map as a social construct, are included and of course, all three overlap. Cybercartographic atlases are much more than maps. As Brian Harley and David Woodward observed ‘there has probably always been a mapping impulse in human consciousness and the mapping experience – including the cognitive mapping of space – indubitably existed long before the physical artifacts we now call maps (Harley and Woodward, 1987:1). Cybercartography encompasses what Woodward and Lewis call ‘performance cartography’ and ‘material cartography’ as they include elements such as song, dance, art and speech and as a result, cybermaps are more often ‘more interesting than the territory’ as Houellebecq (2010) has argued about maps in general.

### 1.5.1 Cybercartography and Critical Cartography

The interaction with indigenous people has led cybercartography into the theoretical field of critical cartography, especially in relation to cybercartography as a social construct (Taylor and Pyne, 2010). ‘Any definition that ignores either the function of maps or their role as social constructs fails to account for the fact that maps are far more than wayfinding devices’ (Woodward and Lewis, 1998:6). Cybercartography can, and often does, present a variety of different viewpoints but the atlases dealing with TK and indigenous people described in this volume privilege one voice over all others, that of the indigenous people whose perspectives and cognitive values drive the content of all of the atlases. They give voice, literally and figuratively to both the Inuit and the First Nations people involved.

All of the atlases make extensive use of narrative and, as outlined earlier, explicitly consider the processes by which these atlases are created. Both narratives and ontogenesis are important elements of critical cartography. The *Lake Huron Atlas*, the *Atlas of Arctic Bay*, the *Inuit Siku (sea ice) Atlas* and the *Views from the North Atlas* are all examples of this.

As Caquard has observed, ‘overall the critical turn in cartography has drastically modified the relations between maps and narratives in two ways: by deconstructing and exposing the meta-narratives embedded in maps, and by ensuring maps are compelling forms of storytelling’ (Caquard, 2013:2). In this volume Caquard provides a spatial typology of cartographic narratives as these relate to cinema.

Cybercartographic atlases are compelling forms of storytelling that are particularly appropriate for Inuit society, which is an oral rather than a literary society. In the cases of atlases
involving the Inuit, the telling of the stories by the Elders is also an important means of preserving the valuable knowledge they possess and passing it on to future generations in both formal and informal education processes (Chapters 20 and 21).

1.5.2 Cybercartography and Volunteered Geographic Information

Volunteered Geographic Information (VGI) has been described as ‘arguably the most significant change in the whole history of cartography...’ (Perkins, 2013). Cybercartographic atlases make extensive use of VGI and in the case of the atlases being created with indigenous people the use of VGI is central. Sui et al. (2012) give an extensive description of VGI and in Chapter 4 Engler, Scassa, and Taylor discuss this in relation to cybercartography. To be useful in the creation of cybercartographic atlases, VGI needs structure and this is provided by the Nunaliit Cybercartographic Atlas Framework, which is described by Hayes and others in Chapter 9. This is a documented oriented framework that replaces earlier relation-based and schematic approach. This framework has been specially designed to allow the easy ingestion of all kinds of VGI. The Nunaliit platform can be used by individuals with little knowledge of geographic information processing and is very easy to use. A prototype Ipad application has been designed to allow for the collection of multiple forms of information including videos, photographs, interviews, etc. to be collected in the field and then uploaded directly into the system (Chapter 9). This tool is ideal for collecting all kinds of VGI and the Atlas Framework also includes metadata giving an indication of the provenance and quality of the VGI entered into the system. In addition, those who enter the data can autonomously decide how they want those data represented and who can use and access them. Intellectual property rights are technologically embedded into the data collection and representation process and aspects of this are discussed in Chapters 18 and 19.

1.5.3 Cybercartography and the Individual

Das Gupta (2013:10) argues that ‘the Internet world has put the individual firmly centre stage in terms of interactive information gathering, storage and delivery. The year 2013 should see the emergence of the individual as the focus for geospatial information in a similar fashion.’ Mobile devices, such as cell phones, are now ubiquitous and can be used both as an input devices for VGI as discussed in Section 1.5.4 and as individually user-centred devices on which cybermaps can be displayed. Gartner, in Chapter 7, discusses advances in location-based services, including the provision of maps although, as Clouston and Peterson observe in Chapter 6 ‘the slow dissemination of a map to a computer or mobile device is the single major limitation to their use’. Rapid advances are being made and as Hellmis, the Vice-President of the mobile phone maker Nokia observes ‘we will redefine mapmaking through computation cartography. This means maps are created on demand to meet a specific purpose, to help govern an individual action, to help answer a personal question’ (Hellmis, 2013). For the individual, ‘maps have recently become the main interface for accruing data over the internet’ (Ron, 2008). In Chapter 5, Cartwright gives an interesting example of how geolocational narratives can be built using social software facilitated through Web 2.0 and use interactive digital media to tell an individual story.
Although many of the cybercartographic atlases described in this volume are community driven, these are collections of individual inputs, often but not always, made by individual Elders who, as in the case of the *Inuit Siku (sea ice) Atlas* (Chapter 14), for example, are identified by name and tell their own individual stories.

