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1. Executive summary

This document describes the work currently in progress within the Virtual Museum Transnational Project (V-MUST.NET), and specifically within the Work Package 2, dedicated to the creation of a common language in the Virtual Museum domain. This deliverable describes the adopted methodology used to build an online common database that collects terms and definitions. It also defines the main 8 categories chosen to initially classify the domain and used as “glossaries” to collect related-terms.

2. Introduction

Virtual Museums (VM) are a new model of communication that aims at creating a personalized, immersive, interactive way to enhance our understanding of the world around us. The term VM is an acronym that comprehends various types of digital creations. Unfortunately, although its idea is not new, development and implementation researches have not, thus far, brought Europe to be the leader in this field, as expected. This sector has not reached a sufficient level of maturity, in contrast to the Cinema or Game sectors, to be as widespread as it should be. Moreover in Europe, unlike in the USA, we still face a disconnection between the research, that develops tools with little interest in their wide application, and the industry, that builds ten-year plans addressing the market. The Virtual Museum domain is the perfect application area where all these problems need to be solved for the real benefit of the community. A European leadership can be achieved only by going beyond the actual research fragmentation, by soliciting a common effort in assessing limitations emerging from all Virtual Museum experiences consolidated so far, finding proper solutions, assessing them through experimental activity and finally consolidating a transnational network. V-MUST.NET bridges technological domains, archival, social and cognitive sciences to advance the state-of-the-art of digital preservation, for future persistence. It creates finally a virtual research area, identifying
research areas for further development and ideal scenarios for the Virtual Museum of the Future, even through the creation of a quality evaluation procedure. The second Work Package aims at building the strategic forum for the entire project, identifying terminological needs, problems and requirements of the Virtual Museum domain, through surveys and debates. It also defines basic criteria for further analysis that will be carried out during the project. It will act as strategic stakeholder communication vehicle.

In the context of a network of excellence, a variety of organizations possessing expertise (be that of a scientific, theoretical, methodological, technical or other nature) are brought together in order to discuss the state of the art in their field, exchange know-how, identify areas where further research is needed, coordinate standardization actions etc. In all these tasks there is one fundamental requirement: that a common language is agreed upon, on which all consequent exchanges are based. At present it is not clear that this terminology is unambiguous and common. It is the goal of this task to specify this common language early on in the life of the network. This language will be used throughout the life of the network and based on this experience it may be incrementally enhanced as required. The relevant partners will discuss the distinction between virtuality and e-reality and specify which levels of interactivity and immersion will be required in the scope of V-MUST.NET in order to classify a specific case in either category. The result of this discussion will be the list of terms relevant to the scope of the network and the list of Virtual Museum types that will be used as input for the Third Work Package, dedicated to creating the semantic level of the project and to define Virtual Museum Theory.

3. Building Language Capacity

Virtual Museums technologies are still rapidly evolving and diversifying. The massive research and development process has reached a point which makes a pan-European structuring and integrating effort an absolute necessity. Moreover, Virtual Museums is the application domain of several different research types: content-related research, cognitive sciences, Information and Communication Technologies (ICT), and more specifically
interactive media management, Technology Enhanced Learning (TEL), serious and educational games, business studies. Virtual Museums are built as an aggregation of content (digital libraries of 3D models, texts, images, geospatial data, audio, videos, etc.) and they are based on the use of ICT solutions for their development and deployment. In such a multidisciplinary research field the standardization of a common terminology is a necessity to enable researchers to develop and implement the Virtual Museum environment to its full potential, knowing that the lexical units they use in their research represent the cognitive meaning they require in the given assigned field of their discipline.

4. Methodology
The consortium has decided this document to define the terms that is related to Virtual Museum domain and meanwhile need to have a common understanding among both technology partners and museum/heritage partners. In addition to terms related to concepts being developed through V-MUST to be used in the context of VM domain. Hence this document will be updated regularly during the life time of the project.

The Definitions are divided into two sections the first section includes terms that are mainly related to the classification of Virtual Museums. The classification is done based on different categories, under each category there are definitions of each type under this category. The second section includes all general terms that are related to Virtual Museum domain.

CATEGORIES
A great afford was therefore put in the definition of main categories that would serve as a primary reference both for the project initial glossary and for the future classification of the virtual museums.

The choice and strategy has been oriented to the creation of categories that would be general enough (high conceptual level) to explain without misunderstanding, all possible concepts related to the domain.
The idea has been to concentrate first upon the definition of such categories and then to identify types and sub-types and finally general terms related to the category. We have therefore followed an initial hierarchical structure that also has provided the possibility to create many-to-many relations. Below the general strategy and structure adopted:

CATEGORIES

MAIN CATEGORY 1

TYPE 1.1

SUB-TYPE 1.1.1
SUB-TYPE 1.1.2
SUB-TYPE n.

TYPE 1.2

TYPE 1.n.

MAIN CATEGORY 2

TYPE 2.1

SUB-TYPE 2.1.1
SUB-TYPE 2.1.2
SUB-TYPE n.

TYPE 2.2

TYPE 2.n.

VIRTUAL MUSEUM TYPES

The methodology was based first of all on discussion between field specialists about the best term for categories, the definition of which they agree upon. The sequence of the process is similar to that required by standardization procedure: first the concept, then several relative applications /installations and projects that provide a clear example of the defined term.

The “definition” methodological approach, involved the revision of a term, its corresponding definition and, in the last stage, the approval of the lemma (term and definition).
The work was based on peer review and discussion among the experts belonging to different disciplines involved in V-MUST: archaeologists, experts in social sciences and design, communication experts, ICT researchers. This also was vital for the design of the database architecture and functionalities as it should not only enable, but also build upon the comments and revisions the experts have proposed on the terms and definitions.

In order to enable such a discussion and to preserve it for future further updating and developments, an online Content Management System was developed, based on an open source CMS: Drupal, currently accessible at http://v-must-dev.cineca.it/. In the general strategy of the project, it was designed to be one of the services offered by V-MUST PLATFORM and, on the other side, a reference point for the online V-MUST PORTAL.

This approach is clearly leading the lexicalization (terminological) discussion towards a strong definition by context criterion; the study of terms that is primarily concerned with organizing them by the context in which they are. The interaction between the different field experts assures a multi-discipline approach which better determines the context of the term.

5. Terminological database architecture and functions
The tool for building the terminology has been created on a customization of Drupal CMS. The database is actually a community site where users can collaboratively gather all proposed terms, discuss them, modify them, organize them and finally promote terms and definitions to the final state. The tool offers two main functions for term editing, corresponding to the two main user roles: editor and taxonomist
1) Definitions creation and discussion: every user in with both the editor and taxonomist role can create a term definition. This is an actual database record holding term name, proposed definition, proposing expert and project partner, term state (proposed, draft, approved), link with other term. The definition page has a commenting system enabled for term discussion. The definitions can be edited with versioning enabled. Every term revision is saved in the database and the term can be reverted to its previous state.
2) Terms in glossary: every user with a taxonomist role can edit the hierarchy of the terms created with its definition. Every term in the glossary can have a relationship with other terms and several different synonyms.
A tracking system allows users immediately to spot new terms added in the tools. Similarly a recent comments lists the discussions regarding the term definitions.
Alongside terms editing and discussion traditional discussion forums are available: a general V-MUST project forum and a single forum for every term category.
Typical community features are available: browsable users profile, user pictures, users' recent posts and comments, personal contact form, who's online box for nearly real time collaboration.

6. Guidelines

The earliest step to start any scientific debate and discussion on a clear basis is the adoption of unambiguous, shared definitions for every term used. Although ambiguity is an essential and useful feature of common language, when dealing with logics, it is a dangerous factor which can jeopardize the developing of a correct discussion. Nevertheless, in the context of an evolving discipline, terms are often lacking clear definitions or they are unshared and even contentious. In such a situation, some basic guidelines have been adopted by the terminology team, to draw up the basic glossary. The definitions adopted should, whenever possible, match some requirements:

Definitions:
- should be **as general as possible, in order to cover all current semantic domains** associated to terms, if presenting relevant common elements;
- In case of different, not overlapping or conflicting meanings in the current literature, definitions should be **based upon the most relevant/updated bibliographic references**;
- should **avoid whenever possible reference to other unclearly defined terms**;
- **references** should always be **quoted** clearly in relation to definitions.
Undoubtedly, definitions will need to be modified and updated in different ways during V-MUST.NET project, and in this sense, the first presentation of terminology has to be considered as a draft work, but it is nevertheless necessary to rely on a solid and unambiguous basis (even if temporary) to start any wide-spread scientific discussion.

**Typology**

Categories' structure is directly connected with V-MUST.NET Work Package 3 and the identification of the various typologies of Virtual Museums. The strong definition by context criterion, followed in this deliverable, is indicative of the “industry's” trends towards an initial categorization of different types of Virtual Museums.

