CULTURAL HERITAGE AND MODERN INFORMATION AND COMMUNICATION TECHNOLOGIES

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Abstract. The paper presents an up-to-date view of entities of the cultural heritage sector and their relationships with other domains of human activity as well as the corresponding business models facilitated by modern information and communication technologies. The economic impact of the interactions established between various actors of the cultural economy landscape, such as cultural heritage institutions, digital "facilitators" and public, is described by using a cybernetic representation and a corresponding mathematical model. A particular emphasis is put on mobile technology-based approach to the cultural heritage sector and an example of a practical online virtual exhibition is provided.

Keywords: cultural economy, digital collections, discrete-time state equations, online virtual exhibitions, mobile technologies.

JEL Classification: L86, Z1.

Introduction

At the Electronic and Visual Arts (EVA'96) Conference held in Florence almost two decades ago, A. De Michelis (1996) very optimistically stated that "the European cultural heritage is a strategic resource playing the same role as petrol for Arabian countries". Almost two decades later, in May 2014, the Council of the European Union confirmed that the Europe's cultural heritage was a strategic asset. It is currently viewed as a set of "resources inherited from the past in all forms and aspects – tangible, intangible and digital (born digital and digitized) – including monuments, sites, landscapes, skills, practices, knowledge and expression of human

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creativity as well as collections concerned and managed by public and private bodies, such as museums, libraries and archives. It originates from interactions between people and places in time and it is constantly evolving. These resources are of great value to any society from a cultural, environmental, social and economic point of view and thus, their sustainable management constitutes a strategic choice for the 21st century" (CEU 2014).

A series of previous papers (Filip 1996; Filip *et al.* 2001; Filip, Cojocaru 2010), exposed the technological and economic aspects of the convergences of interests and activities carried-out both in the cultural heritage (CH) domain as well as in information and communication technology (ICT) sector. A cybernetic scheme and a corresponding mathematical model of the interactions among various actors in the cultural economy were initially proposed, then evolved to reflect the continuous relevant developments in technology, skills and interests of the people involved and government and industry initiatives.

Although De Michelis (1996) or Dertouzos (1997)' expectations have not been met at the extent forecast, there is an ever higher interest for the cultural economy, new entrants show up and the community of organizations and institutions involved is continuously growing and more diversified than several decades ago. At the same time, new information and communication technologies (in particular, mobile communications and applications, cloud computing, IT as a service, virtual reality) gain ever more ground (Filip 2013). It is felt (KEA 2006: 7) that the "expansion of the creative content and the expansion of the ICT sector are the two sides of the same coin". New concepts and business models are proposed, new initiatives of governments and industry are announced and feedbacks from previous research projects and practical applications are reported in the literature.

In the context briefly described above, the paper aims at presenting an updated view of the cultural economy landscape, with particular emphasis on cultural heritage and virtual exhibitions. The remaining part of the paper is organized as follows: the next section contains the classification adopted in this paper of the specialized subclasses (sub-sectors) of the more general class named "cultural sector". In the third section, a review of several milestones noticed in the development as well as the diversification of the cultural sector in conjunction with the ICTs is made. An updated view of the interactions enabled by ITCs that are established within the cultural heritage sub-sector is presented in the fourth section. The particular case of virtual exhibitions is described and a presentation of the SMART virtual exhibition mobile application is contained in the fifth section.

1. The cultural and related sectors

The seminal book of Adorno and Horkheimer (1979) has inspired many authors. A series of works (Adorno 1991; Filip 1996; Throsby 2001; Brosegan *et al.* 1997; Filip *et al.* 2001; WF 2007; KEA 2006; O'Connor 2007; Ronche 2009; Holden, Baltà 2012; Hesmondhalagh 2013; Dümcke, Gnedovsky 2013) published in an effort to define concepts and phenomena referred to the evolution of the cultural sector and the new relationships between culture, new technologies, regulations, society and economy.

