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Evaluation of the CD-I Project, *Charting A New World: Maps of Discovery*

Genevieve Moore

A Thesis-Equivalent

in

The Department

of

Education

Presented in Partial Fulfillment of the Requirements
for the Degree of Master of Arts at
Concordia University
Montreal, Quebec, Canada

May 24, 1994

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ABSTRACT

Evaluation of the CD-I Project, *Charting A New World: Maps of Discovery*

Genevieve Moore

The following thesis-equivalent involved the evaluation of a Compact-Disc-Interactive commercial product. This CD-I product called *Charting the New World: Maps of Discovery* was developed for the David M. Stewart Museum in Montreal with the purpose of highlighting maps and navigation instruments from their collection. The product is an electronic book which offers adult users the opportunity to explore the museum artifacts in their home. The museum in its role as educator of the public, must promote learning which responds to the particular needs and tastes of its user population. Curators seek learning resources which encourage their visitors to actively participate in the exhibit thereby promoting interest and enhancing the image of the museum as educator. CD-I technology offers a number of appealing features to a small museum like the David M. Stewart. The potential of CD-I to respond to the particular needs of museums in their role as educator of the public is examined.

CD-I technology offers a number of challenges to designers and developers. When developing a multimedia presentation in a new technology, designers are called upon to consider many additional factors which are not directly related to instruction, but touch upon the effectiveness of the delivery of the message. The design and development of the *Discovery* disc required making many assumptions. The efficacy of these assumptions is assessed.

An evaluation was conducted with seven end-users and two subject-matter-experts in order to test the assumptions made about the museum and about the design. The procedure for and results of this evaluation are presented. Considerations for the development of future CD-I products are discussed.

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INTRODUCTION

In 1992 a Montreal group ventured the task of developing a CD-I disc for the museum domain. In a collaborative effort between On/Q Corporation, The David M. Stewart Museum (henceforth, DMS Museum), and the Canadian Heritage Information Network (henceforth, CHIN), a Compact Disc-Interactive project was researched and developed which resulted in the production of a consumer product. The intention of the disc is to provide the public with an opportunity to enjoy the highlights of the museum collection in their own homes. It can serve as an introduction to the collection or as a post-visit souvenir to enhance the visitor's appreciation and knowledge.

For two years previous to this project On/Q had developed expertise with CD-I technology with the goal of moving into this market. During this two year period they had searched for partners who could provide funding for development as well as access to a large database to meet the requirements to make a CD-I disc. Up until the *Discovery: Charting the New World* project On/Q had only developed prototypes. This project was an opportunity to develop and extend their knowledge in CD-I and to make their first commercial venture in this new market.

The early research on the potential of CD-I technology had identified the museum world as a potential market. On/Q, with two previous museum projects completed, wanted to continue to develop their contacts and experience in the museum world. Working with the DMS Museum and CHIN would provide them with an excellent opportunity to test the assumptions about the potential for CD-I as a response to the needs of museums.

The purpose of this thesis-equivalent is to relate the process of the development of the disc with its underlying assumptions and to present the results of an evaluation of these assumptions. The assumptions made during the development process are summarized below:

* the target population will be university-educated adults with an interest in maps or history, who participate in informal learning activities, and who are potential purchasers of CD-I technology;

* this target population will enjoy a visual database presentation of information with hotspots to select and access points of interest that allows for the educational browsing which is the museum visitor's preferred way to explore information;
* the population will want the disc to offer an easy-to-use intuitive interface that will permit quick and simple access to the information without elaborate instruction;
* the population will appreciate a presentation that respects the experts' accepted organization and interpretation of the knowledge.

This thesis-equivalent comprises four chapters. In the first chapter I will describe the need for alternative resources for museum education and the potential of CD-I technology as a possible response to this need. In the second chapter I will discuss the challenges of designing for multimedia, specify the limitations of traditional design models, and present the emerging design models. The third chapter describes the process of the development of the CD-I disc *Discovery* and presents it as an example of the application of a combination of two of these emerging models. The final chapter presents the method, results, and discussion of an evaluation of the disc.

CHAPTER 1

Context of the Problem

The role of the museum as educator has evolved over the centuries since the establishment of the first museum. This evolution was influenced by the intellectual and social climate of the culture within which the museum was located. Today, museum curators are faced with many challenges when they create exhibits which reflect contemporary tastes and points of view. They use the natural resources available in the museum setting but they are also influenced by the current ideas about education. One current idea which curators are presently experimenting with is the potential of multimedia to enhance learning. A serious limitation of multimedia is the cost of technology which makes it inaccessible to many museums, in particular, small ones. The introduction of CD-I technology has made the potential of multimedia available to small museums such as the DMS Museum in Montreal. The DMS Museum took the opportunity to research the potential of CD-I technology to respond to some of the particular challenges in its role as educator.

In this chapter I discuss the role and identity of the museum and how these have changed since the establishment of the first museum. The many challenges which confront curators when they are creating exhibits are presented and the potential of multimedia as a possible response to some of these challenges is discussed. The DMS Museum is introduced and the suitability of CD-I technology as an answer to some of its particular needs is proposed.

Identity and Role of the Museum

The identity of the twentieth century museum is that of educator of the public (Hooper-Greenhill, 1992). At the turn of the century North American museums were viewed as storehouses of treasures where learning could occur. Museums today place a greater emphasis on their mission to educate the public. Although they maintain their traditional concerns of acquiring new acquisitions, archiving, and maintaining the collection, the emphasis is now placed on the use of the collection to provide a variety of opportunities for learning (Hooper-Greenhill, 1991). This shift in focus has been identified in the literature by a number of museum curators and

administrators. Bearman notes in a recent publication that the museum has moved beyond the identity of "cabinets of curiosity" to become places which strive to actively involve their visitors in the exhibits in order to promote learning (Bearman, 1991). George MacDonald, the director of the Canadian Museum of Civilization, writes that there has been a shift from viewing the museum as guardian of valued objects to viewing it as a center of learning for cultural grammars (MacDonald, 1991).

A brief examination of the history of the museum in Europe and North America reveals that this so called new role is in fact a modification of the former role which the museum played in previous centuries. The association of education and learning with museums is found in its early roots. Hooper-Greenhill locates the roots of the museum in the Medici Palace in Florence and the Medici's support for learning. From these roots the methods of presentation and interpretation used by museum curators has changed as society's ideas about learning and knowledge have changed.

Although a variety of curators in the museum literature announce the museum's new role as educator, this is not what is new. What is fascinating about the museum's identity as educator in today's society is the way in which it is adapting to the current trends in the intellectual and social environment. In the twentieth century, society's world view has undergone a transformation. The previous world view was shaped by experimental science and manifested itself in our attitudes, our methods for acquiring and shaping knowledge, and our ideas about education and learning. The emphasis has shifted from one of causality to one of totality and experience (Hooper-Greenhill, 1992). We have moved from a viewpoint where we did not consider humans as part of the experience, to a viewpoint where we consider humans as active participants in every experience. This new attitude has gradually made itself manifest in many fields and one of these is museum education. The museum today is viewed as a whole where ideas, not objects, are most important; the objects are the means for conveying ideas (Hooper-Greenhill, 1992). The social environment has also undergone tremendous changes in this century. The shift in the world view has made itself manifest in the social environment in the increasing

liberalization and personalization of education, the introduction of learning theories that present the learner as free agent, the growing diversity of cultures, and the increasing emphasis on information and communication systems.

These societal changes have created pressure on curators to broaden the public appeal of the museum by providing exhibits that invite the visitor to independently participate, allow for diverse points of view, and communicate information in a contemporary way using the latest technology. The curator is challenged to create exciting, educational, and entertaining exhibits in a way that differs from the way museums served the public in previous centuries. The approach to museum education in the 1800s was less active and varied than it is today. The visitor was taught how to observe the artifacts and how to develop her mind through learning the correct approach from which to study the collection of the museum. The role of educator in the 1800s was one of training the visitor to see as the educated man saw. There was little room for the common man's point of view in the museum (Hooper-Greenhill, 1991; Bloom & Mintz, 1990).

Today the education programs in museums reflect the thinking of the cognitive school of psychology with its greater emphasis on the internal processes of learning. The focus in programs is on encouraging experiential and active problem solving in the visitor (Hooper-Greenhill, 1991). In the planning of an exhibition the curator now considers ways in which to encourage the visitor's active participation with the information in the hope of stimulating reflection and learning.

Nature of Education in Museums

In their role as educators, the museum curator must not only be current with the latest educational theories but she must also be an innovator to adapt these to the particular learning context provided by the museum. The challenge to museum curators in their role as educators is very different from the role that a teacher plays in a school system. This is because the learning that takes place in a museum is of an informal nature. The term "informal learning" defines the many ways that people learn beyond the classroom. These ways can include reading books and

magazines, visiting museums, watching TV and movies, and observing the natural world. People usually voluntarily choose their informal learning activities and they participate in them for a variety of reasons: intellectual, personal, emotional, or social. This type of learning is nonlinear, self-paced, voluntary, and exploratory. Often people are enticed to participate in informal learning experiences (Hein & Doering, 1992).

Allison and Gwaltney, reporting a recent visitor study, provide a description of visitors engaged in informal learning. They noted that most people visit a museum to do something fun and entertaining and, although they are happy to learn, they do not generally engage in purposeful learning behavior. Their behavior is described as "...educational browsing. Like someone scanning a book or looking around in a section of a store that interests them, visitors tend to browse an exhibit space" (Allison & Gwaltney, 1991, p. 69). They are there primarily to explore and not to get specific new information. Although they enjoy being challenged, they do not want to have to work too hard.

The nature of informal learning challenges the curator to create an informative and entertaining exhibit that wins the visitor's attention. The curator's next challenge is to provide an environment that holds the visitor's attention long enough to encourage her to explore the information and learn something about the subject (Hein and Doering, 1992). Given the diversity of visitors, the curator must be able to present information in a variety of ways at a variety of levels. Given the current orientation in education, they need to make a place for the visitor's way of seeing in order to engage people's own way of understanding as they experience the phenomena of an exhibit (Duckworth, 1990, p. 4-6).

Today's curator is faced with the challenge of reconciling many goals. Initially she must create an exciting exhibit which attracts, entertains, and holds visitors' attention. The exhibit must respect the integrity of the collection and the message she wishes to convey while respecting the particular nature of the learning her visitors will do. Her work must be current with the contemporary educational ideas. The exhibit must be mounted in a way that offers appropriate guidance. The curator responds to

this extensive list by creating a sense of novelty about the exhibit, presenting the information in context, providing diverse interpretation, providing cues for the visitor to make her way through the information, and offering hands on, participatory learning.

Because of its intrinsic qualities, the museum is well suited to enable the curator to meet the challenges of capturing the visitor's interest and enticing her to learn. Special features of the museum's learning environment include the ability to adapt artifacts to teach different age groups with different skills and capacities, greater emphasis on hands-on or participatory learning, the opportunity to reflect upon the diverse interpretations of objects by scholars and visitors from different backgrounds, and the opportunity to present the object within a context (Hein and Doering, 1992).

Throughout this century, museums have expanded the ways in which they fulfil their role as educator. Hooper-Greenhill cites a report from 1913 where a museum was sending out loan boxes to schools. In recent years, with the increased acceptance and availability of technology, curators have complimented their permanent and temporary exhibitions with real and taped guides as well as catalogues and books. They will frequently create an exhibit where people are encouraged to touch or manipulate an object or a model that illustrates an abstract concept. Many exhibits have included some sort of visual component such as slide presentations, film, or video. The introduction of computer technology into many education settings has induced these curators to begin to research its potential for enhancing the museum visitor's learning.

Museums and Multimedia

In the past few years curators have cautiously experimented with the development and research of potential applications of interactive, multimedia technology in museums. Prototypes include the Canadian Museum of Civilization videodisc which provides either an orientation to the museum or a database of photos of related artifacts which augment an exhibit. The Museum Education Consortium in New York have produced a variety of videodiscs on artists and art over the past six years (Wilson, 1991).

The Smithsonian and Amparo museums were the first to release CD-I discs showcasing their collections.

The use of computer technology is now discussed and debated in museum journal articles and at conferences. Its merits have been sung in numerous ways. van der Weiden (1989), a curator at Museon in Amsterdam, writes of how interactive media can benefit a museum which aims to illustrate processes, develop themes, make connections, cross-links, and cast light on relations between past, present and future.

MacDonald (1991) at the Canadian Museum of Civilization comments on how the use of popular media with its potential of emotion to communicate will bring the museum to wider audiences. He stresses the importance of the potential for multimedia to respond to the diversity of cultures and levels of knowledge represented among visitors. He notes how multimedia provides an opportunity to engage people's own way of understanding by providing many entry points into the exhibit. The information intensive quality of visual information allows the child and the adult to read the same information at different levels.

Howes, a member of the Art Institute in the United States, writes of the recognition in museum circles of the "importance of computer-based learning as a vital educational tool because the nature of the museum audience is so diverse. Each group needs different information presented in different ways which we have attempted to address with our multi-level approach to hypermedia" (Howes, 1991, p.134).

Alsford, from the Canadian Museum of Civilization, discusses the way in which the qualities of multimedia parallel those of the museum. He suggests that they are both information systems which provide access to knowledge domains. As information systems both attempt to capture and represent the complexity and intricacy of a body of information within its context. They provide the opportunity for different information delivery, either self-paced or programmed learning, in order to meet the different needs of the users. Both enable layering of information to accommodate learners at different levels of knowledge. The museum and multimedia have means to

increase the number of senses targeted and, although this may lead to information overload, the variety offered may accommodate learning styles and provide stimulation to hold attention. Alsford claims that because of these similarities museums are a natural environment for multimedia.

Despite the discussion and debate, there have been relatively few multimedia projects developed for museums. One of the reasons for this is that the costs for developing such projects are prohibitively high and, once produced, the potential audience is limited because of the low number of people with access to players. This cost presents a difficulty for many museums. Most curators would agree that the technology holds exciting potential for them and for the users but who will foot the bill for the research and development?

The David M. Stewart Museum

The David M. Stewart Museum calls itself the Discovery Museum. Their collection consists of rare maps, plates, books, and scientific instruments. The focus of the collection is the European development of North America and in particular, New France. Although they are a small museum with a limited budget, in recent years they have managed to create a number of innovative displays. Their curators are open to exploring the possibilities offered by multimedia technology.

Creating innovative displays is no easy task for the curators as the artifacts they work with can appear to the general public to be dull and uninteresting. The objects carry a dense history and require a considerable background in historical and scientific knowledge. The most effective way to convey this knowledge is to provide a context within which the story for each artifact can be appreciated. The challenge for the curators is to place the maps and instruments within a cultural and historical context in order to convey a sense of their interest. During an exhibition the curators attempt to highlight one or two interesting details of each artifact but they can never convey the richly detailed story that each map and instrument can reveal. The visitor misses the opportunity to fully appreciate the museum collection.

Multimedia is a possible solution to the challenge of conveying more of the story behind each artifact. It is well suited to the task of creating a presentation that respects the interwoven and complex story of maps and instruments. The general public, who lack familiarity with the history of the artifacts, can be helped by a multimedia presentation which provides them with a variety of background information. A multimedia presentation provides viewers with a tool by which to explore an artifact in greater detail along with the additional support of sound or graphic explanations. The advantage of a multimedia presentation is that the user can be treated to a guided visit where she can determine the level of information she wishes to explore.

Another appealing advantage of the interactive, multimedia presentation is the close access to fragile artifacts which it provides to viewers. Visitors to the museum are usually separated from these artifacts by glass and consequently only obtain a distant view of the map or instrument. The disc allows viewers to examine the artifacts up close while providing an accompanying explanation. It is thought that this will enhance the viewer's interest and pleasure.

And finally, an interactive presentation makes the museum collection accessible to a wider audience. This is advantageous for the general public who are interested in maps and instruments but who have limited opportunities to visit the museum. It is also beneficial to students who may wish to examine one or more artifacts, sometimes in great detail and for extended periods of time. The disc permits the interested individual or scholar to explore the collection anywhere in the world thereby raising the profile of the museum.

Why CD-I?

The CD-I technology was selected as a delivery platform for this project over competing multimedia, interactive technologies because of its low development cost, its ease of use, market projections provided by Philips, and market research conducted by On/Q. Because it is a technology developed specifically for the consumer market, it offers the possibility of recouping the costs of development and producing a profit from which future

projects can be developed -- an appealing feature for both museums and developers. Advantages of using a consumer product are that it offers the museum public a reasonably priced, quality product with the attractive features of portability and an easy-to-use information source. Another appealing feature is that Philips has laid the groundwork for sales beyond the North American market by developing and enforcing worldwide standards for software and hardware. This ensures that the disc can be viewed on CD-I players anywhere in the world -- an advantage for the museum wanting to broaden its public.

Compact Disc-Interactive is part of the compact disc family. It combines qualities from diverse technologies: telecommunication, publishing, television, computing, and optical and magnetic storage. Its forerunner in terms of offering multimedia was the optical videodisc invented by Philips in 1972. The serious limitation of videodisc was that the data was stored in an analogue, not digital, format. A digital format for storage was in development. The first compact disc player was introduced in 1978 and was standardized by Sony and Philips in 1979. CD-Audio which offered high-fidelity audio became available in 1982. In 1985 CD-ROM was introduced and the high fidelity sound capability was replaced by data. By 1988 Philips and Sony proposed a world standard for the CD format. CD-I was unveiled in 1992 and offered the capacity to store photos, sound, text, graphics, motion video, and animated graphics (Hendley, 1987).

Although it is part of the compact disc family and uses the same technology as CD-ROM, CD-I differs in a number of important ways. The market for CD-I is the consumer and not business. CD-I was developed for entertainment and educational applications in the mass consumer market. It is a stand-alone device, similar to a VCR, which is attached to a television. It has its own microprocessor and ROM-based operating system (CD-RTOS, compact disc real time operating system). Control is through a mouse or a remote. Philips has developed a separate standard which includes formats for audio, graphics, and text (Laursen, 1989).

In the industry, the *Discovery* disc would be described as an electronic book (Haykin, 1993, p. 95). Electronic books serve to extend the

printed word into the digital world. They combine text, illustrations, photos, and sound providing a product that appeals to more of the senses than a book. The advantage of the CD-I presentation over the traditional book is the opportunity to present information in a novel format, eliminate the constraint of the linear presentation of paper-based books, provide access to the details, search quickly to retrieve diverse elements from the program, and provide a greater storage capacity.

CD-I was considered as suitable for the DMS Museum artifacts because of its ability to present layers of information with links and connections. The hypertext ability offered by CD-I is well suited to an ill-structured domain like cartography and its history because it respects the interconnectedness of this knowledge domain and allows the user to explore and learn about these connections. The user is provided with a global view but she also has access to information about each object in increasing depth. Unlike a printed catalogue or souvenir book, a CD-I presentation allows the visitor to navigate with ease to explore artifacts to the depth that she desires. She is free to return again and again to examine the objects in greater detail.

CD-I provides the user with the opportunity to view the museum's artifacts in close-up accompanied by an explanation. The capacity to provide a multimedia presentation allows her to view a story with sound, animation, pictures and text. She can approach the disc in much the same way she would visit the museum. She can browse the information to discover what entertains and enlightens her. But the CD-I presentation gives her access to much more information than she would have during a museum visit.

In conclusion, besides the general advantages of complimenting the museum resources presently available for learning, at a reasonable price, CD-I offered the DMS Museum solutions to the particular needs of their visitor population. These solutions were:

* CD-I can convey more of the story behind each artifact;
* CD-I provides a presentation that respects the interwoven and complex nature of this story;

* CD-I can present objects within a context;
* CD-I can provide background information through a series of easy-to-access hypermedia links;
* CD-I offers the user control over how she explores the content;
* CD-I provides close access to fragile artifacts thereby providing a view of the object that is impossible to obtain in the museum;
* CD-I makes the collection accessible to a wider audience.

Based upon these promises the DMS Museum, in collaboration with On/Q and CHIN, established six goals which they hoped the CD-I *Discovery* disc would achieve. These goals were

i. to provide a selection of the artifacts of The David M. Stewart Museum that complements the existing collection but allows the user to explore it in her own home;
ii. to create an interactive environment which will illustrate, educate, and entertain;
iii. to provide an overview of the art and science of cartography and its development;
iv. to situate specific maps and navigation instruments in a historical context;
v. to provide details of maps and instruments that can be examined by the viewer according to her interest and needs.
vi. To foster an appreciation and an understanding of the wide range of maps and instruments available in The David M. Stewart.

It is with the goals described in this chapter that the three partners of the *Discovery* disc embarked upon the design and development of a CD-I museum disc. The design and development of a multimedia product present many challenges which are, for the most part, not addressed by the traditional design models. Developers and designers have discovered that the reality of design and development does not match the theoretical models and so they have begun to create models which more accurately reflect the actual process. In the second chapter I will discuss the challenges of designing for multimedia, specify the limitations of traditional design models, and present the emerging design models.

CHAPTER 2
Design
The Problem

Although the On/Q team had experience in developing multimedia products, the *Discovery* disc presented many new challenges. This was the first time that they had embarked on a multimedia project of such a scale. The nature of the product was an electronic picture book that offered users easy access to a variety of source material. The product also had to provide support to users as they explored this material. In order to reflect the informal nature of the learning that takes place in museums, the team had to create an environment where users could discover the content in a nonlinear, self-paced, and voluntary way. A project of this complexity requires a design model which enables the development team to meet the specific challenges of the particular situation.