### 1.5.4 The Holistic Nature of Cybercartographic Theory

There are many strands to cybercartographic theory but it is the holistic nature of cybercartography, which is its major characteristic. Cognitive, material, and social constructs are woven together in innovative ways and the results communicated through cybercartographic atlases.

### 1.6 NEW DESIGN CHALLENGES

Each cybercartographic atlas provides design challenges but all atlases have the same issues as far as use and usability are concerned. In the first edition of this book, the human–computer interaction factors were fully discussed (*Lindgaard et al.*, 2005; *Roberts et al.*, 2005; *Tribovitch et al.*, 2005) and these are not further discussed in this volume, although this continues to inform the practice of creating atlases. There is no doubt that the multisensory and multimedia nature of cybercartographic atlases are engaging but the jury is still out as to whether those using the atlases retain information in long-term memory. The issue here is the possibility of cognitive overload. A balance between simplicity and complexity is not easy to find. User testing is critical but difficult given the nature of online atlases. Determining who the users are is challenging, even when users are also knowledge contributors, as is the case with many of the atlases that represent data contributed by indigenous collaborators.

One area where the GCRC has made considerable progress is the design of user interfaces. These have been much improved and research on this topic continues (Chapter 9). In terms of the design of the atlases dealing with TK, we have to take into account use limitations facing users. To serve communities in the North, for example, the current limitation on band width must always be kept in mind, which meant that the design of the *Inuit Siku (sea ice) Atlas* (Chapter 14) was much more basic than existing technology allows.

One of the better designed atlases is the *Atlas of the Risk of Homelessness* where the limitations outlined above were not present. The 21 variables used to construct the Atlas at a variety of different scales from the city, metropolitan region and the nation posed interesting design problems. One of the more innovative solutions was the development of ‘graphomap’ (Chapter 12). This is a combination of geographic position presented in schematic form with an interactive means of expressing quantitative values in a comparable form including change over time and space.

Another major design challenge is the integration of the different multisensory and multimedia components of cybercartography. We have made real progress in design terms with sound and audiovisual media as illustrated in Chapter 10 but very limited progress with the others such as olfaction.

In design terms, a major effort has been concentrated on improving the technical design of the Nunaliit Cybercartographic Atlas Framework. This is described in Chapter 9. The technical design has been completely revised to a schema-less, documented platform.
1.7 RELATIONSHIPS WITH ART AND THE HUMANITIES

Given the importance of the cognitive aspects of cybercartography outlined earlier and the inclusion of art, literature, and other aspects, it is perhaps fair to say that mainstream material cartography has failed to effectively include research on cognitive maps, whereas in the arts and the humanities, research has expanded considerably. Caquard and Naud, in their chapter on cinematographic narratives (Chapter 11), touch on this but as Caquard points out (Caquard, 2013) much work has been done in fiction (Roberts, 2012), in cinema (Conley, 2007), art (Pezzuto, 2011), music (Long and Collins, 2012), and poetry (Horowitz, 2001). There are many challenges involved in including these aspects in cybercartography but cybercartography has much to learn from the substantial and long-term research being carried out on cognitive ‘mapping’ in the arts and humanities.

1.8 MULTISENSORY RESEARCH

We have made considerable progress with new forms of visualization and augmented reality as is illustrated in several chapters in this book. We have also made major strides in the integration of sound and audiovisual media into the design of our atlases as is discussed in Chapter 10. The use of touch and feel has primarily been focussed on use of maps by the blind, which was fully discussed by Araujo de Almeida and Tsuji (2005) in the first edition of the book and some recent developments are discussed by Araujo de Almeida in this volume (Chapter 8). Research on the effective integration of smell into cybercartographic atlases has been discussed by Lauriault and Lindgaard (2006) but as yet has not been integrated into any of our atlases despite the early promise outlined in the first edition of this book. There are two reasons for this. The first is technical. There is as yet no commercially viable olfaction output device that can be used with maps on the market. There are scent diffusers but these are limited to use in specific sectors such as the perfume industry and wine industry or site specific installations and have proven to have limited applicability to cybercartography. Many of the scent diffusers examined also went out of production due to limited marked demand. The potential remains but implementation is a challenge. Adding smell is relatively easy in technical terms but effectively integrating it into design is much more difficult. Brauen (Chapter 10) argues that most uses of sound in mapping, of which there are many, are independent of the map rather than being an integral part of the design.

1.9 PRESERVATION AND ARCHIVING

The need for more effective preservation and archiving maps is the topic of the chapter by Lauriault and Taylor (Chapter 21). The map has been a fundamental facet of the memory of societies from all over the world for millennia. The map has appeared in a variety of forms the main, but by no means the only one, being paper.