### 7. Classification

**Virtual Museum**

According to the ICOM Statutes, adopted during the 21st General Conference in Vienna, Austria, in 2007: A museum is a non-profit, permanent institution in the service of society and its development, open to the public, which acquires, conserves, researches, communicates and exhibits the tangible and intangible heritage of humanity and its environment for the purposes of education, study and enjoyment. ([http://icom.museum/the-vision/museum-definition](http://icom.museum/the-vision/museum-definition)).

Starting from ICOM definition of “Museum”, V-MUST is currently trying to define a “Virtual Museum”. The discussion is leading to obtain an essential and generic definition of a virtual museum, enriched with the specific definitions and uses of the term in the different domains (ICT, heritage, etc.). We report here the evolving definition of the term.

**[Virtual Museum ver 1.1]** A *Virtual Museum* is a digital creation organized on a permanent or temporal basis in the service of society and its development, open to the public, which acquires, conserves, researches, communicates and exhibits, in a digital way, the tangible and intangible heritage of humanity and its environment. It uses various forms of
interactivity and immersion, for the purpose of education, research, enjoyment and enhancement of visitor experience.

[Virtual Museum ver 1.2] A Virtual museum is a digital creation accessible by a public, focused on tangible or intangible heritage. It uses various forms of interactivity and immersion, for the purpose of education, research, enjoyment, enhancement of visitor experience.

[Virtual Museum ver 1.3] A Virtual museum is a communication product accessible by a public, focused on tangible or intangible heritage. It uses various forms of interactivity and immersion, for the purpose of education, research, enjoyment, enhancement of visitor experience. In Digital Heritage it is mainly intended as a Digital creation.

[Virtual Museum ver 1.4] A Virtual museum is a communication product made accessible by an institution to the public that is focused on tangible or intangible heritage. It typically uses interactivity and immersion for the purpose of education, research, enjoyment, and enhancement of visitor experience. Virtual Museums are usually, but not exclusively delivered electronically when they are denoted as online museums, hypermuseum, digital museum, cybermuseums or web museums.

Although the definition is still in progress, within WP3 have identified key words (selected by a group of experts who have indicated the terms they felt critical to the definition of the Virtual Museum¹), which seem to indicate the key criteria for the future definition of the term “Virtual Museum”.

Keywords:

¹ The expert group, coordinated by Susan Hazan and Sorin Hermon, met in Cyprus at the Cyprus Institute from the 22nd to the 25th Jan 2013, during a workshop on: “Innovative Approaches for Sharing Cultural Heritage Knowledge: Virtual Museums, Europeana and Digital Libraries”.

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Further developments in terms of intrinsic dimension of the “Virtual” definition pertain the overlapping between the same concept of “Virtual” and “Digital”. We can report some of the main issues debated:

1. An accent may be placed on the definition of “Experience” which involves both the principle of pleasant and rewarding moment when visiting a museum in terms of emotional involvement and the enhancing learning occasion given by the content assessed.

2. Some comment that a possible shift from “Virtual” to “Digital” may count other and various heritage professionals. That because the term “Digital” may be comprehended into the macro-category of “Virtual”, being digital assets and applications either virtual from a content point of view or from an interaction mode point of view.

Interesting is to investigate more on the relationship between such terms and “Interactive”. It is quite popular and it may reduce the risk that people interpret “digital museum” as a database/index type of service, like websites and services like Europeana.

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2 The expert group, coordinated by Sofia Pescarin, met on a live streaming conference held between September and December 2013 involving the following experts: Sarah Kenderdine, Maria Roussou, Francesco Antinucci, Eva Pietroni, Susan Hazan, Hugh Denard, Maurizio Forte, Alonzo C. Addison, Anna Arici, Marco de Niet, Mauro Felicori, Valter Ferrara.
Categories

These are main categories identified, through which it is possible to classify a Virtual Museum:

1. **By Content**
2. **By Interaction technology**
3. **By Duration**
4. **By Communication**
5. **By Level of immersion**
6. **By Format > distribution**
7. **By Scope**
8. **By Sustainability**

Classification by Content

As in the other cases, any main category represents essential and particular aspects of Virtual Museums. The specific peculiarities have in fact an impact in a part or in the entire digital pipeline of creation, dissemination and preservation of a Virtual Museum.

As in the case of Museums, also Virtual Museums can be classified according to its content. Since it is very difficult to set up all kind of possible museums by their content (see as an example: [http://en.wikipedia.org/wiki/Category:Types_of_museum](http://en.wikipedia.org/wiki/Category:Types_of_museum) which seems still not complete, as lacking of Music Museums), a classification by content seems to be necessarily open (i.e. to which category would belong, for instance a VM such as “fashion and textile museum” or “Valentino Garavani Virtual Museum”)

Types of Virtual Museums defined by their content (identified in VM survey [Del 2.3]) are:

- [Archaeology Virtual Museum]
- [Art Virtual Museum]
- [Ethnographic Virtual Museum]
- [Historical Virtual Museum]
Classification by Interaction Technology

This category includes all Virtual Museums defined in accordance with the type of interaction. [Interaction] is related to the user capability of modifying the environment and receiving a feedback to his/her actions. Both immersion and interaction concur to realize what is one of the main goals of a virtual experience: presence, i.e. the belief of actually being in a virtual space. [Carrozzino & Bergamasco 2010].

This category includes 2 main categories: interactive and non-interactive VMs.

- **Interactive Virtual Museum** [LINK]: An Interactive Virtual Museum is a Virtual Museum responding to a user's input [ref. Oxford Dictionary]. It includes [device-based interaction], [Natural Interaction] and [gesture-based interaction]:
  1. **Device-based interaction** [LINK]: refers to interaction with an application which is facilitated through the use of an input device, such as, but not limited to: keyboard, pointing devices (mouse), composite devices (game controllers, Wiimote), video and imaging input devices (webcam, motion sensor, scanner), and/or audio input devices (microphone).
  2. **Natural interaction** [LINK]. Natural Interaction is a type of interaction that follow an approach to human-computer interaction which uses the natural behaviors (movement, gesture, speech) of the user to interact or "communicate" with an application. The interaction interface is meant to be invisible, or become invisible
through naturalized interaction (requiring limited learning for interaction), and based on nature or natural elements [Blake 2010]. Ideally, natural user interfaces are designed to use natural human behaviours to interact directly with content, and may be facilitated with devices such as multi-touch surfaces (iPad or PixelSense) or motion detection sensors (Wii or Kinect). Bill Buxton, a Principle Researcher for Microsoft and pioneer in human-computer interaction has suggested that an interface is truly natural when it "exploits skills that we have acquired through a lifetime of living in the world" [Buxton, Bill 2010]. It includes:

- [Free-form gestural UI] for example a Kinect game.
- [Speech-based interaction]

3. **[Gesture-based interaction]**: Gesture-based Interaction is a type of interaction that allows users to communicate with a digital system using gestures. A gesture can here be defined as any human movement that conveys meaningful information, such as waving with the hand or raising the eye brows. With gesture-based interaction it is often easier to achieve a more natural and intuitive user interface compared to for example device-based interaction using mouse and keyboard. It includes:

- [Touch user interfaces (TUI)] gestures that are part of all modern smartphone UI and other touch devices: (e.g. “Slide to unlock” gesture).
- [Tangible User Interface] additional tools which allow to asses content interactively and dynamically (i.e. “Tangible Natural Interface” Virtual Museum developed by Gagarin - see Del 2.3. Annex 4)

- **[Non-Interactive Virtual Museum]** [LINK]: Assemblage of digital media providing the user passive (including emotional, intellectual and imaginative) engagement.

Other relevant Terms in this category are:

- **[Gesture]**: any physical movement that a digital system can sense and response to without the aid of a traditional pointing device such as a mouse or stylus. A wave, a head nod, a touch, a toe tap, and even a raised eyebrow can be a gesture (Dan Saffer, “Designing gestural interfaces” )
- **[Interaction Design]**: Interaction design is a Software Development related aspect, and is concerned with defining the complex dialogues that occur between users and computer and how the interface should look like to achieve the aimed user experience.

- **[Human Computer Interaction (HCI)]**: is a term that defines the study and planning of interactions which occur between users and computers by making the latter more usable and effective to users’ needs. This discipline often refers to other fields such as computer science, behavioral science, and design and together try to define and set up methodologies and processes for designing and implementing interfaces - both web, mobile and physical installations - techniques for evaluating and comparing interfaces, developing future models and criteria for interaction.

- **[Multimodal interaction]** provides the user with multiple modes of interfacing with a system by means of several distinct tools for input and output of data (Oviatt, 2002). Example: A VM with multimodal interaction could combine a visual modality (e.g. a display, keyboard, and mouse) with a voice modality (speech recognition for input, speech synthesis and recorded audio for output). REFERENCES Oviatt, S. (2002) Multimodal interfaces. In Jacko J. & Sears (Eds.) A Handbook of Human-Computer Interaction. New Jersey: Lawrence Erlbaum.

