Definition and prospects of the Virtual museum

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Abstract
Virtual museums are becoming increasingly frequent online but the definition of the virtual museum does not seem to be properly set. This thesis discuss the definition of the virtual museum and takes it a step further to see if it is possible for the virtual museum to be regarded a museum in its own right.

Through literature studies, and by studying current virtual museums, the definition of the virtual museum is set as a source of information, generally on the Internet, and accessible to all. A virtual museum presents information through multimedia, and with the help of an interface that is based on a concept of rooms that the user navigate to experience the virtual museum. Information is as essential to the virtual museum as objects are for a physical museum.

By comparing the collect, preserve and display principles of the museum with current applications used in the virtual museum, I found it possible to apply these principles even to the virtual museum, but other sides such as educative and social aspects are currently not being translated, however, by implementing Web 2.0, educative resources and personalization, the virtual museum could be seen as a museum in its own right.

Key words
Virtual museum, On-line museum, virtual exhibition, virtual cultural heritage, digital cultural heritage.
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## Acronyms

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<tr>
<td>AI</td>
<td>Artificial intelligence</td>
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<td>DH</td>
<td>Digital heritage</td>
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<td>EXIF</td>
<td>Exchangeable image file format</td>
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<td>GPS</td>
<td>Global positioning system</td>
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<td>PE</td>
<td>Physical environment</td>
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<td>VE</td>
<td>Virtual environment</td>
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<td>VMC</td>
<td>Virtual museum of Canada</td>
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<td>VR</td>
<td>Virtual reality</td>
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1. Introduction

Virtual museums and exhibitions are becoming an increasingly popular way for museums to present themselves, their collections and information online in an accessible, dynamic environment. Many museums have considered virtual museums a new step of marketing themselves, and putting their museums on the cyber-space map.¹

I first came into contact with the virtual museum during a class on digital documents, and found the concept interesting. Though the class just mentioned virtual museums very briefly, I found an interest to study them further. The main quality that caught my attention was that of accessibility, but also the possibilities in reaching new audiences, and especially young audiences. Young adults have often grown up with computers and the technology, and generally feel very at home in the virtual environment.

It was not until I began searching the Internet for virtual museums that I decided on researching this subject further. I soon realized the extremely varied quality of the virtual museums available online. It seemed like the term virtual museum had become increasingly popular to use in any case of online content produced by museums. Everything from a photo slideshow to advanced flash based websites was by the museum referred to as a virtual museum. There is an apparent need of definition and framework, or else the term virtual museum would soon be over used and in the end loose meaning. When I began the research for this thesis I noticed that very little research had been done focusing exclusively on virtual museums. The research that had been conducted mainly concerned museums and the web at large, not specifically virtual museums. The research involved everything from digitized cultural heritage to websites. There is also a genre of research that deal with the technological aspects of digitizing cultural heritage, what methods and software that can be used for everything from 3D scanning of artifacts to software functioning as virtual museum templates.

2. Research questions

Currently the term virtual museum or virtual exhibition is used on a very large range of material published by museums on the Internet. Everything from photo slideshows to databases being available online are by many museums labeled virtual museums. It is a rather new term that is yet to establish itself fully among the cultural heritage community, along with the definition of what it actually is.

As the current research on virtual museums is very limited, and mainly concern digital collecting or museums and the web at large, it is crucial to put the focus entirely on virtual museums. To be able to do this, the basics of the virtual museum concept needs to be set. Therefore the main questions of this study are What defines a virtual museum? and What are the prospects of the virtual museum?. I would also like to research the possibilities for a virtual museum to be considered a museum in its own right.

Several definitions have been presented about what a virtual museum is, but as that Internet constantly develops, so do the possibilities and the expectations on the virtual museums. The first question concerning the definition of the virtual museum will be discussed in the chapter What is a virtual museum? The concept of the virtual museum may sometimes go by various titles, such as online museum or Internet museum, however, these usually refer to the same idea. There is, however, a difference in the case of the virtual exhibition. The differences between the virtual museum and the virtual exhibition is often mixed up with one another, however, while both of them stand on the same base, making a clear distinction between the terms would also make their respective roles more clear. This is especially important to the future of the discussion on virtual museums and exhibitions, so that it would be clear what the discussion in question would refer to. Virtual exhibition and its unique definition will be studied further in the chapter The virtual exhibition.

The second question on the prospects of the virtual museum, and the possibilities for the virtual museum to become independent, will be discussed in the chapter Possibilities of the virtual museums.

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3. Method, material and outline of the study

The premises of virtual museums are explicated by a comparative analysis of the literature on virtual museums and their nature and of the conceptualizations of what is considered to be a “museum”, and applying this to the study of what a virtual museum is. The literature comprises a selection of theoretical and practical literature on virtual museums between 1991 and 2008. The majority of the literature is published in the 21st century. Even though the selection is not exhaustive, the material presents a recurrence of general ideas, repeated throughout the discussion.

Considering the advancements in technology related to the Internet, this thesis will study the prospects of the virtual museum and whether it is possible for the virtual museum to become a museum in the full definition of the word e.g. if it is possible to create virtual museums where the principles of the physical museum can be applied. In order to answer the second question of the prospects of virtual museums, the study examines central methods and applications that are currently being used in the virtual world and on Internet, and how these could be applied to the virtual museum. The methods would therefore not be futuristic per se, but in general new to the virtual museum environment. Though there are several ideas on how virtual museums can evolve there are some central themes that are firstly, making the similarities between the virtual and the physical museum more apparent, and secondly, ideas that are taking advantage of the strengths of the Internet.

As previously mentioned I will conduct this study by first establishing the definition of what a museum is in the chapter What is a museum? I will then, in the chapter What is a virtual museum? conduct a comparative study of the definitions of what a museum is and what a virtual museum can do, to answer the question concerning the definition of the virtual museum. I will further research the differences between the terms virtual museum and virtual exhibition in the chapter The virtual exhibition, I will in this chapter also review some examples of virtual exhibitions and how various techniques have been implemented to improve the quality of the exhibitions. I will in the next chapter Challenges of the virtual museum look into critique and concerns considering the virtual museum, this to bring a varied picture of the research and debate that is currently ongoing in the research community and in the scientific literature on the subject. It is of great importance to take the critique and concerns presented seriously as they are not only concerns...
of the scientific community but also of museums professionals. The museum professionals work daily with exhibitions and collections and know of the importance and value of the cultural heritage they work with, and the issues that face it by digitalizing and presenting it in a new type of environment.

Based on the chapters researching the definitions and essences of both the physical and virtual museum, the chapter *The possibilities of the virtual museum*, will analyze in what direction the virtual museum is heading, and what needs to be developed to make it become recognized as a museum in its full definition, and in what ways the technologies of the Internet can best be utilized to improve the virtual museum and exhibitions.

I will finish the thesis through a comprehensive analysis and conclusion regarding the subject on virtual museums, their definition and prospects.
4. What is a museum?

Since the public museum and the national museums were introduced in the 19th century, there have been a lot of changes in how museums approach their context and how they work, however, collecting, preserving and displaying objects have always been the core of their work. The museum has taken on several new duties such as becoming an institution for education, not just for higher education research, but also as a resource for all types of learning institutions. Museums today have become a home for exotic objects as well as home for information.

4.1. Collect – Preserve – Display

Collecting and preservation have been around since the proto-museums in the shape of cabinets of curiosities. Displaying these objects has been essential since the introduction of public museums.

4.1.1. Collect
The collecting of objects was, and still is the base of museums, and the base on which museums were first created. Museums are often seen as the physical memory of the society, and the items found in collections contribute to the understanding of individuals and societies in past as well as contemporary cultures. In these days, however, museums have also recognized the importance of collecting contemporary material and incorporating them into collections. New sort of material such as intangible content is also being collected and incorporated into the museum context, this to be able to preserve a more varied picture of the current for the future.

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3 Hooper-Greenhill, Eilean, 1992, Museums and the shaping of knowledge, p 1.
4.1.2. Preserve
As part of the collecting, museums also take on the task of preserving the collections for the future. As an item is incorporated into a museum collection it becomes fixed in history, and is preferably, to be secured in its current condition. This preservation consumes a lot of time, funding and space of the museums, so adding content to museum collections is nothing museum professionals take easily. Once a museum decides on incorporating an item into their collections, it is there for the future. Whether it turns out to be of importance or not, makes no difference, the cost and effort of the preservation will essentially be the same.

4.1.3. Display
Displaying is the public side of the museum. Even though public access to collections can be granted, it is generally in the exhibitions and the museum’s public spaces that the audience can take part in the stories the museum wish to tell, and learn about the collections available at the museum. Today the exhibition has developed more into an experience, and is no longer all about the objects. This partly began in the 1980s when thematic exhibitions made their way into museums. In the thematic exhibition the theme is on display, not necessarily objects. Changing paradigms to information-centered exhibitions also gave way to new types of expression in museum design, incorporating new ways of presenting information, for instance in the shape of various media or interactivity. Today some institutions have taken their exhibition design even further in this direction, incorporating elements of edutainment, education as entertainment.

4.2. Meeting place
Museum professionals often emphasize the importance of the museum as a meeting place. This is apparent in the social aspects of the museums such as tours, seminars and workshops. These activities turn the museum, not only into a meeting place for the audience, but also a meeting place for audience and museum professionals.