Presently there is much debate within the Instructional Design field about the adequacy of traditional design models to support the development of instruction. Much of this criticism arises as a result of the currently popular conceptions of learning advocated by the constructivists. The constructivists advocate that learning occurs when personal knowledge is constructed by an active and self-regulated learner. The learner is viewed as one who grapples with and tries to make sense of things. This active learner demands the creation of a responsive environment which facilitates the generative learning viewed by the constructivists (Seels, 1989). Developers and designers of multimedia products also remark upon the limitations of the traditional design models to guide the process of development. Their concerns are centered upon the inflexibility of the traditional designs which makes them impractical and ineffectual in reality.

Both groups, the instructional designers and the developers and designers, have explored possible alternative models. This chapter presents a brief summary of both groups' arguments against the traditional instructional design models. This summary is concluded with a discussion of the limitations of the traditional models in relation to the development of the *Discovery* disc. Finally, some of the emerging alternative models are presented.

Traditional Instructional Design Models

Traditional Instructional design models have been under criticism for not supporting the development of instruction that supports the type of learning currently advocated by the constructivists. The traditional model reflects the philosophy of Dick and Carey (Dick & Carey, 1985) with the design process represented as a sequence of phases, each independent, with the outputs of the last phase serving as inputs for the next. These models assume that no concrete product will be available until quite late in the process and that it is necessary to keep the design process on track by following the various phases. All components of the model are considered required and none are considered optional. A component is not reconsidered once it has been dealt with. To a certain extent these models are an attempt to simplify a complex process by constraining decisions early on in the planning process.

There are a number of limitations to this unrealistically simplified, overly-structured, and very linear approach to design and development. In an attempt to control the complexity of the design and development, the quality and effectiveness of the product is often compromised. These models demand a level of detail that is not always possible to obtain at the start of a project and therefore they do not allow the product to evolve in complexity over the process of development. The consequence of working in sequentially, independent phases is that the designer is inhibited from working on different parts of the project while modifying tentative earlier parts (Jones et al, 1992; Merrill, 1990c; Tessmer & Wedman, 1990).

The models are lacking in flexibility and pragmatism. In regards to flexibility Merrill (1990c) notes that without the means to integrate the phases of instructional design, the product is often not reflective of the integrity of the interaction between the content, skills and the learner. The models lack sufficient flexibility to support the creation of new, more complex ideas. Creation requires that the design team not only has some means to integrate the phases of instructional design but also that they can work on parts while maintaining a vision of how those parts make a whole (Merrill, 1990c). The models we presently use are closed in that they do not provide us with any

flexibility for following different sequences. In respect for pragmatism, Tripp and Bichelmeyer (1990) lament that the present models do not adequately acknowledge the complexity of design situations with the interaction of budget, time, content, methods, local history, talent, and social interaction.

The present models are reductionist and advocate the break down and identification of the parts of what is to be learned to such a level of detail that it is often difficult for designers to maintain a useful representation of the whole. Designers and developers can become so involved in maintaining the detail that they lose the vision of the design as a whole. Winn notes how this overemphasis on analysis often distracts designers from integrating what they discover about tasks, content, and cognitive processes into a learning plan (Winn, 1990). The reductionistic quality makes it difficult for designers to keep a handle on the whole and therefore to present an integrated product.

A major complaint of many writers is that the traditional models reflect a lack of value for content dependent knowledge and skills (Bednar et al., 1992; Cognition and Technology Group, 1991; Cunningham, 1992; Duffy & Jonassen, 1991; Perkins, 1992; Spiro et al., 1992; Winn, 1989). The Constructivist's conception of learning advocates that experience happens in context and that context is essential to the understanding of and ability to use knowledge. This argument is key in the contemporary discussions on the transfer of learning (Resnick, 1987).

The traditional models provide design techniques but do not allow for the incorporation of the recent theories of learning and instruction with their focus upon learning in context. The traditional models, with their assumption of domain-independent knowledge and skills, offer the tools of analysis of conditions and outcomes, and the selection, testing and revision of strategies before instruction is implemented (Winn, 1990). They offer prescriptions for how to instruct but they are lacking in a way to incorporate our recent understanding of how people learn. Instructional developers need a model that permits and encourages them to consider the consequences of instructional strategies for learning. Winn believes they need a model that encourages reflection in action (Winn, 1989).

Due to their limitations, the traditional models do not respect the present conceptions of learning -- that knowledge needs to be constructed and learned in context. Neither do they offer the flexibility necessary for developing more complex instruction and learning systems, in particular, interactive multimedia systems. The traditional models do not offer adequate tools for maintaining a vision of the finished product while working out the details of the design.

Limitations of Traditional Design Models In Relation to the Development of the *Discovery* Disc

Given the nature of the *Discovery* disc it was difficult to select a design model that could support this particular kind of development. The challenges included the complexity involved in developing a multimedia product, the particular type of learning suitable for this museum product, and the nature of the development environment.

An electronic book offers the capability to present layers of information with links and connections -- a hypermedia of information. Development of multimedia differs in complexity from traditional instructional design for classroom or computer environments. Designers must consider many additional factors which are not directly related to instruction but touch upon the effectiveness of the delivery of the message.

Jonassen (1991a) discusses the differences between traditional instructional design and multimedia design. Designers of multimedia are confronted with a multitude of decisions. Added to the traditional decisions about learner population, content selection, and presentation, the developer must consider such things as total memory capacity, synchronization and memory needs during the program flow, and branching. Memory limitations require that they make decisions about trade-offs of a lower audio level to accommodate other data such as the richness or number of colors in graphics vs image smoothness or resolution; image complexity vs need for cursor movement; size of video display vs frame rate of motion video; and graphics quality vs graphics manipulability. Decisions about strategies require developers to make choices about audio and visual material.

Attention must be paid to the interface which will support navigation through the content as well as support the user's incorporation of the knowledge without cognitive overload. Another difference between traditional instructional design and multimedia is that the former is designed to reflect a task or learning outcome whereas the latter is designed to reflect the organization of knowledge or the content domain. Multimedia reflects nonlinear thinking while traditional instructional design is more linear and procedural.

In addition to the challenges discussed above, the developers of a multimedia museum product must solve the problems of how to quickly engage the viewer's interest and then how to simply demonstrate the operation of the disc. The developers must also meet the challenge of creating a disc which facilitates an informal learning experience. The interface must be tailored for varying levels of computer literacy, multiple age levels, subject matter complexity, varied familiarity with the content, and considerations of information overload. A multilayered complex process of design requires a flexible model that can contain all of these aspects while allowing the complexity to flow easily (Reilly & Roach, 1986). At the time of the development of the *Discovery* disc electronic publishing was still quite new and developers knew that such development required new skills of design and authorship but no such model existed (Jonassen, 1991a).

An additional challenge in developing this disc was that we were not developing a strictly instructional product. We were creating a learning environment that informs and educates through the user's active exploration of the knowledge. CD-I, with its potential to provide multimedia, offered an appropriate medium for reflecting the museum's approach to education. It reflected the informal nature of the learning that takes place in museums by allowing for a wide variety of people to use the disc in a nonlinear, self-paced, voluntary, and exploratory manner. Traditional design models were generally created for the development of the more structured instructional products which have been used in formal education settings. Developing a product like the *Discovery* disc required a model which reflected a particular philosophy and perspective of learning which is found in settings where informal learning is encouraged.

The final challenge in developing the disc was located in the nature of the environment in which the development was taking place. Two key factors contributed to the environment. The first was that CD-I was a new technology still in the research, development, and testing period of its existence. The second contributing factor was that the disc was developed for the marketplace and therefore the design and development had to consider the needs and demands of the market. Developing products while undertaking research and development in new technology places special demands on development. It requires that the design plan remain flexible in order to accommodate new learning. Although the initial concept does not necessarily change, how it is implemented and delivered may change throughout the development process. Since it is not possible to completely envision what the final product will look like, it is necessary that the team maintain an open attitude towards the content and its presentation as they learn the capabilities of the technology. It is necessary to begin with a sketch, make a plan, and then begin to concretely explore the possibility of creating the idea.

CD-I is market-driven and therefore decisions are directed by the view of the marketplace. It is not enough to consider whether a product is well-designed, or whether it accomplishes what it set out to accomplish. It must also be developed within the budget. Development under such circumstances requires flexibility in design and a need to be open to solving problems in a variety of ways. It is a process that involves the sacrifice of many dreams during the development as well as the creation of new solutions.

Given some of the limitations of the traditional instructional design models there has been much written in recent literature about various responses to the new conceptions of learning and the demands of development for multimedia. Although many of the Constructivists (Bednar et al., 1992; Spiro et al., 1992; Jonassen, 1990) have specified what a new model should offer, they have yet to offer a model that practitioners can begin to test.

Emerging Alternative Models

The general force of the arguments against the traditional models is their inflexibility and inability to integrate new conceptions of learning. Three teams of researchers have explored and proposed possible models for development: these teams are the researchers Merrill, Li, and Jones; Tripp and Bichelmeyer; and Tessmer and Wedmen. Beyond the important considerations Merrill, Li, and Jones bring up, their model is still under development and therefore not yet available to developers. Tripp and Bichelmeyer have suggested a new way to view design and development but they leave the details of how to proceed up to the design team. Tessmer and Wedmen have attempted to provide a more detailed description of how to proceed by using the aspects of the traditional models but keeping the attitude of flexibility touted by the two teams of Merrill, Li, and Jones and Tripp and Bichelmeyer.

Merrill (Merrill, Li, & Jones, 1990a, 1990b) argues for a more modular and therefore more flexible model. The phases in his new model roughly parallel those in traditional Instructional Design models which include analysis, design, development, implementation, and evaluation. The difference is that the products of each phase are not considered completed. Interaction between phases exists allowing for the possibility of the designer to add or modify decisions made in earlier phases. These products evolve as the designer's knowledge grows. Merrill's model offers a vision of the future but it is insufficient at this time to offer support to designers and developers.

Tripp and Bichelmeyer (1990) have suggested Rapid Prototyping as an approach to Instructional Design. Rapid Prototyping is an approach to design used by architects and engineers to focus on solving problems and achieving goals through the creation of models. This approach treats the process as uncertain and indeterminate rather than predictable in nature. The different stages of design and development often take place simultaneously. Throughout this process, designers and developers make guesses at the problem and out of many solutions choose one that seems to be best but by no means optimal. The flexibility of this model allows the designers to incorporate their learning into the final product. Rapid

Prototyping allows for the creation of alternate and contradictory prototype designs while formative evaluation of the prototypes allows for problem discovery which can contribute information to the development and shaping of the final product.

Tripp and Bichelmeyer suggest that the model of Rapid Prototyping needs to take into account the foundation of existing Instructional Design. With the model of Rapid Prototyping the definition of needs, content, and objectives come out of the research and development rather than being a necessary input into the construction and realization of the plan. The designer uses this information to create prototypes which contain the basic parts of the final product. These are then tested and based on the results they may become the final product. The model serves as a plan for all team members which facilitates discussion, clarifies the purpose of what is being created, and helps to identify the immediate tasks.

Tessmer and Wedman (1990) have presented a model that reflects many of the features of the Rapid Prototyping model. They call their model "Layers-of necessity" and present it as a practitioner's model which accommodates the design and development strategies of the traditional models as well as the 'lean' approaches often practiced but seldom advocated by Instructional Design professionals. They suggest that their model is sensitive to time and resource constraints without sacrificing the integrity of the Instructional Design process.

They present a selection of instructional design processes that vary in complexity depending upon the complexity of the product to be developed and the time and resource constraints. A developer would select the layer that matched and would apply the process found at that layer to the problem area. The model is adaptable to the situation, that is, if the constraints lessen, the developer can choose to go to a deeper level of the model. This permits work completed at earlier phases of development to be elaborated upon. It permits an adequate but comprehensive job to be done at a simple level of process but it also accommodates development at greater levels of detail and sophistication.

The latter two models are particularly supportive for the development of interactive, multimedia products. The structure which they provide uses components of the traditional models but it offers the flexibility to use them in a way that enables research and development to occur throughout the development phase. These are particularly compelling features to support the development of a disc such as *Discovery*. Despite the knowledge and expertise of the development of interactive, multimedia that the On/Q team brought to the project, the development of CD-I in an informal learning environment was an unfamiliar situation. Despite our previous experience developing prototypes for CD-I, we were still researching the capabilities and limitations of this technology. The process used to design and develop the *Discovery* disc is presented in chapter three.

CHAPTER 3
Development
Development of the disc

Development of a disc begins long before the stage of production. Many months before this stage, it is necessary to have the creative idea for the project and then to begin to assess what resources are available to execute the idea. On/Q wanted to develop a museum disc. They approached a number of potential clients trying to interest them in the idea. In the end it was the DMS Museum and CHIN who were willing to take a risk by becoming partners with On/Q. On/Q was responsible for developing the financing and assembling and coordinating the design team. On/Q, in collaboration with the DMS Museum and CHIN, planned and executed the project.

When it comes to writing down a process of development, one wishes that it had taken place in a sequential manner in order to ease the relating of the tale. Unfortunately for the writer, this is not the case. Fortunately for the participants, the process is alive and dynamic; it never stops to consult the project flow chart but leaves the producer at the whim of the people and the technological tools involved in the process. It is the producer and the team members who must bend and stretch to modify the original idea in order to bring the project to completion as close to the delivery date as possible.

The development of the disc did not follow a traditional Instructional System Design model for reasons described in the previous chapter. The team used a combination of the models described by both Tripp and Bichelmeyer and Tessmer and Wedman. Given the time and budget constraints and that CD-I technology was still in its research and development stage, the team chose to create a prototype at an early stage of development. The designers used their experience of working with the traditional instructional design model and applied this to the novel task of developing an education product in an unknown technology. Similar to Tessmer and Wedman they elected to move through the phases of instructional design respecting all of the components but emphasizing them depending upon the actual constraints of the situation.

To begin, it was essential to establish a process of communication and a plan for keeping all team members informed. At an early meeting a Project Plan was presented to all team members. This plan outlined the project objectives and presented the findings from the initial needs and task analyses. Based on these objectives and findings the team developed a sketch for the concept, identified and organized the tasks, and mapped out the phases of production for the following months. The team built upon this initial sketch throughout the life of the project; over the months the sketch was stretched and modified throughout the process of development.

Within two weeks of the start of the project the programmers and graphic designers were provided with resources to begin to develop a prototype. Based upon their work the initial assumptions about the concept and design were modified and expanded. This work became the building block upon which the development of the rest of the production was based. During the first four months, when the visual and sound segments of the project were prepared and assembled, the development team continued to evolve and test this initial prototype.

In a project which requires the participation of such a large number of people, at different points of the development, it was essential that we could be flexible enough to accommodate the varied suggestions and recommendations made by team members throughout the design and development process. Using the Rapid Prototype and the Layers of Necessity models allowed us to improve the design and give it a more defined and interesting shape as we moved forward in the development of the final product. In this way we were able to use suggestions made by the musician, the museum archivists, the content experts, the photographer, the researchers, and the writers.

In this chapter I will describe the development of the disc. The process is presented in five parts and these are Project Management, Concept and Planning, Design and Development of the Prototype, Production of the Prototype, and Evaluation.

Project Management

The importance of well-balanced management is an aspect of development that is frequently mishandled. Management involves frequent communication, realistic estimates of time and money, and an understanding of the marketplace, technology, and development process. Management is responsible for navigating the project from the initial birth pangs of a creative idea through to the evaluation with the market. The two types of management for the *Discovery* disc were Business and Project.

The Business Management handled the day-to-day details of the operation and growth of the company. On/Q's business manager oversaw all of the finances and ensured that the inventory and equipment were in place to enable the team to work. The Business Management team took care of the image and direction of the company. It was this team that made the decision to enter the CD-I market after carrying out the initial marketing and planning. They set the objective and goals for the On/Q projects of which the *Discovery* disc was only one.

Project Management plays a role from the initial concept of the product to its eventual production and distribution. It involves estimating and coordinating finances, people and resources that are directly related to the specific project. For the *Discovery* project these responsibilities were shared between Michael Palmer and I. The financing of the project, establishing the budget, and constructing contracts was handled by Michael. He also oversaw the legal issues, the marketing and sales. Michael oversaw the pressing of the disc and the planning of the distribution. I was responsible for the organization of the team and coordinating the work of the designers, artists, programmers, and content experts.

To facilitate the Project Management On/Q created a Project Plan (see Appendix A) which was approved by all parties at the start of the project. Project reports were created by On/Q and presented every six weeks. A project report summarized the work completed to date and identified for each partner the tasks left to accomplish. The report was presented at a meeting of all three partners and agreement was reached on what tasks to undertake in

the next phase. These meetings helped to clarify expectations and understanding throughout the life of the project. In this way the team was able to evolve and change the project plan.

Participants

Many people contributed to the various phases of the design and production of the *Discovery* disc. The team included the On/Q production team of instructional designers, graphic artists, programmers, and producers. Outside resources for research, writing, music, and photography were provided by the DMS museum, CHIN, or were hired by On/Q.

At the center of the development process was the On/Q production team. All decisions were made here in consultation, through the project manager, with the government and museum representatives. Team members from the museum and government met every six weeks when a written Project Report was presented and final decisions were made in the presence of all parties.

The role of this writer was Project Manager and Co-Producer. The responsibilities of this role included overseeing the people, the logistics, and the resources of the project. My background in instructional design enabled me to maintain the integrity of the vision of the project while attending to the day-to-day details.

Roles

There are many tasks in the development of a disc and these are generally assigned to particular roles. The roles, along with a brief description of the tasks for each, are presented in the following.

Management.

The President and Vice-President of On/Q oversaw the complete management of the project. They were responsible for seeing that the overall concept of the product fit into the On/Q marketing plan. A challenge was to develop an overall concept and interface that would have a distinct look, yet be flexible enough to be used for other discs. They provided their expertise in the development of interactive products.

Creative Director.

The Creative Director was responsible for the vision and creative aspect of the project. He maintained a consistent design and a consistent interaction model. He was responsible for establishing and monitoring the standards and styles of the individual efforts of the designers, writers, editors, artists, animators, musicians, and programmers.

Project Manager.

The Project Manager was responsible for defining and maintaining the representation of the knowledge, and coordinating the resources with the schedule. She was responsible for overseeing in detail all aspects of the design and development of the disc. This meant the establishment of a project plan and schedule; the assembling and coordination of design and production teams; overseeing the collection of resources which included images, written documentation, and sound; overseeing the production of the photos, graphics, script, music, and narration; and acting as a liaison between the members of the different teams.

Instructional Designer.

The Instructional Designer was responsible for much of the initial analysis in order to ascertain the scope of the content, appropriate organization, and effective strategies for conveying the information. Throughout the life of the project she served as the link the between the content experts the creative director, the artists, and the programmer. She oversaw the selection of the resources used to convey the information and the creation of the interface which determined presentation of and navigation through the information.

Museum Archivists.

The Museum Archivists were responsible for orienting the team towards the resources that conveyed the information while at the same time respecting the identity of the museum. They provided the broad outlines for the story the content would convey. They identified content experts and organized the selection and handling of the artifacts for photography. They acted as editors of the script checking for oversights or inconsistencies. As

well, they served as the population for the initial evaluations acted out in the early stages of the development of the prototype.

Content Experts.

These people were experts in the fields of maps and navigational instruments. They provided feedback on the initial plan and the selection of artifacts. They provided suggestions for where they saw weaknesses. These commentaries guided the selections and the emphasis of the final product. They edited the final scripts for misinformation or lack of clarity.

Researchers.

The Researchers were responsible for surveying the fields of knowledge to gauge the information available. They searched for and collected interesting anecdotes about the artifacts and the historical period. This information was supplied in note form to the scriptwriters.

Photographer.

The Photographer was responsible for shooting the maps and instruments according to the scripts provided by the instructional designer. The slides were then provided to the artists.

Artists.

In collaboration with the creative director they developed the "look" of the disc and the interface. They digitized all the visual documentation and created the art work of the titles, the menus, the buttons, and the introduction segment. In collaboration with the programmer and the instructional designer, they created the plan for the interface and the visual presentation of the information.

Programmer.

The Programmer was responsible for the creation of the program.

Technical Assistants.

These people were responsible for a variety of tasks. Some were involved in the taping and editing of the narration while others were responsible for the digitizing of the visual and sound elements.

Writers.

Using the notes provided by the researchers, the writers created the script.

Musician.

The Musician was responsible, in collaboration with the project manager and the creative director, for the creation of the concept for the music. The musician oversaw the research and selection of the instrumental pieces. He coordinated the performance of the selections and recording of the musical soundtrack.

Narrator.

This person was responsible for narrating the script.

Legal Concerns

A significant amount of time was taken up in making agreements to use content. This was not difficult to arrange with the DMS Museum and it is one of the reasons it is important to consider dealing with one organization for most of the content. It is also an advantage to work with historical documents that have passed the copyright limit of fifty years. The writers and the musician agreements were arranged in our initial agreement with them. When we stepped outside of the DMS Museum and began to include items from other Canadian museums, we had to make agreements with each individual museum. We were fortunate that we were able to reach agreements with the other museums quite easily and that payment was not demanded for the use of their property. The process of attending to legal agreements is time consuming but should never be overlooked.