- **[Tangible interaction]**, or [tangible user interface] (TUI), in an approach to interaction that allows a user to interact with digital information through their physical environment. Tangible interaction was first defined in 1992, when Durrell Bishop created the Marble Answering Machine [Smith 1995], in which a marble was used to represent a message on a telephone answering machine. Dropping the marble back into the dish would replay the message or return the call. Since then, tangible interaction has evolved to include new interfaces, including "smart objects" which are physical objects that have been embedded with sensors that collect information associated with interaction and link it with the associated application [Johnson, Levine, Smith 2009].

- **[User Experience]** User experience (abbreviated as UX) is how a person feels when interfacing with a system. The system could be either a website interface or a web
application, desktop installation or finally a mobile product. It is generally characterized by main features related to human-computer interaction (HCI) disciplines. Compared to many others, UX is newly-born: the term “user experience”, coined by Dr. Donald Norman, relies upon the concepts of usability, interaction design, visual studies and information architecture. According to the ISO definition user experience includes all the users’ emotions, beliefs, preferences, perceptions, physical and psychological responses, behaviors and accomplishments that occur before, during and after use.

- **[User Interface design]**: the process of developing any technical tool with focus on usability, **[user experience]** and interaction. A user interface design process involves a wide array of activities, from user research to graphic design.

- **[User Interface metaphor]**. A set of visuals, actions and procedures that help a user understand a target domain (e.g. a computer) by exploiting Knowledge that the user has of a source domain (e.g. office work). One of the most famous user interface metaphors is the *desktop metaphor*, which introduced the idea that working with a computer is like working at a desktop with folders, a file cabinet, a trash bin etc. Even though frequently criticized for being outdated and for hindering the development of new innovative user interface paradigms, user interface metaphors remain a fundamental component of most modern operative systems.

### Classification by Duration

This classification contains terms related to the timing of a Virtual Museum and the consequences in terms of technology, content, installation, sustainability of the projects.

- **[Periodic Virtual Museum]** A Virtual Museum which is playable not continuously, but according to specific time intervals.
Classification by Communication
This category collects terms related to the type of communication style used to create a Virtual Museum. From the survey carried out during the 1st and 2nd year of V-MUST [DEL. 2.3], Virtual Museums can be classified in accordance to the following type of communication:

- **[Descriptive Virtual Museum]** a Virtual Museum characterized by a mode of communication in which events, monuments, artifacts, artworks, customs or beliefs are defined, described and interpreted by a "Sender" who aims at informing and making aware the "Receiver". Description or Exposition may also rely on schematic/conceptual representations via charts, concept maps, ontologies, outlines, etc... This mode of communication also refers to the organized presentation of items displayed in the form of Exhibitions (temporary or permanent).

- **[Narrative Virtual Museum]** a Virtual Museum that uses a mode of communication in which the "Sender" provides information about events, monuments, artifacts, artworks, customs or beliefs by arranging them in a sequence (e.g. chronological), in order to create an account of a subject by the "Receiver's" side. As with exposition, narration includes description and interpretation and it may also rely upon/encompass some form of schematic representation (e.g. outline) of facts and figures.

- **[Dramatization-based Virtual Museum]** a Virtual Museum where the "sender" delivers a message/information by reconstructing and presenting events, novel stories, actions and items in a capturing and engaging way so as to deeply involve the "receiver"
Classification by Level of Immersion
In this glossary, terms related to the level of immersion have been added, following the main classification proposed by Bergamasco in 2010 [Carrozzino, Bergamasco, 2010].

- **[Immersion]** is here defined as "the extent to which the actual system delivers a surrounding environment, one which shuts out sensations from the ‘real world’, which accommodates many sensory modalities, has rich representational capability [...]" [Slater, Wilbur, 1997].

- **[Immersive Virtual Museums]** a Virtual Museum communicating the content by means of immersive technology, making the user feeling to be immersed in a surrounding environment, shutting out sensations from the ‘real world’. From user perspective, as it emerged from Archeovirtual 2011 evaluation [see Deliverable 7.2], level of immersion is connected not only with the technology used, but also with the type of communication used which contributes to create an experience [narrative virtual museum] and [dramatization-based virtual museum]. It includes [high-immersion Virtual Museum] and [low-immersion Virtual Museum]:
  - **[High-immersion Virtual Museum]** a system communicating the content by means of high immersion technology such as a CAVE with a multichannel sound system [Carrozzino & Bergamasco, 2010].
  - **[Low-immersion Virtual Museum]** a system communicating the content by means of low immersion technology, such as an immersive workbench [Carrozzino & Bergamasco, 2010].

- **[Non-Immersive Virtual Museum]** a Virtual Museum communicating the content by means of non-immersive technology, such as a regular desktop computer with stereo speakers [Carrozzino & Bergamasco, 2010].

Latest on this classification (2014), it is relevant to add some further studies referring to the concept of “Immersion” in comparison with the concept of “Presence”. The feeling of a person who, by interacting with a computer system, becomes incorporated within that system is an interesting area of study from a cognitive viewpoint. It is also an important
area of experimentation for the computer scientists working in the field of virtual environments since the user’s attitude towards that no-real place determines the degree to which it will be affected by what he sees, hears, and feels, becoming therefore absorbed into the virtual world – finally empowering his level of indirect learning. Various definitions (Murray 1997; Nechvatal 1998; Slater 1999) essentially describe the sense of being encapsulated, surrounded and enclosed in either something physical or they implies mental and stimulating activity of feeling part of an alternative reality. Although many digital scholars and humanities researchers also try to dived the concept of immersion into categories (Adams 2014; Staffan and Holopainen 2004), recently the term “Immersion” is always more intended in accordance with the definition of the individual's psychological state which involves impressions and emotions; thus not only in relation with the technology used. That has been made possible also thanks to user experience evaluation carried out at “Archeovirtual expo” (ed. 2011, 2012), Paestum (Italy), which saw the immersion category taking the stage and revealing its relationship with emotional aspects (Gockel et Al. 2013, Pescarin et Al. 2012, Pescarin et Al. 2013). That obliges to split the definition in two:

- **Sensory involvement**: It stands for the personal involvement and engagement towards the artificial environment stimulating both the emotional background related to that artificial environment of an individual and his mental state of perceiving himself to be included in, enveloped by.

- **Sense of Presence**: it stands for the belief that individual is present in the artificial environment generated by the computer. That is possible to study by following the categories like visual features of the virtual environment itself, the grade of isolation from the physical environment and the kind of natural gestures in interaction and self-control in the virtual environment. (Witmer, Singer 1998, Roussou 2002a, Bailenson et Al. 2006).

In these two cases the classification of Virtual Museums follows a ranking method, assigning LOW up to HIGH values, in accordance to the grade of involvement and feeling of being present.
Classification by Sustainability level

Sustainability is one of the key aspects of the V-MUST project, since one of the negative experiences reported in the creation of Virtual Museums is the lack of policy and strategy regarding the future persistence and sustainability of applications (hardware/software solutions), but also of digital and multimedia datasets and assets that are not preserved for future re-use or exchange. Sustainability is connected with VM [reusability], [portability], [maintainability] and [exchangeability]. It also include the concept of [accessibility] ([preservation] in some sort of repository, accessible and visible to some users)

- **[Re-usable Virtual Museum]**: a Virtual Museum which is fully or partially re-usable in other digital applications. Since a Virtual Museum, in the Digital Heritage domain, is a combination of digital content, software and hardware, the kind of re-usability might regard one or all those elements.
  - **[Fully-Reusable Virtual Museum]**: Virtual Museums that are totally re-usable in terms of installations setup, preservation of multimedia assets, re-usability of software tools and of creation pipeline.
  - **[Partially Reusable Virtual Museum]** Virtual Museums that are only partially re-usable, as referred to installations set-ups, multimedia datasets, software tools, creation workflow:
    - **[Re-usable VM setup]** Re-usability of an entire Virtual Museums (software and hardware solutions).
    - **[Re-usable multimedia]** Re-usability of multimedia content (i.e. text, video, audio)
    - **[Re-usable digital content]** Re-usability of digital content (i.e. 3d models, textures, etc.)
    - **[Re-usable metadata]** Re-usability of metadata connected with objects
    - **[Re-usable software]** Re-usability of software and tools the virtual museum is made of. The re-usability of the software is often connected with the use of open source solutions.
• **[Re-usable VM workflow]** a Virtual Museum that preserves its creative, digital workflow (i.e. containing the process that have led to the creation of the VM, storyboard, data connection to the story, etc.)