Another way in which social aspects have come to be incorporated into the museum is through the architecture of the museum. Most museums today have

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11 Schweibenz, Werner, 1998, "The "virtual museum": new perspectives for museums to present objects and information using the internet as a knowledge base and communication system”, p. 188.
made room for cafés or restaurants, in some cases even a playground for children. Even the exhibitions themselves may contain interactive segments, where the idea is for users to work together.¹³

Usually these social aspects are being incorporated into the museum as a way of enhancing the museum visit and favor the emergence of discussion between the visitors about the museum, its exhibitions, and the collections.¹⁴

4.3. Institution of education

The part of the educational work that is most obvious to the audience is that of information through tours. Museum docents work with guiding groups in the various exhibitions of the museum, informing about their themes and collections. Generally there are different types of tours available based, for example, on whether it is a group of adults or children,¹⁵ however, as mentioned by Black in *The engaging museum – developing museums for visitor involvement* museum pedagogies is not just a matter of holding tours of the exhibitions and collections.¹⁶

A lot of the pedagogic work in the museum is done behind the public scene of the museum. Such work include the development of tours and input on the development of exhibitions as well as construction of pedagogic texts. Creating an exhibition with the help of a museum pedagogue implements the pedagogies into the exhibition from the beginning. Not only will that generally make the exhibition better equipped for sole visitors, but it would also be based on scientific techniques to get the audience engaged and to make the exhibition as easy to understand as possible.¹⁷

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¹⁴ Rayward, Boyd, W.; Twidale, Michael, B., 1999, "From docent to cyberdocent: education and guidance in the virtual museum", p. 34.
¹⁶ Black, Graham, 2005, *The engaging museum – developing museums for visitor involvement,*
5. What is a virtual museum?

The first definition of what a virtual museum is, was simply the website of a physical museum. A concept of a museum “without walls” had, however, been introduced as early as 1953 by Malraux, who imagined it being an environment for the presentation of mainly photography and art. The term Virtual museum was first coined by Tsichritzis and Gibbs in their article Virtual museums and virtual realities referring to a museum constructed for a virtual landscape and functioning as a service rather then a location.

Another early idea of the virtual museum was the VR virtual museum that was a copy of the physical museum in its architecture, and it generally contained 2D and 3D images of items from the museum’s collections. The virtual museum later evolved to refer to web sites of museums that contained different types of media (multimedia) to present information, such as images, text, sound etc. This is still partly the case, but a virtual museum is today considered to hold a larger complexity then just different types of media-presented information on a site. The virtual museums have become a matter of not just basic information, but also of how the information is being presented to the users.

5.1. Definitions of a virtual museum

The definition and idea of the virtual museum is still under construction. Just as with the technology, the idea and definition is under constant change, and what once might have qualified as a virtual museum in its encyclopedic definition, may not do so today.

Today the definition of the virtual museum is coming closer to that of what a physical museum is. It is no longer only a website with information presented

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18 Britannica Online Encyclopedia, search for: virtual museum [2009-04-13]
19 Malraux, André, 1953, The voices of silence.
22 Britannica Online Encyclopedia, search for: virtual museum [2009-04-13]
23 Schweibenz, Werner, 1998, ”The "virtual museum": new perspectives for museums to present objects and information using the internet as a knowledge base and communication system”, p. 189.
through multimedia,\textsuperscript{24} or a website with a database connected to it.\textsuperscript{25} Today a database is a database, and a database on a website is a database on a website. Putting a database on a website does not make it a virtual museum.\textsuperscript{26} As Rayward and Twidale describes it:

In the same way that a museum is not merely a physical storehouse or repository of artifacts that has been organised to enable the most efficient access to those artefacts, a virtual museum is not merely a database of digitised images linked to powerful information retrieval software.\textsuperscript{27}

One of the most essential parts of the virtual museum is accessibility.\textsuperscript{28} Originally virtual museums were created for various medium including CD- and DVD ROMs. Today, however, when virtual museums are being discussed, they are mainly referred to as an Internet phenomenon. It is also the Internet environment that makes the virtual museums flexible and dynamic.\textsuperscript{29} Virtual museums burned on disk cannot possess these qualities. The accessibility also gives the museums the possibility to reach a much greater audience in virtual shape compared to in its physical form.\textsuperscript{30} The number of visitors is potentially limitless and so is the geographic range the museum can reach.\textsuperscript{31} But its not just a matter of reaching a larger audience with information, it is also a matter of presenting the audience with an experience, and to provide possibility of further in-depth learning through databases of digital heritage as well as connected references.\textsuperscript{32}

It is information that is the main strength of the virtual museum. The virtual museum takes what is an authenticity centered on objects in the physical museum and turn it into an authenticity centered on information in the virtual museum.\textsuperscript{33} The Internet is constructed based on the distribution of information, however, most information found on the Internet have little base and rarely references of scientific kind. Wikis have become increasingly popular as a way of simply creating collected information databases.\textsuperscript{34} Wikipedia being one of them, where users add data such as text and pictures. The wiki is in constant change as the users add,

\begin{footnotesize}
\begin{enumerate}
\item[] 25 Strömberg, Håkan, 2008, \textit{Islamisk konst ruskar liv i det virtuella museet}.
\item[] 28 Barton, Jane, 2005, "Digital libraries, virtual museums: same difference", p. 150.
\item[] 29 Kaczmarek, Adam Lukasz, 2008, "Exploring contexts of cultural objects in virtual museums", p. 1, 2.
\item[] 30 Barton, Jane, 2005, "Digital libraries, virtual museums: same difference", p. 151.
\item[] 31 Barton, Jane, 2005, "Digital libraries, virtual museums: same difference", p. 151.
\item[] 32 Barton, Jane, 2005, "Digital libraries, virtual museums: same difference", p. 151.
\item[] 33 Barton, Jane, 2005, "Digital libraries, virtual museums: same difference", p. 151.
\item[] 34 Barton, Jane, 2005, "Digital libraries, virtual museums: same difference", p. 151.
\item[] 38 Tepper, Michele, 2003, “The rise of social software”, p. 23.
\end{enumerate}
\end{footnotesize}
change and delete data.\textsuperscript{35} Even though it can work as a good way for smaller groups to oversee information, it is in a case like Wikipedia problematic as there are very few references and very little information being checked by professionals.\textsuperscript{36} The virtual museum could function as a counterpart to this sort of uncontrolled information on the Internet.\textsuperscript{37} The virtual museum, as with the virtual encyclopedias, would work as legitimate information sources in the vast cyberspace.

Another way in which the virtual museums develop the legitimacy of information is through multiple narratives.\textsuperscript{38} The flexibility of the virtual space makes it possible to relatively easily create diverse narratives, for instance with items or ideas where several interpretations have been presented and considered possible and legitimate. The virtual museum can then let it be up its audience to decide on what they find being most accurate. Multiple narratives also improves the democratic aspect of the museum as it shows different scientific sides, not just deciding on one school as truth.

Accessibility and information are two main pillars of the virtual museum, however, they do not set the virtual museum apart from other legitimate information sources online. A function that virtual museums have that differentiate them from other online information sources is that the virtual museum is a matter of experience, of experiencing the information rather than one-way learning.\textsuperscript{39} Just as in a physical museum, information is taken in through text and media but at large it is the experience of the entire museum that contributes to the learning. Just as physical exhibitions are carefully constructed and planned, so should the virtual equivalent be produced, and just as visiting a physical exhibition is an experience, so should visiting a virtual exhibition create an experience to the user.\textsuperscript{40}

Another function essential to the virtual museum and to enhance the creation of experience is the interface of the virtual museum. Information is presented in a different manner in a virtual museum compared to, for example, a regular information website of a museum. In a virtual museum information is presented through navigation, with the interface turning it into an interactive learning experience.

The virtual museum is often referred to as a \textit{museum without walls}.\textsuperscript{41} The architecture of a virtual museum makes it possible for a dynamic architecture, and the architecture of a virtual museum is its interface. It is the interface that put up

\textsuperscript{35} Henning, Michelle, “New media”, 2006, p. 316.
\textsuperscript{36} Tepper, Michele, 2003, “The rise of social software”, p. 23.
\textsuperscript{37} Henning, Michelle, 2006, “New media”, p. 304.
\textsuperscript{41} Schweibenz, Werner, 1998, “The "virtual museum": new perspectives for museums to present objects and information using the internet as a knowledge base and communication system”, p. 191.
the premises on how to navigate the virtual museum and exhibition, and it is the interface that sets the possibilities of the architectural setting. As with a physical museum and exhibition, the architecture of virtual museum or exhibitions is constructed with rooms or halls rather then pages. With virtual exhibitions that have a physical counterpart, this can generally be generated rather easily. Each of the physical rooms can simply get their own setting in the virtual exhibition’s architecture. Though it can pose problematic to visualize a physical exhibition experience in a Internet 2D or 3D environment, care has to be taken to the translation of the physical exhibition. It is easy to do a straight translation of the physical exhibition to the virtual counterpart; however, implementing the physical architecture into a VE would limit the possibilities of the virtual counterpart, and would be a step away from the idea of a museum without walls. It would simply put a static architecture into a virtual shape.

By rooms or halls it is not necessarily a matter of a VR environment. Rooms can as easily be generated for a 2D environment. The idea of creating rooms or halls is generally set to make the interface straightforward and the idea of the virtual museum or exhibition clear to the user. They also turn the virtual museum or exhibition into an experience, more or less similar to a physical museum and exhibition experience.

To summarize: a virtual museum is a source of information on the Internet, or alternatively on various storage medium, but then in a form that is fixed and restrained in dynamic capabilities. A virtual museum presents information through multimedia, and with the help of an interface that is based on a concept of having rooms that the user navigate to experience the virtual museum. Information is as essential to the virtual museum as objects are for a physical museum. The lack of object authenticity in the virtual museum is instead replaced with the authenticity of information. Through its position on the Internet the virtual museum is in theory accessible to all. This gives it an advantage that the physical museums cannot forge.