While modern technologies have enabled mass reproduction of cultural goods, geopolitical evolutions, in particular the globalization, have made possible the communication or/and dis-

tribution of copies (transformed forms) of original cultural goods or of native digital cultural works (Filip 2013). Consequently, several concepts referring to particular classes of entities are to be met in the cultural landscape and its environment. In a report prepared for the European Commission with a view to assess the contribution of the European cultural sector to the Lisbon Agenda, KEA (2006: 3) were identified four particular subclasses (or "circles" in KEA's terminology) of the general class named *Cultural sector*:

- The subclass (or "1st circle") of *non-industrial [cultural] sectors* which produce unique, non-reproducible cultural goods and services meant to be "consumed on the spot" in exhibitions, concerts, artistic performances. "Core art fields", such as visual arts, performing arts and cultural heritage, represent further particular subclasses. They are characterized by two common attributes, such as a) non-industrial nature and b) possible existence of copyright which "might not always be exercised".
- The subclass ("2nd circle") of *cultural industries* which provide the "consumers" with cultural goods aimed at mass reproduction and mass dissemination, such as: books, films, videogames, music and so on. They have in common: a) the industrial character of mass reproduction and b) the importance of observing the copyright.
- The class ("3rd circle") of *creative industries* and related activities that utilize the outputs of the cultural sectors as "creative inputs" for the production of "non-cultural" goods. Interior, industrial and fashion design, architecture and advertising belong to this class.
- The class ("4th circle") of *related industries*, such as manufacturers of ICT devices and software applications, MP3 players and so on.

Other classifications are proposed by Throsby (2001) and WF (2007).

The four-circle view of the cultural sectors described by KEA (2006) and O'Connor (2007: 58) can be further expanded to include other *beneficiary sectors* of cultural goods made available via ICTs, such as education and tourism. Culture may also be seen as a "tool for social integration and territorial cohesion" in Europe (Galloway 2008: 5) and the "cultural industries are agents of economic, social and cultural change" (Hesmondhalgh 2013: 8). In the sequel, the scope of the presentation shall be limited to the cultural heritage subsector (libraries, museums, archives).

2. Steps towards a Cultural Economy

The ideas of using modern technologies to enable a broad, comfortable and financially affordable access to knowledge and cultural goods – accumulated in public institutions or private collections – can be traced back in the past (Filip 2013). For example, the complex and prolific British writer and idealist social reformer H. G. Wells envisaged, in the context of reorientation of the education and information throughout the world, the "creation of a comprehensive encyclopedia, a sort of mental clearing house for the mind, a depot where knowledge and ideas were received, sorted, summarized, digested, clarified and compared", and made accessible to everybody in a distributed manner, in various places all over the world (Wells 1938: 69; Boyd Rayward 1999).

As in many other domains of human activities which have expanded at a very high rate, the *academia people* have been the forerunners and pioneers of the movement of using mod-

ern technologies to devise new ways and tools with a view to preserving the cultural goods accumulated during centuries of human development and ensuring access of a larger number of people to them (Dertouzos 1991; Saltzer 1992). For example, several forerunners of the *Digital Library* (DL) have made conceptual contributions towards the solutions of today. Several important names are mentioned in the sequel: Vannever Bush proposed *Memex,* a system meant to create and retrieve information based on microfilm technology in 1945; J. C. O. Licklider published the book entitled "Libraries of the Future" in 1965 (Licklider 1965); the Internet pioneers Kahn and Cerf (1968) exposed a detailed architecture and a development plan for a digital library.

The *business circles* have promptly perceived the opportunity to set up new activities with a view to exploiting the cultural value in an efficient way, meant to create competitive advantage, by using modern information and communication technologies (Dertouzos 1997). A special attention was paid to libraries and archives which deposited valuable information and knowledge. In 2003 it was estimated (APWPT 2013: 12) that "more than eight million jobs were created directly or indirectly as a result of the sector of cultural heritage (cultural sites, museums and collections, libraries and archaeological sites)". KEA (2006: 3) stated that "the *cultural sector and creative industries* (CCIS) represented highly innovative companies with a great economic potential and are one of Europe's most dynamic sectors contributing around 2.6% to EU GDP". The concept of "Digital Culture Economy" (Salzburg Research 2001; KEA 2006) came into current use. The term "e-Culture" (Ronche 2009) is also frequently used in Europe in the context of the "Information Society", beside "e-government", "e-health" and other "e-domains".

