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BUILDING A VIRTUAL MUSEUM: REFERENCE PATTERNS OF PROFESSIONAL SKILLS, TRAINING REQUIREMENTS, SOCIAL DIALOGUE AND EQUAL OPPORTUNITY IN TRAINING STRATEGIES

- WP 2 outcome-

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1. Definitions, classification and typologies

1.1. The Internet revolution on the sector

The jointly development of the World Wide Web (WWW) and the technological progress in computer graphics has pushed towards the exploitation of innovative ways of supply of cultural goods.

Even if they sometimes showed in the past a conservative approach for the adoption of new technologies, cultural institutions found out in the Internet a useful instrument to develop new modalities of supply of their cultural heritage, which after a first period of experimentation is becoming the main way of provision of culture throughout the world.

Internet, especially the WWW, has allowed the development of museum sites that time by time are getting more sophisticated with an increasing value added respect to their real counterparts with a strong attitude towards *augmented culture*. In fact, traditional museums are not anymore the unique repository for the gathering and exhibiting of cultural goods and discovered out new approaches for providing culture: the virtual museum.

ICT (Information and Communication Technology) that have still found many applications within the walls of museums, usually for educational purposes limited to some categories of visitors, are the instrument for new modalities of provision of cultural heritage.

The adoption of computers within museums is not a quite new concept, since from the seventies computer based methods were applied to the cultural heritage for purposes of developing inventories and catalogues of the preserved contents and digital techniques were the main tool for many branches for the analysis and study of objects (especially for archaeology).

Researchers and academic scholars were the main users of computers methods applied to the cultural heritage usually working off-line in the framework of cost effective scientific projects where the museum world assessed as relevant an electronic access only on centralised basis[1].

[1] S. Gordon (1997) The virtual museum – who needs it Proceedings of the 25th anniversary conference of CAA – Archaeology in the age of Internet Birmingham April 1997. BAR International Series 1999.

In example, before the WWW exploitation, in the United Kingdom from the eighties the use of networks by museums has been restricted to a sample of high-level users like university departments with access to the UK joint Academic Network (JANET)[2].

Internet and the progress of digital imagery brought a disruptive effect because they allowed to increase the targets of museums both on qualitative level (not only experts but mass audience too) than quantitative (systems for scanning imagines are simpler and cheaper with an additional supply of new scansions available).

The WWW and cultural products (Cdrom, DVD, etc…) allowed an increase of the market for museums and allowed new applications revolutionising their approach towards computer based services.

This transformation has created new problems, especially for copyright and for funding of museums (tickets for entrance are not a feasible source on the WWW), and new opportunities due to the potential audience that is global. Especially for small institutions located in a territory far from the tourist routes, Internet allowed to show their cultural heritage to a wider audience.

WWW is a fertile environment for cultural goods that are rising in number[3] and quality even still in a very tumultuous way. Today in the WWW, apart from digital cultural goods as CD-ROM that can be acquired off-line, we can see:

- the homepages of cultural institutions closely referred to a physical museum,
- on-line exhibitions that have not a reference in the real world,
- sites with some virtual reconstruction of some specific issue,
- communities of museums,
- inventories and repositories of 'objects'
- downloadable software referred to the cultural heritage.

[2] S. Gordon (1997) ibidem.
[3] More than 10,000 all over Europe and more than 3,000 in Italy Kim H. Veltman (2002) – European Networks of Excellence and Japanese/Unesco Skill Roads

1.2 The impact of computer graphics and virtual reality

Computer graphics enchantments and virtual reality (VR) have been the second factor for the success of virtual museums.

VR can be assessed as the array of technologies allowing the inclusion of users into an artificial environment, based on computer software.

Still in the sixties, Ivan Sutherland began to experiment some innovative exercises of virtual interaction with computer through an helmet. Instead in the seventies military scientists developed the super cockpit, a helmet allowing to use the instruments of a military aeroplane, by eye movements and voice commands.

Except military application, the entertainment and the cultural sectors contributed to develop VR systems.

Basically the VR technology is based upon three elements:

- tracking sensors for the interaction human-computer
- reality engine for creating the virtual environment
- visualisation tools allowing to get an image sensation of the reality engine graphic computations.

1.3 Digital museum, online museum or virtual museum?

The wide range of available modalities for cultural goods on the WWW brings the necessity of a definition of virtual or digital museum which is able to draw the typologies to stress into the research and to make assessments on which pattern of digital museum we should approach.

A canonical museum definition is not yet available since the technological progress and the high rate of transformation of the available typologies of cultural sites on WWW is demonstrating as a heavy constraint over time for stating a well established definition.

Since a task for the research is also to find a suitable notion able to identify and to explain skills, profiles and the main features of a museum site, we propose to start from the suggestions arising from available references and then following a reference pattern for the key features of a model of digital museum.

Although in 2001, the official definition of Museum supplied by ICOM (International Council of Museums) included 'digital creative activity[4]' there is still a lack of a specific notion of digital (on-line, virtual or electronic) museum[5].
But we can also assess, that from one hand the same definition of museum, as stated by the ICOM statute[6], is suitable also for virtual entities since it is

[4] Article 2 - definitions of the **ICOM Statutes**, amended by the 20th General Assembly of ICOM, Barcelona, Spain, 6 July 2001.

[5] The terminology to adopt finds a variation according to the feature to enlighten. The terms digital and electronic are with no doubts the more general since are based on the computer work that create the museum; virtual museum is based on some virtual reality application, while the on-line museum refers only to the museums with a web site, excluding each kind of provision external from the WWW. It must be outlined that a digital museum can also be stored in some optical support and can be provided off-line, or can be available only at local level (i.e. for small community of privileged users in some institution) through a LAN.

[6] A museum is a no profit making, permanent institution in the service of society and of its development, and open to the public, which acquires, conserves, researches, communicates and exhibits, for purposes of study, education and enjoyment, material evidence of people and their environment.
The above definition of a museum shall be applied without any limitation arising from the nature of the governing body, the territorial character, the functional structure or the orientation of the collections of the institution concerned.
In addition to institutions designated as "museums" the following qualify as museums for the purposes of this definition:
natural, archaeological and ethnographic monuments and sites and historical monuments and sites of a museum nature that acquire, conserve and communicate material evidence of people and their environment;
institutions holding collections of and displaying live specimens of plants and animals, such as botanical and zoological gardens, aquaria and vivaria;

structured for the inclusion of a wide range of cultural goods and services under the umbrella term of museum.