• **[Non re-usable Virtual Museum]** Virtual Museum that is not re-usable (i.e. a virtual museums developed using commercial software, distributed or installed as a binary application with content not available).

Other relevant terms in this category are:

• **[Accessibility]** of Virtual Museums is determined by how easy audience can reach and use them. More generally, in terms of digital content it refers to how users can reach, examine, and access digital objects.

• **[Digital Archiving]** The process of backup and ongoing maintenance of digital objects and the associated software and hardware, as opposed to strategies for digital preservation (Source: DPC Handbook)

• **[Digital Library]** a possibly virtual organization that comprehensively collects, manages, and preserves for the long term rich digital content, and offers to its user communities specialized functionality on that content, of measurable quality and according to codified policies. (possibly add Digital Library System and Digital Libray Management System as reference point out). [The DELOS Manifesto from DELOS NOE, March/April 2007 [http://www.delos.info/ - http://www.dlorg.eu/](http://www.delos.info/)]

• **[Ex-changeability]** possibility of a virtual museum to be exchanged, as a complete set-up or as a specific sub-set (digital content, software, etc.)

• **[Long term]** In the context of virtual museums, “long-term” is not defined as a specific period of time. Also in the context of Digital Preservation, it is not strictly defined: in (Verheuil 2006: 20) it means “five years or more”, in (Research Councils UK 2008:6) “Data should normally be preserved and accessible for not less than 10 years for any projects, and for projects of clinical or major social, environmental or heritage importance, the data should be retained for up to 20 years, and
preferably permanently within a national collection, or as required by the funder's data policy."

More generally in (CCSDS 2002: 1-11) "a period of time long enough for there to be concern about the impacts of changing technologies, including support for new media and data formats, and of a changing user community, on the information being held in a repository. This period extends into the indefinite future."

- **[Maintainability]** the ability of a Virtual Museum to be easily maintained and preserved (see [digital preservation]) for a [long time]. In hardware side it refers to the availability and capability of fixing any malfunction that can appear to the VM. In software side it usually refers to the availability of updates, support, and compatibility with operating systems. Regarding Content Maintenance, it includes activities "to ensure:
  - A robust computing and networking infrastructure
  - Storage and synchronization of files at multiple sites
  - Continuous monitoring and management of files
  - Programs for refreshing, migration and emulation
  - Creation and testing of disaster prevention and recovery plans
  - Periodic review and updating of policies and procedures" (ALA 2007)
- **[Metadata]** Metadata are structured information about resources on the specific cultural heritage object and their purpose include description, management, resource recovery, preservation, curation and rights management amongst other. (Int. J. Digital Library, 2005, 5: 179-192 Digital Object Identifier (DOI))
- **[Portability]** The category refers to all the VM applications whose software or hardware components are not publicly available, whatever the reason (technical need or political choice) of such lack of availability, but which can be potentially fruited in any place at the same conditions, without a binding link between the application's physical placement and its contents
- **[Preservation]: Digital Preservation** is the process of preserving digital assets used in Virtual Museum domain for the longer period possible. In a wider sense, it is
a “set of activities required to make sure digital objects can be located, rendered, used and understood in the future. This can include managing the object names and locations, updating the storage media, documenting the content and tracking hardware and software changes, to make sure objects can still be opened and understood” (source: http://www.digitalpreservationeurope.eu/what-is-digital-preservation/).

"Digital preservation combines policies, strategies and actions to ensure access to reformatted and born digital content regardless of the challenges of media failure and technological change. The goal of digital preservation is the accurate rendering of authenticated content over time." (ALA 2007:2)

It includes "the act of maintaining information, in a correct and Independently Understandable form, over the Long Term" (CCSDS 2002: 1-11), and "all activities concerning the maintenance and care for/curation of digital or electronic objects, in relation to both storage and access." (Research Councils UK 2008: 6)

• **[Repository]** In Computing, a Repository is the place where data are gathered, usually from multiple sources, and stored together with the related metadata. In VM domain it is more related to digital media and resources video, images, 3D, etc.

  • **[Versioned repository]** A central place in which an aggregation of data is kept and maintained in an organized way. A revision control system is used to track the changes to the data. The changes are identified by a number or a letter code termed as "revision number", the date they were applied and a description of the changes (optional). The revisions can be compared, restored and in specific file types merged. An example of a versioned repository is SVN (SubVersion).

  • **[Un-versioned repository]** A central place in which an aggregation of data is kept and maintained in an organized way. In the general sense this is a data directory that does not keep version information and previous revisions. In this way the user edits cannot be tracked and edited. Example are: WebDav, Dropbox, FTP
• **[Reusability]** This term can be used for content, software or hardware of a virtual museum. Any of those components is reusable when it can be utilized in a different VM with no need to rebuild or redevelop this component.

**Classification by Type of Distribution**

This category collects terms related to the level of distribution of a Virtual Museum. Two main types have been defined, while several sub-types have been added in this version of this deliverable:

- **[Distributed Virtual Museum]** This category includes all Virtual Museums distributed in any format and technology, including: **[Mobile Virtual Museum]** is a virtual museum that can be moved from location to another. It is designed to be installed and dismantled easily.

  - It may include VM applications available for mobile devices (iPhones, Smart Phones, Tablets), independently to the accessibility of the application on line or off line. **[Off line distributed Virtual Museum]** This type of "Distributed VM products" include all products distributed in CD, DVD, Blue Ray or other off line supported formats. These Virtual Museums have been often called in the past “multimedia product” **[On Line Virtual Museum]** The term on-line Virtual Museum, that was first used by Tsichritzis and Gibbs [Tsichritzis, Gibbs 1991], describes a museum designed in the nominal world of a computer and existing in the Internet, giving the visitor the illusion of being present in an actual museum [Mateevitsi et al 2008]. Often this term is referred to digital on line copies of real museums or of their collections.

- **[Non distributed Virtual Museum]** It comprehends all Virtual Museums conceived to be not distributed, but only run in specific installations, according to institutional decisions. It includes:
  - **[On Site Installation]** applications whose software or hardware components are not publicly available, whatever the reason (technical need...
or political choice) of such lack of availability, and only placed in a particular site someway connected to their content.

- **[Portable Virtual Museum]** applications whose software or hardware components are not publicly available, whatever the reason (technical need or political choice) of such lack of availability, but which can be potentially fruited in any place at the same conditions, without a binding link between the application's physical placement and its contents.

**Classification by Scope**

Scope glossary is conceived to be focused on the purpose of a virtual museum. This in fact can have a great impact on the technological, communication, and business plans. The scope of the VM refers to its purpose (whether educational, entertainment, experiential); its audience (an educator, a student, a physical or virtual visitor, and what age, gender and familiarity with the content do they have); and what the VM represents, (an historical event, a complex of buildings or an artwork/artefact). This category includes [educational virtual museums], [entertainment virtual museums] and [research virtual museums] with sub-types.

- **[Educational Virtual Museum]**: All VM applications that have been conceived and implemented having in mind specific instructional purposes; these applications have clear and well-defined educational objectives and are directed to a well set up and identifiable target population which possesses definite prerequisites; they are often thought to be used in formal educational settings (schools; Universities, professional training...).

- **[Edutainment Virtual Museum]** All Virtual museums that use a gaming environment to convey specific information, trigger and foster learning. The term edutainment was used as early as 1948 by The Walt Disney Company to describe the True Life Adventures series. The noun edutainment is a neologistic portmanteau used by Robert Heyman in 1973 while producing documentaries for the National Geographic Society. It was also used by Dr. Chris Daniels in 1975 to encapsulate the theme of his Millennium Project. This project later became known as The Elysian...
World Project. To Buckingham and Scanlon [Buckingham and Scanlon 2000] “Edutainment”, is a hybrid genre that relies heavily on visual material, on narrative or game-like formats, and on more informal, less didactic styles of address. The purpose of edutainment is to attract and hold the attention of the learners by engaging their emotions through visual stimuli full of vividly coloured animations. It involves an interactive pedagogy and, in Buckingham et al’s words, totally depends on an obsessive insistence that learning is inevitably “fun”. Educational entertainment is any entertainment content that is designed to educate as well as to amuse. Content with a high degree of both educational and entertainment value is known as edutainment. Edutainment is a growing paradigm within the museum community. This approach emphasizes fun and enjoyment, potentially at the expense of educational content (Zühal Okan, 2003)

- **[Entertainment Virtual Museum]** VM applications that have been conceived and developed for the users’ fun and enjoyment. They nevertheless may convey significant and valuable information on cultural heritage, thus also sustaining informal learning processes.

- **[Enhancement of visitor experience]** concerns VM applications that provide additional or complementary information to a non-virtual museum.

- **[Promotional Virtual Museum]** applications that are aimed at advertising and promoting specific cultural heritage items. They are designed and implemented with the primary aim of capturing and maintaining attention until the main promotional messages are passed through. Such applications may greatly vary in their approach depending on the target population specifically addressed.