Presently, web 2.0 technologies that have a collaborative vocation, enable the proliferation of the co-production of cultural goods, including user-produced content. The once sharp distinction between producers and consumers, underscored by mainstream economics, evolves towards an enriched range of actors involved in cultural economy, bringing about hybrid hypostases of *prosumers* or *produsers* (Chen 2011; Grinnell 2009). *Prosumers*, a category originally delineated by Toffler (1980), exhibit a marked interplay between their capacities of producers and consumers. Leadbeater and Miller (2004) proposed the *pro-am* production models that involved "a joint effort of producers and consumers in developing new and improved commercial goods" (Bruns 2006). In turn, *produsage* was characterized by Bruns with the following main features in 2007 (Bruns 2007):

– a shift from dedicated individuals and teams as producers to a broader-based distributed generation of content by a wide community of participants;

– a fluid movement of produsers between roles as leaders, participants, and users of content […];

– generated artifacts are no longer products in a traditional sense: they are always unfinished and continually under development […];

– produsage needs permissive regimes of engagement which are based on merit more than ownership: they frequently employ copyright systems which acknowledge authorship and prohibit unauthorised commercial use, yet enable continuing collaboration on further content improvement.

Governments and *international organizations* have realized that *the global information society* possesses a more developed cultural dimension than the industrial society. Thus, a series of programmes have been initiated. For example, in his report, Bangemann (1994) aimed at stimulating the *content industry* of EU, among other things. In 1995 two pilot projects launched at the G7 (1995) Conference in Brussels addressed "digital libraries" (in Project #4) and "multimedia extended access to world cultural heritage in museums and art galleries" (in Project #5).

Those actions have been followed and extended by other initiatives and programmes in Europe. For example, the 3rd objective of the Action plan *eEurope,* adopted at the European Council Meeting in Fereira (June, 19–20, 2000), made reference to the creation of "a coordination mechanism for digitization programmes between member states". The *eContent* programme adopted by the European Council on the 22nd of December 2000 aimed at "transforming the rich European content base into a competitive advantage in an information society". On the other hand, *eEurope+* programme, meant for Candidate Countries, indicated several actions, such as a) stimulation of development and dissemination of European digital content, b) supporting the information exploitation of the public sector and setting up a European digital collection of "key" databases and c) access to digitized heritage. After the NSF (1998) initiative, one could mention the *Digital Library Initiative* – DLI (EC 2005, 2007), aiming at "making Europe's diverse cultural heritage (books, films, maps, photographs, music and so on) easier and more interesting to use online for work, leisure and/or study. It builds on Europe's rich heritage combining multicultural and multilingual environments with technological advances and new business models" At present, a *digital library* is defined as "an organization that provides resources, including specialized staff, to select, structure, interpret, distribute, preserve the integrity of and ensure the persistence over time of collections of digital works, so that they are readily and economically available for use by a defined community or set of communities" (Yen 2009).

The *Digital Agenda for Europe* (DAE 2010), launched in March 2010, and the Challenge 8 "Digital Culture" of the EU's *7th Framework Research Programme* (FP7) were conceived to encourage the research efforts and applications meant to make the digitized cultural content an economic asset. In particular, as remarked in (Dulong de Rosnay; de Matin 2012: 36), "the digitization of the European cultural heritage and the digital library are key aspects of the recently implemented Digital Agenda of EU". DAE is viewed as one of the seven flagship initiatives of Europe 2020 (EC 2010: 2).

To conclude this section, the following remarks are to be added based upon the study of historical evaluations referring to the usage of ICTs in the cultural heritage sector.