Shifting the approach towards the properties of digital museum we have to describe a cognitive based view, as suggested by M. Forte[7], who assess, as fundamental, the cognitive impact of ICT for cultural heritage.

As stated by M. Forte[8], a cultural good without a context is without information and is a mere object for aestethic contemplation, indeed is relevant the contrast among digital goods, suitable for exploitation and access with a deep cognitive impact, and cultural goods exhibited in an real museum where object preservation purposes create a distance with users that can be assessed as a barrier to cognitive interactions[9].

Thus, the virtual museum can be considered as a cognitive space that has the property of render intelligible, especially dynamically, the contents[10] in accordance to the network of relations between them and their original context.

The interactive and the informative properties have been also stressed by B. Davis[11] who points out the transformation of the traditional museum in a transactional space (through the digitalisation) where information lay on the links between objects.

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science centres and planetary;
non-profit art exhibition galleries;
nature reserves;
international or national or regional or local museum organisations, ministries or departments or public agencies responsible for museums as per the definition given under this article;
non-profit institutions or organisations undertaking conservation, research, education, training, documentation and other activities relating to museums and museology;
cultural centres and other entities that facilitate the preservation, continuation and management of tangible or intangible heritage resources (living heritage and digital creative activity);
such other institutions as the Executive Council, after seeking the advice of the Advisory Committee, considers as having some or all of the characteristics of a museum, or as supporting museums and professional museum personnel through museological research, education or training.
(ICOM Statutes, amended by the 20th General Assembly of ICOM, Barcelona, Spain, 6 July 2001)

[7] M. Forte, “Realtà virtuale, pensiero ecologico e logiche dell'apprendimento nei beni culturali”. Paper presented at the workshop *Intelligenza artificiale per i beni culturali*, Pisa 23 settembre 2003.

[8] M. Forte (2003) ibidem.

[9] M. Forte (2003) ibidem.

[10] M. Forte (2000) – About virtual archaeology: disorders, cognitive interactions and virtuality

[11] B. Davis (1994) “Digital Museums”, in *Aperture Magazine*, Fall.

In order to provide a suitable interpretation of the contents, the museum have to create contexts and frameworks to the objects exhibited through a network of logical and chronological links[12].

Another interesting definition of virtual museum has been issued by J. Mckenzie[13] who defines a virtual museum as *'…an organized collection of electronic artifacts and information resources - virtually anything which can be digitized. The collection may include paintings, drawings, photographs, diagrams, graphs, recordings, video segments, newspaper articles, transcripts of interviews, numerical databases and a host of other items which may be saved on the virtual museum's file server. It may also offer pointers to great resources around the world relevant to the museum's main focus…'*.

The same author introduces two broad categories of virtual museums:

- *Learning museums* - Based on web sites offering a wide knowledge base that is aimed for multiple visits and in- depth studies
- *Marketing museums* - Based on web sites developed with the main goal of increase the number of visits to the original museum and so offer information on its activities, exhibitions and special events and usually have a virtual shop too.

The approach of J. Mckenzie has the advantage of introducing an element of differentiation among the purposes of virtual museums with an impact in the organisation of the site and on the possibility of building portals for supplying cultural heritage, but leaves out the accessibility issues, differently from M. Forte.

[12] F. Garzotto, L. Mainetti, P. Paolini, (1996) Navigation Patterns in Museum Hypermedia, International
Conference on Hypermedia for Museums, S. Diego (CA).

[13] Jamie McKenzie (1997) – *Building a Virtual Museum Community.* Paper presented to the "Museums & The Web Conference", March 16-19 1997, Los Angeles California.

1.4 Definition and criteria for M.U.S.EU.M. project

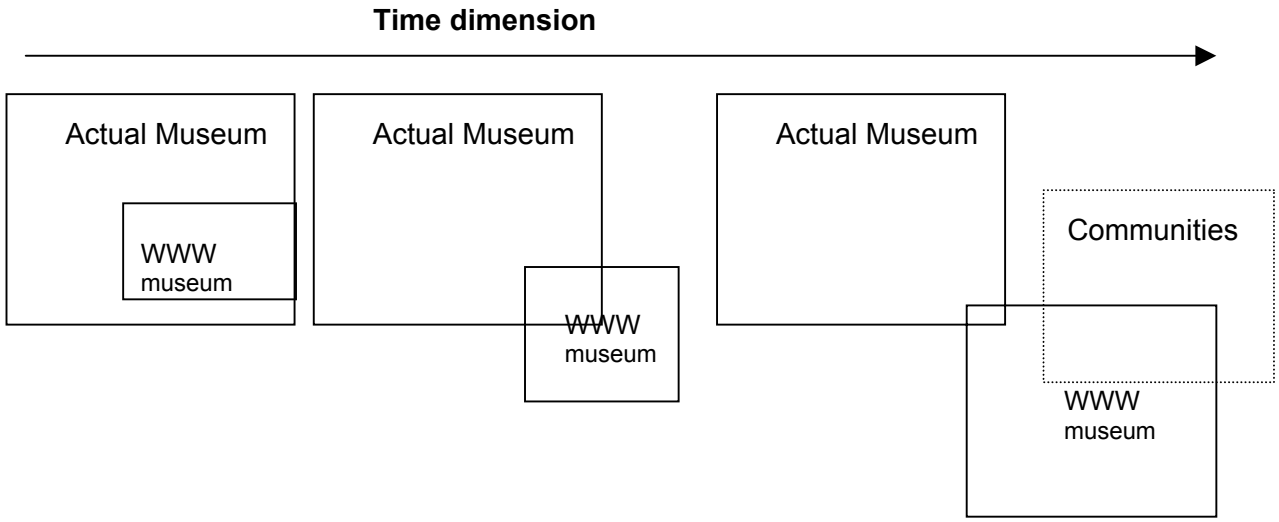
Still in the nineties museum sites have followed a path increasing their degree of differentiation from the original tangible museums. In the beginning of Internet, a virtual museums was the mere digital replica of the original one that was reproduced through an array of HTML pages and a mix of text and images (usually the content was only a subset of the 'objects' exhibited in the real museum), developed with scarce monetary resources, sometimes managed on voluntary basis, with a low value added in terms of additional information or augmented culture and of cognitive experience respect to the original museum.

The introduction of new technologies (i.e. VRML and Java) and the fostering of large bandwidth connections allowed the development of highly complex sites that are not anymore a reproduction of the original but a new product containing new services.

Even if a real museum institution manages virtual museum, the purpose of reproducing, also with high quality, the real museum has been progressively dropped out and today often institutions do not supply a virtual version of the actual exhibition but a new product sometimes available only in a digital environment.