Marketing & Sales

Under this heading falls the negotiations for distribution through the network of CHIN and the DMS Museum. As well, Philips was a part of the plan to distribute the disc. Much of the decision making in this area was handled by the President and Vice-President of On/Q since the *Discovery* disc was only the first of many such discs. Decisions about price and look were made in keeping with the long term plan of what the On/Q niche and

look would be. On/Q made the arrangements with Philips for publishing and distribution.

Concept And Planning

Concept and planning comprises the first phase of development of the disc. It is comprised of a number of activities which define the shape and scope of the project. These activities include elaborating the idea behind the concept; identifying and assessing the target audience; identifying needs and defining a purpose; defining the scope of the content; exploring interactivity, interface, and navigation; determining the scope of the tasks; and the creation of a plan.

Elaborating the Idea Behind The Concept

The development of the concept extended over a year. It began with the initial conversations within the On/Q team and then moved to conversations with the museum representatives. Finally, the broad concept was shaped further in conversations with the CHIN representative. Once the project started, our conversations extended to include the archivists. With the introduction of each new group it was necessary to educate them about CD-I and its potential. As our understanding of the potential of CD-I grew, we continued to develop and refine this initial concept throughout the life of the project .

We presented the concept of the project as an electronic book which offers users some, but not extensive, interactivity. The product is created for use by adults in the home for the purpose of entertainment and education. Built on the model of a story with access buttons, it enables the user to control the kind of information, or related information, she wishes to view. The electronic book provides the user with many options for paths to navigate through the content. It is hoped that such a presentation will promote interest on the part of the user and encourage curiosity, questions, and exploration of the information. The idea behind the story was the exploration of maps and instruments as related through the history of the European's exploration of North and South America.

An additional element to all decisions made about the concept was that it was necessary to create a format that would accommodate future *Discovery* discs.

Identifying and Assessing the Target Audience

The *Discovery* disc is a commercial or mass-market product developed to reach a large audience. The audience for such a product would be adults with an interest in maps or history; these would generally be university educated people who would appreciate a well integrated and aesthetic presentation. These people would have a good level of income in order to afford the delivery system. The audience was identified by the museum from its knowledge of its user population and with the help of the available marketing studies for CD-I.

Identifying the audience and defining the idea behind the concept helped us to define that we were attempting to develop material for users who are seeking an aesthetic experience enhanced with a presentation of esoteric information. The emphasis in such a presentation needs to be placed upon the highest quality of sound and image, and users will set the pace of interaction, ranging from lazy to leisurely. A very dense visual database seemed appropriate, supported by mood music, voice narration, and carefully written supporting narration. It was decided that the product would be modeled on the Sesame Street CD-I discs where the user could touch hotspots on the screen and these would come alive with visual and sound information.

Identifying Needs And Defining A Purpose

The needs of the target audience were identified through discussions with the archivists and the director of the museum. We also examined the variety of art discs available on CD-I as well as the discs released from the Amparo and the Smithsonian museums. From these examples we were able to identify audience needs within the CD-I environment that were implicitly expressed in the disc. The needs which we identified included an informal learning experience that would inform and entertain; an opportunity to explore a knowledge domain in a leisurely and self-directed fashion but with support and guidance provided within the presentation; a presentation that

respected the experts' accepted organization and interpretation of the knowledge; an easy-to-use, intuitive interface that would permit quick and simple access to the information without elaborate instruction.

The purpose of the disc was fairly well refined from Michael's original proposal that stated that the disc would provide people with access to the objects. I narrowed it down to the theme of the discovery of North and South America by the Europeans. The main purpose of this project was to inform, and educate in the museum sense of the word. The product was also developed to entertain: in order to pique audience interest in maps and in the DMS collection. A further purpose was to create an interactive environment that would support the user to explore the development of cartography and navigation.

Defining the Scope Of The Content

In the process of refining a concept, one of the steps is to evaluate the content. In the course of two weeks, discussions were held with three archivists and the general lines of the content were sketched. Our quick survey of the resources available in the museum aided us in our decision to focus on the two main themes of the European discovery of North and South America and the evolution of the cartography industry during the three hundred year period that the disc would cover. We took only a cursory look at the resources available to create the cartographer stories and the timeline. This cursory survey of the resources for these two content areas would lead to complications later when we had to extend our search beyond the museum to find images for these two sections.

It became evident early on that the disc should concentrate more on the maps because there were more people resources available to guide the research and the development of the story. It also became clear to me that we would have to develop all images and most of the story from scratch because the available images were not adequate for this project. Although the museum had created and installed a major exhibition only six years before on a similar theme, this project would be larger and would build on this initial work. We had no idea at this point the extent of research that

would have to be undertaken to produce enough interesting information for the disc.

An important part of assessing the scope of the content is identifying the subject matter experts and their openness to and availability for the project. At this point we assumed that the resources within the museum were probably sufficient.

Exploring Interactivity, Interface, and Navigation

With the information that I had been able to gather in the first three weeks of the project, the Creative Director and I began to sketch out on a dry erase board, the traditional ways that people could approach the content area. We decided to present the information in a manner recognizable for curators and cartography scholars. We chose a linear presentation of maps and historic events thinking that this was an easy and recognizable structure for anyone, even a novice.

After identifying the large categories, we began to explore the ways in which people might want to move from one category to another. It was decided that within this structure the user would be free to wander always being able to return to any of the menus from any screen should she become disoriented. This was our manner of exploring our early ideas for the presentation of information, menus, navigation and interface.

During this initial period, we had photographed one map and instrument. These slides were digitized and the artists and programmer began to experiment. They worked with the results from the photograph sessions to create a demonstration of what could be done with the features available in CD I.

Determining the Scope Of The Tasks

During the assessment of the content, we were also beginning to access the strengths and weaknesses of the team members and how we could best work with them. Both these assessments provided information about the scope of the tasks that would be involved in this particular project. For example, as we discovered that there was inadequate useable material

such as photographs, audio material, or text from previous museum projects, we had to begin to plan for the photographing of all artifacts. This would be an enormous task as each map had to be shot as a whole and then in pieces. It required matching the stories with points on the map and charting this out on a shooting script.

Creating a Plan

Most of this activity comprised what I would call the first phase of development. From this initial work I was able to create a plan that described the broad lines of the concept and the scope of the content. A Production Schedule was created that outlined, generally, what the flow of the project would be with dates. The roles of each partner were outlined as well as a list of tasks that each was responsible for during the project. Included in the plan was a list of tasks identified by partner that were to be carried out in the second phase of development. This plan (see Appendix 1) was presented to all partners along with a tour of the initial sketches for the menus, interface, and navigation. At this same meeting partners were shown the early experiments with the slides of the instrument and map.

Design Of The Prototype

With the completion of the initial sketches and the creation of a plan, the second phase of development began. This second phase lasted approximately seven weeks within which the team continued to refine the content and the concept. We began to work out the practical logistics of carrying out the photographing and digitizing of the information. Research and writing of the script was initiated and arrangements for the music were made. At the completion of this phase the concept, the navigation, and initial interface were much closer to their final shape. The storyboard and the shooting scripts were completed. Development of the program had started along with the production of the graphics. At our team meeting at the completion of this phase the partners were presented with an initial prototype of the disc.

The development strategy for the second phase was to continue to develop and refine the concept and the content through the creation of the prototype. As our knowledge of the content and the domain grew we were

able to incorporate this knowledge into our working model. As we discovered the strengths and the limitations of CD-I we refined our concept.

Defining and Selecting the Content

In the second phase we began to refine our criteria to aid us in the final selection of the maps and instruments for the disc. This criteria evolved as I became more familiar with the story of maps, exploration, and the collection at the DMS Museum.

The first criterion was that the artifact fit in with our themes of the evolution of cartography, science, and exploration. The second criterion was that the artifacts had to capture the story of both continents in order to speak to audiences across North America. A third criterion was that the artifact had to be attractive and of a high enough interest to hold people's attention. A fourth criterion was how representative the artifact was of a significant (as understood by the scholars) development in science, cartography, exploration. A fifth criterion was how easy it was for people to view without becoming lost in a mass of detail: visual or historic. A sixth criterion was how well could it be presented within CD-I technology.

Although the museum's primary focus is New France they had purchased other valuable and important maps that could represent milestones within the story of cartography. Our initial selection was refined in consultation with experts in the field. Later we had to go back and try to even out the initial selection of maps with items which were of scholarly or historic interest but not, at first glance, necessarily very attractive. These changes had to be made in order to maintain an evenness of presentation in the story as well as to respect the scholar's approach to the content area.

Obviously there were some significant maps that were missing from the collection while there were some spectacular maps that were of little value historically or scholarly but were fascinating to look at. The final selection required a balance. In the end it was the entertainment value that was used as a criterion for selection because a map might be of tremendous scholarly or historic interest but if it had no visual appeal it was very unlikely

to capture the interest or imagination of the user and therefore it was unlikely to be selected for viewing.

Since our focus was primarily maps and the scientific instruments were a complimentary theme the selection of these artifacts was not as complicated. The criterion was to highlight the story of the development of these navigation instruments. To do this we selected eight instruments that would communicate this story in a simple and brief way.

Each new project is a learning experience for all parties. Even the content experts must be prepared to stretch their knowledge into new areas. The knowledge of the content experts had to be assessed to evaluate where we might need to investigate further sources for areas where they were weak. In the end, we used two categories of content experts. The archivists from the museum proved to be excellent for a global view of what was possible given their collection and the theme. They were also helpful in terms of their experience in creating exhibits because they knew what would interest people and how to use their artifacts in the best way possible. The second category of experts were generally more scholarly and provided a greater level of detail than we would have been able to research out of books. They often provided a personal touch with anecdotes from their years of study and particular interest. They also were helpful in keeping the tone of the project sufficiently scholarly and in line with the contemporary fashionable ideas of cartographers.

Throughout the refinement of the content we were researching the effective ways of presenting this information to the users. The museum staff were very helpful in providing suggestions for presentation to a population of novices while the experts were helpful in accenting the expectations that a more knowledgeable population would bring to the disc. Both groups had experience in presenting their material to the public and provided many helpful suggestions.

Once the selection was more clearly defined a plan was made for accessing and transporting the maps and instruments from the museum to the photographer's studio. A shooting script was created for each map to

guide the photographer's work. This script would prove to be an essential tool in the final development of the disc as it was used to guide the work of the graphic artists as well as that of the programmer.

During the second phase, a resource for the music research and production was identified. The criterion for the selection of music was that it represent the time period and the nationalities involved in the story.

Research of the historical content was conducted during this second phase. Much of the information was collected through interviews with the museum archivists as well as experts in the field. Additional information came from books on the subjects. This would all be provided to the script writers who would prepare the narration for each map. Writing of the first draft of the script began in this phase. We tried to keep our research and scriptwriting of the maps and instruments ahead of our shooting but this was not always possible. The consequence was that we had to shoot the artifacts with a variety of highlights in order to provide the visuals for a story we only vaguely knew.

Refining the Concept

The more familiar we became with the domain and the museum the easier it was to refine our concept. It became clear that the type of experience we wanted people to have was quiet and fairly cerebral. The image of the museum and the content is generally considered fairly intellectual. We began to aim for more of the style of the information and entertainment documentary viewed on public television.

As the scope of the content we had initially selected became clear, we began to explore ways in which the complexity could be simplified in its presentation. This influenced the development of the interface and the navigation. It was key that we maintain people's interest in the material and that we not overwhelm them with an unmanageable amount of detail. We began to confine types of information to different levels within each presentation of an artifact. In this way, we hoped that people would capture a sense of discovery when they chose to explore an artifact at deeper levels.

We wanted to make the interface as intuitive as possible in an attempt to give the user as much control of the environment as possible without getting lost.

As part of the metaphor of discovery, and also to simplify the interface, we knew that we did not want to overwhelm the users with a lot of information on how to use the disc. We wanted to keep instructions to a minimum and allow people to explore easily and discover the information and the functioning of the disc. We hoped that people would come to the experience of the disc with similar expectations for how they approach a museum: that this is a pleasant way to use their leisure time. We assumed that they would be interested in informal learning but that they would not want to have to work too hard or think too hard. They would be happy to let it roll past them. The idea was to let them enter it as easily and quickly as possible.

As we began to plan the script based on our research, we knew that the script had to reflect a viewpoint like a book or a movie. In writing the script, we had to develop a point of view and a sense of personality so that the disc would be viewed as an electronic book and not a database.

We began to see that we wanted to offer people an experience of travelling uncharted waters through their exploration of the history of science, cartography, and discovery. We used the metaphor of the map and discovery to help to orient and explore this new area. Could we capture in some way the mystery that confronted the early people who stepped onto the shores of the continents? We wanted to convey the challenge which confronted cartographers when they developed their conceptions of the continents.

In developing the concept of the disc we were confronted with a common problem that museum archivists frequently deal with when mounting an exhibition. This is the tension that exists between those who lean towards the popularization of the museum by making the collection a part of the everyday life of the community and those who believe that the collection is primarily for the use of researchers and scholars to extend knowledge. Throughout the development, we had to balance our objective of entertaining and informing a diverse group with maintaining a presentation that reflected the scholar's current understanding of the domain. Since we were

collaborating with scholars it was important that they see that their ideas were reflected and respected within the disc. This would be important if we wanted their endorsement on the final product. The difficulty is that the scholar's interest in a map is not always one that is shared or easily conveyed to the general public. We tried as best we could to balance the needs of these two very different populations.

Development of the Prototype

During the second phase we began to create the prototype and to experiment with the many pieces of the project. The artists and programmers continued to work with the same map as before but they took this initial sketch that they had made in broad strokes and began to stretch it to see how far we could play with it. The map was re-shot based on what we had learned from the early experiments of presenting it within CD-I. Over the weeks, they worked with it playing with the design of the icons, the menus, the cursor, the visual cue for magnification and highlights and sound.

The prototype was the working model for the conceptual design. It served as our drawing board to discover what techniques work and what processes convey the message, concept, and purpose that we had identified. The initial run through with the museum and CHIN people was very encouraging. The archivists were amazed at the quality of detail in the close-up shots and commented that this was greater than any detail they could now obtain. Their excitement suggested to us that we were on the right track and that our concept could work in practise.

The prototype allowed us to try out ideas about interface design and image resolution. It allowed us to pinpoint the trouble spots and then to refine our instructions to the photographer. It helped identify what maps might work and what others should be discarded. We discovered how close we could go into the map before it became disorienting. A path for guiding people through the levels of magnification was developed as well as a pattern for scanning the map at different levels of magnification

The prototype was also a model for production. While gathering the pieces to create the prototype, we were testing our plan of how to work with

the museum. From this experience, we developed the routine for the transportation and care of the artifacts. We identified the information required by the photographer and this helped us to create the shooting scripts for the balance of the maps and instruments.

Development of the Interface

Of prime importance at this point was the development of the interface. The mechanics of the interface comprise the visual, sound, and text elements as well as the screen and mechanical controllers of the material. The art of developing the interface is to combine these various elements with a familiar, stable and consistent metaphor. The metaphor evolved from the concept of discovery and exploration.

The creative director and the artists began to develop the look of the product. They chose parchment with brass buttons to simulate the feel of the maps and the ornaments of an instrument or a ship. They designed a frame that would look like wood similar to how the map is framed in the museum. The sounds of the waves and birds were added later to suggest the ocean voyage. The cursor in the shape of an anchor was added to suggest dropping anchor.

The mechanical aspects of the interface were a little more challenging to develop. Attention had to be given to strategies for quickly engaging the viewer and for demonstrating how the disc could be used. Thought was given to how the interface could facilitate the informal learning experience of a diverse population. It had to be tailored for varying levels of computer literacy, multiple age levels, subject matter complexity, and varied familiarity with the content. We had to develop ways to provide access to the information without leading to overload, a common problem with multimedia. The interface and interaction needed to be clear and simple. It was necessary to limit the choices and number of things to remember to avoid confusion. The interface had to facilitate understanding and interaction.

We had to find a consistent way of presenting information in order to make it easy to follow and to create trust in the user. Taking our cue from the metaphor of discovery and exploration we attempted to make the interface as

intuitive as possible in order to allow the user to explore and discover on her own. The interface was developed to encourage and invite the user to discover the maps as well as to discover the disc.

We tried to create supports for users so that they could solve their own navigation problems. We made sure that the same buttons were always available to the users so that if they found themselves in a place that they wanted to exit, they could do this easily. Our approach in building the interface was to make it as simple and intuitive as possible so that people could use their preferred style of learning without being compromised or frustrated. They could always easily correct any error they made.

Rather than provide a complicated verbal and visual introductory segment of how to use the interface, we decided to provide a simple cue card in the Help feature. The instructions for navigation and an explanation for the buttons were provided through a verbal prompt the first time each new screen is accessed. After this, the user must access the Help button for instructions.

Navigation was facilitated by the consistent use of menus to access information. No matter where the user is in the disc, she can hit one of the buttons which will take her to the menu for that topic area. The button never takes her anywhere else but to the menu; there are no surprises in the menu bar. The surprises are hidden in other parts of the screen where they are likely to be pleasurable and perhaps helpful rather than confusing the user.

It is important that the content and the interface work together. In our case, we decided that in order to help orient the user we wanted the interface to respect the existing way of thinking within the knowledge domain. Examination of how people think in this area as well as how they might want to access the information was used to develop the interface. Information design took place early in the development of the prototype with the creation of a sketch of how the field is conceived by the users. Based on this research we decided to organize the information chronologically. The artifacts in each menu would be accessed with respect to time. Once in a particular section, the information was organized visually and could be accessed by touching points of the map or the instrument.

Production

While the development of the prototype was underway, aspects of production were started. Production in this phase involved the scripting, shooting, digitizing, and final art work of every artifact. Graphics for parts of the interface was completed in this phase.

At the completion of the second phase, the team members met and reviewed the progress, viewed the prototype, provided feedback, and identified and planned for the tasks of the third phase.

Prototype And Production

The development of the prototype continued during the third phase. It grew as new pieces were incorporated into it and it slowly began to resemble the final product. The focus of the third phase was the production of the program code, the completion of the graphics, the audio production and digitizing of the music, and the image scanning. The final research was completed in this phase as well as the final draft of the script, and the verification of the information.

I will briefly comment on only the last three items since my involvement in the other activities was minimal. With the exception of providing information in an organized format and supplying the artists and the programmer with a guide for the organization, I was not implicated in the production phase of the project. My focus continued to be acting as a liaison between the different team members and the participants in the project and coordinating the cataloguing of all of the image, sound, and textual information.

Research in this phase involved interviewing two people whom we had not been able to meet earlier. We were able to easily incorporate this additional information into the script. During this phase we collected slides from various museums across Canada in order to illustrate the timeline.

Verification of the information began during the writing of the script. Both script writers collaborated with experts who provided additional

explanations to clarify certain points. Upon completion the script was sent out to three different people for verification. Once it was returned we were ready for translation and narration of the two language versions.

Evaluation of the Prototype

The fourth phase of the development and production of the disc was the evaluation. The prototype was evaluated at many points during its development and this is explained in more detail in the following chapter.

CHAPTER 4

Evaluation of the Disc

The final chapter presents the method, results, and discussion of an evaluation of the disc. The first two sections serve as an introduction to present the particularities of an evaluation of a multimedia product and to state the purpose of the evaluation of the *Discovery* disc. In the third section I explain the method used for this evaluation. The balance of the chapter contains four sections; the first two are the results of the end users' evaluation of the disc followed by a discussion of these results. The final two parts include the results of the subject matter experts' evaluation of the disc followed by a discussion of these results.

Evaluation of a Multimedia Product

Testing and evaluation are essential parts of the development of an interactive, multimedia product. For products which have a more linear presentation of information, the testing and evaluation traditionally takes place at two, possibly three, stages of the development. For the development of traditional software, the developers may carry out a formative evaluation with the storyboard and then again with the first version of the software. The summative evaluation, when it is done, takes place at the completion of the product. Although summative evaluation is given much lip service, it is rarely carried out with commercial software because of the additional cost.

In comparison, the evaluation of a multimedia product occurs at numerous stages throughout the development. The prototype is used for these evaluations. The advantage of evaluating with a prototype is that the evaluator does not have to imagine what the final product will look like or how it will perform. She views the actual product although not in its completed form.

The evaluations of the prototype can be categorized into internal and external. The internal evaluations take place with the members of the development team. Those who are physically close to the programmer and the artists can provide their feedback daily, while those members who are present less frequently offer their reactions during team meetings. A number

of internal evaluations took place during the initial six months of development of the *Discovery* disc with team members from On/Q, the DMS Museum, and CHIN. These were helpful for validating the interface, navigation, appearance, comprehension, as well as the accuracy, consistency and integrity of the content.

The external evaluations take place with members of the user population and subject matter experts. The first external evaluation of the *Discovery* disc occurred at the ICOM-92 conference where museum curators and administrators provided feedback on the interface, navigation, comprehension, and the appeal of the disc and CD-I technology. The final step in the external evaluation was undertaken for this thesis-equivalent, where the original design assumptions were validated and the attainment of the project goals was assessed. An additional purpose of the evaluation at this stage of development is to identify improvements for future projects.