5.2. Collect – Preserve – Display

Collect, preserve and display is the three main principles of the physical museum. This chapter will compare how these definitions of the physical museum can be applied in virtual form.

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5.2.1. Collect

Though virtual museums cannot handle objects in the way that a physical museum can, collecting is not solely referring to physical objects. As mention in *What is a museum?*, *Collect, preserve, display*, museum collections can also contain intangible material e.g. a collection does not necessarily have to be based on physical objects. Based on this, the virtual museum could to some extent collect material that could be of interest to the museum as well as the scientific community.\textsuperscript{43}

One way for a virtual museum to collect data would be through web logs.\textsuperscript{44} With the help of web logs the virtual museum could track data based on the audience of the virtual museum. Not only would this provide a lot of information about how the audiences approach the virtual museum in question,\textsuperscript{45} but also about Internet usage in general. This sort of data could be of interest to researchers on DH and VE. It would also aid in the future development of virtual museums.\textsuperscript{46} As contemporary collecting, such as Samdok, is currently being done in various fields,\textsuperscript{47} data of Internet usage could also be of interest to save as records of people’s interaction with the Internet.

It is, however, possible to collect information in a more traditional sense of the definition, even in the virtual museum. As will be studied further in *Types virtual exhibition, Interactive exhibitions*, the museum could work as a base of collecting where users of the VE distribute contributions. Through this sort of collecting, the audience could contribute with various types of multimedia to create or increase the collection of the virtual museum. As types of multimedia such as images and videos are already incorporated into collections of physical museums today, the collecting of “born digital”\textsuperscript{48} items to a virtual museum collection could be considered as legitimate as a regular museum collecting.

5.2.2. Preserve

As mentioned above, there are ways for a virtual museum to create its own *born digital* collection. This would be a requirement for any preservation to become involved. Though the virtual *born digital* collections would not require the same sort of preserving as an ancient object would in the physical museum, there would still be a need of some sort of preservation, even on this material. Even though

\textsuperscript{45} Henning, Michelle, 2006, “New media”, p. 312.
\textsuperscript{46} Rayward, Boyd, W.; Twidale, Michael, B., 1999, “From docent to cyberdocent: education and guidance in the virtual museum”, p. 47.
**born digital** material does not exist in any physical form in its original state, preserving ideas have to be put into consideration for the collections to stay available.

The problem with **born digital** material in not necessarily storage, which is generally a problem in the case of the physical museum. Storage media is becoming increasingly cost efficient, however, files also tend to grow larger with the introduction of new, and better quality file formats. The main problem with digital collections overall is that of digital heritage longevity. As just mentioned, new file formats and standards are constantly introduced, and old ones are discontinued.\(^49\) To make sure that the collection would be accessible in the future, it needs to be constantly revised to make sure all the file formats are up to date, however, changing the file format on a **born digital** item also changes it from an original to a copy.

### 5.2.3. Display
All virtual museums have some way of displaying its content in a VE. The VE constructed for the virtual museum promotes various types of activities, created to engage the user in the theme of the museum.\(^50\) A vital part of the virtual museum is the accessibility. Not only does this accessibility turn the museum global but it also contributes to a sort of democratization of the museum, making museum collections available to theoretically anyone.\(^51\) Putting content online in the shape of databases, virtual museums, personalized exhibitions etc. lets not only people of various cultures enjoy each others cultural heritage, but would let cultures that have lost parts of their cultural heritage to other countries, get virtual access to it.\(^52\)

The idea of bringing the museum artifacts to a larger audience can go beyond ordinary databases. One way of realizing this could be in the shape of combined exhibition.\(^53\) Virtual museums and exhibitions would make the terms museums work by, when it comes to putting together combined exhibitions with artifacts from several museums, increasingly simplified.\(^54\) The cost, time and care that museums have to spend today on every single artifact they borrow from another museum or institution is making it difficult for most museums to go through this

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\(^50\) Chen, Xiaolei; Kalay, Yehuda, E., 2007, “Making a livable “place”: content design in virtual environment”, p. 207.

\(^51\) Malpas, Jeff, 2007, “Cultural heritage in the age of new media”, p. 25.


\(^54\) Schweibenz, Werner, 1998, “The “virtual museum”: new perspectives for museums to present objects and information using the internet as a knowledge base and communication system”, p. 188.

These difficulties leads to that ideas of possible exhibitions are overlooked because of the economic costs it would require.55

The virtual world does not have the same limitations as the physical museums when it comes to these matters. Putting together exhibitions with material from various museums or institutions would mainly be an issue of whether all institutions agree on the idea presented, and are willing to contribute with material and information that otherwise would be under copyright.56 There would still be a cost, but not much in comparison to moving a large number of valuable artifacts.57

Combined virtual exhibitions would also spare the objects. Not only does it cost a lot of money to move museum artifacts, there is also the risk of objects being damaged. Though one would not suggest that viewing these artifacts and objects online would compare to watching them in the physical environment. It does pose a possible alternative,58 which not only would be cost efficient; it would also be available to the world.

5.3. Conclusion

As Jane Barton states in her article Digital libraries, virtual museums: same difference? The boundary between regular web information sites and virtual museums is increasingly blurred.59 So what is it that specifically makes a virtual museum differ from similar channels of information available on-line?

As have been established throughout this chapter, virtual museums are not just informative web sites. A complex virtual museum could in theory live up to the main principles of the physical museum, those of collect, preserve and display, however, as the VE is constructed in a different way then a physical, they manage these principles of the museum in different ways. As a virtual museum is a part of the VE, the collections it would accumulate would be of virtual born digital kind. The preservation issues of the virtual museums would also struggle with problems of a virtual kind rather then physical, but in the end the goal is the same, to preserve the collected material for the future, and future audiences.

Museums are looked upon as institutions that stand for authenticity. With physical museums this authenticity have largely been connected to the objects of the museum collections. In a world of information and learning, museums have

58 Schweibenz, Werner, 1998, “The "virtual museum": new perspectives for museums to present objects and information using the internet as a knowledge base and communication system”, p. 188.
been the main institution handling the objects, the real things of history. The virtual museum, however, is not capable of translating this object-centered authenticity, instead the virtual museums is a source of authentic information, in a cyberspace filled with uncontrolled knowledge.\textsuperscript{61}

One of the most important sides of the virtual museum is, however, the accessibility. It is not a part of a location, but available to everyone, everywhere. Not only is this an important quality for reaching audiences, but it also put a democratic aspect to the virtual museum. Content is not just available to the audience living in proximity of the physical collections, but become a part of the global cultural heritage.

6. The virtual exhibition

While the difference between virtual museums and virtual exhibitions is not fully established, the old idea was generally that a virtual museum was the website of a museum and that a virtual exhibition was considered something more complex, as stated in The Encyclopedia Britannica article on the subject. In today’s highly technological world, where change and development in constantly ongoing and redefined, a museum’s general website is considered being only a museum’s website, not a virtual museum.

Another early idea of what a virtual museum is, was generated out of the same idea as the website, that holds the physical museum is its base. In this idea a virtual museum is an exact VR copy of the physical museum and its exhibitions. These museums generally focus on objects from the museum’s collection and display them in 3D in a VR environment.

I consider it being a good idea to look at the differences in the definitions of museum and exhibition in the physical counterpart. In the physical museum world, a museum is something more complex and multifaceted than an exhibition. An exhibition is one part of the museum as a whole, usually one exhibition of many that make up the museum. A museum is, as previously established, an institution concerned with collecting, preserving and displaying cultural heritage. It is also defined as a meeting place and an institution of education. Whereas many exhibitions are meeting places and educative, they are part of the display principle of the museum definition. When museums create virtual displays of their cultural heritage it is generally in the shape of a virtual exhibition, however, there are larger virtual projects such as the VMC that contains several different virtual exhibitions, and also have several ongoing educative projects for students as well as teachers.

When one read articles on the subject, the authors generally use the term Virtual museum, however, what they discuss can usually be applied to both virtual museums and virtual exhibitions. In general they distinguish between the two through differences in complexity.

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64 Virtual museum of Canada, URL: http://www.virtualmuseum.ca
6.1. Types of virtual exhibitions

As with their physical counterparts, virtual exhibitions can be highly specialized and utilize the virtual media in different ways. The following chapters focus on various types of virtual exhibitions and presents examples in each category.

This classification of virtual exhibitions is based on the material of virtual exhibitions found in the scientific literature and examples of various virtual exhibitions I have studied further as part of the research for this thesis. All categories and examples follow the definition of what a virtual museum and/or exhibition is, as stated in the chapters Definitions of a virtual museum and The virtual exhibition.

These categories are naturally simplified. Virtual exhibitions are generally more multifaceted in their construction and hold many more applications then what is the characteristics of the specific category.

6.1.1. In-depth object exhibition

In-depth object exhibition centre around the object, which can seem difficult in the case of the virtual exhibition, however, in-depth object exhibitions presents the object in a different manner compared to how it is presented in a physical exhibition. The in-depth object exhibition does what is difficult to do with a physical exhibition, it takes the audience close to the object, making it possible to view the object from all angles and positions and enabling zoom functions where the user would be able to come closer to the item then would be possible at a physical exhibition.65 In many ways, virtual in-depth object exhibitions actually presents objects in a more thorough way then what would be possible in a physical exhibition,66 and could pose an invaluable source for research, locally as well as globally.