- Both the private business sector and cultural institutions have perceived the advantages of their active partnership (Filip 2013; FN 2014; Rypkema, Cheng 2012).
- The business sector has realized that the digital access to cultural heritage not only stimulates consumers' cultural enrichment, but also facilitates research and innovation activities of the people involved;
- There are good premises to stimulate people to interact with cultural institutions, including their possible contribution to enhance collections and design exhibitions;

  – Recent developments in the domain stimulate favorable evolutions in tourism (by allowing diversified service offered), education (by making the process more attractive and effective), electronic publishing, commerce and production of ICT equipment (Fig. 1).
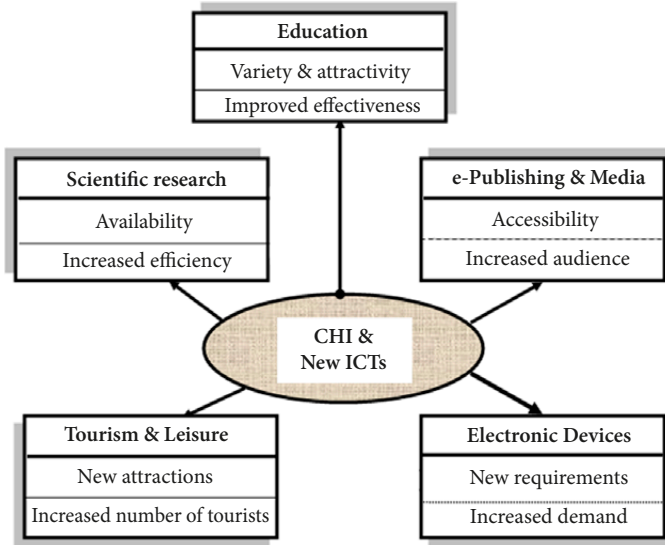

Fig. 1. Influences of modern CHI: sectors, characteristic features and expected impact
Source: adapted from Filip *et al.* (2001).

3. Interactions

In previous papers (Filip 1996; Filip *et al.* 2001), there was proposed a cybernetic representation of interactions between the public and cultural institutions and access facilitators. Modern ICTs, in particular the mobile devices and applications make necessary updating of the previously proposed views.

3.1. Mobile technology and applications

In recent years it has been largely accepted that mobile devices, such as tablets, e-book readers, smart phones and their corresponding applications in various domains, have been a visible and constant part of people's everyday life. In the specific context of the cultural sector, the mobile technology based on ICTs has enabled an ever more personalized, effective and continuous interaction between interested people and cultural heritage institutions than digitized versions of collections available since the 90's (Proctor 2012).

  In a rather recent market study (PortioResearch 2014) it was stated that "[mobile] apps business has finally come of age and this worldwide success story is now growing fast". The same source indicated that 46 billion applications had been downloaded in 2012 and 82 billion application downloads were estimated for 2013. Pocatilu *et al.* (2013) investigated mobile applications in the context of cloud computing.

The most common operating systems utilized in mobile applications are *IOS*, *Android* and *Windows phone*. *IOS* is running on the devices developed and distributed by Apple, such as: iPhone, iPad, iPod Touch and Apple TV. *Android* is an operating system for mobile devices based on the *Linux* kernel developed by Google. It shows a DDM (*Direct Data Manipulation*)-type interface primarily meant for mobile devices equipped with touch screen, such as smart phones and tablets. *Windows Phone* has been developed by Microsoft as a successor of *Windows Mobile*, though the two versions are not compatible. According to Gartner (2014), the market share was: 78% for Android, 15.6% for Apple IOS and 3.2% for Microsoft Windows Phone in 2013.

Mobile applications are gaining ever more ground in the cultural sector too. Museums have a long tradition in the usage of the mobile technology. It was accepted (Tallon 2011; Proctor 2012) that the first mobile guided audio tour, based on radio broadcasting technology, was introduced at the Stedlijk Museum in Amsterdam in 1952. The evolution to new generations of mobile applications with modern devices, such as cellular phones, smart phones followed by tablets, eReaders and so on, has been quite natural and smooth. As Proctor (2012) noticed that "the mobile's disruptive power comes from its unique ability to offer the individual, intimate, immediate and ubiquitous access combined with an unprecedented power to connect people with communities in global social networks".