- **[Research Virtual Museum]** VM applications that are meant to support and enhance research. It also includes applications that, due to their innovative character, may sustain research in other related fields such as: ICT, augmented reality, Artificial intelligence, Virtual Worlds and Serious Games, Geography etc... The considered applications are often prototypes and demos endowed with specific innovative functionalities and can cover specific issues.
Other relevant terms:


- [Learning analytic] Learning analytics is the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs. Reference: Definition agreed during the 1st International Conference on Learning Analytics and Knowledge, Banff, Alberta, February 27–March 1, 2011, as cited in George Siemens and Phil Long, "Penetrating the Fog: Analytics in Learning and Education," EDUCAUSE Review, vol. 46, no. 5 (September/October 2011).


Other relevant terms

The following terms are presented here and will be updated in the next version of the deliverable:


- A [legacy system] is an old method, technology, computer system, or application program that continues to be used, typically because it still functions for
the users’ needs, even though newer technology or more efficient methods of performing a task are now available. A legacy system may include procedures or terminology which are no longer relevant in the current context, and may hinder or confuse understanding of the methods or technologies used.


- **[Real-time 3D]** in Computer Graphics, Real-time 3D is concerned with producing and analyzing 3D scenes in real time, frame by frame depending on the user input, using the Graphics Processing Unit. Real-time 3D is a very important aspect in applications like video games where user interaction in running time is an important part of deciding what to be drawn.

- **[Reconstructed Model]** A 3D model that has been created based on the shape and appearance of a real object. The reconstruction is done either by technological means as 3D scanning (see **[Sampled Model]**) or by scientific data such as architectural designs and reference images.

- **[Remote visualization]** means interactive viewing of scientific data sets over the web. Because scientific data sets are in the gigabyte size range, it is difficult to send the entire data set over the network. Extraction, processing, network latency and rendering add up and make the proposition of near real-time interactive visualization a challenge. Moreover, the client will have a limited amount of memory and CPU power for viewing and interacting with the data.

- **[Semi-automatic content tagging]** A process to add content keywords or phrases that users assign to digital assets in order to classify them, this process can be semi-automated by allowing users to create pool of tags that can be automatically revised, merged or associated to the right digital asset.

- **[Sampled Model]** A 3D model that has been created through means of digital scanning from a real world existing object. The scanning is done with a
device that analyzes the real-world object and collects data on its shape and nowadays its appearance.


- **[Stereoscopy]** is a technique for creating or enhancing the illusion of depth in an image by presenting two offset images separately to the left and right eye of the viewer.

- **[Transmedia]** the type of media that can be transferred – in an automatic way or not depending on the case - across different computer platforms in order to increase the inter-operability of VM applications.

- **[Ubiquitous display]** is a non-desktop display system used to display VM applications, in a way that the application content appears to be blended in a real environment or space.

- **[Usability]** can be defined as the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use (ISO, 1998). Usability of an interface is usually associated with five parameters (ISO, 1998; Nielsen, 1993), derived directly from this definition:

1) easy to learn: the user can get work done quickly with the system,

2) efficient to use: once the user has learnt the system, a high level of productivity is possible,

3) easy to remember: the casual user is able to return to using the system after some period without having to learn everything all over again,

4) few errors: users do not make many errors during the use of the system or if they do so they can easily recover them,
5) pleasant to use: users are subjectively satisfied by using the system; they like it.

- [User Experience] ISO (2009) defines user experience as "a person's perceptions and responses that result from the use or anticipated use of a product, system or service". REFERENCES International Organization for Standardization (2009), 9241-210.

6. CONCLUSIONS
The emerging and currently used terms in the VR area are in constant evolution. Some basic terminology is already established. More is now emerging during the current process of integration of VR technologies in cultural heritage.
The basic difficulty of the task is linked to the multidisciplinary of the approach, given that the significance of individual terms vary in different domains. Some of the relationships observed between the terms are hierarchical: hyperonymy and meronymy, but they are primarily field and context dependent: an expected conclusion given the diversity of the disciplines involved in the field (engineers, architects, archaeologists, historians, multimedia developers, 3D designers etc). Setting up categories, and adhering to the composed terms, faces the above-mentioned difficulty.
A tool has been developed that is accessible by everybody, thereby creating a reference site for those involved in virtual reality applications in museums and CH.
The flexibility of the tool, and the methodological approach, provide the possibility of continuous updates, being a live updated site throughout the project's lifecycle, where researchers and scientists of different domains can interact within a structured framework, allowing proposition of new terms and definitions, interaction and a validation process.
7. Annexes

Glossary
Terms are reported as they appear and are defined in this deliverable:

Glossary in Alphabetical Order

<table>
<thead>
<tr>
<th>TERM</th>
<th>DESCRIPTION</th>
<th>REFERENCES</th>
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<tbody>
<tr>
<td>Accessibility</td>
<td>determined by how easy audience can reach and use a Virtual Museum. In terms of digital content it refers to how users can reach, examine, and access digital assets.</td>
<td>Slater 1999, Schuemie et Al. 2001</td>
</tr>
<tr>
<td>Cultural Presence</td>
<td>Derives from the concept of “Sense of Presence”, which refers to the idea of &quot;being there&quot; of an individual placed in a virtual environment. In practice, it is a way of expressing an internal perception of the environment and ourselves in relation to it, depending on various factors: physical immersion, perceptual realism, naturalness of the interaction, emotional involvement, attention, unconscious reactions, etc. Cultural Presence stresses the contextual, social and symbolic, communicational aspects of presence, and also, implicitly, a learning aim. Through interaction and collaboration, presence becomes a being, not only physically but also culturally, there and then.</td>
<td>Tost Laia and Champion, 2007</td>
</tr>
<tr>
<td>CyberMuseum</td>
<td>The term “Cyber Museum”, is often confused with [Virtual Museum]. the traditional definition describes a Cyber Museum as “a logically related collection of digital objects composed in a variety of media which, through its connectivity and its multi-accessible nature, lends itself to transcending traditional methods of communicating and interacting with visitors.; it has no real place or space; its objects and the related information can be disseminated all over the world”. This definition probably derived from the newly-born examples of “Virtual” applications and it appears somehow misinterpreting. Likely according to McKenzie, in these museums, it is expressed the synergistic effect of classical and online museum with a slight tilt toward the domination of the classical museum.</td>
<td>Schweibenz, 1998</td>
</tr>
<tr>
<td>Digital Library</td>
<td>a possibly virtual organization that comprehensively collects,</td>
<td>Svilicic 2010</td>
</tr>
</tbody>
</table>
manages, and preserves for the long term rich digital content, and offers to its user communities specialized functionality on that content, of measurable quality and according to codified policies. (possibly add Digital Library System and Digital Library Management System as reference point out)

Descriptive Virtual Museum

a Virtual Museum characterized by a mode of communication in which events, monuments, artifacts, artworks, customs or beliefs are defined, described and interpreted by a "Sender" who aims at informing and making aware the "Receiver". Description or Exposition may also rely on schematic/ conceptual representations via charts, concept maps, ontologies, outlines, etc... This mode of communication also refers to the organized presentation of items displayed in the form of Exhibitions (temporary or permanent).

Device-based interaction

refers to interaction with an application which is facilitated through the use of an input device, such as, but not limited to: keyboard, pointing devices (mouse), composite devices (game controllers, Wiimote), video and imaging input devices (webcam, motion sensor, scanner), and/or audio input devices (microphone).

Digital Archiving

The process of backup and ongoing maintenance of digital objects and the associated software and hardware, as opposed to strategies for digital preservation (Source: DPC Handbook)

Digital Collection

Any collection or defined set of digital objects/data that are made available via online shareable platform organized by a collection management systems and/or website on a non-temporary basis for the purpose of preservation and/or enhanced access. Digital collections use new formats, licensed contents, and third-party information over which the library has little or no direct curatorial control.

Digital Museum

See [Digital Collection]. It involves a real or virtual location for the digital collection or defining set of digital objects, on a permanent base.

Digital Exhibition

See [Digital Museum]. It involves a real or virtual location for a special digital collection or defining set of digital objects, on a temporary base.

