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'The digitization of cultural heritage: Conceptual framework, policy analysis and case studies'

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Abstract

The present thesis submitted to the Curriculum in Local Development focuses on the digitization of tangible cultural heritage - defined as the conversion into digital format of the cultural artifacts preserved in museums - within a series of previous studies that have analyzed models of economic development at the intersection of culture and technological innovation. The phenomenon under examination has initially emerged in museology and computer science, but has been addressed only recently by economics and managerial literature. Due to its recent history and its inter-disciplinary nature, however, there is a lack of consistent conceptual frameworks and empirical inquiry.

To this purpose, Anglo-Saxon museology literature is reviewed, with specific reference to the different forms of digitization (digital collections and virtual museums; Web 2.0 spaces; interactive exhibits and Virtual Reality models; museum mobile applications), highlighting the main techno-cultural trajectories and common arguments. A comparison of the latter with economic and managerial studies of digitization leads to identify three research gaps, referring specifically to the economic sustainability of digitization and business models; to the organizational implications and challenges of inter-disciplinary collaboration; and to the size, composition and behaviour of the demand for digital heritage.

In order to contribute with empirical evidence on these issues, the present work adopts a two-layered research strategy composed of an analysis of public policies for digitization in Canada and Europe and longitudinal case studies of one representative museums for each context.

The two research sites provide differentiated points of observation on the phenomenon. In particular, Canada has been the first country to enact a coordinated policy in the digitization of cultural heritage since the 1970s, resulting in the creation of centralized points of access to the national heritage in the late 1990s. In turn, European policies for the digitization of cultural heritage have emerged in the 2000s with the aim of coordinating the initiatives taken individually by Member States, resulting in the launch of the central digital library *Europeana* in 2008.

The two experiences configure two partially differentiated models as regards the relations between museums and technology developers and the utilizations envisioned for digital heritage, although presenting similar issues of economic sustainability.

The comparison of the case studies of Pointe-à-Calliére (Montreal Museum of Archaeology and History) - a young, experience-oriented museum that has developed multimedia shows and exhibits in collaboration with local design firms - and the Uffizi - an historical art gallery where a long-term partnership with the University of Florence and firms has led to the development of digital collections - allows to further substantiate the two models. These can be defined as a *digital value chain* model based on a distinction of the role of museum and technology providers which characterizes the European and Italian experience, and a *co-construction* model dominating in the Canadian context, which sees a closer collaboration between the two parties in the design of modalities for the communication and display of cultural contents.

Upon the bases of policy analysis and case studies, the work concludes with a discussion of the economic and cultural tensions introduced by digitization in museums, and a call for further research.

Sintesi

Il presente lavoro di tesi, svolto nell'ambito dell'Indirizzo in Sviluppo Locale, analizza la digitalizzazione del patrimonio culturale tangibile, definito come la conversione in formato digitale degli artefatti culturali preservati all'interno dei musei, collocandosi all'interno di precedenti studi sui modelli di sviluppo economici derivanti dall'intersezione tra i beni culturali e l'innovazione tecnologica. Il fenomeno in esame è emerso in primo luogo in ambito museologico ed informatico, ed è stato affrontato solo recentemente nella letteratura economica e manageriale. A causa sia della sua storia recente, che della sua natura inter-disciplinare, tuttavia, si evidenzia una generale mancanza di strutture concettuali condivise e di analisi empiriche.

A tale scopo, il presente lavoro svolge una rassegna della letteratura Anglo-Sassone di ambito museologico, con particolare riferimento alle differenti forme assunte dal processo di digitalizzazione (collezioni digitali e musei virtuali; spazi Web 2.0; dispositivi interattivi e modelli di Realtà Virtuale; applicazioni mobili), evidenziando le principali traiettorie di sviluppo tecno-culturale e gli argomenti comuni al dibattito museologico sulle nuove tecnologie. Attraverso un confronto con la letteratura economico-manageriale, si giunge all'identificazione di tre aree di ricerca aperte, riferite rispettivamente alla sostenibilità economica della digitalizzazione e ai modelli di business; alle implicazioni e sfide organizzative derivanti dalla collaborazione inter-disciplinare; e alla dimensione, composizione e comportamento della domanda per il patrimonio culturale digitalizzato.

Al fine di apportare evidenze empiriche sugli aspetti sopra richiamati, il presente lavoro adotta una strategia di ricerca articolata in due livelli: un analisi critica delle *policy* pubbliche per la digitalizzazione in Canada ed Europa e lo studio di caso di un museo rappresentativo per ciascun contesto.

I due contesti di ricerca forniscono punti di osservazione differenziati sul fenomeno in esame. In particolare, il Canada è stato il primo Paese ad implementare una politica coordinata di digitalizzazione del proprio patrimonio culturale a partire dagli anni Settanta, sfociata sul volgere degli anni Novanta nella creazione di punti centralizzati di accesso al patrimonio digitale. Una politica Europea emerge in questo periodo allo scopo di coordinare le iniziative avviate dagli Stati membri, risultando nel lancio della biblioteca digitale Europeana nel 2008.

Le due esperienze configurano due approcci parzialmente differenti alla digitalizzazione, per quanto riguarda sia le relazioni tra musei e gli sviluppatori di tecnologie sia le tipologie di utilizzo previste per il patrimonio digitale, pur presentando analoghe problematiche di sostenibilità economica.

Il confronto tra i casi di studio di Pointe-à-Calliére Calliére (Montreal Museum of Archaeology and History) - un museo giovane ed ispirato ad un approccio museografico di tipo esperienziale, che ha sviluppato spettacoli e dispositivi multimediali in collaborazione con imprese private - e la Galleria degli Uffizi - un museo storico che ha instaurato una partnership di lungo termine con l'Università di Firenze e imprese private per lo sviluppo e la disseminazione delle collezioni digitali - fornisce ulteriori elementi per l'individuazione dei due approcci. In sintesi, questi possono essere definiti come un modelli di *catena del valore digitale* - maggiormente radicato in Europa ed Italia - che prevede una distinzione precisa del ruolo del museo e dei partner tecnologici, ed uno -

caratterizzante il contesto Canadese di *co-costruzione*, basato su una maggiore collaborazione tra le due parti nella definizione delle modalità di presentazione e comunicazione dei contenuti culturali. Dopo una rassegna dei rispettivi vantaggi e criticità, il lavoro si conclude con una discussione delle tensioni di carattere economico e culturale introdotte dal processo di digitalizzazione nei musei e con un invito ad ulteriori ricerche empiriche sul fenomeno.

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Ma soprattutto, grazie alla mia famiglia che non mi ha mai fatto mancare l'affetto e il sostegno, come solo lei sa fare.

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"Chiunque sia capace di studiare questo oggetto, come anche gli altri oggetti intellettuali simili a questo, deve analizzarli per quanto gli permettono le sue forze conoscitive […]. Colui che se ne schermisce è degno di condanna ed è annoverato tra gli infingardi sia nello studio che nell'azione"

Rabbi Beqai, in P. Florenskij, *Lo Spazio e il Tempo nell'Arte*.

"There are more things in heaven and earth, Horatio, than are dreamt of in your philosophy".

William Shakespeare, *Amleto*.

"Chi sa è solo colui che comprende di dover sempre di nuovo imparare, colui che, in virtù di questa comprensione, si è messo anzitutto in condizione di sempre poter apprendere. Questo è ben più difficile che possedere delle cognizioni. Il poter-apprendere presuppone il poter-interrogare"

M. Heidegger, *Introduzione alla Metafisica*.

"*Where is the Life we have lost in living?*
Where is the wisdom we have lost in knowledge? Where is the knowledge we have lost in information?"

T.S. Eliot, *The Rock*

1. Introduction

The present work originates from a set of previous studies that aim to explore models of economic development based on the intersection between cultural heritage and technological innovation (Lazzeretti et al., 2011; Lazzeretti, 2012a), focusing in particular on the digitization of tangible cultural heritage in museums.

Since its emergence, the digitization of cultural heritage has attracted an increasing interest in the humanities and computer science, generating an intense though somewhat disorientating debate. In the same period, it has been the object of policy-makers' attention and interventions both in North America and Europe, which have expressly promoted the diffusion and application of information technologies in the cultural sector. Most recently, the digitization of cultural heritage has been also addressed in economics and managerial literature, focusing on the implications for the management of cultural institutions and the digital-creative economy.

Due to the very recent history of the phenomenon and to its location at the crossroads of different disciplinary areas, however, there is still a lack of shared conceptual frameworks and empirical studies of concrete experiences of implementation.

To this purpose, the present work aims at two main objectives: that of providing a first comprehensive mapping and clarification of the recent (and still ongoing) debate, through a systematic review of existing literature, and of integrating existing empirical knowledge with an analysis of public policies and experiences of implementation in representative museums.

The empirical work has been conducted across Canada and Italy, which offer differentiated but complementary points of observation on the phenomenon as regards the respective historical and policy backgrounds, conceptual approaches to digitization and experiences of implementation.

The work is organized as follows. The remainder of the present Section provides a definitional and historical background of the digitization of tangible cultural heritage in order to contextualize the analysis.

In Section 2, the most relevant contributions to the definition and conceptualization of digitization are identified and analyzed by drawing mostly on Anglo-Saxon literature. Since the digitization of cultural heritage in museums has been addressed both by museological and economic-managerial literature, these two disciplinary domains are reviewed separately and later compared in order to identify common or diverging concepts and arguments.

The work of conceptual clarification above allows to identify the main gaps existing in literature and the main open questions, which regard the size, profile and composition of the demand for digital heritage; the dynamics of collaboration between different professional specialties involved in digitization projects; and issues of economic sustainability of digital heritage and business models. These are presented at Section 3 together with the research strategy, which is based on a critical, historical analysis of digitization policies and cases of implementation.

Section 4 presents the analysis of digitization policies in Canada and the European Union, whereas Sections 5 and 6 respectively illustrate the case studies of Pointe-à-Calliére - Montreal Museum of Archaeology and History - and the Uffizi Galleries in Florence. The findings of the empirical analysis are discussed in Section 7, which concludes the work.

1.1. Definitional issues

Although digitization is seldom defined explicitly in scholarly literature and policy documents, it refers in general to the conversion into digital format of any type of material. Therefore, the digitization of tangible cultural heritage implies the translation of artifacts (monuments, paintings, sculptures, books, documents etc.) into a numerical representation composed of a series of binary 0-1 values. From a technical standpoint, this is achieved by associating optical instruments of photography or scanning capable to acquire digital images, to computers and software - generally defined as *digital image processing* or *digital imaging* (Cappellini, 1985; Schalkoff, 1989) - capable to process, store, archive and display the resulting reproductions. The latter can be either two or tri-dimensional, according to the technology used.

The result of this process of conversion, consisting in digital representations of material artifacts, is frequently referred to as *digital heritage* (Cameron and Kenderdine, 2007; Ronchi, 2009; Navarrete, 2013). In substance, digitization generates intangible copies, surrogates or replica of material objects (Cameron and Kenderdine, 2007) and inserts itself as such within a centuries-long history of means of reproduction of artworks and monuments that include drawings, engraved prints[1] and photographs[2].

A clarification is needed as regards so-called *digital born objects*, or artistic works that are directly generated through the computer such as the so-called *Net Art*. Whereas these artifacts broadly fall within the concept of digital heritage (Navarrete, 2013), it is not accurate in their case to refer to a process of 'digitization', since they are generated since the start in numerical format and do not need any further conversion.

Moreover, material cultural artifacts are theoretically distinct from the category of intangible - or immaterial - cultural heritage that has been identified by the UNESCO as the set of "oral traditions, performing arts, social practices, rituals, festive events, knowledge and practices concerning nature and the universe and traditional craftsmanship" (UNESCO, 2003, art. 2) that "communities, groups and, in some cases, individuals recognize as part of their cultural heritage" (art. 1). When referring to digitization, however, it is hard to trace in practice a neat distinction from material heritage, as performances and traditional knowledge are often documented on material supports (artifacts, texts, photographs, audio or video recordings of oral interviews and memories), presenting significant overlaps with ethnographic heritage. Although policy-makers have recently manifested an interest towards the digitization of intangible heritage (CHIN, 2013) and interesting experiences with oral stories and memories are documented in literature (Giaccardi, 2006; Affleck and Kvan, 2008; Solanilla, 2008), its relatively early history and blurred conceptual boundaries make it a difficult field of investigation; therefore, the present work will focus on the tangible component related to material artifacts.

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[1] A comprehensive historical account of imitation drawings and engravings of artworks and their gradual confluence in the current format of the "art book" is provided by Haskell (1987).

[2] For an interesting overview of early uses of photography as a means of reproducing artworks and the relative debate among art historians, see Freitag (1979-1980).

Within this broad category, two further sub-typologies can be distinguished, whose respective process of digitization have often progressed in parallel and which are sometimes treated jointly in public policies: on one hand, the librarian and archival (sometimes defined as *documentary*) heritage, consisting in books and documents that were produced to store and transmit knowledge for research and teaching purposes or to document facts and events; on the other hand, the artistic, archaeological and ethnographic heritage, which includes artifacts that were originally attributed with a religious or political meaning and aesthetic or spiritual values.

Our focus on the latter category is due not only to its centrality within the ongoing debate on the 'economic enhancement of culture' in Italy (Lazzeretti, 2009; 2012b), but also to the interest it presents to the researcher: compared to the translation of books into digital format, in fact, the migration of artistic works to the virtual realm shows peculiar aspects related to the very aesthetic dimension of the original artifact (Cameron and Kenderdine, 2007; Kalay et al., 2008). However, since in public policies the two types of heritage tend to be treated jointly, documentary heritage will also be included in the analysis (see Sections 4.2 and 4.3).

Table 1: Typologies of cultural heritage and their relation to digitization.

Category	**Tangible**		**Intangible**	**Digital born objects**
	Documentary	**Artistic/Archaeological**		
Sub-category	Librarian Archival	Artistic Archaeological Ethnographic	Oral traditions Performing arts Social practices and rituals Traditional craftsmanship	*Net Art*
Subject to digitization	Yes	Yes	Yes (recorded on a material support)	No

Source: Author's elaboration.

To further complexify the analysis, the digitization of artistic and archaeological heritage has assumed a variety of forms and outcomes throughout the recent history of museums (digital collections and virtual museums, Web 2.0 spaces, interactive exhibits, Virtual Reality models, and mobile applications), depending on the devices used for reproducing, transmitting and visualizing heritage and the context of application (onsite vs online), thus requiring a work of conceptual clarification that will be presented in Section 2.

In order to gain a more complete understanding of the phenomenon, a brief historical excursus on the phase preceding proper digitization and the context of introduction of the latter is presented in the following sub-section.

1.2. The days before we were digital: An historical review of museum automation

The main limitation for an historical review of digitization is that the historiography of computing in the cultural sector is still in its infancy and no comprehensive common accounts can be found in literature. Whereas the first contributions limited themselves to presenting chronological lists of projects (see for instance Jones-Garmil, 1995), a more culturally-oriented historiography has recently emerged which has also addressed the epistemological implications of automation and digitization in museums.

In order to document the pre-digitization phase of the computerization of museum cataloguing, we draw on Ross Parry's[3] book *Recoding the museum: Digital heritage and the Technologies of Change* (2007). Despite being the main attempt to date of conducting a comprehensive review of museum computing, the work has relevant limitations in which it exclusively focuses on the Anglo-Saxon context and adopts a sophisticated theoretical framework based on a dialectical narrative of the relation between the museum and the computer, where an initial incompatibility eventually resolves into mutual coexistence, which contributes to complicating rather than clarifying the phenomenon.

The third chapter *Disaggregating the collection* focuses on the use of computers for automating the entry and management of information related to museum collections, which is generally referred to as *automated cataloguing*.

Drawing on a variety of documentary sources, Parry reconstructs pre-automation practices of cataloguing, illustrating how, until the 1970s, the main device used for cataloguing was the "day book" - a journal where each curator recorded information on every object that entered and exited the museum - which could be integrated by manual index cards. As a consequence of the inefficiency of these practices, cataloguing "required a considerable amount of human intervention" as it largely depended upon the personal knowledge and memory of curators, whereas the indexing systems used to classify collections were highly "personalised and localised" (Parry, 2007, p. 36) across categories and even individual institutions.

Against this background, Parry highlights how "the new managerialism [...] of the 1970s, museums' drive to improve their access and accountability, the curatorial and logistical pressures that accompanied the rise in acquisition" (p. 36), provided a favourable context for a systematisation and codification of cataloguing practices through the computer. Since the late 1960s, pilot projects in the US and the UK[4] had sought to develop systematic codes for describing museum objects and

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[3] The author, who has a background in Renaissance studies, has been involved in digitization projects since 1994 when he was awarded a university doctoral award at the University of Southampton's Department of History and Digital Libraries Research Centre on the application of three-dimensional computing techniques to cultural heritage. Currently a lecturer at the University of Leicester, Parry is a member of national advisory groups and editorial boards of international journals and conferences in the issue of digital heritage.

[4] The first milestones were SELGEM ('Self-Generated Master'), started in 1963 at the National Museum of Natural History in Washington DC, which developed a code composed by "text data fields delimited by numeric tags and special characters" , and the Museum Computer Network, established by the computer scientist Jack Heller at the State University of New York in 1967. The core of the MCN was the GRIPHOS (Generalized Retrieval and

collections which could be used and shared by different types of institutions. In practice, the activity involved the conversion of the paper museum card into an electronic document, relying on data search and retrieval systems to locate appropriate records[5].

However, Parry documents how the first reaction of a significant share of museum curators - especially in the humanities - to automation was one of "resistance, reluctance and inertia", betraying a substantial "antipathy [...] toward mechanization and modernization" (p. 36).

The main reason for this opposition lied in the perception that automation projects were imposing rigid data structure onto existing cataloguing practices and a sharp reduction of the language and terminology in use in the humanities[6]. As Parry describes, the most of early automation projects were in fact conducted within the natural sciences, of which they shared the epistemological and methodological assumptions. In particular, "a very large number of the early adopters of the new automated, standardised, systemised approaches were taxonomists and those working with taxonomies"[7] (p. 43), for which "the new tabulations and hierarchies of automated collections management were highly consistent with existing scientific mappings" (p. 44).

The indexing criteria used in the humanities, though, were far from the hierarchical ordering and consistent standards of the natural sciences, but their flexibility was coherent to a view of cultural artifacts as the carriers of plurivocal meanings and multiple, changing interpretations. Against this background, the fixed grids of classification privileged by new automated systems were perceived by curators in the arts to "objectify the uncertainty, the contested meanings, and the complexity of iconography that might be read into it"[8] (p. 41), a risk that was also acknowledged in technical documents:

"some meaning must inevitably disappear whenever data sets using the same annotators in different senses or different annotators in overlapping senses are merged" (Museum Computing Network, 1971, quoted in Parry, 2007, p. 40).

In turn, the limited data elaboration capabilities of the first machines required a reduction of data description fields and a simplification and natural language, thus further nourishing a the perceived incompatibility of the computer with the museum.

At the peak of tension, however, Parry proceeds to outline "an alternative history of compatibility between automation and the museum" where "the computer [...] emerges as the very embodiment (a metonym even) of what it was to be a museum" (p. 52).

Information Processing for Humanities Oriented Studies) data description standard, previously developed by Heller at the United Nations, which could be subsequently used by all the MCN partners (Jones-Garmil, 1995).

[5] A very similar historical genesis characterized automation of librarian catalogues (Dahlström et al., 2011).

[6] As Dahlström et al. (2011) illustrate, this was exactly the conceptual framework that inspired catalogue automation in libraries, which "have a long tradition of collecting and describing their collections in a standardized and levelling way" according to the principle that "all objects in a collection should be managed in the same way, using the same kind of tools, and with equivalent effort" (p. 460).

[7] As an example, the Leicester Group, one of the first communities to discuss data processing in museums, was formed in the late 60s by biologists and geologists. Similarly, one of the pioneers of SELGEM was the invertebrate paleontologist and zoologist Donald Squires, who aimed to develop "a satisfactory numerical expression for classical Linnean taxonomic binomials and hyerarchy" (Squires, 1969, quoted in Parry, p. 45).

[8] The issue of simplification concerned particularly the 'subject' fields of arts history and the 'types' used in archaeological classification systems, that were deemed too "arbitrary and open to change" (p. 41) to be translated into hierarchic and invariant schemes.

Parry documents how initial incompatibility was partially overcome thanks to the shift from a hierarchical to a relational model of database management systems occurred in the 1980s, when tree-like data structures were replaced by sets of interconnected data tables that enabled cross-referencing - similarly to pre-automation practices. Further steps on the road of flexibility were the addition of free-text data search techniques to Boolean syntax and, eventually, the advent of the mark-up hypertext language.

However, according to Parry the deepest cause for the compatibility of the museum and the machine can be found at a symbolic and epistemological level: as he underlines, in recent times, "the database itself has become profoundly iconic for the museum" (p. 56), so that "the notion of 'collection' is not only structured to accommodate the tools of automation, but is imagined (and frequently presented to its publics) as a database". Building on Manovich's observation that "the database stands as a 'symbolic form' of the post-industrial age", Parry highlights that it not only has become "the metonym for the museum" but, conversely, "the database itself [...] is being endowed with the qualities traditionally associated with the museum" (p. 57), to the point that "the challenge for users and curators alike is how to differentiate between the two" (*ibidem*).

Although the author does not further specify the roots of this affinity[9], a favourable terrain for its emergence can be identified in the influence exerted by information science and the related Information Society discourse on museological thinking in the 1980s and 1990s.

A significant example of an emergent use of 'information' as an overarching concept in museology is offered by Lytle (1981), former Director of the Smithsonian Institute Archives:

"The Smithsonian is information. Museums select objects because they convey information. Artifacts, specimens, models, paintings, photographs and texts all are chosen because they convey information through their uniqueness or representativeness, historical significance, or their aesthetic appeal" (not paged).

A similar view of museums as 'information utilities' in an increasingly information-driven society and economy is further articulated by George MacDonald (former director of the Canadian Museum of Civilization) and Stephen Alsford:

"Today there is a growing appreciation in the museum world that museums do not exist primarily to service their collections of material heritage, but rather to serve society by helping provide the knowledge its members need to survive and progress. Contemporary concerns, changes and challenges plaguing society on all fronts - cultural, technological, environmental - make it more important than ever that museums be responsive and relevant to the information needs of society. If museums fail to keep pace with a changing society, they may be perceived as redundant and be abandoned in favour of other types of information-providing institutions which have better adapted to the 'Information Society'" (MacDonald and Alsford, 1991, p. 305).

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[9] A doubt arises that the latter may be implied in part by the very construction of the narrative: in particular, of the fact that both the museum and the database are inscribed within a "history of structured knowledge" (p. 33) - that also includes disparate devices such as "the sephirot, the kinship table, the reading wheel, the concentric ring mnemonic, or indeed the cabinet of curiosity, or the tabulating classificatory tables of the Royal Society" (p. 40).

The above statements appear as an explicit attempt to reconfigure and reposition the museum as a relevant institution within a changing scenario defined by new technologies and communication networks (Webster, 1995; Castells, 1996). In this sense, the rise of the Information Society as the dominant paradigm in contemporary social theory - or, with Jessop, an 'imaginary' (2004) - seems to have been perceived by museums as a pressure for widening access to their 'information' assets such as digital catalogues and descriptions of the collections.

Remarkably, though, such argument is underpinned by an overall rephrasing of the anthropological conceptualization of culture according to the terminology of information science[10]:

"For we must define 'information' broadly. It may be intellectual, aesthetic, sensory, spiritual or emotional in character; or, more likely, an experience involving some combination of these. Culture is learned as a bundle of 'messages', each bundle comprising various of these types of information. Culture is expressed not only through objects, but also through processes, ideas, feelings, personalities, and so on" (MacDonald and Alsford, 1991, p. 308).

Under this light, an attempt to bring closer the two disciplinary domains on a common epistemological ground seems to have been conducted at the risk of reducing the variety of meanings that 'culture' assumes in the humanities, raising a new potential source of tension that can be seen to resurface in the later museological debate.

A major limitation in Parry's account is that his adoption of a general conceptualization omits to provide an historical genesis of the shift that occurs in the 1990s from the automated cataloguing of object-related information to the proper digitization of cultural objects.

Whilst the present section briefly illustrates the general historical background by relying on other sources, the historical development of the different forms of digitization and their specific treatment in literature will be analyzed in more detail at Section 2 with special reference to the Anglo-Saxon context.

Jones-Garmil (1995) reports that by the end of the 1970s some American museums - such as the Peabody at Harvard and the Museum of Fine Arts in Boston - had started experimenting with imaging technologies such as magnetic videodisks - whose first commercial product had been developed by IBM and MCA - to record images of objects, but pilot projects had either remained incomplete or were not actually utilized by the operators. The shift from the analogue to the digital can be dated to the 1980s, when a pioneering role was played by the Canadian Museum of Civilization in Hull in the acquisition of the collections on optical discs (Alsford and Granger, 1987). Along the following decade, the rapid improvement of digital optical devices such as high-resolution, lightweight cameras and scanners, the increased processing capabilities of computer hardware and software, and the diffusion of more stable supports substantially reduced the rate of failure and costs of the projects. In this phase, digital surrogates were being used as a means to reconciling the need of responding to "greater demand for access to information" (Alsford and

[10] For an historical analysis of the genesis of the concepts, epistemology and terminology of information science, see Day (2002).

Granger, 1987, p. 187) and that of restricting physical access to the original objects for preservation purposes.

The emerging concept of *access* can be seen to polarize the following museological debate on digitization, causing a shift of emphasis on the use of information technologies for internal purposes of collection management and preservation (Besser, 1991), to their role as a support to external communication. Remarkably, this transition can be seen to occur under the pressure of an alleged evolution in museum audience, that MacDonald outlines referring to a "new visitor group" characterized by an "inclination to reject traditional, low-tech, interpretative technologies that employ academic jargon" and a "preference for new information technologies" (MacDonald 1992, quoted in Witcomb, 2003, p. 114).

The specific forms in which this transition takes shape and their main outcomes are reviewed at Section 2.

2. The Protean forms of digitization: a conceptual framework for digital heritage

In the present section, the main museological literature on digitization is reviewed and aggregated around common concepts. The contributions have been mostly selected from the main international academic journals (*Museum Management and Curatorship*; *Curator; Archive and Museum Informatics; Journal of Cultural Heritage*), sector publications (*Museum International; Museum News; ICOM News* and others), books (Routledge's *Museum Meanings* series and others) and conferences (*International Conference on Hypermedia and Interactivity in Museums* (ICHIM); *Museums and the Web*[11]; *Electronic Visualizing and the Arts* (EVA)*; Virtual Reality, Archaeology and Intelligent Cultural Heritage* (VAST) and others) in the area.

Albeit the above sources cause an over-representation of Anglo-Saxon literature, this is consistent with the historical genesis and the global scale of the phenomenon. In order to contextualize the global debate into specific national context, Francophone and especially Italian literature will be also considered (see Section 4.3.1).

Despite the selection of the sources, the reviewed literature presents significant areas of overlap especially between museological and technical literature - since museological contributions to the debate on digitization are often casted in technical terms, and the other way round - and, to a lesser extent, with economic literature. The authors' affiliation and bibliographic references used were thus considered in order to identify the disciplinary belonging. Although a significant mass of technical papers published in conference proceedings were retrieved, the most of them consisted in demonstrations of projects that were not necessarily implemented in practice: therefore, these were only included in the review when referring to actual applications in museums.

The selected publications were thus arranged first around general objects and models of application and, in a second phase, around specific conceptual frameworks, trying to respect wherever possible a chronological order of presentation in order to reflect the historical genesis and development of museological thinking on digitization.

2.1. Digital collections and virtual museums

2.1.1. The post-modernist digital collection: from the simulacron to the personal cabinet

Historically, the first outcome of digitization consisted in so-called digital collections, that is the digital reproduction transposition of actual collections.

In digital collections, images are generally displayed in a 'gallery' mode and supplied by descriptive information (*metadata*) which also allow search engines to retrieve specific images, or accompanied by complete descriptive cards containing historical and stylistic elements. Especially when digital collections are presented within 3D reproductions of the museum setting (such as

[11] Papers presented at the 2013 edition (17-19 April) were not considered since the Proceedings had not been released yet at the time of completion of the present work.

navigable maps or interactive, 360° photographic images and proper virtual tours) the term *virtual museums* (or less frequently electronic museum, online museum, Web museum, cyber museum) is generally used to refer to both, although there is a substantial overlap in literature[12].

Especially in European countries, digital collections and virtual museums were initially distributed through CD-ROMs created in partnership with private multimedia developers: in this sense, the enlargement of access to the collections married with a differentiation of revenue sources for the institution (Vidal, 2003)[13].

Since the late 1990s, with the worldwide assertion of the Internet, the same contents were increasingly made available through museum websites. In the following decade this modality of diffusion seems to have rapidly replaced the former thanks to its wide availability and to the gradual obsolescence of the CD-ROM format (Jones-Garmil, 1998; Keene, 1998).

As it has been mentioned, the dissemination of digital collections was embraced in the museum sector as a means of increasing access to cultural heritage. This consisted in the possibility of enjoying replicas of artifacts and museum environments from a distance, avoiding the physical, spatial and temporal limitations of the actual visit - that is, the necessity to be at one specific place at a particular time and pay an admission fee - and thus potentially reaching an "unlimited audience" (Keene, 1998, p. 11) compared to the limited attendance of permanent or temporary exhibitions, provided for the limited efficiency of Internet connections of the time. In turn, increased access allowed to give a concrete shape to the ongoing efforts of democratizing culture (Besser, 1997; MacDonald and Alsford, 1997), that had been a central tenet of New Museology thinking along the previous decades (Bennett, 1990; Witcomb, 2003).

Despite the early enthusiasm for these opportunities, the fact that - both in the static version of digital collections and in the more dynamic one of the virtual museum - digitization tended to reproduce the structure and appearance of physical collections and museum environments (MacDonald and Alsford, 1997)[14] raised some perceptions of incompatibility on part of a relevant share of curators in the humanities.

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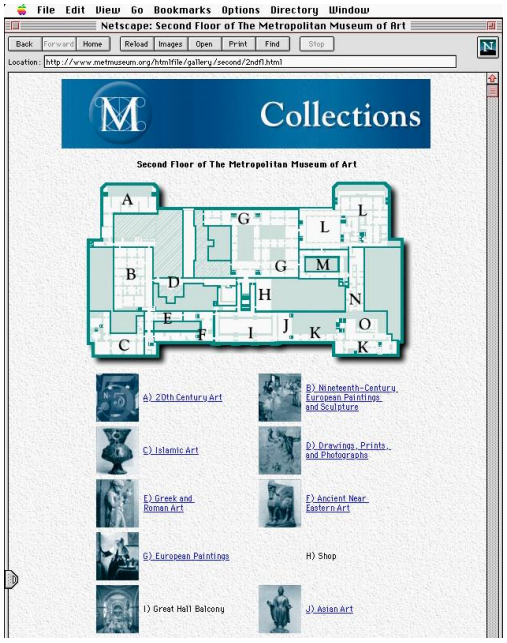
[12] An operational definition of the virtual museum is that of "a logically related collection of digital objects composed in a variety of media which, because of its capacity to provide connectedness and various points of access, lends itself to transcending traditional methods of communicating and interacting with visitors" [...] it has no real place or space, its objects and the related information can be disseminated all over the world" (Andrews and Schweibenz, 1998, quoted in Schweibenz, 2004, p. 3).

[13] Vidal (2003) mentions the first museum-CD to be launched on the market in 1995 as "Le Louvre - Peintures et Palais", co-produced by the Réunion des Musées Nationaux and Montparnasse Multimédia, which marked a commercial success by selling about 26,000 copies in only three months (Liberation, 1995). The product included a selection of 100 masterpieces optimized for 256 colours screens, supplied with biographical and stylistic commentaries, and an exploration facility. In the same year, however, a similar initiative had been started in Italy by Opera Multimedia, which launched a series of CD-ROM named "Virtual Museums", whose first release were the Uffizi Galleries (La Repubblica, 1995). With respect to the French analogue, the product included an explorable 3D model of the gallery generated in QuickTime format.

[14] See to this purpose MacDonald and Alsford: "it is surely likely that the digital museum will adopt metaphors which make it look much like the real-world museum. Museum exhibits and the hypermedia environment of the Web already have characteristics in common. [...] The Virtual Museum section of CMC's Web site employs metaphors associated with real-world museums: Websurfers arrive in a lobby, where they can go to the Information Desk and find

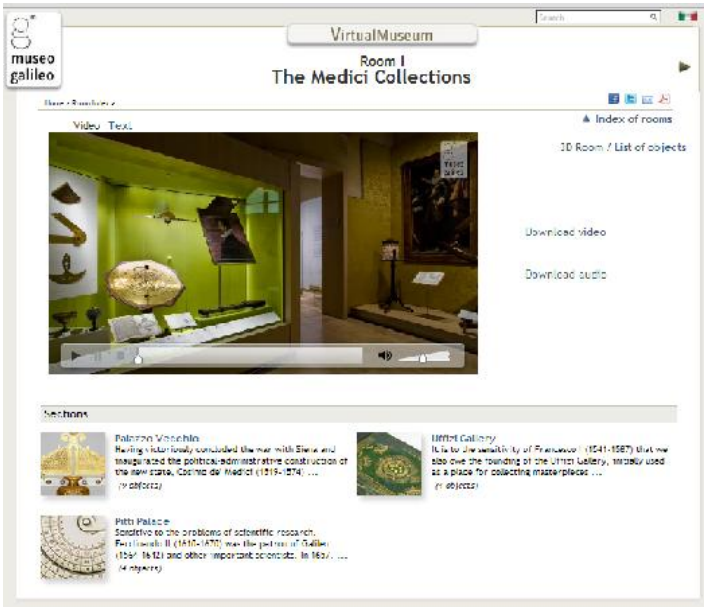
Figure 1: Two different historical examples of reproductive digital collections and virtual museums.

a) The Metropolitan Museum in New York.



Source: Trant, 1999, p. 109.

b) The Galileo Museum in Florence.



Source: Museo Galileo website.

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out "What's On" currently, or can take the elevator to the various floors of the Virtual Museum, each containing galleries or other facilities" (1997, p. 271).

Parry documents the consequent debate at the chapter *Recalibrating authenticity* (2007, pp. 58-81), highlighting in particular how representations and simulations based on numerical codes were seen to threaten the material character and of the artworks and of the very physical setting wherein they were hosted. Furthermore, a growing fascination with the immaterial (or the 'virtual'[15]) in the new Information Society was perceived as tending to marginalize the physical museum[16], despite being incapable of recreating the aesthetic experience that can be only gained through a direct contact with the original, authentic object. In this sense, the ongoing attempts to reposition the museum as a central institution within the information society by opening access to its databases would backfire, tending to distort its specific identity.

Drawing on the same premises, other authors reached the opposite conclusion that the museum would assert itself as "the bastion of originality within a wilderness of media-driven duplicity and insubstantial virtuality" and "as digital copies multiplied, it would be the original objects that would gain value" (p. 62).

Consistently with his dialectical approach, Parry resolves this opposition between the 'real' and the 'virtual' by pointing out at a gradual extension of the notion of 'object' within museological theory, which came to include and accommodate also *e-tangibles* or computer-generated simulations:

> *"in post-industrial curatorship, rather than seeing 'objects' as principally material things, they came to be understood in a wider sense; as discrete, contained units of human experience, identified and extracted in order to substantiate (evidence), record or define an individual or collective epistemology (system of knowledge) or ontology (system of being). In this more circumspect definition, the language of 'objects' (an augmentation rather than a replacement of the 'material object') is released from the semantic quibbling about 'real' and 'virtual', or 'physical' and 'informational'"* (p. 68).

Such a conceptual shift, however, does not seem to eliminate but rather to further increase the issue of authenticity[17], which recurrently emerges in the case of reproductions of artworks circulating

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[15] For a critical analysis of the construction of the 'virtual' as a dominant concept in the Information Society discourse, see again Day (2002).

[16] Different expressions of this view are mentioned by Parry:

"One obvious version of the future has been established as an orthodoxy in current government thinking. This is the idea that [...] there is no point looking at a pile of old bones if you can study them just as well, if not better, on the worldwide web" (Saumarez Smith, 2000, quoted in Parry, 2007, p. 62)

"People are less likely to make a special trip to the museum to see an original object if they can see a quite reasonable facsimile at their workstation" (Besser, 1997, p. 82). "Living in a world where we are constantly bombarded with images [...] could lead towards a blurring of distinction between "good" (artistic) images and "bad" ones. Or, the increased exposure could lead to help the general public develop a more cultivated eye and result in increased connoisseurship. Benjamin points out that the increased access to identical reproductions of originals increases our 'sense of the universal equality of things' " (p. 88).

"The essential experience museums can offer is the confrontation with the real thing, the essential insight they can offer is knowledge about these real things. Today, the value of the real thing, and the value of knowledge about the real thing, are being undermined" (Appleton, 2001, quoted in Parry, 2007, p. 62).

These theses variously resonate with Benjamin's famous idea of the 'loss of the aura' of the artwork in the age of its mechanical reproduction (Benjamin, 1934), which represented the main precondition for the democratization and "politicization" of culture allowed by the increased circulation of images.

[17] A recent article appeared on *Marketing News* opens by observing that "in today's world of apps, social media, smartphones and tablets, it can be difficult to generate enthusiasm for bricks-and-mortar institutions to attract

on the Internet. As early commentators had recognized, the very fluidity and decentralization of the Web make it "an environment where fact and fiction blend and meld" (Walsh, 1997, p. 80) that "defies virtually all the usual guidelines of verifying and checking knowledge" (p. 79), thus potentially challenging the authority of museums and the integrity of contents.

As Trant (1999) highlights, in the virtual space

"museums find themselves unable to rely upon the semiotics of a century of museological symbols that have enabled them, in public buildings and spaces, to create the aura of authenticity and rarification cultivated to communicate the uniqueness of each of artifacts, and the seriousness of the educational experience" (p. 108).

As an exemplification, whereas the task of preventing a loss of reliability and attribution of cultural contents on the Web has been generally assigned to metadata - which convey additional information about the creator and holder of the images - or *digital watermarks*[18] - which act as the equivalent of brand labels for physical products - the recent drive towards an extending open access to digital collections and metadata (see Section 4.3.5) seems to put into question established means of data protection[19], encouraging the development of new technical solutions (Verwayen et al., 2011).

To this respect, the second explanation provided by Parry for the reconciliation of the virtual and the real seems more convincing, pointing out at a re-conceptualization of the digital collection from a mere omologon or model for the physical one, to that of a 'knowledge space' - defined as *virtuality* by Müller (2002) - where ideas, interpretations and experiences of cultural heritage are generated, arranged and shared.

This shift seems to have played a key role in orientating the debate on digitization in the 2000s, as can be seen in the work of other authors.

In this sense, Howard Besser (1997), although adhering to Benjamin's thesis of the loss of the aura of the digital artwork, also highlighted an additional facet of the democratizing potential of new technologies, consisting in their *interactive* features, such as "the ability to zoom in and zoom out and to compare close-ups [of digitized images]", through which "the spectator can begin to make his/her own juxtapositions at various levels" (p. 85). In this sense, digitization allows not only a reproduction and extension of the usual, static modes of experiencing the artwork, but also unprecedented opportunities for the spectator "to participate in activities that previously were almost exclusively within the domain of curators and other professionals" (*ibidem*). On the other hand, however, questions of authorship and authenticity re-emerge, as the possibility for users to

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consumers more attuned to all things digital […]. Why go see Van Gogh's work when you can find it via Google?" (Birkner, 2012, p. 17). When museum operators are interviewed, though, they reassure that "you can never replicate the physical experience of visiting the museum" and that "people are sophisticated enough that they know that seeing an artwork online and seeing a digital representation of it is not the same as experiencing it in person" (p. 18).

[18] Digital watermarks can consist either in visible labels that identify the copyright-holder of the image, or hidden descriptive fields that can be tracked and decoded by the owner. To this purpose also see Section 5 about the watermarking techniques applied to the Uffizi's collections.

[19] For instance, the recent attempts made by the Europeana Foundation (see Section 4) to extend the sphere of the free re-use of cultural data have raised fear on part of cultural institutions of a possible loss of attribution and authenticity, so leading to research new technological solutions to keep track of metadata in the network (Verwayen et al., 2011)

"make small changes to downloaded digital photographs and incorporate these into new pieces that they will call art" "serves to diminish the authority of the original artist, essentially forming a new creation out of a synthesis between the artist's work as originally conceived, and the user-invoked changes" (p. 90).

Taking upon these issues with more polemical intents, Peter Walsh (1997) advanced a more favourable appreciation of the very fluidity and variability of the Web. The view that, in virtual spaces, knowledge is more an ongoing process constantly open to change than a fixed product, and puts into question the established communication logics of the museum - that he defined as the unassailable voice, or an impersonal and disembodied (p. 77) tone of voice that serves to objectify arbitrary choices of display and interpretation, conveying the message that museums have the knowledge and then benevolently dole it out to the comparatively ignorant public[20] (p. 79).

In response, he advanced an agenda for re-conceptualizing museum websites by converting the museum's monologue into a proper dialogue with visitors (p. 81).

Later authors will further articulate Walsh's proposal into concrete examples and taxonomies, shifting emphasis from digitization as a mere driver of 'access', to its potential role as a pillar of a post-modernist model of the museum.

Jennifer Trant (1999) encouraged museums to gain "awareness that they are no longer the sole interpreters of their collections" (p. 107) and resist to the " the temptation, in an information space without maps, to transpose the physical world onto this new medium" (p. 109). For the author, a more productive approach to the Web that also allows to preserve the museum's authority is that of providing rich information and different interpretations as well as cross-linking to multiple sources of knowledge (such as other cultural institutions), so enabling users to follow free paths and associations.

Similarly, Andrea Witcomb (2003, pp. 121-128) documents how digitization can support the fragmentation of the 'unassailable voice', especially when the contents supplied online are clearly differentiated from those provided in the physical exhibition - such as through the creation of online-only exhibitions, constant upgrades of information, and efforts to target specific groups of users.

The most articulate and theoretically informed interpretation of digital technologies is provided by Fiona Cameron (2003), who links them to the theoretical framework of New Museology[21] emphasizing the potential contribution of "multimedia, hypertext, hypermedia and the

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[20] Walsh's view is informed by the conceptual and political positions expressed in the 1980s and 1990s by New Museology, which challenged supposedly scientific curatorial logics of selection and arrangement of cultural artifacts for their marginalization of controversial interpretations (Vergo, 1989; Stam, 1993), calling the museum to become more transparent in their choices of display and to share authority with relevant 'communities' (Wallace, 1995).

Underlying New Museology's agenda is an epistemological shift from linear narratives of technical and cultural progress, towards a social history approach that focuses on the modalities in which objects are created, utilized and interpreted within different cultural traditions and contexts. At the level of visitor education and communication, moreover, some authors were elaborating in the same period - similarly to Walsh - a shift from a "transmission model" that "sees communication as a process of [...] transmitting ideas across space from a knowledgeable information source to a passive receiver", to a "constructivist approach" wherein "communication is understood as a process of sharing, participation and association" (Hooper-Greenhill, 1999, p. 69).

[21] See Note 20.

Internet" to "new styles of postmodern texts in which pluralistic narratives arrange information into galaxies of relationships and links" (p. 326). In this sense, the inter-textual possibilities afforded by the hypertext language of linking different pages and objects and tracing fragmentary paths of exploration, openly resonate with the post-modernist view of knowledge and help disrupt the dominant linear narratives - of technical, economical and cultural progress - of modernism. The post-modernist Web surfer can thus escape not only the spatio-temporal constraints of the actual museum visitor, but also the implicit interpretation imposed by the museum through the chronological and hierarchical ordering of collections and the adoption of a single intellectual framework, creating his/her own idiosyncratic meanings and associations.

On these bases, Cameron identifies a taxonomy of three models of digital collections distinguished according to their varying degree of correspondence to a post-modernist ideal-type.

In the first generation - which is a mere replication of usual curatorial logics - digital objects are presented in a hierarchical story line and the authority of the museum remains intact: authorship is retained by such devices as prescribed subjects, anonymous narratives and singular interpretations (p. 328).

The second generation of digital collections offers users “alternative pathways through collections information while offering greater contextual possibilities via additional multimedia text-based and image-based navigational systems, such as semantic maps, [...] parallel and intersecting narratives" or "spaces […] for play", where "the world is presented as a non-hierarchical system ruled by relationships". These features “enable a shift in knowledge/power relationships between museums and users through a new storytelling, analytical and interactive space” (p. 329).

The third generation corresponds more directly to the post-modernist ideal-type, is relational, in which multiple, non-hierarchically nor linearly ordered modalities of presentation of information are possible. Consequently, "the arbitrary nature of the museum's voice is acknowledged through the inclusion of other voices and sources" and "the writing and presentation of collections information [...] becomes less static and objective and more dynamic and subjective" (p. 331), whilst "the user is conceived as a spatial wanderer, traversing information and freely selecting trajectories and viewpoints".

In order to assess the extent to which these typologies meet different user needs, the author presents the result of an exploratory study conducted on four users groups (curators, collection managers, educators and non-specialists).

Whilst the reformulation of narrative practices is welcomed by some curators as a step towards a constructivist model of education, "surprisingly, for others it was read as a threat to curatorial authority" (p. 335). Such differentiation in attitudes are also mirrored among non-specialists users: whereas young segments of users prefer free browsing facilities to find their own path through semantic spaces, older users and educators favoured information that is structured according to traditional modalities of exhibition and familiar classifications as they "did not want to take full responsibility for the interpretive process" (p. 336)

Drawing on these findings, Cameron concludes with relativizing the distinction between modernist and post-modernist models of digital collections, which in practice appear to be

interrelated, as even in the third generation "postmodernist views are moderated by the presence of authoritative texts to offer some certainty in the interpretive process" (p. 338).

Since the middle of the 2005, the convergence of the above arguments of the multiplication of access (Keene, 1998), interactivity (Besser, 1998; Walsh, 1997) and personal interpretation of collections (Cameron, 2003) led to two main outcomes.

The one with least widespread applications is the involvement of visitors in virtual *storytelling* exercises through the *remixing* of objects - or the alteration and insertion of digital images into personalised narratives - as reported by Fisher and Twiss-Garrity (2007) through the case of an educational initiative.

Another common modality of fostering a multiplication and fragmentation of meanings and narratives is the inclusion within museum websites of *personal collections* or *galleries*, that is separate sections where users can bookmark, select and store preferred images, juxtaposing and rearranging them according to their will (Filippini Fantoni and Bowen, 2007; Boily, 2009). As is also suggested by the frequent naming as "my gallery" (Marty, 2011), the creation of personal galleries is formulated as a way for them to appropriate cultural contents and to become virtual owners and managers of the collections, thus presenting at least in theory the highest possible level of visitor empowerment.

With the above described shift from a mere quantitative notion of access, to more qualitative notions of interactivity and personalization, the initial threat of the virtual as an omologon or simulacrum of the real seem to have been overcome by the emergence of a 'third space' (Stylianou-Lambert and Stylianou, 2010) where cultural heritage is "decoupled from its dominant institutional account" (Srinivasan et al., 2010, p. 747) "through recontextualization, reuse, and reproducibility" (p. 746). As it had been anticipated by post-modern marketing theory (see among others Firat and Venkatesh et al., 1995), the cyberspace thus configures itself not as a simulation of the real world, but as a parallel domain wherein established norms and representations can be easily manipulated and subverted.

The epistemological implications of this transition are substantial.

On one hand, recurrent emphasis on the transparency and malleability of the Web can be seen as a reaction to the previous construction of culture as a bundle of supposedly objective messages (MacDonald and Alsford, 1991) through the standardization of automated cataloguing and the epistemological influence of information science (Parry, 2007; Parry et al., 2008).

On the other hand, the proposed transition to a post-modernist model of communication and education also presents some traits of a return to a pre-modern past, or the period preceding the establishment of scientific taxonomies and linear narratives. This is suggested by the affinities that tie the personal collection to the historical antecedent of the modern museum - the cabinet of curiosities or *Wunderkammer*[22] where the same combinatory and manipulative notion of creativity[23],

[22] The term identifies a type of private collection that diffused among the aristocracy of the late Renaissance, especially in Central and Northern Europe, wherein objects belonging to both the natural and artificial realms (Lugli, 1983; Olmi, 1991), such as stuffed animals, plants and artworks, were gathered and displayed according to a network of

based on a constant de-contextualization and re-contextualization of objects (Delagrange, 2009) is at work.

2.1.2. Reactions to the post-modernist utopia

On the plane of concrete implementations, however, the ideal-type of a purely virtual third space freed from references to its physical original seems to have been realized only in part, as most museum websites are based on 'traditional' digital collections - arranged either according to the architecture of the physical museum or to curatorial criteria such as author, period, subject etc. - which are in some cases complemented by personal gallery sections[24].

In this context, a critical re-assessment of the relation between the virtual and the real seems to be underway, shifting back from the extremes of post-modernism towards more articulated positions.

An interesting example is Cameron (2007), who in the attempt to further differentiate the two spheres by questioning the 'age-old myth' of the loss of the aura of the digital artwork, draws upon the logics of the physical museum. In particular, her proposal to re-consider the digital image not as a mere reproduction or simulacron, but as a creative work in itself, implies an extension of traditional criteria of "authorship, provenance, originality and other commonly accepted attributes of analog objects" (p. 70)[25] to convert the virtual museum from a "repository of digital reproductions of physical originals" in a "digital repository of digital originals" (*ibidem*).

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flexible relations of morphologic or functional similarity[22] (Westerhoff, 2001; Eco, 1994, pp. 56-70). In Wunderkammern, 'rare' or 'curious' objects - such as unicorn horns, or pieces of coral imitating - composed the most valuable pieces of the collection and were particularly praised by visitors, as they showed at the same time the wonder and imperfection of nature, and the man's ability to imitate its generative power. This taste for curiosity exerted, however, only a modest influence in Italy, where a clearer distinction from naturalistic and antiquarian collections persisted (Olmi, 1991). The model of the Wunderkammer fell into gradual oblivion with the conversion of private into public collections in the 17th and 18th century, when relational criteria of arrangement were gradually replaced by scientific taxonomies in the naturalistic field, and by canonical periodizations or 'school' divisions in the antiquities and the arts. However, a new eave of eclectic, idiosyncratic collections emerged as a very reaction to positivism in the late 19th century, when private collectors transformed their residences into personal museums including disparate types of artifacts (see, for instance, the Poldi-Pezzoli and Bagatti-Valsecchi museums in Milan and the Stibbert Museum in Florence).

[23] Delagrange underlines that, in the Wunderkammmer, tools such as distorted lenses were used for magnifying, multiplying and diffracting objects. These manipulative actions enabled a visualization of objects under different points of view and their association. The same process can be transferred to "interactive digital media-as-Wunderkammmer" which may "provide new objects-to-think-with about our slippery, provisional, fragmentary understanding of the world, a framework for exploration and discovery of how its seemingly disparate and disconnected pieces can be joined and made sensible, and thereby help us learn how to act. Constructing digital Wunderkammer thus becomes [...] a strong model for a postmodern understanding of multiple perspectives and subjectivities" (2009, not paged).

[24] The actual level of utilization of these facilities has been called into question by Marty (2011; also see Section 2.8).

[25] In polemic with Benjamin, the author argues that "like the analog, the materiality of the digital acts as a testimony to its own history and origin, and hence authenticity. [...] Benjamin's assumption that the aura is absent in reproductions does not appear to hold up for digital media; rather it represents a lack of understanding of its materiality and thus denies the surrogate and indeed the digital historical object as a creative work in its own right, with a history and provenance" (p. 67). As a consequence, "as with historical collections, photographs, and digital art, digital historical

Stylianou-Lambert and Stylianou (2010) take a critical approach towards views of the Web as post-modernist utopia, underlining how virtual museums - even when they are conceived as a neutral and universally accessible 'third space' - are never fully detached from their physical model. As the authors emphasize, their choices of display continue being framed around "issues of authorship and representation" (*ibidem*) and "influenced by the same cultural, social, and political structures as its physical counterparts" (p. 68). Moreover, the actual extent to which the virtual museum is more accessible than the physical one is questionable, as the exploration of collection databases and the appreciation of digital artworks requires the same cultural references and aesthetic receptivity than those of the original. Finally, the graphical interface of the virtual museum - even when it does not replicate the physical architecture - is not necessarily neutral, as it also actively "influences the degree and quality of a visitor's access" (p. 69).

This last point is expanded by Wilson (2011) through a 'critical code analysis' of the digital collections of the British Museum, where objects are arranged independently from the physical layout and can be freely browsed. The author points out at the similarity characterizing both the layout of digital collections and that of the online shop - wherein objects are "vying for attention from the viewer to engage with them further" (p. 381). As he remarks, in this case "the markup and programme languages used enable the visitor to achieve a sense of possession and ownership - reaffirming their role as the consumer" (p. 384). In this sense, a certain similarity between the virtual and the actual museum is re-established, as the very attempt to break curatorial criteria of display through the mark-up language "is itself marked by issues of power, possession and postcolonialism"[26] (p. 385).

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objects can be understood as independent creative works, acquire the status of objects in their own right and be accessioned into museums" (p. 68).

[26] Wilson's findings strikingly recall Gere's forecast that "the digitization of material necessary for it to be put on the Net resembles the homogenization of commodities as objects of exchange value" and that "the Internet paradigm might [...] simply be a way in which market forces control museums in place of the State" (1997, p. 65).

Table 2: Main authors and concepts related to digital collections and virtual museums.

Authors	Methodological approach	Concepts
Keene (1998)	Theoretical	Multiplication of access Democratization
Jones-Garmil (1997)	Theoretical	
Besser (1997)	Theoretical	Democratization/Loss of authenticity Interactivity
Walsh (1997)	Theoretical	Differentiation between the real and the virtual
Trant (1999)	Theoretical	
Müller (2002)	Theoretical	Multiple interpretations and interactive features
Witcomb (2003, pp. 121-128)	Theoretical	
Srinivasan et al. (2010)	Theoretical Description of project	
Cameron (2003)	Theoretical Exploratory study of website users	Post-modernist digital collection
Delagrange (2009)	Theoretical/Description of project	Personal collection - Wunderkammer
Cameron (2007)	Theoretical	Digital object as authentic 'original'
Stylianou and Stylianou-Lambert (2010)	Theoretical	Critique of the neutrality and accessibility of the virtual museum
Wilson (2011)	Critical code analysis	Digital collections as commodity Virtual visitor as consumer

Source: Author's elaboration.

Under this light, the main limitation of the post-modernist view of the virtual museum is that it emphasizes the individual's potential of interpretation and appropriation of heritage, thus promoting which the main post-modernist theory of the information society, Manuel Castells, had referred to as:

"the fragmentation of sense and the potential lack of codes of communication, a culture in which, paradoxically, the multiplicity of cultural expressions in reality decreases the capacity to share sense and, hence, to communicate" (2001, p. 5).

The question as to if and how idiosyncratic meanings and associations can be communicated and shared by different online visitors around which the following debate will revolve, as will be presented in Section 2.2.

2.2. Heritage-based Web 2.0 spaces and the challenges of implementation

In parallel to the debate on the post-modernist digital collection, in the second half of the 2000s, the quest for a "cultural communication protocol" (Castells, 2001, p. 5) capable to combine interpretive

multiplicity with the creation of collectively shared meanings has been connected to the advent of the so-called *Web 2.0*, which marks the passage from mere interactivity to "intercreativity" (Berners-Lee, 1999). The Web 2.0 (or *Social Web*), although lacking a commonly accepted definition, identifies the variety of virtual spaces of communication such as forums, online communities, blogs, wikis and social networks. The general sociological and economic discourse surrounding these realities emphasizes the ongoing blurring of boundaries between producers and consumers of contents (Fuchs, 2008) and the consequent increase in freedom of expression (Tapscott and Williams, 2006), an extension of the public sphere over the private one (Arvidsson, 2011) and the emergence of online-only communities (Muñiz and O'Guinn, 2001) whose knowledge and skills can be involved in processes of *crowdsourcing* (Howe, 2009) and collective knowledge (Malone et al., 2010).

In this context, the introduction of Web 2.0 facilities in museum websites has started been advocated especially by Northern American authors in order to integrate object-centred or user-centred digital collections and virtual museums with spaces of interaction and communication, where personal interpretations and meanings can be shared with other visitors as well as museum curators.

Although not referring to the theoretical differentiation between the Web 1.0 and 2.0, Soren and Lemelin (2004) claimed that, among six museum websites in the US and Canada, those which offered the best experiences were those supplied with forums, blogs and other opportunities of exchange - both among visitors and with the museum staff. However, the authors did not examine explicitly the connection between this new kind of spaces and 'traditional' digital collections, which some museums have later tried to reinforce by allowing visitors share their personal collections on networking platforms such as Facebook (Cooper, 2006)[27].

A relevant attempt to apply the principles of crowdsourcing to virtual museums has been represented by the introduction of *social tagging* or *folksonomy* facilities, where website visitors are invited to contribute to defining the metadata - in particular the keywords related to the 'subject' field - that describe digitized objects and thanks to which these can be retrieved by other users. In literature, this has been emphasized not only as a way to harness the crowd's knowledge, but overall as an opportunity to include personal meanings into cultural objects, thus bridging the gap between the professional and vernacular language (Trant, 2009)[28]. Differently from hierarchical classifications and taxonomies, the resulting description would be open ended, 'flat' and free from established vocabularies (Macarthur, 2007). Recent projects have also attempted to enhance the community dimension of folksonomy by inviting users to vote and rank the most relevant tags. Another

[27] In order to revitalize its online collections, in March 2012 the Metropolitan Museum in New York launched the "What's your MET?" campaign. Visitors or fans could select up to eight favourite works of art from the digital collection, and to complete the "My MET, my ..." sentence. The post could be tagged and shared on Facebook and Twitter. 11 celebrities, including Alicia Keys and Jeff Koons, were also invited to participate. Twits were re-posted on the campaigns' webpage in the museum website, together with weekly highlights selected by the museum staff. The campaign run until June 2012.

[28] In the main pilot project (steve.museum), the 86% of user-provided tags were not found in existing museum documentation , thus representing an addition to the curatorial vocabulary (Trant, 2009).

emerging strategy is that of connecting digital collections to the social network Flickr (Terras, 2011) - where users can upload and tag their own pictures[29].

The most advanced strategy of engagement in 'collective intelligence' efforts (Malone et al., 2010) to have emerged so far is that of launching calls for contributions to *wiki* pages to be hosted on the museum website, which "take the concept of involvement a step further by allowing users to actually contribute to or edit content" related to cultural artifacts (MacArthur, 2007, p. 59).

Figure 2: Capture from a user's personal collection created in the 'My Met' campaign.

Source: Metropolitan Museum of Art website.

Despite the variety of technological forms that the Web 2.0 can assume, however, the initiatives presented in literature are underpinned by a similar vision as the post-modernist positions that had informed the debate on digital collections and virtual museums.

To this purpose, Lopez et al. highlight that the Web 2.0 "has enormous potential to activate the main principles of socio-constructivist learning theory" as "the user is encouraged to actively construct personal meaning, in a situated context, which is closer to his or her own experience" (2010, p. 236). The main difference with Cameron's (2003) post-modernist model of the virtual museum, however, is that this potential does not depend any more on a mere breaking of linear modes of display, but in a broader transformation of the museum website into "the aggregating center for voluntary processes based on discussion, exchange, collaboration, and collective knowledge building" (p. 238).

Even more explicitly, Hellin-Hobbs (2010) has transferred to the Web and the Web 2.0 Hein's (1998) ideal-type of a 'constructivist' museum based on a " 'bottom up' model of interpretation which allows the visitor to draw their own conclusions about the meanings of exhibits" (p. 73). In this case, the task of enabling the visitors' participation is assigned to a more welcoming inclusion in the museum website of contents generated by users through social tagging, enhanced personal collections and wiki exercises.

Summarizing current views on the role of the curator in the age of social media, Proctor (2010) highlights that it is shifting from that of an expert of cultural objects to an "expert

[29] The main example is that of the Brooklyn Museum which has encouraged users to photograph artworks during their visit, tag the artworks in the digital collections and share their photos both on Flickr and the personal gallery section of the museum website (Bonacini, 2012).

communicator and interpreter" (p. 38) and a moderator of conversations with visitors as well as other sources of knowledge. To some extent, this appears as a forced choice, since new virtual platforms tend to prevent any form of control upon the contents of the interactions (Proctor, 2010; Wong, 2011). The influence of the post-modernist ideal, however, is apparent in the emphasis posed on *storytelling* (p. 37) - or the generation of new heritage-based narratives - as an alternative to the production of "classical art historical knowledge" (*ibidem*), as well as in the acknowledgment that the curator's expertise does not exhaust the possible viewpoints on cultural objects.

The extent of implementation of Web 2.0 spaces in museums websites, however, remained relatively low, as shown by Lopez et al.'s (2010) cross-country study, especially in Europe.