Libraries, containing knowledge accumulated over centuries, represent a fast growing application field for modern ICTs. In particular, mobile platforms and devices enabled "knowledge consumers" to have an ever faster and more comfortable access to a continuously evolving digitized content (Barile 2011). Clark (2012: 5) described three main "candidates" for possible mobile applications in libraries: a) mobile websites, b) mobile web applications and c) native applications. The same author presented the methodology of creating mobile applications in the library environment. Ciurea *et al.* (2014) and Dumitrescu *et al.* (2014) described practical mobile applications for online virtual exhibitions.

3.2. A possible model

 Figure 1 above represents linkages established between *cultural heritage institutions* (CHI) and several sectors of human activity. In the sequel, a deeper analysis is made of interactions between CHIs, *culture consumers* (CC), such as readers in libraries and archives or visitors in museums and cultural sites facilitated by various specialized organizations, such as the new transformers and distributors of the surrogate cultural goods. It extends and updates the cybernetic representation and the mathematical model proposed in (Filip *et al.* 2001) and partially tested in the real case of the Bran Castle (Bologa 2002).

The general class named *Access to cultural goods* (ACG) can be decomposed into *particular subclasses*, such as:

– *Direct access* (DA) subclass which includes entities such as visits paid by the cultural consumers to CHI, such as libraries, archives, museums, sites;

– *Mediated access* (MA) subclass that can be further decomposed into more particular subclasses, such as:

  – *Offline access* (OFA) to *substitution cultural objects* (SCO), such as books, albums, films, CDs, DVDs produced by *cultural industries* of *traditional transformers* (CITT)

and offered by SCO *distributors* (SCOD), such as bookshops, kiosks and so on. *Indirect distributors*, as TV broadcasting companies and cinema theatres that perform a subsequent transformation of SCOs, represent a particular subclass.

– *Online access* (OLA) to *digital collections* (DC) or *virtual exhibitions* (VE) and *virtual tours* (VT) facilitated by a) the *cultural industries of new transformers* (CINT), such as digitizing companies and integrators; and b) *new distributors of digital cultural goods* (NDDCG) that provide specific services, such as searching on demand, document supplying and so on. Online accesses can be performed either locally or remotely, possibly by using mobile devices and applications.

Figure 2 below is a revised version of the cybernetic representation proposed in (Filip 1996; Filip *et al.* 2001). It reflects the impact of new technologies and facilitators organizations. The collections of *physical cultural goods* (PCG), such as books, manuscripts, paintings, carvings and so on, are stored, displayed and consulted in CHI and *directly accessed* (DA) by a set of *direct visitors* (DV). It is now a common practice of many CHI to provide on-site access to SCO which substitutes some original physical cultural objects that have to be protected. The cultural industry organizations that have traditionally transformed the cultural goods into SCO and distributed them to tourists in kiosks, hotels, stations and touristic sites have made possible the mediated access of an *extended public* (EP). A part of EP will be stimulated to directly access, immediately or later, the PCG represented in the SCO they have bought. The reverse influence of buying SCO after a direct visit is not negligible. In addition, a part of the members of the extended public and some direct visitors are tempted to consult the online *digital* collections and virtual exhibitions, with a view to getting more details about the cultural goods they either directly accessed in a limited time frame of the visit or saw in the SCO, respectively. An amplifying effect is to be foreseen after the online access session. Planning the direct visits to be made during touristic activities is the traditional form of taking advantage of online access. The stimulating effect is particularly effective when OLA is performed during virtual tours using mobile devices and applications.
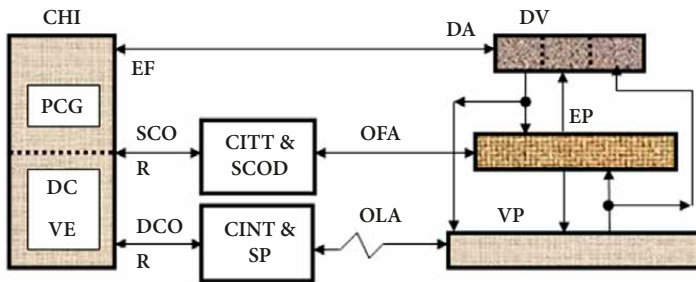
Legend: CHI – cultural heritage institutions; PCG – physical cultural goods; DC – digital collections; VE – virtual exhibitions; DA – direct access; EF – entrance fee; DV – direct visitors; CITT & SCOD – cultural industry of traditional transformers and distributors; OFA – offline access; EP – extended public; DCO – digital cultural objects; OLA – online access; CINT & SP – cultural industry of new transformers & service providers.