Purpose of Evaluation

The product evaluated is an electronic book which offers users some, but not extensive, interactivity. The product was created for use by adults in the home for the purpose of entertainment and education. Built on the model of a story with access buttons, it enables the user to control the kind of information, or related information, she wishes to view. The electronic book provides the user with many options for paths to navigate through the content. It is hoped that such a presentation will promote interest on the part of the user and encourage curiosity, questions, and exploration of the information.

The evaluation undertaken for this thesis-equivalent had three objectives. The first objective was to verify the validity of our original design assumptions to assess to what extent the target audience likes the content, the design, and the new technology. The second objective was to verify whether the final product meets the goals set by the three partners at the beginning of the project. Identification of improvements for future CD-I projects was the third objective. Since the nature of the learning that takes place when users interact with the disc is informal, the evaluation does not focus on the attainment of pre-specified learning goals.

Method

Selection of the Population

In order to verify the effectiveness with which the above-mentioned objectives were met, the disc was evaluated by a selection of the user population and two subject matter experts. The selection of representative users was based upon visitor studies from the DMS Museum. Consultation with the museum staff, early on in the project, revealed that visitors to the museum range in age from fourteen to seventy-seven. Generally their familiarity with the subject matter can vary from a superficial to an in-depth knowledge. The adult population usually has a university-level education. Based upon this research, I selected seven users who fall within the range of characteristics described above. The two subject matter experts are designers and developers of software and multimedia products. Both have previously evaluated multimedia products for the Education Department.

Sample

The target population consisted of seven adults, (three female, four male) ranging in age from twenty-three to fifty. With the exception of one participant with a CEGEP level education, the participants held either an undergraduate or graduate degree favoring arts over science. They match the characteristics outlined by the museum's visitor studies.

The participants were visitors to museums and galleries: five had visited one within the last month, and the other two had visited one in the last year. The average frequency of visits was four times a year. This was used as an indicator of possible interest in the content and approach of the disc as well as whether they have a habit of participating in informal learning activities.

With the exception of one participant who never uses a computer, all participants use a computer either everyday or frequently in a week. Their use of the computer is generally for word processing but two participants use the computer to develop multimedia or graphic art projects. People's familiarity with at least one computer application provided them with a base for understanding the features of the disc. Those with limited experience provided insight into the effectiveness of the interface for novices.

All participants but one own a video machine which they use at least once to twice a week making them part of the home entertainment market. They can be considered as potential purchasers and users of CD-I. In terms of the subject's familiarity or previous experience with CD-I, three people had seen a demonstration of the technology, while four had never heard of it. This is probably not representative of the population since most people have never heard of CD-I or multimedia.

Instrument

A questionnaire (see Appendix C) was developed in order to elicit user's comments on the effectiveness of the interface, the appeal of the product, and the relevance of this and future CD-I products. The questionnaire was in two parts with the first set of questions being generally open-ended in order to encourage the user to describe her experience of using the disc. The second set of questions required the user to rate her experience of using the disc. The two sets of questions were used to obtain first, a general, and then a more precise idea of the user's reaction to the disc. They also provided some variety to the hour long interview. A pilot test with the questionnaire was made with two additional users prior to the start of the formal evaluation. Some modifications were made as a result of this initial test.

Procedure

The evaluations were conducted one-on-one with the evaluator meeting with each subject matter expert and user for approximately an hour. These meetings were carried out in a viewing room equipped with a CD-I player and television monitor. The interview was tape recorded and the interviews were transcribed (see Appendix B for examples of interview transcripts). During the meetings the evaluator took minimal notes which were written up as observations.

Since I was evaluating a new technology with people who had a variety of expertise with computers, it was important to put the interviewees at ease. During the session I provided many cues that they were not being tested. I tried to encourage them to talk about the difficulties they were

having by explaining to them that if they had a problem it was due to a weakness in the system and not the result of their ignorance. In the early part of the interview when they provided feedback, I responded by saying that they were telling me exactly what I wanted to know -- what does not work or make sense.

The interview began with a brief introduction to CD-I and a description of how the interview would proceed. After a quick tour of the equipment and a demonstration of how to hold the remote, point, and make a selection, the user was encouraged to enter the program and to explore with minimal support from the observer. The purpose of the observation period was to assess the effectiveness of the interface. During this time the evaluator was watching for the user's ease of handling the main features and functions of the disc, the effectiveness of the menus and navigation bar, indications of technical problems, and situations of disorientation or cognitive overload. The observation period usually lasted five to fifteen minutes and during this time the user was encouraged to comment and ask questions. Occasionally the interviewer asked for clarification on why a certain selection had been made, or if the interviewee knew what was happening. This period of observation was followed with the user responding to the questionnaire.

The procedure with the two subject matter experts was somewhat different. In these interviews the questionnaire used during the interviews with the users served as a guideline. The subject matter experts were also requested to comment on the effectiveness of the interface and the visual presentation of the disc (e.g. the effectiveness of the graphic design, the quality of images and text, the appeal of the color, and the appropriateness of the icons). They were also asked to comment on the consistency of the concept and the navigation scheme to help assess the effectiveness of the design decisions made during development.

The results from the interviews were analyzed qualitatively. Initially the transcripts were examined individually to verify the observations made during the interviews. The individual responses were then collated by question. The responses to each question were examined to identify similar answers or patterns and then the responses were summarized. The

questions and their summarized responses were grouped according to the three criteria identified for evaluation. The answers were then examined again to identify common responses and patterns and finally summarized.

Results For The End Users

What follows is a summary of the comments and observations from the interviews with the end users. The information has been organized and is presented according to three criteria: the effectiveness of the interface, the appeal of the product, and the relevance of this and future CD-I products.

Evaluation Of The Effectiveness Of The Interface

The first examination of the data will be to assess the effectiveness of the interface at general and particular levels. The information for this comes from observational data and user's responses to the questionnaire. The observations are presented first, followed by the responses to the questionnaire.

A. Observations

The observations are presented under four headings: ease of handling the main features and functions of the disc, effectiveness of the menus and navigation bar, indications of technical problems, and situations of disorientation or cognitive overload.

1. Ease of handling the main features and functions of the disc.

The main features and functions of the disc include entering and moving around the disc, making selections from the navigation bar, scrolling the map, operating the magnification and highlight features on the map, and utilizing the Help feature.

There were two patterns to people's handling of the main features and functions of the disc. The first pattern was found among four people with less computer experience. Some of this group admitted to feeling fearful that they might look foolish because they did not know what to do. They generally began to timidly explore the disc. They looked to me for reassurance or for me to suggest what they should do next. With encouragement from me and a few experiments making selections, they

began to gain confidence. With the exception of one person who never stopped looking to me for suggestions, the three people were making selections and navigating through the menus and the information quite comfortably after five to ten minutes.

The second pattern was found with three people who had more computer experience. They entered the program confidently and began to explore the buttons and to actively figure out how the disc was organized. They were no more familiar with CD-I than those in the first group but they were more confident in terms of exploring the disc and trusting their ability to figure out how to navigate.

One interesting observation was that two people, one experienced and the other inexperienced, became confused at one point in the disc and did not know what to do. They admitted to having expectations for how the disc should operate and when it responded differently they could not figure out what to do.

There was one limitation with the interface that became evident during the user's evaluation. This was with the magnification of the map and the turning on or off of the highlights. With the exception of one person with experience in developing multimedia, these two features, when first encountered, were confusing for everyone. Three people stayed with their confusion and continued to explore the features. They were able to master them with a minimum of effort. Of the remaining three, one finally asked me questions and was able to learn to operate the magnification and the information features. Two other people struggled and then chose to exit the map. With encouragement from me they returned later and with guidance they mastered these two features.

There seemed to be no pattern to how people used Help. Two people chose not to refer to it and commented that this is what they usually do, preferring to explore and discover. One person went directly to Help upon entering the program and listened to the explanations provided. The four remaining people explored Help in the way that they explored the other

icons on the Navigation Bar. There were three people who referred to it later in the program to know what a particular icon represented.

Two people confused the navigation buttons and the explanation buttons. They attempted to exit the feature by selecting the explanation buttons. It was difficult for them to identify that they needed to select a different button to exit.

2. Effectiveness of the menus and navigation bar.

There were no difficulties observed with understanding how to make a selection from the menu. People usually listened to the voice-over instruction and they made their choice without hesitation. Many people missed the comment that to view more maps they could scroll the menu. They discovered this feature at a later point in their exploration and expressed surprise and delight at their discovery.

In general, people used a discovery approach with the icons on the navigation bar. The people who were content to hit the buttons and to be led through the disc in this way discovered slowly what the icons represented. If at a certain point they wanted to go to a specific place, they had to take a moment to figure out which button would take them there. It was not always immediately evident to people what the icons represented. Often at this point people consulted the Help feature. It was usually about half way through the observation period that they became familiar enough with the icons to use them without consulting the Help.

3. Indications of technical problems.

People struggled to learn how to operate the remote and how to master directing the cursor with the joy stick. The remote is awkward to use and even with practice takes a certain amount of concentration to direct to the exact place one wants on the screen. This is a technical limitation with the CD-I system. The track ball developed for children is easier and more pleasant to use.

4. Situations of disorientation or cognitive overload.

A place where people became disoriented is one I have mentioned already: the magnification and the highlights of the map. With the exception of the developer, people experienced disorientation when they explored the magnification and the highlight features on the map. Those who were more intent on hunting and pecking than listening to the instructions were completely lost and there was no way for them to clarify their confusion -- not even with the Help feature. Those who combined hunting and pecking with the voice-over instructions generally faired better. The manoeuvre to get the magnification desired and then to obtain the information takes a few steps and these need to be planned. It is at this point that those using the strategy of hunting and pecking experienced difficulty. They would often get into a high level of magnification and become lost. They found that the changes in the cursor created confusion rather than clarity. The different shapes that the cursor takes and the functions that these represent is not apparent.

Another place where people experienced disorientation was the timeline. Two people reacted very strongly to the timeline and the way that it was organized. For both these people its inclusion and manner of presentation made no conceptual sense. They were disturbed by the lack of explanation for its presence in relation to the rest of the information and they did not understand why it started back before the dates of the maps. For a few people there was some hesitancy about how the highlights worked. They did not know whether to click the highlight off or to wait for the program to return them to the menu. With minimal time, everyone was able to figure out what to do.

B. Comments Elicited by the Questionnaire

Certain questions were designed to elicit the affective reactions of the user, and their comments about the effectiveness of the interface. The responses are presented under four headings: the general difficulties experienced by users, the reactions of users to the experience of navigation, the general comments of users on the helpful features, and the comments of users on specific features.

1. General difficulties experienced by users.

People were asked to give their general impressions about the difficulties, frustrations, or misunderstandings when using the disc. People's responses touched on four areas: the icons, navigation, expectations, and additional features.

Most people said that they learned what the icons represented by using them. For two people, it was not knowing what the icons meant that lured them into exploring and discovering the rest of the program. Two participants found it difficult to know what the icons meant at first glance. Although one person said she had difficulty remembering what the symbols meant she also said that it was easy to figure it out. A few people complained it was difficult to distinguish the difference between the Information button and the question mark.

People expressed difficulties with the navigation. They generally made two types of comments. The first type of comment concerned orientation. For one person, with no computer experience, it was not clear where to go or what to do. At the other extreme, one person, who develops software, commented that she experienced no difficulties. In general, people seemed somewhat uncomfortable in the initial moments in the disc. They were encouraged to follow the voice-over instructions without fully understanding what they were doing. Generally, the Help feature did not provide the support that people said they wanted. The second type of comment concerned the difficulty operating the remote and making a selection in the act of navigation. For two people the remote was difficult to use. One commented that the manipulation of the Magnifying glass and the Information buttons was awkward.

In terms of the users' expectations of the disc's function, two people expressed surprise at the comprehensiveness of the program. A comment made by one person was that she was surprised to accidently discover that the menu could scroll. And finally, one person had misunderstood that the symbols connected her to other menus.

During the discussion of difficulties, frustrations, or misunderstandings people suggested features they would have wanted to have available. They would have wanted to stop the Introduction, to scroll the map while the narrator was speaking, and to view, in detail, the location the narrator was commenting upon.

2. Reactions to the experience of navigation.

In general, people provided consistent responses to the question about the experience of navigation as they provided to the questions about difficulties or frustrations. Five people commented that when they first entered the disc they had difficulty with either knowing what to do or recognizing the icons, but with a minimum of exploration they could easily figure out how to move around. Two of these people appreciated having the choice or freedom to move around without a lot of direction. They commented that there really was no danger the user would become lost because she could always make a choice to return to a menu. Two other people noted again, the awkwardness of operating the remote and how this was a minor irritation when using the disc.

3. General comments on helpful features.

What most helped people move through the information was their own path of discovery, their natural curiosity, the continuous presence of the icons, and the clarity and conciseness of the orientation provided by the narrator. Also, what facilitated movement through the information was people's familiarity with the content and its standard structure, the visual presentation of the information, the organization of the objects by time, the presence of the Information button, and the availability of the Help feature.

To improve the experience of navigation people suggested that explanations be more explicit as to how the content is organized, descriptions be provided about the menu and the information contained in it, additional indications be given that the menu scrolls, explicit indications be offered for how to stop, a more complete demonstration be provided for how to use the icons, and an option to pause be added.

4. Specific features.

Users were asked to comment on four specific features the Introduction, the Help, the Voice-over Instructions, and the Icons. Their comments follow.

a) Introduction.

Four people found the Introduction helpful in creating a general understanding of what was to be presented in the disc. It prepared them to look at maps. There were two types of criticisms of the Introduction. The first was that it was not direct enough in providing a sense of the structure of the information. The second was that it did not demonstrate how to navigate in the disc. In general, people found the Introduction adequate but not highly effective in presenting how the information was structured or how to move in the disc.

One person suggested more specific information be provided in a shorter amount of time. Two people wanted the Introduction to touch on the overall structure of the information and how the parts are related. Three people would have wanted a more detailed demonstration of the icons and how they are used to explore the content. In conclusion, the introduction should serve a variety of purposes and it failed to do this.

b) Help.

Despite people's need for more explanation of how to navigate, five people said the Help provided them with appropriate explanations. One person did couch her answer with a comment that she would have preferred knowing about the icons from the Introduction. One person was not aware that she had looked at Help. In general, people relied more upon their own exploration and discovery than on Help.

The following suggestions were made for changes to Help: identify more clearly how to access it in order to avoid confusion between the Question Mark and Information, provide a demonstration of what happens when an icon is selected (e.g. this takes you back in history to see the development of discovery), indicate that the menu scrolls, and offer an explanation of what Help does.

c) Voice-over instructions.

People's comments indicated that they found the voice-over instructions helpful most of the time or always. They found that the instructions were spoken at an appropriate rate and it was easy to absorb what was said. The information was relevant and provided an auditory cue for the visual information. In one person's opinion the voice did not provide a sense of the global view. Another observed that she had missed the cue for the scrolling menu. There was a suggestion to use a female voice as well as a male voice.

d) Icons.

With the exception of the confusion between the Help button and the Information button, people indicated that they were clear once they had used them or had visited Help.

Evaluation of The Appeal Of The Product

The appeal of the product was evaluated on the basis of the users' assessment of the effectiveness of the tour, likes and dislikes of the disc, desire to view the disc again, unmet expectations, suggestions for changes to the disc, and perceptions about the purpose and focus of the disc.

The responses in this section provide information for evaluating whether the disc meets a selection of the goals as defined by the three partners at the onset of the project. These goals include

i. to provide a selection of the artifacts of The David M. Stewart Museum that complements the existing collection but allows the user to explore it in her own home;
ii. to create an interactive environment which will illustrate, educate, and entertain;
iii. to provide an overview of the art and science of cartography and its development;
iv. to situate specific maps and navigation instruments in a historical context;
v. to provide details of maps and instruments that can be examined by the user according to her interest and needs.

A. Assessment of The Effectiveness of The Tour

People rated the overall effectiveness of the tour as good or very good. Three people commented that it was very interesting, while three others noted that it was easy to use. They found it instructive, comprehensive, precise, and appealing to the senses. Comments included "It gave me what I wanted," "I experienced few problems," and "I was not frustrated." Aspects which deterred from the overall effectiveness of the tour were the lack of orientation for how the content was organized and related, as well as a few minor navigation issues (e.g. a desire to pause the program, scroll while the narrator spoke, and easily manipulate the magnification and information features).

B. Likes and Dislikes of The Disc

People identified three categories of qualities which they liked about the disc: these were its use, its appearance, and its attractiveness. In regards to the first quality identified, two people found it easy to use. One commented on the ease of interaction and said that it was not frustrating: it provided flexibility in terms of what information to examine as well as to what depth. Particular comments included, "It was easy to get a sense of what it was all about and how it hung together," and "It was easy to access particular information."

In relation to the second quality identified, that of appearance, one person commented on the clarity of sound and said she found the sea sounds relaxing. Two people commented on the clarity, color, and sharpness of the pictures. The clarity in the detail shots was noted.

Finally, the third quality, the attractiveness, was noted in three people's appreciation that they learned something. In general, people liked the theme of discovery. Two people made comments about the appeal of the availability of the information on a disc rather than in books. One person noted the availability and access to different types of information. Others commented on the variety of the photographs, the reasonably sized chunks of information, the relevancy of the timeline, the challenge to discover the

new technology, and the variety of movement all of which helped to maintain interest.

People identified three categories of qualities which they disliked about the disc: these were the navigation, the presentation of the content, and the limitations of the technology. In general, the quality people disliked most about the disc was navigation. Four people spoke of their initial frustration about manipulating the magnifying glass and the Information highlights. One person mentioned the confusion over what the icons were and how they were related to the map. Another person noted her desire to either scroll or to have details of the map presented while the narrator described the map. One criticized the difficulty of moving around due to the lack of coherence in the structure of the information, and another remarked on the slowness of access once a selection is made. The final comment about navigation was that the Introduction was too long and that it lacked a pause feature.

The second and third qualities disliked by people were related to the presentation of the content and the limitations of the technology. In relation to the content, one person found the timeline content was poorly integrated with the rest of the content. Another person desired more information about modern cartography. In relation to the limitations of the technology one person noted the cost of the players, while another remarked on the lack of compatibility and the limited availability of players.

C. Desire to View The Disc Again

When asked if the appeal was enough to bring her back, everyone said she would look at it again. Four people said that there was so much more of the disc to explore and that it was fun to do so. Two people wanted to know more. One person commented that the information was simple and accessible. One person admitted that she was not very interested in discovery history.

D. Unmet Expectations

When asked if there was anything that they had wanted but did not get five people responded, "No." One person commented that they had expected a little more instruction or support for how to navigate.

E. Suggestions for Changes to the Disc

When asked for suggestions of what they might change or add three people responded, "Nothing." Others made the following suggestions: explaining the icons; changing the Introduction to present a more comprehensive explanation of the purpose of the disc, the structure of the information and how the various themes complement each other; including information about contemporary cartography and about explorers; and including a game.

F. Perceptions About the Purpose and Focus of the Disc

People's perceptions of the product were in line with those of the development team. Five people identified the focus as early geography or early cartography. Three people specified that it presented the early conceptions of the world. One person noted that it was an encyclopedic account of the history of discovery, while another commented that the disc activated interest in the museum and the technology by making them both more accessible.

When asked about the purpose of the disc, the most common responses were that it was to educate or provide knowledge, to present different points of view, to promote the museum, to present the maps, to provide easy and fast access to more information than is possible in a museum visit, and to entertain. People thought that what they would rotain would be the knowledge acquired, the desire to know more, the sense of the value of CD-I as an educational medium, and the memory of a pleasant experience.

Evaluation of The Relevance Of This and Future CD-I Products

The relevance of this and future CD-I products was evaluated on the basis of the users' responses to questions about their perceptions of CD-I, their assessment of the efficacy of CD-I, their desire to use CD-I again and

their understanding of how they would use CD-I, their identification of the types of information they would like to access, their intentions to purchase CD-I technology, and their perceptions of the museum after viewing the disc.

The responses in this section also provide information for evaluating whether the disc meets the following goals as defined by the three partners at the onset of the project

ii. To create an interactive environment which will illustrate, educate, and entertain;
vi. To foster an appreciation and an understanding of the wide range of maps and instruments available in The David M. Stewart.

A. Perceptions of CD-I

When asked what they thought CD-I was about the most frequent response was, "fun." Others felt it was easy to use, educational, and an efficient medium for the storage and access of information. These perceptions correspond with how CD-I has been marketed.

B. Assessment of the Efficacy of CD-I

With the exception of one person every subject said she had learned something. The answers fell into two categories: those who learned information, and those who learned about CD-I and its development. Most people mentioned they learned some type of information. The kinds of information acquired related to cartographers, maps, and instruments. As well people left with a sense of what information is available and with a familiarity of the David M. Stewart collection. The second most frequent response touched on what they had learned about CD-I and their comments included a fascination with the technology, a renewed appreciation of the importance of icons for navigation, a sense of the importance of fragmenting the information, an insight into the amount of work involved in a multimedia project, and a realization that computers can be user-friendly and unintimidating.

C. Desire to Use CD-I Again and Users' understandings of How They Would Use It

When asked if they would use CD-I again six people said, "yes." They thought that it would be useful as a teaching and a research aid, and three people saw it as a valuable means of entertainment. They would recommend it to teachers, to museum curators, to hobbyists, to children, and to the general public. Generally, they perceived CD-I first as an educational tool for schools and, secondly, as a part of an exhibition, and thirdly, as a source of home entertainment or reference tool. When asked how they might use this disc people's responses fell into three categories: in the museum, in the classroom, and in the home.