Fig. 1 shows the evolution of virtual museum concept that, from a subset of the actual museum simple for content and development, is acquiring a large level of autonomy from the original entity and is becoming an effective instrument for the mission of the real institutions, with the opportunity of empowering virtual cultural communities where the edges of each institution fade in a common environment.

Fig. 1 The evolution of virtual museums



- HTML pages
- Reproduction of a small sample of the actual museum
- Low cost of implementation and maintenance
- Text and fixed images only
- No additional services
- Same target of the actual museum

- Java and VR software
- Reproduction of a large sample of the actual museum with alternative modalities of view
- High cost of implementation and maintenance
- Movies and VR environments
- Additional services (i.e. On-line tickets)
- Inclusion of pieces and exhibitions not available in the actual museum
- High computer based and managerial skills

- High tech solutions
- The majority of virtual content is not available in the actual museum
- High cost of implementation and maintenance
- High level of personalisation
- On line services are a priority
- The management of the site is not under the hierarchical span of control of the actual museum but dialogues with it
- High computer based and communication skills
- The site is a store of incremental knowledge for the original institution
- Humanistic skills must be merged into computer based skills

The evolutionary approach helps also to explain why portals are acquiring a great success in a wider cultural world and why for building a museum site is necessary a multidisciplinary attitude.

A parallel evolution has been followed by exhibitions that, still from the beginning of the diffusion of WWW, made available only digital contents (computer art) that had not a real version, and now are enlarging their scope also on real objects.

The two categories (web sites of a real museum and digital only exhibition) are following a path towards convergence in the modalities of provision and in the typology of supply.

The evolutionary perspective stresses some key features of digital museum that can be assessed as their constitutive foundations:

- a digital museum is developed in an computer environment with high connectivity features (even if limited to small group of users[14]) where the graphic interface is working in a hypertext structure (WWW site) with the main purpose of preserving the information supplied by the contents included and where users can be assessed as interpreters of the goods/services supplied through interactivity, virtual reconstruction and organisation of the contents;

- indexes and metadata are the key factor for defining a bundle of hyperlinked imagines and text as a digital museum. Their codification and their skill to allow a user friendly surfing through contents, maybe also through software packages like chatbots and icons, will determine the real accessibility of the museum site;

- accessibility is a value for a digital museum that wants to supply flexible ways for the acquisition of the information coming from its collections;

- the virtual museum can progressively differentiate itself from the 'mother' museum institution;

- transactions and interactions with other cultural entities and with users are a key feature of digital museums.

[14] A digital museum can be managed off line too stored in Cds, DVD and other systems that can be used offline.

According to the above definition the virtual museum is an indexed computer based environment[15] with high connectivity properties, where the purpose is transferred from preservation of the physical good to the diffusion of the information included in it and where the critical process is the modality of provision of the knowledge flow during the surfing sessions by users.

Since information arises from a raw data processing, the role of the museum structure is decisive for making available the instruments (i.e. specific frameworks, indexes, metadata, search engines and digital reproductions or VR reconstructions) for transforming users to interpreters of data in order to acquire an informative value added from the visit (surfing) of the virtual museum.

Metadata will qualify each museum site and the skill in establishing communities or portals with other entities will be a critical factor, since the satisfaction of an increasingly segmented demand asks for solutions that are beyond the museum institution edges.

Finally, we can assess that a digital museum will consist of the following key elements: digital environment, accessibility, indexes, metadata and networking capabilities.

[15] The museum can be considered an Internet museum only when it is hosted by a tcp/ip server working on the net

2. Objectives and goals of the virtual museums

2.1 *Mission and main constraints for actual museums*

The traditional mission of each museum institution has been preserving cultural objects through their collection into the walls of a physical space, and allowing the access to the mass audience only to the part of the physical space destined to exhibition. The modality of exhibitions of the objects has been constrained by the rigidity of the physical space and by security barriers, creating limits for educational efforts due to the necessity of projecting the educational structures in accordance of constraint of preservation of the cultural heritage.

Territorial location and opening hours of the museums were another constraint for the effectiveness of educational and exhibition efforts and, only in the last twenty years, met a new vivacity thanks to the boom of mass tourism due to a dramatic success (lower prices and more opportunities) of communications.

Any enlargement and modification of the scope of the collected contents has been constrained by the cost of investing in physical facilities (new buildings, new security devices and new furnishing) not easily affordable by the institutions for the lack of additional funding.

Even if financial resources were collected through government subsidies, ticket fees, bookshops, restaurants or fund raising activities they were scarce for new investment.

Human resources were usually acquired by employing experts according to the contents of the museum, administrative personnel and necessary blue collars for surveillance and maintenance of the museum physical building.

2.2 The mission of museums transmuted by Internet

Internet exploitation and the development of digital museums has not touched and affected the traditional pattern (and purposes) of real museums but created new purposes for their digital *alter ego*, far from the traditional ones[16].

Thus, the first goal for a museum web site is to raise the number of people visiting the real museum through its presentation in a way that can be considered as a virtual brochure. In this case the web site has some logistic information about timetables, special events, contents permanently exhibited, in addition to a sample, usually of small dimension, of the objects exposed into the (real) museum.

In other cases, in order to increase tourism, as more general aim, virtual museums can also include links to sites supplying reservation for flights and tourist accommodations, travel guides and general tourist information.

An example of museum site designed for increasing tourism is the 'art trails through Victoria's regional galleries'[17] that has the main goal of promoting on-line tourism in the region of Victoria (Australia).

The development of art trails site has been an evolution of the concept of marketing[18] made by a museum for acquiring, in the territory of the museum a larger share of the increasing tourism flows.

[16] Nevertheless the function of preserving cultural heritage is still a goal of virtual museums.
[17] http://amol.org.au/art_trails/
[18] L. Adendorff (2001) Joining the dots – Museum trails and online cultural tourism paper presented at Ozeculture conference in Melbourne, June 2001.

2.3 Preservation goals

The issues linked to digital preservation consist in the choice of a process that creates not specific platform[19] repositories that must have the feature of not deteriorating over time and, last but not least, that are not closely connected to a particular software or hardware.

In fact, the innovation in computer processors and the fast rate of progress could lock in a technological cage the products of the today cutting edge software packages and hardware machinery. Only a preliminary selection oriented towards platform-free formats gives the opportunity to design an effective project of preservation of the cultural heritage in the long run.