The authors explain these findings pointing out at the challenge that non-expert knowledge advances towards curatorial expertise. In particular, they hypothesize - besides the organizational challenges implicit in creating and constantly monitoring Web 2.0 spaces - a resistance on part of curators against seeing their role of authoritative interpreters questioned by the proliferation of the users' personal meanings and opinions.

More detailed analyses of projects allow to further specify this hypothesis.

In Cooper's (2006) description of the development of a virtual gallery with social sharing facilities, an 'authoritist' attitude emerged on part of the curators, opposed to the 'autonomist' position of educators and marketing people. A compromise between the two views was identified in a curator-driven procedure of approval of the personal collections submitted by the users for publication on the website[30].

The same problem seems to have emerged in cases of implementation of folksonomy, which has been found to "open the door to idiosyncratic, inconsistent, irrelevant or simply incorrect subject terms, undermining the usefulness of the index that is created" (MacArthur, 2007, p. 58), especially with the increase in the number of tags (Chae and Kim, 2011). In order to reduce these risks, manual staff validation (Trant, 2009) or computer-assisted procedures of selection (Chae and Kim, 2011) have been adopted.

Likewise, experiences of implementation showed that, whilst wiki tend to attract a knowledgeable audience who is already familiar with objects, these tend to provide personal and nostalgic rather than fact-based information, which have been therefore left out of the official description of digital collections (Looseley and Roberto, 2009).

Consequently, Hellin-Hobbs (2010) concludes that the outcomes of all the reviewed projects of social tagging, socially-enhanced personal collections and wiki have remained detached from the institutional website and there was seemingly no intention, on part of the curators, to integrate user-generated contents into the digital collections. To this respect, it should be remarked that also the

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[30] As usage statistics showed, during the six months following the launch of 'myVirtualGallery', 250 online exhibitions were created, the 82% though were never submitted. "Of the remaining 45 exhibitions, 28 (62%, or 11% of the total) were submitted but rejected (with comments) — and never resubmitted — and 17 (38%, or 7% of the total) were submitted and eventually approved, mainly with minor modifications". The criteria for reject/approval "went beyond the mere absence of libelous, offensive and factually incorrect statements", their aim being "to produce a set of public exhibitions that are insightful, informative and thought-provoking" (not paged).

examples of Web 2.0 initiatives mentioned by Proctor (2010) are mostly related to special events, consistently with the current tendency of Northern American museums to privilege temporary exhibitions "that focus on creating events and sensations rather than generating knowledge" (p. 37).

Under this light, the main criticality of the implementation of a constructivist model of the Web 2.0 emerges as the integration of user-generated contributions and comments into the 'official' description of digital collections - rather than in separate sections of the website. From here not only a possible crisis of the curator's authority arises (Lopez et al., 2010; Proctor, 2010), but also the complexity of establishing reciprocal trust linkages: in the Social Web, the museum - besides maintaining the role of trusted source of information typical of the Web 1.0 - also needs to assess the relevance and reliability of the contents produced by users and identify "how users will identify seemingly correct or incorrect knowledge" (Hellin-Hobbs, 2010, p. 76).

In this context, an intermediate position - and seemingly prevalent in concrete implementation - between the push of post-modernist relativism and the established curatorial concerns for the accuracy and validity of interpretation[31] seem to consist in viewing the role of the curator in new virtual spaces not only as one of collaboration, but also as one of filtering external sources of knowledge and teaching "audiences how to research and read critically when evaluating sources" (2010, p. 40).

A further critical issue that surfaces throughout the museological discourse on the Web 2.0 but has not been fully developed yet, is related to the connections between user involvement exercises and marketing practices. According to Bonacini, "the utilization of UGC [*user-generated content*] by museums is also considered as a strictly commercial practice" (Bonacini, 2012, p. 102) that contributes to crafting "a museum brand that is not only a product or a cold symbol, but a tool capable of evoking emotions and belonging, pushing towards participation" (p. 103, own translation). Recent empirical studies have underlined. consistently, that social media are used by cultural institutions more as an instrument of marketing communication for creating a museum-centred brand community than as a support to a constructivist learning model (Swiader, 2007[32]; Schick and Damkjær, 2010[33]; Fletcher and Lee, 2012). Although this conservative use of new media

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[31] This tension closely recalls the recent philosophical debate on post-modernism (also in its constructivist version), whose idea of a fragmentation of 'meta-narratives' and their implicit frameworks of power (Vattimo, 1988) has been welcomed in consumer culture theory as a release of potential for playful, creative individual and collective practices that rejoin production and consumption (Firat and Venkatesh, 1995). Whereas the hyper-text has been generally seen as an accelerator of the former side of post-modernity, the rise of the Web 2.0 has been welcomed as a support for the latter. It is interesting to remark that *philosophical hermeneutics* (Gadamer, 1960), which has asserted itself as the main middleground position between traditional metaphysics and post-modernism - also meeting substantial consensus in consumer culture theory (Arnold and Fischer, 1994) - has not been echoed in the museological debate, where polarized positions seem to prevail.

[32] For instance, in large-scale Web 2.0 initiatives such as "I went to MoMA and..." and "My MET, my...", the elicitation of comments on particular objects or exhibits seems to utilize user-generated contents for brand-building purposes.

[33] In their analysis of Facebook profiles of Danish arts museum, the authors found that "content produced by the users is generally limited and of poor quality" whilst "most of the discussion [...] rarely advances beyond small talk and the content shared lacks any immediately apparent theoretical or cultural importance" (2010, p. 37). The authors

has been ascribed to the persistence of a patronizing attitude towards visitors among museum communications staff (Schick and Damkjær, 2010), the issue of the potential exploitation of users' contributions for brand-building purposes has been also raised within general critiques of the Web 2.0 discourse (Fuchs, 2008; Arvidsson, 2011).

Table 3: Main authors and concepts related to Web 2.0 spaces in museums.

Authors	Methodological approach	Concepts
Soren and Lemelin (2004)	Case studies of museum websites	Interactive spaces (forums and blogs) in museum websites
Cooper (2006)	Description of project	Personal collection with social sharing facility
Voss (2007)	Description of project	Folksonomy or social tagging
Trant (2009)	Description of project	
Looseley and Roberto (2009)	Description of project	Museum wikis
Hellin-Hobbs (2010)	Description of projects (taken from literature)	Constructivist virtual museum Inclusion of user-generated contents (from social tagging, personal-social collections and wiki) into website
Proctor (2010)	Theoretical	Changing role of the curator 'in the age of social media'
Lopez et al. (2010)	Cross-country survey of museum websites	Implementation of Web 2.0 spaces in museum websites
Schick and Damkjær (2010)	Analysis of Facebook profiles	Museum profiles on FB as "patronizing friends"
Fletcher and Lee (2012)	Survey of social media staff in museums	Use of social media as instruments of one-way marketing communication

Source: Author's elaboration.

2.3. *Far from the madding crowd? The Semantic Web and meta-collections*

A chronologically parallel development of the Internet which, though, according to several commentators is going to replace the Web 2.0 and to represent a building block of the third generation of the Web[34], is commonly defined as the *Semantic Web* (also metonymically as *linked data*). It stems from the technical attempts, started at the World Wide Web Consortium (W3C) in the early 2000s, to multiply the links between different pieces of data, with the final goal of converting the

conclude that Facebook is still used "as a marketing channel to the users, and not as an environment to interact with the users", behaving "as authoritarian and self-promoting friends" (ibidem).

[34] To date, there is no common agreement yet over the nature of the Web 3.0, which is alternatively defined either as the Semantic Web, the 3D Web, augmented reality or their combination.

Internet into "a web of data that can be processed directly and indirectly by machines" (Berners-Lee et al., 2001). In other terms, coding textual contents according to machine-readable languages turns the computer from a passive repository of information, to an active facilitator of search processes, such as through the suggestion of possible associations between different contents.

These characteristics have been promptly welcomed in the museum sector, wherein it resonates with the conceptualization of the collection as a web of semiotic connections between objects (Day, 2002; Boily, 2007; Parry, 2007; Parry et al., 2008)[35].

Ross (2006) has summarized the implications of the Web 2.0 for the cultural sector, underlining that the Semantic Web combines features of participation (since heritage and academic institutions can participate as well as students allowing for growing interconnections of knowledge), interactivity (since it is possible to trace different pathways across bodies of knowledge and contribute to their development), and trans-disciplinarity (as it is possible to link pieces of data belonging to different domains. Over the last years, scholars in the digital humanities have been involved in research projects aiming to shape the forthcoming generation of the Web, in an apparent attempt to counterbalance the epistemological influence of information science over the previous ones.

However, an agreement in the humanities about what is in concrete the Semantic Web seems slow to emerge, and contrasting visions continue confronting themselves (Parry, 2008).

The main critical issue, in this context, is related to the nature of *ontologies*[36] that form the main cognitive structures upon which the Semantic Web is built. More specifically, a sector-specific ontology is a "hierarchical scheme which organises and classifies all objects within that community" that provides "excellent representations for knowledge in mature domains in which the nature of the entities, and the nature of meaningful relationships is known" (Macarthur, 2007, p. 4). The main building block of an ontology is a discipline-specific vocabulary that describes the possible semantic relations between a set of object, and which is generally defined by a group of domain experts (Macarthur, 2007). As such, the establishment of ontologies consists in an expert-driven procedure whose outcome is a taxonomic, hierarchical tree of semantic associations based on inter-operable metadata standards - an area wherein efforts have been constant along the 2000s in the cultural sector (Parry et al., 2008; Gradmann, 2010).

In synthesis, it seems that the role of domain expertise and hierarchical structures in the Semantic Web configures an opposite model of knowledge production than the 'flat' and fluid vocabularies generated by folksonomy and social tagging (Macarthur, 2007; see Section 2.2).

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[35] This is consistent with Parry's view of the museum as part of a history of structured knowledge (2007, p. 33) endowed with intrinsically semantic and semiotic characteristics: "using numbering, term lists, taxonomy or simply physical proximity, museums have deployed systems that have provided logic, a set of assumptions, and (invariably) a vocabulary to tame and explain their collections. The classificatory project (this syntax) and importantly, the semantics inextricably linked to it, are what has come to define the museum today and through history" (2008, not paged).

[36] An accepted definition of an ontology is that of the "content theories about the sorts of objects, properties of objects, and relations between objects that are useful in a specified domain of knowledge" (Chandrasekaran, Josephson and Benjamins, quoted in Macarthur, 2007, p. 3) the "content theories about the sorts of objects, properties of objects, and relations between objects that are useful in a specified domain of knowledge" (Chandrasekaran, Josephson and Benjamins, quoted in Macarthur, 2007, p. 3)

Although ontologies can be designed so as to be localised and flexible enough to accommodate change over time, in fact, they are based on an *a priori* distinction between expert developer and lay user, and on a control of authorized keywords, thus potentially representing a step backwards from user empowerment to standardization (at least as regards the description of collections).

On the positive side, the main advantages of ontologies versus folksonomy are related to the increased possibility to contextualize data, which increases the efficiency, reliability and stability of information retrieval procedures (Macarthur, 2007). As Gradmann (2010) argues, these opportunities are highly relevant to the users of digital collections, promising to assist them in the conversion of object-related information into proper knowledge[37].

Although it has not been acknowledged explicitly in literature, ontology and folksonomy seem to respond to the needs of different groups - the former to expert users such as researchers and scholars, the latter to general visitors. However, the results of research projects conducted to date - which have been characterized by a chronic lack of funding (Parry et al., 2008) - do not allow to evaluate fully the impacts of the Semantic Web on the cultural sector, also because it is not clear yet whether alternative technologies and ontologies can collaborate or convergence towards an overarching, universal vocabulary is needed.

In reverse, an aspect of linked data that has manifested over the last years is the rapid development of "infrastructure, standards and skills to aggregate content from multiple sources and to broker it to content platforms and services", which is gradually replacing established notions of Web 'sites' and virtual 'spaces' in favour of transversal 'services' (Parry et al., 2008). This is particularly evident in the assertion of centralized data repositories and platforms for the storage and retrieval of cultural contents, or *meta-collections*, such as the Google Art Project (see CASE HISTORY 1) and, to a lesser extent, the Virtual Museums of Canada and Europeana (see Section 4).

Remarkably, this scenario had museological precursors in George MacDonald's conjecture of a comprehensive mega-museum or meta-museum (MacDonald and Alsford, 1997, p. 276), "where the knowledge resources of multiple institutions come together [...] to make possible unprecedented explorations of heritage" (1994, p. 3) and with Schweibenz's later outlook that digitization would lead cultural institutions to "merge into one memory institution" (2004, p. 3).

According to Gradmann (2010), the transition towards centralized platforms presents relevant advantages for the cultural sectors as users will be increasingly able to navigate across the boundaries of single digital collections and to retrieve objects through a single point of access. However, for cultural institutions this shift represents "a big leap, since it requires [...] to think, not primarily within the boundaries of their particular collections, but in terms of what these collections might add to a bigger, complex and distributed information continuum" (p. 8). For Parry et al. (2008), the migration towards a higher level of aggregation and distribution challenges cultural organisations that are still mostly engaged in the production of contents and in the design of their own virtual

[37] Parry et al. (2008) refer to two opposite models of the Semantic Web in the cultural sector: a 'hard' one "with prescribed and persistent ontologies predicated by the sector on existing collections standards (and perhaps term lists and thesauri) by the professional community of practice itself" and a 'soft' one "with user-defined (and likely more transitory and disparate) ontologies generated by different communities of interest outside of the institution" (Parry et al., 2008, not paged), where the latter is exemplified by social tagging projects.

spaces, and lack the financial resources and technical competencies required to participate in the development of infrastructure.

Furthermore, to Carr (2008) the 'centripetization' of cultural resources according into larger technological platforms could entail a further loss of control over the modes of interaction with users and another threat to the museums' status as authoritative interpreters, also because they arguably find themselves in an economically disadvantaged position with respect to large IT corporations endowed with proprietary technologies, established experience in online business models and consolidated user bases.

Under this light, the Semantic Web seems to represent a dilemma for museums, whose solution will have to be assessed in the coming years.

Table 4: Main authors and concepts related to the Semantic Web.

Authors	Methodological approach	Concepts
Ross (2006)	Theoretical	Potential implications of the Semantic Web for the cultural sector
Macarthur (2007)	Theoretical	Comparison between folksonomy and ontology
Parry et al. (2008)	Theoretical	Dilemma of the Semantic Web for the cultural sector
Gradmann (2010)	Theoretical - implementation project	Potential of data contextualization for users of digital collections

Source: Author's elaboration.

Case History 1: Google Art Project

In February 2011, Google has entered the digital cultural sector through a large-scale initiative called *Google Art Project*. In its initial version, the website offered a *Walk Through* function (a virtual tour of museum rooms based on the same technology as Google Street View) and a selection of digital collections of leading art galleries. In the words of the founder and developer Amit Sood, the rationale for the project was to increase "access" to culture by bringing together in one virtual space several art collections (2011).

The navigation systems allows to explore the museum halls and to zoom in high-resolution images of the artworks. These are indexed according to museums and artists, but not genre, subject or period. Differently from Europeana and the Virtual Museums of Canada (see Section 4), moreover, objects are directly visualized on the Google platforms instead of being cross-linked to the providing institution's website, but cannot be downloaded.

Started with 17 partner institutions, the project has currently received the adhesion of 46 museums - including the Metropolitan Museum of Modern Art and the Museum of Modern Art in New York, the Hermitage, the National Gallery of London, Museo del Prado, the Uffizi Galleries and others, with the notable exceptions of some of the main French and Swiss museums - for a total of 32,000 digital artworks.

In 2012, the portal has been enriched with additional features, including a personal gallery section where users can bookmark, save and share a list of favourite artworks. A related You Tube channel has also been launched which broadcasts conversations with leading museum curators (*Art Talks*).

However, Google Art Project has received so far mixed receptions by art critics and reviewers.

The main criticisms point to the fact that Google is only acting as an aggregator of contents by using already established technologies, to the limitations posed by the restricted number of artworks proposed and to the rigid navigation interface (Blouin ArtInfo, 2011).

Whilst Roberta Smith (2012) values positively the possibility to "swim through art" faster than in other museum websites and criticizes institutions refusing to converge into the Google unified platform for being attached to old types of relations with their audience, Sebastian Smee (2011) has questioned such use of technology for a mere reproduction of real-life artistic experiences (similarly to the first reactions against digitization, see Section 2.1.1).

Brian Kennedy, director of the Toledo Museum of Art in Ohio, said "the gigapixel images can bring out details that might not be visible to ordinary museum-goers in a gallery. But scholars will still want a three-dimensional view of the art, which even a very high-resolution two-dimensional image can't provide" (Kennicott, 2011). Similarly, Elizabeth Merritt of the Center for the Future of Museums, "called the walk-through technology an interesting experiment, and the kind of experiment that most museums can't produce on their limited budgets but [...] had questions about whom it would appeal to, and what kind of audience it might find" (Kennicott, 2011).

The blog *Information Systems in the Visual Arts* (NYUISVA, 2013a) has elaborated a more articulated cultural analysis of the project. Despite the novelty effect and the "amazing volume of content", evidence that Web surfers mostly use museum websites to find practical information raises the question as to "what [...] is the purpose behind [...] having all these collections online". According to the reviewers, the portal does not appear as a suitable site for research, as few links to external sources are provided, whereas the personal gallery section has limited features of interaction and limitations in usability. Therefore, Google Art Project seems caught between the failure to establish an "authoritative presence" and the lack in interaction facilities. Consistently, another reviewer underlines that the project aims to "perform a variety of tasks but cannot comply fully with each one of them", as it risks, on one side, overloading the general visitor with an excessive mass of contents and, on the other side, disappointing the researcher with superficial information about the artworks" (NYUIVSA, 2013 b).

2.4. A parallel history: on-site applications

The account given so far of the digitization process has focused exclusively on online applications, as distinct from onsite utilizations of information technologies. A parallel and significant line of development, though, concerns digital devices hosted between the physical walls of the museum. Although not all of these applications can be strictly considered as examples of digitization of cultural heritage, they are conceptually connected to online developments. Therefore, a brief historical excursus over the emergence of interactive exhibits and virtual reality can be useful to gain a more complete picture of the current state of digitization in museums.

2.4.1. Interactive and multimedia exhibits

The first applications of computing technologies within physical exhibitions pre-date shortly the proper digitization of the collections.

Prototypes of mechanic interactive displays were initially introduced in Northern American and European science and technology centres in the 1980s, a period marked by a decline of public participation in scientific education and increasing pressures posed on museums to become more visitor-oriented.

Besides integrating the permanent exhibition of institutions lacking of a stable collection of artefacts, the insertion of interactive devices was deemed as letting visitors gain "a practical and a creative understanding of what it is to be a scientist" (Barry, 1998, p. 99). This emphasis on the acquisition of hands-on knowledge was underpinned by a physical, goal-oriented notion of interactivity, wherein the visitor was invited to perform a specific task or solve a particular problem.

This design concept was translated in the 1990s from mechanical displays to the first generation of computer-based exhibits making use of multimedia features (text, video and audio). Also in this case, interactivity was mostly conceived in practical terms as the opportunity for "the visitor to select from a predetermined set of options" (Barry, 1998, p. 105)[38].

The initial enthusiastic reception of the potential of interactivity can be read against, on one hand, a perceived threat to the museum coming from new media that were more up-to-date with contemporary consumption trends (Phillips, 1986; McDonald and Alsford, 1991) - as in Stickler's remark that multimedia allowed "today's museums to hold their own with television, films and video games" (1995, p. 36) - and, on the other hand, of a liberalist political context that valued the interactive exhibit's potential to "foster agency, experimentation and enterprise, thus enhancing the self-governing capacities of the citizen" (p. 102).

The very success in attendance gained by science and technology centres, as well as children museums, in the 1990s with the help of new interactive devices, though, aroused skepticism among museum curators and educators who perceived a conflict between educational and entertainment goals.

As Barry reports:

"critics pointed out to the lack of historical or industrial contextualization of many interactive exhibits and the frequent absence of any explanation of what scientific principles were supposed to be revealed through the process of interaction. Some exhibits, it was said, can be interpreted in ways which lead visitors to false *conclusions"* (1998, p. 105, italics in the original text).

Furthermore, the educational outcomes of the interaction with the devices were found to depend on the level of scientific knowledge already possessed by the user, thus favouring expert visitors over less knowledgeable ones.

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[38] The underlying one-way, behaviouristic view that underpinned the first generation of interactive exhibits is exemplified by McLean's emphasis on the necessity to integrate, in the design thereof, "communication goals (what you want the visitor to *learn*) with behavioural goals (what you want the visitor to *do*), and even emotional goals (what you want the visitor to *feel*)" (1993, p. 95, emphasis in the original text).

In order to compensate these limitations, more efforts were put into visitor research to target interactive devices at different groups of users and, in some cases, a new figure of museum staff - the "explainer" - was introduced to mediate between the exhibit and users (Barry, 1998).

In an attempt to replicate the success of science centres, interactive exhibits were gradually adopted by arts and history museum (Phillips, 1986).

However, the practical notion of interactivity focused on problem-solving that had informed the first generation of devices clashed with the rising influence of post-modernist thinking in the humanities, which emphasized a higher layer of cognitive interactivity regarding the personal interpretation of cultural heritage (see Section 2.1.1):

> *"there is no space in this conception of interaction for visitors to make their own meanings or affect the display in some way - that is for a two-way model of communication" (Witcomb, 2003, p. 133).*

This aspect betrays a further underlying epistemological tension between science and the humanities besides the clash of taxonomies (see Section 1.2): whereas the interactive devices used in science centres simulated bodily interaction with scientific instruments (Barry, 1998), no immediate analogue of the scientific experiment could be found in the humanities (Phillips, 1986). Although some multimedia exhibits attempted to illustrate the process of historical research by showing "basic methods and techniques used to obtain the information presented in the museum" (Economou and Pujol Tost, 2007, p. 112), this type of devices seems to have met a relatively low diffusion.

A further critical element concerned the effects of multimedia devices on the social relations between visitors and with the overall exhibition. The prevalent design of the interface of interactive exhibits as a linear input-output procedure for a single user prevented them from being used by groups of visitors such as families (Blud, 1990), a limitation that has persisted also in more recent generations of technologies (Economou and Pujol Tost, 2008; see also Section 5). The capacity of the interactive exhibit to attract the visitor's attention tended, moreover, to isolate him from the setting and flow of the whole exhibition, letting the technology become "the protagonist, to the detriment of the message or the objects" (Economou and Pujol Tost, 2008, p. 250).

Due to these shortcomings - which were added to the substantial costs involved in software programming and in the acquisition of hardware (Koestler, 1993) - the types of interactive exhibits most commonly adopted within arts and history museums remained relatively low-tech, mostly consisting in video presentations of the historical-stylistic background of the artwork, and databases of collection-related information - going beyond those displayed in the typical museum label - that were combined in some cases to digital images of the artwork in what is basically an onsite version of digital collections[39] (see Section 2.1). These examples, although making a relatively sparing use of

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[39] The main example of this type of application is the pioneering multimedia kiosk named Micro Gallery (Rubinstein, 1992), installed at the National Gallery in London in 1991, which provided an illustrated catalogue of paintings with reproductions, artist biographies, an historical atlas of Western painting and general indexes and references. The application included the first prototype of a bookmarking function, through which users could select artworks and print down their location on a map of the gallery. The project took about two and a half years, and employed between four and ten people over that period. Funding was provided by sponsored by the American Express

the array of technological solutions available, had the advantage of a more explicit integration within the exhibition design and of a closer relation with the individual artifact.

More recently, the integration of onsite and online interactive exhibits has been further strengthened in arts and history museums. The main trend in the second half of the 2000s has concerned the development of bookmarking facilities allowing visitors to save information of interest at onsite kiosks for later consultation through the website or e-mail,[40] so preserving the centrality of the aesthetic experience in the onsite visit and avoiding to overload it with a deluge of information (Filippini and Fantoni Bowen, 2007). The main aspects and latest trends in this convergence will be analyzed in Section 2.5 as regards more specifically mobile-based developments.

2.4.2. Virtual reality models

Through distinct from a conceptual and methodological point of view, from the standpoint of utilization virtual heritage models can be considered as a sub-category of interactive and multimedia exhibits.

Their historical roots lie in the application of digital imaging and modelling techniques to archaeological research in the 1990s, which concerned specifically the generation of 3D solid reconstructions of archaeological sites and buildings based on the data acquired through excavations and photographical campaigns (Reilly, 1990; Forte, 1997). The development and codification of these techniques gave shape to the sub-discipline of *virtual archaeology* (Barcelò et al., 2000). Whereas in an initial phase 3D reconstructions mostly served as a research tool, they were gradually introduced in visitor communication and education at archaeology parks and museums to simulate the original appearance of buildings, environments and objects and make them more comprehensible to visitors (Forte, 1997; Pletinckx et al., 2000)[41]. As will be highlighted in Section 4.3.1, a relevant development of virtual archaeology took place in Italy.

The main distinctive traits of VR models with respect to other types of devices are *interactivity* and *immersion*.

The former - referring to the possibility for the user to move physically through a virtually reconstructed environment and manipulate objects - resonated with the first season of digital

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Foundation, to the cost of approximately $1 million (Rubinstein, 1992). A CD-ROM was created out of the project in 1999.

[40] Examples are a series of multimedia kiosks implemented at the J. Paul Getty Museum which allowed visitors to save content of interest (videos, descriptions of artworks, artist biographies) and send the saved information to their email addresses or access it on a personal Web page created on the museum's website. The National Gallery's Art Start kiosks, which replaced the Micro Gallery (Rubinstein, 1992) in 2005, though providing similar functions also contains the whole digitized database of the museum collections (Filippini Fantoni and Bowen, 2007).

[41] The main difference between VR models and virtual museums (see Section 2.1) is - besides the object of the representation - that the latter were mostly based, at least initially, on photographic rather than 3D modelling techniques. Due to the high requirements in terms of hardware and the limited capacity of Internet connections, moreover, the first VR installations were provided onsite rather than offline, a situation that seems to have persisted until recently (Styliani et al., 2009). The possible array of installations can include hardware sets with wide screens, head-mounted displays and motion sensors, even though also regular desktops such as those generally used in multimedia kiosks have proved to enable acceptable and cost-effective virtual heritage experiences (Carrozzino and Bergamasco, 2010).

collections (see Section 2.1) and especially with that of multimedia exhibits (see Section 2.4.1). Though conceptually related, the latter - referring to the possibility for the user to 'enter' a site and enjoy a multi-sensorial experience of bodily projection and absorption within the virtual environment - represents a peculiar characteristic of VR, which was welcomed as an enhancement of the interactive features of 'traditional' multimedia devices (Forte, 1997).

However, the first applications of VR principles to cultural heritage were criticized for their lack of theorization, especially as regarded their implications for visitor communication and interpretation.

In particular, evidence that 3D modelling techniques were producing digital surrogates or replica of actual sites raised the same issues of hyper-reality and authenticity around which the debate on digital collections had revolved (see Section 2.1). As Gillings remarked, the first generation of virtual heritage models was characterized by a prevalent emphasis on the realism of the representation - meant as its closeness to the original referent - to the detriment of the conceptualization of their actual utilizations:

"equating VR with fully-immersive, wholly-convincing (i.e. realistic) virtual worlds leads inexorably to the assumption that VR models should act as surrogates, digital replacements for cultural artefacts, structures and landscape. The faithfulness in which these surrogates approximate their original referents is regarded as a direct correlate of the quality and volume of data that has gone into their creation [...]. This uncritical orthodoxy has resulted in a development trajectory characterised by a continual drive towards methodological refinement. [...] Sophisticated VR models are created largely because we can [...]. Only after they have been generated does attention turn to the uses to which such models can be put" (2002, p. 18).

Under this light, these applications and the resulting experience of fruition were marked by an inherent *deficiency* - that is, an inferiority towards the original, no matter how much information was put in reconstructing the model (Gillings, 2002).

The tension between simulation and authenticity was further exacerbated by a series of critical issues.

First, virtual heritage models drew upon photographical data and standards of realism, thus representing a second-order reproduction of the physical referent (Gillings, 2002) - compared to the first-order digitization of artifacts.

In archaeology, moreover, the reconstruction of the virtual site implies a substantial interpretive involvement of the researcher, who is typically called to extrapolate and recombine limited and fragmentary sources of evidence[42] (standing remains, texts, maps, pictorial representations, diagnostic campaigns etc.) into a complete model of its original structure and

[42] Kalay describes well the complexity and the epistemological challenges of this process: "the digital 're-construction' process is [...] quite different from physical re-constructions. It sometimes begins with the actual remains, captured in digital form through photogrametry, laser scanning, or simply measuring of what exists. This information is converted into 3D models, complete with texture maps and weathering effects. When physical evidence is scarce or controversial [...] other means of re-construction may be used. They include ancient maps, textual accounts of travellers [...], period paintings [...], even MRI and CT scannings [...].Yet, each source presents different difficulties, even controversies. [...] Often, it is the very abundance of information that is a problem, rather than its scarcity: what to do about contradictory evidence? Which evidence should be kept, or discarded?" (2008, p. 4).

appearance (Kalay, 2008) under the stimulus of a contingent problem (Earl and Wheatley, 2002). Whereas this re-creative act of interpretation are recognized by the researcher who constantly modifies the virtual model, however, it tends to be concealed when the model is exposed to public fruition as a fixed product (Earl and Wheatley, 2002; Gillings, 2002). In particular, virtual simulation generate into the user an illusion of physical 'presence' - or "the degree to which the users feel that they are somewhere other than they physically are" (Sylaiou, 2010, p. 246) - and of 'non-mediation' - thanks to which "the user fails to perceive the existence of a medium in his/her communication environment and reacts as he/she would if the medium were not there" (Sylaiou, 2010, p. 246). Under this light, the very realism of virtual heritage models and their ability to arouse a "suspension of disbelief" (Carrozzino and Bergamasco, 2010, p. 454) have been questioned for reducing critical distance and leading to an "inability of appreciating heritage as heritage" (Malpas, 2008, p. 23)[43].

Finally, since most virtual environments were designed for single users and even multi-user systems prevented real interaction (Carrozzino and Bergamasco, 2010) they were found to lack of human presence (Gillings, 2002) and thus hampering the exchange of different interpretations among groups of users.

These concerns have been in part confirmed by the few evaluation studies conducted on virtual heritage environments. In particular, fully immersive experiences proved generally effective in arousing an interest in the exhibits, but the level of engagement achieved did not appear related to the actual acquisition of knowledge (Economou and Pujol Tost, 2008).

On the bases of these shortcomings, the first generation of VR models was criticized by some commentators as a virtual equivalent of the contrived experience of 'travelling in time' popularized by the so-called heritage industry (Hewison, 1987; Walsh, 1992) in the 1980s (Silberman, 2005[44]; ; Roegers and Truyen, 2008; Forte, 2010[45]).

A critical reappraisal of implementation projects has thus emerged, establishing the theoretical groundings for an overall re-conceptualization of the role of virtual reality in heritage interpretation.

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[43] This risk is further exacerbated in cases in which the digital model is superimposed to the actual remains, as in the ARCHEOGUIDE project in which "virtual buildings [of Olympia] are rendered in their field-of-view in a seamless way, creating the illusion of a 2500 years travel back in time" through 3D portable glasses (Buhalis et al., 2006, p. 138). The simulation of reconstruction is not limited to the physical heritage, but includes its original animation, as visitors can watch on-site re-enactments of Olympic games through their glasses.

[44] Neil Silberman, in a critical evaluation of digital heritage projects, echoes the concerns of heritage interpretation authors of the late 1980s (Uzzel, 1989), noting that "we can never re-create the past as it actually was, with its sense of uncompleted present-ness and uncertain expectation. [...] We can only guess at the human dimension of past civilisations by piecing their surviving fragments together with the glue of our own ideas of logic and cause-and-effect" (2005, p. 9). For the author, the past is "is one of the most virtual of the realities we have to contend with" (p. 9) towards which the virtual reconstruction is, at the same time, consistent - as it shares the hypothetical character of any historical knowledge - and contrasting - as it tends to conceal it under a claim of scientific objectivity.

[45] To this purpose, Forte has noticed "that the first virtual worlds in archaeology were born at the beginning of the 90s not in academic labs [...], but by the initiative of corporations, industries and multinational companies [...] because of the economic and technological power of these stakeholders, [...] but followed by a significant skepticism of the academic world. Spectacular and esthetic factors obscured a serious discussion about the process: how is it possible to reconstruct the past? How can we evaluate and test models and methods? What happens in this black box?" (2010, p. 12).

The main solution that has been proposed to overcome the pitfalls of virtual reconstruction rests upon a more explicit acknowledgment of its fluid and hypothetical character.

A seminal contribution in this sense is that of Gillings (2002), who had proposed a shift of emphasis from realism to *mimesis*, or a creative and consciously subjective re-interpretation of heritage that increases knowledge of the original object, as the artwork itself does towards natural and artificial landscape.

Similarly, Silberman has called virtual heritage projects to shift from 'theme parks' to "centers for common reflection, productive questioning and historical awareness within every community" (2005, p. 11). Under the influence of these positions, Forte has receded from an initial focus on realism, formulating a cyclical notion of VR-assisted interpretation processes, wherein subsequent phases of immersion into real and virtual environments enhance the cognitive and observational capabilities of the visitor. In this sense, the value of the VR model lies not any more in the 'surrogate aesthetic' experience that it enables, but in its educational potential for the user (2004). More recently, he has proposed to abandon altogether the term of virtual 'reconstruction' in favour of 'simulation', to underline the inherently conjectural character of a "potential past" (2011, p. 10).

From a constructivist standpoint, Roegiers and Truyen (2008) have called for a shift from simply 'showing' a single reconstruction of history to making the process of reconstruction more transparent and fully exploiting the inter-temporal, inter-spatial and social possibilities offered by the hypertext (such as the possibility to navigate across different historical and interpretive layers, or interact with other learners).

At the level of implementation, attempts into this direction are exemplified by VR models that circumvent the apparent transparency of the medium by applying non-realistic techniques of visual representation (such as the pictorial technique developed by Roussou and Dettakis, 2003) or juxtaposing multiple hypothetic reconstructions (Earle and Wheatley, 2002) of particular aspects, ages or areas of the same site that are identified by specific visual markers or varying levels of solidness-transparency[46]. From both a conceptual and operative perspective, these models present similar traits as the post-modernist digital collection (see Section 2.1.1).

Another widespread type of applications that avoid the illusion of non-mediation refers to storytelling - where virtual environments are used as the setting for historical narrations presented by an external voice or a virtual character (Carrozzino and Bergamasco, 2010, p. 456; Pescarin et al., 2012), thus sacrificing interactivity in favour of the educational content.

Despite some pioneering projects in the area, the addition of social interactions among multiple users continues to represent a complex technical challenge (Dave, 2008; Carrozzino and Bergamasco, 2010).

However, the main limitation that has hampered a wider diffusion of VR modesl in museum settings seems to consist in the substantial costs involved in the acquisition of the hardware and data and their 3D modelling, as well as in maintenance and training (Carrozzino and Bergamasco, 2010).

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[46] An authoritative endorsing to these practices has come from the ICOMOS (2008) Charter on the Interpretation of Heritage which recommends that "the information sources on which [...] visual renderings" of heritage sites "are based should be clearly documented and alternative reconstructions based on the same evidence, when available, should be provided for comparison".

Although, on one side, ongoing technological development has made high-interactivity, low-immersion VR experiences available at reasonable costs, investments and space consumption remain relevant for fully-immersive environments (Carrozzino and Bergamasco, 2010) and need to be pondered against the phenomenon of obsolescence, due to which technical solutions of visual representation are replaced by new generations within a relatively limited time-span (Dave, 2008).

Table 5: Main authors and concepts related to Virtual Reality models for cultural heritage.

Authors	Methodological approach	Concepts
Reilly (1990)	Technical	Proposal and review of methodologies for 3D archaeological modelling
Forte (1997)	Technical	
Barcelò et al. (2000)	Technical	
Gillings (2002)	Theoretical	Critical analysis of the implications of VR Focus on technical refinement Reduction of critical distance from reconstruction Call for a reflexive acknowledgment of the interpretive character of reconstruction
Silberman (2004)	Theoretical	
Kalay (2008)	Theoretical	
Malpas (2008)	Theoretical	
Dave (2008)	Theoretically-informed review of projects	Shift from reconstructive to interpretive uses of VR
Economou and Pujol tost (2008)	Evaluation of impacts on users	High impacts on engagement Low cognitive benefits
Carrozzino and Bergamasco (2010)	Review of projects	Positioning of different solutions on a continuum of interactivity and immersion Limitations (costs, complexity of design, weight of mobile devices, risk of spectacularization)
Sylaiou et al. (2010)	Review of projects	Interactivity and immersion
Forte (2011)	Theoretical	Shift from reconstruction to simulation

Source: Author's elaboration.

2.5. Towards ubiquity: The convergence of onsite and online media

As has been anticipated in the previous subsections, the current trend of technological innovation in museums concerns a convergence of different technologies and media towards integrated platforms for communication and interpretation. This process, which has initially regarded the integration of digital collections, multimedia exhibits and social sharing functions within onsite-and-online bookmarking facilities (see Section 2.4.1), has been recently migrating towards mobile devices.

Since the 1960s[47], *audio tours* (or *audio guides*) had been used in museums to provide visitors with information on the collections and exhibitions without incurring in the limitations of guided tours (fixed schedule, pre-determined visit paths, limitation of social interaction) or saturating the museum space with text panels. However, their contents and functionalities have been traditionally designed by curators with little involvement of other museum mediators[48] (Deshayes, 2004), thus resulting in a reproduction and extension of the main characteristics of traditional interpretive tools such as the type of information provided, the style of communication and the very identity of the speaker (Walsh, 1997; Smith, 2009).

A major limitation of audio tours has been related, until recently, to the fact that museums were forced to invest significant financial resources in the purchase, maintenance and update of handheld hardware and, consequently, to charge users with additional fees or increase overall entrance prices (Petrie and Tallon, 2010).

The 2000s have seen the increasing diffusion of consumer multimedia devices such as mobile cell phones, MP3 players and personal digital assistants (PDAs) which have introduced the possibility of including other types of informational contents than traditional audio tours (Proctor, 2005; Filippini-Fantoni and Bowen, 2008). Whereas several museums attempted to exploit the new technological potential for performing a variety of functions, however, a large share of pilot projects have failed due to the complexity and immaturity of the technology. As a reaction, some museums have come back to a more simplified use of handheld devices that added video contents and orientation features (interactive maps and floor-plans, etc.) to audio tours (Smith, 2009).

However, the most recent mass commercialization of smartphones and tablets as well as the stabilization of data communication standards has led to a further change of strategy, allowing a larger potential for experimentation.

In recent years, a "bring-your-own-device" strategy has been increasingly adopted by museums to avoid the sunk costs involved in the acquisition of portable apparel and exploit the increasing availability of large-bandwidth wireless Internet connections (Burnette et al., 2011). Consistently, several (especially large-sized) museums have thus engaged in the production of mobile multimedia applications for smart-phones and tablets, which are made available for download either at the museum or through dedicated marketplaces such as iTunes and Android Stores.

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[47] The first examples of these supports was introduced in 1952 by the Stedelijk Museum in Amsterdam, in collaboration with Phillips. The support, which could be "best described as a closed-circuit short wave radio broadcasting system" that visitors could receive through a portable radio tuner with headphones, had been initially used in cinema theatres as a support to the hard-of-hearing, and was adapted to provide visitors with multiple-language explanations at the "Vermeer. Real and Fake" exhibition. In this case, the main technical problem to resolve was that of ensuring an adequate coverage of extended museum areas. Moreover, since one tour could be broadcasted at a time, visitors had to start the visit at pre-determined hours. These criticalities, added to the visitors' preference for 'real' docents, led to the early demise of radio-based technologies, which raised nonetheless a strong interest within the museum community. Notably, the main advocate of audio tours, William Sandburg, "was among the first to recognize the importance of the visitor's as well as the museum's voice, and to argue that they consist of a dialogue, and not a 'top down' lecture" (Tallon, 2009).

[48] Cases wherein tour guides have been called to transfer their factual knowledge and relational capabilities to the design of audio mobile tours are rare but significant, such as at the Centre Pompidou in Paris (p. 9). In some cases, multiple perspectives - curators, lenders, historical witnesses etc. - are also inserted in the commentaries.

The most advanced mobile applications see a closer integration of different media and functions with respect to the first generation: in best practices, visitors can access interpretive contents, tag the artworks, visualize suggestions for further visit and share comments or preferred artworks with other users, or save resources for later consultation through bookmarking facilities. Under this light, mobile applications promise to combine the advantages of the traditional audio tour - such as the possibility to obtain "just-in-time interpretation to visitors on the spot, in the gallery, without disturbing the delicate aesthetic equilibrium of the white cube cherished by artists and curators" (Burnette et al., 2011, not paged) - and a "unique ability to offer the individual intimate, immediate and ubiquitous access combined with an unprecedented power to connect people with communities and conversations in global, social networks: mobile is both private and public, personal and political" (Proctor, 2011, n.p.). Moreover, the increased volume and variety of contents and facilities potentially enables the museum to target visitors with personalized contents and recommendations (Smith, 2011), so at least ideally promising the "the users to be their own curators (Wang et al., 2009, p. 141). In this context, an ongoing trend of research and development concerns the creation of location-aware devices - through various technologies such as infra-red, wireless LAN, GPS and RFID - for the automatic delivery of contents related to the specific room or object that the user is visiting, although the technical as well as financial challenges of achieving an adequate level of signal sensitiveness are remarkable.

As a survey conducted on a sample of museums showed, the objectives to attract new visitors and to provide them with interactive experiences and particular or multiple voices on the museum - besides the intention to keep up with technology trends - are the main reasons for adopting multimedia mobile guides (Petrie and Tallon, 2010).

However, the very multiplication of the variety of contents and functions arouses a temptation that had been early acknowledged by Deshayes (2004) with regards to the first generation of PDA-based devices - that of using new technology platforms for an unlimited provision and variety of information according to a "database - or 'bottomless pit' - logic", which is "hardly compatible with the visit logic that presuppose an intensive rather than extensive utilization of the devices (aiming to make the most of it in the minimum time)"[49] (2004, p. 12, own translation) and risks causing a cognitive overload on the visitor (Filippini Fantoni and Bowen, 2008). In the attempt to avoid such fallacy, in turn, an unprecedented array of design-related questions emerge - regarding among others the modalities of delivering differentiated informational contents in specific spatial and temporal settings (pre, during and post-visit), the choice of language and tone of voice, the role of visitor agency and interpretation versus curatorial authority and personalization versus social interactions (Tallon and Walker, 2008) - which are being variously addressed by the experiments in place in different museum contexts.

In this context, the increasing ubiquity and seeming transparency of information technologies appears as a double-edged sword: although on one side it multiplies the options of interpretation

[49] This caution applies particularly to the use of image or video contents as a support to the actual visit, which should be managed in a way that assists and enriches the direct relation with the objects and the movement in the exhibition space rather than overwhelm it - as was the original advantage of the audio tour (Deshayes, 2004).

and communication available to the museums, on the other side it leaves these grasping with an unprecedented series of complex and subtle choices, whose solution depends on the specific objectives and vision of the museum as well as on the alignment with specific conceptual approaches to interpretation and education (Parry, 2008). These complexities which add themselves to the relevant costs involved in the design implementation of the software and the creation of contents (Filippini Fantoni and Bowen, 2008; Burnette et al., 2011) can be accounted for the relatively low diffusion of mobile devices, which seem so far an almost exclusive property of large museum.

Table 6: Main authors and concepts related to handheld multimedia tours and mobile applications.

Authors	Methodological approach	Concepts
Deshayes (2001)	Study on users (ethnographic observation)	Utilization of audio tours
Deshayes (2004)	Study on users (ethnographic observation)	Utilization of multimedia tours
Tallon and Walker (2008)	Theoretical Collection of projects	Review of experiences in place with handheld devices and implications for the museum experience
Filippini Fantoni and Bowen (2008)	Historical review of projects	History of handheld devices in museums
Smith (2009)	Theoretical	Discussion of common assumptions on multimedia tour design Principles for implementation
Petrie and Tallon (2010)	Survey	Museum's objectives for implementing multimedia tours and mobile applications
Burnette et al. (2011)	Theoretical	Costs and potential revenue sources for mobile applications
Proctor (2011)	Practical handbook	Design issues and guidelines for mobile applications

Source: Author's elaboration.

2.6. Synthesis of museological literature

The above review of literature has shown how different types and forms of digitization have been conceptualized in Anglo-Saxon museological literature according to diverse theoretical perspectives.

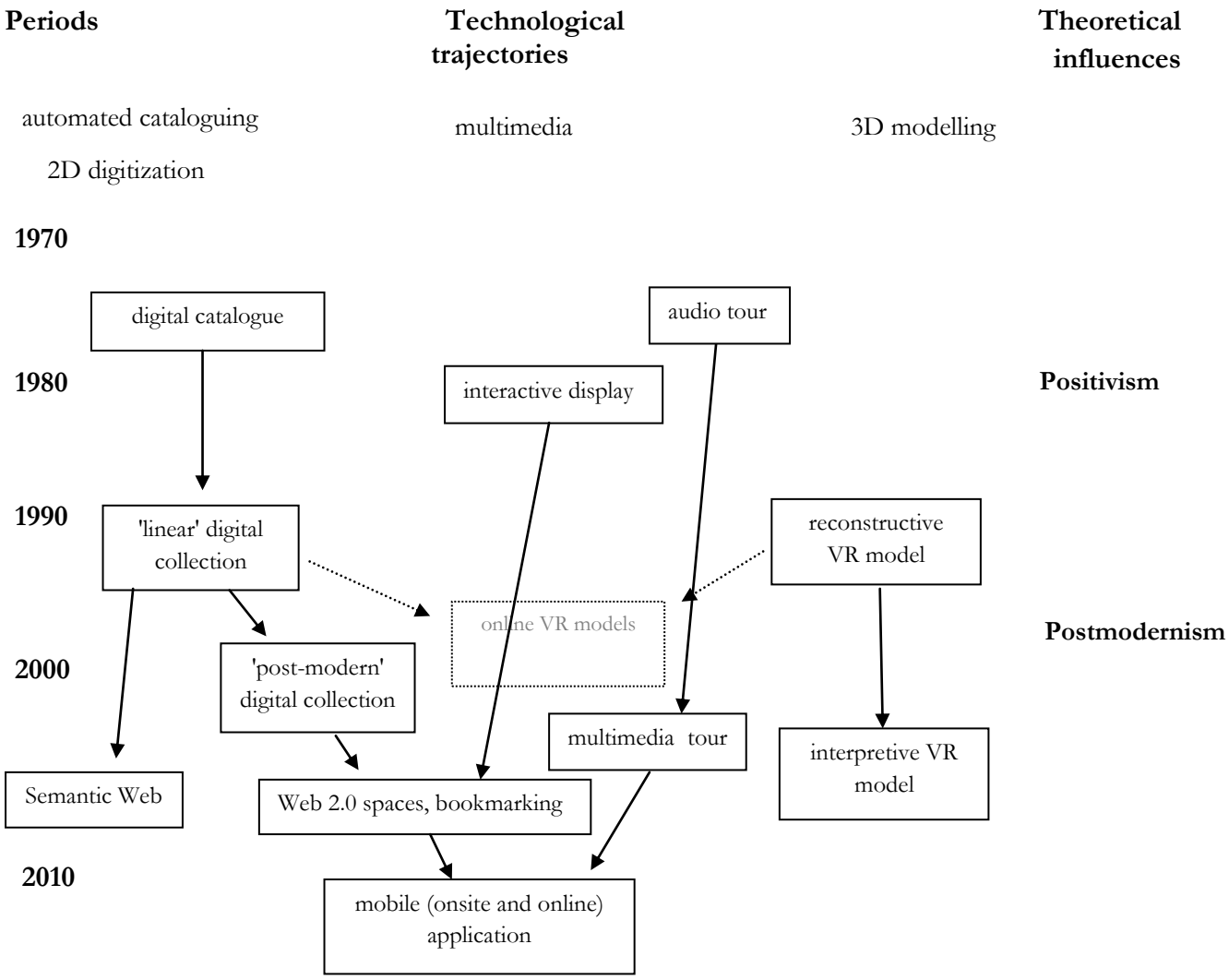
The results consists in a multiple narrative of parallel trajectories of techno-cultural development that are graphically summarized in FIGURE 3. Although the constant oscillation across tension and compatibility of the relations between museology and computing is consistent with Parry's (2007) historiographic framework, in our account these do not necessarily converge and consolidate into a stable alliance. Indeed, the assertion of particular techno-cultural models can lead to identify new tensions that may, in turn, arise further efforts of re-conceptualization. This is the cases of digital collections (see Section 2.1.1) and virtual reality models (see Section 2.4.2): whereas in an initial phase digitization projects were mostly conducted under an enthusiastic fascination for

the potential offered by ICT, in a second phase some dissatisfaction about the outcomes arose, stimulating a wave of critical reflections on the first generations of projects and a consequent re-conceptualization of the goals of digitization.

In the above described processes, merely technological factors - referring both to the state of development of hardware and information infrastructure, as well as what may be defined as 'the structural properties' of digital media (Manovich, 2001) - seem to act either as an enabler or a constraint for the achievement of cultural objectives as defined according to specific conceptual frameworks.

As can be seen from FIGURE 3, some technological trajectories (automated cataloguing and 2D digitization; multimedia technologies and 3D modelling) proceeded in a substantially parallel fashion, whilst other presented potential intersections, only a part of whose were actually implemented consistently with the current state of technology. An example of technology-constrained failure is that of online VR models, whose implementation has been limited by the scarce availability of broadband Internet connections in the late 1990s and early 2000s. Differently, the main paradigm of intersection between multiple trajectories is the ongoing convergence of digital collections, multimedia tours and Web 2.0 facilities towards mobile platforms. Whereas this trend is opening unprecedented opportunities for heritage institutions, it is also likely to open new questions and areas of potential tensions to be assessed in the next future.

Figure 3: Chronological representation of the main technological trajectories and forms of digitization.



Source: Author's elaboration.

Notwithstanding the variety of forms of digitization discussed within museological literature and of the conceptual frameworks adopted, some common arguments and claims can be identified.

In much synthesis, the main arguments advanced with regard to the potential of new technologies can be summarised as follows:

- On one hand, there is substantial agreement on the claim that new technologies enable a quantitative multiplication of opportunities of *access* to cultural heritage, by loosening or eliminating spatial and temporal constraints to fruition. In this sense, digitization also acts as a factor of a *democratization* of culture, allowing to extend fruition towards previously extended segments of the population **(§ 1)**;

- On the other hand, ICT are claimed to qualitatively modify and transform established practices of fruition and interpretation of cultural heritage **(§ 2)** in different senses, depending on the specific forms of digitization considered:
    - by breaking established narratives through the relational character of the hypertext, which enables the user to create idiosyncratic connections and narratives - as in post-modernist digital and personal collections (§ 2.1);
    - by enabling a more immersive and interactive experience of cultural heritage - as in multimedia exhibits and Virtual Reality models (§ 2.2);
    - by creating virtual spaces for dialogue and interaction wherein different interpretations of heritage can be exchanged and shared (Web 2.0) (§ 2.3);
    - by multiplying the quantity and variety of information that the museum can make available to their audiences - such as through mobile devices which combine the functions of audio tours, multimedia kiosks, digital collections and Web 2.0 spaces (§ 2.4).

The main limitation of museological literature is that the above arguments are seldom supported and substantiated with empirical evidence. With few exceptions (Cameron, 2003; Filippini Fantoni and Bowen, 2007), the above reviewed contributions tend to overload technical factors with cultural interpretations, stopping in most cases short of a direct confrontation between theoretical possibilities and their effective implementation, utilization and long-term impacts on users. This generates a certain distance between discourse and reality, which is apparent in the frequent replication of digitization-related claims across different types and generations of technologies and in the tendency to project techno-cultural scenarios towards an ever-receding future[50].

As will be shown in Section 3, this limitation also negatively affect the possibility to examine the digitization of cultural heritage from a properly economic and managerial standpoint. To this purpose, the small body of user evaluation studies that have attempted to compensate for this gap will be reviewed in the next subsection, before reviewing economical and managerial literature on digitization at Section 2.8.

2.7. User evaluation studies

Notwithstanding the recurrent emphasis on the advent of a new technology-savvy audience for museums (see for instance MacDonald, 1992), "so far audience research on on-line museum visitor is, compared with other parts of museum studies, relatively poor" (Parry, 2007, p. 98). However, lack of evaluation studies characterizes even more strongly onsite applications such as multimedia interactives and virtual reality models, where "a wide percentage of projects and applications [...]

[50] This applies particularly to the first claim of democratization, which tends to reappear in the same form throughout the first (Besser, 1998; Keene, 1998) to the latest generation of digital museums (Sood, 2011)

often born and die in digital labs, without being experimented and monitored with people" (Pescarin et al., 2012).

As regards the former, a limited number of empirical studies of museum online visitors has been conducted in the first phase of digitization, with the aim of assessing on how much museum websites were used, by whom and for which purposes.

These first surveys highlighted that the most of websites users - substantially overlapping with an audience of regular museum goers - searched for practical information (hours of operation, admission fees, directions etc.) in order to plan the actual visit (Kravchyna and Hastings, 2002; Thomas and Carey, 2005), although a significant share of specialized users also searched online collections for research and educational motivations (Saffar, 1999; Kravchyna and Hastings, 2002)[51]. However, the surveys did not provide in-depth evidence of why and how digital images were sought.

More recent research, although confirming the overlap of online visitors with regular museum-goers, has shown that a significant share of users resorted to museum websites not only to plan their visit, but also to retrieve detailed information on collections and exhibits after the visit (Marty, 2007).

In particular, Marty's (2008) survey of a sample of 1,215 users at 4 museum websites has yielded partially differentiated results as regards the character of the online visit experience and the role of digital collections. From the survey, images of artifacts (64%) and research (62%) or educational (49%) materials, followed by virtual tours (45%) emerge as the resources most likely to be utilized by the respondents, thus showing an increased weight of digital collections in the online experience. The relation between the virtual and the physical museum also emerges in its complexity. On one hand, three quarters of the sample agreed that museum websites should provide unique experiences that cannot be duplicated in the physical world, and less than the 20% considered the website as an effective substitute for viewing artifacts or exhibitions. On the other hand, the 40% of the interviewees considered the website as a valuable alternative to the physical one for collecting information, whereas customized features - such as virtual tours adapted to individual interests - were more appreciated (66.3%) than personalized ones, such as personal digital collections of favorite museum artifacts (44.3%). This evidence leads the author to conclude that the functions of virtual and the physical museum are differentiated, though complementary: whereas the former seems to be a privileged space for collecting information for advanced research or educational purposes, the latter remains the privileged place for aesthetic appreciation and 'basic' learning.

However, the paper presents significant methodological limitations related to the lack of actual observation of users behaviour, the auto-selection of the sample and the lack of socio-demographic data which prevent any generalization of the results and a segmentation of the respondents.

Further studies focusing especially on interactive features provided through museums websites have confirmed a relatively low level of interest on the part of users.

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[51] These findings were substantially replicated by a survey conducted in France (LeMarec, 2004), where two different targets were distinguished, one who consulted the website to satisfy a generic cultural curiosity (e.g. surfing virtual tours and browsing digital collections), and one who used it in relation to a potential visit.

Filippini Fantoni and Bowen's (2007) review of the evaluation studies of bookmarking features conducted in a sample of museums[52] revealed that "the majority of the projects lag well behind museums' expectations", especially online applications. Although some services suffer from lack of visibility on museum websites and from user-unfriendliness, they have attracted a scarce interest on part of the general public, suggesting that "for most visitors, the experience starts and finishes at the museum and there is no need or curiosity to extend it beyond its walls". In the lack of socio-demographic data on users, however, the authors hypothesize that bookmarking may be a useful tool for segments of specialist visitors such as researchers, students, teachers or frequent museum goers.

More recently, Marty (2011) has expanded its previous analyses focusing specifically on personal online collections.

The 160 interviewed users of six museum websites providing this type of facilities mostly belong to special-interest categories - including teachers (25.9%), professionals (12.6%), students (11.9%) and researchers (10.1%) - rather than general visitors (39.6%). Usage intensity appeared rather low, as visitors reported the creation of few collections, with a limited number of artefacts. As regarded motivations, respondents were most likely to use personal digital collections systems for bookmarking artefacts while browsing online collections, maintaining a personal list of favorite museum artefacts, or identifying favourite artefacts prior to a museum visit and after a museum visit, and slightly less likely to do it for scholarly purposes, for entertainment, or educational assignments. In reverse, the users did not show a particular interest in advanced features such as editing, annotating, or sharing, nor they deemed the integration of personal collections with onsite kiosks or handheld devices to be likely to increase their use.

In general, the findings - also due to the lack of observational data - do not allow to draw conclusive elements about the relative prevalence of specialist versus generalist uses of personal collections. In this sense, Marty highlights a "disconnect between the perceptions [...] of the survey respondents and the actions of [...] the museum professionals who developed these systems" (p. 216). This gap has been addressed by museums in the latest years through a more clear-cut differentiation between general and specialist uses: whereas personal collections that were mostly targeted at the general audience discontinued their dedicated website sections and transferred sharing features to social media such as Facebook and Flickr, others are reinforcing their orientation to a specialist target by offering tools for research and education (Marty, 2011).

Altogether, the above reviewed user evaluation studies find limited support for the quantitative argument of democratization (§1) and mixed results as regards the qualitative potential of digitization (§2). However, serious limitations in sampling methodologies and their focus on

[52] The sample includes the Tate Modern, the J. Paul Getty Museum, the Museum of Science in Boston, The Peabody Essex Museum in Salem, the Cleveland Museum of Art, the Science Museum in London, and the Tech Museum of Innovation in San Jose.

specific types of applications make them not directly comparable nor capable to offer consistent empirical evidence on the usage of digital heritage.

Table 7: Main evaluation studies of digital heritage collections.

Paper	Main element of focus	Methodology	Key findings		Methodological limitations
			§1	§2	
Saffar (1999)	Utilization of museum websites	Online questionnaire to visitors of museum website	Substantial overlap between website and museum visitors (§1✗)	Use of websites for research (§ 2✓)	Limited sample
Kravchyna and Hastings (2002) Thomas and Carey (2005)	Utilization of museum websites	Online questionnaire to visitors of museum website	Substantial overlap between website and museum visitors (§1✗)	Use of websites for visit planning (§ 2✗)	Auto-selection of the sample
Filippini Fantoni and Bowen (2007)	Utilization of (online and onsite) bookmarking features	Usage analysis and review of evaluation studies of specific projects	Not analyzed	Low interest of the general public in bookmarking (§2 ✗)	Different data collection methods used across case studies; Lack of socio-demographic data
Marty (2008)	Utilization of museum websites	Online questionnaire to visitors of museum website	Overlap between museum-goers and website visitors (§1✗), but lack of socio-demographic data	Differentiation between physical museum and website; Low interest of users for online interactive features (§2 ✗✓)	Auto-selection of the sample; Lack of demographic data
Marty (2011)	Utilization of personal online collections	Online questionnaire to users of personal collections	Not analyzed	Low interest on part of the general audience; prevalent use in connection to the actual visit (§ 2✗)	Lack of observational and socio-demographic data

Source: Author's elaboration.

In this context, additional if not conclusive evidence about the use of digital heritage by specialist categories can be drawn by resorting to studies of art historians' information-seeking behaviour, which have traditionally been intensive users of images for research and teaching purposes, in the form of photographs and slides belonging to personal or departmental collections.

The initial phase of digitization was found by Bailey and Graham (2000) and Rose (2002) not to have substantially mutated the habits of art historians, as they perceived digital images to fall short of scholarly criteria of quality and reliability. A later study conducted by the first authors (Graham and Bailey, 2006), however, found more positive attitudes towards digital images within the category, alongside with significant limitations such as widespread lack of knowledge of new technological instruments - which was also identified by Elam (2007) as the main obstacle against a further utilization of digital images.

More recently, Beaudoin and Evans Brady's (2011) in-depth qualitative study of a small sample of archaeologists, architects, art historians and artists showed a preference for digital images by all categories except the last one, which continued to prefer books and personal collections. These latter maintained their relevance, in particular, as a strategy to handle the frustration of retrieving images on the Web. Significantly, the generalist Google Images search engine emerged as the most valued resource by art historians compared to academic or commercial databases.

Despite their sampling limitations, the surveys suggest a growing incorporation of digital images in arts research and teaching as an alternative to analog photography. However, museum digital collections do not seem to have established themselves as a preferred source of contents on part of professional art historians, being outpaced by generalist search engines.

The following subsection reviews how the concepts and arguments of museology literature have been assumed and translated in the economic and managerial domains.

2.8. Economic and managerial literature on digitization

Only in the last decade, the digitization of cultural heritage has started attracting the interest of economics and management scholars. Whereas the main arguments of museology literature have been gradually assumed and translated into economic terms, though, research in this field seems still at an initial phase of exploration, especially as regards the socio-economic impacts of innovation.