In-depth object exhibitions make this possible through various VR and 3D photography techniques.67 Exhibitions may vary from VE style exhibitions to more regular website presented exhibitions. The techniques used to create these virtual exhibitions involve everything from template-style software with low learning-curve, such as the ARCO software,68 that creates a VR environment in which the museum places the 3D pictures of their objects,69 to highly specialized tools and software that demands professionals in the specific field. Even though

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the audience may not see the object in question in real life, one can often study the object to a greater extent in these sorts of virtual exhibitions, then one would be able to through thick security glass, as Maxwell Anderson discusses in the introduction to the book The wired museum: emerging technology and changing paradigms:

The Mona Lisa could be more easily studied today in a high-resolution image over the Internet than in the galleries of the Louvre, where dim lighting, thick ultraviolet-filtered, bullet-proof glass, zealous crowds, and protective guards keep us at arm’s length from the painted surface. We are in effect looking at a painting through a glass screen anyway.

Advanced in-depth object exhibition cannot only function as an exhibition experience for a general user, but it could also, as mentioned above, become a tool for research. Especially considering the accessibility of the virtual exhibition. In theory, researchers from all over the world would be able to study objects in-depth that in real life are very remote to them. Of course for major research, hands-on experience is crucial, but the in-depth exhibition could prove valuable in the selection of items that were to become researched.

Not only could the in-depth object exhibition contribute with information to the public and researchers globally about a specific object, but it could also be taken further to provide multiple narratives. If investments have been made to create a virtual in-depth replica of a specific object, it is on top of that possible to create a reconstruction of it, given such would be of use. Usually reconstructions of objects is a guesswork executed by an experienced archaeologist, art historian etc. There are, however, often disagreements in the scientific community regarding reconstructions. The virtual in-depth object exhibition could solve this by creating multiple reconstructions, where the audience can study the various options and come to their own conclusions. Even more important, the diversity of the scientific research community would be presented in the exhibition, not just one fixed truth.

An example of an in-depth object virtual exhibition could be The Augsburg art cabinet created by Museum Gustavianum at Uppsala University. The object is a cabinet of curiosities, a large cabinet with a multitude of doors and drawers that all keep the different objects that are part of the cabinet’s collection. In real life one can look at the cabinet on a distance, but not touch nor study it further. In the virtual museum one can open every door of it, pull out the drawers, click on each object and be presented with further information on it from the collection.

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73 The Augsburg art cabinet, URL: http://konstskapet.gustavianum.uu.se/webb/index.html
In real life one would never be able to study the cabinet as thoroughly as in this virtual exhibition unless one would receive special permit to.

6.1.2. Thematic exhibitions
The core of the thematic exhibitions in as well physical as virtual shape, is the theme rather then the object. The shift in paradigm began in the 1980s when the idea of information and learning rose from being secondary to become the centre of importance. Since the virtual exhibitions were first introduced, there have been concerns regarding virtual exhibitions and their lack of object-centered authenticity. The thematic exhibition, however, make an example on when this is of no major concern, as objects are not as necessary to a thematic exhibition. Instead the qualities of the Internet can be utilized according to their strengths to produce diverse applications suitable for the thematic exhibition.

The museum of world cultures, based in Gothenburg, Sweden, has developed several virtual exhibitions. In general these are based on exhibitions in the physical museum, but presented on the museum website. One example is the virtual exhibition Pushing the limits, where the main theme concern how it is to live in a conflict region. Pushing the limits is a VR walkthrough virtual exhibition. The exhibit is almost an exact replica of the physical exhibition with VR rooms to navigate through. Though the options of movement around in the exhibition are limited, it is interesting to see how they utilized multimedia such as sound, images, video and text. The Internet is created around the distribution of information in various shapes and multimedia is one of the ways where one can utilize the strengths of the Internet. Where a 2D image of an object in a virtual exhibition fail to live up to the greatness of the original, the multimedia offers a very similar experience online as in the physical environment.

Another example is the virtual exhibition Trafficking. Its theme is based on the trafficking of humans around the world. As with Pushing the limits, this virtual exhibition also has a physical counterpart. The virtual exhibition is greatly influenced by its physical counterpart, however, in difference to Pushing the limits it is not constructed of VR rooms but rather 2D interpretations of the physical rooms. As with a large part of the thematic exhibitions, the information is largely presented through different medium, in this case through sound, text and images. Though much of the media used in the virtual exhibition relates to the physical exhibition, they have still decided on leaving out parts that could rather easily be incorporated such as video, however, the interface itself is well developed through

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74 Attatchment: *The Augsburg art cabinet*, figure 10-14
75 Schweibenz, Werner, 1998, "The "virtual museum": new perspectives for museums to present objects and information using the internet as a knowledge base and communication system", p. 188.
76 *Pushing the limits*, URL: http://www.pushingthelimits.se/english/
77 *Trafficking*, URL: http://www.trafficking.nu/start_en.htm
flash technology and turn in itself this virtual exhibition into an experience to visit.

6.1.3. Interactive exhibitions
Interactive exhibitions are virtual exhibitions where the museum or cultural heritage institution provides a framework for a virtual exhibition, but where the user and audience contribute material to the virtual exhibition.

One example is the virtual exhibition *Silence of the Lands* that is dealing with the theme of natural heritage. This specific virtual exhibition aims to preserve the natural quiet of a natural heritage site in Boulder, Colorado. The cultural heritage institution developed software and the website of the virtual exhibition, that largely consists of maps over the area. They also held workshops for residents so that they could learn how to use the system. The users in turn collect sounds when they are around in the natural heritage area and position the sound with the help of GPS receivers. As they upload their media as well as metadata to the system, it becomes a part of the virtual exhibition database and available on the exhibition website. The virtual museum also features chats and discussion-boards where users comment on and interpret the various sounds. As part of the virtual museum project, so called *soundwalks* are also being offered, where users and visitors walk the physical landscape on tours based on the sound material found in the virtual museum. This takes the virtual museum a step further, connecting it directly to the PE and have the physical and virtual landscape work together seamlessly.

Interactive virtual museums are rather unusual but *Silence of the Lands* is an example of one. Having users also be producers is a way of getting the audience engaged in the museum. It also makes the work of creating the museum less complex, as the users themselves contribute with the material. The museum just has to develop a software framework and educate users in how to utilize it.

The interactive virtual museum or exhibition take the virtual museum a step closer to the physical museum as it through the “user as producer” approach become and institution that not only displays material but also collect and preserve it. As previously mentioned in this thesis, collect and preserve are two of the main

78 *Silence of the lands*, URL: http://www.thesilence.org/
principles of what a museum is, and UNESCO offer born digital resources protection status as heritage.\textsuperscript{84}

As well as with physical museum collecting there may come up issues regarding the authenticity of the material and information contributed by the user/producer. As with most digital heritage sites that let users contribute with material, the Silence of the Lands project have professionals monitoring the material that is being contributed.\textsuperscript{85} This mainly concerns the sound material (object) and the information regarding it (meta-data). When it comes to communicative additions such as chats and discussions, there is generally no need for museum professionals to get involved unless the chat is set up as a communication tool between user and museum. This may pose a problem to smaller heritage institutions as there may not be any financial possibility to have professionals control the contributed material, however, the situation is very similar to that of acquiring physical collections. It would be up to the professionals of the heritage institution in question to decide their priorities with their collecting.

6.2. Conclusion

Though the literature does not strictly set any definition to separate the virtual museum from the virtual exhibition, the general idea is that the virtual museum is more complex. It can for instance be a VE constructed out of various different virtual exhibitions. It can also be a VE that lives up to the principles of the physical museum: collect, preserve and display. Virtual exhibitions on the other hand function much like an exhibition does in the physical museum. It is a place where objects and information are displayed, but is usually just one part of all the various activities a museum could offer.

Virtual exhibitions can look and function very differently. Based on virtual exhibitions studied for this thesis, three categories of virtual exhibitions have been distinguished. These are in-depth exhibition, thematic exhibitions and interactive exhibitions. Though not all virtual exhibitions can be placed in these categories, or does not fit them exclusively. These categories still give a picture of how museums may work on producing a virtual exhibition, depending on the material that would become the base of the exhibition.

\textsuperscript{84} Kvan, Thomas, 2007, “Conclusion: a future for the past”, p. 310.
7. Challenges of the virtual museum

The technological possibilities of today are under constant development. New types of Internet tools are introduced daily and the standards that are developed today seem to be outdated before they even hit the market. Keeping up with the Internet and its possibilities is a challenge few master. In this race of technological development it is hard not to have concerns about the present as well as the future of the Internet.

Though new technology has always been of interest to heritage institutions to aid their work, it has always been of great importance to evaluate the new technology before implementing it to the museum work. A lot of technology have come and gone, today faster then ever, and so have the standards of the technological world. Investing in new technology is a substantial decision to a museum, and it is important for museums, which generally already have strained budgets, to make sure that the advantages would surpass the disadvantages.

Many museums have taken the step to digitalizing their collections and cultural heritage in databases. Though this helps a lot in keeping records available, accessible and standardized, these standards also pose a problem. Though catalogs have usually been made prior to creating databases, setting standards for what the databases are to contain is no easy decision. Though Dublin Core is often used as standard on museum and heritage databases, there is no fixed standard for how a museum database should be designed, like in the case of images where the EXIF standard has been set.

Not only is there no fixed standard for museum databases, there is also a problem with standards at large. As Yehuda E. Kalay discusses in the conclusion of the book *New media: new media and cultural heritage*, turning cultural heritage to a standardized database is like taking a story originating from an oral tradition, and writing it down in print. According to Kalay there is a vast difficulty in taking something as complex as cultural heritage and describing everything of it in a database based on fixed premises.

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86 Dublin Core Initiative, URL: http://dublincore.org/
87 Exif.org, URL: http://www.exif.org/
Another problem concerning standards is that of longevity. Museums invest a lot of time and money in digitizing their collections, and as technology evolves so does the standards of it. New medium as well as new formats are under constant development, and the museums cannot afford to constantly change along with it. For example, one can look at the various image formats available today: JPEG, TIF, GIF, BMP, PNG, RAW and PSD being just a few of them. Museums need to know that their investments in the technology will be worth it and that despite the constant change, their work that will be lasting.