D. Identification of the Types of Information Users Would Like to Access

The most frequent suggestions for other kinds of information that could work well on CD-I included fine arts and science. More specific suggestions included tourism, general information for reference, recipes, biblical information, literature, geography, history, music, architecture, astronomy, space, and biology.

E. Intentions to Purchase CD-I Technology

When asked if they would buy a disc, people noted the kind of disc they would buy: art or science. Others said they would buy it only if they wanted to know more information or if the disc was related to an important topic. The answers seem to indicate that there has to be some intrinsic motivation in buying the disc: it must deal with a topic of interest. One person said, "No", she would not buy a disc.

F. Perceptions of the Museum After Viewing the Disc

As far as assessing whether the disc was representative of the David M. Stewart museum, four people were unfamiliar with the museum while one person felt that the museum was irrelevant to the disc. Their impressions of the museum after viewing the disc were generally fairly accurate.

Discussion of Users' Responses

The discussion of the users' responses is presented with the same organization used in the Results section. Discussion of the observations

and comments is organized according to the three criteria which are the effectiveness of the interface, the appeal of the product, and the relevance of this and future CD-I products.

Effectiveness of the Interface

The observations made of the users helped me to assess the intuitive nature of the general interface and the effectiveness of the supports offered to facilitate navigation. The disc seemed to work best for people who were interested in exploring and discovering and had enough tolerance or interest to continue their hunting and pecking even when they were unsure of what to do.

My observations led me to conclude that the disc offered something of interest to everyone although not everything in the disc was of interest to everyone. Most people were able, on their own, to get some part of the disc to operate. My sense was that if people had been on their own, one person would have given up, but the rest would have explored at least some, or most, of the features offered to them.

From the observations made about the ease of handling it would seem that some of the design and development assumptions were confirmed. People are able to work with the disc in an intuitive manner; they can enjoy a certain amount of exploration and discovery. A few people expressed some discomfort at not always knowing exactly what to do but they also expressed their appreciation at the freedom they had to explore and to discover. They noted that there was no danger of the user becoming lost because the icons were always available to them. When asked, people were able to recognize the supports that were available to them such as the standard structure of the information, the clear visual presentation of the information, the organization of the objects by time, the constant presence of the icons, and the availability of the Help screen.

In general, people's feedback was quite positive but two difficulties were identified consistently by people; these were navigation and orientation. People would have appreciated more support in the way of an orientation to the structure and organization of the disc. They expected to

find this support in the Introduction or Help. The Introduction was effective in introducing the theme, but it did not provide any sense of the global presentation of the information within the disc. The Help did not offer a demonstration of how to use the icons nor did it adequately explain how to operate the features of the disc for navigation. These comments indicate people's desire for a more adequate Introduction and Help.

Decisions about support offered through the Introduction and Help features are difficult to make. Because of the variety of experience and skill people bring to such a program, it is difficult for developers to discover the balance between providing enough support and not offering enough. Too much information or too many clues as to how to navigate detract from the theme and the atmosphere the developers are trying to create. Overuse of the support features interferes with the flow. In order to obtain a balance with the *Discovery* disc, the development team sought to make the product as seamless as possible by offering minimal support features. We gambled that the user's motivation to see the product would outweigh any discomfort aroused by the activity of exploring or discovering. As I observed in the evaluation, this was in fact true. A couple of users perceived the activities of exploration and discovery as part of the pleasure of using the product. The possibility to be surprised and entertained by discoveries is a part of the experience of using the *Discovery* disc. Despite the expressed need for a more elaborate Help, one user admitted to rarely consulting the Help feature in software, while another commented that she usually looks at Help only after she has explored everything else. In addition to these comments, a number of people noted that what they liked about the disc was that it was easy to use.

It would seem that people would prefer a little more support but that the lack of support does not deter the interested user from exploring the disc. A support like an optional demonstration of how the interface works and how the information is structured might clarify peoples' expectations and help them to avoid some of their initial discomfort. Such a decision would need to be weighed against the budget, the available time, and whether the discomfort experienced by people is a deterrent to their continuing to explore the disc. Given people's generally positive comments regarding

their experience of navigation at the completion of their tour of the disc, I would conclude that people's discomfort was not a significant deterrent and therefore the supports are adequate.

There were two places where consideration could be made for changes in supports for navigation. Since almost everyone experienced difficulties with the magnification and the highlight options it would seem essential that more help be provided here. The second place, is the general orientation provided during the initial moments of operation of the disc. It would be fairly simple to add a few comments at the beginning of each menu selection to reinforce the introduction. This would hopefully address the concerns made by people about the timeline and their expressed need for some way of linking the parts together.

Comments indicated that people's expectations sometimes interfered with their appreciation of the disc. Expectations can be clarified through appropriate marketing of the disc. In descriptions of the disc it needs to be clear that the product is made for pleasure. A person under pressure to obtain information would not enjoy using this disc. Such a person would require a product that offered more support for searching as well as a cleaner interface. One purpose served by this evaluation is to highlight the importance of stating clearly what the product is in order to help people put aside misleading preconceptions.

The awkwardness of using the remote is a significant irritation. As developers, this aspect of the experience is generally beyond our control. We can register the users' comments with Philips. Since we know that one person had used the track ball in a previous interaction and had found it more relaxing and pleasant to use we could include this in our conversation with Philips. Finally, in situations where the disc is placed in a public site, like the museum, a recommendation could be made to use the track ball in place of the hand-held remote since it is easier to use.

The feedback about the icons indicates that there is confusion between the Information button and the Help button. The Information button could be changed to "More".

The Appeal of the Product

The responses to the questions about the appeal of the product helped to assess whether the client's goals were met. For the first goal of providing a selection of the artifacts of the museum it would seem that people were able to recognize the link between the museum and the content more as a result of the way that I had presented the disc than because of anything in the disc. One comment was that it did not really matter where the information came from, what was important was how it was presented. This would suggest that such a publication would not serve as a prime way of representing the museum to the public.

For the second goal of creating an interactive environment which will illustrate, educate, and entertain, I examined people's responses to questions about the effectiveness of the tour, likes and dislikes of the disc, desire to view the disc again, and perceptions of the purpose of the disc. Responses to the question about the effectiveness of the tour and likes and dislikes of the disc were quite positive. People noted that it was easy to use, instructive, flexible, pleasant to view and to listen. It offered an advantage over books for portability and the amount of information available in one source. With the exception of one person, people were interested in the topic and they would view it again. Their perceptions of the purpose of the disc corresponded with the vision of the designers and developers. These perceptions included the potential for the disc to educate, provide knowledge, present different points of view, and display maps.

The third, fourth, and fifth goals are related in that they specify providing an overview of cartography by situating maps and instruments in a historical context and providing details of maps and instruments for the user to examine. It is difficult to evaluate whether these goals were met based on the responses. When asked what the disc was about, people identified clearly that it was about cartography, and the history of early conceptions of the world. People did not specifically note the feature of the detail available for the maps and the instruments.

The Relevance of This and Future CD-I Products

The responses to the questions about the relevance of the product helped to assess the potential of CD-I as a home entertainment technology as well as whether the client's goals were met. This small sample suggests the existence of some interest in CD-I as a new technology. It is recognized as something to be viewed for the purpose of education or entertainment. The response to the question of whether they would purchase the technology was moderate. People suggested that it would depend on what type of information was available to them. They were able to provide a number of suggestions for topics that would be of interest to them.

People seemed more open to using CD-I again if the technology was available in an institutional setting. They perceived it primarily as an educational tool for schools. Although they saw the advantages of CD-I as easy to use, educational, and an efficient medium for the storage and access of information, they did not necessarily see these advantages as fitting into their living room.

The goal to create an interactive environment which will illustrate, educate, and entertain would seem to have been met. People acknowledged that they had learned something either about cartography or about the technology itself and that they had enjoyed themselves.

The goal to foster an appreciation and an understanding of the wide range of maps and instruments available in the museum would seem not to have been met. Although people could guess at the focus of the museum they did not seem to consider it that important to their viewing of the disc. The museum did not play a major role in their consideration of the content. There were no indications that their appreciation or knowledge of the museum had increased as a result of viewing the disc.

Results for the Subject Matter Experts

The procedure for the interviews with the two subject matter experts differed from that used with the end users. In these interviews the subject matter experts were requested to comment on the effectiveness of the interface and the visual presentation of the disc (e.g. the effectiveness of the

graphic design, the quality of images and text, the appeal of the color, and the appropriateness of the icons). They were also asked to comment on the consistency of the concept and the navigation scheme to help assess the effectiveness of the design decisions made during development. The results from these two interviews are presented separately. For each subject matter expert the results from the interviews have been presented in two parts; the first part contains the observations made of the expert interacting with the disc while the second part contains the comments made by the expert after the experience of exploring the disc.

Observations of Subject Matter Expert 1

Although this expert develops software she had not previously viewed a CD-I product. Observation of the expert interacting with the disc revealed a number of the weaknesses identified by the end users. In particular this expert struggled with the interface and navigation of the disc throughout her exploration. Neither the structure nor the supports provided to aid navigation were clear to her. A number of times during her exploration, the expert requested clarification from me.

Clarification was requested to repeat the voice-over instructions and to guide her to scroll the menu. Similar to the experience of the end users she found the symbols for the Information and Help icons ambiguous. Once in the Help feature she confused the functions of the Return and the Exit buttons. Also in the Help feature, she misunderstood the explanation return arrow for the operational return arrow. The talking help menu provided more confusion than clarity. She commented that she found the Help inconsistent because it was partly informational and partly navigational.

Throughout her exploration she requested information about how the program was structured in order to help her to exit menus or move to a new menu. She explained that she had expected the program to perform in a similar manner to the Macintosh interface and when it responded differently she found this puzzling.

In her attempt to use the magnification button she was unsuccessful. She became confused between the two cursors; the one for the highlighting

feature and the other for the magnifying feature. Her comment was that in the high magnification it was easy to lose one's orientation because the map represents the world in such a different way from how we represent it today.

Not all of her interactions with the disc were adverse. She spent time selecting highlights from the maps and listening to the narrative explanations. With time she became more comfortable making certain selections and moves in the program. She noted that her need for support lessened as she became more familiar with the program.

Comments Made by Subject Matter Expert 1

Her overall rating of the disc was good. The theme was interesting and she enjoyed the information. She thought that she would look at it again. She also enjoyed being able to select the maps from the different years. The qualities she enjoyed most about the disc were the colors and the graphics. She considered the Introduction impressive and the narration interesting.

The novelty of using CD-I is attractive and motivating. She found it useful to have the information available on the television screen because it makes it seem so accessible. Using the disc is more interesting than watching television. She thought it could be used by parents with their children and that it is a potential educational tool with advantages over a computer because of its larger screen and its novelty.

She expressed some concern over whether the presentation might be too static for people. Despite its educational value, one would have to be motivated to use it since it lacks dynamism. She decided that whether a user would view the disc would depend upon what she was looking for.

One hindrance to her enjoyment of the disc was the difficulties she experienced in navigation. She was uncomfortable with the emphasis upon discovery and felt that in general, the supports offered in the disc were inadequate. The disc suffered from a lack of explanation and demonstration provided up-front. If this had been offered perhaps she would have required less support once she was in the program. She felt that because CD-I is a

new technology it requires more support to orient people to this new concept.

The Introduction was weak in terms of providing information on how to use the program and how the information was structured. The Introduction could provide explanations for the icons and a demonstration of how to move within the disc. It could explain the rationale behind the organization of the information and perhaps include some objectives and a goal or statement of purpose.

Although the voice-over instructions were helpful, at times they were redundant. She suggested including highlights to emphasize the buttons during the voice-over instructions on the initial menu. The repeated instructions at the beginning of each new menu are unnecessary and she felt that it would be helpful to hear them upon viewing the initial menu, but that after that, it was necessary only to hear instructions for any new features as they appear. She found that providing the instructions once with no option to repeat them was limiting and thought that it would be an improvement to offer the option to hear them again.

The Help was weak and could have been improved with the inclusion of a demonstration of how to use it. Perhaps this would clarify that the information is provided only when an icon is selected. It might also eliminate the confusion between the informational and the operational buttons. Help could have offered an additional demonstration of how to move within the disc. It certainly should provide a demonstration of how to operate the highlight and magnification features.

The icons, with some exceptions, were recognizable. The exceptions included the Information, the Help, and the Map icons. These require changes.

As for improvements to the disc she suggested that motion would make it less static and therefore more interesting. The ability to repeat the audio segments would add flexibility to the disc. She noted that some of the information is only accessible when one first enters the map. She found this

frustrating when she wanted to hear it a second time. This would require the addition of a replay button.

Observations of Subject Matter Expert 2

This expert has not only developed CD-I but he had also viewed part of the *Discovery* disc at a conference a few months previous. He noted that he had viewed it quickly and that he had not had the opportunity to interact with it. Observation of the expert interacting with the disc revealed his familiarity with the technology and the underlying design assumptions for CD-I.

In general, he moved easily through the menus and used the features with no trouble. He selected a map and used the magnifying glass feature to examine the detail. Scrolling the map presented no difficulties at any of the magnifications. He quickly explored the instrument and the timeline menus moving easily between them. When viewing the quadrant from the instrument menu he requested clarification that he was viewing the same object from different perspectives. The way that the arrow is drawn suggested to him that he was moving forward to another object rather than turning the same object.

The expert was quite adept at working with both the magnification and highlight features. He recognized that the cursor changed and that this inhibited him from accessing the two features simultaneously.

He did note that the guidance and the content are presented in the same voice. This can be confusing at times because it is not immediately evident whether one is receiving instructions or content. A different voice might have made it easier to make that distinction immediately.

Comments Made by Subject Matter Expert 2

The expert's overall comment was that the application is a very good example of what can be done given the limitations of CD-I. In general. the expert found the product visually pleasing. He noted the quality of the graphics and that this is unusual because graphics are usually kept very basic and computer-like to save room on the disc. He thought that the high

quality graphics provide a rich environment for the user. He found the interface for the *Discovery* disc simple and straightforward.

The expert said he had no concerns with the interface in general. He did note that perhaps some of the icons are too simple and therefore were not immediately recognizable. The Cartographer button is clear while the compass rose for the map menu is confusing. The compass rose could have a number of possible meanings, for example, navigation. He did note that after a few minutes of using the disc one is aware of what the icons represent. With the exception of the magnification and highlight features he found the interface to be very simple.

He suggested that one way to simplify the interface is to limit the features available at one time. For example, when one is using the Information button one would not be able to access the magnification feature. He noted though, that in making it simple for the novice, we might frustrate and bore the more experienced users. An example of this is the Smithsonian Disc where the interface is relatively simple but interest has been sacrificed for simplicity. The interface is so simple that the options it offers are not helpful or interesting after a limited number of viewings.

We spoke of the difficulties for novices of moving through the layers of information. I shared my observations that those with less experience had problems operating the highlight and magnification features. This part of the disc is confusing for these less experienced users because there is a lot of navigation information for them to sort out and sequence. The expert agreed that this was one of the difficulties of developing a product for a population with a diverse knowledge of computers. We discussed that one way to eliminate this dilemma is to provide online help or a demonstration, but he considered that with the exception of the two features mentioned, the interface is straight forward. He suggested that the verbal prompts were sufficient if they could be replayed.

I mentioned that we had developed the interface with the assumption that after a brief period of time even the novice would be comfortable moving around. The expert noted that every user, whether he be a novice or an

experienced user, is confronted with the challenge of a new interface. There is an initial period where learning occurs and during this period there is tension for the user until he reaches the point where he can move about comfortably. The expert agreed with our assumption and felt that it would not take much time for people to begin to feel comfortable.

The expert thought that the disc could be improved with some additional supports for navigation. It might be easier for the user if there were a few more verbal prompts. He noted that if the user is distracted at the moment the verbal prompt is provided he does not have the option to replay it.

The expert found the Introduction was just the right length; if it had been any longer he would have cut it off. Although he considered it static he felt that the information provided an orientation to the content of the disc. It was useful to be reminded of the cartographical concepts such as longitude. The Introduction also placed the maps within an historical context by providing a sense of what the navigators of the period had to contend with. He thought that the option for the user to choose not to watch it is an important one.

We discussed the difficulties of creating Help. It is always a dilemma for developers to decide how much effort to put into the Help feature because of the time and cost involved. It is generally considered important but experience reveals that most people don't use it. Often developers cut corners on the Help and create an interface which they hope is simple enough to use without referring to Help.

The expert remarked that the continuous sound of the ocean and the birds created an environment. The sound quality was good and that narrator had a pleasant voice and presented no distractions.

He found the visual presentation consistent with one exception and this was in the close-up shots of the timeline. At this point the user is presented with images that float on the screen and it is the one place where

the navigation bar is not available to the user. The expert suggested that it might be helpful to keep the navigation bar accessible even at this level.

The expert spoke of his perceived limitations of CD-I the first of which was the speed of the presentation. The transitions between screens take approximately five seconds and this can seem interminable when one is in an active, participatory mode. The speed of the scroll of the menus is tedious. This is due to a common problem with access on both CD-I and CD-Rom technology.

The second limitation of CD-I is the lack of animation and live video which makes for a static presentation. The user is led from one image to another with the accompaniment of sound. The expert was doubtful about how long the program could sustain a user's attention. Despite the high quality of the product, people are use to movement and scenery. The *Discovery* disc offers a fairly static presentation of artifacts. The images are well scanned and the quality is good but the level of interaction, as a whole, pales beside a television show or a video game. We discussed the other art and museum discs on the market and how they suffer from a similar problem. The attention of the user falls after ten to twenty minutes. The expert noted the additional difficulty of moving people away from the "couch potato" mentality and asking them to start interacting with the television at 6:00 in the evening after a long day at work.

We discussed the target audience and how the product would be packaged and marketed. I explained that it is an electronic book designed to serve as a compliment for the museum and as an information source for people who are interested in cartography. The expert noted that although the disc would serve a different purpose from what he had imagined he still felt that it was too static and passive.

In terms of marketing the disc the expert mentioned the importance of clearly identifying, at the outset, what the user can expect from this product. There are many alternative presentation formats available such as a game, an interactive video, an electronic book, or a database. The product needs to be clearly identified as an electronic book and not a database whose

purpose is to entertain and educate. It is not a reference tool. I noted that although one of our goals was to offer scholars an opportunity to view maps close up that this was not the main purpose of the disc. To meet that need we would have to develop another product which would provide scholars with the tools, such as an index, they need to perform efficiently.

We discussed the lack of marketing carried out by Philips and the competition presented by the Kodak Photo CD. In general, people seem to identify CD-I with education and they do not think of it as something to be used in the home. In addition to this misconception, the technology is quite expensive and therefore not a purchase that everyone would make. These four factors may be a real deterrent to the popularization of the technology and therefore a limitation to further development of such products like the *Discovery* disc.

The expert made suggestions for improvements to the disc. He thought an interesting feature would be to have the menus synchronized so that the dates corresponded when the user moves from one menu to another. The menus require a visual cue to signify the end and the beginning of the loop to avoid confusion. The addition of text may help with the orientation although this could create problems because of the bilingual nature of the product. The confusion over the arrow in the detail section of the instrument could be rectified by drawing the arrow with a curve to suggest the object is turning. The addition of an audio or textual cue at this point might also clarify the action that is taking place. Finally, making the highlights on the map more defined would clearly identify what the user was selecting.

Discussion of Subject Matter Experts' Responses

The experiences of the two experts were very different. One expert expressed dissatisfaction at the support provided while the other expert expressed his comfort moving through the disc and made favorable comments about the interface and the navigation supports. This difference may have occurred because the second expert had experience in developing CD-I and therefore was more familiar with the method of presenting information and navigating. During the interview the first expert

noted that she had come with some expectations about the interface that were not met and this led to confusion. Some of the difficulties experienced by the first expert were similar to those experienced and expressed by the users. A discussion of the comments and suggestions made by both experts follows.

For the Introduction both experts thought that it was fine as far as setting the tone for the disc although they found it somewhat static and in once case, a bit long. One stressed the importance of making it optional for the user to view it. The other expert thought that it needed to be expanded to include an explanation for how to navigate in the program.

In their evaluation of the interface the experts' comments differed. Expert two found the interface straight-forward and adequate with some minor changes. Expert one felt the disc required more supports for navigation. The minor changes suggested by expert two were the inclusion of a few verbal prompts to offer additional explanation for how to operate the magnification and highlight features. Expert one noted the importance of orienting users to how to use the new technology and suggested that the disc provide more up-front explanation for how to navigate. She suggested that a demonstration in Help would make it less confusing. Expert one found it difficult to distinguish between the Help and the Information buttons and suggested that they be changed. Expert two suggested that the highlights on the map could be more precise.

Both experts thought that it would be helpful to have more verbal prompts or at least the possibility to replay the ones that are provided. Both suggested ways in which additional cues might provide more orientation for navigation and the structure of the content to users. For both experts most of the icons were clear with the exception of the compass rose for the maps.

In conclusion, modifications suggested by the first expert included

* the addition, in the Introduction, of a demonstration or explanation for how to navigate;

* changing the icon for either the Help or the Information buttons in order to better distinguish them;
* and an explanation for how to use Help.