The cost transferring, i.e. digital imagines, from a format to another every ten years is very expensive and create the necessity of continuous investments for keeping the repository of the museum aligned with the average technologies since it creates an expensive process: acquisition of the original software and hardware, migration and translation of the work or development of emulation software[20].

Looking at the evolutionary pattern drawn in the past chapter, which outlined the relevance of communities and portals as new frontier of digital museums, it is clear the strategicity in the choice of the platform also of exploited standards.

Thus, the aim is not only for the maintenance of cultural repositories but taking advantage of opportunities of shared services with a low additional cost.

WWW allows museums to provide shared services and, one of the most interesting for its impact on the demand of cultural goods, is the overcoming of the walls of physical museums for presenting exhibitions on the 'impossible museum'[21] basis that is considered impossible since the thematic of the site is a virtual reconstruction of objects scattered in more real sites, i.e. the opera omnia of some painter, that cannot gathered together in a single physical building.

The possibility of developing shared database, where users can retrieve records about some specific issues, owned by more than one entity is often a goal of digital museums that implement portals, communities, networks and partnerships

[19] B. Jackson (2001) – Collecting the virtual: acquiring digital media. Paper presented at Ozeculture conference in Melbourne, June 2001.
[20] B. Jackson (2001) ibidem
[21] The term 'not possible museum' has been stated by V. Cappellini (2000) La realtà virtuale per i beni culturali. Pitagora editrice. Bologna

for providing services, especially for meeting the requirements asked by the higher segment of the demand for cultural heritage.

According to this aim, the standardisation of databases is a key feature for allowing services based n a single query in a single search engine that retrieve records from more cultural providers.

The standardisation process must include two sectors: the software package of shared databases and metadata too, in order to ensure common classifications and taxonomies and a common search system within the community.

2.4 Personalisation of the virtual museum and accessibility

Another goal of the digital museum is to make available a customisation of its supply of information.

The segmentation of the user demand implies a different approach for each category and Internet, with his array of electronic controls, allows a high degree of personalisation starting from the marketing that can reach also the single user (one to one marketing)[22].

At least three profiles of users are often included as main target of digital museums: experts, tourists and children[23] and the adaptation of the web site to these categories is necessary for designing personalised paths.

The experts usually ask for in-depth information specific with the content provided, and for enabling tools that show the property of retrieving information in a flexible way. Moreover experts are addressed for a typology of web surfing that is not sequential, like the tour in a real museum, but strongly thematic.

The access to specialised databases 3D applications and digital reconstruction are the key services for experts, especially if these services can be supplied by a high degree of personalisation.

The tourist is the traditional user that enters in a museum for increasing its knowledge, usually of low-medium level, on the cultural heritage exhibited.
Since he is not an expert he needs intuitive interfaces allowing him to visit the site for acquiring information according to a narrative vocabulary that must be attractive for making a suitable experience. Hyperlinks, explanations regarding the context of the goods and rigid but more intuitive interfaces are the key services for tourist target.

Children are the users were interaction is strategic for capturing their interest in the field of the museum.

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[22] Interesting example are of systems for a segmented target are described in: F. Amigoni, V. Schiaffonati (2003) – The Minerva Multiagent System for Museum Organization. Paper presented to the workshop Intelligenza artificiale per i beni culturali, Pisa 23 september 2003; and in C. Baracchini, P. Lanari, F.Tecchia, A.Vecchi - La piattaforma multimediale Piazza dei Miracoli (2003) Paper presented to the workshop Intelligenza artificiale per i beni culturali, Pisa 23 september 2003.

[23] An interesting experience regarding the Marble museum of Carrara with this target has been documented by C. Cherri, F. Paternò, G. Piras (2003) - Imparare Attraverso la Multimedialità i Processi di Escavazione del Marmo in Età Romana. Paper presented to the workshop Intelligenza artificiale per i beni culturali, Pisa 23 september 2003.

Application of edutaiment, chatbots[24] and other interfaces that are able to transform the visit in the museum in a kind of game are fundamental for the children audience. The content for them is different from the other categories since it must be adapted and simplified to their level of education (elementary school) and must address their attention and curiosity.

Starting from the above-mentioned broad categories we can define more subcategories reaching an high degree of personalisation, where the limit is not physical or technological, but financial for the cost of the customisation of software.

A prominent orientation to the adoption of cutting edge technologies for fulfilling goals of quality of the site may result in a constraint for the aim to enlarge the access to the widest audience.

In fact, the availability of the necessary hardware[25] can result in a barrier to the access to the site especially for the categories tourist and children which may not invest money for using large bandwidth connections and for upgrading computers at the step of the market.

In order to ensure accessibility museums must also consider language barriers and access facilities for disabled people too.
Because the WWW gives the opportunity of attracting a global mass audience into the museum sites the barriers of language must be overcome with multilingual sites.
People disabled, a segment of users traditionnally excluded from the fruition of the cultural heritage for physical barriers and more in general for the problems related to reach the real site to visit[26] can surf and use the digital interfaces for accessing the cultural heritage not elsewhere available.

[24] Interesting solutions for chatbots are presented in: P. de Almeida, S. Yokoi (2003) – Interactive Character as a Virtual Tour Guide to an Online Museum Exhibition
[25] Also the software updating, if not free, can be considered another barrier.
[26] The Web connection enables people with disabilities of benefiting of services directly in their residences.

2.5 Tasks of virtual museum

Finally, the above mentioned information allow to assess that the mission of digital museums can be resumed in the following tasks:
maximisation of information flows;
preservation of the information contained over time;
adoption of technologies following standards for supplying shared services;
enlargement of the accessibility to the largest audience;
personalisation of the organisation of the site and of the content according a pattern of a segmented demand of cultural goods;
increase the visits to the real museum.
Each virtual museum will develop a mission based also to a part of these tasks but that are nevertheless an integration of the more general mission of the original institution.

3 Job profiles required by a virtual museum

The concept of developing a digital museum implies the selection of job profiles that must meet the requirements of working in a project framework where teamwork, multi-disciplinarity and co-operation are the key factors.

Differently from the real museums personnel all the profiles of their virtual counterpart are of medium high professional level with peaks in some field of specialisation.

The fundamental broad categories, necessary for each digital museum are enlisted as follows:

- the project leader
- the computer based expert
- the web expert
- the content expert.

According to additional goals such as educational and marketing aims it is relevant also to consider the categories of financial manager, communication experts and of training experts too.