In the case of the virtual museums, there is also the matter of the public sphere. Where museum databases are still largely for internal use, though some museums today have all or parts of their databases available on their websites, virtual museums are created with an external audience in mind. Problems emerge, however, as the objects are often seen as the museum’s base of authenticity, and object authenticity can never be translated in the virtual world. The virtual world can only present virtual replica of the authentic object.

To the cultural heritage institutions the virtualization of objects pose problematic. How can institutions dedicated to the preservation and presentation of authentic objects, at the same time create digital models of their pieces? Many discussions debate over the desacralisation of the objects. Turning an authentic item into a commodity. While some debate that turning authentic objects into commodities is necessary to reach audiences, other say that presenting models of objects in virtual museums and exhibitions will be the end of the specific aura that both the authentic object and the physical museums possesses.

If decisions have been made to invest in new public information sources such as the virtual museum, there are concerns about how this information is to be presented. Museums are considered as institutions of education as well as institutions of authenticity. Several museums that have established themselves online in the shape of virtual museums have suffered great criticism for how information has been presented in an edutainment-like fashion. The balance between information and the usage of applications suitable for the Internet, such as multimedia, have posed problematic for museums. The difficulty lies in combining information and multimedia into virtual museums that still holds that essence of information authenticity. In the creation of virtual museums, professionals therefore shy away from elaborate interfaces in the quest to not have their virtual exhibition regarded as a fun-park.

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8. The possibilities of the virtual museum

Even though the virtual museums available today can be very different, there are certain techniques in production that has been used for some time now and is considered an integral part of virtual museum production. These techniques include for example 3D renderings, web layout, and usage of multimedia content. These techniques will therefore not be presented further in this thesis. This chapter will concern methods that are still experimental in the virtual museum context, and only picked up by a small number of virtual museums. It will also concern methods that today are still not in use in a virtual museum context, even though the techniques exist in other VE.

As discussed by Suzanne Keene, in the case of both physical and virtual museums, people are central to the role of the museum, what is then important is to present the museum in a shape useful for the audience. As virtual museums are available online it should be of interest to adapt them to the VE the Internet holds. There is no point in trying to implement things that are not functional in an environment such as the Internet, but rather take advantage of the strengths of the VE. It is also of interest to study where the development of the Internet is at, and where it is heading, to be able to develop a virtual museum that is up to date and that Internet users can feel accustomed with.

As mentioned, multimedia, VR and interfaces have been integrated with the Internet for some time, and have also become incorporated into the virtual museums. If one look at the current development of the Internet, communication has been taken to another level through the introduction of Web 2.0 services. There are a multitude of communicative services available, which can easily be implemented into the virtual museum context. This will be studied further in the chapter *The virtual museum as a meeting place*.

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Another way in which the virtual museum can develop is in the strengthening their online pedagogic work. As this is an essential part of the physical museum, it should not be overseen in the virtual museum context. As will be presented in *Virtual education*, there are various ways for the virtual museum to embed pedagogic tools to enhance the virtual museum visit, aimed at as well children as the research community.

The virtual meeting place, as well as the virtual education are both principles that have an equivalent in the physical museum. The third principle that will be discussed in this chapter, however, does not. The case of personalized museums is something that could rather uniquely be implemented in the VE, and is perhaps one of the major strengths of the technology. The personalized museum could offer the audience something that could not be offered at a physical museum. Through applications that enhance the sides of the virtual museum that cannot be applied to the physical counterpart, the two could function as complements to one another.

8.1. The virtual museum as a meeting place

As discussed in *What is a museum?, Meeting place*, it has become increasingly popular to incorporate social aspects into the museum, both as part of activities, but even into the physical architecture of the museum through for instance restaurants. The reason behind museums wishing to become a meeting place for the public is usually for enhancing the museum visit and to promote interaction and discussion.

For the very same reasons, the meeting place could also become a part of the virtual museum. In the case of the virtual museum, it would not only be a local meeting place such as the physical museum, it could turn into a global meeting place. Connectivity and communication are some of the strengths of the Internet, and various applications could be incorporated into the VE to promote the virtual museum as a meeting place. Some specifically interesting to the virtual museum will be presented in the chapter *Web 2.0*, and discussed on how they could be implemented into a virtual museum environment in the chapter *Museum 2.0*.

8.1.1. Web 2.0

Web 2.0 is a term that stands for a range of Internet services such as chats, discussion-forums, blogs, wikis, web feeds, and other social software.98 The main function of these Web 2.0 services is that of connectivity and communication, though other qualities they generally have in common are functions such as:

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The concept of a social Web is nothing new. Discussion forums have been around since the early networks, and services we find current such as the blog, were in use already in the mid 1990s. Today there are a great number of these various social services. To mention a few: Chats for direct text, voice or video communication, either through web applications or through social software clients; Blogs as online diaries that are generally connected to other blogs in a web; Wikis that are sources of information, where the users can add, change or delete any entry, users build content together; Feeds provide a summary of content from a specific site, usually to a specialized web feed reader, where the user can collect the information summaries of all the sites he is interested in, in the same application; Forums provides a space online where users can create and take part in discussions. Usually forums are specialized in various subjects, and is a place where users that hold that interest log in to take part in the discussions; Virtual communities where users can join, for instance to network such as the case of sites like Facebook or My Space, or to consume and contribute content, such as in the case of Youtube; Bookmarking allow users to bookmark (or tag) websites, assign keywords, and share these, bookmarks can for instance be shared through feeds. These are the most common services available as part of the concept of the social web, or as it is more known: Web 2.0.

8.1.2. Museum 2.0
As mentioned in previous chapter, there are a lot of different ways of using the Internet in a social and communicative manner. Though all of these services have their place on the Internet, it is a different matter of how they could become incorporated into a virtual museum setting.

Considering how concerned the physical museums are about becoming meeting places for the public, it is interesting to see how little of that that is currently implemented in the virtual counterpart. This especially considering how well

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100 Tepper, Michele, 2003, “The rise of social software”, p. 20.
102 Strömberg, Håkan, 2008, _Islamisk konst ruskar liv i det virtuella museet_.

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suited the Internet is for these types of services. The virtual museums could benefit greatly by taking the step from simply being a delivery medium, to becoming a tool of communication.

So how could one implement the various services described in previous chapter into the virtual museum environment? Some tools such as a chats could be embedded into the museum or exhibition for the audience to use, either through chatting with one another or by organizing events such as curator on call, where users could ask a curator or other museum professional whatever questions they may have and get them answered. Discussion groups could rather easily become implemented into a virtual museum or exhibition, where users could discuss the exhibition, learn from each other and contribute information to each other by linking to external information resources. This could even be combined with the curator on call service in, for instance, guided tours, where a physical museum docent could guide a group of people through the museum or exhibition online, in real time. Discussion groups in a virtual museum or exhibition could also be used for more professional situations, where museum professionals could have discussions in connection to the virtual museum or exhibition, and if public, the users could take part and turning it into a direct museum professional – audience interaction.

In some cases even blogs are implemented into virtual museums and exhibitions. Pushing the limits has incorporated a blog into their virtual exhibition on how it is to live in a conflict region. The direct connection with a human and her words could add to the experience of visiting a virtual museum or exhibition.

Web 2.0 and social software can rather easily be incorporated into a virtual museum environment. The examples mentioned above is just some ideas on how Web 2.0 can be used and shaped to fit the museum context. Just as social aspects in the physical museum engage people and enhance the museum visit, so could well-developed Web 2.0 services also do to the virtual museum.

103 Strömberg, Håkan, 2008, Islamisk konst ruskar liv i det virtuella museet.
109 Pushing the limits, URL: http://www.pushingthelimits.se/english/
110 Museum 2.0, URL: http://museumtwo.blogspot.com/
8.2. Virtual education

As previously mentioned in the chapter *What is a museum?*, *Institution of education* the educative work of museums have increased rapidly over the last couple of decades. When applying museum pedagogies to a virtual museum or exhibition, the experience accumulated by museum professionals through educational work in the physical museum, is generally used on the virtual counterpart. Though much educational experience and work is being applied to virtual museums and exhibitions, little work has been done on developing a specific virtual museum pedagogy. In this section, possibilities of educational services specifically applied to virtual museums and the VE will be discussed. Services that not only adapt well into the VE but also use the strengths of it.

The virtual museum pedagogy is based on the ideas of the physical museum pedagogy but considering the special environment of the virtual world, adaptations need to be made. For once, the virtual museum audience is placed in contexts outside of the physical museum, such as other countries, in a different sort of facility or even in the comfort of their own home.\(^{111}\) As the physical room aids and enhances the museum experience and learning, virtual museums need to consider options on how to present their virtual museum or exhibition in a manner where the physical room is replaced with a well developed interface.

This accessibility of the virtual museum is one of its strengths, however, in a VE such as the virtual museum, the environment is largely constructed for single users. A great part of the educative work museums do is based on interaction between docent and audience or between audience members.\(^{112}\) The same sort of interaction is hard to reproduce in a virtual setting, however, the introduction of a cyberdocent can aid in type of virtual, educative situations. Much like a museum docent guides the audience in the physical museum, a cyberdocent would guide the user through he interface of the virtual museum or exhibition.\(^ {113}\)

As children and young adults have generally been seen as a prioritized group when it comes to museum pedagogies, virtual museums and exhibitions could aid the museums in their quest of being an important part in the educational system. Virtual museums and exhibitions can prove a good tool to reach out to young audiences, as have been established in the article *Educational tool or expensive toy? Evaluating VR evaluation and its relevance for virtual heritage* where

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\(^{112}\) Economou, Maria; Pujol Tost, Laia, 2007, “Educational tool or expensive toy? Evaluating VR evaluation and its relevance for virtual heritage”, p. 244.