De Laurentis (2006) has adopted an innovation economics approach to digitization, exploring the role of cultural or *memory institutions* - a term that groups archives, libraries and museums (Dempsey, 1999) - is as content providers for the emerging *digital value chain* - or the flow of activities that preside over the conversion of analogue resources and their transformation into new products and services. Consistently, the author highlights the opportunities for economic growth arising from the commercial exploitation of digital cultural assets in the media, tourism and education industries, which "offer [memory institutions] a means to maximise their financial potential and accrue revenues from the licensing of their assets" (p. 81). In particular, online cultural contents can represent a particularly relevant resource for peripheral regions, which are called to build economic

strategies based on their distinctive assets and identities in order to reduce their gaps with central areas.

Upon these premises, De Laurentis provides a qualitative scenario of the media industry and digitization projects in Wales, identifying a lack of interaction and cooperation among content producers and an unwillingness on part of cultural institutions "to develop the capacity to create content from their assets" (p. 87), which manifests in their orientation to service provision rather than product development.

However, the main obstacle against digitization-driven strategies of regional development is identified in the underlying uncertainty of demand for digital cultural products, leading the author to invoke a classical market failure argument to claim public incentives to innovation[53].

Under this light, the attempt to impose a framework of innovation economics upon the issue of digitization, without reconnecting with museological literature, leads the author to emphasize economic benefits to the detriment of cultural ones and to prioritize the overarching concept of the 'digital value chain' over the autonomous objectives of heritage institutions. As a result, however, the economic impacts from digitization tend to be overstated and clash with actual evidence about the demand.

A marketing management framework has been adopted by Camarero and Garrido (2008) to analyze the mediating role of technological and organizational innovation between market orientation and socio-economic performance in a sample of Spanish and French museums.

Drawing on marketing literature, market orientation is defined as the organization's understanding of and commitment to the needs of visitors-customers, donors and competitors-cooperators, besides interfunctional coordination within the organization. Performance is defined both in economic (including increased attendance, revenues and jobs) and social terms (including reputation, customer satisfaction and loyalty, conservation objectives and others).

In the absence of existing studies specifically focused on innovation in museums, the authors build on general literature on service for-profit organizations, broadly considering technological innovation as any application of new technologies to products, services or processes.

Data are obtained through a questionnaire administered to museum curator, where technological innovation is identified by 5 indicators that measure the curators' reported level of interest and involvement in adopting new technologies in management and marketing activities. The statistical model confirms the mediating role of innovativeness - the construct including organizational and technological innovation - between market orientation and socio-economic performance.

A major limitation of the paper, however, is that technological innovation is defined in a generic way - without distinction between specific forms or technologies - and it is identified

[53] "The reliance on market processes alone is resulting in underinvestment in research and development, depressing demand and supply to levels below what would be potentially economically justified. Limited appropriability, financial market failure, external benefits to the production of knowledge and other factors suggest that strict reliance on a market system will result in underinvestment in innovation, relative to the socially desirable level" (p. 87).

through the curators' subjective perceptions, without assessing the actual extent and outcomes of implementation.

A more explicit connection between innovation economics and the museological debate is sought by Lise Boily (2009), who - drawing on a previous work on the semiotic value of collections (Rousseaux and Boily, 2007) - re-interprets digitization under the paradigm of the knowledge economy, wherein "collections offer themselves, more than ever, as paradigmatic modes of organizing knowledge" (2007, p. 53). Consistently with the current debate on explicit and tacit knowledge in economic geography (Cohendet and Steinmuller, 2000; Cowan et al., 2000; Cohendet and Meyer-Kramer, 2001) and in the creative industries, the advent of *cybermuseology* is examined by the author as an instance of codification of tacit knowledge.

In this context, the digitization of museum collections presents a two-fold aspect: on one side, it implies an objectification of meanings and interpretations of artifacts; on the other side, it enables to permute, rearrange and recombine individual items according to subjective criteria. The latter possibility - which overtly resonates with Cameron's (2003) disruption of linear narratives - consists in the ability "to rethink the 'real' and transform it, escaping from the limits related to time, space, cultural constraints and so forth" (Boily, 2009, p. 101, own translation). Under this light, codification appears as a necessary pre-condition for expanding the sphere of interpretive freedom and creativity, seen as the constant permutation and 'remixing' of cultural genres - thus showing relevant similarities with Delagrange (2009, also see Section 2.1.1).

Boily exemplifies her view through the case of the virtual-only anthropological exhibition *Peuples des eaux, gens des iles* realized by the Canadian Museum of Civilization, where the hypertext is used to reproduce the oral model of communication of the aboriginal nations of Oceania and ethnographic data are made available to these communities by "avoiding the use of abstract categories to privilege the concrete, offering a direct take on their worldview" (Maranda, 2007, quoted in Boily 2007, p. 54). In this way, "Oceanians can relate the virtual collections to their concrete experiences, connect them to their personal history, establish their own collections and further assert their identity" (2009, p. 105, ot). No evidence on the actual usage, though, is provided, leaving open the question as to whether these opportunities are actually grasped and valued by the users and if this potential refers more to an idealized than an empirical visitor.

Bakshi and Throsby (2010) in their proposal of an overall conceptual framework for analysing innovation in arts and cultural organizations, have touched on digitization issues, attempting to assess empirically the potential economic impacts for cultural institutions.

Seeking to avoid a merely techno-scientific or functional notion of innovation, the authors consider technological change as a transversal driver to the four types of business innovation strategies - namely *audience reach*, *artform development*, *value creation* and *business models* - thus further specifying Camarero and Garrido's (2008) generic notion of innovation. As regards in particular the digitization of museum collections, this is considered as an instrument for the first strategy, as it potentially allows to extend access to cultural heritage towards new target segments - correspondingly with the quantitative claim of democratization in museology literature (§1).

The authors assess this hypothesis through a case study of the Tate Gallery, where multimedia tours have been introduced to improve the visit experience and online versions of temporary exhibitions have been created with the purpose of attracting new audience segments.

The level of utilization of multimedia tours appears differentiated according to the type of exhibitions: whereas the uptake is relatively low for the main collection, where entry is free of charge, it increases at special paid exhibitions.

Evidence on the usage of exhibition websites is more articulated, as resulting from a questionnaire administered to onsite and online visitors of the *Colour Chart* exhibition at the Tate Liverpool in order to identify their socio-demographic profile, expectations and experience.

As regards audience composition, the results show that "most of the expanded audience [...] is drawn from regular gallery visitors, [...] suggesting more generally that online availability of an art exhibition is likely to appeal primarily to those already experienced in going to art exhibitions" (p. 44). A partial differentiation between the two audiences emerges from the higher representation of females (73% among online visitors vs 61% among onsite), adults (87.7% vs 76.1%), non-British (31% vs 25%) and low-income visitors (36.6% vs 26.6%).

As regards the nature and contents of the online visit experience, the attention of the respondents mostly focused on those elements that reproduced the actual exhibition, such as the general introduction (80.2%) and the individual pages of the exhibited artists (71.7%), whilst more advanced features such as interactive games (12.6%), downloads (11.3%) and user-generated contents (22.6%) attracted a lower interest. In terms of expectations, duration and intensity, the virtual experience seems less engaging than the actual one, as the share of online visitors reporting a set of cognitive and emotional benefits is lower than the corresponding value of gallery visitors.

However, there are also elements of differentiation between the onsite and online exhibition experiences: although the 83.4% of the interviewees agreed that the online experience is "not as good as 'the real thing'", the 80.6% also agreed that the Web opens up "new ways of thinking about art". Moreover, the exhibition website stimulates interest towards visiting other 'real' exhibitions in the 46.6% of the interviewees, a relevant share though lower than the 58.4% of onsite visitors.

As a result, the hypothesis of digitization as an instrument of audience reach is partially confirmed, differently from the user evaluation studies reviewed at Section 2.7. On the other hand, the survey provides contradictory evidence of a technology-enabled qualitative change in the artistic experience - that the authors label as *audience deepening* - as demonstrated by the fact that the most popular features of the exhibition website are those that reproduce the actual visit experience.

In order to test the hypothesis of web-based business strategies promoting a reconfiguration of revenue streams, the authors use a contingent valuation analysis that produces mixed results.

Although the 56.6% of online respondents stated they would consider donating a median amount of £2 after seeing the online exhibition, the 80% of respondents stated they were not willing to pay for online access to exhibition websites and no actual donations were collected when a call was posted on the exhibition website.

As a result, there is no evidence of direct economic benefits from digitization, leading the authors to emphasize indirect impacts, such as increased attendance at paid exhibitions and enhanced brand visibility (pp. 59-60). To this purpose, however, the main limitation of the study is

that it focuses exclusively on a temporary exhibition, without addressing the relation between new technologies and the permanent collection.

In general, although Bakshi and Throsby's innovation management framework is more grounded on the reality of the individual cultural institution than De Laurentis' (2006) concept of the digital value chain, they identify a similar tension between the potential economic impacts of digitization and scarce evidence of digital business models, whose implementation in this case appear limited by the audience's expectation for free access.

Bakshi and Throsby's framework has been used by Camarero et al. (2011) for adapting their original framework (Camarero and Garrido, 2008) in order to assess the influence of organizational size and funding sources on innovation and performance. To this purpose, the authors introduce a further distinction between technological, organizational and *value creation* innovation, upon which museum size and private funding is hypothesized to have a positive impact. A further difference from the previous study (Camarero and Garrido, 2008) is that now technological innovation is measured as the number of new technological solutions introduced at the museum[54].

The regression model confirms the positive (log-linear) effects of museum size and private funding on innovation, and the latter's subsequent influence on performance. In reverse, museum size and private funding are not found to have a direct relation with the museums' socio-economic performance - except a positive effect of public funding on social performance. The authors thus conclude that the dominance of public funding has a stifling effect on innovation due to bureaucratic inertia and rigid organizational structure, although the existence of a quadratic effect suggests that the same observation applies to institutions that rely exclusively upon private funding.

Similarly to the previous paper (Camarero and Garrido, 2008), the main limitation of the work is the exclusive reliance on the curators' perceptions as a data source. Moreover, although the sample includes different types of museum located in four countries, no comparative analysis of the tested relations is performed, which prevents assessing whether any differences exist due to national policies and legislation or peculiar museological and/or managerial approaches.

Building on the same dataset and measurement scales, Camarero et al. (2012) have analyzed more in detail the relation between market (visitor and donor) orientation, a new construct of

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[54] Specifically, digitized catalogue of book collections (implemented in the 26.7% of the sample); digitized catalogue of the items in the gift shop or bookshop (12.8%); digitization of archives, books or historical documents (29.9%); digitization of images or photographs (59.1%); digitization of works in the collection (48.5%); software applications adapted to managing the collection (42.0%); databases of friends of the museum and members (41.5%); software applications adapted to managing friends and members (11.8%); staff training programmes (26.7%); use of computers for educational programmes (30.5%); information for visitors through computers or screens (33.4%); projection screens with video tours around the museum (19.6%); screens with virtual visits around the museum accessible to visitors (13.6%); presentation of content through photographic panels or with images (46.2%); in situ experiences (30.1%); environmental scenography (17.9%); informative screens on techniques, materials, exhibited works, etc. (23.4%); webpage (67.4%); webpage with video tours (6.3%); webpage with virtual visit (14.3%); educational programmes on the web (15.9%); dissemination of research or publications through the web (23.0%). The resulting index is thus multiplied by an 1–5 scale that reflects the curators' perceived intensity in the use of new technologies ("We are one of the leading museums in the use of technological resources"). with respect to the categories used in museological literature (see Section 2), the list adopted by the authors shows significant areas of overlap.

service orientation (composed of quality orientation[55] and custodian orientation[56]) and innovation (organizational and technological, which is measured through a set of subjective perceptions as in Cammarero and Garrido, 2008).

The results of the model appear to partially contradict those of previous studies. Whereas visitor orientation is found to have a positive impact on organizational innovation, it does not affect technological innovation, differently from donor orientation which positively affects both dimensions of innovation. Quality orientation, in turn, acts as a mediator between service orientation and innovation, suggesting that visitors place more value on quality provision than mere innovation. The hypothesized negative relation between custodial orientation and technological innovation, moreover, is rejected, showing that a focus on preservation does not stifle change.

On these basis, the authors integrate their previous paper (2008) by positing "two routes that lead to technological and organizational innovation in museums, a business approach based on market orientation and a cultural approach based on service orientation" (p. 53).

In general, the reviewed quantitative studies (Camarero and Garrido, 2008; 2012; Camarero et al., 2011) confirm the first argument of democratization (§1), thus reinforcing Bakshi and Throsby's (2010) results. However, exclusive reliance on the curators' perspectives does not allow to measure the actual extent of increased audience reach, nor provides evidence of the economic impacts of digitization beyond increased attendance. Furthermore, despite the inclusion of different types of museums and countries in the dataset, their respective peculiarities and influences on the tested relations are not analysed.

The lack of consistent evidence on the demand for digital heritage and digital business models also affects more recent economic accounts of digital heritage. Navarrete (2013) has attempted to draw a comprehensive framework for the production and consumption of digital cultural heritage, based on the analytical instruments of cultural economics.

The main assumption is that the process of digitization converts heritage into a "an exchangeable good" (p. 1), whose supply can vary accordingly to changes in the production process, joint supply of products, different aims of production and expected changes in consumer expectations.

On the production side, the author lists the cost items related to digitization, which include "acquisition of hardware and software, migration and integration of content, system maintenance, in addition to initial and ongoing staff training, support from system providers, costs related to hosting, overall management costs, deaccessioning and project planning" besides direct labour (p. 6). Upon these bases, she concludes that "the digitization process still relies on intensive labor and this represents a high cost which has not yet been substituted by machines and consequently limits

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[55] This is defined as "an attempt to achieve the best from a cultural, artistic, or historical point of view, to offer visitors the best possible cultural experience and to offer maximum quality in complementary leisure and entertainment facilities" (p. 45).

[56] This is identified as the museum's commitment to the preservation and restoration of the collections.

supply growth" (p. 253). The attempt to draw a similar list of possible digital business models (p. 257), though, is conducted at a theoretical level since no examples of implementation are mentioned.

On the consumption side, the core advantage brought to cultural heritage by digital technologies" (p. 259) is identified as the "demand for heritage content at any time from any location without reducing availability to others" - thus replicating the quantitative claim of museology literature (§1). In order to analyse the demand side, Navarrete combines a cultural economic model of demand formation - according to which "demand for digital cultural heritage is informed by past experiences, by personal choice and by the familiarity with the content and the medium" (p. 264) - to a model of information selection according to which demand for cultural contents depends on criteria of reliability, validity, completeness, actuality, verifiability, correctness, integrity, relevance and 'findability' (p. 262). The main limitation of this treatment consists in the uncritical definition of digital heritage as "a marketable asset to be placed in a market of information" (p. 258), which tends to obscure the specificity of cultural versus other types of contents and strengthen emerging concerns for commoditization as a potential risk of digitization (see Section 2.1.2). Moreover, the review tends to remain at an abstract level, as little empirical evidence is provided to substantiate the arguments.

In line with Navarrete (2013), Bertacchini and Morando (2013) consider digital heritage as an information good, analyzing the patterns of production and distribution and related business models.

From an economic standpoint, digitization implies substantial fixed and sunk costs, but "the cost of reproducing and distributing digital images is close to zero" (p. 61). This has tow-fold consequences as regards the opportunities for cultural institutions to extract direct revenues from digitization.

On one hand, museums as other information providers are "likely to occupy monopolistic positions in the information market" (*ibidem*), increasing the distribution of their contents thanks to the decrease in transaction costs enabled by new technologies.

On the other hand, digital heritage has the characteristics of a public good (non-rival and non-excludable) and the networked environment makes it easier for other actors to appropriate, use and reproduce the collections also for commercial purposes. In this sense, a wider dissemination of digital objects on the Web may multiply opportunities for appropriation and reproduction, which according to the authors could result in "a new commons based knowledge about museum collections involving users and the general public" (p. 63). Under this light, "museums face a clear tension between favouring increased access and tightening control over their digital collections" (p. 60).

Drawing on current initiatives, the authors identify four main business models for digital collections.

The most widespread consists in allowing *open access and display* of digital objects on the institutional website. As the authors specify, free availability does not necessarily imply a relaxing of control over the use of contents, since technical instruments such as digital watermarks (also see Section 6) can be used to disable copy and track usage: as such, open display can be complementary

with the second model of *proprietary image-licensing*, or the paid distribution of digital images to target users. In this case, the main obstacle lies with the difficulty of differentiating licensing agreements and pricing according to educational or commercial uses of the contents.

An opposite model is *open image-licensing*, which substantiates the "commons-based peer production system" (p. 66) through new licensing schemes such as Creative Commons that allow the free use and re-use of contents. Also in the mentioned cases, though, the possibility to publish digital images in different resolutions (*versioning*) enables cultural institutions to retain traditional sources of income from high-quality reproductions.

The last model based on the *user generation of art images* enables visitors to produce and distribute photos of artworks through social media such as Flickr (see Section 2.2).

Building on the review, Bertacchini and Morando discuss the economic challenges that museums must face in the management of digital collections, analyzing how digitization can be used as "an additional lever available to museums to meet both outreach and sustainability targets" (p. 68). Since - as the authors argue by referring to Tanner's (2004) survey of American museums - the demand for licensed images "has so far not lived up to expectations", the authors recommend museums to "set the price for licensing digital copies of artworks at the marginal cost of reproduction and distribution, which is generally close to zero for information goods in digital format[57]" and "[...] reconsider [...] image-licensing model in order to find a balance between extracting economic value from the commercial exploitation of its digital collection and increasing access in order to advance its mission, [...] particularly [...] for images of artworks in the public domain" (p. 69).

However, once a choice for open licensing is taken, the possibilities to extract direct revenues from digital images seems substantially undermined.

Although the authors suggest museums to establish partnerships with information providers such as Google and photographic stock agencies, which "have the financial resources and technology necessary to provide enhanced services to museums for the digitization and online dissemination of their collections" (p. 69), this choice admittedly exposes museums to the risk that these players could "obtain monopoly rents on access to digital reproductions", by exploiting the ongoing convergence "towards a limited number of distribution and content aggregating platforms" (*ibidem*) that has been underlined at Section 2.3.

Although the framework drawn from information economics risks implying conceptual simplifications when applied to cultural heritage, Bertacchini and Morando have the merit to posit explicitly the issue of the long-term sustainability, which has been identified as a critical challenge since the early phase of digitization (EC, 2002; Zorich, 2003) and represents one of the main open areas for investigation (see Section 3.1.1).

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[57] As will be seen in the review of public policies of digitization (Section 4), a similar view also underlies recent initiatives taken by the European Union for the creation of a cultural commons based on open data. However, the argument seems to underestimate the marginal costs incurred by institutions in digitizing artworks and producing metadata prior to online distribution (CIPFA, 2009; Navarrete, 2013).

Table 8: Main economic and managerial studies on the digitization of cultural heritage in museums.

	Methodological approach	Concepts	Findings/limitations
De Laurentis (2006)	Qualitative case study of innovation networks in Welsh cultural industries	'Memory institutions' as content providers for the 'digital value chain'	Scarce networking and collaboration in regional networks Low intensity of demand for digital cultural contents
Camarero and Garrido (2008)	Survey of Spanish and French museums	Technological and organizational innovation as mediators between market orientation and socio-economic performance	Confirmation to the hypothesis Lack of distinction between different forms of technological innovation and types of museums Reliance on the curators' subjective perceptions
Boily (2009)	Description of a virtual exhibition	Digital collections as spaces for interpretive freedom and combinatory creativity	Lack of empirical evidence on usage of virtual exhibitions
Bakshi and Throsby (2010)	Case study of the Tate Gallery Liverpool: Questionnaire to onsite and online visitors of a (physical and virtual) exhibition	Digitization as a support to audience reach, artform development, value creation and business models	Slight differentiation between the onsite and online audience (partial support to §1) Low WTP for digital contents
Camarero et al. (2011)	Survey of Spanish, French, British and Italian museums	Effects of size and funding sources on innovation and performance	Significant effect of museum size and private funding on innovation Lack of distinction between different types of museums Reliance on the curators' subjective perceptions
Navarrete (2013)	Theoretical review based on cultural economics	Theoretical review of digitization and related issues	Lack of empirical evidence on usage of digital heritage
Bertacchini and Morando (2013)	Theoretical review based on information economics	Digital business models	Trade-off between increased access to collections and appropriation of revenues

Source: Author's elaboration.

In synthesis, the previous contributions mostly focus on Web-based technological applications as new channels of distribution of cultural heritage, thus replicating the quantitative argument of democratization that has been identified in museology literature (§1).

Only Boily (2009) and Bakshi and Throsby (2010) attempt to integrate this focus respectively with a theoretical and empirical analysis of the potential impacts of digital collections and exhibitions on the museum experience, whereas Camarero et al. (2011) conflate different types of applications into a general category of technological innovation, without comparing their respective relation with socio-economic performance.

With little connections to the economic studies but more explicit relations with the museological debate on digitization, a small body of studies have applied consumer behaviour or experiential marketing approaches to assess comparatively the impacts of different technological mediation devices on the museum experience, thus providing evidence on the qualitative claim of museology literature on digitization (§2). From a methodological standpoint, they have in common the use of drawing on qualitative techniques such as ethnographic observation and interviews.

In particular, vom Lehn and Heath (2005) have analyzed the effects of a PDA-based interpretation device and a video interactive display on the time spent by visitors and their experience the artworks, by a video-based field study conducted at a contemporary arts museum. The findings confirm early concerns (Blud, 1990; Walter, 1996; see also Section 2.4.1) that the individual's involvement with a mediation device during the visit tends to weaken connections with other members of the group and desensitize him/her towards the immediate museum environment due to the lack of opportunities for simultaneous fruition. Moreover, although interactive devices significantly increase the time spent at the museum by visitors thanks to their rich informative contents, they also tend to attract their attention away from the actual object to the device itself - which in some cases even act as a substitute to the artwork - thus pointing out to the "rather fragile relationship between interpretation devices and the objects whose interpretation and exploration they are designed to enhance" (p. 17).

A more complex framework has been applied by Carreras and Rius (2011) to evaluate 16 interactive exhibits at a Spanish museum, drawing on the disciplinary fields of human-computer interaction, cybermuseology and traditional visitor studies. To investigate the utility, comfort and usability of ICT applications and their contribution to the users' meaning making, the authors have drawn on a variety of qualitative data collection techniques including interviews, questionnaires and direct or video observation.

The findings identify a series of technical (location, scarce usability of navigational tools) and psychological (lack of privacy in front of other visitors) barriers to interaction, besides highlighting a relatively negligible contribution of interactive displays to interpretation, caused by the excess of informative contents and the lack of direct relations with the objects. As concerns the effects on user behaviour of different types of devices, audiovisual non-interactive displays had a higher attracting power over visitors than proper interactive exhibits, although visitors tended to spend more time with the latter. In general, the excessive duration of the displays emerged as the main

limitation to the visitors' propensity to interact, which tended to decrease in the second part of the exhibition.

Although this evidence has enabled the authors to formulate a set of required adjustment in the design and contents of interactive exhibits for improving the user experience, it does not allow to draw conclusive statements on their effects over the learning process, calling for further research in this direction.

Most recently, Jarrier and Bourgeon-Renault (2012) have expanded vom Lehn and Heath's (2005) focus on the temporal and praxeological (related to social interactions) effects of new mediation devices to their emotional (or sensorial-hedonic) and rhetorical dimension (related to construction of meaning), through in-depth interviews conducted with 21 visitors about different types of devices.

Comparatively, audio guides and interactive displays elicited the most negative emotions, whilst smart-phones were perceived as an obstacle to aesthetic pleasure. Tablets, instead, were found "more readable, brighter, more convivial and thus more satisfactory" (p. 23) although less lively than actual guided tours. Under this light, the emotional benefits of mediation devices are outweighed by their cognitive effects, letting a trade-off between the two dimensions emerge.

As regards the rhetorical dimension, tablet applications based on augmented reality were valued more positively than audio guides and fixed interactive displays because of their location functionalities, which enable a more direct comparison between the artwork and related information. In reverse, web-based applications are potentially more rich in contents but require a more active role of the visitor in targeting the required information.

The introduction of tablets also reduces the praxeological complexities found by vom Lehn and Heath's (2005) with regard to audio guides and interactive displays, as they lend themselves more easily to being used by couples of visitors thanks to the larger screen. Findings related to the temporal dimension of the visit are also mixed, since visitors seem to adopt differentiated strategies for managing and saving time, such as bookmarking contents of interest for later consultation. Consistently, the interviewees expressed diverse views as to whether mediation devices act as a stimulus towards increased museum attendance and a factor of loyalty to the individual institution - which seems more likely for young generations. However, a major limitation in Jarrier and Bourgeon-Renault (2012) is that the interviews are conducted at a general level, without reference to a specific museum context.

Despite their mostly explorative nature, qualitative consumer behaviour studies on museum technologies highlight the challenges of designing and structuring interactive and interpretation devices so that they enhance rather than replacing the aesthetic experience and actually stimulate rather than stifling social interaction - also comparatively to the proven effectiveness of low-tech interpretation devices such as mobile paper cards (vom Lehn and Heath, 2005). Whereas the recent advent of technologically-advanced mobile platforms such as tablets seems to have significantly increased the interpretive solutions available to museums (Jarrier and Bourgeon-Renault, 2012), it should be reminded that their general level of diffusion is still relatively low.

Consequently, support to the qualitative claim of a technology-enabled change in the museum experience appears mixed (§2), calling for more in-depth research on specific user profiles in relation to different types of interpretive devices.

Table 9: Main marketing studies on mediation devices and museum experience.

	Methodological approach	Concepts	Findings/limitations
Vom Lehn and Heath (2005)	Video-based ethnographic observation	Effects of technological mediation devices on the duration and deepness of the museum experience	Trade-off between informative richness and social interactions Difficult relation between interpretive devices and displayed objects
Carreras and Rius (2011)	Interviews Questionnaires Direct and video-based ethnographic observation	Utility, usability and comfort of interactive devices Contribution to interpretation and meaning-making Attractive and 'holding' power (length of interaction)	Technical and psychological barriers to interaction Excess of contents and scarce relations to objects Lack of time as main behavioural limitation against interaction
Jarrier and Bourgeon-Renault (2012)	Interviews with a sample of visitors	Effects of technological mediation devices on the emotional, rhetorical, praxeological and temporal dimensions of the museum experience	Differentiated evaluation of devices Lack of contextualization in a specific museum setting.

Source: Author's elaboration.

From the present review, economic and managerial literature on the digitization of cultural heritage in museums appears rather sparse and fragmented, highlighting a general lack of shared conceptual frameworks and empirical evidence.

Despite mirroring the complex and multi-disciplinary nature of the phenomenon, the adoption of different and relatively disconnected disciplinary approaches (innovation economics; cultural economics; service management and experiential marketing), contributes to the fragmentation of the research area and prevents the identification of general or transversal research questions. Consistently with the lack of explicit connections with the museological debate, moreover, economic and managerial literature tends with few exceptions (Boily, 2009; Bakshi and Throsby, 2010) to adopt a functionalist view of technological innovation that proves scarcely

suitable to the investigation of a jointly technical and cultural phenomenon. Finally, the influence that may be exerted by specific public policies and national or institutional contexts[58] on the conceptual design and implementation of digitization is not explicitly considered.

In order to integrate these gaps, instead of starting with the adoption of a specific theoretical framework, the present work privileges the identification of areas of investigation that have not been sufficiently addressed in literature prior to the selection of a suitable a research strategy.

The research questions, methodological review and research strategy are discussed in the following Section.

3. Research questions and strategy

3.1. Research questions

3.1.1. The economic sustainability of digital heritage and business models

The first conceptual step for conducting an economic evaluation of the digitization of cultural heritage consists in assessing its long-term economic sustainability.

Although the issue has been recently explored from the perspective of cultural economics, it is largely open to further investigation, as no explicit attempts have been made to compare the costs and economic impacts of digitization.

As regards the former, the digitization of collections and the design of online and onsite applications implies substantial investments whose size is seldom mentioned in museological literature. In particular, 2D digitization requires the acquisition of hardware and collections management software, besides dedicated workforce and specific actions to ensure long-term preservation of digital collections against the physical deterioration of magnetic and optical supports and the obsolescence of data storage formats - whose costs are particularly difficult to estimate (CHIN, 2013d; Navarrete, 2013). Investments in hardware tend to increase in the case of onsite multimedia devices or virtual reality models which require constant maintenance, update and replacement against technological obsolescence. In this context, although the growing diffusion of consumer technology products is likely to reduce the absolute amount of investments in the middle-long term, these will likely continue representing a significant barrier against technological

[58] The existence of diversified national approaches is shown by Kéfi and Pallud's (2011), whose interviews with leading actors on digitization in France have revealed mixed receptions of the main arguments of Anglo-Saxon literature and the ongoing dominance of a curator-driven model of digitization over a visitor-oriented one (see Section 1.2). Remarkably, the 'democratization' argument seems to be indifferently invoked with reference to both the visitor-oriented and the content-driven approach (which one interviewee opposes to mere 'vulgarization'). Some interviewees, instead, argue that digitization is more helpful in encouraging regular museum-goers to repeated visits than attracting new segments.

innovation in the short term, especially for small-sized cultural institutions (Spinazze, 2007; Camarero and Garrido, 2011).

Differently, software programming[59] and the creation of multimedia contents (Burnette et al., 2011) are likely to persist as significant sources of costs.

On the side of economic impacts, conversely, a lack of explicit business models has been identified since early surveys of digitization projects in the museum and librarian sector (EC, 2002; Walls, 2003; Zorich, 2003).

In the museological debate, the reliance on different sources of funding has been mostly considered from the standpoint of the cultural mission of heritage institutions. Initially, the concern had been expressed that relying on private funding and transferring to market forces the task of selecting which objects and collections to digitize would lead to 'skimming' the most lucrative items to the detriment of less known works (Besser, 1997, p. 89). However, early surveys showed a marked prevalence of public funding which, despite ensuring the prevalence of cultural objectives over commercial ones, would make digitization subject to possible shifts in political priorities and budget allocations (Zorich, 2003). Against this background, several policy reports (Walls, 2003; Zorich, 2003) have called for increasing the share of user-generated revenues in order to ensure the long-term economic sustainability of the initiatives.

In the current context, the question as to which mix of funding sources is most appropriate for pursuing cultural goals whilst covering the costs of digitization in time remains open both in the case of museums as in digital libraries (Chowdbury, 2013).

This issue is closely related, on one side, to the lack of consistent empirical evidence about the demand for digital heritage and the benefits gained by users of digital applications compared to other media, which represents a significant obstacle for advocating further public investments (Economou and Pujol Tost, 2008; Falk and Dierking, 2008; Filippini and Fantoni Bowen, 2008).

On the other side, it relates to the role of private-public partnerships for digitization (see Section 3.1.2) that have represented a complementary source of funding especially for multimedia tours, although being perceived to limit the range of possible achievements (Proctor, 2005, p. 29).

Against this background, economic and managerial literature have offered only partial insights into economic sustainability.

Although Camarero and Garrido (2008) and Camarero et al. (2011) have found a correlation between technological innovation and the museum's economic performance, the latter refers to indirect economic effects, such as increased attendance at the physical museum, as identified by the curators' self-evaluation. Likewise, Bakshi and Throsby, despite initially claiming for a technology-driven revolution in the value creation process of cultural institutions (2010, p. 18), do not find evidence of online business models being implemented at the Tate Gallery and conclude by hypothesizing the existence of indirect effects such as increased attendance and enhanced brand visibility.

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[59] In the case of smart-phone or tablet-native applications, initial development costs are estimated between 10,000 to 60,000$ and can substantially increase if different versions are released for specific platforms (iTunes; Android; Windows Phone etc.) (Forbes, 2011).

Consistently with her view of digital heritage as an exchangeable good, Navarrete (2013) has attempted to classify digital-only business models through an analogy to the domain of digital media, identifying five types - *selling online space to advertisers*, *selling physical products online*, *digital commerce*, *subscription-based environments*, and *online donor programs* - of which, though, only the third is directly related to digital objects and seems compatible with the mission of cultural heritage institutions. A more articulated analysis has been recently provided by Bertacchini and Morando's paper (2013), which discuss four business models for digital collections based on current experiences at leading heritage institutions (see Section 2.8). On these bases, the authors identify an underlying tension between the objectives of increasing access towards, and extracting revenues from, digital collections, highlighting a lack of sustainable business models based on open access - that has been also highlighted with reference to digital libraries (Chowdbury, 2013). A similar trade-off between diffusion and revenue generation is also emerging in the case of multimedia tours and mobile applications, as "experience to date has shown that apps and other mobile products that are free to the end-user achieve greater usage rates than those with a charge" (Burnette et al., 2011).

Under the light of recent contributions, thus, heritage institutions seem to be framed within a set of sensitive choices that may further increase the historical tension between cultural and economic objectives (Kotler and Kotler, 2000).

In this context, Bertacchini and Morando have called for "more in-depth studies [...] and empirical evidence [...] to better understand the optimal balance between control and openness" (2013, p. 60). Consistently, further research is needed to:

- identify culturally and economically sustainable business models for digital heritage that are suited to the objectives and characteristics of different types of organizations (mandate and mission, size, financial sources etc.);
- empirically explore and further highlight the trade-off between increased access and the extraction of direct revenues from digital collections;
- assess the role of public policies in promoting the adoption of specific business models by cultural institutions.

3.1.2. The organizational implications and challenges of digitization: collaboration and knowledge transfer

Museological and economic literature have mostly emphasized respectively the cultural and economic aspects of digitization. However, with few exceptions, they have not explicitly addressed the organizational changes and challenges brought about by the phenomenon. From this perspective, digitization seems to involve a new set of complexities for heritage institutions.

A first choice that museums have to face is whether to acquire or outsource ICT skills, which is likely to depend not only on the size and financial capabilities of the institution, but also on the complexity of the tasks to be undertaken.

Anecdotic evidence suggests that only larger institutions can afford to build or absorb qualified human resources, whereas small museums are limited in their recruitment capabilities and are thus forced to cooperate with external firms (Spinazze, 2007). However, the performance of

complex activities such as the design of multimedia exhibits and mobile applications is likely to require also larger museum to establish partnerships with external actors endowed with the necessary know-how and expertise. With reference to this scenario, though, Morbey (2006) and Wilson (2011) have raised concerns regarding the potential implications of the relations of power between museums and technology partners for the socio-cultural mission of the institution. In particular, Morbey has considered the partnership between the Hermitage and IBM as an instance of *cyber-colonization* wherein a global, business-oriented format of communication was imposed on the museum website, reducing the role of the museum staff to that of providing basic contents. In order to compensate for the bias in power, Morbey (2006) has advocated a more equitable negotiation between the two parties involved and a mindful contamination between the respective disciplinary and 'political' approaches.

In the case of the internalization, digitization represents an additional - and largely transversal - process to be inserted within the organizational structure of the museum. Similarly to the case of libraries (Bock, 2008; Gueguen and Hanlon, 2009), fragmented evidence suggests that digitization tasks in museums were initially performed by dedicated units or teams (EC, 2002) and have then been gradually internalized within general functions such as collections management and marketing communication (Kéfi and Pallud, 2011). The integration of IT skills in museums, however, poses cognitive challenges arising from the differences in disciplinary backgrounds, competences and languages between curators and computer professionals. As Morbey (2006) and Wilson (2011) have observed, the apparently simple development of a museum website poses a series of linguistic, aesthetic and ethical choices whose solution may vary significantly according to the different disciplinary codes and approaches carried by the actors taking part to the design process. The level of complexity of inter-disciplinary interactions and knowledge transfer is likely to increase when shifting from the mere digitization of collections to the design of technologically-advanced and content-rich types of applications.

Due to the dominance of Anglo-Saxon literature on digitization, scarce attention has been paid so far to the potential influence that different national and institutional contexts can exert over the intensity and dynamics of inter-disciplinary collaboration. Whereas Northern American literature shows a partial contamination between the curriculum of the curators and that of IT specialists (Proctor, 2011), which may lead to a potential cross-fertilization (Lazzeretti, 2009), in France Kéfi and Pallud have identified a substantial separation between the two profiles and a one-way modality of collaboration: whilst curators are increasingly invited or forced to perform ICT-related tasks, computer professionals are not typically asked to perform curatorial tasks. In the above scenario, moreover, some authors have called for extending participation to the design of online (Hertzum, 1998; Marty, 2011) and onsite applications (Carreras and Rius, 2011) to the users.

Against this background, further investigation should address:

- the nature of knowledge transfer and collaboration between the different stakeholders and disciplinary communities involved in digitization projects (museum management; curators; IT staff; marketing and communication staff; external technology providers or sponsors);

- whether opportunities for cross-fertilization or tensions between different competences tend to prevail in specific contexts;
- the influence of the power and cognitive relations between the actors involved in inter-organizational partnerships on the outcomes of the digitization process;
- the role of users in the design of online and onsite applications.

3.1.3. Demand for digital heritage applications: size, composition and behaviour

Albeit some authors have proposed to consider digital heritage as an exchangeable good (Navarrete, 2013), economic analyses suffer from a lack of empirical evidence about the extent, profile, motivations and behaviour of the demand, which seriously limits the possibility to assess the claims of museological literature (see Section 2.6) and the economic sustainability of digitization (Section 3.1.1).

This situation can be ascribed not only to the "cursory understanding of their user's needs and demands" (Walls, 2003) on part of heritage institutions and to the dominance of a theoretical attitude in museological literature, but also to relevant methodological complexities.

In this context, a first cognitive gap concerns the size of the demand for digital heritage, which is under-researched in literature and practice compared to actual museum attendance.

Web traffic statistics (Navarrete, 2013), which are scarcely utilized by heritage institutions, can provide a general quantitative picture of the frequency and intensity of use of heritage contents. However, direct research strategies are required to identify different segments - defined in socio-demographic, motivational or behavioural terms. Online surveys (Kravchyna and Hastings, 2002; Marty, 2008; 2011) have provided exploratory evidence of the existence of different motivations and interests to digital heritage - as well as varying levels of artistic expertise - among users of online applications, leading the authors (Marty, 2011) to question the recurrent assumption of a generalist, undifferentiated audience as the main target of digitization. Against this background, the diffusion of cultural codes, interpretive frameworks and aesthetic preferences[60] - besides mere technical skills - among virtual museum visitors emerges as a relevant and largely open area of investigation for marketing and consumer behaviour scholars (Stylianou-Lambert and Stylianou, 2010).

The identification of consistent user profiles and the assessment of ICT's capability to attract new segments of the audience (§1), however, would largely benefit from the collection of consistent socio-demographic data, which lack both in user evaluation studies of online applications - with the sole exception of Bakshi and Throsby (2010) - and marketing studies of mediation devices in physical museum settings (von Lehm and Heath, 2005; Jarrier and Bourgeon-Renault, 2012).

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[60] As Stylianou-Lambert and Stylianou highlight, likewise to the physical counterpart, a rewarding virtual heritage experience requires "trained eyes" (2010, p. 69) and "accessibility measured by the ease and sense of confidence with which a visitor views and interacts with visual information holds true both in the physical and in the virtual museum" (ibidem).

Moreover, relatively little knowledge is available about the cognitive and experiential benefits that users obtain from online and onsite applications. A first attempt to fill this gap has been made by Bakshi and Throsby (2010) who have compared the cognitive and emotional impacts of a virtual exhibition with those of its physical counterpart. However, more fine-grained evidence of the effects of virtual museum environments on learning, entertainment and memory seem necessary to advocate further investments in new technologies (Falk and Dierking, 2008).

Laying more attention to cognitive issues should not lead to neglect the potential economic barriers to fruition, whose relevance seems to increase in the case of mobile applications (see Section 2.5). To this purpose, recent studies of the diffusion of portable devices among museum visitors have shown that, although the market for smart-phones and tablets is growing, the usage rates of multimedia tours is less than proportional. In particular, according to a survey conducted in three leading American museums only a minority of users prefer using their own device for onsite interpretation (Petrie and Tallon, 2010), raising the question whether a 'bring-your-own-device' strategy can bear exclusive effects on a segment of the audience.

A final element of complexity in analyzing the demand for digital heritage is related to the potential long-term effects of the adoption of technology-based modes of communication not only in museums, but also in the wider educational system (Ott and Pozzi, 2011). In other terms, the use and design of mediation devices may exert a regulatory influence on visitors' expectations and behaviour, encouraging them to align with a particular model of relation to the museum setting and the artworks[61] (LeMarec, 2004; vom Lehn and Heath, 2005). Public policies may also exert an active role - as in the historical establishment of the modern museum (Bennett, 1990) - in nurturing a demand for digital heritage and fostering specific behaviours. Under this light, longitudinal research would help assess whether the fruition of digital heritage presents self-feeding dynamics in time through the - visible or implicit - regulations posed by public institutions on visitors and users.

In general, an overall gap of knowledge about the size, characteristics and behaviour of the demand is even more marked referring to industrial users that commercially exploit digitized cultural contents (De Laurentis, 2006).

In synthesis, the following research issues related to the demand for digital heritage can be identified:

- the socio-demographic profile, cultural background and interpretive frameworks of users of digital heritage applications;
- their motivations and expectations with regard to digital collections and interpretation devices;

[61] As LeMarec highlights, "visitors are attracted by mediation devices because they see in them an opportunity to understand what the institution expects from its visitors, how to watch the works for instance. [...] In this context, it is evidently less the utilization in terms of individualized appropriations, than the interpretation that the visitor makes of what the devices reveals of the relation between the institutions and the public, that is decisive in the long term" (2004, own translation, pp. 16-17).

- the contents and benefits of their experience with digital heritage, in terms of both emotional (sensorial involvement, aesthetic appreciation etc.) and cognitive outcomes (learning, memory etc.);
- the potential long-term effects caused by the users' exposure to ICT or by an explicit attempt by policy-makers to create an audience for digital heritage.

3.2. Methodological review

The existence of relevant open issues regarding the digitization of cultural heritage can also be ascribed to the limitation and fragmentation of the methodological approaches that have been adopted in museological as well as economic and managerial literature.

In particular, a limited number of economic studies on the digitization of cultural heritage in museums have adopted a quantitative statistical approach either to the supply (Camarero and Garrido, 2008; 2012; Camarero et al., 2011) or the demand side (Bakshi and Throsby, 2010). A further group of studies that have not been explicitly reviewed in Section 2 have been conducted as part of digitization projects and policy reports adopting a survey methodology (Zorich, 2003; Walls, 2003; CIPFA, 2009; Poole, 2010). Besides the issue of sampling size[62], the main limitation of this quantitative approach is that it tends to ignore the economic, cultural and political context wherein digitization initiatives are undertaken. This seems particularly relevant in the case of heritage institutions, which can significantly differ in terms of history, mission, size etc.

In this context, the present work aims to contribute to existing methodological approaches through a double-layered research strategy that privileges the selection of suitable research sites over the prior identification of a specific theoretical framework.

On one hand, the focus will be extended to national and supra-national policies of digitization, exemplified by the representative cases of Canada and the European Union, in order to investigate the economic, cultural and political background for specific digitization initiatives. Besides enabling filling a relevant gap in literature, which has not specifically addressed yet the role of public policies in driving digitization activities, this layer of analysis provides a macro-level contextualization to individual experiences of implementation.

On the other hand, in-depth case research focusing on the experience of representative heritage institutions will be conducted. As in the former, case research allows to address a significant

[62] This is especially relevant for policy reports. In the cases of Zorich (2003) and Wall (2003), limited sample size - respectively consisting in 7 and 33 institutions - do not allow to provide a statistically representative picture of the state of digitization at a country-wide level, nor across different categories of institutions. Although the NUMERIC project funded by the European Union adopted a broader sampling design in order to trace a statistical framework for analyzing digitization in the Union, the varying composition of the sample of 'relevant institutions' does not enable cross-country comparisons, although providing a fairly reliable representation of different categories of heritage institutions (e.g. libraries, archives, museums etc.) at an aggregated level. However, a part of the results are not fully reliable due to a lack of agreement on definitions and the difficulty experienced by the institutions in collecting accurate data on funding and usage issues (CIPFA, 2009).

gap in economic and managerial literature, which has not attempted - with the partial exception of Bakshi and Throsby (2010) - to investigate digitization activities within their specific context and temporal development.

Accordingly to the techno-cultural nature of the phenomenon under examination and the complexity of the research questions, the main criterion for the choice of the research strategy consists in the capability to take into account the historical and cultural context of digitization initiatives and to conduct a critical assessment of innovation policies and processes, in order to bridge the gap between discourse and reality that has emerged from the analysis of museological literature.

In the following subsections, the main methodological streams and traditions that can be relevant to the present research adopted will be reviewed, whilst in Section 3.3 the methodological framework and data collection strategies adopted will be illustrated.

3.2.1. Historical case study research

Case research is a particularly broad methodological approach, which has been applied to different disciplinary contexts in accordance with different epistemological approaches. Although this makes the definition of its traits and boundaries difficult, its flexibility allows it to adapt to different situations of empirical inquiry. In the following subsections, the main traditions of research that are directly or indirectly related to the research issue under consideration are presented and discussed. In Section 3.2.2, the case for a critical study of technology, which is identified as the main gap in literature, is presented.

3.2.1.1. General methodological and epistemological traits

Notwithstanding different definitions of case research can be found in literature (Guercini, 2004), the most often adopted one is that of "an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident and […] there will be many more variables of interest than data points" (Yin, 2003, pp. 13). According to the author, the distinctive characteristics of case research consist in a focus on multiple aspects of the observed events, with an explicit analysis of the context wherein it takes place, and in the consequent use of multiple sources of evidence such as participant observation, interviews, text analysis and others. Differently statistical or experimental methodologies, thus, case research typically generates 'rich' data.

Further methodological and epistemological traits can be summarized as follows:

- the explicit attempt to reveal the intentions, values and meanings attributed by relevant subjects to their actions, which requires an active communication between the researcher and the informants (Guercini, 2004);

- an aptitude to investigate the development of events and their temporal links, privileging a longitudinal approach and often a narrative style of presentation (Thomas, 2010);
- the adoption of a theoretical rather than statistical type of sampling, where the units of analysis are selected according to an initial hypothesis regarding their potential to exemplify, integrate or challenge established theory (Yin, 2003).

Qualitative case study strategies have been extensively used in management research since the 1970s, especially in the US, mostly adopting single organizations as the unit of analysis (the *case*). Thanks to its flexibility and richness of evidence, in particular, qualitative case research has represented the methodological foundations for the emerging discipline of strategic management (Mintzberg, 1979; Piore, 1979).

Consistently with this key role, early methodological literature tended to present case research as a suitable methodology for building theoretical bodies that adheres closely to the phenomena (Bonoma, 1985; Eisenhardt, 1989). Under this light, case studies have been mostly used in an exploratory phase of research that is preliminary to the application of statistical methods, allowing researchers to "move up the hierarchy of study types toward causal disconfirmation" (Bonoma, 1985, p. 201). However, this view has been recently challenged for supporting a positivistic paradigm by advocates of other epistemological approaches such as post-structuralism and critical realism (Flyvbjerg, 2006; Easton, 2010; Jarvensivu and Tornröos, 2010). It should be noticed, though, that Yin (1981; 2003) had already rejected attempts to insert case research within a fixed hierarchy of research strategies, claiming that it can also perform descriptive and explanatory besides exploratory purposes: in particular, he defines explanatory case studies as those aiming to answer "what?" and "why?" questions by dealing with "operational links that require to be traced in time, rather than with mere frequencies or incidences" (Yin, 2003, p. 6). A further application regards the evaluation of the effects of public policies and programmes, wherein case research can be used for "explaining presumed causal links in real interventions that are too complex for applying questionnaires or experimental strategies" or "describing an intervention within the life context in which it has happened" (Yin, 2003, p. 15).

The main criticism that has been traditionally addressed to case research by the advocates of statistical methodologies refers to the impossibility to generalize the findings, due to the limited number of observations and to their dependence on particular contexts. Although case research does not allow to perform statistical inference from a sample to a population, Yin (2003) proposed to consider it as subject to an analytical type of generalization that consists in the replication of the results of a single case study to support a specific theory or disconfirm alternative explanations. As Halkier argues, however, analytical generalization is "much more specific and context bound than understandings of generalization as universalizing" and could be defined as the activity of "producing context-bound typicalities" (2011, p. 788). He thus specifies three methodological approaches - *ideal-typologizing*, *positioning* and *category zooming* - for generalizing on the basis of qualitative data.

Furthermore, although for Yin (2003, p. 1) case research differentiates itself from history in that it observes contemporary events in their real-life context, they are both characterized by a

reliance on diversified sources of evidence upon as well as by a common orientation to understanding the meaning of events (Dray, 1964; Danto, 1968). Under this light, relevant similarities in the respective notions of generalizability can be identified. Similarly to case research, "the experimental design and sample sizes of history are inadequate for making inferences about it" (March et al. 1990, p. 7): therefore, the discipline has resisted attempts - the main of whose proposed by Carl Hempel (1942) - to apply the epistemological paradigm of the natural sciences based on the identification of general laws. Differently, a long-standing foundation has been provided by W. H. Dray's *principles of action*, consisting in "reasons to act that have a character of generality and universality [...] that is different from the generality of an empirically validated law" (1957, p. 129), thus representing an intermediate position between positivist and relativist approaches. Remarkably, the identification of principles of action shows a further point of contact with case research, since it requires the researcher to pass through - though without identifying with - the agents' perspectives and experiences, which in history has been defined as an act of *re-thinking* (Collingwood, 1956; Dray, 1964).

Analogies between case study and historical research are indirectly demonstrated by the extensive application of historical case studies in the social sciences, which will be reviewed in the following subsection with a particular reference to the study of technological innovation.

3.2.1.2. Historical case research in economic theories of innovation

History in economic analysis has always enjoyed a contentious and oscillating status. As Freeman and Louca (2001) describe, though, ensuing a long marginalization of history due to the prevalence of equilibrium-based models, interest in historical understandings of economic growth has been recently revived by the evolutionary paradigm, whose main purpose is "to explain economic growth at a macroeconomic level" (Nelson, 1995, p. 71) through an "expressly dynamic" model (Nelson, 1995, p. 56). Technological innovation lies at the core of evolutionary models, that conceptualize it as the variation of *routines* within firms - which in turn "can be regarded as merely the incubators and carriers of technologies and other practices" (Nelson, 1995, p. 67). Successful variations are then selected by an exogenous environment which coincides with market forces, thus determining the profitability of firms.

Besides their dynamic character, a key element of differentiation between evolutionary and neoclassical equilibrium models is that the former explicitly consider institutional factors as enablers or obstacles to economic growth. Consistently with their conformity with the epistemological foundations of biology, however, evolutionary models tend to utilize history as a mere 'timeline' (Edgerton, 1999), as demonstrated by their preference for stylized accounts of facts (Dosi et al., 1994) over more complex and realistic interpretations.

Against this background, a relevant attempt to incorporate a deeper appreciation of the temporal character of institutional change within evolutionary theories has been made by Freeman and Louca (2001), who claim that "economics is meaningless outside the framework of history, since economies are historical by nature" (p. 3). To this purpose, the authors adopted Kondratiev's

concept of *long waves*[63] - defined as long-term fluctuations in growth, industrial structure and power relations determined by major technological innovations - in order to identify recurring socio-economic patterns in history since the Industrial Revolution to the current context. Their analysis privileges a macro approach, according to which technological revolutions "cannot be simply analysed as individual, discrete events, although, of course, micro-level agents have been essential for their inception and diffusion" (2001, pp. 336-337).

This marks a difference with another group of evolutionary models, which have largely adopted historical case studies of particular technological innovations "to illustrate the phenomenon of path dependence" (David, 2001, p. 17). *Path-dependence* studies have carved out a specific position within evolutionary theories by emphasizing that the outcomes of innovation processes are determined by the decisional patterns that are bounded by previous events and embedded in a set of relations between different actors and institutions, whose alignment of interests and economic incentives is crucial in determining the emergence and establishment of a specific design (David, 2001). Due to the interrelation of social and technical elements and to the (often implicit) investments made by the actors involved, in other words, at a certain point of the process a particular design asserts itself so that it becomes difficult to go back to a previous state. Such irreversibility may give rise to phenomena of *lock-in* within sub-optimal technological solutions, a canonical example of which is the diffusion of the Remington-Sholes QWERTY keyboard standard that resisted the competition of more efficient layouts thanks to the quasi-irreversibility of accumulated scale economies and network externalities (David, 1985).

However, David (2001, p. 23) specifies against critics (Liebowitz and Margolis, 1995) that the 'historical accidents' that may lead to sub-optimal equilibria are not caused necessarily by irrational behaviour of the involved actors, but rather by a lack of awareness of the effects of local decisions on the consequent evolution of technological standards[64].

In this context, it should be remarked that case research is frequently used - although not always explicitly defined so - within evolutionary models to the purpose of illustrating and exemplifying technological dynamics (see, for instance, Levinthal, 1998; Adner and Levinthal, 2001). Recently, Cattani (2006) has applied an individual, longitudinal case study approach to "identify the micro-organizational processes and evolutionary forces (internal and external to the firm) responsible for the emergence of fiber optics technology" (p. 291) at Corning.

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[63] Although the author do not mention it as a relevant influence, the emphasis laid on long waves resonates with Fernand Braudel's call for a *longue durée* (long term) perspective in history that aims to trace the long-term effects of phenomena more than the phenomena themselves.

[64] "In most cases" the innovators "can be held to have failed entirely to foresee the complementary innovations and investments that would be influenced by their initial commitment to one rather than another course of action. In other words, their failure of imagination took the form of not thinking *systemically* about the technological and industrial structures that they were engaged in developing" (David, 2001, p. 35).

3.2.1.3. Historical perspectives in social studies of technology

Despite the above mentioned points of contact, economic theories of innovation and historical studies of technology remain largely separated and non-communicating disciplinary fields, as the latter on its part has often neglected to analyze the broader socio-economic and cultural context in which technological developments take place. The prevalence of an 'internalist' approach to the history of technology was the original polemic target of Lucien Febvre, who proposed an agenda that analyzes technology through the convergence of different disciplines (natural sciences, history, economics, sociology, philosophy, psychology etc.) "around the problem to be studied" (1935, p. 535).

This has been one of the main objectives of the Society for the History of Technology and its journal *Technology and Culture*, both founded in 1959, around which a composite group of scholars has gathered. Although in an initial phase the main interests of the discipline focused on "questions that are internal to the development of technology", with "a relative neglect of problems outside the technical realm" (Bijker, 2009, p. 601), this focus has expanded over the last decades. A further element in this direction has been represented by the emergence of social constructivist studies of technology (SCoT) (Bijker et al., 1987; Bijker, 2010) and actor-network theory (ANT) (Latour, 1987; Law, 1991).

ANT stems from the observation that "the main difficulty of integrating technology into social theory is the lack of a narrative resource", thus calling for an attempt "to follow the development of an innovation" in time (Latour, 1991, p. 111). According to Latour (1987), this amounts to reconstructing the process along which scientific discoveries and technological innovations are transformed from mere 'claims' to acknowledged 'facts'. His seminal contributions (1987; 1988) underline how, in order to have their claims accepted in the community, scientists and technologists mobilize a set of resources composed both by human (colleagues, referees, sponsors, users etc.) and non-human elements (specimens, scientific instruments, laboratories, publications, financial resources etc.) that allow an original discovery or idea to resist against multiple tests of robustness. When a variety of actors align their interests with the initiators creating a stable network of associations (Callon, 1991), ideas and prototypes are thus converted into proper innovations which can thus be treated as 'black boxes' by users and other inventors.

Similarly, SCoT polemicizes with technological determinism - the view that grants agency to technologies over humans - by underlining how science and technology are not only inserted in a broader socio-economic context ('moderate' constructivism) but that they are themselves constructed through social processes ('radical' constructivism). Adopting a relativistic methodological approach, a technical artefact "is described through the eyes of relevant social groups" that "attribute explicitly a meaning to that artefact" (Bijker, 2010, p. 68) moulded on specific *technological frames*[65]. Initially, the claims uttered by different social groups regarding a specific artefact

[65] According to Bijker, the concept "is similar to Kuhn's concept of 'paradigm' with one important difference: 'technological frame' is a concept to be applied to all kinds of relevant social groups, whereas 'paradigm' was exclusively intended for scientific communities" (2010, p. 69).

are thus analyzed without "prioritising winners over losers, successful machines over failing ones, the working of technology over the non-working" (*ibidem*); in a later phase of investigation, their confrontation and stabilization in time is identified, which leads to the establishment of a specific design.

It should be remarked that, despite the terminological differences opposing constructivist studies and evolutionary models, they provide a similar account of some key aspects and phases of the innovation process.

SCoT in particular adopts an evolutionary model of variation and selection to explain how alternative technological designs and configurations are channeled into production by relevant social groups through the adoption of specific criteria of improvement (Russell, 1986). Likewise, ANT's description of the emergence of dominant technological standards as the consolidation of socio-technical networks (Callon, 1991) shows relevant analogies with the focus on network externalities characterizing path-dependence models (David, 1986; 1993; 2001).

However, SCoT and ANT challenge the of evolutionary theories' assumption of a hierarchical order between science and technology, considering them instead as twin components of inextricably techno-scientific (Latour) and socio-technological (Bijker) networks.

Moreover, SCoT and ANT are more ecumenical and flexible than economic theories with respect to the unit of analysis, as actors may indifferently include individuals, firms and institutions, whose intersecting paths can be best followed by adopting a perspectivist[66] approach (Latour, 1999).

ANT explicitly attempts to conflate the macro and micro levels into a "circulating entity" (Latour, 1999, p. 17) formed by networks that gradually stabilize without losing their local character. Consistently, SCoT has moved in time - but not replaced - its analytical focus from singular artifacts (Bijker et al., 1987), to *technological systems* including wider institutional variables (Hughes, 1983; Bijker et al., 1987), to complex *socio-technical ensembles* wherein "it is never clear a priori and independent of context whether an issue should be treated as technical or social" (Bijker, 2010, p. 67), up to *technological cultures* emerging through the mutual relations of technical and social factors.

This emphasis on the jointly technical and socio-cultural character of innovation strongly resonates with the intermingling of theoretical and technological claims in the museological debate on digitization, as it has been underlined in Section 2.6. Moreover, the attention devoted to the different perspectives of relevant social groups make SCoT and ANT potentially appropriate approaches to analyse the relations between technologists and curators in the innovation process.

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[66] Interestingly, Latour gives the methodological suggestion to "be as undecided as the various actors we follow as to what technoscience is made of; to do so, every time an inside-outside division is built, we should follow the two sides simultaneously, making up a list, no matter how long and heterogeneous, of all those who do the work" (1987, p. 175). Such perspectivism also entails a minimization of its predictive claims, as ANT emerges as "simply a way for the social scientists to access sites, a method and not a theory, a way to travel from one spot to the next, from one field site to the next, not an interpretation of what actors do simply glossed in a different more palatable and more universalist language" (pp. 20-21). However, the extent to which ANT-based empirical analyses live up to its perspectivist orientation has been questioned by Whittle and Spicer (2008).

3.2.1.4. Organizational case research on information systems

Over the last two decades, historically oriented case research strategies have also been increasingly applied to organizational studies of information systems. A seminal contribution in this sense has been provided by Mason et al., who acknowledged the introduction of digital technologies in organizations is "heavily conditioned by the historical milieu from which they emerged" (1997, p. 310). Bannister (2002) has reviewed the main methodological aspects of historical research on information systems, identifying its main advantages in the possibility to obtain "an account of important past events; use of the data collected in a process of inductive reasoning to see historical patterns; validation or falsification of existing theory and new hypotheses" (p. 7).

As Mitev and De Vaujany have recently remarked, one of the main advantages of an historical perspective on information systems is the avoidance of being "blinded by the glare of technology" and "being victims of IT fads and fashions" (2012, p. 110) in favour of "reflexivity and criticism" (*ibidem*) which may help bridge the highlighted gap between discourse and reality. Despite these potential applications, though, historical studies of information systems have represented until recently a missed opportunity (Land, 2010). Mitev and De Vaujany's bibliographic review shows that, similarly to evolutionary economic models, organizational studies of information systems have tended to adopt an historical perspective more to confirm and consolidate, than to extend or challenge established theories.

In recent years, the influence of constructivist social studies of technology has increasingly manifested itself within the historical stream. Their intersection has originated, in particular, an *emergent perspective* (Markus and Robey, 1988) which - in opposition to *technological* and *organizational imperatives,* where ICTs are viewed respectively as an exogenous force with the ability to determine organizational change and as the outcome of managerial choice - analyzes the adoption of ITs by firms as a result of the interaction between technical and organizational factors (Orlikowski, 1992; Walsham, 1997).