3.1 The project leader

As a curator manages real museums, a project leader manages their digital counterparts. The role of the project leader is basically to address the virtual museum into the framework of the mission of the original institution. He is the human interface among the virtual and real museum and he has to find out the purposes of the virtual site in connection with the mission of its institution and raise a suitable budget for reaching them.

Thus, he has to present a project for the virtual museum to the institution, find an agreement with the institution for the aims of the web site and for the budget.

A strategic view of the whole digital project is necessary for asking resources, allocating them and for creating a team of people that has the capacity of working closely each other and, moreover, he must work also on the project itself.

The drawing of a detailed project is a key point for developing a virtual museum because the fast change in network technologies and the structure of the site that must be aligned with the selected goals.

On the other side the project leader will manage the development and maintenance of the virtual museum with a special focus on human resources since he will allocate tasks and will co-ordinate the interactions between the different profiles.

More than a traditional manager he will be the strategic leader of the virtual museum.

Since the project leader profile will cope with two separate arenas: board of directors of institutions and working team, its role can be separated into two figures.

The interactions with the institution can be focused on a single man, often a member of the board of directors or the curator himself, leaving to another people the profile of virtual museum manager.

On one side who will work directly with the institution will supply resources, will draw objectives like reaching of a target in terms of audience, quality and visibility of the site or, in general, the fulfilment of the tasks assigned by the institution.

He will be specialised in resuming the tasks of the institution in a project and in searching consensus (within the institution) for the WWW option and he will be the main reference for the virtual museum manager.

On the other, the virtual museum manager will organise the work operatively focusing his efforts on the alignment of technologies (to the purposes), the selection of the necessary people, the efficiency and effectiveness of the whole project.

The virtual museum manager will supervise all the phases of realisation of the museum promoting the dialogue among the technological and content experts.

A positive action for increasing the degree of interactivity among personnel will be strategic, especially for the updating and for the follow ups arising from the digital project, because applications of virtual museums are still based on a mix of content and technology that must be organised in an optimal way.

Last but not least, the virtual museum manager will be the supplier of metadata for their relevance in terms of codification of the information made available and for their eventual impact on standards that affect eventual participation in the provision of shared service with other virtual entities

3.2 The computer based expert

The process for creating a digital museum can be, at least, divided into three steps: digitalisation, processing and lay out into the virtual structure of the museum[27].

This kind of sequential process requests a separation of the work of digitalisation of the objects[28] from their on-line publication and a different approach to the aims: people working on digitalisation look at the quality of the images as priority, on the other side people working on the Web site look at the whole structure of the site assessing is effectiveness in terms of accessibility and attractiveness as priority and content experts will point out the information level of the cultural heritage.

Thus, digitalisation must be approached in a multidisciplinary way where graphic specialists work in team with the content experts and the web manager.

Nonetheless digitalisation, like web publishing, is based on an high level of specialisation especially when based on 3D imagines and on the creation of virtual environments.

The pattern to follow should point out the value of interactions between people through a framework where the computer graphic (typical profile of the digitalisation step) should answer to the content specialist (i.e. an archaeologist) for 3D reconstruction (i.e. of some ancient building) showing him the best technical practices in term of quality, for creating an informative value added within the product.

Their agreement should be validated by the web expert (a web designer) in order to be compatible with the overall architecture of the site.

Their teamwork should follow a model where each specialist tries to communicate its knowledge to the other for reaching a shared product and, in order to avoid the institution of jerarchical relations.

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[27] Other authors stressed the three step process as: acquisition, procession and publishing on the web (D. Conte, L.P. Cordella, P. Foggia, A. Limongiello, C. Sansone, M. Vento (2003) - *Acquisizione e Fruizione su Internet di Opere d'arte.* Paper presented at the seminary Contesti culturali e fruizione dei beni culturali -Napoli, Certosa di San Martino 22-23 maggio 2003. Another author resumed the process into: storage, retrieval and interaction (B. Davis 1994 ibidem)

[28] Digitalisation includes all the work of computer graphics necessary plus the eventual development of databases. In general all the computer based off-line activities.

Even if the relevance of the content is often considered a priority[29], especially by the curators of real museums, the inclusion of some jerarchic chain within the team is a barrier for a result that is an optimal mix of different approaches.

The digital expert profile category can be divided into:

- the technologist responsible of the selected technology
- the computer graphic designer[30] that will process data for obtaining the final product

When the digitalisation consists of the development of databases we should add also a profile of database expert[31] who must work closely with the technologist for the choice of software and with the graphic designer for finding a format of objects that can be compatible in the database system.

The interaction with the content experts will allow answering to what and why reproducing, indeed the interactions with the web expert will be aimed to answer to how will the digitalisation experts have to define the formats for being suitable with the WWW.

In detail, the technologist should act as interface with contents and Web, while the digitalisation experts (both the database developer than the graphic expert) should implement the products[32].

[29] Forte points out the relevance of the content expert when thinking to the construction of aercheological 3D environments. Aercheologists should manage the efforts architets, computer scientists, graphic artists and multimedia experts M. Forte (2000) – About virtual archaeology: disorders, cognitive interactions and virtuality

[30] A further profile working with the graphic designer is a photografer profile necessary for increasing the quality of the artificial environment of the objects. The photografer, if disembodied form the graphic designer should work closely with the content expert.

[31] Apart the design of database it is necessary a low level job profile for the population of the database.

[32] All the process of digitalisation should be managed under the supervision of the project leader.

3.3 The content expert

The focus of all its activities should concentrate on the contents with an effort of integrating them into a web site according to a minimum level of quality.

The content expert is the profile category with an in-depth knowledge of the specific cultural field of the museum.
His work will supply the inputs for the selection of objects, for additional information to include into the databases, for eventual bibliography and for a first evaluation of the effectiveness of the digital reconstruction.

The content expert should interact with the digitalisation experts for reproducing the objects according to a level of high cultural quality and, on the other side, with the web experts for finding a shared solution in the way they are allocated into the WWW.

The content expert category should also think how enlarge the scope of the exhibition, the management of special events and the logistic information to include into the web site.

The profile can be divided into:

- a researcher that after the selection of objects must manage additional information to make available, documentation, bibliography and, in general, the content specific literature;

- a content architect that should propose a museum concept for the site in the sense of selecting arguments considered strategic to exhibit, the logistic information and the more rationale ways, according to a cultural perspective, for surfing within the collection[33] exhibited;

- an expert in training methodologies for the implementation of eventual sections destined to educational aims. He will define the educational modules according to the selected target.

In the overall framework, the researcher will work mainly with digitalisation experts, indeed the content architect and the expert in training with the web designer since their products have a deep impact in the design of the site, especially in the medium run, during the phases of updating of the site and in the case of modification of network technologies.