Digital Object

A general term used for the body of digital material, includes digital files, both online and offline, born-digital and digitised

Digital Preservation

See [preservation]
**Digital Reconstruction**

see also below [3d Reconstructed model]

Design for all

is about ensuring that environments, products, services and interfaces work for people of all ages and abilities in different situations and under various circumstances (EDeAN, 2011). The Council for Museums, Archives and Libraries (2001) provides guidance for all museums and galleries in improving their services to disabled people based on the Design for All philosophy.

http://www.edean.org

**Digital Preservation**

the process of preserving digital assets used in Virtual Museum domain for the longer period possible. In a wider sense, it is a "set of activities required to make sure digital objects can be located, rendered, used and understood in the future. This can include managing the object names and locations, updating the storage media, documenting the content and tracking hardware and software changes, to make sure objects can still be opened and understood"

"Digital preservation combines policies, strategies and actions to ensure access to reformatted and born digital content regardless of the challenges of media failure and technological change. The goal of digital preservation is the accurate rendering of authenticated content over time." (ALA 2007:2)

It includes "the act of maintaining information, in a correct and Independently Understandable form, over the Long Term" (CCSDS 2002: 1-11), and "all activities concerning the maintenance and care for/curation of digital or electronic objects, in relation to both storage and access." (Research Councils UK 2008: 6)

**Distributed Virtual Museum**

This category includes all Virtual Museums distributed in any format and technology.

**Dramatization**

A mode of communication where the "Sender" delivers a message/information by reconstructing and presenting events, novel stories, actions and items in a capturing and engaging way so as to directly and deeply involve the "receiver".

**Educational Virtual Museum**

All VM applications that have been conceived and implemented having in mind specific instructional purposes; these applications have clear and well-defined educational objectives and are directed to a well set up and identifiable target population which possesses definite prerequisites; they are often thought to be used in formal educational settings (schools; Universities, professional training...).
## Edutainment Virtual Museum

The term edutainment was used as early as 1948 by The Walt Disney Company to describe the True Life Adventures series. The noun edutainment is a neologistic portmanteau used by Robert Heyman in 1973 while producing documentaries for the National Geographic Society. It was also used by Dr. Chris Daniels in 1975 to encapsulate the theme of his Millennium Project. This project later became known as The Elysian World Project. To Buckingham and Scanlon (2000) “Edu-tainment”, is a hybrid genre that relies heavily on visual material, on narrative or game-like formats, and on more informal, less didactic styles of address. The purpose of edutainment is to attract and hold the attention of the learners by engaging their emotions through visual stimuli full of vividly coloured animations. It involves an interactive pedagogy and, in Buckingham et al’s words, totally depends on an obsessive insistence that learning is inevitably “fun”. Educational entertainment is any entertainment content that is designed to educate as well as to amuse. Content with a high degree of both educational and entertainment value is known as edutainment. Edutainment is a growing paradigm within the museum community. This approach emphasizes fun and enjoyment, potentially at the expense of educational content (Zühal Okan, 2003).


## Enhancement of visitor experience

Concerns VM applications that provide additional or complementary information to a non-virtual museum.

## Entertainment Virtual Museum

VM applications that have been conceived and developed for the users' fun and enjoyment. They nevertheless may convey significant and valuable information on cultural heritage, thus also sustaining informal learning processes.

## Ethnographic Virtual Museum

A virtual museum concerned with Ethnography and having major collections in Ethnology or Anthropology. More in depth, Ethnography may be defined as both a qualitative research process or method (one conducts an ethnography) and product (the outcome of this process is an ethnography) whose aim is cultural interpretation.

## Ex-changeability

Possibility of a virtual museum to be exchanged, as a complete set-up or as a specific sub-set (digital content, software, etc.)

## Exposition

A mode of communication in which events, monuments, artifacts, customs or beliefs are defined, described and interpreted by a "Sender" who aims at informing and making aware the "Receiver". Exposition may also rely on schematic/conceptual representations via charts, concept maps, ontologies, outlines, etc... The exposition mode of communication also refers to the organized presentation of items displayed in the form of exhibitions (temporary or permanent).
Free-form Gestural User Interface

It is an interface that works as a line of motion sensing input devices. It enables users to control and interact with consoles or computers without any devices (i.e. mouse, joystick etc.), using natural body gestures.

Gamification

Gamification is using game-based mechanics, aesthetics and game thinking to engage people, motivate action, promote learning, and solve problems.


Gesture

Any physical movement that a digital system can sense and response to without the aid of a traditional pointing device such as a mouse or stylus. A wave, a head nod, a touch, a toe tap, and even a raised eyebrow can be a gesture.

Dan Saffer, “Designing gestural interfaces”

Gesture-based Interaction

A type of interaction that allows users to communicate with a digital system using gestures. A gesture can here be defined as any human movement that conveys meaningful information, such as waving with the hand or raising the eye brows. With gesture-based interaction it is often easier to achieve a more natural and intuitive user interface compared to for example device-based interaction using mouse and keyboard. It includes [Touch-user Interface] and [Tangible User Interface]

High Sense of presence

A system whom technical features reveal high immersion in terms of “being there” such as a CAVE with a multichannel sound system.

High sensory involvement

A system communicating the content by means of high immersion technology taking advantage of storytelling strategies, evocative atmospheres and familiar environments, like a dramatized cinematic projection.

Human Computer Interaction

Is a term that defines the study and planning of interactions which occur between users and computers by making the latter more usable and effective to users’ needs. This discipline often refers to other fields such as computer science, behavioral science, and design and together try to define and set up methodologies and processes for designing and implementing interfaces - both web, mobile and physical installations - techniques for evaluating and comparing interfaces, developing future models and criteria for interaction.

Immersion

Is here defined as “the extent to which the actual system delivers a surrounding environment, one which shuts out sensations from the ‘real world’, which accommodates many sensory modalities, [Slater, Wilbur, 1997].
**EXPERIENCE THE FUTURE OF THE PAST**

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<tr>
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**Immersive Virtual Museum**

A Virtual Museum communicating the content by means of immersive technology, making the user feeling to be immersed in a surrounding environment, shutting out sensations from the ‘real world’.

From user perspective, as it emerged from Archeovirtual 2011 evaluation [see Deliverable 7.2], level of immersion is connected not only with the technology used, but also with the type of communication used which contributes to create an experience [narrative virtual museum] and [dramatization-based virtual museum]. It includes [high-immersion Virtual Museum] and [low-immersion Virtual Museum]

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**Interaction**

Is related to the user capability of modifying the environment and receiving a feedback to his/her actions. Both immersion and interaction concur to realize what is one of the main goals of a virtual experience: presence, i.e. the belief of actually being in a virtual space.

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**Interactive Virtual Museum**

An Interactive Virtual Museum is a Virtual Museum responding to a user’s input [ref. Oxford Dictionary]. It includes [device-based interaction] and [gesture-based interaction]

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**Learning Analytic**

Learning analytics is the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs

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**Legacy system**

Is an old method, technology, computer system, or application program that continues to be used, typically because it still functions for the users’ needs, even though newer technology or more efficient methods of performing a task are now available. A legacy system may include procedures or terminology which are no longer relevant in the current context, and may hinder or confuse understanding of the methods or technologies used

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**Linked Open Data cloud**

According to "data.europaea.eu", part of Europeana project, Linked Open Data is a way of publishing structured data that

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[Carrozzino & Bergamasco 2010].


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**Grant Agreement 270404**

CULTNAT / CNR

Public 36 /52
allows metadata to be connected and enriched, so that different representations of the same content can be found, and links made between related resources. Using a "cloud" platform it is possible to make the metadata available on the web using online services of data sharing and data retrieving.

Long Term

In the context of virtual museums, “long-term” is not defined as a specific period of time. Also in the context of Digital Preservation, it is not strictly defined: in (Verheuil 2006: 20) it means “five years or more”, in (Research Councils UK 2008:6) “Data should normally be preserved and accessible for not less than 10 years for any projects, and for projects of clinical or major social, environmental or heritage importance, the data should be retained for up to 20 years, and preferably permanently within a national collection, or as required by the funder’s data policy.”

More generally in (CCSDS 2002: 1-11) “a period of time long enough for there to be concern about the impacts of changing technologies, including support for new media and data formats, and of a changing user community, on the information being held in a repository. This period extends into the indefinite future.”

Low Sense of presence

a system whom technical features reveal low immersion in terms of “being there” such as an immersive workbench.

Low sensory involvement

a system communicating the content by means of low embodiment grade with the system or the environment like a descriptive application.

Maintainability

the ability of a Virtual Museum to be easily maintained and preserved (see digital preservation) for a [long time].

In hardware side it refers to the availability and capability of fixing any malfunction that can appear to the VM.

In software side it usually refers to the availability of updates, support, and compatibility with operating systems.

Regarding Content Maintenance, it includes activities “to ensure

• A robust computing and networking infrastructure
• Storage and synchronization of files at multiple sites
• Continuous monitoring and management of files
• Programs for refreshing, migration and emulation
• Creation and testing of disaster prevention and recovery plans
• Periodic review and updating of policies and procedures” (ALA 2007)


Metadata

Metadata are structured information about [digital objects]; they may regard specific cultural heritage object and their purpose and include description, management, resource recovery, preservation. (Int. J. Digital Library, 2005, 5: 179-192 Digital Object Identifier (DOI))

Kaltenbok 2012.