The general challenges of archiving and preserving digital maps are substantive as outlined by Lauriault and Taylor (2012) but interactive multimedia cybercartographic atlases pose special problems that as yet have not been fully resolved while the lack of dedicated institutional support towards the creation of trusted digital repositories is another.
In the Internet era, websites are expanding exponentially but many of these are neither effectively maintained nor updated and often disappear without notice. In almost every chapter in the book, reference is made to websites with URLs in order to support an argument or illustrate a point. This is also briefly discussed by Brauen (Chapter 10) as many audiovisual maps examined in the last decade have fallen into disrepair or have disappeared completely. We have no way of knowing if all of the URLs or the new audiovisual maps examined will be accessible by the time this book is published.

The atlases dealing with TK are one means of preserving that knowledge and are especially important because they preserve this in context, not in isolation. In many cases, it is the first time that the aural knowledge shared and represented in the atlases has been documented. TK is not a set of artifacts but is ‘a way of knowing’ as outlined earlier in this chapter and individual elements lose much of their meaning when removed from their cultural setting.

1.10 LEGAL AND ETHICAL ISSUES

Chapters 4, 18, and 19 deal with important legal and ethical issues, especially as those relate to TK. The notion that researchers working with indigenous people must engage in ethical practices is not new but this takes on new urgency when digital distribution of information is the norm. What does ‘informed consent’ mean, for example when that information is to be distributed on the Web? When TK is part of a cybercartographic atlas that is accessible by anyone, anywhere, and at any time, what are the most appropriate ethical practices? These ethical questions are considered in Chapters 18 and 19 and suggestions made on best practices.

Cybercartography offers a rich potential for the mapping of TK as outlined earlier in this chapter but that knowledge is much more than a collection of ‘artifacts’ that can be placed on a map. It forms part of a knowledge system that is often fundamentally different from dominant western systems. Chapter 19 looks at the legal issues involved in protecting community rights to knowledge and fostering a culture of respect, not only for discrete pieces of knowledge but also for the integrity of the knowledge system from which it emanates. Existing law, such as that of copyright, intellectual property, and data ownership are of limited value as these are based on individual rights and not collective or community-centred rights. What is required are entirely new ways of looking at legal and ethical issues including a greater consideration of ‘soft law’ solutions.

1.11 EDUCATION

Chapter 20 discusses the great potential of cybercartography in both formal and informal education. Many of the characteristics of cybercartography lend themselves to improved teaching and learning in a variety of different settings. In theoretical terms, cybercartography supports the multiple intelligence and interactive learning theories of Howard Gartner (2011). In an applied sense, the Cybercartographic Atlas of Arctic Bay (Chapter 20) and the Inuit Siku (sea ice) Atlas (Chapter 14) are both being used to improve education in the North. The Atlas of Arctic Bay is being used as a central part of a new course for community educators.
1.12 CONCLUSION

Cybercartography has come a long way since the first edition of this book was published. Indeed, this volume contains over 90% new content and is, in essence, a completely new book. Many of the same authors from the first edition have contributed entirely new chapters. These include William Cartwright, Georg Gartner, and Michael Peterson (with Andrew Clouston), three of the world’s leading cartographers in the field of mapping on the Internet. The research group at CentroGEO in Mexico City, which made an important contribution to the first edition, have substantially updated their work on the concept of geocybernetics and presented a new theory based on extensive practice. Regina Araujo has updated her work on mapping for the blind and added a new description of participatory indigenous mapping in the Brazilian Amazon, while Sebastien Caquard has described his most recent work on cinematographic cartography. The extensive work on mapping with the Inuit and First Nations is entirely new as is the important topic of the legal and ethical issues involved in mapping TK. Several of the chapters on mapping the TK have been co-authored with writers from the Kitikmeot Heritage Society, the Gwich’in Social and Cultural Institute, and Nunavut Arctic College. This input has been of great value to the content of the chapters concerned and is an indication of the valuable partnerships on which the creation of many our cybercartographic atlases depend as well as the importance of the processes by which these atlases are built. Inuit and First Nations’ input to the atlases through the Elders, youth, and other community members, is critical and the quality, and acceptability and authenticity of the information, is dependent on this input. The narratives they present are the core of many of our atlases.

Cybercartography and the Nunaliit Cybercartographic Atlas Framework can be applied to a wide variety of topic in addition to the mapping of TK. In this volume, for example, there is a description of the Pilot Atlas of the Risk of Homelessness. There are also common issues regardless of what application area is involved such as archiving and preservation. The legal and ethical issues, for example, apply to a much wider field than traditional the knowledge context in which we discuss them.

Sir Tim Berners-Lee (2009), widely recognized as the originator of the World Wide Web, identified two major challenges for the future of the Web. The first is linking datasets on different topics, both quantitative and qualitative and generating new and more useful combined information. The second is finding new innovative ways of displaying that information in ways that people can be more readily understood. Cybercartography, using location as a linking mechanism, does both and is very much a technology for the Web 3.0 era.
References