Economou and Pujol Tost conclude: “VR’s power of attraction seems to appeal to several age groups. From primary education through to university students.”  

As virtual museums in Internet shape are dynamic, they are easy to develop and change if needed. This is in turn could pose useful in keeping up with the educational curricula of the aimed school audience. This could turn the virtual museum or exhibition into a resource not only in itself but also for visitors such as a school class that is planning a visit to the physical museum. Virtual museums could function as a resource of information for teacher as well as student, and the museum could be discussed in a local environment such as the classroom.

Where it is important to interpret, tell stories and contextualize in the museum pedagogy aimed at a general audience, there is also the field of the virtual museum functioning as a source of information for researchers, locally as well as globally. In this case, however, it is of greater importance to provide realistic visualizing and details, as well as more comprehensive information.

Much is possible with the virtual museum and exhibition, but on top of the regular museum pedagogies that have its base in the work executed in the physical museum, the development of virtual museum pedagogy would support the transference into the VE.

8.2.1. Teacher’s Centre
As previously mentioned, museums collaborate closely with schools, this to engage teachers as well as students in the museum and to aid their preparations before a museum visit. When it comes to physical museum visits, a lot of this information is sent out to teachers or they are invited to go through material with the help of a museum pedagogue. This approach, however, would differ in the case of virtual museums and exhibitions, as they are generally only available on the Internet, not in the physical museum.

One example of a virtual museum that has developed their service towards teachers is the VMC. A specific website have been developed to function as a teacher’s center, and where you can find information about the various virtual exhibitions at the virtual museum, as well as in-depth information adapted to the various age groups and class levels.

A lot of inspiration on how to best refine the pedagogy of the teacher’s centers connected to virtual museums, can be taken from the on-line and distance

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117 Virtual museum of Canada Teacher’s Centre, URL: http://www.virtualmuseum.ca/English/Teacher/index.html
learning type of pedagogy, as Parry and Arbach states in their article *Localized, personalized, and constructivist: a space for online museum learning*:

museums recognizing these kinds of online learning spaces as opportunities for situated learning will become empowered with an array of pedagogical tools and rationales that may help strengthen and expand their institution’s educational provision.\(^{119}\)

There is, however, also a different role that the virtual museum can play. Not all virtual museums or exhibitions are solely available on-line. Many virtual exhibitions have been created as a virtual model of an existing physical exhibition, such as *Pushing the limits*\(^{120}\) and *Trafficking*.\(^{121}\) In the case of virtual exhibitions that have a physical original, the virtual exhibition can function as a teacher’s material, used for preparation before the visit to the physical museum.\(^{122}\)

8.2.2. Research

Digitalizing cultural heritage and putting it on the web make it in theory accessible to anyone, anywhere. Local cultural heritage become global. Not only is there an advantage in this for the general population but perhaps even so for various education and research institutions.\(^{123}\) Virtual museums and exhibitions do not always have to be aimed at the public. Having cultural heritage content available on the Internet also make it interesting to various research institutions, or for users with greater interest and knowledge in the subject beforehand.

As the virtual museum and exhibition are global, they create an interesting source of information, not only to the public, but also to students, professionals and specialists.\(^{124}\) The virtual museum could function as a forum for research on the collections in question, connecting professionals of different levels of expertise to discuss and learn from each other.\(^{125}\)

Aiming a virtual museum and exhibition to a professional audience, however, requires a different approach. While context is important in a public virtual exhibition, the legitimacy of the information and the quality of the media is of greater concern to its professional counterpart. Connection to collection databases and


\(^{120}\) *Pushing the limits*, URL: http://www.pushingthelimits.se/english/

\(^{121}\) *Trafficking*, URL: http://www.trafficking.nu/start_en.htm


library sources for references is also of great importance to the professional virtual museum. 

Also imaging has to be of better quality then what is generally presented in public virtual museums and exhibitions. Large files with zoom capabilities for detail studies would also aid scientists in their work. This without having to leave their offices, which may be on the other side of the world in relation to where the physical museum is set.

In some cases as with the *Museum of the terra-cotta warriors and horses of Qin Shihuang*, the creators have decided on making one version for the public and another *learning* version that is mainly aimed at the scholarly audience. Where in the public virtual exhibition the information is presented through interface and context, the *learning* version is more constructed like a regular information page, however, there is still a navigation and connection between various sources of information.

Even though a lot of information that would be crucial for research can only be acquired through hands-on experience with the objects, virtual museums functioning as information resources for professionals can be helpful in the selection of what artifacts to pick out for further hands-on research. This would not only make research more efficient when it comes to deciding the need to travel to study an item. It would also make the selection-process more efficient and spare objects that, thanks to the initial virtual selection, do not have to be packed, processed and studied, and in turn put into risk of being damaged.

As presented, professional, virtual museums could function as a first source of legitimate information for researchers. It could also function as an on-line forum for discussion amongst students, specialist and other professionals, however, the professional virtual museum could never compare to hands-on research of objects.

8.2.3. The Cyberdocent
As described in the chapter *What is a museum?*, *Institution of education*, museum docents are the core of the pedagogic work of the physical museum. Arranging and holding tours of the museum’s exhibitions and collections take up a large part

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126 Barton, Jane, 2005, "Digital libraries, virtual museums: same difference?", p. 149.
132 Bernier, Roxanne; Bowen, Jonathan, P., 2004, “Web-based discussion groups at stake: the profile of museum professionals online”, p. 120.
of their daily work.\textsuperscript{133} Even though museum docents preferably take part in the work with creating a virtual museum or exhibition, it would not be realistic to consider having museum docents carry out tours in a virtual exhibition, as the Internet is open for business all day and night, every day.

The audience of the virtual museum and exhibition are, however, in as much need of pedagogic aid as any audience and therefore the implementation of a cyberdocent could bridge the gap, and take over some of the tasks usually executed by museum docents in a physical environment.

The cyberdocent was first introduced in the shape of an audio guide.\textsuperscript{134} The audio guide is an automated museum docent that both increases and decreases the flexibility of the museum docent. While it is flexible in the way that it is available any time, and the tour can be taken in an order selected by the user, and usually in a varied selection of languages.\textsuperscript{135} The audio guide is at the same time less flexible in the way that the tour cannot be adapted to the audience on spot. It cannot answer questions or create discussion in the same way a museum docent can either.\textsuperscript{136} Though the cyberdocent could never replace a museum docent, it can fulfill tasks equal to that of the audio guide, and in Internet shape even more advanced functions then that.\textsuperscript{137}

The cyberdocent for the Internet could carry out similar tasks as the audio guide, holding tours through the virtual museum or exhibition as well as being flexible in language and tour route. But as Internet is a dynamic medium, tasks that would have been impossible to incorporate into an audio guide, could somewhat be part of the tasks of an online cyberdocent.\textsuperscript{138} Where the audio guide is limited to the exhibition it is designed for, the online cyberdocent can connect information widely outside of the virtual museum or exhibition in question. A cyberdocent could connect to library information as well as databases and other information available on the Internet.\textsuperscript{139} Considering the speed of the automation, the information could be provided in a click, which is more effective then the information a museum docent could provide.\textsuperscript{140}

\begin{thebibliography}{99}
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frequently asked questions could also be set up, where users could ask the cyber-
docent for help.

Even though the cyberdocent still have weaknesses in comparison to the mu-
seum docent, the cyberdocent would be developed for virtual museum use, and be
available to the audience all day, every day. To incorporate the human touch into
a virtual museum or exhibition one could also consider the idea of combined do-
cents, with a cyberdocent holding tours but with a museum docent logging in on
set hours to be available for questions and directions for users, as mentioned in the
chapter The virtual museum as a meeting place.

8.3. The personalized museum

Personalization in a museum environment is a rare occurrence. With the help of
technology and AI it would, however, be possible to incorporate personalization
in a dynamic environment such as the Internet. The virtual, personalized museum
is a virtual museum or exhibition that is personalized based the needs and interests
of the user. This personalization can, for instance, take the form of personalized
text, user interface and tours.141

At a physical museum the creation of an exhibition is limited by a range of
factors, the room of the museum being one of them, space another. In the virtual
world, however, there are no limits and restrictions in the same sense as room or
space. I will in following chapters present the possibilities of dynamic hypertext
and dynamic architecture, but I would like to begin with explaining how this per-
sonalization can be accomplished.

There are two main types of personalization. The first is of categories. In this
case the virtual museum or exhibition is created in various versions.142 It can be
based on language, where the exhibitions would be offered in various languages.
It can be based on age group, where the exhibition would be offered in various
forms for different age groups. It can be based on knowledge level, where there
may be an intermediate version as well as specialist version of the exhibition.
These are just a few examples, but the creators of the virtual museum or exhibi-
tion could themselves work out what categories would fit their exhibition the
best.143

The second type of personalization is customization, where the exhibition is
customized for the specific user, and not a category of users. This can be executed

141 Rayward, Boyd, W.; Twidale, Michael, B., 1999, “From docent to cyberdocent: education and guidance in
the virtual museum”, p. 41.
143 Deshpande, Suhas; Geber, Kati; Timpson, Corey, 2007, “Engaged dialogism in virtual space: an explora-
tion of research strategies for virtual museums”, p. 273.
on various levels. A virtual exhibition can be customized on limited functions such as searches, where a result is presented based on the information the user acquired. It can also be taken to extremes where the entire virtual exhibition would be customized for the specific user. In this sort of personalization, the AI embedded into the system requires information from the user to develop the personalized environment. This can take place in various ways, one way being that the user can contribute with information through filling in a profile, with questions regarding language, age, previous knowledge etc.\textsuperscript{144} The AI then construct a customized experience based on the information given by the user.