[33] Its counterpart in the real world is the choice of the lay out of the objects in the museum building.

Moreover the training expert will work in team with the web developer for the adoption of communication software, like Java applets, that can be a key element for manage educational games and for increase the attractive of the educational section of the site.
In general all the three profiles described above[34] should test the suitability of the site and will give e feedback to the web designer for increasing the quality and the accessibility of the site. Thus, they have to use technologies and have the skill of be communicative with the web experts.

[34] Also a translator should be considered since, especially for museum originating from not English speaking institutions, a multilingual site is relevant.

3.4 The web expert

This category is the final builder for the product: the web site or the portal or the community.

The project leader will work with the web expert team explaining them the purposes of the virtual museum, then they interact with the content experts which design the sections of the site and with the digitalisation experts for finding a format suitable with the constraint of accessibility and attractiveness of the site.

In co-operation with the web experts, the project leader will have to decide also the level of access because for some information the access can be restricted (usually personnel of the institutions or selected scholars will receive a full access, while mass audience will be limited).

The category web expert can be divided into the following categories:

web designer which works with the project leader for drafting a plan of web site aligned to the assigned purposes.

He will design the structure of the site, indexes and metadata, still in close co-operation with the project leader.

Especially the structure of the site is a vital element for the success of the project because it means the realisation of the concept of digital museum and it is the counterpart of the real museum physical structure: walls and rooms.

Many institutions have still realised a wide range of web structures starting from the virtual proposition of the real version of the museum until reaching patterns not comparable with the real version of the museum.

The increasing distance between real and virtual is mainly due, apart experimental technological solutions, to increase the personalisation of the visits, to enlarge the scope of the potential audience and to experiment advanced communication patterns.

The task of the web designer is also to propose the eventual creation/participation in virtual communities or to find partnerships for portal and other shared services[35].

[35] This kind of eventual proposals will be in any case the answer to eventual aims that remain a task of the project leader.

Web developer, which work specially in team with content and digitalisation experts because its task is to realise the virtual museum, according to the project proposed by the web designer.

The web developer have to find technological solution for ensuring the well functioning of the site and so he will interact with digitalisation experts in order to put into the site a digital product suitable for the web environment and with the content experts for ensuring the development of a site offering an high informative value added.

The web developer will participate to the test of the final web site and will publish on-line the final product: the virtual museum.

Web manager which starts its activity after that the site is still on-line.
He will be responsible of the maintenance and updating of the site over time, with a more active role if the museum is included in some community or network.

He will be responsible also of software, of the security devices and of the quantitative parameters such as the number of hits, average time of each hit, most visited sections, first feedback with users and, finally, of the transactions with the host[36].

[36] Of course each Internet site needs an host that more than a job profile is a service supplied by the market.

3.5 The additional profiles

The financial manager
The construction of a virtual museum needs, of course, of financial resources, that are not anymore, as in the beginning of Internet, of small amount. Today many museums invest a lot of money on virtual museums with figures reaching also the million of dollars[37] and the homepages arranged on voluntary basis are decreasing.

Moreover the investment cannot be a lump sum but a flow a resources[38] that can be supplied by the original institution or by other sources for the necessary upgrading of the virtual museum.

If the resources of the institution are not enough for following the virtual museum experience, the financial manager has the task of searching alternative sources too such as:

- sponsorships
- fund raising activities
- advertising sources
- selling in the site of products on the pattern of a virtual shop.

In this case the financial manager will interact with the project leader[39] and with the category of web experts for maximising the inflow of resources.

The communication expert

In the Internet environment visibility is the main rule: more the museum is visible and has an interface that is assessed as communicative from the potential target, more the museum is considered successful, especially if its the success affects positively the visibility of the real museum.

The communication expert will act mainly with the web experts for creating a museum that, apart the informative value added of its contents, is able to gain notoriety and success on the web too.

[37] Guggenheim museum invested more than 1 million of dollars in three years for its virtual version.
[38] K. De Vorsey (2001) in MIT Communications forum, The digital museum, 8 march 2001.
[39] The profile of financial manager, especially if the institution alone finance the project can be embodied into the project leader profile.

He will propose all the necessary measures for enlightening the initiatives of the museum such as special events, participation in portals, network and communities and will interact with the whole team for fulfilling this task.

The training manager

In virtual museum training is relevant for two main needs:
the requisite of a multi-disciplinary approach by the whole personnel;
educational purposes included into the mission by the museum management.

Some authors have stressed the importance of education and of cognitive experiences[40] in the computer environment and many software packages developed for cultural goods have been designed according to educational purposes[41].

The training manager has the task of manage training modules for a better communication between personnel and for ensuring a minimum level of knowledge of the cultural field of the museum to digital and web experts, and, on the other side, updated knowledge of web and computer based solutions for the content experts.

On the web he is responsible for educational modules and for the eventual organisation of web training courses.

[40] In M. Forte (2002) – Communicating the "Virtual" a pattern of cognitive interaction is outlined and is developed the idea of reticular spatial learning as typical feature of VR.
[41] In A. Sbrilli Eletti (2003) – Immagini dense. Le riproduzioni digitali d'opere d'arte come interfacce di esplorazione delle opere stesse. Paper presented at the seminary Contesti culturali e contesti dei beni culturali. Napoli, 22-23 may 2003 is avalaible the presentation of some cultural product of the edutaiment kind, for promoting learning through an easy approach.

3.6 The framework of the professional profiles

Finally, we have detailed 4 fundamental categories and 4 additional profiles[42] for managing a virtual museum from its conceptualisation by the institution to his final realisation and on-line management.
Fig. 2 that shows schematically the categories and sub- categories of necessary profiles describes the overall framework of the team. It must be added that all the profiles share a common approach towards multi-disciplinarity and towards the necessary network of interactions of teamworking.

Fig. 2 The profiles for a virtual museum

Project Leader	**Digital expert**	**Content expert**	**Web expert**	**Additional profiles**
Institution manager	Technologist	Researcher	Web designer	Financial manager (can be embodied by the project leader)
Virtual museum manager	Computer graphic designer/database developer	Content architect	Web developer	Communication expe (can be embodied by the web experts)
	Photographer (optional)	Expert in training methodologies (can be disembodied from the contents)	Web manager	Training manager (can be embodied in the content group)
	Computer operator (optional)			Translator (can be embodied in the content group)

[42] They are not considered into the basic team both for the small dimension of teams working in virtual museum (less than 10 people for the majority of sites according to the results of Internet Museum - The World Wide Museum Survey on the web. 1998 http://www.museum.or.jp), than for they can be easily embodied in to the basic categories.