Under this light, Constantinidis and Barrett have conceptualized the development and use of ICTs in organizations "as the consequence of a series of decisions and interactions among different interest groups or actors in different roles within the organization or between organizations and of unintended occurrences including external events" (2006, p. 78). The authors also borrow ANT's attempt to "move [...] the level of analysis from the individual, the group, and the organizational to the network level" (p. 77), considering particularly the role of conflicts and negotiations in shaping relations of power between different stakeholders.

An element of interest is that the processual approach to technological innovation that is privileged is particularly "appropriate to understanding the long-term relationship between ICT and organizational change because the impact of ICTs continues and is more noticeable after implementation" (Constantinidis and Barrett, 2006, p. 78). This brings the emergent perspective close to Edgerton's concept of *technology-in-use*, that will be presented in the following subsection.

3.2.2. In search for a critical approach to technological innovation

3.2.2.1. Criticism to socio-economic studies of technology: 'technology in use' and the Frankfurt School

Although ANT and SCoT have contributed to bridging historical, sociological and organizational studies of technology by inspiring a number of empirical case studies, they have been recurrently questioned for not providing an adequate basis for a reflective analysis of technological innovation.

From an epistemological and methodological standpoint, Edgerton (1999) has criticized the dominant approaches to technological change for their incapability to assess deep socio-economic impacts, which manifest themselves not in the mere stabilization of networks and in the launch of innovations, but in their long-term adoption within production processes and consumption practices. In response, the author has called historians to focus on technology-in-use,[67] which entails an extension of the temporal and geographical scope of historical inquiry beyond the prevalent focus on localized inventions.

A more radical form of criticism has been addressed against SCoT's and ANT's methodological relativism, which entails an indifference not only towards the nature of the actors involved in networks, but also to the quality of their associations (Russell, 1986; Amsterdamska, 1990; Whittle and Spicer, 2008). In particular, ANT's tendency to describe neutrally the use of strategies of persuasion, corruption or coercion in order to coalesce and consolidate networks has been criticized as an implicit legitimization of Machiavellian behaviours (Amsterdamska, 1990; Whittle and Spicer, 2008). Although ANT claims to avoid any bias towards 'winners' against 'losers', for Whittle and Spicer its ethically neutral approach "actually reinforces the state of affairs that it describes" (2008, p. 622).

A similar criticism had been addressed towards SCoT's methodological relativism:

"if we accept that arguments over technological options are socially constructed, then it follows that a relativist approach with respect to them leads us into relativism with respect to social interests - in other words, political neutrality" (Russell, 1986, p. 333).

The above remarks reveal a recurrent tension opposing constructivist approaches to more politically oriented perspectives, which have their main historical reference in the Frankfurt school of social critique.

In particular, Jürgen Habermas had raised early concerns regarding the potential negative effects of a rapid technological development exclusively inspired to efficiency and productivity

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[67] To this purpose, Edgerton quotes a statement by Paul Stoneman and Paul David, according to whose "What determines improvements in productivity and product quality, thereby enhancing economic welfare and the competitiveness of firms and industries, is not the rate of development of new technologies but the speed and extent of their application in commercial operations" (p. 113). Similarly, Walter Vincenti highlights a "danger [...] that preoccupation with novelty on the one hand and undue influence from the study of science on the other could lead to a partial or faulty epistemology of technology".

criteria (1970). Although Habermas' view has been labelled by social constructivists as 'essentialist' - that is postulating technology's autonomy from society - he did not deny that "social interests still determine the direction, functions, and pace of technical progress" (1970, p. 105) but pointed out at an overextension of technical modes of acting and thinking (*technocracy*) in the Post-War society.

In this sense, his position partially converges towards the constructivist proposal to "extend the set of groups involved in political deliberation about technological choices" (Bijker, 2010, p. 72), though specifying that a mere enlargement of representation is not a sufficient condition for a participatory deliberation unless scientists are engaged in assessing and communicating the societal effects of technological development and the public opinion is capable to agree upon common criteria of evaluation.

Even this, though, could not suffice for a truly open dialogue, especially when the design of technological devices is imbued with implicit normative assumptions that are placed beyond discussion (Feenberg, 1996).

A further task that the social sciences may perform, under this light, is that of clarifying these underlying assumptions through a reflective linguistic analysis, and that of performing a 'control of results' (Habermas, 1970), or an assessment of the actual impacts of public deliberations.

These calls have been lately taken on by the emerging approach of *discourse analysis* that is reviewed in the following subsection.

3.2.2.2. Organizational discourse analysis

Recently, a critical approach to technology has also emerged within organizational studies of information systems with the purpose "to critique the *status quo* through the exposure of what are believed to be deep-seated, structural contradictions within social systems" (Orlikowski and Baroudi, 1991). In this context, the linguistic turn in the social sciences (Alvesson and Kärreman, 2000a), inspired to the work of Habermas and Foucault, has brought a new focus on the performative effects of language and discourse and their capacity to build, consolidate or challenge power relations.

Likewise to historical case research on organizations, different traditions and epistemological approaches can be identified within discourse analysis.

A 'functional' stream views discourse as a body of communicative actions that can be instrumentally mobilized by the actors in order to legitimize particular actions or outcomes (Hardy et al., 2000; Hendry, 2001), whilst an interpretive stream conceptualizes discourse as a symbolic medium that contributes to constructing socio-economic realities by moulding the actors' interpretive schemes, as in the case of organizational narratives (Law, 1994; Barry and Elmes, 1997; Cziarniawska, 1998; Dunford and Jones, 2000). Heracleous and Barrett (2001) have proposed a 'structurational' analysis of discourse that highlights the relation between visible communicative actions and underlying discursive structures - defined as "resources and rules" or "interpretive schemes" (p. 758) such as metaphors and arguments - that represent both the medium and the outcome of communicative actions.

A more explicitly critical stream, inspired by the work of Norman Fairclough (1992; 1995), analyzes language and texts as both representations and components of power relations within organizational and institutional contexts.

Fairclough uses discourse in various senses, including (1) meaning making as an element of the social process, which he also names as *semiosis*; (2) the language associated with a particular social field or practice (for instance, managerial discourse), and (3) a way of construing aspects of the world associated with a particular social perspective (2013).

At the third level, which is most analytically relevant, Fairclough underlines how the use of language and the production of texts are embedded within institutional and political structures, contributing - similarly to the functional perspective - to legitimating their authority and to constituting 'subject positions' such as social and group identities.

On the other hand, critical discourse analysis considers language as a communicative form of action that exerts indirect impacts over social practices and structures by shaping the actors' interpretive schemes, consistently with the interpretive view.

Applied to organizational and political contexts, CDA highlights how the use of language in documents and conversations affects the actions taken by a variety of stakeholders (Alvesson and Karreman, 2000b; Phillips et al., 2008; Vaara et al., 2010). However, these latter can in turn adopt different interpretation schemes to decode the texts and mobilize them for their own purposes, with the potential outcome of deviating strategies and policies from their initial objectives or resisting their implementation (Heracleous and Barrett, 2001; Phillips et al., 2008; Vaara et al., 2010). In this sense, discourse can attribute agency to actors at the same time that it constitutes them as subject: as such, a critical understanding of discourse can contribute to reveal and modify established social relations.

As Vaara et al. summarize:

> *"it is this consumption [of the text] that ultimately determines whether the 'force potential' of a text will be realized (Fairclough, 1992: 82), that is, what the text will accomplish socially: whether and to which extent the textual agency of the strategic text will be actualized, whether it will have performative effects, whether and how it will affect power relations and whether it will reproduce or transform ideological assumptions"* (2010, p. 689).

In this perspective, a thorough understanding of the power of language requires a detailed analysis of text, an analysis of the socio-economic context wherein it is constructed, and an assessment of the performative effects that it generates, in turn, on the same context.

However, CDA does not prescribe a single methodology consisting a set of precisely defined sequential steps of research, but mostly relies on qualitative methods of analysis of (written and spoken) texts collected through secondary documents and interviews, whose level of detail can range from the identification of macro structure, major themes and rhetorical strategies to the syntactical examination of single sentences. The main purpose of this analysis is to reveal the 'hidden' assumptions underlying texts and their capability to reflect power relations between socio-economic groups.

An essential feature of discourse analysis is the intertextual character of discourse, which is composed by mutually related and referring bodies of written and spoken language, across which common or differing themes can be identified depending on specific situations (Heracleous and Barrett, 2001; Goodwin and Spittle, 2002; Vaara et al., 2004).

Some applications of CDA also show a specific focus on the temporal evolution of discourse, which is investigated through longitudinal text analysis tin order to reveal shifts and clashes between multiple discursive structures (Heracleous and Barrett, 2001). In some cases, the resulting evidence is compared with the communicative patterns and social practices of different stakeholders as emerging from ethnographic observation (Heracleous and Barrett, 2001; Vaara et al., 2010).

Although, to the current date, CDA has mostly adopted the organization as a unit of analysis, being often embedded within longitudinal case studies, its conceptual view and instruments have their origins in the analysis of public policies, as will be shown in the following subsection.

3.2.2.3. Policy analysis: discourse and 'reality check'

Over the last decades, public policies have emerged as a particularly fertile field for the application of discourse analysis.

Bacchi has considered policy discourse as a representation of problems to be solved, which defines and limits the possible solutions considered for implementation (Bacchi, 2000; 2009). Consistently, the author (Bacchi, 2009) has challenged dominant evidence-based approaches to policy-making by proposing a 'problematization of problems' as represented in the policy discourse. However, this type of analysis has a limited focus on the phase of policy formulation, without considering the broader context wherein this occurs nor the consequent phase of implementation.

From a specifically methodological standpoint, Yanow (2000) has proposed an hermeneutic epistemological framework for policy analysis that, differently from quantitative techniques of evaluation such as cost-benefit analysis, is situation-specific and capable to highlight the role of meaning in guiding policy actions. The author suggests a four-step research strategy based on the identification of "relevant policy artifacts (language, objects, acts) that are carriers of meaning for policy issues"; an identification of the "communities of meaning/interpretation/speech/practice that are relevant to the policy issue under analysis"; an identification of the relevant discourses and "their specific meanings being communicated through specific artifacts and their entailments (in thought, speech and act)" and, finally, an identification of "the points of conflict and their conceptual sources (affective, cognitive and/or moral) that reflect different interpretations by different communities" (p. 22). The main data sources used are official documents, media coverage of policy debates, interviews with the relevant actors and participant observation.

Such hermeneutic focus on the multiple interpretive frames held by the stakeholders involved in deliberative processes has been integrated by Fischer (1985; 2003) with Habermas' pragmatic analytical framework of argumentation in public contexts. According to the latter, policy debates can be considered a combination of three types of discourse: a moral/normative one based on the interpretation of social norms and values, an ethical one focusing on the question of 'good life' for

the community, and an empirical one resting on statistical inductions, each characterized by specific validity claims and horizons of agreement (the former two at least potentially aim to universal consensus, whilst the last relative to group-related particularities). Fischer expands and applies this analytical framework in order to assess the logical coherence and dialectical adequacy of policy arguments, with the aim of facilitating the communication between policy analysts and the social groups relevant for deliberation. To this purpose, he proposes a discursive model that integrates empirical findings within normative questions in four phases that range from the micro dimension of policies - i.e. their specific action setting - to the broader social system wherein they are inserted (1985; 2003, pp. 187-201). Specifically, a first order of analysis concerns the technical valuation of policy objectives and the validation of their relevance for the concrete policy situation, whereas the second layer addresses the impacts of the policy on the societal system as a whole (*societal vindication*) and the evaluation of the normative values underlying the social order at play (*ideological choice*). Consistently with Habermas, this latter discursive phase aims to combine normative reflections and empirical evidence for selecting the social order that enables to solve existing value conflicts and that best corresponds to ideals of rationality and 'good life'. In this context, the task of "comprehensive-critical evaluation" is "to make explicit" the policy assumptions that "generally serve as part of the background consensus and are called into question only during disputes [...] through a progressive critique extending from validation to ideological choice (or from validation to ideological choice)" (Fischer, 2003; p. 195). However, policy evaluation can start at any of the four steps depending on the particular policy at issue and the related debate.

Post-structuralist or hermeneutic approaches to policy-making have been questioned for paying little attention to the material character of the socio-economic relations wherein discursive action is located and which influence the communication process.

To this purpose, Jessop (2004; 2010) has advocated a *critical political economy* (CPE) approach that combines a semiotic inquiry of policy discourse with an institutional analysis of the political economy. Although rejecting the "universalistic, positivist account of reality" (2004, p. 160) of orthodox political economy, CPE also differs from post-structuralist discourse analysis (Yanow, 2000; Fischer, 2003) as it sees semiotic elements as dialectically related with "the constraints and affordances of the material world" (p. 162) and embedded in networks of socio-material relations. Under this light, Jessop considers policy discourse as the semiotic creation of economic 'imaginaries' that orient regulatory actions and strategic projects (Jessop, 2004; 2010). Under this perspective, both semiotic and material factors guide an evolutionary process of selection - at a local and/or global level - of particular discourses "for interpreting events, legitimizing actions, and (perhaps self-reflexively) representing social phenomena" (Jessop, 2004, p. 163), their retention or enactment into practice and their reinforcement or stabilization[68]. The approach is exemplified through an analysis of the emergence and establishment, among alternative discursive objects, of the knowledge economy as the dominant imaginary for a Post-Fordist future due to its capability to reflect, on one hand, ongoing processes of technological nature and, on the other hand, to legitimate "a neo-liberal

[68] A significant weakness in Jessop's evolutionary framework is that it starts with the selection phase, without describing nor explaining the emergence of multiple alternative discourses.

policy for productive capital that safeguards US superprofits behind the cloak of free trade in intellectual property and so complements its neo-liberal policy for financial capital" (p. 166).

Adopting a more moderate position, Paul (2009) reconnects with post-structuralist epistemology to discuss the relation between discourse and institutional practice, with reference to the 'Europeanization' of national policies (Paul, 2012) - or "the process in which transnational meanings are allocated to 'social and physical phenomena'" (2012, p. 551), which aggregate around "integrative nodal points" (p. 552) and are translated into specific institutional arrangements and practices.

Most recently, Fairclough (2013) has intervened to synthesize the epistemological links and differences between critical discourse analysis, post-structuralist approaches to discourse (Fischer, 2003; Bacchi, 2009) and CPE (Jessop, 2004; 2010). Specifically, CDA differentiates from post-structuralism in which it adopts a critical realist rather than an interpretive perspective. Consistently, CDA lays more emphasis on the relation between discursive and material structures: for instance, whereas CDA agrees with post-structuralism that "problems are constructed in thought", it stresses that "the 'difficulties' they problematize are produced by material processes and [...] some problematizations capture these difficulties better than others" (p. 186). Under this light, the distinctive purpose of CDA is to combine negative critique - consisting in a "normative evaluation of arguments" (p. 187) that leads to alternative problematizations - with positive critique - that consists in the imagination of alternative desirable goals and means to achieve them.

Compared to the broad analytical scope of CPE, CDA tends to focus on the analysis of specific bodies of texts in particular contexts but is faced with the problem of how to generalize from them. As such, it can be usefully embedded within CPE, contributing in turn to grounding its generalizations within the analysis of concrete realities.

It can be noticed that, besides Jessop's (2004) contribution, a small body of literature has analyzed Information Society and Knowledge Economy policies as a particular form of discourse that not only reflects, but contributes to establishing relations of power between different actors (Garnham, 1994). In particular, Goodwin and Spittle (2002) have applied CDA to assess the role of strategic documents in shaping, circumscribing and orientating the European policy debate on the information society. However, their analysis has stopped short of assessing discourse against the actual structure of policies (e.g. in terms of stated objectives, funding mechanisms, etc.) and their implementation.

Servaes (2003) has gone further into a critical direction by proposing a 'reality-check', that is an evaluation of the claims made by European policy statements regarding the Information Society against empirical evidence of the effects of their implementation.

Table 10: Main characteristics of the methodological approaches reviewed.

Main characteristics	Managerial case study	Evolutionary models of technological innovation	Social studies of science and technology (SCoT-ANT)	Organizational case research of information systems	Discourse analysis in organizations and policy
Analytical levels					
Micro (es. firm)	**X**	**X**	Conflation of micro and macro levels	**X**	**X**
Meso (es. network)	**X**	**X**		**X**	
Macro (es. public policy, innovation system)		**X**			**X**
Role of history	Key to understanding the context and temporal chaining of events	Timeline for technological evolution; role of institutional factors	Narrative strategy for illustrating the process of enrolment-translation	Contextual factor for the introduction of IS	Unfolding of discursive structures and their performative effects in time
Main epistemological perspective	Interpretivism; Critical realism	Evolutionism (biology)	Constructivism; methodological relativism	Interpretivism; Critical realism	Interpretivism; Critical realism

Source: Author's elaboration.

3.3. Research strategy

In order to contribute filling the main research gaps identified in literature, the present analysis aims to provide an historical, context-specific analysis of the digitization of cultural heritage.

To this purpose, a double-layered research strategy is adopted which explicitly analyses, on one hand, the policy context wherein digitization initiatives take place and, on the other hand, how these contextual factors are realized in the local experiences of individual heritage institutions.

3.3.1. Analysis of digitization policies

The first layer of research consists in an analysis of digitization policies in Canada and Europe, which can be deemed as particularly relevant cases since they represent respectively the first historical attempt to enact a coordinated national policy of automated cataloguing and digitization of museum collections (1971), and the largest initiative of digitization currently underway within the global scenario. Besides addressing the absence of literature on digitization policies in the cultural sector, this analysis contributes to compensating a general lack of appreciation for the historical, socio-economic and political contexts wherein different initiatives of digitization are rooted.

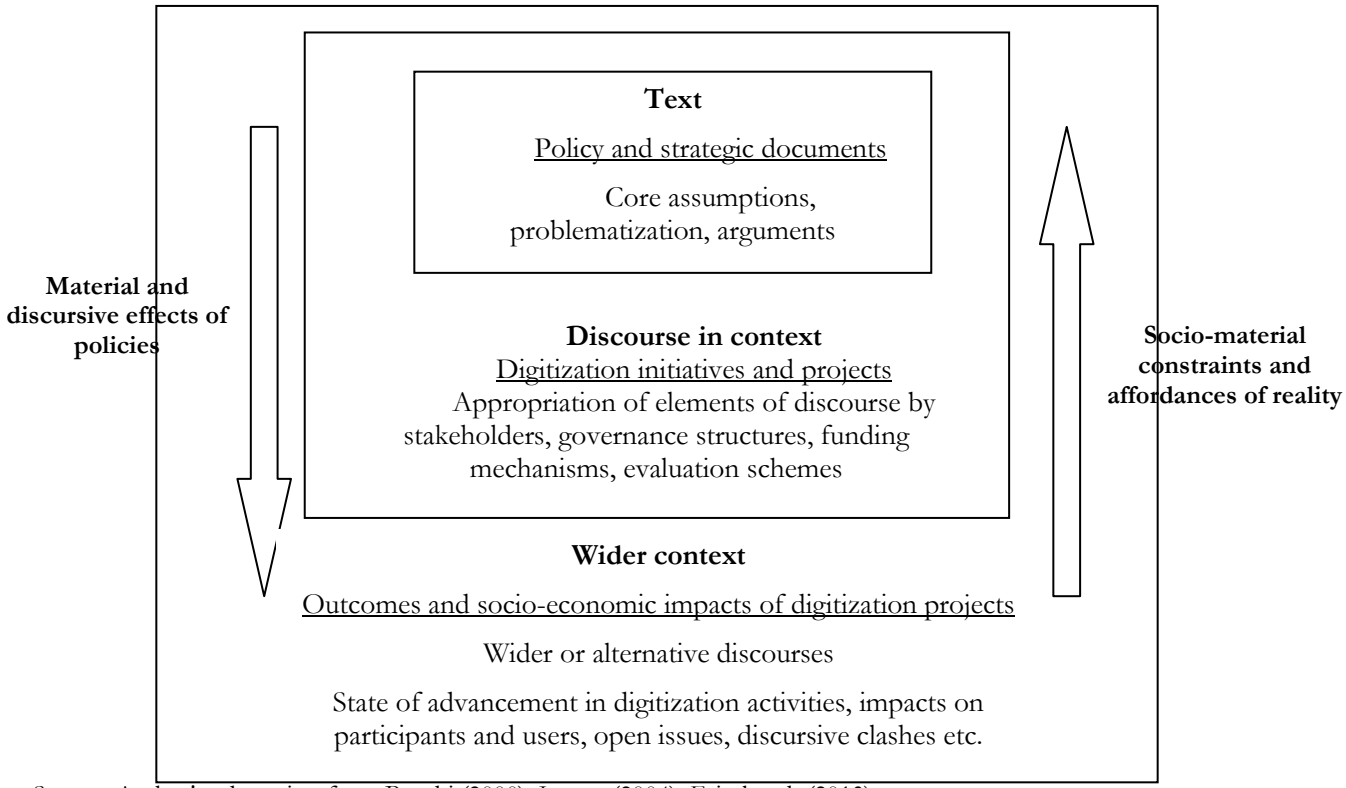
From a methodological standpoint, policy analysis is articulated into three analytical layers (see FIGURE 4).

At an inner level, discourse analysis is applied to key policy documents through an interpretive text and inter-textual examination, with the purpose of identifying the main assumptions, arguments and claims used to construct policy problems and issues, as well as variations in the former across different phases of the same policies. The methodological approaches combines the contributions of hermeneutic approaches focusing on problematization (Bacchi, 2009) and practical argumentation in policy-making processes (Fischer, 2003) with those of critical discourse analysis (Fairclough, 2013).

At a second level, the discursive structures and patterns so identified are compared with their enactment and implementation, through the analysis of actual digitization initiatives and their main characteristics (coordination and governance structure, funding mechanisms, role of stakeholders and business models). This approach is consistent with Fairclough's (1992; 2013) and Jessop's (2004) conceptualization of a dialectical, mutually constructive relation between text and context and with their attempt to integrate post-structuralist approaches focusing on problem-setting (Bacchi, 2000; 2009; Fischer, 2003) with a critical-realist analysis of the problem-solution nexus (Fairclough, 2013).

As a third and final stage, an attempt to analyse the wider socio-economic impacts of digitization policies is made on the basis of the availability of secondary data. This type of analysis is based on Servaes' notion of a 'reality check' (2003) of the assumptions and arguments of Information Society policies.

Figure 4: Extended model of discourse-centred policy analysis.



Source: Author's adaptation from Bacchi (2000); Jessop (2004); Fairclough (2013).

In order to reconstruct the history of public policies for digitization, both secondary and primary sources were collected and analyzed. However, a rather unbalanced situation between the two case studies was identified: whereas a large mass of legal and project documents could be retrieved concerning European policies (recommendations and communications, policy statements and reports, strategic plans, institutional web pages etc.), a lower mass of relevant documentary sources was identified in the Canadian case, especially concerning the initial phases of the digitization of artistic and archaeological heritage (1970s and 1980s). In order to integrate secondary information, semi-structured interviews of about 1 hour were conducted with 4 officers of the Canadian Heritage Information Network endowed with relevant expertise and historical memory in specific areas of digitization policies (program coordination and analysis; investment programs; content management) in June-July 2013. A draft version of the chapter was submitted to the informants, whose comments were screened and included in the final version.

As regards Canadian policies for the digitization of documentary heritage, wherein a key role has been played by a Federal institution (Libraries and Archives Canada), access to informants was impossible due to a code of conduct which restricted the staff's freedom to diffuse sensitive information on digitization policies. As a consequence, the history of digitization policies and the related public debate were reconstructed respectively through strategic plans and secondary sources (online press articles, public statements of stakeholders, web pages and blogs administered by relevant stakeholders etc.). In this case, policy analysis thus comes to coincide with a longitudinal organizational case study that applies discourse analysis to strategic documents and to the viewpoints of the stakeholders involved (Heracleous and Barrett, 2002; Doolin, 2003).

3.3.2. Case research

The second layer of the analysis is represented by a comparative case study of the experiences in digitization of two representative heritage institutions in Canada and Italy.

The research sites selected are the Uffizi Gallery in Florence, where digitization strategies mostly concerns the implementation of digital collections (see Section 2.1) and mobile applications (see Section 2.5), and the Pointe-à-Calliére Museum of Archaeology and History in Montréal, where digitization is conceived in broader terms including the design of immersive multimedia applications and interactive exhibits within the permanent exhibition (see Section 2.4). Research sites were selected both on the basis of their accessibility to investigation and to their capability to provide insights about differentiated forms and aspects of technological innovation. In particular, Pointe-à-Calliére provides insights about the dynamics of inter-disciplinary collaboration and knowledge transfer involved in the design of technologically-advanced onsite applications (see Section 3.1.2), whereas the Uffizi Gallery offer a privileged point of observation over the issue of business models (Section 3.1.1) and the challenge of public-private partnerships for digitization (see Section 3.1.2).

To this purpose, a longitudinal approach was adopted to analyse digitization strategies in their historical origins and development, extending the prevalent focus from the implementation phase to the long-term use of ICT (Constantinidis and Barrett, 2006; Mitev and De Vaujany, 2012).

Consistently with the emphasis posed both by constructivist (Callon, 1991; Bijker, 2010) and emerging (Mason and Robey, 1988; Orlikowski, 1992; Constantinidis and Barrett, 2006) perspectives on the interactions among different interest groups or actors within the innovation process, moreover, an interpretive discourse analysis of written (internal documents; publications; institutional communication etc.) and oral (interviews) texts was used to identify and compare the viewpoints of the stakeholders involved (managers, museologists and technology developers) upon the functions, goals and meanings of digitization (Heracleous and Barrett, 2001; Phillips et al., 2008; Vaara et al., 2010).

As regards the relations between theory and empirical evidence, an abductive approach (Dubois and Gibbert, 2010; Jarvensivu and Tornröos, 2010) was applied wherein theoretical reflection constantly interacts and evolves simultaneously with the results of empirical observations.

At Pointe-à-Calliére, 1 semi-structured interview was conducted with the Head of the Exhibitions Department, 2 with independent historians and museologists involved in the definition of the contents of the multimedia theatre show, and 2 interviews with the project managers of the external technology contractor involved in the design of the show. The interviews were held between November and December 2012.

At the Uffizi, 2 interviews were conducted in June 2012 and March 2013 respectively with the technologists at the University of Florence who collaborated with the museum in the first phase of digitization (late 1980s-1990s) and with the main external partner since the 2000s. An interview with the Director of the museum was also conducted in October 2013.

3.3.3. Limitations

Besides the issue of generalization from case studies, the main limitation of the research strategy adopted stems from a lack of opportunities to collect data on users of technological applications. Whereas an online survey of users of digital collections at the Uffizi and the Virtual Museums of Canada was initially envisioned, it was not possible to obtain the institutions' cooperation to this type of research. This represented a relevant obstacle towards data collection, since collaboration with museums is highly recommendable for administering online surveys, in which case the most efficient means of collecting data is to insert a link to the questionnaire on the museum website (Marty, 2007; 2008; 2011).

As a result, it was not possible to collect primary evidence on the patterns of demand for cultural heritage, which prevents the present work from addressing the questions at Section 3.1.3 and limits a critical examination of the arguments and claims associated by the stakeholders to digitization initiatives. Only in the case study of Pointe-à-Calliére, secondary data sources were collected as a partial integration by performing a qualitative text analysis of visitors comments posted on TripAdvisor (Section 5.5).

4. Policies for the digitization of cultural heritage in Canada and Europe

In the present section, the public policies for digitization enacted by Canada and the European Union will be reviewed according to the methodological approach identified at Section 3.3. As a relevant case within the wider European scenario, a particular focus will be laid on the Italian context.

In the case of Canada, policies for the digitization of artistic and archeological heritage will be reviewed separately from those relating to librarian and documentary heritage, as they have been the target of different initiatives with specific characteristics. Differently, since the two typologies of cultural heritage have been jointly addressed by European policies, they will be presented and discussed in the same subsection.

4.1. Artistic and archaeological heritage

4.1.1. Pioneers of automated cataloguing

Canada has a vast geographical extension with a low population density, wherein different ethnic and cultural constituencies co-exist. The first Francophone settlements in the East territories dating to the 17th century were included, since 1763, by the Anglophone majority settled in Ontario and the Western Provinces, whilst aboriginal communities belonging to the First Nations remained scattered all over the territory. These main ethnic constituencies have been integrated, since late 19th century, by several waves of immigration from Europe, Africa and Asia. The current result is a diverse and multicultural fabric, where the high level of integration is confronted with recurrent independentist pressures in Québec.

In this context, the intention to build cultural bridges across distant territories and to preserve the country's cultural identity from the influence of the powerful neighbour - the United States - have historically featured among the main objectives of Canadian cultural policies throughout the 20th century (Audley, 1994; Volkerling, 2001). Consistently, Canada has been one of the leading countries in acknowledging and embracing the potential of new information technologies for the preservation and communication of cultural heritage since the early 1970s.

A first encouragement towards a more systematic collection of information on cultural objects for mapping and preservation purposes was provided by the adhesion of Canada to the UNESCO Convention on the Safeguard of Cultural Heritage of 1972. In the same year, the National Museum Policy (Auditor General of Canada, 1981) was launched with the purpose of reinforcing the identity of Canada building on the common - though composite - cultural heritage. The creation of a computerized inventory of cultural and scientific collections was promoted through the National

Inventory Programme (NIP), which initially involved the 5 national museums[69] and was later extended to all the heritage institutions in the country. To this purpose, a data dictionary was defined which could adequately describe not only the characteristics of the cultural artefacts, but also the related activities conducted by the museums such as acquisition, loans, restorations and de-accessioning. This information would be thus be inserted into a centralized retrieval system which could be accessed through computer terminals located at each institution. The planning and technical development of the project was assisted by a multi-disciplinary Advisory Committee formed in 1973 to ensure the representation of the museum community.

The first attempts to implement a "rational and workable system of documentation" (Homulos, 1978, p. 158), though, confronted themselves with the existence of variable, idiosyncratic cataloguing practices across individual museums and even within single museum departments - as underlined by Parry (2007) - which caused inconsistencies "in the terminology used and the depth of detail recorded" (*ibidem*). As a solution, classification codes were defined so as to be "similar in structure and content to the typical museum card" (Homulos, 1978, p. 155) and a flexible database management system was developed which accommodated discipline-specific lists of fields reflecting "the different interests of the various museum disciplines" (*ibidem*).

Initially, museums submitted information to the central offices in paper forms or cards, where they were preliminarily checked against the correspondent disciplinary lists of categories. A specific database for each museum was thus created and coordinated with the other through a bilingual information retrieval system. The latter contained some advanced features for the time, such as the possibility to perform keyword-based search through different categories. Subscribing museums could access the central system to print data on their own catalogue cards and reports.

Due to the limitations of the hardware and of the human resources allocated to data entry and information retrieval procedures, though, the system was incapable to cope with multiple requests for processing new documents, updating existing records or printing specialized reports at one time. This was also an unanticipated consequence of the initial assumption that "database updates would not be required with great frequency" (Homulos, 1978, p. 157), which was contradicted by evidence that, as museum professionals became aware of the possibilities afforded by the computer system, they gradually increased their demands and expectations for data entry and management services. As a result, the NIP started rejecting new membership requests in 1978.

Moreover, because the museums did not have comprehensive inventories of their collections at the time, it proved impossible to estimate the total number of objects to be catalogued and the size of the resulting database, thus preventing the implementation of a work schedule. In order to address these issues, a change of the hardware and software was approved by the Board of Trustees in 1981 but in the same year a Report by the Auditor General of Canada recommended that

"before making a major investment in new data processing methods and equipment, the National Museums of Canada should undertake a comprehensive feasibility study of the whole National Inventory program. This study should include

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[69] Namely the National Gallery of Canada, the Canadian Museum of Civilization, Canadian Museum of Nature and the National Museum of Science and Technology.

identifying the program's scope and extent and available alternatives, analysis of costs and benefits, a proposal for the preferred option, and a complete implementation plan" (Auditor General of Canada, 1981, 11.68).

However, the NIP (which in 1987 was re-named as CHIN - Canadian Heritage Information Network) managed to resolve these issues through a gradual decentralization of its activities. Since the early 1980s, provincial museum associations were involved in digitization policies by providing museums with technical assistance and expert advice on the acquisition of hardware and software and the adoption of cataloguing standards. This support proved especially valuable for small-sized community museums that could not afford hiring or outsourcing qualified IT skills.

In the same period, as the first commercial database management systems started being distributed on the market, CHIN published comparative evaluation reports and developed a toolkit that enabled museums to compare different software packages against a checklist of criteria in order to assist them in the choice. Thanks to these initiatives, museums were helped establish an efficient set of instruments and an adequate basis of knowledge in order to perform autonomously data maintenance and update tasks.

The National Inventories project resulted in the creation of three separate inventories of collections belonging respectively to the Humanities, the Natural Sciences and Archaeological Sites. The latter, though, was later discontinued due to a decrease in interest and funding on part of Provincial administrations, although some of these continued to maintain their own regional inventories.

4.1.2. The shift to public access

Since the late 1980s, CHIN began to work with the heritage community to assess the potential of new technologies for disseminating collection-related information.

Experiments in the release of information on new CD-ROM and CD-I formats were conducted at National Museums (Alsford and Granger, 1987), allowing the participants to establish competences and experience in the emerging field of multimedia publishing. In the same period, some institutions also ventured into the proper digitization of artefacts - that is the acquisition of 2D images in digital format through photographic devices.

These innovations fostered a major changed in policy priorities, whose focus shifted from the creation of central information repositories targeted to the research and academic community, to the dissemination of cultural contents towards the general public. Such transition was significantly accelerated by the growing political influence of the Information Society discourse, which fostered the discursive reconfiguration of Canadian museums as 'information utilities' (MacDonald and Alsford, 1991) and provided an argument for public funding to digitization projects. In particular, the potential of new communication networks was welcomed as a means for increasing access to Canadian cultural contents - thus showing a prompt reception of the democratization claim (see Section 2.6) - and for improving the country's identity and profile on the Internet.

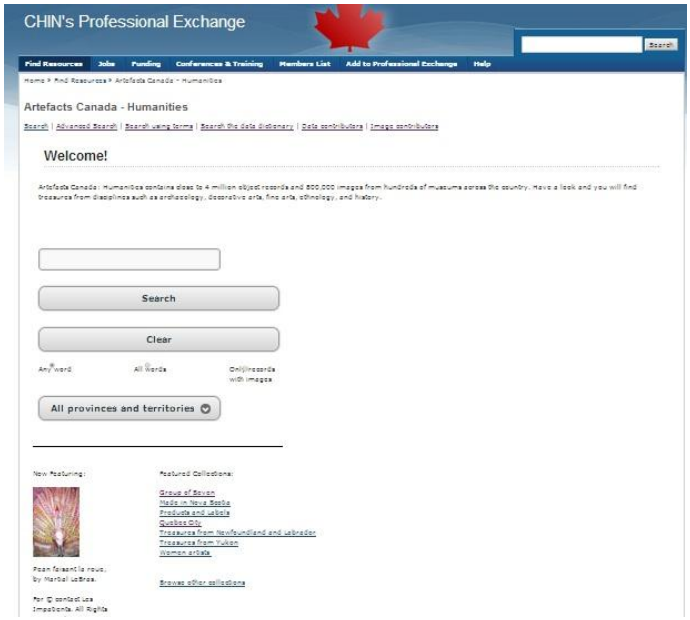
These arguments were explicitly stated by the *Ninth Report of the Standing Committee on Canadian Heritage* (1999):

"A notable feature of new technologies is that they allow individuals to visit galleries, archives, museums and libraries without leaving home. With a personal computer, Canadians who might not visit a library, archive, gallery or museum can do so via the Internet or a CD-ROM. This represents an opportunity for heritage institutions to reach a new audience, and to generate revenue from sales. It is now possible for images from Canadian galleries, museums and archives to be distributed as multimedia. Online sources or access through consumer products such as CD-ROMs are becoming a low-cost and convenient way to view collections. Another possible by-product of Internet access is increased attendance at cultural venues since viewing a collection online may foster the desire to visit a heritage institution" (Standing Committee on Canadian Heritage, 1999).

Against this background, in 1995 a major review of CHIN's scope and activities was undertaken in consultation with the heritage community, resulting in a re-definition of the institution's mission as to "broker effective access to Canadian and international heritage information for public education and enjoyment, and for the collective benefit of Canadian museums" (CHIN, 2012).

To help this transition, all of CHIN's products and services, that were previously accessible only through a dial-up subscription from contributing museums, were made available on a Professional Exchange section hosted on the new institutional website. In 1999, the National Inventories were renamed as Artefacts Canada and integrated into a web-based platform, providing researchers with the possibility to consult a database of over 4 million records of cultural objects through free text and field-based search functions.

Figure 5: Homepage of the Artefacts Canada portal.



Source: CHIN website.

In 1999, the General Governor's Speech from the Throne anticipated the Federal Government's decision to open a second web-portal of digital collections targeted to the general public, with the aim of reinforcing the country's common identity in diversity:

"The strength of Canada is reflected in its rich diversity. Across this country, Canada's culture comes alive through our writers, singers and performers, through our filmmakers and artists, and through those who chronicle our history and preserve our heritage.

New technologies offer new opportunities to strengthen the bonds between Canadians. The Government will bring Canadian culture into the digital age, linking 1,000 institutions across the country to form a virtual museum of Canada" (Governor General of Canada, 1999).

After a process of consultation with 160 institutions, the Virtual Museums of Canada (VMC) were thus launched in 2001 to provide access to images-supplied records by utilizing the same search engine of Artefacts Canada. The first version the VMC included six sections: an Image Gallery which provided access to 200,000 Artefacts Canada records supplemented with images; a series of virtual exhibitions produced by member institutions, presenting digitized cultural objects in a thematic fashion; a museum search engine; an online Boutique; a Send a Postcard section through which users could send promotional images from virtual exhibitions to friends.

In this phase, the main source of public funding for the digitization of cultural heritage was provided by the Canadian Culture Online Program (CCOP) of the Federal Department of Canadian Heritage, originally launched in 2001 and renewed in 2006 and 2009.

Centred upon three objectives (supporting the creation of digital cultural content that reflects diversity of cultures and heritage; help to ensure access to that content; facilitate the sustainability of the new media cultural sector), the CCOP financially supported the digitization of existing artefacts and the creation of digital-born contents through an annual competitive call for proposals. The selection of the projects was assisted by an Advisory Board including composed of industry experts.

The programme included two specific funds (Partnerships Fund and Canadian Memory Fund) addressed to digitizing respectively the holdings of Provincial, municipal and local cultural institutions and those of Federal cultural institutions - including libraries, archives and broadcasting companies - in the form of virtual exhibitions. A further stream expressly dedicated to the development of the VMC which was directly managed by CHIN. In this context, a transversal priority was devoted to the digitization and dissemination of cultural contents in French - which were found to be outnumbered by Anglophone ones - or related to aboriginal communities (Bairstow, 2004).

Although a separate stream was targeted at Research and Development in the new media industries, a cross-sector approach was adopted to foster creative partnerships and collaborations between diverse actors and stakeholders such as technology developers, broadcasting companies and cultural institutions, aiming to the development of interactive products and services (Bairstow, 2004).

In the 2001-2007 period, the Partnerships Fund received 34,9 million CAD (out of an overall budget of 340 million) that were allocated to 121 projects and the Canadian Memory Fund over 80 million for 556 projects, whereas the VMC received a total of 43,6 million CAD distributed among 432 projects (Canadian Heritage, 2008).

These initiatives were marked by a good interest on part of the public: in its inaugural year of activity, the VMC portal attracted almost three million visits from more than 140 countries, which increased constantly until reaching a total of 12.5 million single visits and an average of over 500,000 single visitors in 2008 who spent about 7 minutes at the portal (Canadian Heritage, 2008). In the same period, CHIN's membership increased from 600 to 1,300 institutions (Canadian Heritage, 2008, p. 37).

The portal was then enriched with additional sections and functions along the following years.

In 2006, a Knowledge Exchange section was opened to provide partner institutions with guidelines and assistance on classification and indexing standards, digital asset management and preservation.

In 2007, a Teachers Centre was introduced to provide access to learning materials, whilst in 2009 the graphic aspect of the portal was completely redesigned. Within the renovation project, a special section My VMC has been also included, which enables online visitors to create their personal collection by selecting or bookmarking items from the virtual museum and sharing on social networks (Facebook, Twitter, MySpace) (CHIN, 2011).

As to the end of 2011, the VMC collected 830,000 objects supplied with images - which represents a subset of Artefacts Canada's nearly 4 million records - in addition to over 600 virtual exhibitions and 1,480 learning objects (CHIN, 2011).

The Professional Exchange section of CHIN's website provides advice and reports on digitization - either produced in-house or by member and partner institutions - focusing on technical aspects (see for instance CHIN, 2009a; 2009b), training (Duff et al., 2009), collections management (Green, 2010) and audience development (Soren, 2005).

4.1.3. Current challenges: desperately seeking sustainability

In 2008, an evaluation study of the Canadian Culture Online Programme conducted through consultations with relevant stakeholders highlighted some shortcoming in the strategy (Canadian Heritage, 2008).

In particular, the interviewed cultural institutions in the audiovisual sector expressed dissatisfaction with the Canada Memory Fund for favouring the realization of virtual exhibitions, identifying instead mass digitization of the collections as the main priority (Canadian Heritage, 2008)[70]. Moreover, Canadian museums were reported to lag behind other countries in the use of

[70] Incidentally, the report confirms the dialectics of compatibility/incompatibility of digitization that has been described at Section 2.1.1:

digital technologies and to be delayed in the digitization of the collections by lack of funding and the complexity of copyright management.

In reverse, the VMC received consistent support by the museum community besides the appreciation of the general audience[71], whereas the 92% of the interviewed cultural institutions stated that had they not been funded by the VMC stream, digitization projects would not have been carried out. Moreover, the participation to VMC's calls had positive indirect effects in capacity-building and networking, especially with web design firms (Canadian Heritage, 2008).

As a result, although the CCOP as a whole was not extended after fiscal year 2008-2009 - with the exception of the fund dedicated to new media industries that was renewed for 2 further years - dedicated funds to the VMC continue being provided by CHIN through two schemes: the Virtual Exhibitions Investment Programme and the Community Memories Program.

The former issues an annual call for the realization of thematic virtual exhibits and tours to be inserted in the VMC Gallery and learning materials to be made available in the Teaching Centre (CHIN, 2013b). The proposals are evaluated by an Editorial Board comprised of representatives from the museum community, as well the publishing, education, library, and new media sectors (CHIN, 2011). In the 2008-2011 period, 31 virtual exhibits were approved and launched with an yearly budget of 1,6 million CAD. Since 2013, a thematic stream focusing on a list of identified commemorative events related to Canada's sesquicentennial in 2017 has been opened, but museums can continue submitting proposals on subjects of their choice.

The technical requirements for realizing virtual exhibitions are particularly challenging, as a high level of data coding is needed and CHIN is currently promoting a transition to Html5 language and mobile optimization: due to this complexity, the participant institutions are encouraged to resort to specialized IT firms for their implementation.

The Community Memories Program is specifically targeted to small community museums, defined as those having five full time paid employees or less. The scheme supports the realization of thematic multimedia online exhibits about "the events and the people that shaped a community", in order to "create a national online portrait of Canada's history by connecting individual local histories" (CHIN, 2013c). In this case, the selected institutions are provided with a software package for facilitating the creation of image galleries. Between 2008 and 2011, 149 proposals have been approved with an annual budget of about 150,000 CAD.

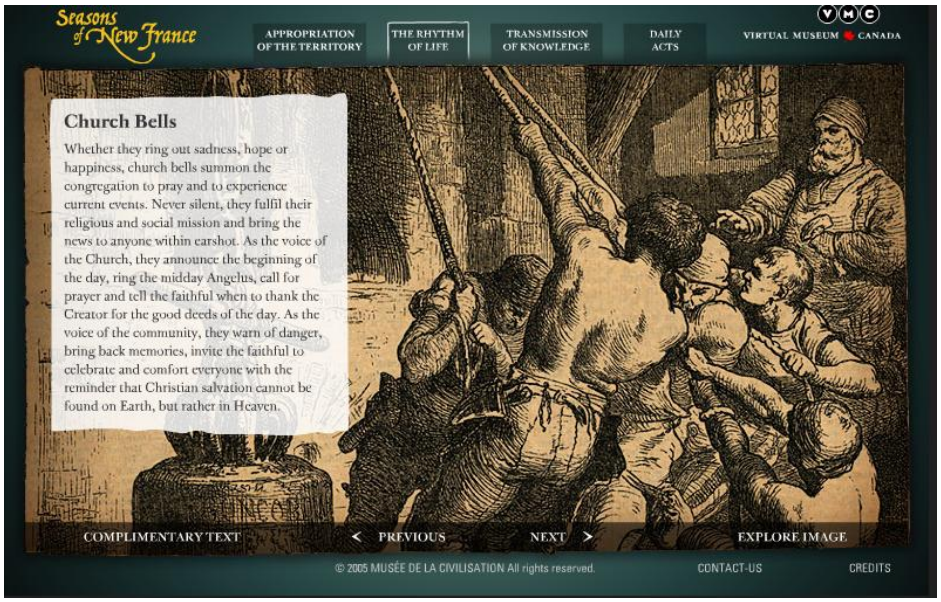
A limited number of virtual exhibitions are also developed directly by CHIN's staff (CHIN, 2011).

"Going back to the late 1990s [...] there was a concern that the advent of online virtual exhibits was a "threat," as they might take away visitors to their physical locations. Today, most observers believe that websites and other digital technologies can enhance a museum's "brand" and overall success. [...] Note, however, that there was a strong minority opinion from the museum community, which states that a virtual experience will never replace "being there" [...]. Thus they questioned the merits of spending scarce government resources on creating virtual exhibits" (p. 18).

[71] A POR survey mentioned in the report highlighted that the 64% of the users were satisfied with the VMC portal (Canadian Heritage, p. 36). A case of successful project mentioned in the report is the virtual exhibition "A Journey to a New Land" realized by the Simon Fraser Museum of Anthropology and Ethnology for the VMC, which had reached a total of 5,064 unique users in March 2008 who spent an average of 3:13 minutes on the site (Canadian Heritage, 2008, p. 30).

Consistently with the Canadian Culture Online programme, thus, the realization of online exhibitions continues representing to the current state the main opportunity for museums to digitize materials in analog format and make them accessible to the audience, whilst engaging in the creation of interpretive contents.

Figure 6: screenshot from the 'Seasons of New France' virtual exhibition (Canadian Museum of Civilisation, 2005).



Source: VMC website.

Additional sources of funding are represented by programmes that are not expressly targeted at digitization goals. The most important one is the Museum Assistance Programme administered by the Department of Canadian Heritage (Canadian Heritage, 2012), which supports heritage institutions and workers in the preservation and presentation of heritage collections through an annual call for proposals that includes a 'collection management' axis offering support to the adoption or update of collections information systems and storage solutions.

A further - though indirect and limited - public funding source is represented the training programmes offered by provincial museums associations and Federal departments, wherein a small number of objects are digitized. In particular, CHIN is attempting to establish synergies and collaborations with the Canadian Conservation Institute - a Special Operating Agency of the Department of Canadian Heritage that promotes the care and preservation of Canada's cultural heritage by offering cultural institutions a range of services - which offers cultural institutions courses and workshops on the digital photographing of artworks for preservation purposes (CCI, 2013). Moreover, CHIN is trying to integrate its own courses into the training programmes supplied by provincial associations, provincial administration and academic institutions.

However, the interviewees have acknowledged that these funding sources in total do not seem to represent an adequate financial basis for the mass digitization of cultural collections.

In this sense, attempts have been made to encourage the attraction of private donations or foundation grants through matching fund programmes, as is characteristic of the US model of digitization (Zorich, 2003). Notwithstanding the relevant results obtained in some Provinces - such as British Columbia, where the University has launched in 2006 the BC History Digitization Program - the implementation of public-private partnerships has been highly uneven across the national territory.

Individual institutions, especially of national relevance, have also attempted to commercially exploit digital collections through licensing schemes, in order to cover the costs of ongoing digitization projects.

To this purpose, a study issued by CHIN (1999) had envisioned broadcasting and publishing as the main target markets for digital heritage and media contents, whilst advertising and corporate markets were deemed less promising due to their relatively low interest in the provenance and integrity of the contents and their demand for quick copyright-clearing services. The possibility of licensing contents to the educational community was excluded, as it was likely to arouse conflicts with museum researchers.

Attempts to put the guidelines in practice, however, were confronted not only with relevant investment in the acquisition of high-quality photographic equipment and the recruitment of specialized staff, but overall with the complexity of copyright management activities, which substantially reduced the operating margins available to heritage institutions. To this purpose, CHIN has engaged in providing institutions with guidance on copyright clearing and licensing issues (Green, 2010).

As regards intellectual property management, contributing institutions maintain their rights over the objects and data uploaded on Artefacts Canada and VMC, which are provided in low resolution. CHIN also requires its partners to allocate specific resources to copyright clearance in the budget submitted when participating to the Virtual Exhibitions Investment Programme's call. This provides the institutions with an opportunity to negotiate or re-negotiate their rights of utilization for a limited period (virtual exhibitions are generally reviewed over 3-5 years, and either discontinued or renovated).

Figure 7: Screenshot from the virtual exhibition 'The Photographic Studio of William Notman' (McCord Museum of Canadian History, 2005).

Source: VMC website.

In the current state, however, the long-term sustainability of ongoing digitization activities, as well as of CHIN's development projects[72], continues to represent an unresolved challenge.

According to a survey of digital preservation practices conducted in 2011 (CHIN, 2013d), although the most of the interviewed institutions possessed digital assets and metadata in digital format, they did not have adequate resources for creating and updating a consistent inventory. In this context, shortage of funding and lack of expertise on crafting 'sustainable business models' were identified by the respondents as the main limitations against digitization and long-term digital preservation.

Against this background, the vacancy of the space left by the Canadian Culture Online programme and the apparent decline in political 'momentum' of digitization policies, combined to an overall squeeze of public funding to culture caused by the current economic crisis, are likely to make the mass digitization of Canadian heritage a goal to be postponed to the next decades.

4.1.4. The experience of Québec

Within this historical framework, the experience of Québec shows some distinctive characteristics.

The political case for the digitization of the Belle Province's cultural heritage is rooted in the debate over the advent of the Information Society and the emergence of *information highways* (in French, *autoroutes de l'information*) in the 1990s (Angell, 1995). Commentators and policy-makers

[72] Current and forthcoming projects involve a restructuring of the Artefacts Canada search engine, a homogenization of image and metadata quality, a venture into linked open data, and the implementation of simplified taxonomies to help non-expert users in their search (CHIN, personal communication).

observed that the debut of computers and the Internet was marked by a dominance of English both as a programming and a communication language, raising concerns about a perspective downgrading in relevance of the French language (Canadian Heritage, 2008). In this context, the insertion on the Internet of Francophone cultural contents was embraced as a means not only to ensure the preservation of a specific cultural identity, but also as a way to compete against the increasing dominance of the Anglo-Saxon cultural industries[73] (CLF, 1996). Consistently, the State was called to play a key role in a 'boost' of French language by providing its own products and services in a digital form[74] (Roy, 1998). A Francommunautés Virtuelles programme administered by Industry Canada was launched in 1998 to encourage the development and use of ICTs in Francophone areas and to create web-based networks of cooperation and partnering between organizations and communities (Industry Canada, 2008).

As will be highlighted in Section 4.3.3, similar arguments were used to advocate for the digitization of French cultural heritage, thus representing a significant point of contact with the dawning 'European way' to digitization.

Since the 1990s, the Provincial Government of Québec and the heritage community joined efforts for accelerating the digitization process.

As regards documentary and librarian heritage, a leading role was played by the Association of Libraries and National Archives of Québec (BANQ) (Bisonnette, 2006), whereas the artistic and historical domain were targeted by the joint initiatives of the Provincial Ministry of Cultural Heritage and the Society of Museums of Québec (SMQ). A milestone in this field was the launch, in 1991, of the Info-Muse project, which aimed to provide provincial heritage institutions with an information exchange network and a comprehensive repository of museum collections. The objectives of the project, financed by the Provincial Fund for the Information Highway (Fonds de l'autoroute de l'information), were to facilitate collection management activities relying on the description standards defined for the National Inventory Programme and supporting the acquisition of dedicated software by museums (Simard et al., 1999; Simard and Lapointe, 2003). As an increase in the estimated costs of digitization[75] was caused by the need to resort to external skills, though, the initial budget resulted inadequate for the most of the receiving institutions, thus requiring specific interventions to support the temporary recruitment of qualified staff (Simard et al., 1999).

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[73] Likewise to the nascent European debate over the information society, 'moral panic' arguments were echoed in governmental documents to call the State to actively intervene in digitizing cultural heritage: "S'ils ne sont pas numérisés dans les prochaines années, notre savoir et notre culture seront condamnés à la marginalisation. Le marché ne peut garantir, à lui seul, un tel effort: il ira au plus rentable. À l'État d'imaginer les mécanismes incitatifs pour accélérer le mouvement et, dans certaines circonstances, pour le forcer" (Minc, quoted in CLF, 1996, p. 8).

[74] "Il faut se souvenir que l'autoroute électronique, c'est d'abord et avant tout un moyen de communication. Par ailleurs, le plus grand communicateur, le plus grand acheteur, le plus grand payeur de toute société, c'est le gouvernement. Si nous réussissons à mettre en place l'autoroute de l'information avec l'objectif que son utilisateur principal soit les différents ordres de gouvernement, alors nous aurons gagné notre pari, car il n'existe pas d'organisation qui n'échange pas d'informations avec le gouvernement" (Bouchard, 1995, quoted in CLF, 1996, p. 26).

[75] As resulted from the final project budgets, the actual cost of digitizing a single object was 13.8 CAD, against an initial estimate of 10 CAD.

The Info-Muse adopted an organization model similar to NIP: museum uploaded autonomously their collections-related information, which were thus centrally controlled and managed by the organization. In case of need, Info-Muse acted as an intermediary between individual museums and the NIP-CHIN. Since, 1999, the data collected were also transferred to Artefacts Canada, to which the museums of Québec were estimated to contribute with the 75% of the overall amount of items in 2002 (Simard and Lapointe, 2003).

The shift towards public access as the main objective for digitization policies (see Section 4.1.2) forced Info-Muse to adopt an information delivery model suited to a wider dissemination, thus implying a restructuring of metadata standards and a simplification of the taxonomies. To this purpose, in 2002, 2.500 digitized objects were released through a Museums to Discover web-portal hosted by the SMQ, which was organized as a virtual gallery composed by five rooms, corresponding to as many categories of artifacts. The virtual environment contained intuitive references to actual museum deposits (shelves, chair rails, etc.) whilst the information was organized in a form that resembled the classical museum label. The visual interface was integrated by a search engine that allowed to retrieve objects through keywords (Simard and Lapointe, 2003)[76].

Despite the variety of the initiatives undertaken, though, from a quantitative standpoint the results appeared unsatisfactory with respect to objectives of mass digitization.

In 2009, BANQ and SMQ jointly released a survey on the state of digitization of museum and library collections, which revealed that only the 6% of the artifacts had been already converted in digital form[77]. Furthermore, ongoing digitization projects were reported to suffer from a lack of dedicated financial and human resources as well as by fragmentation and duplication of efforts (SMQ and BANQ, 2009).

In order to obviate to such situation, 18 institutions, associations and universities have formed a multi-disciplinary committee named Rèseaux Quèbecois de Numerisation Patrimoniale (Québec Network of the Digitization of Heritage), which has launched in 2010 a public call for digitizing the Province's heritage, under the claim that "digitization is a democratic response to the problems of access to and dissemination of cultural heritage" (BANQ, 2010). At its closure in October 2012, 60 applications had been received, among whose 10 have been prioritized for 2013 and other 11 have been put on a waiting list for the following years.

Under this light, the initiative appears as an attempt made by the heritage community of Québec not only to integrate Federal efforts in order to overcome the increasing difficulties in sustaining digitization activities, but also to reaffirm the specificity of a Francophone approach that bears significant analogies to the European experience.

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[76] The website is not currently available.

[77] It should be specified that the proportion of digitized heritage varied significantly across different types of collections, ranging from the 30% of artistic artifacts and books to less than the 1% of archaeological objects, specimens in the natural sciences, books and magazines.

4.2. Librarian and documentary heritage

4.2.1. Developing a national digital library

The digitization of Canadian librarian and archival heritage has followed a parallel, but substantially independent, path compared to the digitization of artistic heritage.

The first attempts to coordinate a Federal level the preservation of books and historical documents date to the establishment the Canadian Institute for Historical Microreproductions (CIHM) in 1978. With the support of the National Library of Canada and Federal and Provincial institutions, CIHM engaged in the use of microfilming as a solution to the physical deterioration of Canada's documentary heritage and to rising access costs. In this context, the first preservation standard and a catalogue of early documents of Canadian history were developed.

Since the early 1990s, the digitization of documents acknowledged and adopted by the Federal Government as a support to the preservation of Canadian librarian and archival heritage. In 1997, a non-profit alliance named Canadian Initiative for Digital Libraries was founded to support communication, collaboration and knowledge exchange among Canadian libraries and archives within digitization activities. Rather than performing actual digitization projects, though, the Initiative focused its mission - showing, to this respect, relevant similarities with the renovated CHIN - to the diffusion of guidelines and best practices related to production and organizational issues (metadata standards, interoperability, copyright management, training, advocacy issues, funding sources etc.) (Swain and Haigh, 2001). Moreover, it aimed to coordinate individual digitization efforts with the final objective of developing a 'national digital collection' upon the model of the NIP for artistic heritage.

In 2005, the Canadian Initiative for Digital Libraries was re-branded into Canadiana.org, maintaining a non-profit orientation and positioning itself as a "coordinator, facilitator and advocate for digitization initiatives, while also providing access services and preservation infrastructures" (Canadiana, a). Similarly to its predecessor and differently from CHIN, Canadiana acts not only as a service centre for libraries and archives in the areas of digitization, digital preservation and access, but it directly performs digitization activities and the creation of metadata on a per-page pricing basis, according to the providing institutions' requirements.

Access is enabled through the development and maintenance of custom portals on the institution's website. Digitized objects can be published on Canadiana's Discovery Portal[78], which provides a keyword-based or thematic search facility targeted to a generalist more than academic user. The Canadiana Metadata Repository format (CMR) is used internally as an intermediary format for both Canadiana's own metadata and metadata supplied by contributors.

Furthermore, Canadiana can store digital images on a secure repository for an additional per-page fee, ensuring long-term preservation and the ongoing adaptation of the outputs to evolving

[78] http://search.canadiana.ca/

technological standards. The complete digitization + preservation + access service is delivered at a cost of 0.25 CAD per page (Canadiana, a).

The Discovery Portal currently provides free access to objects belonging to 33 libraries, archives and museums in the country. An Early Canadiana Online section has been added which provides access to 80,000 rare books, magazines and government publications dating from the 1600s to the 1940s. Differently from the Discovery Portal, Early Canadiana items are accessible through individual or institutional subscriptions for educational organizations, whose rates vary according to the number of registered students (Canadiana, b).

4.2.2. Modernization at Libraries and Archives Canada: discourse analysis

Together with CHIM, the role of leader within the initiatives leading to Canadiana was performed by the National Library of Canada, which had been established in 1952 to gather and preserve a librarian collections of a national relevance through a legal deposit mechanism. Since the 1960s, information technologies had featured among the main supports for fulfilling the institutional mission. In introducing the National Library Act in 1969, Parliamentary Secretary Richard Stanbury had remarked that "the age of electronics is creating new opportunities for libraries to serve as complete information centres" and the National Library had to act as "the nerve centre of a fully integrated and highly automated information system at the disposal of the Canadian people and their institutions" (quoted in English, 1999, p. 7).

Projects of automated cataloguing conducted in the 1970s concerned in particular the design of a system based on MARC (Machine-Readable Cataloguing) format, for compiling a national bibliography (*Canadiana*) and coordinating an automated Canadian union catalogue system (Wiper, 1975). In later decades, the Library engaged in the development of automated information retrieval systems (Buchinski et al., 1977) that eventually resulted in a first online national catalogue (*AMICUS*) gathering over 30 million items held by 1,300 libraries over the country. The 1990s saw increasing efforts in making collections accessible to the public through the Internet, in particular through a Digital Library of Canada service and an Electronic Collection that included samples of digital-born publications such as electronic journals and Governmental documents (Delsey, 1997; Swain and Haigh, 2001). In the same period, the National Library started collaborating with

the National Archives (founded in 1872 as the Dominion Archives, renamed in 1912 as the Public Archives of Canada and then again in 1987) whose collections partially overlapped, especially as regards the librarian component. When a new preservation centre was opened in 1997 in Gatineau (Québec) for the Archives, the Library was also enabled to use it through a client services arrangement. Against the background of budget cutbacks to both institutions, in 1999 the so-called English Report (English, 1999) called for further cooperation through a the creation of a common Board, although it did not endorse a merger due to the opposition of the stakeholders that had been consulted.