(Verheuil 2006: 20)
(Research Councils UK 2008:6)
(CCSDS 2002: 1-11)
Mixed Reality
Mixed reality (MR) (encompassing both augmented reality and augmented virtuality) refers to the merging of real and virtual worlds to produce new environments and visualizations where physical and digital objects co-exist and interact in real time. The term encompasses both augmented reality, where digital information and virtual objects augment images of the real world, and augmented virtuality, where real objects augment artificial computer-generated images co-exist.

According to Paul Milgram and Fumio Kishino the Virtuality Continuum extends from the completely real through to the completely virtual environment with augmented reality and augmented virtuality ranging between. In this context mixed reality is defined as “…anywhere between the extremes of the virtuality continuum”.

Mobile Virtual Museum
is a virtual museum that can be moved from location to another. It is designed to be easily installed and dismantled easily.

It may include VM applications available for mobile devices (iPhones, Smart Phones, Tablets), independently to the accessibility of the application on line or off line.

Motion Tracking

Multimodal interaction
provides the user with multiple modes of interfacing with a system by means of several distinct tools for input and output of data (Oviatt, 2002). Example: A VM with multimodal interaction could combine a visual modality (e.g. a display, keyboard, and mouse) with a voice modality (speech recognition for input, speech synthesis and recorded audio for output).

Narration
A mode of communication in which the "Sender" provides information about events, monuments, artifacts, artworks, customs or beliefs by arranging them in a sequence (e.g. chronological), in order to create an account of a subject by the “Receiver’s" side. As with exposition, narration includes description and interpretation and it may also rely upon/encompass some form of schematic representation (e.g. outline) of facts and figures.

Narrative Virtual Museum
a Virtual Museum that uses a mode of communication in which the “Sender” provides information about events, monuments, artifacts, artworks, customs or beliefs by arranging them in a
sequence (e.g. chronological), in order to create an account of a subject by the "Receiver's" side. As with exposition, narration includes description and interpretation and it may also rely upon/encompass some form of schematic representation (e.g. outline) of facts and figures.

**Natural interaction system**

Natural Interaction is a type of interaction that follows an approach to human-computer interaction which uses the natural behaviors (movement, gesture, speech) of the user to interact or "communicate" with an application. The interaction interface is meant to be invisible, or become invisible through naturalized interaction (requiring limited learning for interaction), and based on nature or natural elements [Blake 2010]. Ideally, natural user interfaces are designed to use natural human behaviours to interact directly with content, and may be facilitated with devices such as multi-touch surfaces (iPad or PixelSense) or motion detection sensors (Wii or Kinect). Bill Buxton, a Principle Researcher for Microsoft and pioneer in human-computer interaction has suggested that an interface is truly natural when it "exploits skills that we have acquired through a lifetime of living in the world" [Buxton, Bill 2010]. It includes [Free-form gestural UI] and [Speech-based interaction]

**Non-distributed Virtual Museum**

It comprehends all Virtual Museums conceived to be not distributed, but only run in specific installations, according to institutional decisions

**Non-immersive Virtual Museum**

a Virtual Museum communicating the content by means of non-immersive technology, such as a regular desktop computer with stereo speakers

**Non-interactive Virtual Museum**

Assemblage of digital media providing the user passive (including emotional, intellectual and imaginative) engagement.

**Non-preserved Virtual Museum**

VM that could be either re-used or not re-used but have not been updated and stored resulting in their loss and inaccessibility.

**Non re-usable Virtual Museum**

a Virtual Museum that is not re-usable (i.e. a virtual museum developed using commercial software, distributed or installed as a binary application with content not available)

**Off-line distributed Virtual Museum**

This type of "Distributed VM products" include all products distributed in CD, DVD, Blue Ray or other off line supported formats. These Virtual Museums have been often called in the past "multimedia product"

**On-line Virtual Museum**

The term on-line Virtual Museum, that was first used by Tschiritzis and Gibbs [Tschiritzis, Gibbs 1991], describes a museum designed in the nominal world of a computer and existing in the Internet, giving the visitor the illusion of being present in an actual museum [Mateevitsi et al 2008]. Often this term is referred to

References: (1) Blake, J. What is the Natural User Interface (Book Excerpt), Deconstructing the NUI, March 2010, (2) Buxton, Bill (2010-01-06). “CES 2010: NUI with Bill Buxton”. Microsoft Research.

[Carrozzino & Bergamasco, 2010].

[Carrozzino & Bergamasco, 2010].

[Carrozzino & Bergamasco, 2010].

[Carrozzino & Bergamasco, 2010].

[Tschiritzis, Gibbs 1991]

[Mateevitsi et al 2008]
digital on line copies of real museums or of their collections.

**On site installation**

Applications whose software or hardware components are not publicly available, whatever the reason (technical need or political choice) of such lack of availability, and only placed in a particular site someway connected to their content.

**Partially re-usable Virtual Museum**

Virtual Museums that are only partially re-usable, as referred to installations set-ups, multimedia datasets, software tools, creation pipeline.

**Periodic Virtual Museum**

A Virtual Museum which is playable not continuously, but according to specific time intervals

**Permanent Virtual Museum**

A Virtual Museum which is playable continuously in time.

**Portability**

The category refers to all the VM applications whose software or hardware components are not publicly available, whatever the reason (technical need or political choice) of such lack of availability, but which can be potentially fruited in any place at the same conditions, without a binding link between the application's physical placement and its contents.

**Portable Virtual Museum**

Applications whose software or hardware components are not publicly available, whatever the reason (technical need or political choice) of such lack of availability, but which can be potentially fruited in any place at the same conditions, without a binding link between the application's physical placement and its contents.

**Preservation**

**Digital Preservation** is the process of preserving digital assets used in Virtual Museum domain for the longer period possible. In a wider sense, it is a “set of activities required to make sure digital objects can be located, rendered, used and understood in the future. This can include managing the object names and locations, updating the storage media, documenting the content and tracking hardware and software changes, to make sure objects can still be opened and understood” (source: [http://www.digitalpreservationeurope.eu/what-is-digital-preservation/](http://www.digitalpreservationeurope.eu/what-is-digital-preservation/)).

"Digital preservation combines policies, strategies and actions to ensure access to reformatted and born digital content regardless of the challenges of media failure and technological change. The goal of digital preservation is the accurate rendering of authenticated content over time." (ALA 2007:2)

It includes “the act of maintaining information, in a correct and Independently Understandable form, over the Long Term” (CCSDS 2002: 1-11), and "all activities concerning the maintenance and care for/curation of digital or electronic objects, in relation to..." (Research Councils UK 2008: 6)
| **Promotional Virtual Museum** | applications that are aimed at advertising and promoting specific cultural heritage items. They are designed and implemented with the primary aim of capturing and maintaining attention until the main promotional messages are passed through. Such applications may greatly vary in their approach depending on the target population specifically addressed. |
| **Real-time 3D** | in Computer Graphics, Real-time 3D is concerned with producing and analyzing 3D scenes in real time, frame by frame depending on the user input, using the Graphics Processing Unit. Real-time 3D is a very important aspect in applications like video games where user interaction in running time is an important part of deciding what to be drawn. |
| **Reconstructed Model** | A 3D model that has been created based on the shape and appearance of a real object. The reconstruction is done either by technological means as 3D scanning (see [Sampled Model]) or by scientific data such as architectural designs and reference images. |
| **Remote Visualization** | means interactive viewing of scientific data sets over the web. Because scientific data sets are in the gigabyte size range, it is difficult to send the entire data set over the network. Extraction, processing, network latency and rendering add up and make the proposition of near real-time interactive visualization a challenge. Moreover, the client will have a limited amount of memory and CPU power for viewing and interacting with the data. |
| **Repository** | In Computing, a Repository is the place where data are gathered, usually from multiple sources, and stored together with the related metadata. In VM domain it is more related to digital media and resources video, images, 3D, etc. |
| **Research Virtual Museum** | VM applications that are meant to support and enhance research. It also includes applications that, due to their innovative character, may sustain research in other related fields such as: ICT, augmented reality, Artificial intelligence, Virtual Worlds and Serious Games, Geography etc...The considered applications are often prototypes and demos endowed with specific innovative functionalities and can cover specific issues |
| **Re-usability** | This term can be used for content, software or hardware of a virtual museum. Any of those components is reusable when it can be utilized in a different VM with no need to rebuild or redevelop this component |
| **Re-usable Virtual Museum** | a Virtual Museum which is fully or partially re-usable in other digital applications. Since a Virtual Museum, in the Digital Heritage domain, is a combination of digital content, software and hardware, the kind of re-usability might regard one or all |
Re-usable VM installation  
Re-usability of setups: software and hardware solutions

Re-usable VM multimedia dataset  
Metadata containing level of accuracy, type of MM data, reliability, communication channel for which they are built, type of license, datasets are preserved in some sort of repository, accessible and visible to some users.