Fig. 2. A cybernetic representation of interactions between CHI,
access facilitators and culture consumers
Source: adapted from Filip (1996).

A mathematical model of discrete-time, dynamic state equations with time delays could describe the interactions and corresponding synergic effects. To keep the notation simple, let us consider a basic configuration made up of three entities: a) a particular CHI, b) a traditional transformer and distributor and c) an integrator and service provider. The dynamics of evolutions that characterize the interactions can be modelled by the following discrete-time state equations with distributed time delays:

$$x_i(k+1) = x_i(k) + \Delta x_i(k) + \xi_1; \; i = 1, 2, 3; \; k = 1, 2, \ldots \tag{1}$$

$$x_i(k+1) = x_i(k) + c_{ij}(k) - u_1(k); \; i = 4, 5, 6; \; k = 1, 2, \ldots \tag{2}$$

where:

$$\Delta x_i(k) = \sum_{\tau=1}^{\vartheta} a_{ii}^{k-\tau} x_i(k-\tau) + \sum_{j \neq i}^{3} \sum_{\tau=0}^{\theta} a_{ij}^{k-\tau} x_j(k-\tau) + \sum_{\tau=9}^{\theta} b_{ij}^{k-\tau} u_i(k-\tau) + \xi_i;$$
$$i = 1, 2, 3; \; k = 1, 2, \ldots \tag{3}$$

$$c_{ij}(k) = \sum_{j=1}^{3} a_{ij}^{k} \Delta x_i(k) \, ; \, i = 4, 5, 6; \; j = i{-}3; \; k = 1, 2, \ldots \tag{4}$$

- k is the time interval, say a month;
- $\xi_i(k)$ ($i = 1, 2, 3$) represents the influence of various factors, such as season, social, economic and political situation and so on during the k-th time interval;
- $x_i(0)$ is the initial value; $i = 1, 2, \ldots, 6$
- The *state variables* (all at the end of the k-th time interval) are:
- $x_1(k+1)$ is the accumulated number of direct visitors of the CHI;
- $x_2(k+1)$ is the accumulated number of people who buy a SCO concerning the particular CHI;
- $x_3(k+1)$ is the accumulated number of online virtual visitors of DC and VE;
- $x_4(k+1)$ is the income of the CHI from the collected entrance fees and royalties paid by CITT and CINT;
- $x_5(k+1)$ is the profit of the CITT from selling the SCOs of the CHI;
- $x_6(k+1)$ is the profit of the CINT and service provider from OLA performed to DC and/or VE.

The *control variables* are:
- $u_1(k)$ is the investment made in the k-th time interval by the CHI, with a view to upgrading the collections and preservation conditions and to improving the services provided to visitors;
- $u_2(k)$ is the production and distribution costs of the SCO edition in the k-th time interval k;
- $u_3(k)$ is the investment and running costs paid by the CINT and online service provider in the k-th time interval.

The *parameters* are:

- $a_{11}^{k-\tau}$ is the mean ratio of the visitors who repeat the previous visit after τ time intervals only influenced by the impression the previous visit;
- $a_{12}^{k-\tau}$ and $a_{13}^{k-\tau}$ are the proportions of SCO buyers and virtual online visitors, respectively, stimulated to visit to the CHI after τ time intervals;
- $b_{11}^{k-\tau}$, $b_{22}^{k-\tau}$ and $b_{33}^{k-\tau}$ are the influences of the investments made by the CHI, CITT and CINT on the increasing the number of direct visitors, buyers of SCO and online virtual visitors, respectively, after τ time intervals;
- $a_{21}^{k-\tau}$ and $a_{23}^{k-\tau}$ are the proportions of direct visitors and online virtual visitors, respectively, influenced to buy SCO as souvenirs after τ time intervals from their direct or virtual, respectively, visits;
- a_{41}^{k} is the entrance fee during the *k*-th time interval;
- a_{52}^{k} is the price of a single SCO during the *k*-th time interval;
- a_{63}^{k} is the payment for the on line access;
- θ is the maximum relevant time delay.