In 2003 the Auditor General of Canada highlighted serious shortcomings in the Library's activity of preserving paper documents, due to the lack of adequate facilities and "sufficient

specialized competencies" (Auditor General of Canada, 2003). The Report thus called the institution to elaborate a strategic document "to better evaluate and explain its strategic preservation choices and the affiliated costs" (6.44), in response to which the management stated it was drafting a "corporate and comprehensive strategic plan for the preservation of collections" (6.63). At the end of the year, a voluntary merger with the Archives was decided as the most effective solution to avoid duplications or conflicts in the respective institutional mandates and in the management of locations, whilst providing one point of access to documentary heritage (Moulineaux, 2012).

The new institution Libraries and Archives Canada (LAC) thus came to include collections spanning the whole history of Canada and counting millions of items among films, books, drawings, photographic images and music sheets, besides all governmental documents and 343,000 artworks.

The Act also specified the mandate and functions of the new institution, that had to report to the Parliament through the Ministry of Heritage, as well as those of the Director - named The Librarian and Archivist of Canada - who was attributed with the faculty to "do anything that is conducive to the attainment of the objects of the Library and Archives of Canada" (Parliament of Canada, 2004). The organizational structure, and the governance though, were not specified in the Act but delegated to the management.

In the same year, a strategic document titled *Creating a new type of Knowledge Institution* was released to further articulate the objectives and characters of the transition that had been defined through "numerous working groups and discussion forums" (LAC, 2004, p. 3).

The document envisioned a "transformation process that will take several years to accomplish" (LAC, 2004, p. 3), which would eventually lead to a conversion from a "passive repository" towards a "new type of knowledge institution" engaged in finding "new ways to organize and describe [...] resources, including an increasing body of digital content, for easier access and more widespread and wide-ranging use" (LAC, 2004, p. 4). In this context, priority was assigned to the adoption of new technologies:

> *"LAC will consciously, proactively seek to understand the impact of digital and adapt itself to the 21st century digital information environment [...]. Digital is core to our business, and will be pursued as an over-arching strategic priority"* (p. 9).

The transition, however, was presented to involve not only the individual institution, but also the whole cultural domain:

> *"Building the strength of the broader Canadian collection; facilitating its coherent access, use and understanding; and preserving it over time—all are essential and require coordinated effort from archives and libraries of all types, cultural centres, other heritage institutions, and the communities of creators and publishers of Canadian cultural and documentary resources. A network for access, capitalizing on cooperative collecting and preservation responsibilities, will allow Canadians from all parts of Canada to access resources from other parts of the country"* (p. 7).

A participatory approach was substantiated, throughout the document, by a section titled "Questions for you" placed at the end of each paragraph, which apparently invited to internal and external stakeholders to contribute:

"What do you see as the most important opportunities for this new institution? What are the long-standing programs, services or practices that you believe fit a "new kind of knowledge institution"? Any we should let go of? Where do we need to modernize? Where should we innovate?" (LAC, 2004, p. 5).

In 2006, another strategic document titled *Direction for Change* was released to substantiate LAC's transition into a "truly national institution working with others to strengthen the whole of Canada's documentary heritage", a "prime learning destination" and "a lead institution in government information management" (LAC, 2006).

The document was underpinned by the argument of an alleged substitution of the digital to the analogue in the production and consumption of information, which provides the "deep discursive structure" (Heracleous and Barrett, 2001, p. 758) for an overall reconfiguration of the institutional activities:

"The information environment has been irrevocably transformed by digital information and the Internet. The rapid move to digital has changed publishing, government, research, learning, culture, our professions —everything that our mandate touches. Within a few years, the preferred, authoritative record of government will be digital, and there is already a policy in place requiring web-based versions of all print publications. The publishing industry is intrinsically digital now. Photography and audio-visual production are rapidly transforming to digital. Much tangible evidence of Canada's business and economic activity, political environment, government content, current affairs commentary, research output, and community information is found in the newest of publishing vehicles: websites. [...]

Paramount in pointing to the need to change is the fact that an increasing majority of users seek, as their first and often only choice, web-based information. They do this at a convenient computer at their home, school, office or library. [...] These users will bypass print resources; they will bypass online catalogues; they will bypass inter-library loan and reference assistance; and they will bypass physical libraries and archives. But they may very well be seeking resources that we have" (LAC, 2006, p. 19).

The above technologically determinist argument of rapid and irreversible changes brought about by the advent of digital media is absorbed from the general discourse of the Information Society (for a critical analysis, see Garnham, 2000 and Jessop, 2004) that also influences European policies for the digitization of cultural heritage in the same period (see Section 4.3.3). The argument also legitimates LAC to assist other heritage institutions in the ongoing technological transition, interpreting leadership with a collaborative approach:

"A national knowledge institution is expected to provide leadership and focus within the broader Canadian "information ecosystem," but in a manner that strengthens the contributions of others as well. The ultimate goal is to promote conditions and infrastructure that will see the whole system work optimally for the benefit of Canadians" (LAC, 2006, p. 6).

Consistently, in 2006 LAC proposed itself as a national leader in the definition of a coordinated approach to the preservation of digital documents and information[79]. A draft of the Canadian Digital Information Strategy was released for public comment and consultations with

[79] This was defined broadly as "digital material that is created, used, shared, accessed and preserved in a digital format" (p. 9), including digital-born documents such as "email, websites, web databases, blogs, wikis, webmaps, multiplayer online games, data portals, and user-created web profiles, photographs, and videos" (*ibidem*).

stakeholders, including "publishing and media producers, creators, rights bodies, academics, provincial and federal officials, and memory institutions" (LAC, 2007, p. 3). In the paper, the economic consequences of digitization were emphasized together with socio-cultural ones as the main rationale for prompt intervention:

> *"Digital information and networked technologies are recognized worldwide as key drivers of economic growth and social well-being in the 21st century. Canada cannot afford to be left behind. A digital information strategy is crucial to strengthening Canada's presence, participation and ability to compete in a global information market. Furthermore, we must ensure that the needs of all Canadians—citizens, scientists, students, creators, workers—are met. A Canadian digital information strategy is essential if we are to reflect in the digital realm the fundamental values of our nation, such as bilingualism, multiculturalism, inclusiveness, and equity"* (p. 9).

The final agenda included three main areas of intervention: strengthening content through mass digitization; ensuring preservation; maximizing access and use for learning, leisure and creative activities. To this purpose, the mass digitization of documentary heritage - especially orphan works (see Note 95, p. 131) - was planned in a mid-term horizon (5 to 10 years) to replace the existing "short-term funding [...] focused on selective interpretive content" (p. 15), encouraging indefinite open access to digitized resources in the public domain.

However, the relative rise in priority of economic arguments led the Department of Industry to lay claims to the enactment of the strategy. In May 2010, a National Consultation on a Digital Economy Strategy was announced jointly by the Ministries of Industry, Canadian Heritage and Official Languages, and Human Resources and Skills Development, excluding LAC's management from the decision-making process. In the discussion paper (Industry Canada, 2010), the digitization and digital preservation of documentary heritage was subsumed within a wider strategic plan for increasing public and private R&D in the ICT sector and the production of digital contents and services, as key elements for Canada's competitiveness on the global information market. Individual stakeholders in the cultural and librarian sector[80] submitted contributions to the Digital Media area (Industry Canada, 2012). Despite repeated announcements, however, there is no evidence of a final agenda having been adopted by the Government (Turcotte, 2013).

Drawing on Heracleous and Barrett's techniques of codifying enthymemes, the discursive structure of the 2004-2008 period can be summarized as in TABLE 11:

[80] Canada Science and Technology Museums Corporation; Canadian Library Association; Library Association of Alberta; Canadian Association of Research Libraries; Ontario Library Association; Canadian Urban Libraries Council; British Columbia Library Association.

Table 11: Enthymeme pattern for LAC's discourse in the 2004-2006 and 2007-2008 periods

	Periods		
Enthymeme component	**2004-2006**	**2007-2008**	
Stakeholders	**LAC**	**LAC**	**External stakeholders (Department of Industry and others)**
P1	Due to the advent of ITs, the production and consumption of information in digital format is rapidly substituting traditional modes	Due to the advent of ITs, the production and consumption of information in digital format is rapidly substituting traditional modes	
P2	Our institutional mission is to provide access to documentary heritage	The production and consumption of information in digital format is a key driver of Canada's development as a knowledge-based economy	The production and consumption of digital contents is a key driver of Canada's digital economy
C1-P1'	Therefore, we must adapt to the new technological environment and move our activities to the digital	Therefore, we must adapt to the new technological environment and move our activities to the digital	Therefore, digitization and digital preservation strategies should fall within industrial rather than cultural policies
P2	The complexity of the digital information market requires the contribution of different stakeholders	The complexity of the digital information market requires the contribution of different stakeholders	
C2	Therefore, LAC should work in a cooperative manner with other relevant actors	Therefore, LAC should work in a cooperative manner with other relevant actors	

Source: Author's elaboration.

In April 2009, a new Librarian and Archivist of Canada in the person of Daniel J. Caron - endowed with a managerial background and a curriculum in Federal organizations, including the National Archives - had been appointed in replacement of the librarian Ian Wilson.

The following year saw the release of a further strategic paper titled "Shaping our continuing memory collectively" (LAC, 2010), wherein the scenario of a transition to the digital was invoked in support to "a reconceptualisation of the way Library and Archives Canada conducts its business in order to continue to fulfill its legal mandate in a relevant, efficient and effective manner" (p. 1). The implications for preservation and access, however, were presented under a more interrogative and problematic light than in previous documents:

"This [scenario] forces us to revisit our practices by asking some fundamental questions: How do we determine what is important to document in a persistent way for present and future generations? Should LAC become the filter assigning value to all forms of information? How do we monitor and respond to public expectation of instant access, while capturing less immediate, yet important contributions? How do we best engage citizens and professionals from all domains in our efforts? How do we reach out to the new generation of "born-digital" consumers? How do we ensure they can find the documentary heritage we have acquired and described? How do we represent the diversity of views? How do we work in collaboration with stakeholders?" (LAC, 2010, p. 3).

In particular, the last question, problematizing the relations between LAC and its stakeholders, seems to encourage a reconsideration of the participatory approach advocated in previous documents (LAC, 2004; 2006) which is also evoked by the term "collectively" in the title.

The document emphasizes, in particular, that some adjustments to acquisition and preservation activities are required to face the ongoing technological change. Building on the previous acknowledgment "that comprehensive preservation is an unattainable goal" (LAC, 2006, p. 16), thus, *Shaping Our Continuing Memory Collectively* specifies that acquisition should respond to more pragmatic criteria of selection of relevant documents:

"In a world of information scarcity, the criteria of "significance" and "breadth" of our documentary heritage collection may have been sufficient to remain relevant. However, in the present environment of information superabundance, considerations of sufficiency based on subject, type of material and period coverage may be needed to introduce some important pragmatism to our collecting efforts.

The context is such that it is increasingly difficult to capture a satisfactory image of Canadian society. To deal with the profound challenges of the digital age, our interpretation of "acquisition" must of necessity be more focused than it has been in years past. This is why of the principles for acquisition [sic] has inspired decision criteria, such as significance, sustainability, sufficiency and society" (LAC, 2010a, p. 3).

Although the new principles for acquisition are defined in a generic manner, a major shift compared to previous documents is supported at a discursive level by the adoption of a managerial vocabulary composed of "business processes" (p. 4), "functions" (p. 4), intelligence (p. 4, 7) and "efficiency" (p. 5).

In this context, the document introduces a two-year "modernization cycle" articulated in five phases, whose content is defined generically as a revision of working processes to be determined "in consultation with employees and external stakeholders" (*ibidem*). An element of ambiguity, however, concerns the relations with the latter: whereas a horizontality criterion is stated which "requires that we consider how we can obtain support and advice from stakeholders for each of our work processes", this seems to be interpreted as a one-way process in which LAC is left free to "determine which stakeholders should be involved and how, and by which mechanisms we should be accountable" (p. 5).

Compared to the previous period, *Shaping Our Continuing Memory Collectively* thus adds a set of further element to the discursive structure, as can be seen in TABLE 12.

Table 12: Enthymeme pattern for LAC's discourse in the 2008-2010 period.

	Stakeholders
Enthymeme component	**LAC (management)**
P1	Due to the advent of ITs, the production and consumption of information in digital format is rapidly substituting traditional modes of dissemination
P2	Our institutional mission is to provide access to documentary heritage
C1-P1'	Therefore, we must adapt to the new technological environment and shift our activities to the digital
P2	The digital environment is characterized by a superabundance of information
C2	Therefore, acquisition in the digital environment must be more focused and pragmatic than in the past and based on criteria of significance, sustainability and sufficiency.
P3	The complexity of acquiring and preserving documents in digital format requires the contribution of different stakeholders
C3	Therefore, LAC should work in a cooperative manner with other actors, after identifying relevant stakeholders and modalities of involvement

Source: Author's elaboration.

A more operative setting for implementing the Modernization Cycle was provided by the *Evaluation Framework for Modernization*, issued in June 2010, "based on a document review and interviews with key informants at LAC" (LAC, 2010b, p. 2). Although specifying that consultations with external stakeholders on the strategy were still underway (p. 4), the document articulated a series of immediate, intermediate and long-term outcomes, with the final goal of increasing access to documentary heritage (p. 7). A set of performance indicators - plans and strategies; work processes redefined; horizontal collaboration; employee engagement; policy-driven organization; professional bureaucracy - was also defined to monitor the state of implementation. From a discursive point of view, moreover, the Evaluation Framework adopts the same managerial tone and terminology as *Shaping Our Continuing Memory Collectively* which differentiates it from previous documents (LAC, 2004; 2006).

4.2.3. The paradox of implementation

An analysis of press documents issued in the period following *Directions for Change* and preceding *Shaping Our Continuing Memory Collectively* (2007-2010) allows to compare the objectives set out in strategic documents with LAC's actions and relations with external stakeholders[81], suggesting that an informal revision of institutional programmes was in place since 2006, when LAC suspended works on 'The Virtual Gramophone' multimedia website, originally begun in 1995 by the National Library.

[81] The following timeline is taken from ExLibris (2013) which is a list of events in constant update, containing links to original documents. Every quoted event was thus cross-verified through the links.

In September 2007, LAC had attempted to reduce public service hours by 12.5 per week, claiming that increased access to digitized documents would make onsite consultation less relevant. The measure, however, was withdrawn after the official protestation of the Canadian Library Association CLA, 2007). The following month, a Service Advisory Board was formed to conduct regular consultations on service-related issues with relevant stakeholders.

In November 2007, the Virtual Reference Canada - a free, bilingual reference service coordinating a network of libraries, archives, museums, information centres and research institutions - was discontinued. Likewise, in June 2008 the Canadian Book Exchange Centre - through which libraries exchanged surplus paper publications among each other - was found not aligned with LAC's core responsibilities and terminated.

March 2009 saw the termination of the Archival Community Digitization Fund, which provided community archives with financial support for digitizing their collections through the development of virtual exhibitions focusing on local or regional history - similarly to CHIN's Virtual Exhibitions Investment Programme (see Section 4.1.3). In May same year, after the appointment of the new Director, a 10 months moratorium on acquisitions was announced.

In March 2010, the decision was taken to close the Learning Centre at LAC's headquarters, where teaching and research assistance was provided to schools since 2004. Albeit in the press release the action was claimed to be compensated by the online publishing of digital record, it raised a wave of protestations and petitions on part of national associations of the educational sector (Chaktiris, 2010).

These measures suggest that an overall revision of LAC's programmes was already underway before the launch of the Modernization Cycle (LAC, 2010a), affecting both onsite and virtual services to the archival and research community. The lack of clearly identified criteria for distinguishing 'core' from 'additional' services in early strategic documents (LAC, 2004; 2006), however, seems to have left a discretionary margin of intervention to LAC, raising in reverse, the opposition of relevant stakeholders.

Against this background, the ambiguity contained in *Shaping Our Continuing Memory Collectively* with regards to LAC's accountability and the immediate release of the *Evaluation Framework* may be interpreted as an attempt to bypass the influence of external stakeholders in the decision-making process and to reinforce a more active role on part of the management in applying the modernization strategy (LAC, 2010b). This is confirmed indirectly by the Canadian Historical Association's protest against the reduction of consultation frequency after the advent of LAC's new management (CHA, 2010); in response, the latter converted the Service Advisory Board created in 2007 into a Stakeholders Forum that would support the creation of a Pan-Canadian Documentary Heritage Network. A survey of consultation activities dated March 2011, though, "revealed considerable dismay at the state of LAC's relationship with each of the communities, and widespread questioning of LAC's commitment to working with its key stakeholders" (LAC, 2011, p. 3), calling for renewed collaboration efforts.

In December 2010, LAC announced that most of its services would be provided digitally by 2017, with increased efforts in the preservation of digital material through "commercial and networked partners", the phasing out of paper copies of documents and theses, a doubling of the

volume of on-line content genealogy, and work with contributing libraries to identify common digital search tools for the National Union Catalogue (LAC, 2010c).

The following month, however, the institution announced the discontinuation of the project of a Trusted Digital Repository for digital documents, which had already undergone multiple tests for a cost about 7 million CAD, as well as of AMICAN, a multi-year project to provide an integrated approach for access to library and archival records.

In November 2011, the Canadian Association of University Teachers (CAUT) launched a national campaign *Save Library and Archives Canada* that directly challenged the modernization project for reducing public access, introducing too selective criteria of acquisition for analogue documents and blocking the replacement of essential positions in the staff. CAUT's call for amendments to the LAC Act specifying the obligation to maintain a comprehensive collection of Canada's documentary heritage and the need for adequate public funding, though, was doomed to remain unheard, as in May 2012 a cutback of Federal funding of 9.6 million CAD for three years was announced. According to the officials, this entailed a decrease in the 20% of the staff affecting 1,100 posts as well as the closure of several libraries serving Federal departments, causing further reductions of acquisition activities and onsite services.

In response, the Canadian Association of Law Libraries joined CAUT's campaign, complaining that access to documentary heritage was being undermined by the cutback. Criticism was further injected by the replacement of the inter-library loan service with an online reprography service - whose date of launch was not specified - the closing of 5 LAC regional offices out of 8 (LAC, 2012), as well as the discontinuation - without previous consultation or notice - of the National Archival Development Program that supported 90 digitization projects. In response to the latter event, the Council of Canadian Archives launched an online petition claiming its restoration (CCA, 2012a), whereas the Association of Canadian Archivists withdrew its participation from the Pan-Canadian Documentary Heritage Network deeming it incapable to "address the diverse needs and interests of archives across Canada" due to the strict governmental control on the agenda of consultations (ACA, 2012).

In February 2013, the adoption of an internal code of conduct that defined the employees' participation to public activities such as educational activities, conferences and social media as "high risk" activities, consequentially restricting the expression of personal comments on LAC's mandate and activities to authorized spokespersons, was interpreted by ACA as an attempt by LAC's management to discourage employees from expressing 'voice' over staff cutbacks (Munro, 2013). Concerns and protestations were also expressed by the Canadian Association of Professional Academic Libraries (CAPAL, 2013), which complained an infringement of freedom of expression. The Royal Society of Canada also joined the front of the critics launching in February 2013 an Expert Panel on the State and Future of Canada's Libraries and Archives.

Under the pressure of mounting tension and accusations of spending the institutional budget for personal purposes, Daniel J. Caron presented its resignation on May 20th, 2013 and was replaced on interim by Hervé Déry, Assistant Deputy Minister for Policy and Collaboration, also endowed with an economic background.

Just before the announcement, a "broad spectrum of members from the heritage stakeholder community" had issued a Joint Statement in which they proposed a list of "qualities" that should guide the Ministry in the appointment of the new Librarian and Archivist of Canada (CCA, 2013). Pressure by stakeholders on the Ministry continued in the following month, when the Royal Society "to discuss the government's vision and policy about libraries and archives" (RSC, 2013) under the light of the pending appointment of a new Librarian and Archivist of Canada.

In November 2013, the new management partially acknowledged stakeholders' requests by reintegrating the inter-library loan with a new policy of lender of last resort (LAC, 2013).

Another front of polemics, in the meanwhile, had been opened in June 2013, when an archivist blogger posted a secreted document referring to an agreement between LAC and Canadiana for the digitization of the institution's collections. According to the document, Canadiana would acquire exclusive rights over the materials for 10 years as a compensation for the initial investment (CBC News, 2013). Newspapers such as the *Ottawa Citizen* and blogs hosted critical comments on the contents and secrecy of the agreement. CAUT featured again among the most tenacious detractors, attributing a strategic intention to the reduction of staff prior to outsourcing and blaming the choice of a fee-based model of access (Kabanova, 2013).

Minister of Cultural Heritage James Moore replied that the official announcement was scheduled for mid June, but it had been delayed due to Caron's resignation. The agreement - named *Héritage Project* - was then disclosed on Canadiana website where it was reported to encompass approximately 60 million pages of primary-source documents, divided into 5 categories - genealogy materials; documents related to aboriginal peoples; governmental documents; military history documents; papers written by prominent Canadian characters.

On its part, Canadiana specified that a fee would be charged only for metadata-based search, and the revenues would be used to enhance the search engine (Kabanova, 2013). Canadiana's Partnership Manager Ulrich Werneburg also accused CAUT's complaints of being driven by a political agenda.

On June 12th, the Minister replied to a parliamentary interrogation stating that the Héritage Project would be reviewed when a new Deputy Head was appointed for LAC, and indicating a preference for free access to archival data (Open Parliament, 2013). The Canadian Library Association took position in support to the project, underlining that "the only way this [digitization] work can be accomplished is through creative partnerships, such as the one proposed in this project" and that Canadiana is "a solid partner in this initiative" (CLA, 2013). In turn, the Canadian Association of Research Libraries declared itself a sponsor of the agreement (CARL, 2013).

On June 16, an unreleased report dated January - according to which "LAC has not made any real progress toward mass content digitization" and it had to face difficult challenges in "sustainable funding, digital storage, accessibility of images, rights, and resources discovery" - was accessed by researcher Ken Rubin and publicly shared on the Web, further fueling concerns and polemics about LAC's modernization programs (Spears, 2013).

4.2.4. Modernization between smokescreen and reality: discursive clashes between management and stakeholders

The actions taken by LAC after the change in management in 2009 seem to describe an acceleration in the adoption of a managerialist approach, whose diffusion in the cultural sector has been widely documented in the Anglo-Saxon and European context (Zan, 2006; Lusiani and Zan, 2010).

However, it should be remarked that the arguments for the discontinuation of onsite services are consistent with the digitization scenario outlined in earlier strategic documents (LAC, 2004; 2006):

"LAC's service statistics provide a vivid illustration of this digital revolution. Our website now gets close to half a million visits per month. In contrast, LAC's in-person service hub located at 395 Wellington Street, receives about 2,000 visits per month. These two service points are also trending in opposite directions, with online consultations increasing rapidly, and in-person visits declining slowly but steadily" (LAC, 2012b).

Remarkably, the emphasis on the Web as the main channel of access consists in a radical interpretation of the 'digital-era governance' discourse (Dunleavy et al., 2006), wherein automation and disintermediation are claimed to enable more effective and agile service delivery to citizens.

The autonomy of LAC's management in selecting priorities of intervention or disinvestment is indirectly confirmed by Minister of Cultural Heritage James Moore, who claimed that job losses had "to do more with the modernization initiative" (Kirkup, 2012) than with budget cutbacks.

In this sense, to legitimize the slash in funding to the purchase of documentary materials - which drops from $385,461 in 2008-09 through 0 in 2011-12 to $12,000 in 2013, extending in fact the moratorium on acquisition started in 2009 - Caron invokes the selective criteria introduced by *Shaping Our Continuing Memory Collectively*, specifying that "in its various incarnations over 140 years, LAC has never been completely comprehensive":

"this idea of comprehensive [acquisition] . . . it was a dream [...]. We had a collection (in the past) that was built differently because in (the) . . . predigital world, we were able to control to some extent the printed environment [...]."It's not everything that is of enduring value," Caron says with understatement "We need to have the tools to be able to appreciate, to appraise, to evaluate what is being produced there. Moreover, Caron says, electronic materials give LAC a new opportunity to be more rigorous and revelatory with its collections, not less" (Hall, 2013).

To this purpose, however, the Director acknowledged that "the experts needed for this web-based archiving have not yet been hired" and "these competencies are not easy to find on the market" (Hall, 2013).

Moreover, the flexibility of the digitization discourse as regards the temporal horizon of technological change represents a further rhetorical resource for the management. A short-term and a long-term view of innovation are alternatively emphasized in different situations: whereas the former is generally evoked to justify immediate interventions - as in the case of the reduction of service hours (LAC, 2012b) - the latter serves to rebuke detractors' positions as hind-sighted:

"Most of what is being said today will never be printed," he [Daniel Charon] says. "The vision we have to have is a long-term vision. What will be in our vaults in 50 and 100 years from now? That is my mandate: That there will be something to chew on for historians and genealogists — something that will continue to feed Canadian culture in those years? [...].

"To those who would wrap themselves in the Canadian flag while digging in their heels to protect the status quo, I would respond: We could continue with our business-as-usual approach of only acquiring and cataloguing the physical objects that make it to our door. However, to do so would mean that in 50 years from now we would not be able to account for the vast materials that Canadians have produced digitally during the first half of the 21st century" (Caron, quoted in Cobb, 2013).

Against this background, the stakeholders' attitudes towards modernization policies can be arranged along a spectrum of cooperation and opposition.

'Radical opposition' is emblematically represented by CAUT, which was not directly involved in consultations and proposes itself as an outsider dissenter by launching the Save LAC campaign (Stewart, 2011). Other extremist detractors see the digitization discourse as a corollary of neo-liberal ideology, as in the case of the consumer advocacy movement Sum of Us:

"Across Canada, our public treasures are being commodified and sold off to the highest bidder for a quick profit or political favours. Whether it's our health system or our books, corporations know that if they can get their hands on them, they can make a buck (or a million). It's up to us to stand up against the rising tide of corporate control in Canada -- and we're drawing the line at privatizing our national books" (Sum of Us, 2013).

At an intermediate level that may be labelled as 'obligated opposition', the Council of Canadian Archives, seeing its own survival threatened by the elimination of the National Archival Development Programme, launched a petition inviting its members to send the Minister and MPs "stories from the constituency about the positive impact of NADP projects in your community" (CCA, 2012b). At the same time, it complained that meetings of the Pan-Canadian Documentary Heritage Network had been "marked by inconsistent direction, lack of continuity, and an absence of concrete goals or benchmarks" and "an absence of follow through on commitments and discussions" (CCA, 2012b). On this point, the CCA was joined by the Association of Canadian Archivists, which complained strict governmental control over consultation, and by the Bibliographic Society of Canada which questioned the reality of the "collaborative model":

"while on the one hand LAC/BAC has publicly professed a desire to move toward a more "collaborative model" of collecting and preserving Canada's documentary heritage, on the other it cut entirely the National Archival Development Program. The modest annual budget of $1.7 million devoted to this program supported local archives and their initiatives in communities small and large throughout the country. [...] In the view of stakeholders, this decision exhibited neither leadership nor a collaborative sensibility" (BSC, 2012).

On the opposite side of the spectrum, the CHA replied to CAUT's invitation to join the campaign, advocating participation to forums and working groups as a more effective way of expressing 'voice' over the modernization process:

"On the issues that LAC has control over, such as acquisition policy, access to specialist archivists, and others, we have taken the approach of discussing these directly with LAC in face-to-face meetings and through an advisory process. We feel this is bound to be more productive than a confrontational public campaign [...]. in 2011 the Canadian Historical Association accepted LAC's invitation to participate in national stakeholder consultations and working groups connected to its modernization initiatives. To date, our representatives have attended several meetings of both the stakeholder forums and working groups" (CHA, 2012).

This position suggests that partners were identified and involved in the process to different extents.

A further group that partially overlaps with the former and could be defined as 'moderate opposition', proposes an articulated interpretation of the modernization discourse that diverges significantly from that of LAC's management, as regards especially the relation of the digital towards the analogue and the time horizon of technological change.

Referring to the reduction of service hours, the Canadian Library Association states that "more digital access does not replace the need for in-person access to original documents and artefacts" (CLA, 2007), whereas addressing the closing of the Learning Centre, the Historical Education Network claimed that digitizing documents was "no substitute for the archival experience of guided, hands-on primary research, which has proven so popular in fostering the vital link between young people and Canadian history" (Chaktziris, 2010).

Similarly, the CHA and the BSC underlined that digitization alone would not fulfill the complex needs of professional researchers:

"Even if all projected digitization projects scheduled over the next several years were to be carried out, most serious researchers would still need to travel to Ottawa in order to identify the collections they needed to research, and then carry out research in these collections on site. And many large, important collections will never be transferred to electronic form. A good website will remain not a portal to the whole collection, but largely a useful tool for planning a research trip in order to actually open books or boxes in the reading room" (CHA, 2010).

"On LAC/BAC's website and elsewhere, the institution's officials have rebutted stakeholders' concerns about access and preservation with assurances that the institution is embracing a new model of service that emphasizes online delivery of services and digital access to holdings. Canadians experienced in working in libraries and archives are not reassured. Indeed, these assurances are worrying since they suggest a lack of basic knowledge on the part of the highest officials assigned to preserve and provide access to our documentary heritage" (BSC, 2012).

These remarks reflect to a large extent the results of studies on the information-seeking behaviours of historians in libraries and archives.

The interviews conducted by Duff and Johnson in 2002 revealed a preference for informal over systematic research tools. Specifically, historians started their search with printed rather than online finding aids, "since print copies helped them better acquire this sense of the whole collection" (p. 481) and by informally talking to the archivists in order to seek suggestions and better articulate their information needs. As regards the preferred search terms, names of persons and organizations were generally favoured over dates, places and events, thus showing a potential contrast with the

thematic choices made by Canadiana (see Section 4.2.1). Online collections classified by keywords, in reverse, were seen as a potential support to the retrieval of known materials as well as for the search across different collections. Tibbo's (2003) survey similarly showed that traditional methodologies for locating primary materials remained the most utilized.

In 2004, Dalton and Charnigo's survey yielded similar results, albeit showing a more frequent use of online bibliographic catalogues and indexes for the retrieval of secondary sources[82]. In 2008, Warwick et al.'s log analysis and questionnaire revealed that, although humanities scholars "valued [digital] information resources very high" - particularly referring to large-scale reference collections - these "have not replaced physical information resources", but rather serve as "an aid to further resource discovery" (p. 22). The same complementarity of the two types of sources has been further confirmed by Tahir et al. (2009) and Rhee (2010).

On the institution side, the reliance of professional users on the intermediation of archivists and librarians resonates with recent reflections on the transformation of archivists into mediators and facilitators rather than mere information providers (Cook, 2013). To this purpose, with reference to staff reductions in Department libraries, Valerie Knowles - writer and former history teacher and archivist - claims that traditional skills in referencing and research assistance would prove irreplaceable even in a digitized scenario:

"[...] no matter what type of format is consulted, skilled and knowledgeable librarians have provided quick and efficient research access to the information federal government policy analysts and researchers need. And this should continue to be the case so that their advice to ministers on matters affecting Canadians every day is well-founded" (Knowles, 2012).

The above evidence highlights a difference in the respective formation of the management's and the stakeholders' discourse. Whereas the former is based on a macro-level scenario of technology-driven transformations in the production and consumption of documentary resources by 'generalist' user - in *Directions for Change*, for instance, it is specified that "only a small percentage of users require [...] access to the original" (LAC, 2006, p. 12) - the latter is rooted in the experience-based knowledge of actual information search practice. In this context, LAC's effort to promote a disintermediation of access is impeded by the persisting relevance of pre-digital practices - consistently with Dunleavy et al.'s remark that "disintermediation is essentially accomplished only when citizens or consumers of public services change their behaviors in line with facilitating shifts by government agencies and officials" (2006, p. 486).

Another polemic target of moderate opponents is the lack of actual progress in digitization at LAC, that they ascribe to an underestimation of the challenges and complexities involved in the process:

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[82] According to the authors, this reflected the increase in the volume of scholarly publications in the field and the consequent need for historians to keep up with the developments in the discipline.

"They use the D' word as a magic rhetorical bullet because it's an easier sell to the public and only nerds like me know that the reality is a lot more complex, expensive and labour intensive" (Myron Groover, archivist at the Vancouver Holocaust Education Centre, quoted in Cobb, 2013).

"What the Government fails to mention is that only a minuscule percentage of the LAC collection is online and that LAC documents online can be incomplete and of little use to a researcher. One can therefore question whether digitization is all that it is held out to be. In any event, with all the staff cuts digitization's progress at LAC will be severely hampered" (Knowles, 2012).

"As for archival holdings, it should be obvious that the sheer volume of materials and the financial constraints inherent in digitization of such records will inhibit how much material LAC/BAC can realistically place online. Digitization is an expensive and complex business, so how can officials at LAC/BAC plan to make digitized versions of its vast holdings the primary method of access? [...] So, just how many decades of dedicated effort do LAC/BAC officials have in mind when they talk about digitizing the institution's holdings? (BSC, 2012b).

In this sense, despite generally agreeing on the benefits of technological innovation, criticism is addressed to budgetary cutbacks which prevent digitization form being further pursued:

"[...] we would want our concerns to be understood in terms of our overall broad support for efforts to expand the digital presence of LAC/BAC in the name of great accessibility and in order to gain a more active place for our documentary and archival heritage in the lives of citizens. But that effort, particularly in its early stages, should not be seized upon as a pretext for economies that can only diminish the institution's reach. The digital world is certainly more accessible and frequently more flexible, but it is not less resource-intensive" (CCIS, 2012).

"LAC does need *to modernize, and the goal of expanding access beyond just Ottawa is actually a laudable one. But what they're doing here, under the guise of 'modernization', is simply cutting services and diminishing our access to Canada's past. [...] If LAC was really serious about modernization, if they put more of their collection online in a comprehensive manner, if they were open to new forms of research, and if they didn't do this at the expense of their on-site collections, this would be a good thing. But, given the state of their online collections, I don't see any reason to be happy here. [...].*

There's a kernel of truth to some government pronouncements: all Canadians, not just those who can come in person to Ottawa, deserve access to their national archive. But instead of using that chip as a talking point to justify cuts, let's actually mean it. All Canadians deserve robust archives, be it on-site or online" (Mulligan, 2012, italics in the original).

"Few archivists dispute the need for digitization and preservation of archival collections — it is the buzz of the twenty-first century. But institutions like LAC need not only ministerial protection and understanding but also an appropriate level of funding if they are to advance toward the future in a way that will address Canada's best interests and the preservation and development of its archival heritage" (Peterman, 2013).

The positions of stakeholders are summarized at TABLE 13.

Table 13: Positioning and discursive patterns of LAC's key external stakeholders.

Position towards modernization	**Participation**	**Forced opposition**	**Moderate opposition**	**Radical opposition/resistance**
Representative stakeholders	CHA	CCA; ACA; BSC	CLA; BSC; CHA; CCIS; independent archivists and librarians	CAUT Sum of Us
Enthymeme pattern				
P1	LAC has sought the Association's opinion on strategic changes	LAC has stated horizontal collaboration with stakeholders as a priority	Digital access is no complete substitute to onsite services and physical preservation	LAC is reducing onsite services and resorting to private actors for digitizing its holdings
P2	Controversial decisions have been taken, but the Association has been invited to discuss them	LAC has discontinued programmes without notice and has reduced consultations	LAC is disinvesting from qualified skills and shows no progress in digitization	The Government and LAC's management have the intention to promote a particular version of Canada's past and sell off its heritage to private players
C1 - P1'	Continuing to collaborate is the most effective way of influencing LAC's decisions	LAC is breaching its collaborative approach	An integration of the digital with the physical should be promoted through adequate funding	The Parliament and Government should restore LAC's original public mandate

Source: Author's elaboration.

Against the above background and contrary to the claim of radical detractors (Sum of Us, 2013), the outsourcing of digitization activities to Canadiana seems to respond less to an intentional policy of privatization than to a contingent attempt to seek an economic support to the initiative: as such, it was labelled by the former Librarian of Canada Ian Wilson as a symptom of "desperation" (Spears, 2013). In this sense, rather than the actual content of the agreement, the main cause of controversy seems to consist in the mishandling of communication by both parties (Bibliocracy,

2013b)[83] that has left relevant issues unspecified (Bibliocracy, 2013a; New Jack Librarian Almanac, 2013), especially as concerns the financial sustainability of the initiative. Although 60 millions CAD are required for producing searchable full-text transcriptions of the digitized documents (Canadiana, 2013), the members of Canadiana - through the Canadian Research Knowledge Network - have so far contributed with only 1.74 million for start-up. Therefore, the current revision of the project will be called to assess the adequacy of the differentiation between basic and fee-based premium services as a source of user-generated revenues.

In this context, the mass digitization of Canadian documentary heritage is affected by the same issue of economic sustainability that has emerged in the case of artistic heritage (Section 4.1.3) and will be seen to be involved in European policies (Section 4.3.4).

4.3. The digitization of cultural heritage in Europe

4.3.1. The Italian context

A peculiarity of the Italian case compared to the Anglo-Saxon context is that new technologies for information and communication have enjoyed a widespread application in the academic field of art history and in the diagnostics, preservation and restoration of artworks, besides the cataloguing domain.

The first applications of computers to cataloguing date to the 1960s: in 1964, the famous art historian Giulio Carlo Argan promoted a study group - under the Ministry of Education and the National Research Council to propose the establishment of a national body in charge of cataloguing cultural heritage. The initiative was endorsed by the Ministry, which officially established the Italian Cataloguing Institute (ICCD) in 1975 with the task of converting information about collections and monuments that were preserved in analog format into digital records[84] (Signore, 2009). Although the Italian approach suffered from a five-years delay compared to analogue initiatives such as the Canadian National Inventory Program (see Section 4.1.1), over the following decades the ICCD rapidly asserted itself as an international centre of excellence in the field of automated cataloguing (Signore, 2009).

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[83] This aspect, and the likely consequences for further partnerships between the Government and not-for-profit organizations, is particularly underlined by the Bibliocracy blog: "there is no agenda to discredit well-meaning non-profit organisations as a societal force. If anything this argument can be inverted fairly neatly; if the people behind the scheme had not made such a mess of the negotiations and the ensuing media spectacle, we could have had an amazing precedent for a viable "third way" around heritage digitisation efforts in Canada. Instead, the amateurishness and uncoordinated nature of efforts by LAC, Canadiana, CARL, CRKN, CLA and others to stem the flow of bad PR stemming from this initiative may have placed it in serious jeopardy; if all the actors had been at least reading from the same playbook this would not have been possible. If there is indeed a "chilling effect" which muddies the waters for future public-private partnerships of this kind, it might perhaps be better laid at the feet of those who have failed to advocate effectively for it" (Bibliocracy, 2013b).

[84] The epistemological complexities of the initiative, which mostly stem from the interdisciplinary nature of the catalogue - which would include artistic and librarian heritage - are described by Signore (2009) and can be usefully compared to those highlighted by Parry (2007) in the Anglo-Saxon context.

In the meanwhile, the potential of computing technologies were promptly acknowledged in the academic field. The *First International Conference on Automatic Processing of Art History Data and Documents* was hosted at the Scuola Normale Superiore in Pisa in 1978, focusing on data description and automated cataloguing techniques. Over the following years, the opportunities offered by the availability of software capable to collect and compare large volumes of data on materials, themes and iconography provided the basis for the adoption of a new methodological approach to documentary analysis focusing on the historical, economic and geographic aspects of artistic production that was further developed at the Centre for the Automated Elaboration of Historical and Artistic Data and Document founded by art historian Paola Barocchi (Contini, 2010). Pilot projects resulted in the systematic cataloguing of heritage sites and the production of digital versions of historical sources, as well as the computation of 'frequency indexes' of keywords in canonical texts such as Vasari's *Lives*.

In the following decade, leading art historians such as Eugenio Battisti, Carlo Ludovico Ragghianti and Corrado Maltese experimented computer's assistance to morphological analysis, using the plotter in order to acquire graphical reproductions and schemes of the image and identify the geometrical patterns (lines, curves, points, whole figures etc.) and structure (Ragghianti, 1984; Maltese, 1988). Despite their differences, these approaches had in common an attempt to re-found or reform art history upon more scientifically 'objective' groundings (Cappellini, 1979; Ragghianti, 1984), thus reducing the sphere of emotional response and subjective interpretation that had previously characterized the discipline.

Advanced digital imaging techniques were also experimented since the 1980s in the Italian schools of restoration based in Rome and Florence to the purpose of acquiring, collecting and processing the data resulting from the diagnostic campaigns conducted with optical techniques such as scanning, spectroscopy and radiography. In this sense, the possibility of collecting information related to the state of degradation of the artwork, which could be integrated with standard museum cards, supported and facilitated the planning of restorative interventions (Stanco et al., 2011).

A related use of digital imaging software concerned the area of *virtual restoration*, that is the computer-based process of extending the effects of cleaning interventions conducted on samples of the pictorial surface to the whole artwork, whose results could serve as a basis for evaluating the potential effects of different techniques and as a guide for the actual restoration (Cappelini, 1979-1980).

Italian archaeologists were directly involved not only in the computerized collection and management of data from excavations, but also in the development of computer graphics for the 3D reconstruction of sites and buildings which they helped disseminate at an international level (Forte, 1997)[85].

In the 2000s, ongoing initiatives for the cataloguing of cultural heritage have been officially endorsed by the policy-maker through the *Code of Cultural Heritage and Landscape* (*Codice dei Beni*

[85] The debate on the role of computers in archeology found its main space in the review «Archeologia e calcolatori», founded in 1989 by Riccardo Francovich at the Institute for Etruscan and Italic Archaeology of the National Research Council, the first international publication to be specifically devoted to the issue.

Culturali e del Paesaggio) (Repubblica Italiana, 2004, art. 17). The actual implementation of the central catalogue, though, has been substantially delayed by the complex territorial articulation of the Italian administration - including the State, Regions and local administrative entities (Provinces and Municipalities) all of which are endowed with relevant and often overlapping competences in the cultural field - and is currently in progress.

The subsector wherein cataloguing and digitization have proceeded more easily is the librarian one, also thanks to the active involvement of the Ministry and the whole community in policy initiatives and research projects.

A first milestone in this direction was the realization, in 1999, by the General Direction for Librarian Heritage and Cultural Institutions of a feasibility study for the creation of a national digital library. In 2001, a Steering Committee for the Italian Digital Library was established gathering the representatives of national and regional libraries, museums and universities, with the task of coordinating existing activities, identifying priorities and defining common standards. In 2003, the Italian Digital Library was included as one of the pilot projects of the Ministerial Committee for the Information Society (CMSI) for the automation of the public sector and the development of the knowledge economy (Internet Culturale, nd). The following years saw the participation of the Italian Ministry to European thematic networks on digitization - especially the MINERVA network, that Italy coordinated since 2002 to 2005 - and projects for the coordinated management of librarian records - such as TEL and MICHAEL (see Section 4.3.2).

The main outcome of these initiatives was the launch of the portal *Internet Culturale* (2005), which was designed as a meta-catalogue of national public libraries and archives allowing users to retrieve bibliographical information and digital contents across different information sources (MINERVA, 2007), besides displaying a series of virtual exhibitions and 3D reproductions of heritage sites.

Within MINERVA's activities, moreover, the Ministry conducted a first national census of digital collections by involving the 20 Regions and 77 Universities. The resulting contents would be made available through a new web-portal named *Cultura Italia*, which would act as an aggregator for the Italian (physical and digital) cultural heritage (MINERVA, 2007). Particular attention was devoted to standards interoperability[86], in order to allow public and private museums, libraries and archives to submit directly their metadata to the portal.

The first version of Cultura Italia, launched in April 2008, included a geo-referenced catalogue and a thesaurus of metadata, integrated with editorial contents, a range of cultural itineraries and directories of selected cultural websites. However, the portal was the target of criticism by an inquiry of the Presa Diretta national TV broadcast in February 2012, which highlighted its unfriendliness to the non-expert user and to the poor performance of search engines compared to the total cost of the portal (9 million euro, that included though also the implementation of institutional websites and the digitization collections). Similarly, a survey on users carried out in 2009 revealed that, although

[86] To this purpose, the same standards and protocols defined for the MICHAEL project (see Section 4.2) were adopted.

the portal received a good evaluation in terms of accessibility and usability, Cultura Italia was seen as a point of reference more for specialists than general users (Natale, 2009).

Also thanks to these inputs, a renovation was completed in 2012, adding new multimedia contents besides a more efficient, open-source search engine with semantic search features. The site has been also enriched with Web 2.0 facilities, such as the possibility to rate and comment the contents, to share them on social networks, and to personalize pages by selecting favourite themes and categories. To April 2012, the number of digital items available amounted to 2.5 millions, that were set to reach 4 millions by the end of the year (MIBAC, 2012). The collections are also provided to Europeana (see Section 4.3.2) so increasing the Italian contribution which is still lagging behind those of France and Germany[87].

In March 2010, the Italian Ministry for Cultural Goods and Activities and Google have announced a partnership for the digitization of about 1 million books falling under the public domain and preserved by the National Libraries of Rome and Florence. The costs of digitization will be covered by Google and matched by a public funding to the production of metadata, for a total investment of about 2.3 million euro. A clause of the contract specifies that Google will provide the two libraries with the digital copies of each book included in the project, so that these can in turn be made available on Europeana. However, operations have effectively started only in 2012 due to administrative as well as technical difficulties, including the time required by Google for implementing a scanning centre in Rome (BNCR, 2012).

Within the renovation project of Cultura Italia, a further project named MuseiD-Italia was financed within the eGov 2012 Framework of the Department for Innovation and Technology of the Ministry of Public Administration. The main aim was to create a section within CulturaItalia specifically dedicated to museums. MuseiD-Italia[88] aims to become a comprehensive registry of all the art galleries, monuments and archaeological sites located on the national territory, where users can search information on opening hours, the range of services provided, the collections as well as highlights and updates on temporary exhibitions and events. The portal also offers museums a digital preservation service (Teca Digitale Italiana) where the metadata and digital objects uploaded by institutional users are stored and archived in different formats.

On 2 August 2013, the Italian Government announced that, under the new bill Decreto Valore Cultura, the Ministry of Cultural Heritage and Activities will recruit up to 500 1-year interns in the digital cataloguing of the national cultural heritage. The bill includes the "implementation of integrated knowledge systems through the production of digital resources based on the digitization of images and reproductions of heritage in its diverse components", through the involvement of the national librarian and archival systems, Cultura Italia and the technical support of the Agency for Digital Italy (Camera dei Deputati, 2013). The initiative is also specified to be consistent with the directives of the Digital Agenda for Europe.

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[87] At 27 April 2012, Italy was the fourth contributing countries with almost 2.2 millions objects, ranking after France (3.7), Germany (3.4) and Sweden (2.3) (Europeana, nd b).

[88] http://www.culturaitalia.it/opencms/museid/index_museid.jsp

Despite the variety of experiments in place in the academia and in the public administration, however, the adoption of ICT in the museum sector as a support to visitor communication has been relatively slow and presents a series of criticalities compared to Anglo-Saxon countries.

The first websites of Italian museums mostly consisted in "electronic shop-windows"(Micelli et al., 1998, p. 256) with promotional aims and little coordination with other communication channels, whilst the initial interpretation of the virtual museum amounted substantially to the creation of static replicas of physical galleries (Antinucci, 1998; Feliciani, 2010). The first country-wide survey (Vorrasi, 2003) confirmed this observation showing that less than the half of Italian art galleries had a website, whose contents were limited in most cases to a general presentation card and a list of services and educational activities. Only a smaller number of sites allowed to download learning materials or to navigate thematic paths based on hypertext language (Vorrasi, 2003).

In this context, the prevalence of a strictly 'reproductive' (Antinucci, 1998) use of new technologies attracted criticism raised on part of humanists and museologists about the possible devaluation of the value of tangible cultural objects when replaced by their immaterial reproduction[89] (Pinna, 2005). Moreover, it overshadowed an alternative use of new technologies, that according to some authors consisted in the possibility "to overcome the rigid logics of the museum path, in favour of a higher flexibility in the relationship with the demand" (Micelli et al., 1998, p. 252) and in a 'productive' use of ICTs aiming to extend the existing modalities of arrangement and exhibition (Antinucci, 1998). The main requirement for this transition would consist in an overall re-conceptualization of established museological criteria and a new attitude targeted to the identification of "new and alternative keys of interpretation" (Micelli et al., 1998, p. 252).

Antinucci (2007) has identified the main causes that prevented Italian museums from making an optimal use of ICTs.

First, the experimentation of new modalities of communication and interpretation was hampered by the prevalence of a technology-driven approach to innovation that privileged the development of cutting-edge solutions over the production of contents, the identification of user needs and long-term sustainability. Second, the limited involvement of humanists and curators in digitization projects, also due to the scarcity of IT-trained staff in cultural institutions, reduced museums to play a role of mere content providers, renouncing to intervening in the very conceptual design of technological applications (Antinucci, 2007).

Furthermore, Italian museums - with the partial exception of large institutions of science and contemporary arts - have showed a certain reluctance towards adopting the instruments of the Web 2.0, remaining "tied to a top-down communicational vision and to a limited involvement of the

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[89] "[...] l'aberrazione di sostituire un museo con un CD o con un portale internet mostra tutta la sua evidenza nel confronto fra una vera visita a un vero museo, fisicamente reale, e la visita virtuale on-line alle sue sale e alle sue collezioni. Nel primo caso il visitatore diviene parte di uno spazio fisico, si confronta con oggetti materiali e dialoga con i loro significati simbolici. Egli ha in questo dialogo un'esperienza fisica, reale e tangibile. Nel secondo caso il rapporto del visitatore è con uno schermo piatto su cui può far scorrere le immagini degli oggetti e le relative didascalie. Lo schermo è tuttavia una superficie che non mostra realtà ma solo rappresentazioni, ne deriva che la visita virtuale on-line a un museo non è un'esperienza, ma solo la rappresentazione di un'esperienza" (Pinna, 2005, p. 1).

user" (Bonacini, 2012, p. 116, own translation - even though the author's observation rests on a rather uncritical reception of the Social Web discourse).

Overall, thus, the Italian museum sector represents an exception to the Anglo-Saxon scenario of digitization, as its approach to new technologies has been rooted in a specific vision wherein the cultural artifact and the collection maintain their centrality.

4.3.2. Towards an European digital library

As it has been highlighted, the digitization of Italian cultural heritage has seen an acceleration within European policies, to which Italian Governments have actively participated since the 1990s.

Besides Italy, a leading role in promoting the digitization of European heritage has been played by France, where in 1996 - in the context of the projects for the expansion of the Bibliothéque Nationale Francaise (BNF) - Jacques Attali had proposed to create a digital national library that would gather the collections of individual heritage institutions (Tessier, 2010). Although this ambitious goal was bound to be fulfilled only a decade later, a first step into this direction was represented by the 'Gallica' project, which in 1995 had started the selective digitization of the most valuable items of the BNF's collections. These initiatives received the political endorsement of leading political characters - among whose Francois Mitterrand (Tessier, 2010) - who welcomed the insertion of Francophone cultural contents on the Internet as a balance to the dominance of English cultural industries and contents on the Web - thus presenting relevant similarities with the case of Québec (Section 4.1.4).

Against this background, Europe-wide initiatives were started in the 2000s with the objective of coordinating and integrating the approaches taken individually by member States, avoiding fragmentations and duplications of efforts.

In 2001, a first National Representatives Group (NRG) on digitization policies was formed gathering national institutions, with a six-month meeting schedule. At a NRG meeting held on 4 April 2001, under the Swedish EU-Presidency, the so-called Lund Principles were adopted and were then further developed in the Lund Action Plan, that recommended Member States to:

- establish an evolving forum of coordination;
- to support the development of a European view on digitisation policies and programmes;
- to develop mechanisms to promote good practice and skills development;
- and to collaborate to make the digitised cultural and scientific heritage of Europe visible and accessible (MINERVA, 2006).

The MINERVA (MInisterial Network foR Valorizing Activities in digitization) project - participated by all the National Ministries of Culture and coordinated by the Italian Ministry of Cultural Goods and Activities - was launched in 2002 within the IST (Information Society Technologies) Framework in order to translate these goals into practice.

On the 19th November 2003, under the Italian Presidency, the Parma Charter (MINERVA, 2003) was adopted with the aim of strengthening the group's mission, obtaining a political acknowledgement at the highest political levels in Europe and promoting the adoption of international recommendations and guidelines. The final product of the NRG was published in 2005 under the British Presidency with the title *Dynamic Action Plan for the EU co-ordination of digitisation of cultural and scientific content*, which outlined the following objectives:

- Providing strategic leadership in a dynamic and changing environment in which rapid technological and economical developments are taking place;
- Strengthening co-ordination and forging stronger links between Member States' digitisation initiatives, EU networks and projects;
- Continuing efforts in overcoming fragmentation and duplication of digitisation activities and maximising synergy;
- Assessing and identifying appropriate models, funding and policy approaches to sustain development and long-term preservation strategies;
- Promoting cultural and linguistic diversity through digital content creation;
- Improving online access to European cultural content (MINERVA, 2006).

In this context, the MINERVA network, which was extended in 2004 as MINERVA Plus, and in 2006 as MINERVA EC, worked to the definition of common guidelines and best practices, to the creation of a common platform for access to digitized materials, as well as to issues of multilingualism and interoperability of standards.

The recommendations and coordination activities undertaken in the 2001-2005 period gradually converged towards the idea of creating a unified European digital library, a goal that received relevant endorsements by Member States in the context of the attempts made by Google in the digitization of librarian heritage through the Book Search project (originally started in 2004 as Google Print).

Case History 2: Google Books Search

The Google Book Search (now Google Books) project initially regarded the digitization of the off-copyright works held by national libraries, through individual agreements with the institutions. The works were integrally scanned and integrated by metadata so that they could be searched through the Google engine and downloaded in full-text pdf format. However, also orphan works (i.e. works whose right-holders cannot be identified) were digitized, raising contentions and legal controversies especially with France (Tessier, 2010)

In a second phase, the project was extended to copyright-protected and new works without explicit agreements with the publishers, though only a selection of pages was made accessible to the user.

In September 2005, the US Authors Guild filed a class action lawsuit against Google for alleged "massive copyright infringement". In response, Google invoked the principle of *fair use* of digitized works - that is, a limitation to copyright for scientific or creative, non-commercial purposes (Fisher, 1988) - whilst temporarily suspending scanning copyrighted works to allow for changes to the program and allow copyright owners to submit lists of books they wished to be excluded (*opting out*).

A first settlement between the parties was agreed in October 2008, called for Google to pay $125 million to compensate authors and publishers, releasing in turn Google and its library partners from liability. The Settlement met criticism for its approval of Google's monopoly over the exploitation of works in the common domain (Sag, 2010) and was amended the following year, limiting the systematic digitization to books published in Anglo-Saxon countries (US, UK, Canada and Australia) or registered at the American Copyright Office. However, the amended settlement was rejected by the court in 2011.

In the meanwhile, the number of digitized works had risen steadily, reaching a volume of 10 millions in 2010 and driving a significant share of traffic to Google's search engine and other services. Although no advertisings announcements or banners are inserted into Books Search's results, links to e-retailers that distribute the books (such as Amazon) are provided.

On November 14, 2013 the judge has dismissed the Authors Guild's lawsuit, endorsing Google's scanning program on the basis of the fair use principle (Albanese, 2013). For the Judge, "[Google Books] has become an invaluable research tool that permits students, teachers, librarians, and others to more efficiently identify and locate books [...]. It has given scholars the ability, for the first time, to conduct full-text searches of tens of millions of books. It preserves books, in particular out-of-print and old books that have been forgotten in the bowels of libraries, and it gives them new life. It facilitates access to books for print-disabled and remote or underserved populations. It generates new audiences and creates new sources of income for authors and publishers. Indeed, all society benefits" (Judge Chin, quoted in Albanese, 2013).

Whereas the librarian community has expressed consistent support to the ruling, the Authors Guild has announced that it will appeal against it.

An open letter signed on 16 March 2005 by the French President Jean Chirac encouraged the Ministry of Culture and the National Library to commit to the diffusion of the librarian heritage with the help of new information technologies (Le Monde, 2005). They produced a general statement signed by national libraries in Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Lithuania, Luxembourg, Netherlands, Poland, Slovenia, Slovakia, Spain and Sweden, whose contents were recalled, on 28 April 2005, in a letter addressed to the Luxembourg Presidency of the European Council by 6 European countries (France, Germany, Hungary, Italy, Poland and Spain).

On 3 May 2005, the Commission responded announcing that it would accelerate its policy of preservation and exploitation of Europe's written and audiovisual heritage through the creation of a centralized digital library.

The announcement was followed by the release, on 30 September 2005, of the Commission's Communication *i2010: Digital Libraries* (EC, 2005), which outlined the vision underlying the digital libraries initiative, and later in the *Recommendation of 24 August 2006 on the digitisation and online accessibility of cultural material and digital preservation* (EC, 2006a). Both documents called member states

to develop quantitative targets for the digitization of analogue materials not only in the librarian, but also in the artistic domain, and cooperate to the creation of a common access point.

Under the pressure of Google's moves, the official endorsement of a common library marked a shift from the initial 'selective' approach to digitization that had characterized early national projects such as Gallica, to a 'mass digitization' objective that envisioned a full accessibility of European heritage on the Internet.

The Commission's policy initiatives also connected with the projects conducted by the Conference of European National Libraries - GABRIEL (Gateway and Bridge to Europe's National Libraries, 1997-2000) and TEL (The European Library, 2001-2004)[90] - which had laid the technical foundations for developing a central repository of the catalogues and collections held by national libraries. Further improvements in this direction were then made through MICHAEL (MultiLingual Inventory of Cultural Heritage in Europe) - started in 2004 under the Italian coordination with the participation of France and the UK and extended to other 11 member countries through MICHAELPlus (2006-2008). The project aimed explicitly to create an European information space for providing access to digital cultural collections of librarian and audio-visual nature, through the promotion of interoperability between national portals. The main outcome was a meta-catalogue of digital collections and digitization projects, which allowed to draw an overall map of digitization activities over the Continent.

Under the 6th Framework Programme (2002-2006) a group of research projects and networks of excellence were also financed by the European Commission with the objectives of gathering and coordinating professional communities in the application of software infrastructures to digital libraries, among whose BRICKS (Building Resources for Integrated Cultural Knowledge Services) and DELOS (A Network of Excellence on Digital Libraries). These were integrated by more specific projects, such as CALIMERA (Cultural Applications: Local Institutions Mediating Electronic Resource Access) whose aim was to raise awareness among local cultural institutions on issues of usability of digital heritage, and MULTIMATCH (Multilingual/Multimedia Access to Cultural Heritage, FP7), which aimed to develop a multilingual search engine specifically designed to access, organise and personalise presentation of cultural heritage information in a semantic-web manner (CORDIS, 2013).

Policy initiatives were intensified in 2007. In February, the Commission established a High Level Work Group gathering cultural institutions, publishers, technology firms and academics to address issues of interoperability, copyright management, public-private partnerships and provision of scientific information. In November 2007, the Europeana Foundation was established by representatives of the main national Ministries and cultural institutions - mostly belonging to the

[90] TEL involved the National Libraries of Finland, Germany, Italy (Biblioteca Medicea Laurenziana in Florence and Biblioteca Nazionale in Rome), Netherlands, Portugal, Slovenia, Switzerland and United Kingdom, which were later joined by other 10 institutions belonging to newly entered Member States through the TEL-ME-MOR extension (2005-2007).

librarian sector[91] - to provide the organisational structure of the digital library. A static demonstration site of Europeana was publicly presented in February 2008 at a conference in Frankfurt, whilst the first prototype was launched in November 2008 (Europeana, a).

Although the librarian sector has played a role of leadership in the advocacy and technical development of Europeana, the initiative has rapidly involved the museum sector, whose digital collections represented a significant share of the portal's contents[92].

From a technical standpoint, the organization of Europeana is moulded upon the protocol defined in the MICHAEL project: adhering institutions supply descriptive information (metadata) relating to their digital contents, which are stored and made centrally accessible through the Europeana web-portal. Metadata allow users to locate the collections and be re-directed to the institutions' websites, where the actual digital collections are hosted.

Under this light, the core requirement for the establishment of a central registry of cultural resources has been the definition of a common inter-operative standard for metadata, the first steps of whose had been laid by TEL. These were further elaborated by the Europeana network, leading to the adoption of the European Data Model (EDM). The Europeana Professional web portal[93] offers guidelines and support to institutions willing to map their data into EDM.