Re-usable VM pipeline  
Virtual Museums that have preserved their creative, digital pipeline (i.e. containing the process that have led to the creation of the VM, storyboard, data connection to the story, etc.)

Sampled Model  
A 3D model that has been created through means of digital scanning from a real world existing object. The scanning is done with a device that analyzes the real-world object and collects data on its shape and nowadays its appearance.

Semi-automatic content tagging  
A process to add content keywords or phrases that users assign to digital assets in order to classify them, this process can be semi-automated by allowing users to create pool of tags that can be automatically revised, merged or associated to the right digital asset

Speech-based interaction  
It is an interface that works as a line of motion sensing input devices. It enables users to control and interact with consoles or computers without any devices (i.e. mouse, joystick etc.), using spoken commands

Sensory involvement:  
It stands for the personal involvement and engagement towards the artificial environment stimulating both the emotional background related to that artificial environment of an individual and his mental state of perceiving himself to be included in, enveloped by. It involves [low sensory involvement] up to [high sensory involvement]

Sense of Presence:  
It stands for the belief that individual is present in the artificial environment generated by the computer. That is possible to study by following the categories like visual features of the virtual environment itself, the grade of isolation from the physical environment and the kind of natural gestures in interaction and self-control in the virtual environment. It involves [low sense of presence] up to high [sense of presence]

Witmer, Singer 1998, Roussou 2002a, Bailenson et Al. 2006
Serious Game

Serious games are games that do not have entertainment, enjoyment, or fun as their primary purpose.


Spatial Resolution

Spatial resolution is related to pixel size and is considered a measure of visual quality (Bowman, Kruijff, LaViola, & Poupyrev, 2005). Spatial resolution depends on both the number of pixels and the size of the screen.


Stereoscopy

Stereoscopy is a technique for creating or enhancing the illusion of depth in an image by presenting two offset images separately to the left and right eye of the viewer.

Tangible interaction

Tangible interaction, or [Tangible User Interface] (TUI), in an approach to interaction that allows a user to interact with digital information through their physical environment. Tangible interaction was first defined in 1992, when Durrell Bishop created the Marble Answering Machine (1), in which a marble was used to represent a message on a telephone answering machine. Dropping the marble back into the dish would replay the message or return the call. Since then, tangible interaction has evolved to include new interfaces, including "smart objects" which are physical objects that have been embedded with sensors that collect information associated with interaction and link it with the associated application (2).


Tangible User Interface

See [Tangible interaction]

Touch User Interface

gestures that are part of all modern smartphone, tablet, touchscreen UI and other touch devices.

Temporary Virtual Museum

a Virtual Museum which is conceived to be played for a limited time span, also according to a specific event or an exhibition

Transmedia

the type of media that can be transferred – in an automatic way or not depending on the case - across different computer platforms in order to increase the inter-operability of VM applications

Ubiquitous display

is a non-desktop display system used to display VM applications, in a way that the application content appears to be blended in a real
environment or space

**Un-versioned Repository**

A central place in which an aggregation of data is kept and maintained in an organized way. In the general sense this is a data directory that does not keep version information and previous revisions. In this way the user edits cannot be tracked and edited. Example are: WebDav, Dropbox, FTP.

**Usability**

Can be defined as the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use (ISO, 1998). Usability of an interface is usually associated with five parameters (ISO, 1998; Nielsen, 1993), derived directly from this definition:

1) easy to learn: the user can get work done quickly with the system, 2) efficient to use: once the user has learnt the system, a high level of productivity is possible, 3) easy to remember: the casual user is able to return to using the system after some period without having to learn everything all over again, 4) few errors: users do not make many errors during the use of the system or if they do so they can easily recover them, 5) pleasant to use: users are subjectively satisfied by using the system; they like it.

**User Experience**

User experience is how a person feels when interfacing with a system. The system could be either a website interface or a web application, desktop installation or finally a mobile product. It is generally characterized by main features related to human-computer interaction (HCI) disciplines. According to the ISO definition user experience includes all the users' emotions, beliefs, preferences, perceptions, physical and psychological responses, behaviors and accomplishments that occur before, during and after use.

**User interface design**

The process of developing any technical tool with focus on usability, [user experience] and interaction. A user interface design process involves a wide array of activities, from user research to graphic design.

**User interface metaphor**

A set of visuals, actions and procedures that help a user understand a target domain (e.g. a computer) by exploiting Knowledge that the user has of a source domain (e.g. office work). One of the most famous user interface metaphors is the desktop metaphor, which introduced the idea that working with a computer is like working at a desktop with folders, a file cabinet, a trash bin etc. Even though frequently criticized for being outdated and for hindering the development of new innovative user interface paradigms, user interface metaphors remain a
fundamental component of most modern operative systems.

**Versioned Repository**

a central place in which an aggregation of data is kept and maintained in an organized way. A revision control system is used to track the changes to the data. The changes are identified by a number or a letter code termed as “revision number”, the date they were applied and a description of the changes (optional). The revisions can be compared, restored and in specific file types merged. An example of a versioned repository is SVN (SubVersion).

**Virtual**

simulated by a computer / related to Virtual Reality / occurring or existing primarily online / hypothetical whose existence is inferred from indirect evidence

(from Encycl. Britannica)

**Virtual Collection**

it consists of set of digital objects/data (See [Digital Collection]) that have a double aim of detaining and interactively involve individuals.

See [Virtual Collection] and [Virtual exhibition]

p. 26
http://icom.museum/fileadmin/user_upload/pdf/Key_Concepts_of_Museology/Museologie_Anglais_BD.pdf

Roussou 2002b

**Virtual Exhibition**

“VirtualHeritage” (VH) is a broad term to define the whole set of items and assets that deal with virtual-reality (VR) and cultural-heritage. In general, virtual heritage and [Cultural Heritage] refer to independent fields: cultural heritage claim for properties and sites with archaeological, aesthetic and historical value; while “virtual heritage” deals with instances of these properties and sites within a digital representation which implies materializing the heritage content digitally and to process and disseminate it using computer graphics technology and enhanced strategies of communication.

From ICOM definition of Museum

**Virtual Museum**

Starting from ICOM definition of "Museum", V-MUST is currently trying to define a “Virtual Museum”. The discussion is leading to obtain an essential and generic definition of a virtual museum, enriched with the specific definitions and uses of the term in the different domains (ICT, heritage, etc.). We report here the evolving definition of the term.

[Virtual Museum ver 1.1] A Virtual Museum is a digital creation organized on a permanent or temporal basis in the service of society and its development, open to the public, which acquires, conserves, researches, communicates and exhibits, in a digital way, the tangible and intangible heritage of humanity and its
environment. It uses various forms of interactivity and immersion, for the purpose of education, research, enjoyment and enhancement of visitor experience.

[Virtual Museum ver 1.2] A Virtual museum is a digital creation accessible by a public, focused on tangible or intangible heritage. It uses various forms of interactivity and immersion, for the purpose of education, research, enjoyment, enhancement of visitor experience.

[Virtual Museum ver 1.3] A Virtual museum is a communication product accessible by a public, focused on tangible or intangible heritage. It uses various forms of interactivity and immersion, for the purpose of education, research, enjoyment, enhancement of visitor experience. In Digital Heritage it is mainly intended as a Digital creation.

[Virtual Museum ver 1.4] A Virtual museum is a communication product made accessible by an institution to the public that is focused on tangible or intangible heritage. It typically uses interactivity and immersion for the purpose of education, research, enjoyment, and enhancement of visitor experience. Virtual Museums are usually, but not exclusively delivered electronically when they are denoted as online museums, hypermuseum, digital museum, cybermuseums or web museums.

**Infrastructure**
The physical platforms upon which systems, facilities and networks are run. It enables connectivity and provides services via applications.

**Innovation**
development of an idea into something new.

It is different from Creativity. CREATIVITY is the process through which new ideas are produces; INNOVATION is the process through which they are implemented.

**Intellectual property**
Ownership of intangible information [...]. It is a legal framework that enables information to be owned and hence allows the owner to constrict its use or determine who uses it.

COPYRIGHT is one example of intellectual property.

**Interactivity**
Signifies the development of the relationship between person and computer, and with other via the computer.

**MEDIUM/MEDIA**
simply any material through which something else may be transmitted. [...] Media of communication are therefore any...
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**Means by which messages may be transmitted**

*John Hartley Communication Cultural and Media Studies: The Key Concepts, 2002: p.142*

**Methodology**

The study of methods of investigation in research of any kind, or the body of methods used in any one branch

**Cultural Heritage**

Traditions or living expressions inherited from our ancestors and passed on to our descendants, such as oral traditions, performing arts, social practices, rituals, festive events, knowledge and practices concerning nature and the universe or the knowledge and skills to produce traditional crafts

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