4 Role and skills of the selected profiles

The description and the analysis of the skills is based on the evidences emerged in the previous chapter and have the main purpose to enlighten the more specific skills necessary for building an on-line virtual museum, regardless its cultural heritage and regardless specific skills into the museum mission.

4.1 Project leader role and skills

The institution manager
The institution manager should have reached high level education, not necessarily specialised in the content of the museum or in science based disciplines, but should also show skills in public relation and in communication since is the unique profile that have to interact among the real museum management and the virtual museum team. He has also an attitude to work on projects.

Virtual museum manager
The priority skills of the virtual museum manager are ability in designing projects and manage their realisation. His skills must meet also the requirements of problem solving and of personnel management, maybe acquired during past working experiences, because he is the engine for the teamwork.

He is a generalist with a very strong attitude towards multi-disciplinarity and so his university degree can also be not related to the content of the museum[43]. Nevertheless he has to show a skill in classification since he has to supply metadata to the web developer for creating indexes.

[43] The Guggenheim virtual museum has been designed by two architects: Hani Rashid and Lise Anne Couture.

4.2 Digital expert role and skills

Technologist
The technologist must have a specialist science based education and must be aware of the cutting edge technologies, both hardware both software, which can be of interest for a virtual museum.

His skills are based on a problem solving approach in order to fulfil the needs of the content experts (in terms of finding an optimal technology for high quality products) and web experts (in terms of technologies compatible with the features of Internet).

His teamwork enlightens a multidisciplinary approach, so the technologist must show knowledge, even if at a medium level, of the cultural heritage to transform in digital objects.

Computer graphic designer/database developer
He is specialised in software packages for digital scanning or database related.
Even if he is a computer based profile he must be aware of the needs that can arise by the cultural heritage.
He can also have a technical upper secondary diploma, instead of a university degree specialised in software, at the condition of having still acquired considerable experience in digital work for cultural heritage.

Photographer and computer operator
For these profiles is necessary upper secondary school, working experience in project driven enterprises and a good attitude for team working.

4.3 Content expert role and skills

Researcher
He is the specialist of the field of interest of the museum because he will be the main knowledge resource for the contents of the virtual museum.
He has a PhD or an university degree in a discipline corresponding to the content of the museum.
Since he will co-operate with the digital experts his computer based skill must be of sufficient quality for using the digital versions of the cultural heritage and testing their suitability.

Content architect
He has an university degree specialised on the cultural heritage of the museum, but differently from the researcher, he will work with web experts more than the other categories.
Although he will not develop directly the site he must show knowledge of web related technologies and since he will draw also the logistic sections of the virtual museum he has to show knowledge of the real institution and skills in selecting the logistic issues to include into the virtual version of the museum.

Expert in training methodologies
He is a profile with a university degree in the field of interest of the museum and his skills are related to training on Web methodologies.
He is a content expert for his primary focus on the content included into the virtual museum that he has to codify for educational aims.
He will work in team, especially with web experts and the project leader, and should be aware of the best methods linked to training in Internet, or more generally to supply education from cultural heritage sites.

4.4 Web expert role and skills

Web designer
He is specialised in projecting web sites, with a degree in communication, networking, computer-based sciences, and will work closely with the project leader, the content experts and the web developer since he is the 'designer' of the virtual museum
His skills must also include the designing of a web site open to eventual upgrading and integration into communities and portals.
His skills should include also an attitude to codify the purposes of the museum and the content collected into the overall site architecture that means also a skill in implementing indexes, including also the metadata supplied by the virtual museum manager.

Web developer
He is the final creator of the virtual museum and must have a specialised skill in implementing web sites.
He should have a computer-based degree with a specialisation in networking and a skill for showing a strong approach in interaction with the whole team since everybody will act as a commitment with him for the realisation of the final product.
He must show interest for cutting edge solutions for web sites in order to ensure that also the museum site will be in line with most advanced realisations.

Web manager
The web manager is the responsible of the virtual museum after it has been realised and on-line published, and so he must hold a engineering specialisation in order to solve, both hardware than software, eventual problems with a special focus on security issues.
Since the whole team will contact him for eventual updating of the virtual museum sections he should develop skills of communication with people with a different background. He has also a knowledge in statistics since he have to report figures like number of hits, average time spent on the site, most preferred sections and so on.
He will manage security issues, like passwords, firewalls, payment systems and in general against hackers.

4.5 Additional profiles

The financial manager
He is a profile with a degree, preferably in business administration, with experience in non profit organisations in order to manage the necessary know-how and the know-who for fund raising and sponsorships.
He must be also very communicative with people external to the museum for attracting interest and he must select and manage systems of payment suitable on Internet

The communication manager
He is a person with experience of communication for cultural institutions showing skills oriented towards the usage of Internet as a medium for exploiting the visibility of the museum.
He must know the main initiatives for virtual museums, maybe working in team with the financial manager, for creating the opportunities for increasing the number of hits and the flow of financial resources.

The training expert
He is a professional with experience on training in computer related issues and internet. He will also have the skill of developing personalised training modules for distance learning, working closely with the content experts.

The translator
He has a language degree with a specialisation in the idioms selected by the virtual manager and he has also experience in the cultural field preferably related to the specific content of the museum in order to master the proper technical dictionary.

5 Problems related to training needs

Virtual museum affects training on two dimensions:

- the first one is the answer to need of a working team multidisciplinary where awareness of Internet and of the contents of the museum are a common skill;
- the second dimension is the empowerment of the educational mission of the museum that is based on the feature of providing personalised training to different targets.

On the first dimension, that is internal to the team working for the virtual museum, the impact on training will focus on the implementation of modules that are flexible on the terminology and that are strongly interactive with concerned personnel.

The adoption of distance learning instruments is a key feature because the team must be aware of their potentiality and for they represent a further opportunity to test a pattern that can be followed up also with some segments of the museum audience.

Anyway, the working team must be empowered also on the basis of maximising knowledge flows between people through informal meeting and through the self-selection of other internet instruments (newsgroups and e-mail in example) by themselves.

Role training is strategic for solving problems related to the team working and for harmonising interactions in a team where horizontal links are the main rule.

For virtual museums training will be a fundamental factor, open also to external knowledge sources, as communities and newsgroups that can provide training on shared basis.