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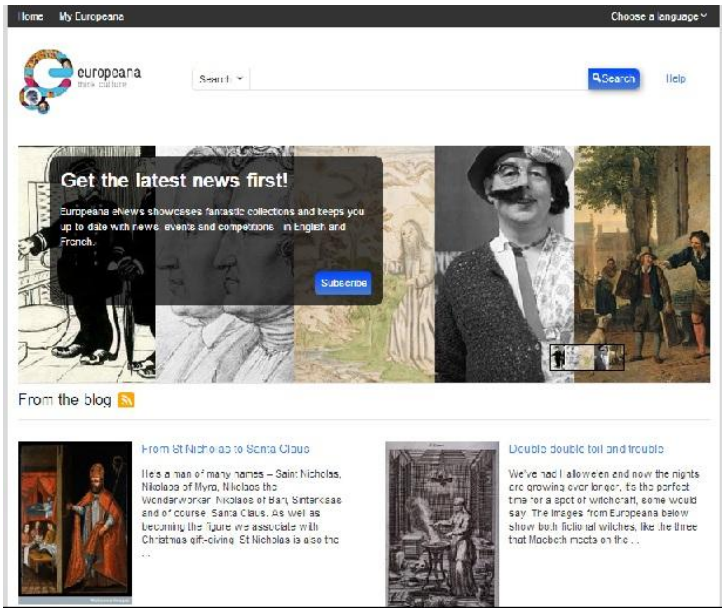
[91] The founding members are the National Libraries of Spain, France and the Netherlands, besides the Spanish Ministry of Culture and he French National Institute of the Audio Visual. In a further step, the main sector associations have entered the Board: Association Cinémathèques Européennes (ACE), Conference of European National Librarians (CENL), Consortium of European Research Libraries (CERL), European Museum Academy (EMA), the European Museum Forum (EMF), the European Regional Branch of the International Council on Archives (EURBICA), the International Federation of Television Archives (FIAT), International Council of Museums Europe (ICOM), the International Association of Sound and Audiovisual Archives (IASA), Ligue des Bibliothèques Européennes de Recherche (LIBER), MICHAEL network, the Network of European Museum Organisations (NEMO), Open Access Publishing in European Networks (OAPEN), European Association of History Educators (EUROCLIO) and National Authorities on Public Libraries in Europe (NAPLE).

[92] At the launch in 2008, Europeana counted a total of 6 million object, only 200,000 of whose consisted in books (Tessier, 2010, p. 7).

[93] pro.europeana.eu.

Figure 8: Europeana homepage.



Source: www.europeana.eu [accessed 7 December 2013].

After the launch of Europeana, the Commission has constantly tried to sustain the Member States' efforts in the digitization of librarian, archival and museum collections.

In April 2010, a High Level Reflection Group (Comité des Sages) composed by three leaders in the librarian and publishing sectors[94] was assigned the task of making recommendations to the Commission, cultural institutions and stakeholders, on "ways and means to make Europe's cultural heritage and creativity available on the Internet and to preserve it for future generations, looking in particular at funding sources, at how cultural organisations and the private sector can interact in the digital age" and addressing issues of copyright management - with particular attention to the problem of orphan works[95]. The Comité delivered in January 2011 a final report that stressed the economic and societal benefits of bringing the European cultural heritage online, endorsing plans for the further development of Europeana (Comité des Sages, 2011).

After a public consultation process, on 27th October 2011 the European Commission adopted the suggestions of the Reflection Group through a *Recommendation on the Digitisation and Online Accessibility of Cultural Material and Digital Preservation* (EC, 2011a), which addresses issues of organization and funding, encouraging further measures for the preservation of digital materials. A

[94] Namely, Maurice Lévy (Chief Executive Officer of Publicis) and Elisabeth Niggemann (Director General of the German National Library) and Jacques De Decker (writer).

[95] Analogue-born works whose rights owner cannot be located, making it impossible to get consent for using or distributing the work, are defined as 'orphan'. These had been identified by the European Commission as one of the main barriers against a mass digitization of cultural heritage, especially in the librarian and audio-visual sector. In 2008, a report (Vetulani, 2008) has been commissioned to find legal solutions to increase their distribution. Consistently, the 'New Renaissance' report has encouraged the adoption of a common legal instrument to address the situation.

newly established Member States Expert Group (MSEG) has been tasked with coordinating and monitoring the application of the Recommendation.

4.3.3. A discourse analysis of European digitization policies

The digitization of cultural heritage and the development of the European digital library have been financially sustained by the Commission through two distinct groups of initiatives: on one side, R&D projects for the implementation of digitization-related technological solutions and, on the other side, projects and networks for the actual digitization of cultural contents.

The former have been financed through the IST (Information Society Technologies) and ICT (Information and Communication Technologies) Programmes of the 6th and 7th Framework Programme respectively in the 2002-2005 and the 2006-2012 periods (CORDIS, 2013). The overall amount of funding devoted to digitization technologies represents a marginal share of the two Programmes, absorbing respectively the 0.62% and the 0.36% of their overall budget (our elaboration).

Within the 6th Framework Programme, the most represented areas of research (as to the end of 2011) are represented at TABLE 14.

Table 14: Main areas of research related to the digitization of cultural heritage in FP6.

Area	Projects	Main objects
Digital preservation	APARSEN, ARCOMEM, BlogForever, DPE -DigitalPreservationEurope, CASPAR, ENSURE, KEEP, LiWA, PLANETS, PrestoPRIME, PROTAGE, SHAMAN, SCAPE, TIMBUS, Wf4Ever	Methods and systems for ensuring availability of digital resources over time, through novel concepts, techniques and tools, such as portable emulators, workflow modelling or social media analysis"
Digital cultural experiences	3D-COFORM, ARtSENSE, AXES, CHESS, CINeSPACE, CULTURA, DECIPHER, EPOCH, ISAAC, iTACITUS, MOSAICA, PATHS, P2P-FUSION, QVIZ, V-City)	Exploration of leading edge technologies (e.g. knowledge management systems, semantic tools, graphics, interfaces, novel displays) empowering applications that improve the meaningful use of cultural resources and the experiences users get from visits of museums and sites
Information retrieval and use	CONTRAPUNCTUS, EASAIER, ethnoArc, IMAGINATION, MEMORIES, MultiMATCH, PAPYRUS, QVIZ, Treble-CLEF)	Methods and tools for (semi)automatic indexing and semantic annotation of non-textual objects (music, speech, image
Virtual heritage	AGAMEMNON, CINeSPACE, EPOCH, TNT, VENUS, V-MusT.net)	ICTs for capturing, rendering, modelling and visualising cultural artefacts support both study and creative use of these artefacts, and their aggregation into virtual collections.
Digital libraries	BRICKS, CALIMERA, DELOS, DL.org, MINERVAplus, TEL-ME-MOR	Creation of scalable and interoperable platforms supporting digitisation and retrieval of heterogeneous content, in multimedia formats, from distributed collections and across languages.
Digitisation technologies	3D-COFORM, EPOCH, IMPACT, PRESTOSPACE	ICTs for large-scale digitisation. Tools and methodologies ranging from recognition and enhancement of printed text and audiovisual material to ICTs for capturing and rendering non-textual cultural artifacts.
Web Archiving	LiWa	Preservation and long-term accessibility of Web history.

Source: Author's elaboration on CORDIS, 2013.

Table 15: Framework for the funding of research projects on digitization and the digitization of cultural contents.

Programme	Call	Period of opening	N. funded projects[96]	Co-funding to digital heritage (millions euro)
FP6	IST 1	2002-2003	8	37.7
	IST 2	2004	1	
	IST 5	2005	16	42
Total FP6			**25**	**79.7**
FP7	ICT 1	2006-2007	6	27.6
	ICT 3	2007-2008	5	23.5
	ICT 6	2009-2010	15	69
	ICT 9	2011-2012	22	70[97]
Total FP7			**48**	**110.1**
eContentPlus		**2005-2008**	**51**	**149**
ICT-PSP	Theme 2	2009	8	26.5
	" "	2010	8	30
	" "	2011	11	40
	" "	2012	n.a.	24
Total eContent Plus and ICT-PSP				**243**

Source: Author's elaboration on CORDIS, 2013; EC, 2008; EC, 2010c; EC, 2011b; EC, 2011c; EC, 2012a.

The actual digitization of cultural contents and initiatives for the development of Europeana were co-financed by the Directorate-General for the Information Society and Media through the eContentPlus (2005-2008) programme, whose overall budget of 149 million euro supported the establishment of best practice and thematic networks on the digitization of geographic (30% of the budget); educational (20%); cultural and scientific/scholarly contents (50%) (EC, 2008).

Since 2009, digitization projects and networks related to Europeana have been financed through a dedicated Digital Libraries strand (EC, 2010c) - renamed in 2010 as Digital Content - within the Policy Support Programme (ICT-PSP) of the Competitiveness and Innovation (CIP) framework (EC, 2011b). TABLE 16 reports EU-funded projects specifically referring to the development of Europeana and its provision with cultural contents.

[96] Includes best practice and thematic networks as well as Pilot A and B projects (in the ICT PSP Programme).

[97] The total sums the funding of the "digital preservation" axis (30m€) to that of " ICT for access to cultural resources" (40m€).

Table 16: Research projects, best practice and thematic networks related to Europeana.

Acronym	Programme	Coordinator	Period	EU funding (m euro)
Content-providing projects				
APENET	eContentPlus	Spain	2009-2011	3.10
ATHENA	eContentPlus	Italy	2008-2011	2.40
BHL-Europe	eContentPlus	Germany	2009-2012	3.36
CARARE	ICT-PSP 2009 2.2	Denmark	2010-2013	4.30
DCA	ICT-PSP 2010 2.3	Belgium	2011-2013	1.97
ECLAP	ICT-PSP 2009 2.2	Italy	2010-2013	3.40
EFG	ICT-PSP 2010 2.3	Germany	2008-2011	4.50
EFG1914	ICT-PSP 2011 2.2	Germany	2012-2014	2.10
EUScreen	eContentPlus	Netherlands	2009-2012	4.30
EURO-Photo	ICT-PSP 2009 2.3	Italy	2010-2012	2.30
Europeana1914-1928	ICT-PSP 2010 2.3	UK	2011-2014	2.70
Europeana Fashion	ICT-PSP 2011 2.1	Italy	2012-2015	2.65
Europeana Libraries	ICT-PSP 2011 2.2.	Netherlands	2011-2012	3.10
Europeana Regia	ICT-PSP 2009 2.3	France	2010-2012	1.70
EuropeanaLocal	eContentPlus	UK	2008-2010	3.44
EuropeanaPhotography	ICT-PSP 2011 2.2.	Italy	2012-2015	2.55
EuropeanaTravel	eContentPlus	Estonia	2009-2011	1.40
HOPE	ICT-PSP 2009 2.2	Netherlands	2010-2013	2.65
Judaica Europeana	eContentPlus	Germany	2010-2011	1.50
Linked Heritage	ICT-PSP 2010 2.2	Italy	2011-2013	3.10
MIMO	eContentPlus	UK	2009-2011	1.60
Natural Europe	ICT-PSP 2009 2.5	Greece	2010-2013	2.35
Open Up!	ICT-PSP 2010 2.2	Germany	2011-2014	3.50
TELPlus	eContentPlus	Estonia	2007-2009	3.25
thinkMOTION	ICT-PSP 2009 2.3	Germany	2010-2013	2.20
Total funding				**69.42**
Technology and content-providing projects				
APEx	ICT-PSP 2011 2.1	Netherlands	2012-2015	4.45
DM2E	ICT-PSP 2011 2.1	Germany	2012-2015	2.10
EuropeanaAwareness	ICT-PSP 2011 2.3	Netherlands	2012-2014	4.00

EuropeanaCloud	ICT-PSP 2012 2.1	Netherlands	2013-2016	3.80
EuropeanaCreative	ICT-PSP 2012 2.1	Austria	2013-2015	4.25
EuropeanaInside	ICT-PSP 2011 2.1	UK	2012-2014	3.20
EuropeanaNewspapers	ICT-PSP 2011 2.1	Germany	2012-2015	4.12
Europeana v1.0	eContentPlus	Netherlands	2009-2011	6.20
Europeana v2.0	ICT-PSP 2010 2.1	Netherlands	2011-2014	9.00
Total funding				**41.12**
Technology-providing projects				
ARROW	eContentPlus	Italy	2008-2011	2.55
ArrowPlus	ICT-PSP 2010 2.4	Italy	2011-2013	4.50
ASSETS	ICT-PSP 2009 2.1	Italy	2010-2012	4.25
EuropeanaConnect	eContentPlus	Austria	2009-2011	4.50
LoCloud	ICT-PSP 2012 2.1	Norway	2013-2016	3.40
PATHS	FP7 ICT 2009 4.1	UK	2011-2013	2.30
PRELIDA	FP7 ICT 2007 4.3	Italy	2013-2014	0.77
PrestoPrime	FP7 ICT 2012 9	France	2009-2012	8.00
Total funding				**30.27**
Overall funding				**140.2**

Sources: Europeana, 2013; EC, 2008; EC, 2010c; EC, 2011b; EC, 2012a.

The above listed projects have been integrated by a total co-funding of 70 million by national Ministries (Europeana, 2012e). Although additional funding to culture may be provided by Structural Funds, no specific strands have been opened for the digitization of cultural heritage, making it impossible to quantify precisely the extent of the support.

Evidence that, after its 'Europeanization' (Paul, 2012), the digitization of cultural heritage has been subsumed under the competences and funding of Information Society framework programmes instead of properly cultural policies and frameworks - such as the Culture Programme - calls for a preliminary analysis of the core assumptions and arguments of the EU's Information Society policy discourse before assessing its relations with, and impacts on, the cultural sector.

Some authors (Garnham, 2000; Goodwin and Spittle, 2002; Servaes, 2003) have ascribed the remarkable influence exerted by the Information Society and Knowledge Economy concepts in European policies to the attractiveness of a technologically determinist argument that identifies ICT as the main driver of economic growth and societal transformations (Bell, 1973; Webster, 1995; Castells, 1996; Garnham, 2000). Emphasis on immaterial communication networks thus provided an appealing 'imaginary' for overcoming the dramatic socio-economic consequences of the de-industrialization process that had affected Europe in the 1990s, and has consistently informed policy strategies at different territorial scales - from the local to the national or supra-national - and in different sectors - from industrial production to welfare, health and education (Jessop, 2004).

The first milestone of a coordinated European approach to the Information Society was represented by the so-called *Bangemann Report* (EC, 1994), wherein ICT was defined as "the prime generator of the digital or information society" (p. 233). Technological evolution, though, was presented both as a "threat to traditional forms of European society (the nation-state, local and regional cultures)" and "an opportunity to strengthen those societies" (*ibidem*). In particular, the rapid diffusion of ICT in other areas of the Western world was considered as a major competitive challenge for the Union, which was called to take action by de-regulating the telecommunications and audiovisual markets - adopting a substantially neo-liberal model (Goodwin and Spittle, 2002).

The same core arguments can be seen to inspire following policy initiatives.

The *i2010 Framework for an European Information Society*, launched in 2005 by Commissioner Viviane Reding as part of the Lisbon Strategy for Growth and Employment, aimed to provide an "answer to the fast-moving changes in technologies and global markets brought about by digital convergence" through "a package of proactive policies to improve the competitiveness of Europe's information society and media industries" (EC, 2006b). A key component of the strategy was the creation of a Single European Information Space based on the common regulation of communication networks and the free circulation of digital contents and services.

The latest update of European policies for the Information Society is the Digital Agenda for Europe, launched in 2010.

The opening statement that "Europe's future sustainable growth and competitiveness depends to a large extent on its ability to embrace the digital transformation in all its complexity" (EC, 2012b, p.2) closely resonates with the main premises of the Bangemann Report. Likewise, technological evolution is portrayed in the document as an exogenous force to which both public institutions and the private sector must adapt. A call for action is thus issued to accelerate the Union's response to the challenge, in particular regarding investments in technical infrastructure and the implementation of the Digital Single Market:

> *"the EU is not positioning itself well enough to benefit from these digital developments. It risks losing out in global competitiveness, economic growth and societal development. [...]*
>
> *The Digital Single Market remains fragmented, with public service infrastructures and online commerce still being determined by national territories. Investment in public and industrial research, development and innovation is falling well short of the target. Inaction in any of these areas is not an option for the EU" (ibidem).*

Adopting Fairclough's method of identification of practical arguments, the general discursive structure of European policies for the Information Society can be summarized as in TABLE 17.

Table 17: Practical arguments in EU Information Society policies according to Fairclough's (2013) method.

Value premise	The main goal of EU policies is to increase the economic competitiveness of the area
Circumstantial premise	ICTs have emerged as the main factor of economic competitiveness in the globalized world, but the EU is lagging behind
Goal premise	The EU must increase its competitiveness by seizing the opportunities offered by new information networks
Means-goals premise	The development of technical infrastructure for access to, and exchange of, information ('information superhighways') will increase the Union's competitiveness in the global scenario
Claim-Conclusion	The EU should devote increased efforts in establishing a common Information Space and Digital Market for the exchange of information

Source: Author's elaboration.

Against this background, the ongoing initiatives towards the creation of a single digital space or market may offer an additional interpretive key for the creation of a European digital library.

In this perspective, economic arguments concerning ICT's capability to generate employment and growth seem to have complemented and gradually outweighed the prevalently cultural motivations that led member countries to involve in the initiative - such as Italy's focus on knowledge and access to collections, and France's emphasis on the preservation of the national identity on the Internet.

This opposition is even more striking when considering the arguments expressed by the cultural institutions that had been consulted in the DIGICULT study in 2001-2002, in the initial phase of digitization policies. The final Report, echoing concerns about the potential utilizations of digital heritage, stressed "the importance of education as the most promising and therefore most significant area of future use" (EC, 2002, p. 64):

"education should become the focus of every digitisation policy and a central point in every cultural heritage policy. For example, when selecting material for digitisation and producing new cultural heritage resources, memory institutions should follow a multipurpose approach focusing on education. This kind of "education pull" should always be a part of the strategy" (ibidem).

"Beyond the obvious economic benefits of a well-educated population", education was argued "to play a crucial role fostering integration and mutual understanding among citizens". Consistently, a clear priority was assigned by the stakeholders to the cultural over the economic values of heritage, in explicit opposition to the Information Society discourse:

"Increasingly, cultural organisations and their activities which until now have been regarded as separate from commercial, profit-oriented considerations, are evaluated in economic terms, having business models in mind that would allow for a "monetarisation" of symbolic cultural goods in the Information Society. Yet, this view needs to be reconsidered, paying attention to the fact that, on the one hand, what national governments are paying for goes far beyond an economic value, and on the other hand, that commercial success stories in the cultural heritage sector so far have been rare [...].

What governments need to understand is that the value of cultural heritage resources and the benefit that is gained in building and maintaining digital cultural heritage repositories goes beyond the economic value. In fact, it is these other cultural

value characteristics and the "intellectual exploitation" that are the true value of cultural heritage. This does not mean to totally ignore market opportunities, but it implies to maintain a realistic view on the exploitability of cultural heritage resources and the return on investment" (pp. 69-70).

The view, after initially inspiring the participation of cultural institutions and State members to digitization policies, seems to have later gradually receded into the background under the increasing influence of the Information Society.

The coexistence of the two orders of argumentation is exemplified by the Recommendation of August 2006. At Art. 6, the contribution of digitization to preservation, access and cultural identity was acknowledged:

"The online accessibility of cultural material will make it possible for citizens throughout Europe to access and use it for leisure, studies or work. It will give Europe's diverse and multilingual heritage a clear profile on the Internet, and the digitisation of their assets will help Europe's cultural institutions to continue carrying out their mission of giving access to and preserving our heritage in the digital environment" (art. 6).

An economic argument that would prevail in further digitization policies, though, was introduced in the following article:

"Moreover, the digitised material can be reused – for both commercial and non-commercial purposes – for uses such as developing learning and educational content, documentaries, tourism applications, games, animations and design tools, provided that this is done with full respect for copyright and related rights.

This will give an important input to the creative industries, which account for 3,3% of EU GDP and 3% of employment. These industries are faced with a digital transition that is shaking up traditional models, transforming value chains and calling for new business models. Digitising and providing wider access to cultural resources offers enormous economic opportunities and is an essential condition for the further development of Europe's cultural and creative capacities and of its industrial presence in this field" (art. 7).

It should be noted that - with relative disconnection from the intense academic debate existing in the policy and academic domain (UNCTAD, 2010; Lazzeretti, 2012c) - European policies for the creative industries have adopted an operational definition of "those industries which use culture as an input and have a cultural dimension, although their outputs are mainly functional" (EC, 2010a, p. 6) - whilst cultural industries including "traditional arts sectors and cultural heritage" (EC, 2010a, p. 5) play the role of providing those inputs.

According to Garnham (2005), the currency gained by the 'creative industries' within European economic policies is closely related to the influence of the Information Society discourse. In particular, the creative industries are presented at the same time as the main drivers and beneficiaries of technological innovation, emphasizing the potential of emerging digital value chains and business models to improve the distribution of creative products and activate cumulative innovation processes (KEA, 2006, pp. 135-144; EC, 2010a). Similarly to UK policies and opposite to the DIGICULT's emphasis on cultural value, in this case "it is [...] innovation or creativity 'spill-over', and not the intrinsic or substantive economic and cultural value, that is the prize to be gained

from the promotion of the cultural economy" (Jeffcut and Pratt, 2009, quoted in Oakley, 2009, p. 408).

Consistently with the input-output relation postulated between cultural and creative industries, thus, the *re-use* of cultural contents - that is, their insertion or packaging in digital products and services - tends to equal or even outweigh access as a key motivation for digitizing, as exemplified by the *i2010 Digital Libraries* communication:

"Europe's future prosperity as a knowledge-based economy and society depends on ready access to diverse information. The Internet is the most powerful new tool we have had for storing and sharing information since the Gutenberg press. We must use it to make the wealth of material in Europe's libraries and archives accessible to all" (Viviane Reading in EC, 2006b).

*"The objective [of the Digital Libraries Initiative] is to make the collections held by Europe's libraries, archives, museums and audiovisual archives available online [...]. Once online, this material could be used for a variety of purposes – developing new products and services in the creative and information industries, producing new digital tourist services or creating teaching materials, for instance" (*EC, 2006c).

"More compelling on line content will make completely new products and services possible, stimulating growth in the entire communications industry. Europe's cultural industries - audiovisual, media, publishing, libraries, museums and more - are well placed to supply that content, but they must evolve in this rapidly changing world. And everyone wins when they can visit Europe's best museums and libraries or watch European film productions online from their living rooms and school desks" (EC, nd,).

"Digitisation and online accessibility are essential ways to highlight cultural and scientific heritage, to inspire the creation of new content and to encourage new online services to emerge. They help to democratise access and to develop the information society and the knowledge-based economy" (European Council of Ministers, quoted in Europeana [2011]).

These arguments also resonate with the Digital Agenda, according to which a crucial condition for the successful implementation of the European Single Digital Market is that it is "fuelled by the free flow of data and access to and supply of content and services" (EC, 2012b).

The above outlined argumentative structure can be largely accounted for the prevalent emphasis on the volume of the contents to be inserted in the digital library - according to the mass digitization goals set for Europeana that have their origins in the librarian sector[98] - and the consequent conflation of different types of heritage into an indistinct category, as exemplified by the target of 10 millions works to be made available through Europeana as stated by the EC's Communication of August 2009 (EC, 2009a) and by the strictly statistical approach adopted in evaluation schemes (CIPFA, 2009; Stroekers and Voegel, 2012).

[98] As it has been mentioned, a mass digitization approach to documents has been first applied by the National Library of France in response to Google Books. Museums, in turn, have consistently maintained a more selective approach to the digitization of their collections on the basis of the different relevance of the objects (Dahlström et al., 2012).

The quantitative innovation argument, under this light, seems to have asserted itself in European policies to the detriment of other qualitative contributions that culture can provide to creativity (KEA, 2009)[99] and of a deeper understanding of the socio-cultural impacts of digitization (Antinucci, 2007), as will be highlighted in Section 4.3.5.

At an operational level, the influence of creative industries policies on European digitization strategies is reflected by the inclusion in the 2012 call for proposals of the ICT-PSP Programme of a 24 million Europeana and Creativity strand, aiming to explore and support the re-utilization of cultural contents by the creative industries (EC, 2012a).

TABLE 18 summarizes the main arguments for the digitization of heritage as based on the Information Society discourse and creative industries policies, while the related shifts in the notions and functions of digitization are presented at TABLE 19Source: Author's elaboration.

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Table 18: Practical arguments for the digitization of cultural heritage in policies for the creative industries.

Value premise	The main goal of EU's policies is to increase the economic competitiveness of the area
Circumstantial premise	ICT and the creative industries are a key factor of economic competitiveness for the Union
Goal premise	The EU must seize the opportunity of ICT to the benefit of the creative industries
Means-goals premise	The development of technical infrastructure for centralized access to cultural contents will increase the Union's competitiveness in the global scenario by enhancing the growth of the creative industries
Claim or Conclusion	The EU should devote increased efforts in establishing common points of access to digital cultural contents for boosting the growth of the creative industries

Source: Author's elaboration.

[99] With respect to the previous KEA report on the Cultural Economy (2006) wherein the contribution of cultural contents to the growth of the digital economy was emphasized, the Report on the Impacts of Culture on Creativity marks an explicit rupture, as it attempts to "develop a concept of culture-based creativity [...] going beyond artistic achievements or "creative content" feeding broadband networks, computers and consumer electronic equipments" (KEA, 2009, p. 3, our emphasis). Some possibilities in this sense are also highlighted in the *Green Paper*, such as "more intensive, systematic, and wide-ranging collaboration between the arts, academic and scientific institutions [...] as well as private-public initiatives to support artist-led experimentation" (EC, 2010a, p. 9).

Table 19: Notions of user and fruition implied by different arguments for digitization.

	Stakeholder	Type of user	Modality of fruition
'Purely cultural' argument	Cultural institutions - Member states	Citizens	Access to cultural heritage, reinforcement of common cultural identity and education
Information Society discourse	European Commission	Consumers	Free choice among cultural contents and products
Information Society & Creative Industries	European Commission Europeana Foundation	Consumers Creative Industries (software developers)	(Free choice among cultural contents and products) Re-use of cultural contents for creating new digital products and services.

Source: Author's elaboration.

4.3.4. Reality check: the quest for economic sustainability

In the preset Section, a comparison is drawn between the above reviewed policy initiatives for the digitization of cultural heritage and evidence of their actual implementation, drawing on existing studies and data sources.

The main effort to develop a statistical framework for monitoring the state of advancement of digitization policies has been made through the NUMERIC study, wherein a questionnaire focusing on budgeting, funding and organizational issues has been administered to 1,539 'relevant' cultural institutions - as identified by a coordinating institution in each member country - with a response rate of the 51% (CIPFA, 2009).

Due to the different criteria of relevance[100] adopted in each country, the results are not suitable for cross-country comparative analysis, although providing a general overview of the state of digitization in Europe and within specific groups of institutions (museums, libraries, archives and audio-visual broadcasting institutes).

As regards budgeting issues, less than half of the respondents (49%) stated they had a budget specifically dedicated to digitization and only one third had an explicit plan or strategy for digitization, although with significant differences across individual categories - from the 70% of broadcasters to the 23% of 'other' museums.

Among these, the share of institutional resources dedicated to digitization equalled the 1.1% of the overall budget, again with a high variability across different categories of institutions - from the 4.5% of archives to the 0.6% of art museums and the 0.3% of broadcasting institutes. Despite its

[100] In most countries 'relevant' institutions were defined as state-owned entities with collections of national value. The main exceptions were Ireland - which excluded three prominent national institutions, two of whose had been engaged in more digitisation activity than the others - and the Netherlands, where relevance was interpreted as the existence of specific initiatives of digitization.

limited amount, the regular institutional budget represented the main source of funding for digitization activities (62%), whilst governmental programmes and grants accounted for a further 30%. Differently from the Northern American case (Zorich, 2003), thus, private sponsorships or donations represented a marginal share of the budget, despite the explicit encouragement to public-private partnerships given by the Commission's Recommendation of 2006 (EC, 2006a). Also in this case, a significant differentiation across groups emerged: whereas in libraries private sponsorships covered the 16.6% of digitization costs, they only accounted for the 3.3% in art museums.

The high incidence of public sources over total funding to digitization thus appears as a critical element, especially in the light of the relatively low state of advancement in digitization activities highlighted by the report: the proportion of materials waiting for digitization according to existing plans - with the exclusion of materials that do not need to be digitized - ranged between the 69.4% for art museums[101] and the 96.5% for national libraries, corresponding respectively to a backlog of 2.3 and 27.6 times the current stock of digitized items. The report, though, does not assess what criteria are used by heritage institutions to select and estimate the share of their collections to be digitized, thus leaving a fundamental uncertainty as regards the approach adopted to digitization.

Remarkably, only the 55.8% of art museums possessed an online catalogue of their collections, among whose only the 58% were able to distinguish digital from analog contents, showing a substantial delay with respect to the librarian sector wherein the diffusion of online catalogues reached the 90%. This gap was reflected in the proportion of digital collections that were accessible online, which ranged from the 70% in libraries to the 5.5% of arts museums.

As regards access policies, varied evidence was reported: half of the respondents (ranging from one third in art museums to three quarters for libraries) operated a free access policy to digital collections, whereas around the 10% charged fees for access and a further the 20% adopted mixed models. A particularly high incidence of restricted access - such as in-house fruition of digital collections and records - was found among science (38%) and art museums (33%).

In general, the NUMERIC study thus highlighted a relatively low state of advancement and priority given to digitization by European cultural institutions with respect to an objective of mass or full digitization, besides identifying a relevant gap between the librarian and the museum sector.

Provided for their limited reliability, however, data produced by NUMERIC on the unit cost of digitizing different types of materials were elaborated for calculating the total costs of digitizing European cultural heritage in a report addressed to the Comité de Sages (Poole, 2010). According to the study, the full digitization of the collections of museums, libraries and archives would require an expenditure of about 100 billion euro, in addition to a budget for digital preservation ranging between 10 and 25 billion. Comparing this amount with the overall budget devoted to digitization by

[101] To explain the relatively high percentage of digitized collections compared to other categories of institutions, it was suggested that the respondents may have interpreted 'digitization' as the recording of materials on online catalogues rather than the actual acquisition of the artifacts due to an ambiguity in the question (CIPFA, 2009, 3.4.8).

the institutions surveyed in NUMERIC (53.9 millions[102]), a significant funding gap emerges, which implies term of 1,855 years for the achievement a full digitization goal.

Remarkably, the extent of outstanding digitization tasks resulted increased from a later survey conducted within the ENUMERATE project by adopting a different sampling methodology that prevents a direct comparison with NUMERIC's results (Stroeker and Vogels, 2012, p. 11). On the basis of estimates made by the responding institutions, art museums appeared to have progressed more in digitizing their collections (42%) than national libraries (4%), accounting for an average 20% of collections already digitized. An opposite differentiation between groups was found with regard to the formulation of access policies for digitized materials, which ranged from the 60% of national libraries to the 22% of archaeology museums. Overall, however, the budget devoted by heritage institutions to digitization tasks was substantially unvaried with respect to the NUMERIC study and public-private partnerships were mentioned as being in place only in the 7% of cases.

The 2010 Report of the Member States Expert Group on the state of digitization in the Union has supported the existence of a funding gap, confirming that "genuine PPPs are not yet a widespread method for financing digitisation by cultural institutions in Europe" (EC, 2010b, p. 11). Specifically, they were implemented only in limited numbers of large university and national libraries, with the involvement of leading extra-European IT companies such as Google (which has partnerships with leading librarian institutions in the UK, Germany, Spain, France, Austria besides the Italian Ministry [see Section 4.3.1]), Proquest (with a partnership at the Oxford Library), and Microsoft (British Library). Since this scenario would run into contrast with the original motivations of member States - especially France - for developing the European digital library (see Section 4.3.2), the Comité des Sages has specified a set of criteria and requirements for balanced public-private partnerships - respect for right-holders, transparency, free and cross-border access to digitized materials, quality of copies, freedom for cultural institutions to re-use contents in non-commercial scenarios, revenue-sharing schemes and non-exclusivity - and suggesting a maximum term of 7 years for preferential use of commercial exploitation. In order to avoid a potentially ruinous competition between Europeana and Google Books, moreover, some institutions have negotiated to make digital public-domain contents available through both portals.

The relevant gap in funding to digitization emerging from the surveys and reports closely mirrors the lack of a sustainable business model for Europeana, which has been acknowledged and addressed by the European Commission and the Foundation itself over the last years.

In particular, the 2009 Recommendation *Europeana: Next Steps* has put into evidence the limitations of the current project-based model of funding, exploring alternative solutions:

"For the further development of Europeana one can conceive of widely divergent models, ranging from a fully Community funded operation to a model in which the private sector plays a key role in running the service. [...]

For the period beyond 2013 additional ways of financing Europeana should be considered, which strike the right balance between Community funding and other resources, and moving away from the present project-based financing. Complementary

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[102] This is calculated as the 0.77% of the overall institutional budget of the identified relevant institutions, equal to 7 billions (our elaboration on CIPFA, 2009, 3.3.3-3.3.4).

sources of financing could be provided through public private partnerships or through a more structural contribution by the Member States. Some site revenue can also be expected, but this will only cover a very modest share of the total costs for running the service. Making the end user pay for finding the content through Europeana and for the other functionalities of the site is not an option, since this would seriously jeopardise the take-up by the users and would run counter to the basic aim of the site" (EC, 2009, art. 4).

To this purpose, the Recommendation has considered different possible models of public-private partnership, including private sponsoring, commercial advertising on Europeana website, payment for the links provided by Europeana to the websites of supplying organisations and a recourse to private technology-providers for performing digitization activities. A direct involvement of the private sector "in running Europeana and generating revenues to operate the site" was also considered, though subject to a series of constraints related to the prominence of "cultural and information policy objectives" (EC, 2009, art. 4.2).

The Comité des Sages, however, has partially challenged the recourse to private funding, according to the principle that "the control over Europe's heritage cannot be left to one or a few market players" (2011, 8.3.1). In reverse, the Expert Group has asserted "the opinion that public funding should cover the largest part of Europeana's operational costs, also after 2013" and that these should be considered "together with the investments of Member States in digitisation and in setting up national aggregators" (8.4.1). To this purpose, the Report has identified relevant limitations to a wider diffusion of public-private partnerships not only in the current economic crisis, but overall in the expectation, on part of private investors, for "a business return based on hard visitor numbers and profiles and/or a clear link between the site and the brand" (8.4.2). Nonetheless, the Report envisioned sponsorships or partnerships with "Telco and IT companies operating on an Europe-wide basis" as "a realistic perspective" (*ibidem*) for complementing public funding for Europeana in the medium term.

The uncertainty of the long-term economic sustainability of Europeana, however, has been further aggravated with the proposed shift of financial support from the Competitiveness and Innovation Programme to the Connecting Europe Facility[103] starting from 2014, as the reduction of the latter's budget from the proposed 9 to 1 billion euro has caused a gap of 426,000 euro in the Foundation's balance sheet. In 2013, Europeana has multiplied its advocacy efforts towards the Commission, preparing the submission of a new project proposal (Europeana Version 3) (Europeana, 2013b, p. 10) - that does not result to have been officially presented to date - and

[103] The Connecting Europe Facility is a new funding scheme of the Digital Agenda for Europe, aiming to act as "a key instrument to promote growth, jobs and competitiveness through targeted infrastructure investment at European level" by supporting "the development of high performing, sustainable and efficiently interconnected trans-European networks in the fields of transport, energy and digital services" (EC, 2013). Funding under CEF will be delivered through a two-layer approach: core service platforms (central elements or hubs ensuring trans-European connectivity, access and interoperability) and generic services (functionality and content of digital service infrastructures, connected through core service platforms). Europeana has adapted to this framework by differentiating its core services platform - referring to storage and preservation of data - from generic services, including aggregation of contents, search services and crowd-sourcing facilities.

launching a public petition *#Allez Culture* to call for increased support to digital cultural heritage, which has collected 7,500 adhesions (Europeana, 2013d).

In this context, the Foundation has provided the Commission with two funding scenarios, respectively based on a 180 million and 134 million 6-years operating budget (Cousins, 2013) and an increase, in both cases, of market-generated revenues from 0 in 2013 to 6.75 millions in 2014, up to 16 in 2020 through "sponsorship, end user donations, shared revenues, payment for services, membership fees or government funding" (Europeana, 2013e). Whereas Europeana has claimed to be able to provide core services in any case, though, it has specified that the latter scenario "would reduce the potential to fully exploit the multiplier effect of the network and aggregators to increase usage and creativity and [...] require more effort spent on raising money" (Cousins, 2013).

Under this light, the economic sustainability of digitization activities as well as Europeana seems thus to represent an open issue for the next years.

4.3.5. At the roots of current challenges: tensions between cultural and economic arguments

The above highlighted uncertain economic sustainability of digitization initiatives seems rooted to a large extent in the difficulties experienced by European cultural institutions and the Europeana Foundation in defining and implementing consistent business models based on digital heritage.

To this purpose, a review of the positions and proposals advanced by the different stakeholders involved in digitization policies can provide relevant insights for interpreting the current situation.

Initially, despite its focus on cultural over economic values, the DIGICULT report did not exclude on principle the possibility for heritage institutions to charge users for access to digital collections, but specified that this should aim "to generate revenues in order to cover at least a part of the total cost of ownership in holding their collections and all the related activities (e.g. exhibitions, catalogues, educational products)" (p. 134). The report had thus drawn on the experience of dot.com firms to explore potential online business models[104] for cultural institutions - although warning that the extent of commercial opportunities appeared to be limited especially for smaller institutions that did not possess substantial budgets to invest or renowned brands to exploit. As a result, the DIGICULT report substantially envisioned a mixed business model combining public funding and user-generated revenues: whereas the former was advocated on the basis of the educational function of culture, the latter was legitimated by its contribution to covering the costs of digitization.

Europe-wide surveys (CIPFA, 2009; Stroeker and Voegels, 2012) suggest that a large share of cultural institutions - especially in the museum sector - have followed this model, differentiating between basic contents (e.g. low-resolution images) which are freely accessible, and high-resolution

[104] Specifically, the following models were identified as potentially suitable to different types of cultural institutions: selling user attention and information; e-retailing; e-ticketing; digital commerce; pay-per-view models for interactive TV and online subscriptions (EC, 2002).

images and metadata to which one-off payments or revenue-sharing schemes are applied for commercial use[105] depending on the purpose, format, distribution etc.[106] (to this purpose see also the case study of the Uffizi Galleries at Section 6.3).

This model received a first integration by the Comité des Sages which has not only encouraged institutions to continue providing free access to cultural contents in the public domain - according not only to the principle that "public domain material digitised with public money should be freely accessible for all" (Comité des Sages, 2011, art. 4.3.1) but also to reasons of market competition[107] - but has also invited them to "make their digitised material available as widely as possible for commercial entities to build upon" in order to "stimulate the use of the material for new information products and services" (2011, 4.4.2). However, the Expert Group has preserved the right for institutions "ask private companies to pay for the commercial re-use of the material, in order to recoup the digitisation costs and finance further digitisation" (4.4.3).

The Comitè's suggestions have been implemented and expanded by recent initiatives of the European Commission and the Europeana Foundation, pursuing an open release of cultural contents also for commercial uses, in order to provide an input to innovation in the creative industries.

In September 2012, Europeana has released its bank of metadata under a Creative Commons 0 (CC0) waiver that enables free access and free re-utilization also for commercial purposes. Remarkably, this was presented as "a new boost to the digital economy, providing electronic entrepreneurs with opportunities to create innovative apps and games for tablets and smartphones and to create new web services and portals" (Europeana, 2012a).

In order to "demonstrate the social and commercial potential of open cultural data" Europeana has also organized in the same year a round of Hack4Europe contests[108], where its dataset have been made available "to developers and designers as an API to create prototype mobile apps and pilot services". The organizers have claimed that "now that the data is available under CC0", the selected applications "would be able to be taken into commercial production instead of existing only as prototypes" (Europeana, 2012c).

Consistently, the ongoing Europeana Creative project (ICT-PSP call 2012, 2013-2015) aims to promote the re-use of cultural resources available via Europeana by the creative industries, pursuing an expansion of the Europeana Licensing Framework to "allow content providers to make content

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[105] Adopting Bertacchini and Morando's (2013) framework, this substantially corresponds to a mix of *open display* and *proprietary licensing* models.

[106] In most cases, a 'purchase' function is directly added to each image in the digital collection. Some institutions, such as the National Gallery of London, have also established a system for the real-time licensing of digital images, which calculates in real time the price according to the type of publication, circulation and format.

[107] "Google has set a standard of free access for the end-user to major collections of digitised public domain books through Google Books. Models in which cultural institutions charge the end-user for accessing the public domain resources they have digitised are therefore unlikely to be sustainable, since non competitive in market terms" (art. 4.3.2).

[108] Hack4Europe! has been organized within the Europeana Awareness Best Practice Network (2012-2014), which aims to "publicise Europeana to users, policy makers, politicians and cultural heritage organisations in every Member State so as to encourage the use and contribution of content, raise awareness of cultural heritage as an economic driver and promote knowledge transfer, promote its use by a broad public for a variety of purposes including recreation and hobbies, research, learning, genealogy and tourism" .

available for re-use scenarios and to communicate the conditions necessary for commercial re-use" (Europeana Creative).

In this context, the possibility for heritage institutions to share revenues with commercial users to recoup the costs of digitization that had been acknowledged by the Comité des Sages, seems to have been underplayed or even openly discouraged by policy-makers. This shift seems to have raised, though, some elements of tension with providing institutions.

In particular, the release of Europeana's metadata bank has been decided at the end of a consultation process in which stakeholders resented a potential loss of control over subsequent utilizations of contents and loss of quality and unity of data (Verwayen et al., 2011). Among these, only the risk of a loss of attribution has been explicitly addressed by Europeana by obliging re-users to give attribution to the data provider and aggregators (Europeana, c). Moreover, cultural institutions - especially museums - have not shown so far a particular interest in the digital applications developed thanks to open metadata within the Hack4Europe initiative. This may be due to the fact that, they do not seem to add any creative contents or re-interpretations[109] and limit themselves to providing new modalities of access to Europeana database - consistently with the envisioned shift from a centralized to a distributed model of data delivery that makes contents accessible in multiple contexts through mobile platforms (Europeana, 2011, p. 12) -

In the consultations, furthermore, a relevant part of the stakeholders showed reluctance against sacrificing the potential revenues generated from metadata (Verwayen et al., 2011). Likewise, national aggregators such as the Cultura Italia portal (see Section 4.3.1) are currently experiencing difficulties in re-negotiating metadata attribution agreements with providing institutions from a CC1 licence (all uses enabled except commercial ones) to a CC0 waiver (Di Giorgio, 2013). In this specific case, the possibility of releasing metadata of public domain works is prevented by the attribution of the exclusive right of commercial exploitation to Google for 15 years as part of the digitization agreement with the Ministry (BNCR, 2012).

In order to advocate the potential of open data towards stakeholders, users and policy-makers, the Europeana Foundation has recently built on the idea of a *Cultural Commons for Europe*[110], defined as "a set of resources in the public domain that are owned collectively or 'held in common' and shared openly among the community", which is claimed as "fundamental to the successful operation of a web ecology of content and services" (Europeana Business Plan 2013, p. 7). To this purpose, a Discussion Paper has been issued in 2012 (Europeana, 2012b) after a series of consultations with experts in order to identify possible applications of the commons model to digital heritage.

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[109] For instance, the winning application in the category Most Innovative App at the Hack4Europe! session in Warsaw (26-27 May 2012) "promotes access to art in everyday situations i.e. Europeana collections can be made available in public places such as coffee shops, libraries, schools and hotels"; the winner in the category of Social Inclusion "allows end-users to create geo-tags referring to chosen multimedia content [...] that can be organised into albums, shared and finally browsed using mobile devices"; whereas the winner in the categories Best Commercial Potential and Developers' Pick "recommends Europeana content providers near to a user's location (based on his/her current GPS coordinates) and shows their content on Europeana" (Europeana, 2012d).

[110] The definition of the concept stems from an extension of Elinor Ostrom's works on natural resources to the knowledge or cultural domain, in connection with the changes brought about by new technologies (see Hess and Ostrom, 2005; Madison et al., 2010; Ostrom, 2010).

The main distinctive traits of commons are identified as a polycentric governance model; communities built around specialist knowledge, shared values and interests; forms of collective action and collaborative platforms - a set of elements that in literature are used to define groups or networks of scholarly users of open academic repositories (Hess and Ostrom, 2005).

In this context, though, the shift from simple open data to cultural commons shows some elements of complexity: in particular, it requires a distribution the benefits and costs among the actors involved, according to a "concept of equity" which "holds that those who benefit from a service should bear the burden of financing that service" (Hess and Ostrom, 2005, p. 65). This relates to evidence that the cultural commons model places additional financial burdens on content producers, as in the case of open-access scholarly works which are "free of charge for readers and users, but not for producers [...] who require revenue or subsidies" (Suber, 2005, p. 172). The possibility of "a financial contribution [to Europeana] made by the cultural organisations who contribute content", though, has been rejected by the European Commission since "the heterogeneity of this group [of contributors] is an obstacle to the design of a system of contributions that all concerned would consider as fair" (EC, 2011, art. 4.2), thus making the introduction of some licensing or revenue-sharing schemes between providing institutions and commercial users of data the only feasible alternative.

Most relevantly, however, at the current state the Europeana Foundation does not seem to offer an adequate governance structure for a commons model, due to the gap of representation between the librarian and museum sectors and large and smaller cultural institutions (Europeana, 2012b, p. 9).

Under this light, although the commons represents a potentially suitable model for reinforcing the links in the research community[111], the initial questions raised by the Discussion Paper as to what could be the potential "relationship with private enterprises in the cultural sector, supported by some form of open content" (Europeana, 2012b, p. 1) remain substantially open, leaving to ongoing and future projects the task of exploring the issue:

"What is fair exchange, how can the cultural heritage organisation reap the benefits of preserving, digitising, maintaining the content while encouraging the use of their digitised material within new and innovative applications?" (p. 11).

[111] This is one of the main goals of the new Europeana Research platform that will be established within the forthcoming Europeana Cloud project (2013-2015).

Table 20: Positions of different stakeholders towards digital business models.

	Heritage institutions	Comité de Sages	European Commission and Europeana
Motivations for digitizing	Educational > commercial uses	Educational and commercial	Commercial > educational
Business models involved	Free access to data for personal educational purposes Fee-based access to data for commercial utilizations to recoup the costs	Free re-use of data also for commercial utilizations is envisioned, provided for the institutions' need to recoup the costs	Extension of the sphere of free re-use also for commercial utilizations, without alternative funding sources envisioned (commons model)

Source: Author's elaboration.

An underlying element of vulnerability for recent policy initiatives regards the difficulty experienced by Europeana in producing consistent evidence of the economic impacts of digital heritage on the creative industries.

The Foundation has built on this argument in its current advocacy for further financial support under CEF[112], emphasizing quantitative economic benefits of digitization over qualitative social effects:

"Digitised cultural material has the potential to be a core resource for European cultural and creative enterprise. According to the European Competitiveness Report 2010, creative industries account for 3.3% of EU GDP and 3% of employment in the EU. Digitisation and online accessibility of Member States' cultural heritage contributes to economic growth and job creation and to the achievement of the digital single market through the increasing offer of new and innovative online products and services.

OECD calculation models show that direct and indirect economic benefits will surpass the investment in making cultural heritage accessible digitally. In addition, there are social benefits not easily quantifiable, such as the use of Europeana as a vehicle for inclusion, supporting teachers and the growth of multimedia literacy, as well as underpinning European identity by contributing to the retention of culture and the sharing of cultural diversity" (Europeana, 2012e).

"With the current levels of funding at 30 million euros per year, Europeana can greatly contribute to high growth sectors, such as the creative industries (7% compound annual growth). With reduced funding or with a larger share of the investment coming from the market, we are confident that we can still contribute significantly" (Cousins, 2013).

[112] It is significant, to this purpose, that the first argument used in support to further funding is that 'Europeana supports economic growth', followed by 'Europeana connects Europe' and 'Europeana makes Europe's culture available for everyone' (Europeana, 2013e).

Although the Foundation has claimed to have engaged in an estimation of the direct, indirect and external economic impacts of digitization (Europeana, 2011, p. 22; Europeana, 2012e), however, no reports have been published yet. In this context, the volume of requests for digital cultural contents by software developers represents the main source of evidence on the size of the demand:

"The creative industries have shown strong early signs of being extremely keen to make use of the material to develop new businesses. Over 550 requests have been made for the API[113] since September [2012] and several hackathons have already begun to produce viable products. Extrapolating from the numbers of pilots and applications built to date on Europeana data (over 100) and looking at the number of API requests for use of the data, an expected multiplier of three on investment is more than reasonable. This would mean that for 30 million euros invested per year a return will be calculable at 90 million euros," (Cousins, 2013)

A critical examination of the above claim, however, suggests that the conversion of open data into marketable applications is not immediate. At one year of distance from the Hack4Europe! competition, in fact, opposite to the initial expectations the winning applications do not result in commerce yet.

Moreover, web traffic statistics provide controversial evidence of the general interest in the initiative if compared both to initial expectations and analogue initiatives such as the Virtual Museum of Canada.

In 2012, the portal received 5.13 million visitors - corresponding to 3.9 million unique visitors - with an increase of the 16% from 2011 and a peak in September in conjunction with the CC0 release. However, the overall feature fell below the expected target of 6 million visits (Europeana, 2012f) and the online experience emerged as relatively poor, as demonstrated by the high (49%) bounce rate[114], the low proportion of visits with search[115] (21%) and the short length of visit (2 minutes, compared to the VMC's 7 minutes in 2008).

In the first three quarters of 2013, 4.3 million visits have been recorded, falling below the target of 7.1 million (Europeana, 2013c) - which is in reverse outweighed by the VMC's feature of over 16.8 million visits[116] in 2007 (Canadian Heritage, 2008, p. 33) - thus shedding mixed light on the long-term interest generated by open cultural data.

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[113] The API [Application Programming Interface] is a web service which provides remote access to the Europeana collections, allowing software developers to build applications, websites and mash-ups that integrate Europeana contents (Europeana, d).

[114] The percentage of visitors that leave the site from the entrance page.

[115] The number of visits during which at least one portal search occurred.

[116] Unique visitors are counted as the number of IP addresses that access the website, independently from the number of visits.

4.4. Discussion of the case studies

Although the Canadian and the European paths in the digitization of cultural heritage cannot be directly compared due to obvious differences in the scale of the initiatives and in their historical context, a confrontation can draw significant insights on the innovation process and provide elements of benchmarking as regards organizational issues and economic sustainability.

Canada's approach to museum automation follows closely the introduction of computers in museums in the US in the late 1960s. However, different organizational models were adopted in the two neighbouring countries: whereas in the US projects of automated cataloguing mostly emerged under the spontaneous initiative of museums, universities and research centres (Jones-Garmil, 1995), in Canada the Federal Government played a role of leadership in promoting and coordinating standardization efforts through the National Inventory Programme. In this context, the creation of a computerized repository of Canadian heritage was envisioned to facilitate the retrieval of information related to museum collections and to increase opportunities of collaboration and exchange among the research community. Consistently, the initial adoption of a centralized model of data processing was functional not only to the reliance on a single mainframe, but also to ensuring the homogeneity of the information collected.

A distinctive characteristic of the Canadian process is the constant involvement of stakeholders in key decisions, seeking an adaptation to established practices of cataloguing and collections management, for instance by defining flexible data dictionaries. After experiencing technical difficulties in managing the volume of data and requests for participation to the programme, a process of decentralization was promoted by enabling individual institutions to assume a more direct responsibility in the insertion, maintenance and update of data. In response, the central organization (NIP-CHIN) evolved from a central data manager into a service centre providing technical support and consultancy to member institutions.

With the advent of the Web, the main argument for pursuing digitization activities shifted towards extending 'access' to cultural heritage. In this context, the rise of new communication networks amplified the initial political concerns for the preservation and reinforcement of Canadian cultural identity, leading the Federal government to stimulate the production and dissemination of Canadian cultural contents on the Internet in order to balance the hegemony of the United States.

However, the Information Society discourse was interpreted coherently with the initial focus on the cultural function of digital heritage. In this sense, a differentiation between user targets was introduced by providing two distinct and complementary points of access to digital heritage contents: the research-oriented Artefacts Canada portal - which is the direct heir and of the NIP - and the Virtual Museum of Canada which is targeted to a general audience and whose funding schemes are addressed to educational and community projects contributing with creative interpretations of heritage contents.

The limited number of artifacts being digitized in each virtual exhibition, however, seem to pose significant constraints to the possibility of conducting mass digitization of collections (Canadian Heritage, 2008), whose priority though seems to be higher in the audio-visual than in the

museum sector. Due to the dominance of public funding and to the difficulties experienced in implementing partnerships with private players, current efforts for a wider digitization of museum collections are thus confronted with the challenge of economic sustainability.

With respect to artistic heritage, the digitization of librarian and documentary heritage presents more critical aspects, since in this case the adoption of a centralized model based on the leadership of Libraries and Archives Canada has raised significant frictions with partner institutions and associations of professional users. In particular, LAC's attempt to legitimate a reduction of funding to onsite services with an alleged replacement with digital delivery, combined with scarce evidence of an actual progress in digitization of the collections, have raised a wave of protestations and contributed to a change in the general management. Also in this case, though, economic sustainability represents a serious challenge, as it is uncertain whether LAC's agreement with Canadiana - where the hopes for overcoming the current *impasse* have been placed - provides an adequate basis for the mass digitization of documentary heritage, also in the absence of clarity about models of access.

The European experience starts, in temporal concurrence with the 'second phase' in Canadian policies, with the efforts made spontaneously by Member States in the 1990s to create central catalogues and repositories for their national heritage, which gradually converged in the early 2000s towards the creation of an European Digital Library.

As it has been highlighted is Section 4.3.3, a complex set of cultural, political and economic motivations brought by the diverse stakeholders can be seen to be involved and interact. In particular, Member States had initially envisioned digitization as a way of preserving their national identity and profile on the Internet - also against the moves of private players (Google) in the heritage sector - a motivation which has been transferred to an European scale by the Commission in order to strengthen the Union's cultural identity. Cultural institutions, in turn, saw digitization mostly as a means to increase access to cultural heritage and as a support to education (EC, 2002).

These objectives, however, can be seen to be conflated with and gradually outweighed by a technologically determinist argument that emphasizes the role of new information infrastructure (*information highways*) as a driver of economic growth (Levy, 1997; Niebel, 1997). Under this light, the digital library tends to be presented in policy documents as an analogue of the European Single Digital Market for cultural heritage, emphasizing the contribution that the free circulation of cultural contents can provide to the creative industries. At an operative level, this is mirrored by the choice to coordinate and fund digitization projects and networks under the Information Society and ICT Programmes.

The coordination model of European policies is based - similar to the Canadian one - on a central organization (the Europeana Foundation) that manages the access portal and has recently started providing partner institutions with technical assistance. Europeana relies heavily on the active participation of intermediary entities such as national aggregators (e.g. Cultura Italia) and project aggregators (e.g. the Athena network) in collecting the metadata and channelling them towards the digital library, which in turn provides links to the providing institutions through the aggregators.

Against this background, a significant conceptual difference between the European experience and the second phase in Canadian policies can be identified in the respective definition and implementation of the concept of 'access'.

With the shift in priority from scholarly to public access, the CHIN has encouraged museums to contribute to the VMC with virtual exhibitions and teaching materials targeted to a non-professional audience. The adoption of a critical approach to digitization that seeks to interpret and contextualize the object (Dahlström et al., 2012), in this sense, has allowed museums to maintain their role as privileged interpreters of their collections. Consistently, the Virtual Exhibitions Investment Programme has encouraged partnerships between museums and software developers that are not limited to technical tasks such as the creation of metadata, but involve the generation of new modalities of visualization and thematic arrangement of the contents.

Differently, the European Commission has pursued since the 2006 Recommendation a mass digitization approach expressed in quantitative volume targets that has its roots in the librarian sector and tends to conceive heritage institutions as information providers, limiting their role in the interpretation of contents (Dahlström et al., 2012). Compared to the former, however, this framework seems to provide only a generic identification of the demand and of the prospective utilization of the contents, as witnessed by the fact that Europeana does not differentiate its services between general and special-interest users - although the latter seem to represent the main audience[117].

The main risk, in this context, is that the increasing mass of objects contained in the digital library can remain under-utilized, unless potential user segments are specifically targeted and stimulated to use the contents. To this purpose, specific projects such as Europeana Awareness and Europeana Creative have been recently launched with the aim of sensitizing and involving potential targets - primarily software developers, and secondarily the educational and research community - in experimenting possible applications of data and metadata within different contexts.

In order to involve general users, furthermore, Europeana has recently opened profiles on social media (Facebook, Twitter, Pinterest and Google+) and a blog.

These ongoing attempts to establish closer links with final users may bring Europeana's model closer to that of the VMC. For instance, a spin-off website[118] has been opened in 2011 to hosts the virtual exhibitions developed by partner institutions in digitization projects, currently collecting 28[119] displays that provide an historical context to the digitized objects. Although some Europeana-related projects such as TEL, EU Screen and Judaica Europeana have generated a considerable numbers of exhibits, however, these represent more a secondary than a primary outcome of the initiatives.

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[117] Through (unpublished) user-focused research, four profile of users of cultural heritage have been identified, all broadly falling within the special-interest category: school teachers, cultural heritage professionals, cultural heritage amateurs and undergraduate arts and humanities students (Europeana, b).

[118] http://exhibitions.europeana.eu/

[119] Among these, 2 have been curated by Europeana's staff selecting user-generated contents from Wikipedia's Wiki loves Monuments annual contest, wherein participants are invited to submit pictures of historical monuments and heritage sites in their region (Wikipedia). In 2013, Europeana has assigned a special prize to the best picture portraying First Word War monuments (http://www.wikilovesmonuments.org/special-award-first-world-war-winner/).

Against this background, a key requirement for the success of current initiatives at Europeana seem to consist in a more explicit commitment to the interpretation of the contents, with the active involvement of providing institutions - especially museums, which are currently under-represented in the projects. In this sense, restoring the priority of interpretation and education could lead to the consequence of temporarily deferring or loosening goals of full digitization in favour of a more selective approach, relying on the ability of supplying institutions to set priorities for digitization.

A further observation regards the effects of digitization policies on the museums' relation to their environment.

Whereas in the Canadian case providing institutions are encouraged to widen their audience at a national scale, they do so while maintaining at the same time a specific identity and potentially reinforcing the links with their local community - as is especially apparent in the Community Memories programme.

In reverse, with the creation of an European digital library, museum collections are inserted in a network of linked data in connection and at an equal level with documentary and audio-visual contents. Although the long-term effects of this 'migration' of artistic heritage need to be further assessed, it seems to present both potential advantages and disadvantages for the mission of individual heritage institutions.

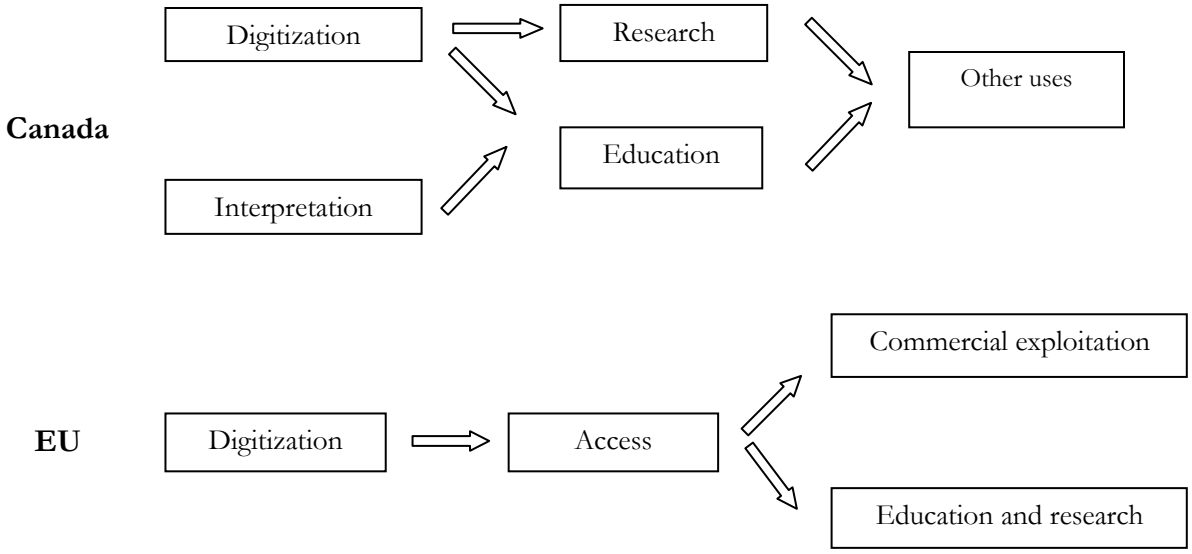
On one hand, the possibility for users to obtain a cross-sectorial access to a mass of contents belonging to different institutions may contribute to enhancing the relevance of museum collections, as their connection with additional contents (books, catalogues, other artworks etc.) may facilitate their contextualization and description (Dahlström et al., 2012).