Modifications suggested by the second expert included

* making a visual distinction between the beginning and the end of each menu;
* synchronizing the menus by time to facilitate the comparison of information;
* creating an arrow with a curve and perhaps a verbal prompt in the Instrument detail to clarify that the same artifact is viewed from different perspectives;
* making the highlights on the map more defined;
* and using different voices for the narrator and the voice-over instructions.

Both experts suggested the following changes

* the addition of an explanation or verbal prompts for how to use the magnification and highlight features to provide users with the support they need to use these;
* a new symbol to replace the compass rose for the map menu;
* and including a button to replay the verbal prompts.

The comments on the static nature of the product were made by both experts. At the time of development, video was not available with CD-I. The lack of video is a limitation with the *Discovery* disc and could deter people's long term interest in the product. Future products should benefit from the availability of video.

CONCLUSION

The purpose of this thesis-equivalent is to relate the process of the development of the disc, with its underlying assumptions, and to present the results of an evaluation of these. The underlying assumptions of the disc were identified in the first and third chapters.

In the first chapter I discussed the potential of CD-I as a response to the needs of the museum. The museum in its role as educator of the public must promote learning which responds to the particular needs and tastes of its population. Curators seek for learning resources which encourage their visitors to actively participate in the exhibit thereby promoting interest and enhancing the image of the museum as educator. CD-I technology offers a number of appealing features to a small institute like the DMS Museum. Besides the general advantages of complimenting, at a reasonable price, the existing museum learning resources, CD-I offers the museum solutions to the particular needs of their visitor population. These solutions are:

* CD-I can convey more of the story behind each artifact;
* CD-I provides a presentation that respects the interwoven and complex nature of this story;
* CD-I can present objects within a context;
* CD-I can provide background information through a series of easy-to-access hypermedia links;
* CD-I offers the user control over how she explores the content;
* CD-I provides close access to fragile artifacts thereby providing a view of the object that is impossible to obtain in the museum;
* CD-I makes the collection accessible to a wider audience.

Based upon these promises the DMS Museum, in collaboration with On/Q and CHIN, established six goals which they hoped the CD-I *Discovery* disc would achieve. These goals were:

i. to provide a selection of the artifacts of The David M. Stewart Museum that complements the existing collection but allows the user to explore it in her own home;
ii. to create an interactive environment which will illustrate, educate, and entertain;

iii. to provide an overview of the art and science of cartography and its development;
iv. to situate specific maps and navigation instruments in a historical context;
v. to provide details of maps and instruments that can be examined by the user according to her interest and needs.
vi. To foster an appreciation and an understanding of the wide range of maps and instruments available in The David M. Stewart.

In the evaluation of the disc I verified how well these goals were met.

In the third chapter I described the process of design and development of the *Discovery* disc and discussed the many assumptions made by the designers and developers during this process. These assumptions were:

* the target population will be university-educated adults with an interest in maps or history, who participate in informal learning activities, and who are potential purchasers of CD-I technology;
* this target population will enjoy a visual database presentation of information with hotspots to select and access points of interest that allows for the educational browsing which is the museum visitor's preferred way to explore information;
* the population will want the disc to offer an easy-to-use intuitive interface that will permit quick and simple access to the information without elaborate instruction;
* the population will appreciate a presentation that respects the experts' accepted organization and interpretation of the knowledge.

There were three objectives for the evaluation of the above-mentioned assumptions. These objectives were:

* to verify whether the final product meets the goals set by the three partners at the beginning of the project;
* to verify the validity of our original design assumptions to assess to what extent the target audience likes the content, the design, and the new technology;

* to identify improvements for future CD-I projects.

A discussion of each objective follows.

To begin, I will discuss whether the final product meets the goals set by the three partners at the beginning of the project. Interviews with end users and subject matter experts indicated that we were correct in many of our assumptions about the appropriateness of CD-I to meet the museum needs. For the first goal set by the museum it would seem that the disc does present a selection of the artifacts and provides access to these, but, that people do not immediately associate the disc with the museum. The ability to have access to the artifacts of the museum is not what initially strikes people. People are intrigued with the story, the technology, and the objects themselves: that the objects compliment the museum collection is of secondary interest.

The second goal of creating an interactive environment which will illustrate, educate, and entertain was met and this is revealed in users' comments that the disc can educate, provide knowledge, present different points of view, and show maps. People enjoyed the availability and access to different types of information and the flexibility to examine information according to their preferences.

The disc met the third, fourth, and fifth goals of providing an overview of cartography by situating maps and instrument in a historical context and providing details of maps and instruments for the user to examine. The users identified that the disc was about cartography and the history of early conceptions of the world.

The sixth goal to foster an appreciation and an understanding of the wide range of maps and instruments available in the museum would not seem to have been met. There were no indications that users' appreciation or knowledge of the museum had increased as a result of viewing the disc.

I will next discuss the validity of our design assumptions. The users selected to evaluate the disc met the criterion of university-educated adults

who participate in informal learning activities. Although they enjoyed the disc and considered it entertaining they perceived it as a useful teaching and research aid. They did not consider using the disc as a leisure activity but considered it firstly as either an educational tool for schools or museums and only secondly, as a source of home entertainment. They would only invest in CD-I technology if it related to a topic of specific interest to them.

The assumption that this population would enjoy a visual database presentation of information with hotspots to select and access points of interest would seem to be valid. People were intrigued by the technology and impressed with the amount of information to which they had access. The novelty of the presentation was appealing and, in the short term, compensated for its static nature. They enjoyed the self-directed quality of the disc which allowed for educational browsing but they would have appreciated a few additional supports for orientation and navigation.

Our assumptions about what is an easy-to-use intuitive interface were somewhat inaccurate and this was revealed in the comments of the users and the experts. Although people were able to work with most of the disc in an intuitive manner and expressed their appreciation for the freedom to discover and explore, the quality users and one expert disliked most was the navigation. The weaknesses included the lack of a demonstration for how to manipulate the magnification and highlight features, the difficulty distinguishing three of the icons, and the limited explanation for the structure of the information. People expected to find these items explained in the Introduction or the Help. The addition of a few comments at the beginning of each menu selection would improve the navigation supports. A more detailed explanation and perhaps a demonstration is required in Help to clarity the magnification and highlight features. The compass rose symbol for the Map icon could be changed as could the symbol for the Information icon. Consideration of how to improve Help should be made for future CD-I discs.

The final design assumption that the population will appreciate a presentation that respects the experts' accepted organization and interpretation of the knowledge proved to be valid. People found their

movement through the information was facilitated by their familiarity with the content and its standard structure.

The third and last objective of this evaluation was to identify improvements for future CD-I projects. The most striking finding was the persistent request on the part of most users and one expert for more adequate help. With the exception of the minor changes I suggested making to the *Discovery* disc I would not provide further support in this disc. I believe that people's interest in the topic and in the presentation is sufficient to motivate them to continue their exploration of the content, even when they are frustrated.

However I would not recommend using this same strategy in a future disc of this sort. If multimedia is one response to the constructivists' request for a learning environment that embodies many of the qualities they advocate, then future products should provide more supports to users. When a misunderstanding arose during the user's exploration of the disc they intuitively sought for a resource to help them solve the problem. They looked to Help and later they commented on the limitations of the Introduction for providing them with an explanation of how to navigate. While I believe that the intuitive nature of the interface is a strength I know that as a designer there will always be situations of misunderstanding. It is therefore my responsibility to provide adequate explanations and/or demonstrations to clarify these misunderstandings and to do this in a way that is as non-intrusive as possible. Further reflection is necessary for how this can be offered in the Help feature.

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APPENDICES

Appendix A: Project Plan

DISCOVERY

MANAGEMENT REPORT

FEBRUARY 11, 1992

DISCOVERY

CONCEPT OUTLINE

OBJECTIVES OF THE DISC:

-to provide an overview of the art of cartography and its development.

-to situate cartography and specific maps in a historical context by illustrating the influences that explorers, kings, cartographers, fortune, scientists, and clergy have had upon the evolution of maps.

-to provide details maps according to the viewer's needs.

-to foster an appreciation and an understanding of the wide range of maps available in the David M. Stewart collection.

The focus of the disc is the antique maps found in the collection of the David M. Stewart Museum. The disc will provide the user with a survey of the collection by highlighting nine maps from the period 1450-1750. A map will be representative of a fifty year interval from this period. These maps include:

1. 1493, Schedel, (983-406-1, p. 8) *Pre-Columbian World*

2. 1550, Munster, (979-537-1, p. 63) *Tauola dell'isole nuoue, Le quali son nominate occidentali, & Indiane per diuersi rispetti. Cum Privilegio*

3. 1589, Ortelius, (980-491-1, p. 62) *Maris Pacifici (Quod vulgo mar del zur) cum regionibus circumiacentibus insulisque in eodem passim sparsis novissima descriptio*

4. 1589, de Jode, (984-20-1, p. 35) *Totius orbis cogniti universalis descriptio...MDLXXXIX*

5. 1595, Mercator, (M979-262-1, p. 24) *America sive India Nova Ad Magnse Gerardi Mercatoris avi Universalis imitationem in compendium redacta per michaelem Mercatorem Duysburgensem*

6. 1635, Blaeu, (979-531, p. 64) *Americae nova tabula auct. Guiljelmo Blaeuw*

7. 1670, Seller, (979-525-1, p. 57) *The Western Ocean*

8. 1700, Schenk, (M979-195-1) *Planisphaerium terrestre cum utroque coelesti hemispherio sive diverna orbis*

9. 1740, Nolin, (980-489-1 p. 59) *L'Amerique dressée sur les relations les plus récentes rectifiées sur les dernières observations dédiée et présentée à sa majesté très...des victoires*

The user will be able to explore each of the nine maps in detail to discover the unique geographic and artistic qualities. Each map will also allow the user to explore: the state of cartography at that moment in history; information about the knowledge of navigation; the historical context of the map.

The disc will also contain 100 additional maps which the user will be able to explore. The user will have a short introduction to the map as well as access to a number of detailed views of the unique qualities of the map. The user will access these maps by cartographer, by date or by nationality.

The disc will be a simple but well-illustrated presentation which provides the user with a survey of the collection with highlights of particular maps.

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PROJECT TASKS

A) On/Q Corporation

1. Select a project manager and assemble a production team.
2. Coordinate the development of the project in cooperation with the three partners.
3. In cooperation with the three partners develop the concept of the disc.
4. Conduct an audience and content analysis.
5. Assemble an image catalog of the artifacts to be used in the disc.
6. Develop the dialog and program design.
7. Produce the script and ensure that it is verified by all partners for accuracy.
8. Translate the script.
9. Coordinate the talent casting and the booking of studios.
10. Oversee the development of a storyboard.
11. Create the computer graphics.
12. Create the program code.
13. Oversee the taping, editing and digitizing of the audio.
14. Supervise the photographing of the artifacts.
15. Scan the images.
16. Beta programming.
17. Coordinate the pressing of the disc.
18. Develop the design for the label and the printed insert.

B) David M. Stewart Museum

1. Participate in the design of the disc by attending weekly brainstorming meetings.
2. Participate in the content analysis process by reviewing the museum's collection and cataloging artifacts appropriate for the disc.
3. Assemble and supply documents, anecdotes, and historical facts to be used during scripting. This includes:
   - background information on mapmakers and the historical period covered by the disc;
   - detailed information on the geographic maps and the cartouches found on the maps;
   - information on the celestial maps including background information concerning how they were used;
   - information on the navigational instruments as well as background information concerning how they were used.
4. Continue to provide background information during the scripting process.
5. Validate the correctness of scripts for historical and scientific accuracy.
6. Provide artifacts and arrange for photography of the artifacts.
7. Assemble museum artifacts to be photographed.
8. Provide access to a photography studio.
9. Photograph museum artifacts.
10. Provide comments on the appropriateness and accuracy of graphics.
11. Provide comments on the appropriateness and accuracy of the printed insert and label.
12. Participate in the promotion of the disc.

C) Canadian Heritage Information Network

1. Participate in the design process by attending bimonthly meetings with participants from On/Q and the David M. Stewart Museum.
2. Organize technical facilities to scan images.
3. Evaluate the worth of digital imaging for archiving by participating in the image scanning process. This includes transfer image files between On/Q and CHIN.
4. Research materials and resource people from other Canadian museums (music, artifacts, information).
5. Evaluate the feasibility of multimedia archiving and publishing.
6. Study the issue of image copyright.
7. Explore Photo CD technology
8. Prepare a direct mailing list to Canadian and American museums.
9. Actively promote the disc within the CHIN network.

TASKS COMPLETED IN PHASE ONE

A) On/Q Corporation

1. On/Q has appointed a project manager who is responsible for coordinating and overseeing the production tasks. These tasks are outlined on the Production Schedule. A production team has been assembled to carry out these tasks.
2. Two administrative meetings have taken place with participants from the three partner organizations (January 15, 1991; January 29, 1992).
3. Members of the On/Q and the David M. Stewart Museum have met three times to discuss the design of the disc (January 22, 1992; January 29, 1992; February 5, 1992).
4. The project manager has met with the museum archivists on five occasions to assemble the image catalogs and to select the artifacts for the disc (January 24, 1992; January 29, 30, 31; February 3, 1992).
5. Research for the historical content of the disc has begun using the resources of the museum library.
6. On February 5, 1992 participants from On/Q Corporation and Canadian Heritage Information Network met to review the technical aspects of the CD-I development process. CHIN's technical participation in the project was clarified.
7. An introduction to CD-I and the development process was provided to the participants from the David M. Stewart Museum on January 15, 1992 and on January 29, 1992.
8. Tasks from the Production Schedule which have been completed during this period are the following: Audience analysis; preliminary disc design; and Image catalog.
9. Preliminary discussions have been undertaken with Philips and Eastman Kodak to archive the projects images using Photo CD Technology.
10. Preliminary discussions have been undertaken with private companies for the remaining $30,000 investment.
11. Preliminary discussions with Granada TV and Madison Press Books concerning the acquisition of the electronic rights to their materials.
12. Kanien'kehaka Raotitiohkwa Cultural Center have declined investment in the project. They have however offered to assist on a part-time basis in the development of an aboriginal module within the disc.

B) David M. Stewart Museum

1. Participants have attended three design meetings.
2. Participants have undertaken the content analysis by reviewing the museum's map collection and cataloging 40 maps appropriate to the disc.
3. The navigational instruments have been cataloged.
4. Participants have assembled and supplied documents, anecdotes, and historical facts to be used during scripting. These include background information on select mapmakers and the maps.
5. Provided artifacts and arranged for a photography studio and photographer to carry out tests.

C) Canadian Heritage Information Network

1. Participants have attended two design meetings.
2. Participants have begun the initial stages of organizing technical facilities to scan images.
3. Resource people from other Canadian museums or government departments have been suggested.

TASKS TO BE COMPLETED IN PHASE TWO

A) On/Q Corporation

1. Concept development.
2. Dialog design.
3. Program design.
4. Writing and translation of the script.
5. Development of the storyboard.
6. Arrangements for the photography sessions.
7. Tests for photographing the artifacts.
8. Research the booking of a sound studio and the hiring of narrators.
9. Contract a Latin translator.
10. Contract a historian.
11. Continue negotiations with music historians to obtain access to 15th-18th century music.
12. Continue Photo CD negotiations.
13. Continue exploring with Granada TV and Madison Press Books the electronic licensing options for their materials.
14. Continue discussions with private companies for the remaining $30,000 investment (i.e. Telemedia Inc., Columbus Shipping, Bank of Montreal, Canada Steamship Lines).

B) David M. Stewart Museum

1. Participate in two final design meetings.
2. Assemble and supply documents, anecdotes, and historical facts to be used during scripting. This includes:
   - information about the life, particular style and/or skill in cartography, of the following mapmakers: Schedel, Munster, Ortelius, de Jode, Mercator, Blaeu, Seller, Schenk, Nolin;
   - background information on the historical period with appropriate images;
   - information on the following geographic maps: 983-406-1; 979-537-1; 980-491-1; 984-20-1; M979-262-1; 979-525-1; M979-195-1; 980-489-1; the Blaeu map, *Americae Nova Tabula Auct. Guiljelmo Blaeuw*, 1635. Information is needed to describe the cartouches, the illustrations, the conception of the land as depicted by the cartographer.
   - general information for the maps found in Appendix A
   - select the parts of the maps, found in Appendix A, which should be highlighted in the narration and the photographs
   - information on the following instruments: cross staff, compass, traverse board Davis backstaff, octant, quadrant, astrolabe, sundial, nocturlabe. Information is needed to describe the instruments, how they were developed, and how they were used.
3. Continue to provide background information on the maps, the cartographers, the period of history, and the instruments during the scripting process.
4. Validate the correctness of scripts for historical and scientific accuracy.
5. Make a selection of navigational instruments to be included in the disc.
6. Provide artifacts and arrange for a photography studio to begin to photograph the artifacts.

C) Canadian Heritage Information Network

1. Participate in two final design meetings by attending weekly meetings and providing suggestions.
2. Organize technical facilities to scan images.
3. Research materials and resource people from other Canadian museums (music, artifacts, information).
4. Contact map expert, Ed Dahl, at the National Archives

Discover
PROJECT: Discover
CURRENT DATE: 02/19/92
AS OF DATE: 01/01/92
Name
DEVELOPMENT PHASE
Concept Development
Audience Analysis
Image Catalog
Content Analysis
Dialog Design
Program Design
PREPRODUCTION
Script - 1st Draft
Script - 2nd Draft
Script - 3rd Draft
Talent Casting
Storyboard
Script Translation
Script - Final Version
PRODUCTION PHASE
Computer Graphics product
Alpha Program Coding
Audio Production
Photography
Audio Digitizing
Image Scanning
Beta Programming
Beta Program Disc
Printed Insert
Final Program Modificatio
Label Design
Disc pressing
Release Version
1992
JAN 20 29
FEB 6 14 25
MAR 5 16 25
APR 3 10 17 24
MAY 1 8 15 22 29
JUN 5
critical
noncritical
baseline
completed
milestone
total float
free float
delay
conflict

APPENDIX A
Base Content (Maps)

1500
1511, Sylvano, plate #2, map of the world that includes the new world

1522, Frisius, plate #3, Ptolemy's scheme with America added into the picture

1532, Grynaeus, plate #4, application of the Copernican theory

1530, Ptolemacus, plate #5, early attempt to use scientific method in its construction

1547, Gastaldi, plate #10, Italy's outstanding 16th century cartographer

1550
979-537-1, Tauola dell'ifole, Conception of N. & S. America, Munster, 1550

1555, Munster, plate #6, map of the world that was a reference

1556, Gastaldi, plate # 40, illustrations of domestic activities

979-70-1, Carta Marina, Navigational knowledge, one of the earlier sea charts, Ruscelli & Valgrise, 1561

982-237-1, Septentrionalium, N.W. Passage, Ruscelli, 1561

M979-268-1, Septentriona, Ortelius, N.W. Passage, 1575

1576, Porro, plate #39, New World, misinterpretation of geographical features

1581, Bunting, plate #54, world in a clover leaf

1581, Bunting, plate #57, Europe in the shape of a spanish woman to suggest Spanish domination

1581, Bunting, plate #56, Asia in shape of Pegasus

1581, Kilian, plate #55, map of Bohemia

1582, d'Anania, plate #23, St. Lawrence and Sauenay Rivers

979-53-1, Conception of N. America, Munster, 1588 (Munster important as early cartographer)

1588, Munster, plate #7, map of the world

1588, Petri, plate # 35, update edition of Munster's map of N. & S. America

980-491-1, Maris Pacifici, S.W. Passage, Ortelius, 1589

984-20-1, Totius Orbis, N.W. Passage, Conception of the World, de Jode, 1589

1590, Ortelius, plate #24, map of the Pacific Ocean

1590, Hondius, plate #45, world in the shape of a fool's cap

1592, Plancius, plate #31, secrets of the Portuguese navigaitonal charts revealed here

1594, Plancius, plate #15, continents and celestial maps combined

M979-262-1, Septentrio N.W. Passage, Mercator, 1595
Islandia, N.W. Passage, Ortelius, 1595

1595, de Bry, plate # 36, N. & S. America

979-542-1, Rhumb lines, Navigational knowledge, Conception of N. & S. America, Magini, 1596

1598, Anonymous, plate #58, political upheaval

1600
1600, de Bry, plate #16, Drake's voyage plotted

M979-263-1, Hemispheriu N.W. Passage, arctic shown with island, de Jode, 1600

985-3-1, America, N. & S. America, Artistic, Mercator-Hondius, 1606

M979-139-1, Polus Arcticus, N.W. Passage, de Bry, 1613

1618, Lescarbot, plate #46, Gulf of St. Lawrence with illustrations

1630, Hondius, plate #17, double hemisphere, four elements, medallion portraits

1632, de Champlain, precise charting by Champlain

1635, Blaeu, plate #11, map of the world

1635, Blaeu, plate #(p. 64), map of N. & S. America

M979-182-1, Misconception of the antarctic and strait btw. N.A. and Asia, Conception Of the World, N. & S. America, S.W. Passage, Merian, 1638

1650
979-584-1, Development of the east coast, N. America: eastern coast, Artistic, Visscher, 1656