Moreover digital communities[44] are a reference for the challenging with the fast innovation rate in Internet and for they are an extraordinary source for acquiring information especially of experience kind.

[44] In Jonathan Bowen, Mike Houghton, Roxane Bernier (2003) - Online Museum Discussion Forums: What do we have? What do we need? is available a relevant analysis of the resources for cultural communities on the WWW.

For the second dimension (visitors or surfers of the museum) distance learning will be the key element for training because the experience of surfing in a cultural site has a strong cognitive impact[45] and because of the educational mission of virtual museum is considered an important purpose by many institutions.

The adoption of instruments like chatbots or children sections leads to the development of methodologies often based on innovative approaches.

These methods must provide knowledge through software driven modalities in environments where interactions with the users are based on the feedback of a computer.

Moreover in Internet the timing is not based in days or hours but in seconds and minutes[46] and this reduction of the time scale affects strongly the methodology for providing learning.

The software based modules have to cope with a cognitive impact following an experience pattern where the users has the aim of acquiring the requested knowledge through the interactions with the site more than listening or reading a formal lesson with a strong similarity of many edutaiment packages.

According to this pattern the reference of traditional training courses will be replaced by distance learning where the software packages will maximise the training effectiveness on a segmented audience.

The personalisation implies also the codification of indications for the audience in order to give them the opportunity of self-selecting suitable modules.

According this approach the availability of metadata will be useful for addressing people towards the courses they are interested.

Finally, we can affirm that training in virtual museum will enlighten multidisciplinarity through personnel and will assess Internet as an open environment where training methodologies have to empower the team with motivations and instruments for retrieve useful information, especially if referred to the experiences of other cultural entities.

Role training will act has a tool for harmonising relations within the team and for developing an environment that maximise the flow of knowledge between the

[45] M. Forte (2003) ibidem
[46] In terms of average time of surfing a site.

digital, web and content categories with a unique codification suitable for each category.

6 Impacts and chances for equal opportunities

On equal opportunities side to conceive, to plan and to realize a virtual museum may affect three fields:

- small institutions,
- gender inequalities,
- people with disabilities.

For small museums, especially that one located in territories not included into the traditional tourist routes, the virtual business is relevant for:

- enlighten their collections in a de-territorialised environment,
- giving more visibility to the local community.

For a minor museum the participation to a portal or a community of European virtual museums is essential since the implementation cost of its own virtual museum is not low anymore, especially if resources are scarce and there is not enough experience with technology.

Thus, Internet is not only an opportunity but also a danger for small museums without a virtual counterpart because of the risk of being marginalised by users.

The challenge is to invest in technologies and to look for the best options in terms of -sustainability for small entities.

Portals, also if focused on the regional territory or on tourist perspective, can be a solution since they offer to the minor museums both know how than visibility on Internet.

The opportunity of inclusion of small entities is fundamental for ensuring diversity that is a key element of culture and Internet can be an optimal medium for this purpose.

On this field the strategic purposes for Internet of small museums are the key for investing in the future or falling into exclusion from many cultural (and virtual) communities.

Regarding gender inequalities, a virtual museum can make available new employment opportunities suitable for the organisation flexibility of working time and that can enlarge the impact of the cultural sector with an increase of audience, both for virtual museums than for their real counterparts.

In general the WWW has never been a special barrier for gender equalities, indeed, it has supplied more opportunities to categories of women with problems in traditional jobs due to working time and to distance from the home.

There are many women participating in virtual museums, sometimes as leader and, the analysis of 5 WWW sites[47] representing 5 museum affirms that the number of women is nearly 50% (22 out 50) and for 3 museums they act in the leader profile too.

Regarding people with disabilities, virtual museums are an opportunity for they allow accessibility to the cultural sector without physical barriers.

Traditionally people suffering of disabilities have been involved in the Internet (and in computer working) by the beginning and virtual museums are both an opportunity for them of professional employment than a new possibility of surfing through sites without barriers as users[48].

Finally, equal opportunities find an excellent medium in Internet and since for some categories Internet can be an engine for reduce eventual gaps, on the other side it must be stressed how the digital divide can increase dramatically among people with computer literacy and connectivity and people without this two requisites that are necessary for acting as users.

The divide can rise dramatically especially for people with humanistic education without a computer based literacy and for people living in developing countries where both virtual museums than potential surfers are a small share of the total since there is a lack of technological resources.

[47] The sample has been selected with a random process and the number and the profiles of women arise from the analysis of the information included into the site. The sites of the sample are:
Vivre au bord du Danube il y a 6500 ans http://www.culture.gouv.fr/culture/arcnat/harsova/fr/index.html
A More Perfect Union: Japanese Americans and the U.S Constitution. http://americanhistory.si.edu/perfectunion/
Van Gogh Museum http://www.vangoghmuseum.nl
Czech National Museum http://www.nm.cz/english/
Mysteries of Catalhoyuk http://www.smm.org/catal/introduction/

[48] Even if the accessibility for disabled people is not yet common in cultural sites. It is worth of mention the site Mysteries of Catalhoyuk http://www.smm.org/catal/introduction/ because it meets the requisites of accessibility of US Government's Section 508 accessibility guidelines

7 Effects on social dialogue in training strategies

Virtual museums are often managed by small group of people (10-20) with high professional skills and often working from different location.

This pattern affects the traditional scheme where blue collars (usually for security and maintenance jobs) were the majority of largest groups of personnel.

On this side virtual museums follow a path were trade unions have difficulty to be a player, but it must be stressed the virtual museums helps to increase the targets and the mission of their actual counterparts.

The problem to solve will not be neither the dimension of teams neither their qualification but the outsourcing effects. Except for contents, the web and the digital categories can be outsourced with problems in term of control of the labour population by trade unions.

Nevertheless the outsourcing approach arises usually from the dimension of the original institution than from the virtuality dimension of the museum itself.

It must be outlined also that employment effects of virtual museums are not negative since they do not substitute physical museums but they integrate and empower them: the overall employment effects are eventually positive but never negative.

Finally, trade unions will have not to play a role for avoiding a shift of resources from the real world to Internet but ask for investment that also indirectly benefits both the dimensions.

The other task of trade unions is to avoid the transfer, even if digital, of the knowledge base of the museum towards the external environment in term of outsourcing companies located abroad or in low cost areas and, as a result, for empowering internal competencies for participating into digital projects[49] that mean a requested factor for following to challenge in the ‘cultural market’.

[49] This last feature arises also because the construction of barriers to virtual museums can affect negatively also to the physical one, especially, as mentioned above, if of small entity.