On the other hand, in the long term it may tend to dilute the identity of museums as an historically specific model of cultural institution *vis-à-vis* libraries, archives and audio-visual repositories, which in European policies are increasingly treated as one homogeneous group of *information* or *memory institutions* (Dempsey, 1999; EC, 2002; De Laurentis, 2006). Under this light, museum artefacts - provided for the ability of descriptive metadata to preserve correct attribution - may tend to lose another layer of contextualization rooted in their belonging to a specific collection, whilst their insertion within linked data networks may exert in the long term a levelling impact on their individual significance (Dahlström et al., 2012) - similarly to cataloguing standardization (see Section 1.2).

The co-existence of opposite effects stems from the fact that IT tend to operate (and be operated) through sequential movements of de-contextualization and re-contextualization, which imply at the same time a potential enrichment and loss of meaning.

The two conceptual approaches to digitization policies in artistic and archaeological heritage are summarized in FIGURE 9, highlighting the respective centrality of education and access, whose characteristics will be further outlined and assessed through the case studies of Pointe-à-Calliére and the Uffizi presented at Section 5 and 6.

Figure 9: Conceptual approaches to digitization policies in Canada and Europe.



Source: Author's elaboration.

Despite the different conceptual approaches, however, both experiences are likened by the current challenge of economic sustainability.

In both cases, public funding supplied in project-based forms represents the backbone of financial support to digitization.

Although the European Commission has explicitly encouraged the transition towards a more balanced model based on public-private partnerships (EC, 2009), to date this option has been implemented in a limited number of mostly national libraries, seeing a further diffusion undermined by the lack of an adequate legal framework on IPR and of clear economic incentives.

The attraction of private funding has been also encouraged by CHIN, though more intermittently and attributing the priority to research and educational uses of digital heritage (Green, 2010). Albeit Canadian cultural institutions are able to partially cover digitization costs through licensing agreements (CHIN, 1999; Green, 2010), this does not seem sufficient to sustain the mass digitization of the collections in the long term.

In this context, collective models of licensing of contents for commercial utilizations may be considered to increase the contribution of user-generated revenues to the progress of digitization activities. For instance, CHIN and Europeana may study the feasibility of establishing a collective rights management agency connected to Artefacts Canada and Europeana to assist individual institutions in distributing and licensing digital copies of artworks, according to existing commercial services such as Heritage Images in the UK. Although it is likely that only the most 'popular' works would generate a relevant stream of revenues (EC, 2002, p. 155), these could be thus partially redistributed in favour of the digitization of less visible collections. In this sense, a clear governance structure and criteria for redistribution would be required, which would likely imply substantial costs of set-up.

Case History 3: Heritage Images Partnership Ltd.

Founded in 2000 by the National Monuments Record of English Heritage and the City of London Corporation, Heritage Images is an online picture library that aggregates the digital collections of leading British institutions in the artistic, photographic and librarian domains (including the British Library and the Museum of London) for a total of over 100,000 images in high resolution and supplied with curatorial metadata. Images are organized by providing institutions and themes, in order to facilitate retrieval. Heritage Images pools the right on collections from the contributing institutions and licenses them to the publishing and media industries. Through its website, it has also launched a print-on-demand service targeted to general users.

Most importantly, though, the lack of a consistent framework for the assessment of the socio-cultural and economic impacts of digitization represents a significant gap in both cases, which tends to undermine advocacy initiatives for public and private support to digitization.

A model into this direction may be offered by the MAXICULTURE meta-project (ICT-PSP Call 9, 2012-2014) which aims to maximise the socio-economic impacts of digitization techniques, addressing a longstanding bias within the R&D domain in favour of technical infrastructure over their concrete applications. To this purpose, a review of FP7 projects will be conducted to define a list of impact indicators and best practices, and to create a self-assessment toolkit that project teams would use to evaluate the impacts of their activities. Albeit it remains to be seen whether this initiative will be effective in balancing technical and socio-cultural parameters in the evaluation of digitization projects, this type of assessment seems crucial to the transition from a 'start-up' to a 'maturity' phase in the digitization of cultural heritage.

Table 21: Comparison between Canadian and European digitization policies.

		Canada - artistic and archaeological heritage	Canada - documentary heritage	Europe - cultural heritage
Main arguments for digitizing		Documentation and research (1970s-80s) Access and education (90s-2000)	Preservation and access	Access Growth of the digital economy and the creative industries
Main sources of funding	Public	Governmental and Provincial grants Institutional budgets	Governmental funds	ICT Framework Programmes Institutional budgets
	Private	Public-private partnerships put in place individually by some institutions	Partnership with not-for-profit organization (Canadiana)	Public-private partnerships envisioned but scarcely implemented
Role of the central coordinating institution		CHIN: Service centre; manager of central repository and point of access	Canadiana: Service centre, manager of central repository and point of access	Europeana: manager of central point of access
Role of cultural institutions		Privileged interpreter of heritage	Information provider	Information provider
Role of creative industries		Software producers: collaborators in communication	No specific roles	Main re-users of digital heritage
Proportion of digitized collections		≈ 33% (national unofficial estimate) 9% (Québec museums) (SMQ, 2009)	≈ 5% (unofficial estimates for LAC)	Between 2.3% (public libraries) and 27.2% (art museums, likely overestimated)
Main business models		Free access for educational and personal purposes Licensing for commercial utilization	Free access for educational and personal purposes Subscription for 'premium service'	Open access envisioned for personal uses and currently extended to commercial re-use
Main open issues		Long-term economic sustainability Digital preservation	Long-term economic sustainability Shortcomings of 'modernization' initiatives at LAC	Long-term economic sustainability Identification of possible uses for contents Application of a 'commons' model

Source: Author's elaboration.

5. Case study Pointe-à-Callière: Montreal Museum of Archaeology and History

5.1. The foundation of the museum and the first multimedia show (1992-2008)

Pointe-a-Callière, the Museum of Archeology and History of Montrèal, was founded in 1992 as part of celebrations for the city's 350 birthday.

Archaeological diggings had been conducted since 1979 at Place Royale - in the western area of the Old Port where the foundation of the city by Monsieur de Maisonneuve and Jeanne Mance took place in 1642 - bringing to light remains dating to different periods of the city's history from Prehistory to the 19th century. The City Hall thus charged the local project management firm GSM Design with a feasibility study for opening the site to public fruition whilst ensuring its preservation. The contractor's proposal to create a new museum complex that would incorporate the vestiges was then accepted by the municipal government. Local specialists and firms were involved in the project, including a consultancy firm run by the renowned museologist Francine Lelièvre[120].

After an intense debate on the form that the new complex should take, the local architect Dan Hanganu was charged with designing the building - named l'Éperon - that would host the museum. Although Hanganu adopted a markedly modernist language, he devoted specific attention to the insertion in the urban context, in particular by reproducing the triangular shape of the former Royal Insurance headquarters. An underground path across the architectural remains was realized with access from l'Èperon to provide the core of the permanent exhibition, also displaying the collection composed of about 4,000 excavation finds plus historical prints and photographs.

In the expectations of the city government, the new museum would act both as a privileged point of interpretation of urban history and as a tourist attraction of international profile, whose stated mission was "to bring visitors to know and appreciate the Montréal of yesterday and today through outreach, education, conservation and research activities revolving around Montréal's archaeological and historical heritage" (Pointe-à-Calliére, nd). A non-profit organism - the Société du Musée d'Archéologie et d'Histoire de Montréal, whose board of trustees included representatives of the municipal government and other public and private stakeholders - was established as the administrative body for the museum and Francine Leliévre was subsequently appointed as the first Director.

Along the following decades, the museum complex was expanded by including the old Custom House, the Youville Pumping Station and, in 2012, the Mariners House, all located in the immediate proximity of Éperon. The archaeological exhibition was integrated by temporary exhibitions focusing on urban history and foreign civilizations and educational activities for schools and families. Since the museum opening, a restaurant was also operating at l'Éperon.

Francine Lelièvre apply to the new museum the principles of New Museology that she had already successfully experimented at the Museum of Civilization in Québec City. Within this context,

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[120] With a background in school education and history, Leliévre had professional experiences at Parks Canada - as a project manager and then head of interpretation services - and the Museum of Civilization in Québec City - as Director of Exhibitions.

the adoption of new technologies played a fundamental role in the attempt to attract a wider public than conventional archaeological sites by offering an immersive, spectacular experience of the past (Boudreau, 1992).

In 1991, a public call was issued to realize a theatre hall on the site of the old cemetery at l'Éperon. The project bid included the realization of high-tech technological infrastructure and of a multimedia the show on the theme 'Montrèal: a place of economic and cultural exchanges', which would serve as an introduction to urban history and a teaser to the permanent exhibition. The overall duration of the show was predetermined by the museum management in about 20 minutes, so that two projections could be screened every hour. Besides the overall budget, in the selection process particular relevance was assigned to the reliability and durability of technology, which was expressly evaluated by a Technical Committee composed of independent experts. Among the submissions, the museum management selected the proposal presented by GSM Design, a local firm specialized in the design of technological environments that had already created interactive museum exhibitions[121] besides carrying out the feasibility study for Pointe-à-Calliére. The contractor proposed to integrate the theatre hall within the archaeological vestiges, designing a suspended structure with a view over the remains of the cemetery.

A Scientific Committee composed by two local Francophone historians and one museologist was also established to warrant the rigour of the historical contents of the show.

As a first step of the project, the Scientific Committee and the GSM team drafted a list of the main thematic units that the show should treat - corresponding to the main periods of Montréal's history, from the foundation and the Great Peace with the Amerindians, to the British conquest, to the immigration and the contemporary emergence as a contemporary city. Each theme was accompanied by a list of documents and images to be used as textual and visual references. The contractor had the task of synthesizing these elements into a visual scenario and a narration: a series of preliminary proposals were thus submitted to the evaluation of the Scientific Committee, who would either approve them or ask for a modification.

Since the show had to target a generalist public endowed with a low level of historical knowledge, , the choice was taken to use a simple terminology and an illustrative type of narration . To this purpose, two virtual projections of actor-impersonated historical characters - Monsieur de Maisonneuve and Chevalier de Callière - served as the narrators, directly addressing the audience to involve it in the story. Such choice was replicated in the first set-up of the permanent exhibition, which included five interactive characters who would respond to a set of questions predetermined by the Scientific Committee.

In order to add movement, at some points of the show the two characters would be present on the same scene and interact with each other, questioning and correcting the respective versions of history. Due to the current state of technologies, however, GSM resorted extensively to

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[121] In 1980, GSM had realized the innovative permanent exhibition at the Louis St. Laurent Historical Site in Compton (Québec) under the scientific supervision of Francine Leliévre. In the same decade, the firm realized two multimedia shows for the '86 Expo in Vancouver and the temporary exhibit 'Memoires' at the Museum of Civilization in Québec (Gsmprjct°, not dated).

mechanical effects such as moving screens to animate the narration, shifting the view from virtual characters to filmed sequences and projections. The architectural remains were an integral component of the show, offering the stage for a part of the action.

Figure 10: Capture from the 1992 'Tales from a city' show.

Source: *Gsmprjct*[O] website.

The show was shot without interruptions since 1992 to 2000, contributing to attracting a yearly average of 185.000 visitors (our elaboration from Tourisme Montréal, 2013), when the mechanical elements started presenting signs of usury. Moreover, the imminent celebration of the 300th anniversary of the Great Peace of Montréal provided an opportunity for rethinking the contents of the show, whilst exploiting the most recent evolutions in technology to create even more spectacular effects.

A further call for bids was thus issued under funding of federal and governmental ministries, and GSM Design was selected again as the winner. The new show saw both elements of continuity and novelty with respect to the previous version: first-person narration was maintained, though this time performed by a single character - a Francophone resident of the Royal Insurance building in early 19th century - whilst mechanical movements were replaced with a wider fixed screen that enabled a more immersive impact. As regards the contents, more relevance was assigned to the Great Peace and to the relations between the French and Iroquoian nations.

5.2. 2008-2010: The renovation of the permanent exhibition and the new show "Yours Truly, Montréal"

The second version of the show run from 2000 to 2010.

In this period, the museum had decided to undertake a major renovation of the set-up and display of the archaeological crypt which was considered to be lagging behind recent developments in exhibition philosophy and technologies, as well as incapable to accommodate an audience that had increased from 191,000 in 2001 to 324,000 in 2008 (Tourism Montréal, 2013)

The planning, implementation and monitoring of the new permanent exhibition 'Montreal was born here' were directly coordinated by the Department of Technologies and Exhibitions under the Director's supervision, resorting to a grant of the Provincial Ministry of Culture of over 800,000 CAD. The main objective was to make the display more interactive and capable to prompt the curiosity of the visitors through a more pervasive use of new technologies.

Not possessing dedicated IT units or specialised skills, the museum selected as a contractor Bluesponge, a local firm specialized in the use of new media for creating "immersive brand environments" (Industry Canada, 2011) which had previously realized the new website of the Canadian Centre of Architecture. The firm was charged with designing 10 multimedia exhibits, whose visual scenario was created by drawing on prints and paintings of the Old Port of Montrèal, which were animated and adapted to user interaction, showing the transformation of the urban landscape over the three centuries of its history. Images were complemented by brief textual information focusing on the economic and social activities taking place at the harbour or on specific historical characters. An interactive display showing a 3D reconstruction of the Royal Insurance headquarters based on historical illustrations and photographs was also added in proximity of its foundations.

The main innovation of the new exhibition, though, was represented by a 16,5 meters long "magic interactive fresco" (Pointe-à-Calliére, 2011, p. 10) that winds across the second section of the crypt, showing the facade of the Port in 1845 as seen from the actual position of the museum. The image was reconstructed by relying on two authentic paintings of the period. The frieze is retro-illuminated, animated and punctuated by quotes of authors regarding the aspect and activities of the port, whilst interactive exhibits and glass cases of artefacts are framed in the middle of the fresco, so to be easily visible to younger visitors. This "visual immersive environment" (Bluesponge, 2011) is completed by sounds recalling the voices and screams of the dockers and immigrants.

Figure 11: A section of the interactive fresco at the archaeological crypt with plastic models on ground.

Source: Pointe-à-Callière website.

It should be remarked, though, that the relation between the visual scenario and textual contents was not determined at the beginning of the project, but emerged after repeated negotiations between the contractor and the Exhibitions Department staff.

In particular, the curators attributed a high importance to historical texts, seeing images as a support and exemplification of the latter. The software development team, instead, built on the opposite observation that "the public's [...] attention [...] tends to remain fairly low [...] especially with written content" (Bluesponge, 2011) and thus attempted "to summarize concepts and ideas in a few seconds in the most intuitive, graphical and fun way possible (animations, drawings, video)", according to the motto "less text for more interactivity" (Bluesponge, 2011).

Figure 12. An example of the dominance of a visual over a textual approach in the interactive exhibits.

Source: Bluesponge website.

In order to facilitate an agreement on such divergent approaches, a mixed operative team was formed including one museologist and Bluesponge's art director. The designers prepared slide presentations showing different possibilities for expressing and animating contents, in order to reduce the museologists' uncertainty, leaving to the client the choice of preferred modalities of presentation. After repeated interactions, a balance was found by differentiating between two layers of contents, targeted to as many 'model audiences': a 'generalist' visitor to be addressed through an appealing and immersive visual interface, and an 'expert' visitor who was offered the possibility to "dig further in the topic" (Bluesponge, 2011) through hidden text boxes that expand under the user's action, providing information on specific places (see FIGURE 13).

Figure 13. An example of the insertion of explanatory texts in an interactive exhibit.

Source: Bluesponge website.

Likewise, the idea of the 'interactive fresco' emerged after repeated consultations, as a compromise between Bluesponge's intention to create a sensorially appealing environment and the Exhibitions Department's requirement that the interactive exhibits should be integrated within the overall layout of the exhibition, without abstracting the visitors' attention from the visit path.

A further element of compromise between innovation and conservation is that the new devices did not completely replace analog panels nor the interactive elements included in the previous exhibition. An interactive round-shaped table showing reconstructions of the archaeological site in different historical periods dating to 2003 and 3 out of the 5 digital interactive characters designed by GSM for the first permanent exhibition were preserved: as these had proven able to live up to technological evolution - "wherein 20 years is an eternity" (Interviewee, personal communication) - the juxtaposition of old and new would show the progress - as well as the continuity - in almost two decades. Numbered and retro-illuminated chronological-thematic panels or story-boards containing textual and photographic materials were also created for the new exhibition by the Department's staff.

Figure 14: Textual and photographic panels at the permanent exhibition.

Source: Pointe-à-Calliére website.

However, in 2008 and 2009 the museum's energies were absorbed in another major innovation: the planning of a new multimedia show that would replace the former one, relying on financial support provided by local and provincial ministries, a private sponsor (Hydro-Québec) and the Foundation for a total of about 3 million CAD.

This time, GSM Design (now rebranded as *gsmprjct*°) presented its proposal in partnership with two other Montréal-based firms: Moment Factory, specialized in the conception and implementation of multimedia experiences, and the marketing and branding agency Sid Lee. With respect to the previous bids, the joint venture introduced a new division of responsibilities: whilst *gsmprjct*° exclusively concentrated on the development of technical infrastructure, Moment Factory focused on the design of the show and Sid Lee took charge of web communication.

The proposal attracted the interest of the direction and the Technical Committee as it introduced a significant infrastructural innovation, that is the realization of a 270 degree screen occupying three sides of the theatre hall, which would allow to reorganize the space by taking advantage of the existing features (such as by opening new walkways so to enable new points of view over the archaeological remains). A further advantage of the new project was the implementation of a movable stage, which allowed to transform the theatre hall into a multi-purpose space to be used for cultural and corporate events. Finally, Moment Factory's international reputation in the realization of technologically advanced, immersive and engaging shows and installations was also deemed consistent with the objectives of providing an entertaining and sensorially appealing experience.

Case History 4: Moment Factory: the firm and the creative process.

Moment Factory is a "new media and entertainment studio specialized in the conception and production of multimedia environments combining video, lighting, architecture, sound and special effects to create remarkable experiences" (Moment Factory). Established in 2001 in Montréal, over one decade of activity the firm has experienced a steady growth in the size and variety of the client portfolio, as well as in the number of the employees which counts currently a total of 110. These results have been made possible also by the attraction of professional and talents from other creative organizations in the city. The headquarters of the company are located in a multifunctional space at the frontier of the Mile End, one of the main creative clusters of Montréal (Rantisi and Leslie, 2010).

In Moment Factory' creative philosophy, adaptation to the site environment, attention to the client's requirement and inclusion of the visitor into the experience assume a central relevance. To this purpose, three teams are typically involved in the creative process, respectively dedicated to the design of the multimedia contents, to the implementation of the systems that provide the technological infrastructure for the show (projection and sound systems, movable platforms and interactive components), and the integration thereof into the environment, through field trips and simulations conducted on scale models of the event venue. In each project, the three teams interact constantly in order to find the most suitable solutions for the specific client and site, supported by the project management and administration structures as regards contractual procedures. Especially in large-size or particularly complex events, external partners such as freelance designers may be involved, whilst on-site technical teams are used to assist logistic operations.

Drawing on the first years of activity, the project management has identified a general scheme of the creative process that assists the team in the phases of planning and implementation.

The conception stage includes the definition of the general objectives, themes and the aesthetic scenario of the show. The environment and technical design phases are respectively concerned with the definition of the surface, look and style of the show, and with the planning of the technical infrastructure best suited to support these. Once defined the hardware, the production of multimedia contents (art direction and definition of visual contents, 2D or 3D animations, sound track etc.) takes place through successive steps.

The hardware and software components are then integrated and synchronized on-siteby relying on proprietary control systems. In the case of repeated shows or permanent installations, Moment Factory also trains of the onsite staff to correctly operate the show through tutorials and update sessions .

Such structuring of the creative process has proven useful to combine the designer's freedom to explore new technical and visual solutions with the necessity to respect tight deadlines on the part of the client, a paradox that is common to many organizations in the creative industries (Cohendet and Simon, 2007; Cohendet et al., 2010): although modifications of the initial concept are allowed to account for theto step-to-step evaluation of the technical feasibility of the solutions envisioned, the scheme offers the project managers a reliable guideline that helps anticipate the timing of individual phases and compensate for unexpected delays.

The project portfolio of Moment Factory is divided in 4 areas:

- "on the street", including shows performed in public spaces in collaboration with urban institutions or private organizations, inspired by a "New Urbanism" and "a notion of place making" aiming to the invention of new public spaces "for people to gather and be entertained in the city". The main projects in this area are the award winning sound and light spectacle realized at the Sagrada Familia in Barcelona in September 2012 under charge of the Town Hall, and the 30 minutes show *Mosaika*,

commissioned by the National Capital Commission at the Federal Parliament buildings in Ottawa with the aim to represent Canadian history in a vibrant and contemporary way. To realize the latter, Moment Factory's staff embarked in a series of 200 interviews with Canadian people from diverse backgrounds, whose voices and experiences were integrated in the show.

- "between walls", referring to permanent installations that aim to "transform a public space into an environment that is designed to mold message and mood and to provoke and entertain". Besides the intervention at Pointe-à-Callière, recent projects are the realization of an interactive musical walls at the hall of Sainte Justine Hospital in Montréal and a giant miniature replica of Manhattan in occasion of the launch of Microsoft Windows 8, creating an immersive experience for the shoppers.
- tightly related to the former, the "on traffic" area refers to temporary installations at public spaces with an intense flow of people, that create "controlled, immersive environments that convey a tactical message to a targeted audience". A recent example is the installation of a giant interactive Christmas tree at Union train Station in Toronto, commissioned by Tribal DDB agency on behalf of Canadian Tire in 2011, whose decorations lit up as Christmas messages were shared through online social networks. Moment Factory was also invited by Cirque du Soleil to collaborate to the animation effects for the *Velocity* and *AquaMagika* installations at the Canadian pavilion in Shanghai World Expo 2010, which provided visitors with a virtual journey through the Canadian landscape and a sensorial interactive experience of water
- the "on stage" area includes the planning and implementation of one-of-a-kind entertainment and music shows. Over the last years, Moment Factory has developed a substantial experience in music shows, collaborating with international pop and rock stars such as JayZ, Usher and the Arcade Fire. For Madonna, the firm has designed stage animations effects at the NFL's Super Bowl Halftime Show in 2010, which resulted in an invitation to create personalized multimedia contents for the MDNA world tour in 2012.

Although the use of advanced technological solutions both at the level of hardware (such as punctual digital projectors, capable to overlap visual impressions to the surface of buildings) and software (such as cutting-edge 3D animations and interactive features) is fundamental for the quality of the final result in all the four areas, Moment Factory's philosophy is to integrate the technical components in the environment and "hide" them to the spectators' eyes, so to intensify their reaction of amazement and emotional involvement. The variety of the portfolio in terms of sites, clients, objective and media enables Moment Factory to maintain a balance between diversification and specialization. The re-composition of ad hoc teams for new projects enables a contamination between individual experiences as well as a transfer of creative ideas from one field to another.

In order to assist the definition of the contents, Pointe-à-Callière organized five round tables on likewise thematic units - the Iroquoian settlements; the French colonization; the British conquest; the oscillating fortunes of Montréal as the Canadian metropolis and the contemporary expansion - involving 20 historians, whose consultation allowed to share research and discuss alternative interpretations. Although the richness of contents and the variety of perspectives emerging from the consultation could hardly fit the tight limitations imposed by the format of the show, this proved useful to identify the main events and elements upon which to lay the stress.

Continuity in the Scientific Committee - whose members had remained unchanged since 1992 - provided the possibility to re-use old documentary materials for the new show, thus accelerating the submission of the historical dossiers to the designers team. Since it was Moment Factory's first experience of collaboration with a cultural institutions, a professional archivist was hired to support the visual scenarist and manage the documentary materials.

After preliminary discussions, Moment Factory begun to translate the historical dossiers into a set of storyboards and visual concepts. Various solutions were experimented to convey visually information about the demographic, economic and infrastructural expansion aspects of the city. These were presented to the Scientific Committee, which asked for modifications. In particular, because of historiographical perplexities as well as technical difficulties, the first hypothesis of narrator was discarded. After a round of consultations, it was agreed to let the city (impersonated by a feminine narrator) speak for itself, so to create a personal identification with Montréal in the spectators.

As the interviewees remarked, the themes chosen for the third edition of the show imposed a new challenge at the level of script writing, which had to underline the respective contributions and reciprocal intersections of different ethnic and socio-cultural groups: the Amerindians, the French, the Anglo-Saxons and the new waves of immigrants from Europe and Asia.

Moreover, the intention to summarize these elements within a single and inclusive narration imposed sensitive decisions on how much space to devote to particular events or characters. To this purpose, the two parties engaged in a process of incremental adjustment which ended when an acceptable balance was achieved. Whenever there were disagreements among the historians, they were first resolved within the Committee, so to present the designers a common point of view. At a further stage, a local writer and poet was charged with translating the storyboards into an effective narration.

The possibility to use an increased amount of visual materials, thanks to Moment Factory's reliance on cutting-edge technical solutions for simultaneous projection posed the problem of aligning the volume of contents used for each period, since the first two centuries of Montréal's history are less iconographically documented than the following ones. In order to fill in this gap, the visual content team resorted to shootings taken at archaeological sites and historical drawings, all of which passed through the Scientific Committee's validation.

Four versions of the storyboards were submitted for approval by Moment Factory and a sample projection of the preliminary video was held at the company's headquarters in the presence of the Direction and the Scientific Committee.

This process of incremental improvement and adjustment increased the overall duration of the project to a total of 18 months.

In the words of the Director, the show titled *Yours Truly, Montréal* consists in a "truly immersive experience" where "the projection takes visitors into the heart of the action and the city's history", providing them with a "spectacular voyage through time and space, presenting Montréal's story using an artistic and technological approach".

The show is divided in a number of micro-sequences dedicated to specific periods, with an average duration of 30 seconds, punctuated by the projection of dates on the archaeological vestiges.

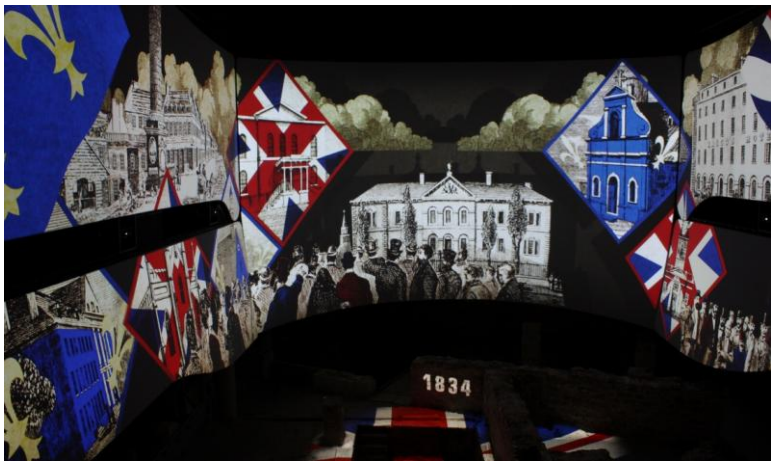
In order to ensure continuity in the narration and to avoid a 'slideshow effect', each scene is characterized by a distinct graphic motive which acts as a unifying pattern for the images and animations. In the first part, in order to compensate for the scarcity of authentic historical documents, an evocative approach is adopted through the utilization of drawings and cartoon-like animations.

Figure 15. Use of plastic models for the Iroquian village of Hochelaga in *Yours Truly, Montréal.*

Source: Moment Factory website.

On the opposite, the section on the 19th and 20th century draws more extensively on paintings and archive photographs, which are brought to life through graphic effects and animations. Black-and-white pictures are superimposed with coloured patterns and juxtaposed to give the illusion of movement, whilst silhouettes of characters and buildings pop-up from the urban landscape.

Figure 16: Capture from 'Yours Truly, Montreal' with the juxtaposition of historical prints.



Source: Moment Factory website.

In the section on contemporary Montréal, particular emphasis is given to the main events - Expo '67 and the Olympics of 1976 - that projected the city on the international scene.

The narration is conducted at a linguistically unsophisticated level and with a 'catchy' tone, and concluded by including the audience within a common identity: "I am Montréal, we are Montréal".

The realization of the new permanent exhibition and the installation of the new multimedia show in 2009-2010 seem to have fulfilled long-lasting attempts to create an immersive, spectacular environment at Pointe-à-Calliére through the use of technologically advanced solutions. The common objective to these initiatives is that of enabling visitors to 'travel into the city's past' whilst providing at the same time rigorous informative contents and a proud view of the city's past and future.

Although it is not possible to trace a direct connection between the two events, due to the relevance of blockbuster temporary exhibitions as a motivation to visit[122], it seems that the innovations have met a good appreciation as the attendance has risen from 324,000 visitors to in 2008 to 390,000 in 2010 - to decrease the following year and stabilize around the previous levels in 2012.

5.3. Onsite and online: Differentiation and consistency

Despite the main efforts and investments of Pointe-à-Calliére have gone towards the improvement of the onsite experience, though, this has not occurred to the detriment of online applications. Thanks to financial support from Industry Canada's Francommunautés Virtuelles program and the Department of Canadian Heritage's funds, Pointe-à-Calliére has contributed with over 3,700 items to the Info-Muse network and Artefacts Canada (see Section 4.1.2). In 2006, the museum has developed an interactive exhibit-game focusing on the foundation of the city (*Building Montréal*) for the Virtual Museum of Canada, in partnership with two private graphic design and sound production firms and relying on the scientific advice of 3 local historians[123].

In order to exploit the mass of documental materials gathered for *Yours Truly, Montrèal*, a book and an interactive website associated to the show have been created. The former, presenting the same visual code of the video, included texts written by the author of the scripts and historical cards curated by members of the Scientific Committee. The latter has been developed by Sid Lee in collaboration with the museum Communication Department. A dynamic timeline based on the graphical code of the show allows users to navigate across the main events of Montrèal's history by accessing content "that is accessible, entertaining, and visually rich" (press release). A game section

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[122] A milestone in this sense was the organization of the temporary exhibition *Pirates, Privateers and Freebooters* (running from May 20th 2009 to January 10th 2010) that proved particularly successful in attracting a segment of families that previously were under-represented at the museum, also through the life-size reconstruction of a ship deck in the museum hall. Since one entrance ticket is issued for the museum and exhibition, though, it is not possible to disaggregate visitors data.

[123] http://www.batirmontreal.net/public/creditEN.aspx.

targeted at under-12 students invites users to discover and collect 12 artefacts, which are then added to a log book in order to gain a badge of 'virtual archaeologist'.

In the intentions of the museum, the website would act as a teaser to the multimedia show and as a complement to the range of information and experiences available on-site.

Although it was planned to follow shortly the inauguration of the show, however, the website was only made available in 2010. The 3D reconstruction of the Royal Insurance building has also been published in a dedicated section of the website[124], whilst 50 digitized objects of the collections have been provided to Google Art Project[125].

Under this light, Pointe-à-Calliére seems to have used the Web to showcase the permanent collection and to provide a preview of the onsite experience, inspired to the same criteria of interactivity and playfulness.

5.4. Discussion: the challenges of co-design of museum multimedia

Pointe-à-Calliére well exemplifies the case of an entertainment-oriented museum that has consistently adopted advanced technological solutions throughout two decades with the aim of providing an immersive and entertaining experience of the past. Under this light, it has sought for technological expertise actively and selectively, scanning the local environment to identify suitable developer partners.

Although from a technical standpoint the results of the innovation process are remarkable, some tensions have arisen from the confrontation of the different assumptions and objectives regarding visitor communication carried by the museum and the technology community, whose collaboration has not been immune from factors of complexity.

On the part of historians and museologists, the realization of a multimedia show poses challenges that are unusual to their academic activities of teaching and publication. Likewise to mass media such as TV and radio, in fact, the nature of the medium strongly restricts the volume and deepness of the contents that can be transmitted: in both cases, the message needs to be extremely condensed and should result comprehensible to a general audience, whilst avoiding at the same time any mitigation or oversimplification of the issues. The selection of members of the Scientific Committee among historical consultants with an established experience in popular media communication ensured that these knew the 'rules of the game' - that is, the need to address a rigorous historical message towards an ideal spectator who does not possess a specific knowledge.

In the first edition of the multimedia show, GSM's substantial experience in the design of museum exhibitions and the early level of development of digital technologies allowed historians and the museum direction to limit their involvement in the definition of contents and to anticipate more easily the final outcome. The second version of the video brought relatively little changes, due to the continuity in the actors involved and the incremental approach to innovation.

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[124] http://www.pacmusee.qc.ca/en/exhibitions/ici-naquit-montreal/royal-insurance-building.
[125] http://www.google.com/culturalinstitute/collection/pointe-a-calliere?projectId=art-project

Since informal collaboration with developers represented the only source of technology-related knowledge for the historians and curators, however, the cognitive gap experienced with the contractors tended to widen at each new generation of projects alongside with technological evolution. In this context, the underlying differences in the respective approaches to visitor communication openly emerged in the renovation of the permanent exhibition, wherein two different user models or prototypes were confronted. Although a balance between the two positions has been finally found, to a general look it seems that software developers have managed to attribute a precedence to visual contents over textual ones and push through a physical notion of interactivity - meant as the possibility to select among a limited range of informative contents, likewise to the first generation of multimedia displays (see Section 2.4.1) - over an interpretive one. Moreover, despite the concerns expressed by the curators, from observation of museum visitors, the graphical attractiveness of the interactive fresco seems to draw the visitors' interest and attention towards the frieze itself rather than to the items on display.

The cognitive challenges of collaboration were further amplified in the design of the new multimedia show, wherein the selection of a contractor specialized in hi-tech entertainment experiences let the distance between two different approaches to museum communication emerge more evidently than in the previous editions, thus requiring relevant mutual adaptations on both sides.

Paradoxically, the increased volume and variety of the visual contents and effects that could be inserted in the video thanks to the new technique of simultaneous projection called the Scientific Committee to step beyond a passive role of 'warrantor' of historical rigour and engage more closely in the evaluation of the graphical and narrative solutions. In other terms, due to the increased complexity of technological solutions, the historians were involved more actively in the definition of the contents, resulting in a closer interaction with the developers along the creative process.

On the contractor side, *Yours Truly, Montreal* marked a difference from 'pure entertainment' shows where relatively free associations between visual contents and other sensorial stimuli can be created, as in this case graphical imagery had to conform to an oral narration. Moreover, the necessity to rely on historical documents and to submit every proposal to a scientific check limited the range of artistic autonomy available to Moment Factory's designers. The firm reacted to this challenge by selecting the members of the team on the bases of their personal motivation for the project and by integrating a professional archivist to assist the relations with the historians. The complexity of the contents also forced the firm to adapt its scheme of the creative process (see

CASE HISTORY 4) by working in parallel upon six 'plots': the 'essentials', representing the key messages to address; the 'historical', including relevant historical information; the 'networks', referring to the variety of commercial and transportation relations developing in time with Montréal at their core; the 'soundtrack', including elements taken from data banks as well as new recordings; the 'cartographic' plot, aiming to contextualize geographically Montréal's history through the use of maps; and the 'visual' plot consisting in the graphic patterns and effects that characterize each scene.

Along the creative process, storyboards and projection tests conducted on scale models of the site acted as boundary objects that enabled interpretive flexibility on part of the two communities and facilitated an anticipation of the final results (Carlile, 2002).

Under this light, the outcomes of the collaboration appear particularly complex to evaluate.

On one hand, a partial cross-fertilization between unrelated competences (Lazzeretti, 2009) seems to have been achieved, as the historians and curators have been familiarized with a visual approach to narration that requires a balance between documentary accuracy and allusive or suggestive imagery (as demonstrated by the use of cartoon-like drawings and plastic models in the first part of the show); in turn, the designers have acquired expertise in coping with specific client expectations and have opened new opportunities of development in the cultural sector - a first result of whose is the assignation by Pointe-à-Calliére of a further interactive fresco to be installed at the newly opened Mariners House[126].

From a critical perspective, however, the new multimedia show finds its main limitation in a relative lack of integration with the architectural remains. Whilst in the previous versions the foundations of the old cemetery and Calliére's residence provided the very stage for the narration, in 'Yours Truly, Montreal' the setting is directly involved only at the start of the narration - when a special projection effect gives stones the illusion of movement - but are not further evoked in the remainder. This relates to the fact that the new projection techniques tend to superimpose visual contents onto, rather than inserting them into, the architectural environment, thus arising a certain disconnection from the overall museum setting which is also perceived by some visitors (see Section 5.5).

To summarize, the renovation projects undertaken at Pointe-à-Calliére exemplify the challenges posed by the collaboration between different disciplinary communities endowed with a specific mix of assumptions, theoretical frameworks and practical orientations.

At each new project, technological evolution and the absence of regular schemes of cross-fertilization can be seen to widen the cognitive distance between the two communities and thus to pose novel challenges to communication and collaboration. In this context, the identification of boundary objects with variable levels of complexity - from simple scripts to composite storyboards, to simulations of the show - is crucial in ensuring mutual understanding whilst complying with the interpretive constraints of each involved party (Star and Griesemer, 1989; Carlile, 2002; 2004).

A further sensitive point regards the role of assumptions regarding the end users: although these are not directly involved in the design of the applications, both communities involved in the design carry with them implicit assumptions regarding their motivations, interpretive schemes and expected reactions. In this sense, the curators-historians and the designers act as spokespeople of two different 'model readers': whilst the former tend to address a conventional visitor familiar with text explanations, the latter mostly envisioned a young segment of the audience that is more attracted by visually evocative contents. Consistently, the negotiation of the contents of the new show did not depend exclusively on 'hard' power elements such as contract specifications, but also

[126] The building will host temporary exhibitions, cultural events and the museum shop inaugurated in 2012. To the purpose, the contractor has designed an animated, 12 meters long digital fresco inspired to maritime motives which serves both to attract the attentions of passer-bys, being visible from the street, and as a cue to direct visitor flows inside the pavilion.

on the implicit argumentative force of the respective modes of experience advocated by each party. At this level, the relative primacy of a visual over a textual approach can be considered as the sign both of the influence of the leisure industry as the main driver of the Northern American cultural economy (Kirshenblatt-Gimblett, 1998) and of the increasing discursive relevance of the *Net Generation* (Tapscott, 1999) or *digital natives* (Bennett et al., 2008) within education studies.

At this point, the specific solution to be found to this confrontation seems to depend very much upon the format and characteristics of the particular media adopted.

Depending on the level of interactivity, it is either possible to find a balance between different requirements - as in the case of the tension between entertainment and rigour underlying the design of the multimedia show - or provide differentiated layers of information in response to users' action - in the case of the interactive exhibits, where a basic visual pattern addresses to a general visitor whilst textual contents appeal to more curious users.

In the absence of consistent data from ethnographic observation or interviews, a netnographic qualitative text analysis was performed on TripAdvisor comments, in order to provide an exploratory assessment of the visitors' perception of the interpretive media used at Pointe-à-Calliére. As can be seen in the following subsection, some problems related to the characteristics of the media chosen, as well as to specific choices made at the level of the contents emerge.

5.5. An attempt to unveil user evaluation through an analysis of TripAdvisor comments

Netnography consists in an extension to the Web of the data collection techniques - such as participated ethnographic observation - that have been traditionally used by marketing and consumer behaviour researchers to study the dimensions and meanings of the consumption experience. In this sense, netnography is particularly useful to "study the tastes, desires, and other needs of consumers who interact in online communities" (Kozinets, 2002, p. 62).

Although the observation of virtual spaces presents several limitations with respect to surveys (lack of statistical significance of the sample; self-selection of the respondents and over-representation of specific segments; variable length of the comments provided; possible lack of socio-demographic characteristics data), it provides a naturalistic and unobtrusive perspective over the main factors of importance and satisfaction/dissatisfaction with the visit experience. TripAdvisor[127], which is the first online travel community for years of activity and participation, represents a relevant channel to which tourists resort in order to choose their accommodation and

[127] TripAdvisor was founded in 2000 as a travel portal and an online community where registered users can share reviews and evaluations about tourist accommodations, attractions and restaurants. Operating in 30 countries, TripAdvisor counts more than 60 million single monthly visitors which generate 65 million reviews and opinions on tourist accommodations and attractions (source: comScore Media Metrix for TripAdvisor sites, July 2012). Ratings can range from 1 to 5 stars, and the reviewing users are ranked on the basis of their number of contributions: contributor (from 2 to 5 reviews); expert contributor (5 to 10); reviewer (11 to 20); expert reviewer (21 to 50) and super reviewer (over 50 reviews)

attractions and the comments posted by users have a relevant influence on the decisions of other potential visitors (Ayeh et al., 2013).

In the present case, netnography was applied to analyse the visitors' experience of the museum, as regards especially their use and satisfaction with the different technological devices used in the renovated permanent exhibition as of 2010. At the moment of consultation (January 2013), 157 reviews were retrieved on TripAdvisor, with an average evaluation of 4 stars[128] that placed Point-à-Callière as the 17th tourist attractions in Montréal. The overall judgments on the museum were so distributed:

73 Excellent (5 stars), 53 Very good (4 stars), 16 Average (3 stars), 10 Poor (2 stars), 5 Terrible (1 star). As is a general characteristic of TripAdvisor, comments varied significantly in terms of length, amount of information provided, ordering and writing style.

Among these, 129 reviews referring to visits conducted in the post-renovation project (since November 2010) were selected, although prior reviews were considered when a qualitative comparison between the two exhibitions was mentioned. Comments focusing on additional services such as temporary exhibitions or the restaurant were excluded as they did not pertain to the focus of the analysis.

Relevant comments will be reported alongside with the writers' nickname, their status in the community and their geographical provenance when provided.

For the most o the reviewers, the main distinctive feature of Pointe-à-Calliére consists in its location on the site of authentic archaeological vestiges:

*"Musée incontournable si on veut connaître l'histoire de Montréal car il est implanté sur les lieux mêmes où se sont déroulés les événements fondateurs de la ville" (*Reviewer from Mons, Belgium, 5 stars).

"*Musée édifié sur les lieux de fondation de la ville de Montréal. A voir absolument si l'on veut mieux connaître Montréal*" (Expert Reviewer from Lausanne, 5 stars).

"*The best part is the archeology/history of Montreal part in the basement. I thought it was really neat to tour a real archeological "dig"! It wasn't like any museum I've been to before. The admission fee seemed a little high compared to other museums in the area, but it was worth it!"* (bonleeballerina, Expert Reviewer from Tempe, 5 stars).

"a really neat archeaological dig site, as it is completely inside, basically the basement of the building which houses it..." (Contributor from Vancouver, 4 stars).

"I have never seen a museum like this before. You start at the theater for a brief history of Montreal. Afterward, you go into the basement to see the dig. Archaeologist have removed layer upon layer of history to reconstruct the history of Montreal" (TexansAlso, Super Reviewer from Texas, 4 stars).

[128] TripAdvisor rounds the average of evaluations at 0 when it is inferior to 0.5 and at 1 when it is superior.

"By traveling through the ruins of old Montreal the visitor gains the understanding of early life and architecture of this beautiful city along the St. Lawrence. We enjoyed walking along the walls and ramparts of old Montreal and viewing the artifacts of everyday life from years ago" (reviewer from New Jersey, 5 stars).

"Very interesting to see the history of the area and actually be able to touch parts of history that are 300+ years old" (Reviewer from Saskatchewan, 4 stars).

"The building over the dig was built after the dig was concluded. This could be little interest for children – but very enlightening for an old man like me" (Expert Contributor from Massachussets, 4 stars).

As regards 'Yours Truly, Montréal', for several reviewers it offers an entertaining general introduction to city history:

"The video opening gave a great introduction about the history of Montreal" (Contributor form Vancouver, 5 stars).

"Enjoyed the AV presentation - a quick primer on Montreal's human history." (Super Reviewer from Sydney, 5 stars).

"They have a fantastic movie presentation spanning the history of the area and Montreal itself. The movie alone made the visit worth it to me" (Reviewer from London, Ontario, 5 stars).

"The 30 minute a/v show was one of THE best we have ever seen." (Expert Reviewer from Iowa, 5 stars)

"the 20 minute video in the beginning was the prefect [sic] overview of the city. Coming from the States, we aren't exposed to this piece of history, and we often forget about the Native Americans and how they also changed our lives just as much" (Expert Contributor from New York City, 4 stars).

"Very cool video, very well done" (Expert reviewer from New York City, 4 stars).

"Fabulous media presentation on the history of the city and Canada" (Super Reviewer from Colorado, 5 stars).

"There is a multimedia presentation that you really need to go to. It is well done and very informative. Tells all about Montreal's history" (Expert Contributor from Michigan, 4 stars).

"This museum was helpful in my understanding of the long complex history of Montreal. The multimedia presentation is informative and, although a bit overdone, keeps your attention" (Super Reviewer from Tucson, 4 stars).

"The 20 minute video covering Montreal's history from beginning to present day is really well done, I haven't seen better around the world." (Super Reviewer from Adelaide, 3 stars).

"The best part was the multimedia show." (Expert Contributor, 3 stars).

It is significant that some reviewers express particularly positive evaluations of the multimedia show and the interactive exhibits within the context of a visit with the family:

"I went with my husband and 2 children ages 10 and 13. We all enjoyed this museum. It is a very different type of museum. You see and touch actual ruins. There is an amazing multimedia show as well" (Contributor from New York State, 5 stars).

"When I told my kids that our next sightseeing stop was a museum in Old Montreal, they groaned and said they would rather go shopping. However, by the time we were done they said that they were glad we went. In a nutshell - multimedia show of how Montreal came to be, underground archeology exhibit with real life ruins on the actual site, 3D models, exhibits related to modern life in Montreal and its diverse people [...] " (Expert Reviewer from Toronto, 5 stars).

"Great movie and exhibits on history of city. Family and even teenage son loved it" (Contributor, 5 stars).

"Fun and interesting museum with great information on the beginnings of Montreal using various technologies. [...] Great for children of school age" (Contributor from California, 4 stars).

However, a segment of mostly single adult visitors also express mixed opinions on the video, referring in more critical terms to its orientation towards a young target and detecting some simplifications in the information presented:

"Then on to the multimedia show (ok, not super informative, good for kids)" (Expert Contributor from New Jersey, 4 stars).

"The movie is a little bit hyperactive and short on specifics, and it's clearly directed at kids about 8-15, who should enjoy it a lot. In fact, we were there at the same time as a school group (looked like 5th graders), and despite lots of squirming and noise before the movie started, they seemed spell-bound throughout the show" (Super Reviewer from Philadelphia, 4 stars).

"The introductory film is overly saccharine and is too fast to really comprehend much of anything about the history of Montreal" (Expert Contributor from New York City, 3 stars).

"The multimedia movie you see at the start is only good for children and teenagers. It is pure eye candy and does not go in-depth about the history of Montreal" (Reviewer from Hong Kong, 2 stars).

"I typically enjoy museums and history so the idea of a museums with ruins in the basement peaked my interest. Upon arrival I was greeted by 60 plus out of control grade schoolers on a field trip. I believe the museum is geared toward young children. I began with the multimedia movie. It was very high level and not very interesting. It would state things like, in the 20's the people in Montreal bought cars and then move on to the next decade. It did not contain insightful facts I did not know about the history of Montreal" (Expert Reviewer from Illinois, 2 stars).

"The movie is like a cartoon version of history with "Montreal" as the narrator. It goes from silly to offensive to stupid. The archeological site underneath it is a bit better but still lacks real depth" (Expert Reviewer from Oakland, 2 stars).

These critical comments reveal, on the part of the reviewers, an expectation for deeper historical contents and interpretive hooks, which in some cases are also added to a certain dissatisfaction with the format and style of the narration.

"Disneyfied version of history [title of the comment]. We read many review and thought this would be a great overview of the history of Montreal. The movie is hokey to say the least and the rest of the museum takes about 1/2 hour to see. If you want a good history/ archeology museum go to the Stewart Museum instead" (Reviewer, 3 stars).

"La nouvelle présentation multimédia essaie de raconter passer à travers l'histoire de Montréal de Jacques Cartier à aujourd'hui... en 18 minutes!! Quelle farce. On nous bombarde d'images à une vitesse infernale tout en racontant une histoire très simplifiée. La présentation que j'ai vu il y a 10 ans était bien plus pertinente!! Elle parlait bien plus en détail des débuts de Montréal" (Contributor from Montréal, 2 stars).

Although these comments are numerically inferior to positive reviews, they are particularly significant as they unveil an underlying conflict between the expectations and criteria of evaluation of two target segments, which is amplified by the very nature of the medium. In this sense, the intention to address an undifferentiated audience by conveying a general historical background meets the dissatisfaction of a segment of more knowledgeable visitors who search for thicker contents.

A further set of issues, though, emerges from the specific choices made at the level of the contents, which are questioned by some commentators for privileging particular voices of Montreal's history to the detriment of alternative narratives.

"The movie on the history of Montreal falls so very short of its promise. It's very selective and misleading at times. As it is the only description you get, it is very disappointing and incomplete - not a very good first impression. Perhaps it does reflect the city's attitude..." (Super Reviewer from Québec, 3 stars)

"Terrible displays (esp. the film) devoted to trashing the English in favour of the French who apparently brought peace and harmony to the local inhabitants! Amusing but not history. And this is the official museum" (Contributor from London, 3 stars).

This tension stems from the fact that, whilst the previous versions of the show included multiple characters that discussed and contested one another's versions of history, the adoption of a first-person narrator representing the whole city as a unitary and inclusive entity tends to merge and silence different voices. In this case, the efforts put in balancing graphical attractiveness with historical rigour paradoxically risk distancing a more 'history-savvy' segment of the audience who perceives a single narration as a limitation to their interpretive freedom: a risk that Moment Factory had tried to circumvent in the *Mosaika* show in Ottawa by presenting the viewpoints of different speakers (see

CASE HISTORY 4).

Therefore, a further factor of complexity in the relation between museum education and entertainment emerges, whose balance does not only require compensating the lightness of the

narration with a rigorous representation, but also finding a compromise between - using Moment Factory's words - the intention to "mold message" and "provoke".

As regards the renovated permanent exhibition, the visitors' judgment is generally positive, but only few direct references to the interactive displays can be found. Some of them highlight the contribution that multimedia exhibits bring to the comprehension of the archaeological vestiges:

"You are then able to view the archaeological sit under the building. It is well worth following the numbered story boards and viewing the models[129] they have created showing the changes to the area over time" (Super Reviewer from Sydney, 5 stars).

"Although they are a bit bewildering in their layout, the exhibits have lots & lots of interesting details, including interactive features on illuminated "story-boards." Be sure to leave lots of time for these (1-2 hours)" (Super Reviewer from Georgia, 4 stars).

"Other reviewers have cited the various multimedia presentations as being dated[130], but in general they were still interesting and informative. One criticism is that some of the display cases are located somewhat low for easy viewing by upright adults, but would be fine for children" (Reviewer from Michigan, 5 stars).

"There is an excellent video, and the trip underground to see the origins of the market place etc with proper historical videos" (Reviewer from Montréal, 5 stars).

When reviewers explicitly compare the multimedia show with the archaeological crypt, however, the latter does not seem to satisfy the expectations aroused by the former:

"I was expecting lots of exhibits and displays that would bring the buildings to life and explain the roles they played in the history of Montreal and Canada. Instead...I got a lot of rocks. Very cool rocks, but very little guidance on what I was looking at. Add that to the many empty display cases and broken videos, it was a very disappointing morning. There is an 18 minute intro video you're supposed to watch before you tour the museum and that was EXCELLENT - I hope that they carry that over to the actual exhibits at some point!" (Reviewer from Boston, 2 stars).

"There were many interesting tidbits, but not a spectacular as the initial presentation movie makes out" (Super Reviewer from Boston, 3 stars).

"The exhibition [...] focuses on building foundations as well as artifacts of daily life recovered from the site. Lots of photos and drawings illustrate the history. Although there is an interactive area, I don't feel that the museum is particularly suitable for kids, due to the amount of detail, some of it fairly technical, in the presentations " (Expert Contributor from New Jersey, 4 stars).

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[129] This reference is ambiguous, as it may either refer to the interactive displays and the plastic models maintained from the first permanent exhibition.

[130] This probably refers to reviews dating to the pre-renovation project (2009 and 2010) that critically observed the lack of update to new museological criteria.

"Beyond the movie, you're pretty much on your own (I don't know if guided tours are available). The archaeological part of the tour is relatively easy to follow, but requires a fair amount of reading if you want to get much out of it. (It's pretty interesting if you do read it.)" (Super Reviewer, Philadelphia, 4 stars).

"As for the site itself - it is an archaeological site (from the eighteenth century) so very authentic, but the reality is there just isn't that much to see there. They have made the most of it, and I can see why school groups tour to give students a good basic introduction to the history of their city, but in the end it is more about information that actually seeing much." (Super Reviewer from Adelaide, 3 stars).

Some visitors report in particular some difficulties in finding their way across the foundations and in distinguishing the buildings from one another, which prevents their orientation and interpretation.

"The remains of the buildings under the museum could be marked better at times, especially for those not used to reading building plans. Many of the display ideas are great, but the execution is sometimes rather odd or confusing" (Expert Contributor from New York, 3 stars).

"You get to wander around the archaeological site after the movie. I use the word 'wander' because that is what a lot of people did, in a slightly confused state. The exhibits really didn't make sense on their own and there was no one to answer questions. What a wasted opportunity" (Reviewer from Hong Kong, 2 stars).

One reviewer even mentions difficulties in accessing the second section of the archaeological crypt, where the interactive fresco and the most of multimedia display are located:

"[...] the layout was extremely confusing. I think most people miss the 2nd portion of the museum entirely because there is a lack of signage that it even exists (we were the only ones up there, although the rest of the museum was very crowded)" (Reviewer from California, 5 stars).

In cases like these, recourse to tour guides is necessary to reassure the visitors against the complexity of the visit path and to enhance their understanding of the site:

"This is a rare museum that focuses on the layers of history on display through the achaeological digs. It is fascinating, but would highly recommend seeing it with a tour guide to be able to understand all the different things you are seeing" (Expert Contributor from Alabama, 5 stars).

"This is an excellent museum but you'll benefit from taking one of the 'free' guided tours because - as others have mentioned - the layout can be a bit confusing." (Super Reviewer from Gloucestershire, UK, 5 stars).

"N'hésitez pas à attendre une visite guidée par le personnel, celui-ci est très compétent, sympathique et intéressant. Sans guide, je pense que nous aurions beaucoup moins appris sur cette magnifique ville." (Reviewer from Hyeres, France, 5 stars).

"The guided tours make this museum, and Montreal's history, come alive! Our tour guide for the history of Montreal was funny, entertaining, and very knowledgeable" (Expert Reviewer from New York, 5 stars).

"If you must go to this museum do take one of the guided tours (in French or English). Fortunately we did join a tour and the guide really brought the place to life. She showed as pictures and artifacts that WEREN'T exhibited and told us stories and gave explanation that could NOT be gathered from the exhibits themselves. The guide did a wonderful job and she was a wealth of information. Bravo to her!
(Reviewer from Hong Kong, 2 stars).

These comments indirectly confirm a scarce connection between the archaeological vestiges and the interpretive devices implemented by the museum (see Section 5.2). The new multimedia show, aiming to provide a general introduction to Montréal's history - with respect to the previous ones that lingered more on specific periods - seem to offer limited guidance to the interpretation of the vestiges. Despite the original site of the museum provided the visual scenario for the interactive frescoes and displays, moreover, the positioning of the individual buildings within the historical and spatial environment is not immediate as no direct references are provided.

A possible strategy to satisfy the expectations of both targets would be to differentiate more precisely the interpretive tools adopted in relation to specific objectives: at a more punctual level, signing and labels could be used to mark the individual vestiges and buildings, whilst textual panels and/or interpretation points could be used to describe their architectural features; at a more general level, storyboards and interactive displays would help provide a general viewpoint over the urban environment. An even more cost-effective alternative to replicate the appreciation of actual guided tours, would be represented by the realization of handheld audio or multimedia guides.

6. Case study Uffizi-Centrica

6.1. Brief history of the museum and its reproductions

The Uffizi Gallery is one of the most ancient and important art galleries in Italy and Europe.

The building was designed and realized in 1560 by the illustrious artist, architect and historian Giorgio Vasari under the commission of Cosimo I Medici as a headquarter for the judiciary administration ('uffizi') of the Duchy, next to the family residence Palazzo Vecchio. In 1581, Francis I (1541-1587) decided to convert the *loggia* on the second floor into an art gallery to exhibit the collections of artifacts and artworks that were previously preserved in the *Studiolo* at Palazzo Vecchio and the *Sala delle Nicchie* at Palazzo Pitti. At that time, the core of the collections was represented by the antiquities (small bronzes, medals, coins, ivories etc.), followed by classical sculptures and portraits, including modern artworks and a series of portraits of eminent characters[131]. Francis I also commissioned the construction of an octagonal room, the *Tribuna*, to the architect Bernardo Buontalenti in order to host the most representative paintings of the collection[132].

The building was further transformed by Ferdinand I (1549-1609) to host the Manifattura delle Pietre Dure, which was bound to became a leading centre of production of jewellery and applied arts. Remarkably, mathematic and geometric instruments were exhibited in the room next to the workshop, consistently with the close link between theoretical speculation and practice that characterized 'mechanic' arts.

Due to the relative prevalence of naturalistic interests in the first half of the 17th century, in this period the collection of artworks only underwent gradual increments mostly through donations and integrations, such as the translation of the Renaissance paintings hosted at the *Casino di San Marco* by Ferdinand II (1610-1670). However, the emergence of a more systematic classification of artworks based on schools (Florentine, Venetian, Flemish etc.) and subjects (religious, portraits, landscapes etc.) can be also traced throughout the inventories of the period.

A new impulse to the collection was given at the middle of the century by Cardinal Leopoldo (1617-1675), who purchased a relevant number of paintings to complete the above school groups, building on explicit criteria of preference[133] and on an increased historical awareness[134].

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[131] Francis integrated the so-called *Serie Gioviana* (from the name of the collector Paolo Giovio), of whose Cosimo I had commissioned a copy to Critofano dell'Altissimo, with a new group of portraits realized by Federico Barocci.

[132] Precisely, 7 Raffaello, 10 Andrea del Sarto, 2 Fra Bartolommeo, 4 Giulio Romano, 1 Leonardo, 2 Pontormo and 4 Allori, 1 Beccafumi, 1 Giorgione and two Flemish painters. As Barocchi (1982) underlines, this selection was inspired to the evaluation proposed by contemporary historiography (Vasari) and differed significantly from the more markedly personal choices made in the Studiolo and the Casino di San Marco.

[133] These were specified in the so-called *Listra de' nomi de' pittori di mano de' quali si hanno disegni* (1673), which gathered the information provided by the network of informers and dealers upon which the Cardinal relied for his purchases.

[134] To this purpose, the Cardinal commissioned to his bookkeeper and curator of the Gallery, Filippo Baldinucci a work titled *Notizie dei professori del disegno da Cimabue in qua* (started in 1681 and partly published posthumously in 1728), which appears particularly innovative in its attempt to provide a genealogy and chronicle of Italian painting relying on a critical assessment and integration of previous sources such as Vasari's *Lives*, inspired to criteria of historical accuracy and completeness.

The Grand Prince Ferdinand (1663-1713), besides further increasing the collections, also made the first attempts of reproduction, hiring a team of drawers and engraver coordinated by Giovan Battista Foggini to copya selection of his own and Leopoldo's collections mostly belonging to the Venetian school (Borroni Salvadori, 1982). Foggini's work aimed specifically at increasing the popularity of the Gallery by exploiting the increasing demand for illustrated publications by European collectors, artists and amateurs[135] (Borroni Salvadori, 1982; Barocchi, 1982, pp. 77-78) that was emerging at that time.

The first attempt to create an illustrated catalogue of the museum shortly followed thanks to the initiative of a group of noble Florentines, who committed to the antiquarian Anton Francesco Gori the supervision and publication of the *Museo Fiorentino* in 10 volumes - each dedicated to a specific collection[136]. The work met a consistent circulation among artists, amateurs, travelers and diarists (Boroni Salvadori, 1982), although the quality of the engravings was inhomogeneous (Bencinvenni-Pelli, 1779). An illustrated inventory including reproduction of the main rooms in the Gallery was commissioned by Francesco Stefano of Lorena (1708-1765) to the Dominican friar Benedetto Vincenzo de Greys in 1748, but remained incomplete also due to a lack of support on part of the curators[137].