Another way in which the AI can require user information is through web logs. The web log would work in the background, monitoring the user’s navigation of the website, specific searches etc., to create an idea of what would be of interest to the user.\textsuperscript{145} This alternative would not require anything of the user, however, it is not an immediate system. The web log would have to monitor the user before being able to provide customized content, though, the more the user would use the system, the more specialized the customization would become.\textsuperscript{146}

8.3.1. Dynamic hypertext
In the article \textit{Virtual museums on the information superhighway: prospects and potholes} Milosavljevíc, Dale, Green, Paris and Williams discuss the possibilities of the dynamic hypertext.\textsuperscript{147} What they refer to as dynamic hypertext is texts that are adapted for the user. The text can be adapted depending on the level of knowledge the user has on the subject in question. It can also be adapted depending on age or special interest to give a few examples. Text can either come fixed in a few different options, or be completely customized for the user.

The use of dynamic hypertext is especially well suited for virtual museums and exhibitions available on the Internet, as they are placed in a dynamic environment that can constantly be adapted and changed. With virtual museums and exhibitions you can also easily connect data sources to the virtual museum or exhibition, and retrieve information from these as well as external information sources. With the help of embedded AI structures the customization of the text would take place in an instant and with a wide range of information, which would have been impossible to deliver in a PE.\textsuperscript{148}

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\textsuperscript{144} Fantoni, Silvia Filippini, 2003, “Cultural institutions and digital technology”, p. 3.
\textsuperscript{146} Fantoni, Silvia Filippini, 2003, “Cultural institutions and digital technology”, p. 4.
\textsuperscript{147} Milosavljevíc, Maria; Dale, Robert; Green, Stephen, J.; Paris, Cécile; Williams, Sandra, 1998, “Virtual museums on the information superhighway: prospects and potholes”
In the case of the virtual museum and exhibition, the dynamic hypertext could be used as part of the pedagogic work. It could partly be used for museum texts and partly for creating personalized tours of the collections of the virtual museum or exhibition. In the case of functioning as a museum text, the text could be adapted to the user based on for instance age, previous knowledge, or large letter text. Both the informative as well as the layout qualities of the text can be adapted. In difference to physical museum text, where space for text is limited, by using dynamic hypertext one can use the same sort of museum text as an introduction, but if the user is interested, additional and more informative text would just be a click away.

Previously mentioned example would be a matter of personalization through categories. All text would be written and developed in a pedagogic fashion, however, what the dynamic hypertext does is that it makes choices available, much like the choice of language with a audio guide. What the AI would do in this case of dynamic hypertext based of categories, is to establish what sort of user it is, and how to best adapt the exhibition for him. This can either be done by simply setting some fixed choices such as “student”, “professional” or “child” and have the various version of the exhibitions set up depending on category, however, it have been shown in studies that people do not like being categorized, even if the material seem to be well adapted for them. Another way of establishing user is for the website to track the user through his use of the exhibit, and along the way, as the AI collect more information based on choices and searches the user make, the AI can then adapt the exhibition depending on what seem to be in the interest of the user.

The other way in which dynamic hypertext can be used is in the case of developing customized tours of the virtual museum or exhibit. Similarly to how the dynamic hypertext operate in the example above, where it’s a matter of museums texts, the same functions are here applied to the virtual museum tour. Again, depending on the interests of the user, the AI of the virtual museum or exhibition would combine a tour for the user, with the items and themes that would be of special interest to that specific user. As with the case above, depending on the system, tours can range from specialized tours depending on category or completely customized. In the completely customized version the movement in the

\[149\] Rayward, Boyd, W.; Twidale, Michael, B., 1999, "From docent to cyberdocent: education and guidance in the virtual museum", p. 34.
\[151\] Fantoni, Silvia Filippini, 2003, “Cultural institutions and digital technology”, pp. 6, 11.
virtual museum or exhibition as well as the texts would be combined depending on possible interest.\textsuperscript{153}

There are different ways of accomplishing dynamic hypertext, depending on what sort of result one is looking for. For the most advanced type of tour, where any piece of text can be combined with any other piece of text, one would have to create a database specifically for the cause. Where the items, multimedia and themes are added, along with special information on how they are connected. When that is done it is up to the AI to learn about the user, along with information he could be interested in and combine the texts and the objects, media or themes into a completely customized tour.\textsuperscript{154}

As creating an entirely new database is consuming in both time and funding, one can also use a regular database. As most museums have digitalized large parts of their collections, they could use this sort of database as a basis for the dynamic hypertext. Though this is a more cost and time effective way to work, the dynamic capabilities will suffer. One could link the various parts of the database together through keywords, however, as it would not initially be constructed for dynamic hypertext, it would not contain any type of pedagogically developed text where any piece of text could be combined with any other piece of text. Therefore the completely customized texts and tours would not be recommended with a regular database as base, however, it could function in a customized-by-category scenario.

The idea of dynamic hypertext is highly interesting, though the technology is available, and used in other VE; it has yet to be introduced in to the virtual museums. Steps have been taken towards making several versions of a virtual museum or exhibitions, for example offering them in various languages and on public and professional levels. There is, however, a problem in categorization of groups of people. As mentioned above, in cases where it has been used in a virtual museum environment, the audience has been negative to the fact that they are to categorize themselves. The option is to let an embedded AI do the job by tracking the user and his choices. The problem in this case is that it is not an immediate service, the AI need to learn the users interest and behavior, and cannot provide customized content to the user until searches and usage of the virtual museum have taken place. If a user enter the museum, have a short look and then leaves, the AI would not have had enough material to built upon to be able to provide the user with customized content.

\textsuperscript{153} Barton, Jane, 2005, "Digital libraries, virtual museums: same difference", p. 152.
\textsuperscript{154} Milosavljevic, Maria; Dale, Robert; Green, Stephen, J.; Paris, Cécile; Williams, Sandra, 1998, "Virtual museums on the information superhighway: prospects and potholes", p. 3.
8.3.2. Dynamic architecture
As discussed in the introduction The personalized museum, the architecture of a museum often pose limiting in the creation of an exhibition, however, in the virtual room there are no such restraints. The architecture of a virtual museum or exhibition is dynamic and fluid,\(^{155}\) and one could in theory do whatever one would want to do with the virtual room. Space is not a matter, neither is room size or the height of the walls. A virtual space could be completely adapted for the virtual museum or exhibition.

Early ideas regarding the virtual museum imagined it a virtual copy of the physical museum it was part of. A virtual reflection where the virtual museums sought to be as similar as possible to the physical original. Though these virtual museums are still interesting examples, there are sides of the virtual world that have strengths not applicable in the physical world, dynamic environment being one of them.\(^{156}\)

The base of the dynamic architecture is to personalize the VE to the user.\(^{157}\) In a VE one does not have to move from room to room. Through hyperlinks in the virtual museum or exhibition one can move freely in the museum, visiting the various rooms in whatever order one would please.\(^{158}\) This in itself is a dynamic architecture,\(^{159}\) however, with the technologies of today it can be taken to another level. While links to various parts of the virtual museum or exhibition is good, it still would not necessarily contribute to constructive navigation of the VE.

To aid the user in constructive navigation, dynamic architecture could be used similarly to the dynamic hypertext, but instead of personalizing information, it would personalize navigation.\(^{160}\) Also similarly to the dynamic hypertext, this could be accomplished with the help of an embedded AI that would collect information about the user, process it, and apply it by providing the user with customized content. In this case by generating a customized tour through the rooms of the virtual museum or exhibition.\(^{161}\)

There is another way in which dynamic architecture can develop, and that is in the shape of dynamic virtual exhibitions. These exhibitions would disregard the possibilities of the physical world and completely customize an experience for the

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\(^{156}\) Charitos, Dimitrios; Lepouras, George; Vassilakis, Costas; Katifori, Vivi; Charissi, Anna; Halatsi, Leda, 2001, “Designing a virtual museum within a museum”, p. 2.

\(^{157}\) Santini, Simone; Jain, Ramesh; Corvi, Marco, 1998, “The virtual museum: an integrated text and image database”.

\(^{158}\) Charitos, Dimitrios; Lepouras, George; Vassilakis, Costas; Katifori, Vivi; Charissi, Anna; Halatsi, Leda, 2001, “Designing a virtual museum within a museum”, p. 4.

\(^{159}\) Teather, Lynne; Wilhelm, Kelly, 1999, “Web musing’: evaluating museums on the web from learning theory to methodology”.


user.\textsuperscript{162} In dynamic virtual exhibitions there would not be a fixed virtual exhibition, but much like dynamic hypertext, the virtual exhibition would be generated for the user. Rooms could be added and taken away and combined in any order. Similarly to the advanced version of the dynamic hypertext, these sort of virtual exhibitions would have to be based on the creation of a new type of database, connecting everything together, and adapting the information so that every piece of text, every object description or piece of virtual media could be combined with one another. The job of the AI would be to combine them all together. Though this is a complex piece of work, it could generate highly interesting results.

As with dynamic hypertext, the technology is currently available, but is for the time being very sparsely applied to virtual museums and exhibitions. The part of dynamic architecture that is in use in virtual museums and exhibitions today is of simple hyperlink navigation. A few cases can also be found that base their personalization on categories of audiences such as a virtual exhibition created for \textit{Carrara Marble Museum}.\textsuperscript{163} Though it is a step forward in the quest of personalizing the virtual museum and exhibition, there is no customization of content for the unique user. Some virtual museums have begun to implement library resources into their virtual museums and exhibitions. Through searches the user can find information he is looking for, however, there seem to be little implementation of AI into virtual museums and exhibitions as of today.