979-529-1, Planisfere du Globe Celeste, Navigation/Astronomy, Sanson, 1658

979-510-1, Decorative chart of the winds, Astronomy/Navigation, Sanson, 1660

1660, Du Creux, plate #42, New France

979-525-1, Chart with the Rhumb lines, Astronomy/Navigation, Conception of the

World, S.W. Passage, also shape of S.A. and Gulf of Mexico, Sellar, 1670

1670, Sanson & Blome, plate #12, double hemisperes

1670, de Wit, plate #18, cartouches symbolizing harvest

M982-409-1, Development of the east Coast, N. America: eastern coast, Cgilby, 1671

M979-264, Poli Arctici, (for the cartouche showing ships), De Witt, 1675

978-548-1, Sea Chart enabled navigation at night, Navigational knowledge, Astronomy/Navigation, Sanson, 1679 (in french catalogue it is dated at 1710)

M979-500, Underwater currents, Navigational knowledge, Conception of the World, S.W. Passage, N.W. Passage, Kircher, 1680

M979-265-1, Poles without the islands, Conception of the world, Sanson, 1690

1690, Sanson d'Abbeville, plate #43, New France

1690, Coronelli, plate #22, Atlantic coast line of 4 continents

1700

M979-195-1, Map of the World etc., Conception of the World, Navigational Knowledge, Astronomy/Navigation, S.W. Passage, N.W. Passage, Artistic, Schenk, 1700

M979-184-1, Scientific Knowledge, Navigational knowledge, Conception of the World, Halley, 1702

1702, de Fer, plate #44, New France

1703, Delisle, plate #45, New France with Hudson Bay

979-530-1, Planispharerum Caeleste, Astronomy/Navigation, Eimhart, 1705

979-527-1, Planisphaerium Ptolemaicum, Cosmology, Schenk, 1706

979-528-1, Planispharerium Copernicanum, Cosmology, Schenk & Valls, 1706

M979-176-1, Map of the World, Conception of the World, N.W. Passage, Artistic, Willdey, 1714

979-587-1, Wall map, Moll, N. America, Artistic, (detail of eastern coast), 1715

979-588-1, Beaver Wall map, N. & S. America, Artistic, (interesting for its cartouches depicting life on both continents), Chatelain, 1720

1728, Bion, plate #49, study of the moon

M979-256-1, Detail celestial, Astronomy/Navigation, Flamsteed, 1729

1730, Delisle, plate #19, double hemisphere

M979-62-1, Detail..., Astronomy/Navigation, Thomas, 1730

M979-63-1, Detail..., Astronomy/Navigation, Thomas, 1730

M979-64-1, Detail..., Astronomy/Navigation, Thomas, 1730

M979-65-1, Detail..., Astronomy/Navigation, Thomas, 1730

979-532-1, Americas, N. & S. America, Artistic, Overton, 1730

1730, Clouet, plate #29, western hemisphere with the history of the New World

1731, Danet, plate #25, N. & S. America with medallions

1733, Popple, plate #26, eastern coast

980-489-1, L'Amerique, N. & S. America, Artistic, (interesting for its cartouches), Nolin, 1740

M979-258-1, Tabula Selenographica, Navigation/Astronomy, Hemispheres of the moon, Homann, 1742

M979-267-1, Poles without the islands, Conception of the world, Bowen, 1752

1756, Mitchell, plate #28, detailed map of America

1760, Chambon, plate #30, horizontal view of N. & S. America
two new acquisitions, celestial maps, Astronomy/Navigation,
Schenk & Vale

Appendix B: Examples of Interview Transcripts

What appears in italics is either a question or a comment by the interviewer. The end users' and experts' comments and responses appear in plain type.

End User 1

Introductory questions.

1. *When is the last time you visited a museum?*
   The last time was two weeks ago.

2. *How frequently do you visit a museum?*
   I visited the Marché de Bonsecours. Pretty often. Maybe I should say that I'm not from Montreal I'm from Mexico so for me it's very different to go to museums and know more about the culture here in Canada. Maybe I'm not a typical person to ask this kind of question.

3. *What type of museums do you enjoy visiting?*
   Well I like history museums and also galleries of art that's the kind of museums I like.

4. *How often do you use a computer?*
   Pretty often.

5. *When is the last time you used a computer?*
   This morning.

6. *For what do you usually use a computer?*
   For many things. I'm interested in multimedia so I use it for that a lot. But also for word processing. for E-mail.

   When you say multimedia are you talking about development?

   Yes.

   What have you developed?

   When I was in Mexico I did my BA in Educational Science and we developed some small programs for the training of teachers like on instructional tactics, things like that. And we were also working on some programs for secondary school. We were working on one for physics. That was not finished. Here I worked on a project as part of my thesis. It was for design and development of hypermedia tools. It's an environment where you learn. It's more like a tutorial.

   And who would use that?

   Educational technologists in the department.

7. *Do you have a video player in your home?*
   In my home yes.

8. *How often do you use it?*
   Pretty often.

9. *Have you heard of CD-I?*
   When Robert showed you the demos did he show you the one from the Amparo Museum.

   Ya. I've been to the Amparo Museum.

   What did you think of that disc?

   I like it. Now they have developed something a little bit more complex and they have it in different rooms so it is a lot more complete.

   Have you had a chance to use it within the museum.

   Yes.

   And how did it work? Because it's very different for us to sit in a room and look at it here. How does it work within a context.

   Within the context, well you have your head phones so that you don't interfere with the rest of the visitors and you go and ask about any of the pieces that are being shown in that room. So you get information about where was it found, what are the characteristics of that piece and what period does it belong to. What kind of influences from other cultures does it have.

   And does it integrate well. Do you see people using it? Do you find that it was a good tool?

   Yes, I think people use it. People like to use it a lot. The problem there is that if you want to use it you have to pay more. So many people just don't want to.

   Ok. Well that's crazy when you think about it.

   In terms of administration that shouldn't happen. Information should be available to everybody. That was the only thing that I didn't like. I think that it is a waste of technology. You have the technology there and you have invested so much money you should try to offer it to as many people as possible. But you get a lot of information and beside you go into what you are really interested in.

   I know that CD-I is a technology that uses compact disc and it can store information that allows you to interact with the information so

that you can explore the content. It has a huge capacity of storage for images for sound. I know that it is not very good in video but for still images it's great and velocity to access information is wonderful. The capacity for sound is great. The quality of the sound is wonderful and you can keep, well like at the Amparo museum where they have different languages it's great to have that in one disc.

10. What do you expect to see in this disc?

I expect from what you told me many maps and maybe some explanation of the history of how they explored the new world and what kind of instruments. Really to be immersed in that world. How that time was.

Observation stage of the Evaluation.

[She took a little time at the beginning to get use to using the remote. I had to prompt her to keep the remote down towards the machine]

Selected a map other than the Schedel. She did not know at this point that she could scroll the map menu and select a later map. Was quite focused in her examination of the map. She hit the i button and then she hit South America. She selected the compass rose. Ok so that brings me back to the menu.

Ok you were checking to see,

Yes.

Ok. You were exploring. What does that look like to you now that you've hit it and it brought you back?

Well, I was not sure whether it was going to bring me back or whether it was going to bring me to another map; probably in more detail of the same period.

Selected the Ptolemy map. Explored with the cursor. She went to the instrument button and selected the quadrant. Hm. That's interesting.

That's more of your science background.

Yes. *Selected the i button and listened to the whole explanation of how to use the quadrant. Viewed the different views. Selected the Cartographer button.*

Do you have any idea where you might go with that? Where that icon might lead.

That one certainly represents persons so I expected someone who was important in that period. I was not sure whether, and this is something I want to ask you, if you are in the instruments you get people that are important for

the development of instrurnent? And the maps are you getting important people who were explorers.

Ok. You'll always come back to this menu. This button always brings you back to the same place and these are cartographers.

Selected Munster. Is it possible to pause?

It's possible to stop it. It's not possible to pause. If you wanted to stop it you have to select it to go back in again. You know that you can get out of it whenever you want.

She stopped Munster and then selected the timeline. Selected three of the icons. She came to the end of the screen and I said, You can go further than that. Did you know that?

Oh No. That's great.

Actually that's interesting. A few people, I'm just catching that, they think that is all they can access.

I guess I have to press it for it to change?

Some of them have a timeout but for that one you have to press it. It is to give you time to look at it.

This is wonderful this feature that one is not aware of. we are use to a computer where it is a fixed screen.

What do you mean, oh that it can move. And that's interesting because in the Amparo what they do is that they move it for you. You can move it as well but they move it for you so you catch on right away. And that's why I thought that you would make that assumption too that you would think, ok I can go forward. And yet you had that same sense that, not this is all I have.

Yes. I don't know. Maybe someone who is more related to this technology would know but uh

No. Actually it was not until I was on my fourth or fifth interview that I started to, by a couple of comments people made afterwards I began to ask, How many maps do you think are on this? They would say, six, seven.

If you access the maps you always come to the same images?

That's right. I'd like to show you one more feature on the map and that's the magnifying, I 'd like you to look at the magnifying glass.

Why does the cursor change because it's at the top or

Yes. And then you don't have access to the magnifying glass. Now what do you think you can do with that magnifying glass.

Look into more detail.

The compass tells you now that your cursor is doing that particular kind of

Movement.

That's a very subtle cue though. She used the magnifying glass.

Was there anything that you wanted to

Yes, this one. I don't know what it is. *Selected the catalog card and then selected the cartographer.*

Oh this is great. I was expecting it to go back to the menu with the people but no. It actually give the biography of the person.

You like that direct link.

Oh yes. *She selected the help feature.*

The last one you look at. Is that your usual way of going through something new is to hunt around for yourself?

Yes.

Yes. I think that it is for a lot of people.

It was the first thing I should have looked at.

But you said ordinarily you wouldn't have done that anyway.

No. Well maybe here where you have all this to tell people that you have that feature that I wasn't aware of.

The feature that you can link directly?

That you can scroll and have more information.

Ok. There's a little verbal prompt when you first go in that to view more maps place the cursor at the side of the screen but obviously

I missed it.

It's one of the first things that is said but I think that that is a problem for a lot of people because they go in and they're not necessarily ready to hear that information right away.

11. What parts of the disc were difficult to use?

I didn't find it difficult to use. For me it was very clear. The interface is clear. You can guess even if I didn't access the information screen before it was more or less easy to guess what was expected to come. Maybe it was difficult to manage with this thing but is something that has to do with hardware not with the program itself so that's the only thing.

12. What did you not understand?

No not really. although I would like in the introduction when they mentioned about the instruments I was expecting them to mention the name of the instrument and they didn't and well they should. But then I said, well maybe this is a strategy to arouse the motivation to look for it. And in fact it did because I looked at that instrument if you realize which one I chose it was exactly that one. So it worked. And in that sense my curiosity was satisfied so it was good.

13. What helped you to figure out what was going on?

The voice certainly gives you a lot of information about what's going on and also the information button I found it useful.

In terms of getting more detail.

Yes. And of course you.

And actually your questions were more to do with the structure in terms of what kind of information can I get. Asking underlying questions if I hit the person can I get people who contribute to science or cartography; does it change depending upon where I am, where I access it.

14. What helped you to figure out how to make your way through the information?

The voice give you a lot of cues of how to get there and the icons are pretty clear. Giving the date is very important because in that case people are interested in a particular period they can go and access that period. Otherwise they would go from the beginning to the end in a linear way if i didn't know much about the topic.

I noticed that you went through the maps and you did pick a particular date. Did you have a reason for picking that date? Were you looking for something.

Yes.

Was it satisfied?

Yes, yes.

What were you looking for?

I was looking for how they imagined South America in that particular date it was 1930 and it was just after the conquest of America. And so i said, well what kind of idea did they have? And in fact they mentioned that they imagined a whole sea separating North America from South America and the drawing was kind of off from what it really is.

I noticed that you were searching with a real purpose.

Yes.

15. *What do you think that this disc is all about?*
I think it is about geography, about history and it gives you an idea of how geographers and explorers had to, how did they work with the kind of instruments that they had, the kind of knowledge that was available at that time, the kind of people that made a difference at that time. That is what it is about.

Ok and you had a sense of that from playing with the disc.

Yes. Well, that's what I thought.

16. *What was missing that would have helped you?*
Well as I mentioned that feature of scrolling I didn't, I missed the information the first time and maybe including it in the information section it would be nice. What else. Like being able to stop it I had to ask you and I didn't know before. For me it would be more, well what I would usually do was to click the pause button and I don't know what would have happened in that case. That would be more natural for me.

Yes it's always difficult when you're in a room with someone else to do things that you would just do ordinarily and it makes the evaluation a little bit biased.

Yes. I know but that's why I asked you because that's what I would have done.

17. *Where were you frustrated?*
I was frustrated at the beginning in the Introduction because I couldn't stop it. I didn't know at the time.

What would you have liked to have done?

Well maybe if I was seeing that it was not very relevant just to click and get out of it skip information.

18. Would you recommend it to someone else? whom, why, why not?

Oh yes for sure. I'm sure it is very useful for museums for example for schools. It is for adults I'm sure. I don't think that kids would really enjoy looking at maps that much. You need another approach for them. I'm sure that for maybe CEGEP level even H.S. it would be interesting for them. Or even at home some people might like to have it.

19. Was there something that you wanted but did not get?

In fact I was expecting to have explorers and I didn't get that. But maybe it was because I had seen some programs at the Stewart museum where they had just explorers and they have this Macintosh. When you told me about these maps and things that was my first image. So I had a bit of bias in that sense

So you've used that other system? What did you think of that.

I liked it. It is not as complete as this one I think but also it is a different situation. I was using it in a museum where you have a restricted time and you also have sound pictures which is a bit disturbing for others who are there. It is only one person who can use it so you have to wait till you get your turn and you can not be there forever.

Were there a number of people waiting to use it?

Yes, it was in the summer when I went so there were some tourists. I'm sure if it had been a quieter day it would have been different.

20. If you are familiar with the DMS collection please answer the following:

Does the disc present a reasonable impression of the collection of the DMS museum? does it adequately represent the collection?

It presents a lot of information. I don't think it presents the collection itself. But it presents a lot of information.

What was your impression of the museum before you had seen this.

I like the museum a lot. I visited there in the context of, when they were celebrating the discovery of the New World so it was very relevant at that time for me to visit.

21. If you are unfamiliar with the DMS collection please answer the following:

After your tour of this disc, what do you think you would see on exhibit if you visited the museum?

N.A.

22. Could you see yourself using this disc again?

Oh yes. Just for knowledge. Just to know more. I don't much about geography and most of the people you were mentioning, all the cartographers, I didn't know about them. I knew about Munster and I knew about Ptolemy because he is kind of Science. But not about the rest. And also I would like to look at different maps at other times. I found it very rich.

23. *How do you feel now, at the end of your tour, about having to figure out how to get around in the disc?*
I find myself comfortable. I'm sure that now I know how to use it it would be pretty easy next time but it wasn't difficult as I told you. The icons are to me pretty clear, the maps are, I was expecting more maps or something but it was not clear. I had to guess but the expectations were not that far from what it was.

So you didn't feel hindered

No, no.

24. *How would you describe your experience?*
I enjoyed it. I really did. I think I learned a little bit. More about geography. And I was really impressed with the amount of information that is behind all this, behind each map. I don't know how many maps you have there but there is such amount of information it is amazing.

25. *How might you see yourself using this disc?*
I would like to, for me it would be great to have it in a museum or I would even have it as a demonstration for multimedia courses. I might be teaching next year in Mexico so that I would like.

26. *What other information would you like to see on CD-I?*
From different topics, different from this one? Well I also like to see art. I find it very appropriate for this kind of technology. You can get so much about it and relate it to history. It's not only visual art but maybe art like the different currents that you have at the different periods of time and I could see that for example. Another, I'm not so sure about...I would also like biology, biological topics to be offered. It could not only be biology but you could integrate the physics principles behind it and chemicals that you usually don't see.

Making some links between the disciplines.

27. *What do you think is the purpose of this disk?*
Hm. good question. I think that the purpose is to let people explore the different maps and instruments that were used through time and the people that were important for that. That's my impression.

28. *How else could this disc be used?*

Except what I mentioned before. Maybe part of an exhibition I'm sure that people would love to play with it.

29. *Who else do you think might use this?*
Well, I cannot think of anybody else besides teachers and geographers, people in general who wold like to look at this topic.

30. *Would you buy another kind of disc?*
If it is related to a very important topic I'm interested in then for sure I would.

31. *Would you consider purchasing something like this to use in your home?*
Probably not in my home but at the University where I will be teaching or probably in a hospital if there are teaching facilities there. Then I would certainly use it.

32. *What do you think you learned from using this program?*
Well from the content or from the experience?

Both.

From the content I learned about other cartographers I was not aware of. I learned about all the information. I also learned about the different instruments that you can use. I didn't know that one in particular. I had seen it before but I didn't know exactly how they use it. And you know it's pretty well explained that's why I went into three levels of information in order to get how did they use it. That was what I was interested in and I got it. So I was satisfied with that. So I learned that. From the experience of using it I learned that wonderful feature that I loved I also learned how important the icons are to navigate there and also how important it is to fragment the information at levels that you want. Because maybe to somebody else it is not important to know how to use it but for me it was and I was able to access it. And I think that for a user it is very important to even if she goes and looks for it but if she gets it that's worth it and she feels satisfied. And I think that that is a very important feature in any kind of interactive program.

It's interesting because just listening to you I see how important it is to have somebody with an education background because other people would not notice something like that and I think that would be just another feature of the program that would wash over then and that they would appreciate it but they wouldn't necessarily recognize it.

Yes I really found very well like it is difficult to know exactly how big the chunks of information have to be. I think that you really achieved what you want. I think that you were really successful in that.

33. What are you going to take home with you from this tour?

A wonderful experience. It was really wonderful I really enjoyed it. It is a very good quality product really all the images are great. Everything has been taken care of.

Responses to Questionnaire.

1. *Rate the overall effectiveness of your tour of the disc by circling one of the following words:*
   * very good

2. *Briefly describe why you gave your tour this*
   Because I was satisfied with what I was looking at. I got all the information I was looking for. And it was pretty clear to me how to navigate within the program so I didn't feel frustrated at any time.

3. *Your tour was organized around a theme. Did you enjoy this theme?*
   Oh yes I did enjoy the topic. I like the way it was organized for me it was pretty clear like to establish the time frames and everything that was very comfortable for me. Besides then I was looking for a particular information I could access it immediately. I didn't have to look here and let's try another one. It was very clear.

4. *If not, briefly describe what approach you would have preferred?*
   N.A.

5. *Did the Introduction help you to understand what would happen in the disc?*
   The introduction certainly gave me an idea of what's going to be presented.

   You know I want to ask you something about the introduction because one of the things you said there was a point where you wanted to turn it off.

   Yes.

   Can you talk a little bit about that.

   Maybe at the beginning I found it a little bit long. And I am a very concrete person and sometimes I like, ok tell me exactly what is it that I'm going to be watching. But it depends. It is a matter of personality. There's people that like narration and there's people that like exactly what point is it that you are going to be touching. So it depends. And maybe it is because I'm from education I like all my objectives pretty clear whereas someone who is using it for entertainment or for a museum you would not present the objectives at the very beginning. It would be shocking for them. So I don't know that is something that you may consider. But I found it a little bit long to get to the point.

   Yes. And yet you just said that it helped you to know sort of

   Yes, it did help me but it was a little bit long to get to that point.

Ok it's more I guess I'm just trying to get a sense of where the balance is for you. How can we communicate to you in a way that gives you what you want and helps you to put it in context yet gives you that flexibility as well.

I think the narration is good. I mean I don't know exactly how it is you are going to be using but from what you told me it might be used as something that is not certainly educational purpose and more of a . I found that the narration is a good approach for that however I found it a little bit long.

Ok and you're not the first person that has said that.

6. *Describe what you might change in the Introduction.*
   N. A.

7. *Did the Help provide you with the explanations you were seeking?*
   Oh yes. It did provide me with the explanations. The problem is that I looked at it at the end but that's personality problem too.

8. *Describe what you might change in the Help.*
   Well I wouldn't change anything in the help. I would only add that particular feature that most people would not be aware of if they are use to be working with still frames in computers.

9. *Circle the word that describes how you would rate the success of this tour?*
   *very good

10. *Explain your rating.*
    I gave it this rating because as I told before I got what I wanted. I was looking for particular information and I got it.

11. *What did you like most/least about the tour? Why?*
    Well I liked all the information that is available. I liked the photographs, they were very good. Also the sound, it is pretty clear. And the information is presented also is very good chunks of information, the size of the chunks is very good. Least about the tour, well the fact that you can't pause it is certainly a hindrance to this because if I had to do something else and if I come and I want to access it at the same point it would, maybe it would take me a little bit more of a time. I don't think that it would be too difficult because of the way you have structured it but it would be nice to be able to have a pause.

12. *Would you look at the disc again?*
    Oh yes I would like to be able to look at it again.

13. *Why or why not?*
    This was just a little taste. Because I liked the topic and I found it really interesting. There were a lot of things I didn't know about and I would like to look at them if I have more time.

14. *How would you rate the effectiveness of the voice-over instructions?*
    I found it very helpful.

15. *Please explain your rating.*
    As I told you before it helped me to go through the program. And certainly the information that they were giving was relevant.

16. *How would you rate the appropriateness and readability of the icons?*
    They were very good.

17. *Please explain your rating.*
    One can guess what is behind. Maybe one doesn't know whether, I know that there is a man so it has to be with someone related to men people I didn't know exactly whether it was cartographers or explorers or inventors but I knew I was expecting people behind that.