The advent of Pietro Leopoldo of Lorena had a major impact upon the Gallery, whose fruition, that had been previously restricted to scholars, travellers and noble hosts, was opened to the general public in 1769. This decision marked the start of an overall re-organization of the museum according to the new Illuminist principles of pedagogy, such as the separation of artistic from scientific collections - that were moved to the Cabinet of Physics, now the Specola Museum - as well as between specific genres (paintings, drawings, sculptures, antiquities[138]) as well as between primary and inferior exemplars. Under the influence of the eminent antiquarian Abbot Lanzi, alphabetical, chronological and systematic criteria of classification were introduced following the model of the Imperial Gallery in Vienna created by Joseph II August and privileging the completion of series composed by homogeneous works in terms of age or provenance (e.g. of busts of Roman emperors, medals etc.). At an architectural level, new exhibition spaces were created devoting an

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[135] "Il gran concetto, che partorì la vastissima mente di V.A. Reale, di rendere pubblica al mondo tutta la numerosa e rara raccolta di preziosissimi quadri che adornano il suo reale appartamento con far gli intagli a sé in rame, il quale lavoro à già V.A. Reale fatto cominciare e tirare avanti con tale magnificenza e grandezza di rami e con il numero che è stabilito farne fare, che, terminati, sarà un'opera da non potersi superare da qualsivoglia grandissimo principe, e la pubblicazione della medesima, che è universalmente desideratissima, accrescerà appresso a tutte le nazioni il glorioso nome di V.A. Reale mediante la facilità con la quale in ogni più lontano paese di mandano le carte stampate di questa grande impresa [...]" (ASF, Carteggio d'artisti, quoted in Barocchi, 1982, p. 78, our emphasis).

[136] The balance, however favoured the antiquities over painting, as the first two volumes were devoted to gems, one to statues, one to busts, one to bronzes, three to medals and two to self-portraits.

[137] In particular, the Director Giuseppe Querci underlined in 1769 that the reproduction of the Gallery may result "one day least faithful and exact [...] wanting H.M.R. [...] to give a new order or system to the Gallery, the new will not correspond any more to the old state, and the work representing the old will lose its merit. [...] What has been said above seems to evidently demonstrate the disproportion between the enterprise and the value of the work and consequently tends to prove that it not really useful, nor glorious" (quoted in Barocchi, 1982, p. 82, own translation).

[138] Within this category, separate Cabinets were realized in turn such as the one of gems, medals and coins and those of the ancient and modern bronzes.

unprecedented attention to the illumination and distribution of the works, whereas a new monumental access and vestibule was designed by Zanobi del Rosso.

The work of rationalization was directly reflected in the efforts put by the new Director Giuseppe Bencivenni Pelli[139] in creating a comprehensive and updated inventory of the Gallery, whose main element of novelty would consist in the adoption of a "brief method" that focused on the "destination of the piece, [...] the particular history thereof and the observations necessary to recognize it and provide an idea, as well as the citation of prints and descriptions that can be found"[140]. However, Bencivenni's work remained eventually unpublished at his replacement by Tommaso Puccini in 1793.

During Pietro Leopoldo's reign, moreover, a competition between private publishers, merchants and engravers - often coinciding in the same person - arose for granting the privileges of reproducing selections of artwork, 'flooding' the Florentine market especially with portraits from the series of eminent men and masterpieces (Borroni Salvadori, 1982)[141]. These initiatives added to, and competed with, those undertaken directly by the Granducal Printing House, where a *Collection of the Paintings Painted by the Most Eminent Brushes and Possessed by Grand-Duke Pietro Leopoldo* appeared in 1778 with didactic and celebratory purposes and were distributed with a good commercial success. The widest circulation, though, was achieved by a group of French engravers coordinated by Jean Baptiste Massard, who started publishing in 1789 a series of 200 engravings under the title *Galeries de Florence*, that were completed in 1807 meeting the appreciation of Quatremére de Quincey, David, Ingres and Goethe (Borroni Salvadori, 1982).

During 19th century, the acquisition of paintings ordered by schools was constantly pursued by the Directors, although with an increasing emphasis on the quality and representativeness of the single works.

With the Italian Unity, a large part of the collections of modern sculptures and antiquities were moved respectively to the Bargello and the Museum of Archaeology, in order to make the Uffizi an a privileged destination for painting masterworks, in compliance with the international museographic orientations introduced by the Anglo-Saxon collectors settled in Florence such as Bernard Berenson and Herbert Horne. The concept of the Uffizi as a 'masterpiece gallery', though, besides breaking the links with the Medicean past, fell prey of the frequent revisions and reappreciation of specific artistic periods (purism, neo-Renaissance, the rediscovery of the Middle Ages and the 17th century etc.) across the 19th and 20th century.

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[139] The contrasted relation between Lanzi and Pelli and the divergence of their principles of classification and methods of attribution are brilliantly reconstructed by Barocchi, 1982.

[140] As from the proposal of Raimondo Cocchi, dated 15 January 1773, quoted in Barocchi, 1982, p. 89, our translation.

[141] The main initiatives diversely involving works at the Uffizi are the Azioni gloriose de gli uomini illustri fiorentini espresse co' loro ritratti nelle volte della Real Galleria di Toscana, 1745; Ritratti de' più celebri Professori di pittura *in Firenze taken* from the collection of portraits of Cardinal Leopoldo; *Pitture del Salon Imperiale del Palazzo di Firenze*, 1751; *Chronologica series simulacrorum Regiae Familiae Medicae*, 1761; *Serie degli uomini i più illustri nella pittura, scultura e architettura*, 1775; *Disegni originali d'eccellentissimi pittori esistenti nella Real Galleria di Firenze* and *Istoria pratica de l'incominciamento, e progressi de la pittura, o sia raccolta di cinquanta stampe estratte da ugual numero di disegni originali esistenti nella* R. *Galleria di Firenze*, to which smaller series must be added (Borotti Salvadori, 1982).

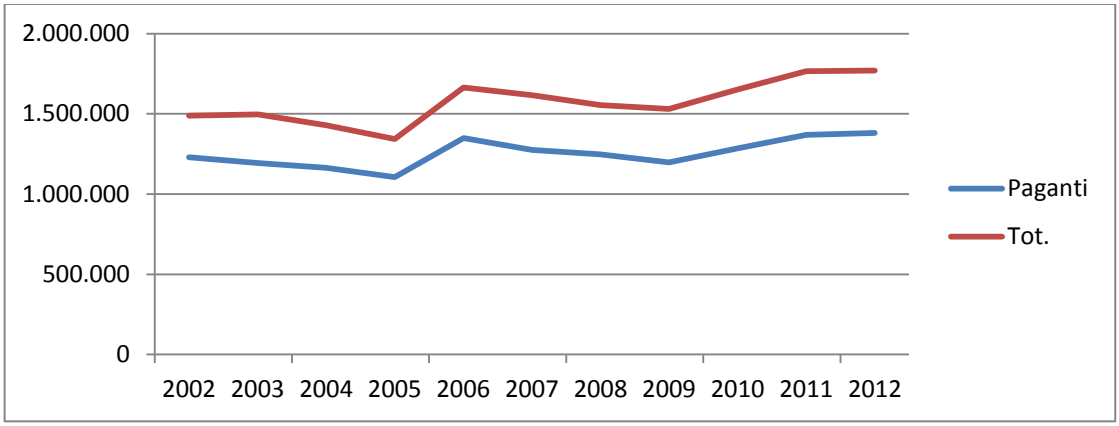
In 1929, the first official photographic catalogue of the Gallery organized by rooms was released by the Fototeca Italiana.

The ordering by school was significantly altered only after World War II, when a diachronic-synchronic arrangement was adopted accordingly to the recent evolutions in historiography (Panofsky, Friedländer, Venturi etc.) (Barocchi, 1982).

The Gallery is currently part of the Polo Museale di Firenze, administered by the Superintendence for Architectural, Landscape, Artistic and Ethno-Anthropological Heritage (Sovrintendenza per i Beni Architettonici, Paesaggistici, Storici, Artistici ed Etnoantropologici) for Florence, Pistoia and Prato, an administrative branch of the MIBAC.

Stably featuring among the 10 most visited museums in Italy, as shows, the Uffizi have experienced a substantial stability in visitors numbers over the last decade and a slight increase since 2009.

Graph 1: volume of paying and total visitors at the Uffizi, 2002-2012.



Source: author's elaboration on data of the Italian Ministry of Cultural Heritage.

6.2. First experiences of technological innovation at the Uffizi: from VASARI to DADDI (1989-2005)

The first formalized project of computerization at the Uffizi Gallery dates to 1989, when the State Archives hosted in Vasari's building were moved to another location and their vacant premises were allocated to the museum. The Uffizi Strategic Project was thus launched by the Superintendence with the aim of upgrading and adapting the newly acquired areas for exhibition purposes, allowing at the same time for further expansions of the museum. The project included four main axes of intervention, specifically a) the monitoring of environmental conditions in exhibition rooms, b) the analysis of the state of conservation of artworks, c) the automation of data collection and d) their remote diffusion. Each of these fields offered an opportunity for testing and validating innovative techniques developed by the projects' scientific partners: the Department of Information Engineering of the University of Florence (DIE) and the National Council of Research (Cappellini, 1993). Besides applying new physical and chemical technologies, computer-based applications were introduced for the purposes of:

- collecting data on the environmental conditions of the gallery rooms and studying microclimatic models of preservation (Cappellini, 1993, p. 19);
- analyzing the results of non-invasive pre-restoration diagnostic techniques, such as spectrum analysis, for instance to identify the pigments used in paintings;
- experimenting techniques of electronic (or virtual) restoration, that is the computer-based simulation of the original chromatic appearance of degraded or altered artworks (Cappellini, 1979; 1979-1980);
- preparing diagnostic cards for individual artworks that collected the data obtained from different diagnostic analyses;
- acquiring digital images of artworks through different methods (computer-assisted photographic cameras and opto-electronic scanning devices) and with different output resolutions[142];
- managing the resulting variety of information through hierarchic and relational databases and making these remotely accessible at various locations both inside the museum - through multimedia workstations - and outside - through different types of remote connections (videotel, slow-scanning video and the Optical Fiber Network owned by the University of Florence).

Directly promoted by Superintendent Antonio Paolucci and the Director of the museum Annamaria Petrioli Tofani, the Strategic Project demonstrated a willingness, on part of the public cultural administration, to experiment with emerging technological innovations that were taking place at the same time within local research labs.

In particular, digital imaging represented one of the main areas of specialization of the DIE since almost two decades, emerging from the convergence of optics, electronics and computer sciences. Since the late 1970s, a Laboratory of Digital Images had been operating within the Department to experiment and validate the acquisition of 2D digital images. In this early phase of research, cultural heritage was considered as a relatively new field of application with respect to more established ones (processing of data from X-ray radiography and nuclear body scanning; remote sensing of terrestrial resources, and robotics) (Cappellini, 1985, pp. 289-329). In this context, the main potential for the computer was identified in the "totally objective" (Cappellini, 1979, p. 57) acquisition of artwork images, from which the geometrical modules and mathematic proportions underlying the composition could be extracted through suitable digital filters (Cappellini et al., 1978).

The first tests had been conducted autonomously at the Lab since the late 1970s yielding technically encouraging results, which allowed the developers to sensitize cultural professionals

[142] Technical aspects related to the quality of digital images and possible computer-assisted solutions to distortions in the acquisition process are discussed by Argenti et al. (1993).

about their potential to through scientific publications (Cappellini, 1979; 1979-1980) and then through personal contacts with historians and curators[143].

In this context, the Progetto Strategico provided the first opportunity for conducting tests in collaboration with a museum, which was formalized through the establishment of a Department of New Technologies for Artworks at the Uffizi, with the mission of sharing digital imaging expertise with the users. In this context, some successful pilot applications were conducted such as the application of virtual simulation techniques to Domenico Veneziano's *Pala di Santa Lucia dei Magnoli*, which unveiled more brilliant colours than those upon which critics had commented, thus revising in part established views of the author's style (Bellosi, 1992).

In 1994, the partnership was strengthened through the joint participation of the Uffizi, DIE and SIDAC-STET (a branch of the State-owned IT group FINSIEL, then acquired by the Telecom Italia group), to two pilot European projects of museum automation and digitization, namely RAMA (Remote Access to Museum Archives) and MUSA-ESPRIT (Petrioli Tofani, 1995). The former had the objective of connecting the existing databases of leading European museums[144] through telecommunication networks, enabling different forms of research and data exchange from remote, such as the consultation of catalogue records based on text fields, the sharing of results of diagnostic campaigns, and the request of licences of use of contents for publishing purposes (Cappellini et al., 1995a).

With respect to RAMA, MUSA-ESPRIT focused more specifically on the development of digital imaging techniques for the remote diffusion of cultural contents, especially with the aim of improving the links between museums and the publishing sector within the value chain of multimedia publishing. The main achievement of MUSA was the development of the 'VASARI' scanner by DIE and its installation at the Department of Technologies of the Uffizi. VASARI consisted in a black-and-white, high resolution (300 ppi) camera connected to a multi-spectral (7 bands) system of digital acquisition that allowed to reconstruct colour images characterized by a higher level of chromatic fidelity compared to earlier devices (Casazza and De Rocco, 1995). This application was initially envisioned as a valuable support to preservation and restoration activities, fulfilling the necessity for the museum to "gather a diagnostic expertise capable to converge into a database, in order to enable a 'comparative' reading of the behaviour of artworks in time and their variation" (Casazza and De Rocco, 1995, not paged).

Within MUSA, a smaller version of the unwieldy equipment was developed by the British firm Time and Precision under guidance of DIE and the National Gallery, and a software system of colour certification was developed which enabled to compare the colour of digital images with that of 'real' artworks. The resulting digital images were thus inserted into the Uffizi database (developed by SIDAC-STET within RAMA) and made accessible to members of the network.

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[143] Among these, the renowned art historian Carlo Ludovico Ragghianti had been particularly open to digital imaging techniques, which he had experimented since the early 1970s also in collaboration with the DIE (Ragghianti, 1978) in order to analyze the geometrical structure of the artwork and to reconstruct in this way the artists' *language*.

[144] Other museums involved in the project, besides the Uffizi, were the Musée d'Orsay, Ashmolean Museum, Museo Arqueologico (Madrid), Museum of Cycladic Art, Museon (The Hague).

The achievement of these goals also marked the end of the experience of the Department of New Technologies for Artworks, which was deemed to have successfully accomplished its function and was discontinued in 1999.

In the same year, Marco Cappellini and three other partners established the firm Centrica s.r.l., which initially operated in the development of websites and multimedia products for cultural heritage, but gradually specialized in image processing techniques through participation to research projects.

The main initiative in this period was the DADDI (Digital Archive through Direct Imaging) project, started in 2000 by the Uffizi, DIE and Centrica, with the technical sponsorship of Phase One A/S, Xippix Co. and the financial support of Toppan Printing Co. Ltd.. The project aimed to define a standard procedure for the direct digital acquisition and processing of artworks with functions of controlled lighting and chromatic correction. The project involved the acquisition of all the artworks exhibited at the Gallery at a minimum spatial resolution of 8000 x 8000 pixels and their insertion in a digital archive in multiple resolutions for specific types of utilization (research, restoration, database management etc.) (Acidini and Cappellini, 2008).

The actual acquisition phase was performed by Centrica, under the guidance and supervision of the Uffizi and DIE and using hardware and software equipment provided by the technical sponsors (which were joined by Hitachi Corp. in the following phases of the project). As DADDI showed a more marked focus on the opportunities for diffusion and commercialization of digital images, copyright management issues were addressed by testing a 'digital watermarking' technique - consisting in the insertion into the digital image of an identifying field that is invisible to the user, but can be easily tracked and decoded by the owner (Barni and Bartolini, 2004) so to control further utilizations of the file.

Between 2008 and 2009, digital images have been integrated within digital museum cards (i.e. the descriptive labels containing all the information related to specific artworks, including restorations and movements) for which a consultation software has been specifically developed by the firm Parallelo in order to simplify the retrieval and management of the collections (Sframeli and Parallelo, 2007; 2009). Whilst the information are used internally for documentation purposes, they have also been made available to the public through a dedicated section of the website.

6.3. Technologies for the distribution and fruition of digital images at Centrica (2005-2010)

Whereas, over the latest years, the DIE has further pursued the application of digital imaging techniques for preservation and virtual restoration (Cappellini et al., 2003), Centrica has specialized in the development of computer-based systems for the remote distribution of digital images.

The first system of this kind was launched in 2000 with the name of *XLimage*. Consisting of an Internet server that enables the visualization in high-resolution of digital artworks in different modes (Intranet; Internet; mobile), the system incorporates a colour management system in order to limit chromatic alterations in the migration across different devices, and a watermarking technique based on the insertion of an alphanumeric code in the file. Following the previous experience of

collaboration, the Uffizi were the first adopter of XLimage, using it for distributing images through the museum website.

Following evolutions concerned the design of an integrated system of access to digital collections, which was launched in 2005 as *XLphoto*. With respect to XLimage, the product includes a set of additional features such as an automated and customized facility for the commercial licensing of cultural contents on the basis of a set of parameters (type and country of publication; exclusivity of use; size and position of the image in the publication) and a database-driven search engine (XL Spider) that enables to track digital watermarks. As these characteristics promised to facilitate the distribution and licensing of digital images to the publishing industry, XLPhoto was adopted by the Uffizi to manage requests by external buyers.

The most recent direction in product development at Centrica has targeted the integration of software systems for the distribution of digital artworks with hardware interfaces, in order to provide a complete experience of fruition. To this purpose, a new product named *Ars Touch* was launched in 2008, consisting in a PC workstation that runs the XLimage software, connected with a touch screen that allows the visualization in high resolution and the interactive exploration of digitized artworks.

Ars Touch has been mostly used in cultural events at Florentine institutions (among which the exhibitions *Painting Light*, *Galileo* and *EternArtemisia* at Palazzo Strozzi) to offer visitors the possibility to visualize paintings or other visual or textual materials.

The Arts Touch platform also provides the basis for *Uffizi Touch*, an interactive software application launched in 2010 that provides access to the digital archive of the museum. Through a touch screen available in 3 size formats ('totem', 'wall' and 'studio'), the system enables the visualization in high resolution (between 40 and to 150 megapixels) of over 1,100 artworks belonging to the collection, which can be searched and browsed by author, title, historic period and museum room - though de-contextualized from the actual museum environment.

Whereas the software has been entirely designed by Centrica, descriptive cards of the artworks in Italian and English have been provided by the museum, which has licensed the commercial distribution of digital images to the firm under a royalty calculated as a percentage of the unit price of the application (although the details of the agreement have not been released). In order to prevent further utilizations, each image is protected by a visible watermark. Since 2011, the system is also distributed as a mobile application for iPhone, iPad and iPod Touch at the current cost of 10.99 euro.

An updated version of Uffizi Touch has been launched in 2012 with additional functions based on the new *XLknowledge* platform - developed by the Entia Lab for Applied Ontology[145] at the University of Florence, of which Centrica is industrial partner - such as a thematic search facility and

[145] Applied ontology refers to the definition of conceptual schemas (ontologies) for the representation of knowledge in a disciplinary domain through semantic techniques, which are used for organizing information which are in artificial intelligence and the Semantic Web (see Section 2.3). The Entia Lab website aims to develop a multi-disciplinary approach to the definition of ontologies through a collaboration between philosophers and computer scientists (website).

the dynamic suggestion of artworks according to specific iconographic elements, such as jewellery, landscape, or pieces of furniture.

Representing the outcome of a two-decade long experience of collaboration between technology developers and the museum, Uffizi Touch allows to analyze the respective expectations from, and perceptions of, technological innovation. These can be identified by comparing textual presentations of the product written respectively by museum curators and technology developers.

6.4. Different perspectives over digitization: curators vs developers

Cristina Acidini, the Superintendent of the Polo Museale, describes the experience of using Ars Touch to "surf through" Michelangelo's Tondo Doni by emphasizing its potential to reveal small or hidden details of the painting:

> *"I surf moving from one part to another, I enlarge particulars that do not lose clearness even when they are brought to sizes larger than natural, and I can distinguish even the most subtle layers of colour, the filaments of paint, the map of crevices in the pictorial coat. Observations that have already been proposed by the critics [...] are confirmed by this analytical and close scrutiny"* (Acidini and Cappellini, 2008, p. 80, own translation).

> *"The navigation inside the virtual image reveals a small and almost secret device used by Michelangelo to potentiate the plastic evidence of the three protagonists"* (Acidini and Cappellini, 2008, p. 81, o.t.).

From the curator's perspective, the technological instrument enables an accurate analysis of the artist's technique and of the state of preservation of the pictorial surface, which can support in turn the diagnostic phase and critical exercises. The focused posed in details is also a consequence of the main technical limitation of digital imaging, that of allowing to zoom only one area of the painting at a time. The curator's view over the potential of digitization is consistent with the initial objectives of early computerization projects, which aimed to provide "more in-depth knowledge of artworks, entering - if one may say so - into them in order to cajole their more intimate secrets and rhythms" (Cappellini, 1979, pp. 55-56, own translation), finding their main historical antecedent in the long-standing use of photographs for documentation and analysis.

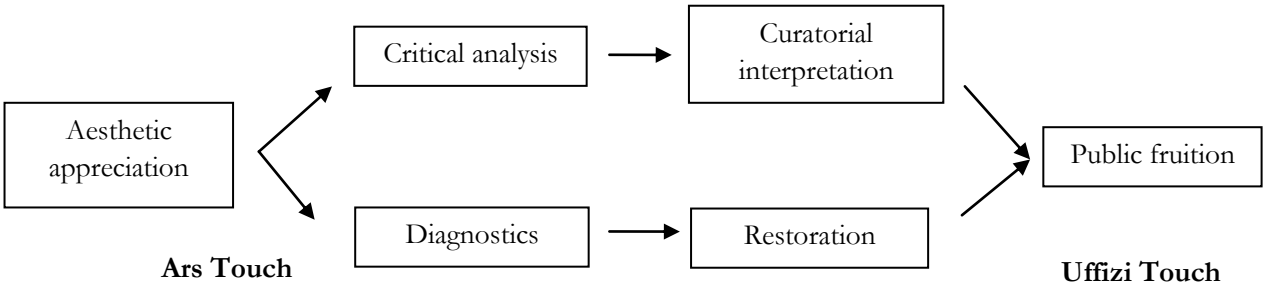
The promotional material released by Centrica presents Uffizi Touch as a new modality of fruition characterized by some advantages compared to the actual visit:

> *" 'Visit the Uffizi whenever you want' [...]*
> *Imagine being able to get up close to each artwork in the Uffizi Gallery with no queue, no crowd, no worrying about opening hours, enjoying them with the best lighting and being able to explore its every detail, up to the point of perceiving the artist's brush strokes and hidden features. With Uffizi Touch®, your imagination becomes reality. Virtually owning and being able to visit one of the world's most famous museums is an absolute privilege' "* (Centrica).

Here emphasis is laid, on one hand, on the ability to overcome the usual constraint of the physical visit (opening times, crowding, lighting conditions) and, on the other hand, on the direct nature of the aesthetic experience it provides to the user, which - similarly to the curatorial view - implies an enhancement of human sight. Granting the user a 'virtual property' of the artworks, moreover, Uffizi Touch is claimed to extend a 'privileged' aesthetic experience that was formerly restricted to the curator - thus representing the latest technological update of the centuries-long history of artistic reproductions of the Gallery (see Section 6).

The comparison between the curatorial and the commercial perspective over the product highlights how the same technology may perform differentiated but complementary functions within the value chain, according to the schema proposed in , thus virtually intervening at the two ends of the process.

Figure 17: Functions performed by Arts Touch and Uffizi Touch within the process of interpretation and display.



Source: Author's elaboration.

It should be remarked that, due to its characteristics, Uffizi Touch represents an exception within the current scenario of museum mobile applications.

Having their historical origins in the mobile audio tour (Tallon, 2009), the first generation of mobile applications for PDAs and smart-phones provided information for visit planning purposes (opening hours, ticket fees, calendar of events and temporary exhibitions) and later included multimedia resources and interpretive tools (descriptive cards, audio tours, podcasts, videos etc.) in support to the visit experience (Burnette et al., 2011).

The latest developments seem to concern an extension of the actual visit towards the post-visit phase, offering opportunities to expand one's knowledge of specific or related artworks at home. To this purpose, bookmarking facilities have been introduced through which the visitor can select artworks and related interpretive materials to be consulted after the visit on the museum website (Filippini Fantoni and Bowen, 2007; Marty, 2011). A parallel direction of development refers to facilities of social interaction, such as the sharing of comments with other visitors through social networks, either in real time or after the visit (Proctor, 2011).

Uffizi Touch differentiates from the former examples as it focuses less on the provision of interpretive supports and interaction than on the quality of the aesthetic experience. In this sense, the application presents more similarities with the first generation of digital collections which aimed to increase access to heritage by replicating actual visit experiences into the virtual domain (Cameron, 2003). Although the product is promoted as a personal collection, the fact that the user is encouraged to explore through basic search filters and the absence of bookmarking facilities may lead him/her "to get lost amongst all those paintings" (Roe, 2011).

Consistently with their focus, Ars Touch and Uffizi Touch have best deployed so far their potential in situations that are unrelated or substitutive to the actual museum experience. As an example, in one of its first public presentations in 2009, Ars Touch screen installations were used to create a virtual gallery at the Baptistery of Pistoia where a selection of artworks from the Uffizi and other collections were displayed. Similarly, the following year Uffizi Touch was selected by the Commission of the Italian Government for World Expo 2010 in Shanghai to realize, in partnership with national and regional institutions, the *Virtual Uffizi* exhibition at the Art Museum of Shanghai (June 27th - July 21st 2010) where a selection of artworks was displayed through nine large touch screens, receiving a total of 35,000 visitors in 25 days. A series of virtual exhibitions organized in Japan in partnership with Hitachi Ltd. at the Institute of Italian Culture in Tokyo in November-December 2011, at the Tokyo Fuji Art Museum, the Kyoto University Museum and the Hitachi DIS Showroom in Yokohama followed in 2012. Here, besides the navigable digital collections, 10 life-size replicas of masterpieces and a digital theatre composed of 5 wall screens projecting works and a virtual tour of the museum were added, achieving a satisfactory results of attendance[146]. In July 2012, Centrica has inaugurated a dedicated 'Space Italy' section at the National Museum of China in Beijing, where narrative videos and interactive touch-screen installations presenting the geography and history of Florence are displayed as a complement to virtual replicas of artworks.

[146] Specifically, the exhibition at the Italian Institute of Culture received 8,000 visitors in 27 days (296 per day), the one at the Fuji Art Museum received 14,000 visitors in 75 days, on average of 187 per day, overcome by the average of 340 daily visitors at the Kyoto University Museum. It should be remarked that 2012 was a record-breaking year for exhibitions of 'real' loaned paintings from Western museums in Japan: 'Masterpieces from the Mauritshuis' held at the Tokyo Metropolitan Art Museum was the most attended art exhibition worldwide, with a daily average of 10,573 visitors, whilst the 'Japanese Masterpieces from the Boston Museum of Fine Arts' at the Tokyo National Museum ranked in 6th position with an average of 7,374, '400 Years of European Masterpieces' at the National Art Center Tokyo recorded 5,362 daily visitors, 'The collection of the Prince of Lichtenstein' at the National Art Centre welcomed 3,550 visitors and 'Goya: Lights and Shadows from the Prado' at the National Museum of Western Art an average of 4,528 visitors (Art Newspaper, 2012).

Figure 18: Picture from a virtual exhibition organized by Centrica and Hitachi in Japan (2012).

Source: Centrica website.

These applications of Ars Touch have been showcased as a promotional opportunity for Italian heritage. In particular, its success in Japan can be ascribed to the relative lack of differentiation between the original and the copy that characterizes Japanese aesthetics, whereas the presentation of replicas would likely arise concerns of authenticity in a different context. As the Director of the Gallery remarks, the unprecedented possibility of appropriating a faithful reproduction of the collections may have two opposite cultural effects on the Western user, that is either a 'healthy' relativization of the cult for the authentic, or instead an increased veneration of the masterpiece as a 'relic' (Natali, personal communication).

However, a further question remains open as to whether *Uffizi Touch* is complementary or alternative to the actual visit, as is exemplified by the coexistence of these opposite possibilities in the same user review:

> *"If, like me, you have not yet got round to visiting the Uffizi art gallery in Florence [...] but you are lucky enough to have an iPhone, or even better, an iPad [...] you can now [...].*
>
> *And you don't have to come to Italy to do it. All you have to do is to acquire the Uffizi Touch app and away you go, virtually speaking"* (Roe, 2011).

> *"The Uffizi Touch app may well increase you desire to come to Italy to see the Uffizi for yourself – be warned! It will, however, help you get the most out of your trip to the Uffizi"* (*ibidem*).

The peculiar character of Uffizi Touch within the museum app scenario is indirectly confirmed by the fact that, in the same period, the Polo Museale authorized another mobile application named *Uffizi* by the local IT firm Parallelo, which has also developed the system of consultation for digital museum cards and the museum website. The product is based on the software platform *Ars First Guide,* that combines three functions within the same support: that of a mobile tour guide, a digital collection and an educational tool.

The application includes four modalities of exploration: *map*, which displays the most representative rooms of the museum and lists the exhibited works; *works*, which enables the visualization of 33 masterpieces from the collection with related descriptive cards; *museum*, providing practical information for visit planning such as opening times, ticket fees, directions and

reservations; *news*, including a calendar of the events at the museum. Likewise to Uffizi Touch, a smaller selection of images in high resolution belonging to the digital archives and descriptive texts are provided by the Polo Museale.

The promotional material presents its possible functions before, during and after the visit, stressing more complementary than alternative utilizations:

> *"You can use it to discover the main masterpieces of Italian and European art, find your way around the Gallery rooms and plan your trip to Florence, having practical information about the museum constantly at your fingertips"* (Parallelo).

Under this light, the two applications seem to intervene in distinct contexts, allowing the museum to differentiate its interpretive and promotional strategies: whereas Uffizi Touch acts mostly as a 'visiting card' for the museum, 'Uffizi' offers a support to the visit experience.

This differentiation is consistent with the museum's overall communication strategy, wherein the Web is adopted as a communication channel capable to ensure the widest "dissemination of knowledge" (Acidini and Cappellini, 2008, p. 21). To this purpose, the museum website has undergone a major renovation in 2011 wherein new sections have been inserted, such as a virtual tour of the museum containing images and textual descriptions, a calendar section containing updates about events, restorations and latest acquisitions, and a didactic section presenting educational activities and offering downloadable teaching materials. Furthermore, the Uffizi have been the first Italian museum to subscribe to Google Art Project in 2011, where 73 digital artworks are currently shown besides a virtual tour of selected rooms.

With its focus on the "quality and quantity of data inserted on-line" (Acidini and Cappellini, 2008, p. 26), however, the Uffizi's web-based strategy differs from the latest developments in museum online communication taking place especially in Northern America (Soren and Lemelin, 2004) where emphasis has shifted from the provision of access of authoritative contents towards the adoption of an interactive and participatory model of communication (Proctor, 2010; see also Section 2.2).

Interactive features are largely absent from the Uffizi website, which does not offer spaces of discussion nor links to social network profiles, except a YouTube channel opened in 2011 by the Superintendence to broadcast curatorial presentations or videos related to museum activities.

Both cultural and organizational motivations can be invoked in order to understand the prevalence of a traditional model of online communication, such as the museum's willingness to preserve the reputation as a trusted source of knowledge, and the rigidity of organizational charts in the Italian cultural administration, where hybrid figures such as social media managers can be hardly accommodated.

To this purpose, the long-standing partnership between the Uffizi and software developers such as Centrica and Parallelo seems to have been goal-oriented, focusing more on the definition and implementation of high-quality digitization techniques rather than on the experimentation of innovative communication strategies. The unidirectional nature of knowledge exchange is indirectly demonstrated by the short-lived experience of the Department of New Technologies for Artworks, whose activity was discontinued after the successful technological validation of the digital archives.

In this context, the choice to outsource website administration and the design of mobile applications, albeit corresponding to a criterion of economic effectiveness and enabling a differentiation of communication channels, seems to have limited the opportunities for cross-fertilization of competences and communication strategies between the museum and the IT community.

6.5. From cultural heritage towards new sectors of application

The versatility of digital imaging techniques is confirmed by the multiplicity of applications that Centrica has envisioned for its visualization system, targeting a range of sectors wherein the high-quality distribution of digital images is required.

As an example, XLimage is also marketed to the health sector[147], where it is claimed to offer a "possibility of publishing large-sized radiological images to allow remote access for specialized consultation purposes, tele-didactics with data bank, reference case, study and research" (XLimage website). In order to fit the specific requirements of users in terms of data protection, adaptation is provided by replacing digital watermarking with "other forms of visitor tracking and content management".

A further potential field of application envisioned by the producer is the improvement of publishing workflows, especially as concerns the pre-press phase, wherein the product promises "to optimize productivity and profitability making available online an archive of high resolution images" to clients. XLimage is also presented as "a revolutionary opportunity" in the manufacturing industry, especially in the area of marketing and customer management, as it "allows the customers to explore the product in every detail and in the whole range of tones of color of the original one", so enabling pre-purchase customization in replacement to physical samples and printed catalogues.

Similarly, the system is claimed to offer "a new and revolutionary e-commerce experience" as "users can explore the images of the products in high details and full color fidelity", thus reducing the risk of missing correspondence between the image and the product (Centrica b).

The same application is proposed for Ars Touch, which is claimed to "allow to present products at their best, providing your clients with the possibility of touching them with their hands, zooming to appreciate the quality of details". This application is particularly targeted at 'Made in Italy' sectors, where it can be used to "make quality perceivable" and "involve users in a unique and unforgettable experience"[148] (Centrica c).

The expansion to the other 'Made in Italy' sectors has been formalized through Centrica's participation to Vidi Trust, a spin-off established in 2010 by the Visual Information Processing and Protection group at the University of Siena that focuses on the development of anti-counterfeiting

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[147] To date, the main user of XLimage in the medical field is Milan Lab, a research centre established at AC Milan Football Association in 2002 for the optimization of players' psycho-physical conditions and performance.

[148] An Ars Touch installation incorporating XLknowledge has been used for enhancing the visual presentation of products during the 400th anniversary of the Officina del Profumo Farmaceutica di Santa Maria Novella in 2012.

techniques such as label authentication, document certification and traceability systems for the fashion, food & beverage and pharmaceutics sectors.

Centrica contributes to the start-up as an industrial partner with its know-how in digital imaging and watermarking methods built in research at DIE and heritage digitization projects, which can be ideally applied to the tracking and geo-localization of labels incorporated in products along the distribution chain.

6.6. Theoretical implications: the techno-cultural dynamics of the innovation process

In the present section, the main phases and aspects of the innovation process depicted by the case study are discussed. In particular, we draw on two theoretical approaches to technological innovation, namely evolutionary theories of technological paradigms (Dosi, 1982) and social constructivist studies of technology (Bijker et al., 1987; Bijker, 2010), here broadly meant as including also actor-network theory (Latour, 1987; Law, 1991).

The first phase of the innovation process of digitization is represented by the emergence of digital imaging from the intersection of two broader technological trajectories such as optics and information technologies (Cappellini, 1985).

Along the 1970s, a sufficiently coherent and established body of knowledge about the optic and mathematic principles underlying the digital acquisition of images and the computer-assisted treatment of images had been established. In this context, the increasing power of electronic calculators made them potentially capable to acquire and handle an unlimited variety of images and to envision a cluster of possible applications. Researchers at the DIE preliminarily identified four potential fields of application for digital imaging techniques: biomedical diagnostics, remote sensing and robotics (Cappellini, 1985).

In the late 1970s, cultural heritage had already emerged as a promising domain of application within experimental projects conducted with laser videodisks at American and Canadian museums, where difficulties of implementation or partial utilization were encountered (Alsford and Granger, 1987; Jones-Garmil, 1995, p. 5). Whilst in North American projects digital imaging had been initially used to create archives of the collections, in Italy computers were initially used in support to critical analysis, diagnostics and virtual restoration (Ragghianti, 1978; Cappellini, 1979). In particular, the computer was considered to enable an 'objective' approach to the critical analysis of the artwork (Cappellini, 1979), wherein geometrical and statistical methods were applied to 'measure' its compositional and chromatic aspects (Ragghianti, 1978; Contini, 2010).

Consistently with Dosi's (1982) model, the early phase of the innovation process marks the emergence of a specific path of development within a broader technological trajectory. A cluster of potential applications are envisioned by the researchers, among whose cultural heritage is identified as promising also thanks to the first exploratory collaborations with museum professionals. Due to the specific nature of the cultural sector compared to other industrial sectors, in the examined case the 'promise of success' of digital imaging is based less on economic criteria such as economies of scale than on specific parameters of functionality (such as the quality of reproduction and the

accuracy of diagnostic simulations). Furthermore, with respect to the assumption of evolutionary models that "new technological departures are being generated by individual firms" (Nelson, 1995, p. 70), in the present case it is the research centre to play the entrepreneurial role of forecasting market applications of the emerging technology.

This leads us to attempt to interpret the early phase of the innovation process according to actor-network theory as a process of translation-enrolment (Callon, 1991) wherein scientists 'translate' technological artifacts and systems into a set of claims that can be shared a group of target users and co-developers: when the interests of these latter are successfully aligned, the latter are recruited or 'enrolled' into the innovation process and thus contribute to its further advancement (Latour, 1987). Despite the neutrality towards relevant social groups postulated by constructivist models (Bijker, 2010, p. 68), however, in the case of digital imaging for cultural heritage an underlying asymmetry between researchers-developers and lead users appears as the former keep the initiative in R&D, whilst the latter limit their intervention to the validation and adaptation of the applications to their local needs. A closer analysis of the experience of collaboration at the Uffizi within projects conducted in the 1989-2010 period reveals, in this sense, a complex set of evaluations of compatibility and incompatibility between the technology and curatorial objectives and practices.

Whereas the use of digital images as an integration of descriptive and diagnostic cards was deemed by the museum community as a relatively neutral innovation, since photographs were already extensively used for purposes of documentation and analysis[149], the introduction of more sophisticated facilities of virtual restoration met a twofold reception by the curators. Although restorers and curators realized the diagnostic support offered by computer-assisted analyses and simulations[150], they also showed some reluctance about a potential takeover of decisional power by the machine. In other terms, new techniques were considered as sources of valuable data on the state of preservation and past interventions, but it was stressed that their interpretation and following action remained a responsibility of the curator. This view is exemplified by the Superintendent Cristina Acidini: although she highlights the significant cognitive contribution that 2D and 3D simulation techniques can provide especially in absence of material evidence or in the impossibility of actual interventions - such as in anastylistic reconstructions of archaeological sites and simulations of the original polychromy of decoration - she warns against the risk of reducing the restoration process to a mere recovery of the pictorial surface, neglecting the material support (2008, p. 43). A similar perspective is expressed by the Director Antonio Natali as regards the complex question of attributing an artwork to an author: although the computer can provide useful elements to the puzzle (such as information from diagnostic campaigns), when doubts arise they can only be

[149] We do not have available evidence to analyze more closely the standardization of data vocabularies at the Uffizi, which, as Parry (2007) underlines, has represented a complex issue within the first phases of automated cataloguing.

solved thanks to an accurate confrontation between the curator's 'expert eye' (i.e. his/her capacity to recognize the style and the personality of an author) and documental evidence (Natali, personal communication).

Also as a consequence of these mixed perceptions and the limited areas of application, the 2000s saw a gradual slowdown of R&D in virtual restoration techniques compared to emerging areas such as 3D optical scanning and VR simulations. Similarly, after the achievement of reliable quality levels, the research trajectory in 2D digitization gradually approached its stabilization, shifting to a phase of commercial exploitation marked by a change in the target market: under the initiative of the industrial spin-off (Centrica), the innovation exited the museum backstage and was promoted as a commodity product to a general audience. This shift also corresponds to a further 'translation' of the technology's claim, as Uffizi Touch is now proposed as the extension of an aesthetic experience that was previously restricted to the curators.

Whereas the incubation and validation phases were supported by public funding, in the commercialization phase the market can be seen to start operating as the main selective environment (Dosi, 1982; Nelson, 1995), as the technology sees its economic sustainability mostly depending on the end users' willingness to pay.

Table 22: Summary of the phases of the innovation process at the Uffizi.

Phases of the innovation process	Resourcing	Type of application
Incubation phase (in-house experiments)	Internal	Multiple applications envisioned
Testing and validation phase (first experiences of application)	Project-based public funding; Material contributions of private technology partners	Data automation; virtual restoration
Commercialization phase (extension to the general public)	Commercial	Extension of access and fruition

Source: Author's elaboration.

Moreover, the commercialization phase also coincides with an extension or branching of digital imaging techniques from cultural heritage into multiple domains of applications, corresponding to as many market segments characterized by partially common requirements (colour fidelity, resistance to manipulation, copyright protection and traceability, etc.), a process that is described by evolutionary theories as technology speciation (Levinthal, 1998; Adner and Levinthal, 2002). In the case study, speciation is preceded by an intentional translation of the technology's potential applications and benefits towards different target groups, which may then contribute to its further development by adapting it to their requirements. Likewise to the initial phase of the innovation process, an entrepreneurial capability to envision multiple potential applications of the technology is here at play.

[150] A recent and particularly successful case of application regarded the newly recovered Federico Barocci's *Madonna della gatta*. In order to anticipate the likely results of a restoration, a virtual simulation was conducted which supported the Director in the search of funding for the initiative (Natali, 2003).

Whereas evolutionary models highlight the role of market competition in selecting different applications of the same technology, though, in the case study competition has not fully manifested yet, as Centrica seems to have maintained a competitive advantage over potential entrants mostly thanks to the expertise and reputation accumulated in previous research projects.

Although the suite of the innovation process of digital imaging still needs to be observed, each application will likely be subject to commercial tests, which will allow in turn the firm to identify and specialize in the most promising application.

6.7. Managerial and policy implications

The case study of the Uffizi Galleries provides a privileged point of observation over the dynamics of collaboration between technology developers and the economic sustainability of digitization initiatives and policies in the Italian and European context, representing an historical and relatively rare example of a long-term partnership between research centres, museums and private enterprises for the digitization of collections.

As it has been underlined in the previous paragraph, the collaboration between the Uffizi and the University initially focused on the automation of collection cataloguing and management and the experimentation of virtual restoration techniques, shifting to the dissemination of digital collections and contents with the intervention of Centrica and Parallelo. As regards the museum's role in Web communication strategies, however, a paradoxical situation seems to emerge.

On one hand, the institution - consistently with the Italian scenario outlined by Antinucci (2007) - tends to act as a mere content provider, supplying digital collections and descriptive information but delegating to the technology partners the definition of the modalities of access and display.

On the other hand, the applications developed by the latter tend to replicate different and complementary aspects of the actual museum - in Uffizi Touch, the chronological arrangement of the collection and the 'concentrated' modality of aesthetic fruition, though with the elimination of the physical context; in '*Uffizi*' application, the physical display of the Galleries.

Under this light, despite the relatively scarce engagement of the museum in the definition of digital communication and educational strategies, a model centred on the actual museum experience and on the established canons of museology has been adopted. This differentiates the Uffizi from the case of Pointe-à-Calliére, where the final design concept resulted from the confrontation of the different - and to many respects, alternative - conceptions of visitors' expectations and experience carried by the curators and technology providers.

From an economic standpoint, the collaboration between the Uffizi, Centrica and Hitachi for the digitization of museum collections is the emblematic case of a private-public partnerships for digitization whose establishment has been encouraged by the European Union over the last years (EC, 2009a).

Also in this case, opposite elements for evaluation emerge.

Thanks to the technical and financial contribution of technology providers, quantitatively and qualitatively remarkable results have been obtained, as the full digitization of the collections has been completed in less than a decade at high resolution. The resulting digital archive of artworks lends itself to different utilizations and to the dissemination through multiple platforms of access (Uffizi Touch, Uffizi application, Google Art Project) and at different levels of resolution (*versioning*), thus preventing exclusive commercial exploitation by a single partner. In all cases except Google - where images are not available for download - digital artworks are protected by visible digital watermarks so to prevent third parties from re-using the contents, besides being licensed to commercial users through the institutional website. To the current state, in reverse, the Uffizi are contributing to Europeana only with low-resolution images of the photographic inventory, which are more targeted towards specialist than general users.

Although this scenario is functional to the museum's objective to recoup the costs of digitization and to remunerate technology partners for their investments, it may feed the Commission's concerns for a lock-up of public domain contents (EC, 2009, 3.3) and run into tension with ongoing attempts of the Europeana Foundation to extend the sphere of free re-use for commercial purposes. In particular, the agreement between the Uffizi and Centrica, whose contents have been negotiated before the Report of the Comité des Sages and have not been publicly released, may be in contrast with the prescription of a limited duration of preferential commercial use (Comité des Sages, 2011, Annex 1, art. 2) and open competition between private partners (Annex 1, art. 3).

On one hand, thus, the existence of an underlying tension in European digitization policies - that is the difficulty of balancing the legitimate expectations, on part of providing cultural institutions, to cover their costs through licensing agreements, and the will to ensure unlimited access and commercial re-use of digitized materials - is confirmed by the case study.

Conversely, albeit it is too early for conducting an economic analysis of the initiative, the speciation of multiple applications for digital visualization systems from the core platforms developed by Centrica suggests that the long-term economic benefits for software firms involved in digitization may consist less in the development of heritage-based digital applications than in the application of the same technologies platforms in other industrial sectors.

7. Concluding remarks

7.1. Discussion of the main findings of policy analysis and case studies

Provided for the difficulty of generalizing from a limited number of research sites, the case studies conducted in Italy and Canada have highlighted relevant economic, organizational as well as museological differences, thus confirming to a large extent the preliminary comparison that had been outlined in the policy analysis. Emphasizing these elements of difference over the analogies, two possible approaches to the digitization of cultural heritage can be broadly distinguished.

The former - which prevails in the European context (see also Kéfi and Pallud, 2011) and is exemplified by the Uffizi's experience - substantially conforms to a *pipeline* (Silberman, 2005) or *digital value chain* model (De Laurentis, 2006) wherein digital heritage contents are produced in the museum for collection management purposes and are then disseminated through the Web. In this context, there tends to be a substantial division of roles between the museum and technology partners: whereas the former preside over the definition of cultural contents such as metadata, the latter typically intervene in the design of the technical platforms and interfaces. Independently from their duration - which can embrace a long time span as in the case of the Uffizi - the resulting relations of collaboration tend to remain focused on technical goals, thus providing limited opportunities for cross-fertilization between the different disciplinary backgrounds and competences.

From a museological and epistemological viewpoint, the pipeline or value-chain model emphasizes the scientific rigour of the reproductions and metadata inserted into the Web - accordingly with a view of communication as a one-way process of data transmission from an authoritative source to the audience. Depending on the scale of the initiative, this conceptual framework tends to result in digital applications that replicate the physical museum, as in the case of Uffizi Touch, or in the development of meta-repositories of heritage contents belonging to different domains (artistic, documentary, audiovisual) and institutions.

From an economic standpoint, the current European scenario of digitization is characterized by a serious challenge of long-term sustainability due to the inadequacy and uncertainty of public funding and to the limited implementation of public-private partnerships - against which the Uffizi represent a relevant exception.

In this context, recent policy interventions risk increasing the tension between the interests of museums and software developers in appropriating the revenues generated by digital heritage, albeit the case of Centrica suggests that the main long-term benefit for the latter may consist less in the mere re-use of cultural contents than in the commercialization of technological platforms in multiple sectors. In this sense, the long-term impacts of the increased availability of new technical instruments for the negotiation of licensing agreements and the control of subsequent uses of digital images, such as the digital watermarks developed at the DIE-Unifi, should be further assessed.

The second model - whose historical roots are older than the former but have seen more continuity in time - has been implemented in Canadian policies for digitization especially in the 2000s and is exemplified by the case of Pointe-à-Calliére.

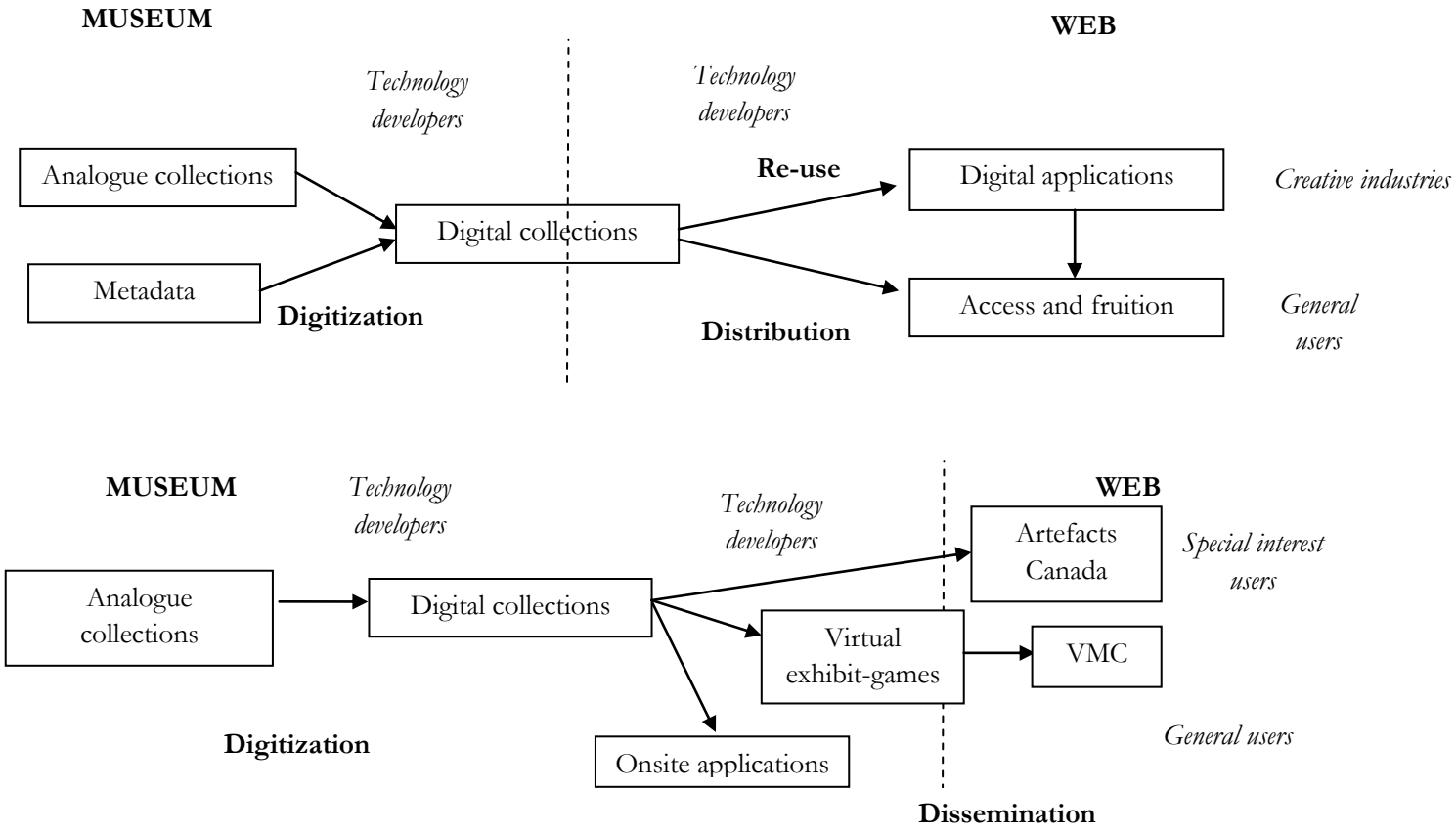
In this context, a linear model of technological innovation shifts towards a proper *co-construction* of digital applications, wherein museum professionals are involved not only in the mere provision of contents but also in concept design, whilst technology developers exert in turn a stronger influence on curatorial choices of display and communication. This is exemplified by the annual call of the Virtual Museum of Canada (see Section 4.1.2) that invites museums to collaborate with software developers to create virtual exhibitions, as well as by the partnerships that Pointe-à-Calliére has established with different technology providers for renovating the permanent exhibition and realizing a new multimedia show (see Section 5). Although collaboration is mostly oriented to the development of onsite multimedia applications or online exhibitions, these do not replace conventional digital collections but rather act as mediation devices, distinguishing a target of special-interest users who directly access digital collections for research purposes (through the Artefacts Canada portal) from a general audience that is addressed with *edutainment* applications.

From the viewpoint of inter-organizational and inter-disciplinary relations, a closer collaboration between museum curators and technology partners in the design of the communication and education strategy presents both advantages - such as an easier alignment of goals and wider opportunities for cross-fertilization - and factors of complexity - referring to potential tension between divergent approaches to communication. The latter has clearly emerged in the case of Pointe-à-Calliére, where a prevalently visual and a mostly textual approach confronted themselves within co-design sessions and repeated consultations and mutual adaptations were required to identify a balance between the two. In this context, a further level of complexity relates to the fact that the resolution of the interactions depended less on the bargaining power of the two parties, than by the different discursive ascendancy of the respective assumptions regarding visitor expectations and experience. More specifically, the currency of notions of interactivity, immersion and edutainment in Anglo-Saxon museology seem to have favoured the final prevalence of the multimedia developers' approach (Bluesponge, 2011), albeit without leading automatically to the adoption of a constructivist model of education (Hein, 1998; Hellin-Hobbs, 2010) since the visual style of communication adopted in the multimedia show and exhibits aims more to crafting a sensorial immersive experience than fostering the interpretive autonomy of visitors.

The relevant role played by the assumptions regarding users' expectations and behaviour in the design of multimedia applications recalls the need of a closer confrontation between the latter and empirical evidence. In the case of Pointe-à-Calliére, no field research on visitors has been conducted, nor panels of users have been involved in the renovation of the permanent exhibition. At a general level, however, the claim that a replacement of textual with a visual, game-like type of interaction is underway among younger generations has been questioned in recent literature (Bennett et al., 2008). Therefore, the risk arises that an uncritical alignment with new museological and educational trends may be perceived negatively by relevant segments of the audience, as is suggested by the netnographic analysis conducted on TripAdvisor comments.

From the point of view of economic sustainability, however, the Canadian model is more similar to the European one, as it mostly relies on public funding in the form of annual calls for proposals or provincial grants, which in the current context do not represent an adequate basis for sustaining the mass digitization and long-term digital preservation of cultural heritage (CHIN, 2013d).

Figure 19: Graphical representation of the innovation process in the European and the Canadian contexts.



Caption: In normal characters are inputs and outputs; in bold, phases; in italics, actors. Source: Author's elaboration.

It should be noticed, however, that a partial convergence of the two models represents a potential outcome of current trends acting on both sides.

On one hand, Canadian policy-makers may replace or integrate the current project-based model of funding to virtual exhibitions with a more continuous support to the mass digitization and digital preservation of cultural collections, as a part of the cultural community is currently advocating.

On the other hand, the results of the ongoing initiatives taken by the Europeana Foundation aiming to foster partnerships between heritage institutions and software developers remain to be assessed.

Also in the current scenario, however, a potential erosion of the possibility to extract direct revenues from licensing schemes may encourage heritage institutions to adopt a business model based on the production of derivative works (Bertacchini and Morando, 2013), as has occurred in the musical industry (Bach et al., 2010). In this case, museums could start collaborating more actively with technology partners to develop digital publications and multimedia applications to diversify their revenue sources, entering into competition with those produced by independent software developers. Whereas, in this case, brand visibility and reputation is likely to represent a competitive advantage for museums, though, it is not easy to forecast whether the impacts of a potential shift in business models on economic sustainability, due to the evidence of a low willingness to pay for museum multimedia applications (Burnette et al. 2011).

7.2. Conclusions and further research directions

The present work has attempted to provide a preliminary conceptual framework of the digitization of tangible cultural heritage, a rapidly evolving and strongly multi-disciplinary phenomenon that has first been addressed in museology and computer science. The synthesis of techno-cultural trajectories outlined at Section 2.6 may provide a basis for further theoretical and empirical investigation to be conducted both from a cultural and an economic perspective.

As regards the latter, the present work has identified three open areas of research that cut across the sub-disciplinary domains of cultural economics (especially referring to the issue of business models, copyright and the extent of the demand for digital heritage), organizational studies (referring to the dynamics of inter-disciplinary collaboration) and consumer behaviour (as concerns in particular the users' profile and experience). Since these issues present relevant spaces of overlap and intersection, however, future research will benefit from a closer integration and contamination between different theoretical frameworks.

In particular, a partial convergence between the approaches of cultural economics and economics of information can be identified (see, for instance, Bertacchini and Morando, 2013; Navarrete, 2013) due at the same time to ontological and policy reasons. With digitization, tangible cultural objects are *de facto* converted into immaterial data that can be considered in the same manner as other *information goods* such as electronic publications, news or music. In turn, public policies, especially in the European case, have actively contributed to absorbing digital heritage within the general category of 'cultural contents' by framing digitization policies within Information Society programmes oriented to the growth of the digital economy.

Therefore, a new field of application for the theoretical and empirical instruments of cultural economics would seem to open, as the economic valuation of freely circulating 'contents' presents less conceptual difficulties than that of immobile and non-marketable assets such as monuments and museums - which has typically required the simulation of fictional scenarios for estimating the willingness-to-pay of potential consumers (Throsby, 2003). However, serious technical difficulties have undermined attempts conducted so far to identify, quantify and segment the demand for digital heritage, whereas the transfer of established methods such as contingent valuation to the virtual

domain has proved ineffective (Bakshi and Throsby, 2010). The valuation of the economic impacts of digital cultural contents will thus represent a relevant methodological test-bed for economists and IT specialists over the next years, which may draw - among others - on the *webometric* tools that have been applied to scholarly publications (Eccles et al., 2012). Before a consistent body of empirical evidence becomes available, however, any transfer of conceptual frameworks from information goods to digital heritage should be critically pondered.

Although the research strategy adopted in the present work does not offer conclusive evidence of the demand and economic sustainability of digitization, it helps further substantiate the trade-off between the dissemination and the commercial exploitation of digital collections (Bertacchini and Morando, 2013). The current tension can be largely ascribed to the fact that the advent of the Internet has raised divergent expectations of increased revenues for cultural organizations and free access to contents for consumers and re-users (Farchy, 2011), which have translated into a general difficulty of designing and implementing effective business models (Wunsch-Vincent, 2013). In this scenario, the overall economic impact of digital heritage depends to a large extent on the relative capability of different actors - museums, the creative industries (in particular software developers) and for-profit data aggregators such as Google - to appropriate a share of user-generated revenues. In comparison to private Web players, however, the leeway of public heritage institutions is significantly constrained by their cultural mission, in particular as regards recourse to online advertising that is becoming the main source of revenues for the digital economy (OECD, 2012).

Especially in Europe, moreover, where the idea of cultural heritage as a set of non-transferrable goods subtracted from market exchange (Settis, 2005) is historically rooted, the economic enhancement (Lazzeretti, 2012b) of digital objects and collections may turn into a real cultural 'minefield'. Whereas the choice to authorize industrial exploitation by for-profit players may awaken recurrent criticism of privatisation policies (Benedikter, 2004; Ponzini, 2010), a stronger activism by heritage institutions in reaping commercial benefits may meet the same disapproval as recent attempts to license museum brands and rent their collections[151] (Clair, 2008).

Potential responses to these scenarios also relate to the conceptual rapport between the digital copies and their original, which has not been settled despite recent propositions. It should be noticed, in this context, that the current diffusion of consumer 3D printing devices, which has been welcomed as a source of commercial revenues for museums (Clark, 2013), may open a further front of opportunities and challenges.

The above tensions between economic and cultural goals add themselves to the cultural antitheses - between analogy and differentiation of the physical and the virtual; authority and interpretive 'democracy'; immersion and critical distance - that have been raised by different conceptualizations of the digitization process.

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[151] This position is most clearly stated by Jean Clair: "the lethal threat for art consists in considering it as a market good, that is an object that has a price and falls thus within a circuit determined by a commercial value" (2008, p. 64, our translation).

Against this background, a re-focusing on the initial educational aims of digitization over its alleged economic impacts seems to represent the most immediate way out from the current *impasse*. This would require, on one hand, further ethnographic research into the learning benefits of online and onsite digital applications and, on the other hand, an overall redefinition of museum education frameworks so to avoid the opposite extremes of positivism and constructivism and remain more grounded within actual learning experiences[152]. Conversely, the possibility for public and private actors to reap economic benefits should be linked to their ability to contribute to the educational process and to the long-term sustainability of digitization.

In any case, further efforts to observe and assess the phenomenon over the next years are welcomed.

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[152] A particular effort of re-conceptualization should focus on the very notion of the museum's authority. In the debate on digital collections and the Web 2.0 (see Sections 2.1 and 2.2), this tends to be conceived as the provision of a rigorous and virtually unchallengeable interpretation of the past, thus raising opposite reactions that emphasize the freedom of interpretation of visitors (Cameron, 2003; Proctor, 2010; Bonacini, 2012), to the point of legitimating subjective and arbitrary readings. This goes to the detriment of the etymological meaning and historical role of the educational authority, which is that of entrusting (in Latin *tradere*, which is also the etymological root of *tradition*) a series of past experiences and symbols to the contemporaries, providing the latter with the necessary criteria for interpreting them critically and personally appropriating them (Casado Marcos de Leon and Sanchez-Gey Venegas, 2011).

Consistently, history should be conceived neither as an inert repository of knowledge nor as the destination of escapist attempts of 'immersion', but rather as a source of experiences that may resonate with those lived by the contemporaries and thus help illuminate the present times.

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