### 8.4. Conclusion

The prospects of the virtual museum is partly tied to the physical museums, as they contribute content and framework, but also to the development on the Internet, as that is the environment of the virtual museum and virtual exhibition. The virtual museum and exhibition are part of both. The technologies today make it possible to incorporate every principle of the physical museum in to the virtual counterpart. Since the introduction of Web 2.0 services, the Internet has developed in its tools for communication. These communication services cannot only be used in enhancing the virtual museum in to a global meeting place online, but can also aid in developing educational programs for the virtual museum. The most advanced of the prospects presented is, however, the personalization of content. Though this is something that has no equivalent in the physical world, it is a way of using the strengths of a dynamic, interactive environment such as the Internet, and implementing it into a traditionally static environment as the museum.

\textsuperscript{163} Fantoni, Silvia, Filippini, 2003, “Personalization through it in museums. Does it really work? The case of the marble museum website”, pp. 1-16.
9. Conclusions

I began this thesis by stating the question *What defines a virtual museum?* and: *What are the prospects of the virtual museum?*. The research of the definition of the virtual museum was conducted through literature on the subject as well as looking at various websites defined as virtual museums by their creators. Though there are definitions presented in the literature regarding the virtual museum, I consider them in general out of date. Internet is under constant change and new functions appear on a daily basis. As new functions appear, old are discontinued. As Internet is constantly renewing itself, so should the virtual museum and the definition of it.

The virtual museum can be defined as a source of information, mainly available on the Internet. The authenticity of the virtual museum is centered on information rather than objects, which is the case of the physical museum. The architecture of the virtual museum contains rooms rather then pages, and is navigated with the help of a dynamic interface. This dynamic interface make it possible to go from one room to another without having to follow a restricted path, as in the case of the physical museum where the architecture make it impossible to navigate freely.

Where there has been some confusion in the literature on the differences of virtual museums and virtual exhibitions, the definition above can be applied to both of them. As I researched throughout the chapter *The virtual exhibition*, the difference between them is similar to that of the difference between the physical museum and exhibition. The virtual museum is a place of greater complexity, for example, a place that contains several virtual exhibitions, or that incorporates museum principles to a greater extent. The virtual exhibition however is largely based on displaying information and material, much like its physical counterpart.

The definition of the virtual museum presented above is fully capable, I wanted to take it a step further and study if it would be possible for a virtual museum to be regarded as a museum in its traditional definition e.g. a place where material is collected, preserved and displayed, and also offers educative as well as social services as discussed in the chapter *What is a museum?*.

As discussed in *What is a virtual museum?* and exemplified in *The virtual exhibition*, the three main principles of the definition of the museum can be applied to the virtual museum. Collecting can be accomplished either by tagging Internet
data or by creating a collection of born digital material that for instance could be contributed by the museum’s users. As the born digital data would instantly be implemented into databases and stored there, the preservations issues would rather consider that of data longlivity. As file formats are coming and going, the preservation of born digital material would be aimed at keeping the databases up to date, so that they could be used and accessed even in the future. The display features of virtual museums are implemented into all virtual museums, and the accessibility of the virtual museums in comparison to the physical museum, give the virtual museum a democratic quality. As the information of the virtual museum in theory is accessible to all, they can reach audiences never possible to the physical counterpart.

In the current stage of the virtual museum, however, other sides of the museum such as the educative and social aspects, is currently not being translated to its full extent in the virtual museum context. For this reason I stated the second question of the Prospects of the virtual museum, to try to answer if it would be possible to develop these sides within the virtual museum environment, and how. Though some implementation is currently being done, these are sides of the virtual museum that can and should be developed if the virtual museum wants to be considered a museum in its own right.

In the case of applying social aspects to the virtual museum, Web 2.0 services could be used. Discussion-forums, chats, comments and direct dialog with connected museum staff would enhance not only the communication between museum professionals and their audience but also the communication between members of the audience. Just as in the case of the physical museum, the virtual counterpart should strive to become a meeting place. This would not just engage the audience but also make the virtual museum more independent.

In the case of museum education, pedagogies are currently implemented into the virtual museum when it is produced, in interface creation as well as in the production of texts and tours. Virtual museum education could, however, take a step further, adding features that are currently applied in the physical environment but rarely in the virtual environment. Where a museum docent is daily executing educational work in the physical museum such as tours and information distribution, a cyberdocent could present these services in the virtual world. Tours can either be conducted by the cyberdocent or by a connected museum docent. Teacher’s centers can be incorporated to aid teachers in how they are to present and prepare their students for the virtual museum visit.

The cyberdocent can even take a step further and provide more or less customized tours for the users of the virtual museum. This customization could be applied on as well text as navigation of the virtual space. Personalization is a field that is exclusive for the virtual museum and not applicable to the physical counterpart.
Through my studies of the virtual museum I set a definition of the term, however, as noticed by looking at old literature on the subject, the definition as well as the Internet is under constant change, and it is very well possible that the definition may look different ten years from now. While defining the virtual museum I also took the question a step further to see if it would be possible to consider a virtual museum a museum in the full definition of the word. I found that there are current virtual museums that are constructed in a sense where they live up to the three principles of what a museum is, e.g. those of collect, preserve and display.

I did, however, find that there are still limitations when it comes to more modern additions to the museum concept, such as institution of education and meeting place. Though applications are being used at various virtual museums that enhance the educative as well as the social experience, there is a lot more that could be done. Communication is one of the main strengths of the Internet, and I find it a loss for the virtual museums not using that to its advantage. When it comes to the educative part, I find it as important to contribute well-developed pedagogic material and applications to the virtual museum as it is to the physical museum. Though pedagogic work is implemented in the creation of the virtual museum, there is no continuous pedagogic work being executed. The general intent with virtual museums seems to be to create them but not maintain them.

There are of course concerns regarding the virtual museum. One the one hand concerning the frailty of Internet standards and on the other hand concerning the risk of the virtual museum turning into a source of edutainment rather then information. When it comes to concerns regarding standards, they are hard to address at this point in time. One cannot know how the Internet develops; however, there are generally standards that pose less frail then others. JPEG is an example when it comes to images. Though the longevity of standards is hard to predict, most museums have already taken the step to digitizing their collections, and therefore enforcing their material into information technology standards.

In the case of edutainment, one cannot say that this could never become implemented into the virtual museum. Edutainment is already emerging into many physical museums, and surely one can find examples of edutainment in virtual museums too. A virtual museum is, however, designed and developed by someone, and it is simply up to that institution to decide how it wish to construct their VE and implement information into it. As with physical museums, some decide to present their material in a more edutainment like fashion, where other museums prefer a more traditional approach.
10. Summary

Virtual museums are becoming increasingly frequent online, however, the definition of the virtual museum does not seem to be properly set. In this thesis, the definition of the virtual museum is researched through literature studies and by examining the current state of virtual museums online. Even though the quality of the virtual museums is generally very varied, the definition that can be applied to most virtual museums is that of the virtual museum being a source of information, generally on the Internet. The virtual museum can be distributed on various storage media, however, the form in this case would be fixed and restrained in dynamic capabilities. Through its position on the Internet, the virtual museum is theoretically accessible to all. A virtual museum presents information through multimedia, and with the help of an interface that is based on a concept of having rooms that the user navigate to experience the virtual museum. Information is as essential to the virtual museum as objects are for a physical museum. The lack of object authenticity in the virtual museum is instead replaced with the authenticity of information. There is, however, a difference between the virtual museum and the virtual exhibition. Even though they both fit into the virtual museum definition, the virtual museum is, as in the physical world, a more complex phenomenon, whereas the virtual exhibition is largely a case of display and presentation.

The virtual museum is generally considered as a virtual complement to the physical museum, however, considering the advanced technology offered today, I wanted to study whether it is possible for the virtual museum to function as a museum in its own right. Museums are defined as places that collect, preserve and display cultural heritage. They are also considered being institutions of education as well as meeting places. In examples of virtual museums given in the thesis, it is apparent that the virtual museum can live up to the main principles of the museum e.g. those of collect, preserve and display. There is, however, still problems translating the educative as well as social aspects of the museum into the virtual context. To improve these aspects, Web 2.0 services can become implemented to improve the social aspects, and to improve the educative sides of the virtual museums, cybdocents, teacher’s centers and personalization would enhance the user experience.
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Appendices

Museum of terra-cotta warriors and horses of Qin Shihuang

Figure 1. Frontpage of Museum of terra-cotta warriors and horses of Qin Shihuang. It presents the selection of public and learning edition of the museum.
Figure 2. Introduction page of the public edition.

Figure 3. Virtual exhibition example from the public edition.
“Pushing the limits” virtual exhibition

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Figure 5. Frontpage of the virtual exhibition Pushing the limits.
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Figure 7. Example of text that appears when clicking on assigned areas of the exhibition.
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Figure 10. Frontpage of the virtual exhibition The Augsburg art cabinet.

Figure 11. Example of the interface.
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Figure 13. Connection to the database within the virtual museum.
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Figure 14. Frontpage of the virtual exhibition Trafficking.

Figure 15. Example of the interface.
Figure 16. Example of a “room” in the virtual exhibition.

Figure 17. Example of a “room” in the virtual exhibition.
Figure 18. Photography from the physical exhibition.

Figure 19. Clipboard “room”.
Figure 20. Discussionboard for users.

Figure 21. References and links for further research.