18. *Describe the best part of your tour.*
    Was when I could get all the information of that instrument I was looking for. I didn't expect really. I was saying well let's see if they really tell how is it that they used it. So when they did

19. *Describe the worst part of your tour.*
    Maybe just the frustration just at the beginning not being able to forward it or something in the introduction.

20. *CD-I discs are..*a technology that you can use for providing information to people and they can store so much information that they are very useful and you can have access nonsequentially to this kind of information which makes it wonderful. And also the voice overs that you can have, the quality of sound is great.

21. *The quality(ies) I enjoyed most about this disc was...*the availability of that information that you can I thought that it was only six maps and then you told me, no you can scroll there and there is until, I don't know which date. That was a discovery for me.

22. *The quality(ies) I enjoyed least about this disc was..*the fact that I couldn't stop it or pause it.

23. *I would expect to purchase a disc like this at...*the university just to demonstrate it I would. At a museum or a part of maybe a learning center.

24. *If I could change this disc, I would change...*the introduction for sure. Maybe it would be also useful, I wouldn't change...Oh that's another question.

25. *If I could add something to this disc, I would add..* a little bit of information on explorers too. Because in the information they mentioned how with the Turks everything was a new setting so they had to explore new routes and all that so I was expecting that.

    And how would you like to see that presented.

    Maybe with the maps it would be good. I don't know how the icon would be differentiated with the cartographers but maybe explorers of that time. Besides many of those cartographers use to really travel with the explorers so it would be nice to have that.

26. *If I could create a disc like this I would make...*I would also focus on the inventors maybe because I'm interested in science that I would.

27. *Sex*
    *female

28. *Level of education*
    Masters degree

29. *Occupation*
    University professor

30. *Degree of knowledge and familiarity with the content.*
    *Minimal

    I like history but I'm not good in geography.

Subject Matter Expert 2

People seem to identify CD-I with education. They don't think of it as being used in the home.

It's very hard to get away from the couch potato mentality. Difficult to ask people to start interacting with the TV at 6:00 at night after a long day.

And the other thing that I noticed is that they almost always mention the cost. And it's still pretty expensive.

I've seen part of the disc at a conference in Banff. I think that somebody from the government was showing it there.

So you already have a sense, how long ago was it that you saw it?

Last spring. I saw it very quickly. I'm just telling you that. I didn't have a sense to interact with it.

So you already have a sense of what you're going to look at.

Do you want me to interact with it or do you want to show me?

That's what I want to get a reaction from you how easy is it to make your way around.

[there was a bit of a struggle to get it up and going. We thought that it was the batteries but it eventually started to work]

The graphics are very nice [he was looking at the introduction, the graphics of the map with the description of the fall of Constantinople]

[Selected Ptolemy's map. Listened to the narration] Where should I go? Ok. *[Used the magnifying glass to go into the detail and then he scrolled the map. Went back to the map menu and scrolled to the end and returned to the beginning]*

Why is there a map...why is it not chronological?

You've done a loop.

Ok. I'm starting again. It's a bit confusing. For me I just suddenly saw 1493

After seeing 1776.

I don't know if there could be some sort of divide.

Something that indicates that you've returned to the beginning.

Even though it's a loop, it's a good idea I think that it's a loop

But it's not evident.

Yes. No here I wondered how come suddenly I thought I was going to look at, I didn't know what was the exact span went right up to today. Went through the 1700's getting there it's slow and suddenly I get back to 1493. It's just that. Some kind of way of knowing that we just finished a loop or that we're starting again.

[Selected the cartographer icon] Do you have any idea what that was?

No.

Do you have any idea what that is?

Oh they're people that made the maps. *[scrolled the menu]* I'll tell you an idea I just had. These are the people for each and every map.

That's right.

I sort of expected that the two timelines would be synched. So if I was to click now on the map I would get the map and it would be on the same type of thing. That would be interesting. I don't know how difficult it is to do.

There is a link once you're inside the map and you go from the catalog card to the cartographer for that particular map. Otherwise every time you hit the cartographer button you get the same.

By default.

Yes.

I think that it would be a nice feature too for everything. It would make one more level. And that would have added another level of complexity.

[went to the instrument menu and selected the quadrant] This is Ptolemy again. I'm not sure. *[went to the timeline and selected an icon] [Andre moved quickly through the different options] [Went back to the instruments and scrolled through the menu]*

What were you interested in looking at?

I'm just wondering, I think I saw this thing on the blue background twice and the first time it was on the top. [He had noticed that the pictures in the menu appeared twice but the second time their positions in the top or the bottom had been reversed] I'm a visual person. My question was is he using the same image for different sound clips or is it just.

He's just laid the menu out twice so the loop is longer.

[selected the quadrant again] Let's look at the catalog. *[he looked at the catalog and then he looked at the next level of information on the quadrant. Listened briefly to the narration and then he played with the arrows at the side]* I have the feeling that the clip I get now is not the same object. Or is it the same object?

Yes. It's the other side.

Ok. These arrows is the same object but viewed from different, ok I thought I was seeing different objects.

Ok. Alright. It wasn't evident enough that it was the same object. I tried to put it in words why, probably the idea of the timeline again. I thought that this was a way to jump from one to another.

Ok. You were brought here after that little narration.

Yes. It might have to do with the way the arrows are drawn. To me those, an arrow flat like that tells me that something is there

Ok. We're going on, we're moving forward.

But if the arrow had a curve in it you like a, then it would say we're going, we're turning. It could be interesting. Ok. That's fine.

Have you seen the other museum discs.

Yes I saw the Mexican one.

That's good for me to know because some of the features are similar so if you already have a model in your head

Yes. No, so far I don't think the interface is very complex. One problem I found is the guidance or the help is given by the same voice that also gives the content. So sometimes is he talking about the content or is he helping me right now? That's one thing I noticed in one place it tells you about the map then suddenly it switches to telling you how to use the map. Maybe a different voice would have made a more

Would have made it a little easier to click in right away.

Well, that's it. This is my guide or this is the narrator. It may be the object I chose also. [selected the chronometer] Is that the same object or is that the object open up or Since we never, we don't have any cue either audio or textual of what it is, especially that I'm not even sure what this after listening to the clip I would have known but after that I'm not sure if I was looking at the same thing or

And the other thing, I think that the very first time you look at an instrument you're given a verbal prompt to hit the arrow if you want to see alternate views. But that's only one and I find that there's a few times when have been a little bit distracted they've missed that verbal prompt and there's no way of getting again.

That's right. This is general help? *[selected the cartographer menu. Selected Munster, listened to the first two lines and then clicked it off]*

There is something that I would like you to play with a little bit on the map. It's the, you've played with magnification, it's the i button. If you could just see how that works [selected a map and went right into the i feature. Was quite adept at working the i and the magnification feature together.]

That's interesting. How did you find that moving around with those highlights and picking them.

Oh. Ok. My only concern is that, let's say as soon as I overlap this or here I cannot go down. To zoom out

Ok well you zoomed in, you solved the problem of going in. [he played with the magnification feature]

I'm not sure. It went 1, 2, 3 and then the possibility is to come back.

And what, do you know what that number in the magnification means?

It's the next one.

Yes. Now that wasn't difficult for you to figure out. It took a little bit of energy.

Yes.

My concern on this, well you tell me you said that you had some reactions.

I don't have much problem with it. My problems are when we get the added layer of the information. Then if you want to navigate, oh I thought that if you wanted to move you would have to move around those things.

Oh ok. What I've noticed working with a couple of people who don't have in their background a way of sorting that information out it's very confusing for them. Because the highlights disappear when they're moving and they don't understand that. If they want to magnify a particular area they don't understand that the magnifying glass has to be outside the highlighted area for them to do that. It's a lot of navigation information to sort out and sequence.

Yes that's one thing. I think that layer of information is very interesting but as you say if I want to zoom out it's like let's say on Japan what I did is that I had to zoom out outside of Japan.

Yes and you figured that out quite quickly. But I would think that comes from some of your experience.

Yes I think that's it. I think it is. I thought also we would use the ability to scroll when the highlights were there.

But I'm not really sure how you might sort that information out for a new person. But I found, well in particular I worked with someone who had no background at all. He just looked at it and went to something else straight away.

That can happen. Unless you have online information or a demo or something that shows you what to do.

I wanted to ask, get some of your insight on that. Almost everyone says they want a demonstration of how to move it. My experience is that people don't really look at those when they are there.

Ya it's true, it's true. I'm working on a project right now and I'm at exactly the same point. I'm designing the help and I think, how much effort should I put. I know it's very important but I know that most people don't use it. You have to find a way to make it interesting enough that people will use it. But it's a lot of energy usually wasted you know in some ways. If your interface is simple enough you hope they'll never use your help. It's always as bad as having a very powerful tool as this where you can go in from different point of view etc. etc but it's like having a software that comes on a diskette with sixteen books you say there's a problem. There is something too complex somewhere they have to explain us in sixteen books what that little software does it's the same point here. If you find that you have so much to explain about the interface probably because the interface is not simple enough. You may want to do only one thing at a time or you may want to limit, I don't know this may not be the right solution but you say when you ask for information, the i button, you disable the other possibilities.

Yes, it's hard too for the different like for you no problem, like now you have that flexibility and you know how to use it and your comfortable with it and you would find that irritating if you didn't have it.

That's true. I know what you mean. There's a

It's a real, and I think for sure that was part of the philosophy when developing it was that people like the man I showed it to on Friday within a couple of hours would have that necessary sophistication...

Yes, that's another point, I mean, whenever you get into a new interface since there's not, and thank the Lord that there's no standards right now, then you know it takes, for me it takes time to learn the interface. What you say is true after a while that shock goes away. I mean it's like any new software if you want to write in the new word processor well you ask for the five, ten first minutes your like where's the print, how do I print, how do I make this but as soon as you find it if it's coherent it makes sense and then you won't have a problem. I think there's, this is probably the most difficult part, the rest is pretty straight forward you either touch one side of the screen or the other to scroll or to make the object turn. My feeling what I'm listening is, and I'm not talking about a lot of text on screen, I understand there's probably no text on screen because of the English and the French version. Are you using the same image for both?

Yes the same image. The only thing that would change would be the catalog card. But that wasn't our reason for no text.

No you wanted something

was very visual. What are you missing?

I'm missing some information once in a while like having to guess what those buttons are at the bottom. I know I can go into help and see it. I know that it's also part of the shock the initial shock, I'm not sure what those icons mean but if I use it for two days I'll know what they mean, I mean it's not like there's twenty-five icons there's eight icons and by the end of the day I should remember what they are. I don't know I think its as far graphics as far as the look the feel I really enjoyed the application. My problem comes from the speed of the CD-I mostly. All those transitions that takes five seconds you know you're in the mode where you want to be active and participate but every time you do something you have to wait five seconds. That's not a problem with the application itself it's a problem with CD-I or CD-ROM has the same problem, the access. I like the sound, I like that you hear the ocean, the birds, it's an environment, more or less continuous sound, create an environment. My problem is really with the dynamics that are going on, like there is almost no animation or no live video. Nothing that moves really except we go from one image to an image and we hear sound, the sound quality, the narrator has a nice voice there's no problem with that he's not monotone or anything like that it's just that I feel I don't know how long this can sustain my, if I, you always have to think of the threshold where people will get bored at some point. Even if it's high quality because they're use to something else. You know if the people have seen Columbus the movie and they saw those great scenes on the boat and when he comes to the island and all this and then you show something like this where they're all artifacts or all maps from a museum no, I don't know if there's actual pictures of other places that were discovered, it gives a bit, not that the images are well scanned, the images, I mean the quality of the image is there, the quality of the sound is there, I'm just talking about interaction as a

whole, not necessarily your application but, the fact that as compared to a TV show or a video game or something like that this is very you know

It's very static isn't it.

Yes, it's very static.

Yes and I would say that that was one of my criticisms of the, the other art discs, like the one on Florence and the one on the Renaissance. Yes, I would say that after ten, fifteen, twenty minutes my threshold was passed.

Yes and I think that's too bad because I think it is high quality work but there is something that as a user if I'm used to watch TV or play or as a I don't know what exactly a target is for this, your audience was

The idea is that it would be adults mostly unless younger people were studying it in school. It's considered an electronic book and something like a compliment for the museum and for people who are interested in cartography. Very much like a coffee table book.

Well, then it serves a different purpose. I mean the

It's more of a head thing and more academic which doesn't make it as big a market.

At the same time I have the feeling that there is I don't know, it's a lot like a slide show it's a lot like, although we do this, the contents meshed with by the author, by the maps they did by the different instruments and all this and then you start making links between the different things. It's still a bit passive. The intro clip at the beginning where they explain everything was I mean just the right length because if it had been a bit longer I would have, I was ready to cut it short. It's just that you think that you're going to be active and then you're on I don't know how long it was for me it sounded like ten minutes. It's a bit too long. But I don't know it was just if it had been 30 seconds longer I would have clicked it. I think it was a good introduction if I didn't do the introduction I would have been lost in there.

You would have. In what sense would you have been lost?

Maybe just a bit of the idea of you know what are the longitude and those sort of things, just freshening up your mind of what cartography is about and what they had to understand and just the fact that they didn't know that the earth was round or whatever just gives you a bit of a fresh look at it so I think that it is a good, and it's good also you don't have to watch it every time you know you have the option of not watching it if you don't want to. No concern as far as the interface I think that the interface is very simple you try to keep it as simple as possible but if you keep it too simple then it is a problem. The fact that ok for the profile of the person it's ok on the sense that I'm going to deal with people but the compass rose for me is something very abstract, it

means navigation, it means a number of things and I didn't know that I would end up on the map again. Again you know after two minutes I know and that's it

It's not something that you look at and automatically identify as something with the maps.

Yes. You know if you had put that as the continents or the earth or

a globe

then I would have connected it a bit more. One thing I don't know if it is the limit of CD-I but I have a lot of trouble when, like here a highlight is basically a large rectangle and there are so many things in there that I don't that I'm not even sure what I'm going to click on I don't even know what's highlighted there so I don't know if it's possible to have polygon highlights you know like Japan

You mean more defined.

More defined Yes, yes that's it

Of what you're going to get

Yes of what, that's it. I'm not sure if it is possible but

No I don't think it is at this point. I think that was the only way of handling that.

Discussion of the lack of marketing done by Philips and the versatility of the Photo CD.

You said at one point you like the graphics.

The quality is there. One thing that often you see in a project like that is that the graphics are either very computer like, very basic graphics, almost no scan because it takes a lot of room on the disc. The fact that you have high quality images, nice scans, it makes a nice rich environment for the viewer with the sound quality and everything. I think we always come back to that threshold of why would you watch it if you can watch something else. Well I watch it because the image are nice the narrator has a nice voice and the content is interesting and the music is nice and you know you have to add up all those things to make it interesting. And I think that visually it was quite nice. I find that maybe there could be a bit more of a link sometimes. You have a background at some point or you have part of, when you have the timeline you have certain color schema and sometime we go to full frame video where we only have the object but nothing else. And sometime you say you know it's like not necessarily framed but it could be some kind of that color scheme being somewhere. I don't know where it's just at some point I

feel like I you know you take different layers and then suddenly your at the layer where there is only the picture everything else is you know all those nice buttons that you have absolutely there is no button whatsoever on the screen there is nothing it's like it's a bit poor visually. You only have the image and then nothing else. I don't know if you understand. I'm explaining myself

Is it stark you mean

Yes basically. Especially when the image doesn't fill the whole screen because you have verticals or

Are you thinking more of the instruments?

Yes basically that's the part where I you know where suddenly you ha 'e an instrument and then a lot of black around it or you know. It's not it's just the continuity feeling that you are in some kind of environment and you don't get out of it suddenly. It's like suddenly coming out of the spaceship and being really in space but nothing to grasp on. You just have this picture that floats in the middle of the screen. While when you have your buttons at the bottom or something then you know that you are in this CD-I application. You have this link with the fact that you are in this particular application. You would have the same problem if at one point your menu bar was blue and another time purple and another time green for no reason. If there's a reason it's ok but what I mean is this continuity. If you try to have something that for some reason you feel that you're always the same environment it's securing it gives this feeling of being in a certain context, in a certain environment. I think it's not much there not big problems.

Discussion on Help

Is it cost effective. It is important but it takes a big chunk of your budget in time and money. Want to make an interface simple enough that you hope that people will not be using Help; then this may justify not investing so much time and money in help.

In the Smithsonian Disc the interface is relatively simple but they have sacrificed interest for simplicity. The interface is so simple that what it does is not that important after I have done it a few times.

With the variety of ways in which a topic can be approached, game, interactive video, electronic book, database, it is important to clearly identify for the user at the outset what s/he can expect from this product. This is an electronic book not a data base. It is meant for entertainment and education and not for reference. So although one of our goals may have been to offer scholars an opportunity to view maps close up this is not the main purpose of the disc and in fact we can answer this question quite easily from our model and then if there was a demand we would develop another product to

offer to scholars, one which would provide them with the tools they need to perform efficiently i.e. an index.

It is interesting that it loops but it does not really make sense that it loops because it has a beginning and an end. This is a bit confusing. Maybe it just needs something visual that helps me understand that I am starting over. The objects located twice in the same menu is confusing.

The speed of the scroll of the menus is tedious.

Absence of text is a bit disconcerting. Might have been nice to have some text for orientation.

The application is a very good example of what can be done. It is within the limitations of CD-I.

Appendix C: Questionnaire

EVALUATION OF

CHARTING A NEW WORLD: MAPS OF DISCOVERY

Introductory Questions

1. When is the last time you visited a museum?
2. How frequently do you visit a museum?
3. What type of museums do you enjoy visiting?
4. How often do you use a computer?
5. When is the last time you used a computer?
6. For what do you usually use a computer?
7. Do you have a video player in your home?
8. How often do you use it?
9. What do you know about CD-I?
10. What do you expect to see in this disc?

Guide for Observation Stage of the Evaluation

Talk to me while you use the system.

PROMPTS:

-ask questions about how the program or the user is functioning

-look for the following:

*technical problems
*affective reactions of user
*ease of handling main features and functions of the disc
*effectiveness of user interface with characteristics and needs of the user
*adaptability of the product to the characteristics and needs of different users
*effectiveness of the menus
*navigation-observing for disorientation, inefficiency, and cognitive overload
*appropriateness and adequacy of the information

After they have played with the disc for a period of time ask the following questions:

11. What parts of the disc were difficult to use?
12. What did you not understand?
13. What helped you to know what was going on?
14. What helped you to figure out how to make your way through the information?
15. What do you think this disc is all about?
16. What was missing that would have helped you?
17. Where were you frustrated?
18. Would you recommend it to someone else? whom, why, why not?
19. Was there something that you wanted but did not get?

20. If you are familiar with the DMS collection please answer the following:

    Does the disc present a reasonable impression of the collection of the DMS museum? does it adequately represent the collection?

21. If you are unfamiliar with the DMS collection please answer the following:

    After your tour of this disc, what do you think you would see on exhibit if you visited the museum?

22. Could you see yourself using this disc again?

23. How do you feel now, at the end of your tour, about having to figure out how to get around in the disc?

24. How would you describe your experience of using the disc?

25. How might you see yourself using this disc?

26. What other information would you like to see on CD-I?

27. What do you think is the purpose of this disk?

28. How else could this disc be used?

29. Who else do you think might use this disc?

30. Would you buy another kind of disc?

31. Would you consider purchasing something like this to use in your home?

32. What do you think you learned from using this program?

33. What are you going to take home with you from this tour?

EVALUATION OF
CHARTING A NEW WORLD: MAPS OF DISCOVERY
Questionnaire

1. Rate the overall effectiveness of your tour of the disc by circling one of the following words:

    *very poor
    *fair
    *mediocre
    *good
    *very good

2. Briefly describe why you gave your tour this rating?

3. Your tour was organized around a theme. Did you enjoy this theme?

    *yes
    *no

4. If not, briefly describe what approach you would have preferred?

5. Did the *Introduction* help you to understand what would happen in the disc?

6. Describe what you might change in the *Introduction.*

7. Did the *Help* provide you with the explanations you were seeking?

8. Describe what you might change in the *Help.*

9. Circle the word that describes how you would rate the success of this tour?

    *very poor
    *fair
    *mediocre
    *good
    *very good

10. Please explain why you gave this rating?

11. What did you like most/least about the tour? Why?

12. Would you look at the disc again?

    *yes
    *no

13. Why or why not?

14. How would you rate the effectiveness of the voice-over instructions?

    *rarely helpful
    *I did not use them
    *helpful at times
    *helpful most of the time
    *always helpful

15. Please explain your rating.

16. How would you rate the appropriateness and readability of the icons?

    *unrecognizable
    *I recognized one
    *I recognized two to three
    *I recognized four to five
    *I recognized all of them

17. Please explain your rating.

18. Describe the best part of your tour.

19. Describe the worst part of your tour.

Complete these sentences:

20. CD-I discs are..

21. The quality(ies) I enjoyed most about this disc are...

22. The quality(ies) I enjoyed least about this disc was...

23. I would expect to purchase a disc like this at...

24. If I could change this disc, I would change...

25. If I could add something to this disc, I would add..

26. If I could create a disc like this I would make...

27. Sex

    *female
    *male

28. Level of education

29. Occupation

30. Degree of knowledge and familiarity with the content.

    *very high
    *high
    *moderate
    *minimal
    *none at all