Remarks:

- As one can easily notice, the above model is based on several simplifying assumptions. In more realistic settings, characterized by several entities of each subclass of agents involved, large-scale vector equations will be necessary. The good news is the matrices of the model are highly sparse and the coefficients are relatively constant in time. For such models adequate solving methods (Andrei 1985; Filip 1990, 1998) could be envisaged for usage. For example, it is very likely that a) the parameter a_{22} can be neglected over the whole time horizon, b) a_{11}^{τ} is almost negligible at least for the first time intervals (τ = 1, 2, 3, 4) and c) $a_{11} \ll a_{33}$;
- The parameter identification is a difficult problem itself: huge amounts of reliable data are necessary. Independent organizations to perform such large-scale projects are needed;
- The model could serve to evaluate via simulation the impact of various decisions concerning the collaboration between the actors involved and investments to be made. For example, while some coefficients are to be identified, others, such as a_{42} and a_{43} should be the result of a decision made through negotiations between the pairs of entities involved by using a reduced model.

4. A special case: virtual exhibitions

4.1. Virtual exhibitions

Cultural heritage institutions (CHI), such as: museums, libraries, archives, archaeological sites have accumulated and preserved rich collections of objects which contain informa-

tion, knowledge, artifacts and various other expressions of human endeavor evolved in time (Kalfatovic 2012: III). A great number of them have digitized their collections and created digital archives to better preserve the cultural objects and subsequently making digital copies available to a large public in various forms (Foo *et al.* 2009). For example, Dumitrescu *et al.* (2010) present the digitization of the original manuscripts of Romania's national poet, Mihai Eminescu, meant to ensure their preservation and subsequent facsimile publication and posting on the library website.

Museums that are typically organized as legal, nonprofit institutions (AAM 2014) have a long tradition for organizing exhibitions meant to facilitate the education or leisure purposes. Libraries, that are meant to serve education, research, reference and recreation purposes (ALA 2009), also have a tradition of organizing exhibitions, with a view to promoting their collections and stimulating potential readers to come to reading halls. Several remarks can be made concerning differences between museums and libraries and archives, concerning exhibitions they organize (Kalfatovic 2012). While museums exist to a great extent to organize exhibitions, for libraries and archives, exhibitions represent an adjuvant for other missions and services. A second remark concerns the content of physical cultural objects. In the case of libraries and archives, the information content is of a 2-D nature (in the pages of a book), while the content of a part of objects of museums can be represented in a 3-D format.

A modern presentation form that is enabled by the recent information and communication technologies is the *online virtual exhibition* (OLVE). An OLVE can be defined (Foo 2008; Foo *et al.* 2009) as "a web-based hypermedia collection of captured or rendered multidimensional information objects, possibly stored in distributed networks, designed around a specific theme, topic concept or idea and harnessed with state of art technology and architecture to deliver a user-centered and engaging experience of discovery, learning, contributing and being entertained through its nature of its dynamic product and service offerings". The central feature which characterizes an OLVE and differentiates it from a digitized collection is the "tight connection between the virtual exhibition, idea object and script that ties them all together" (Silver 1997; Kalfatovic 2012: 3). In other words, an online exhibition is not "just another way" to present the cultural objects by using a new technology" (Walsh 2000: 488; Kalfatovic 2012: XV). According to Kalfatovic (2012: 3), five types of effects could be taken into consideration in defining the exhibition theme: a) aesthetic, b) emotive, c) evocative, d) didactic and e) entertaining.

Mobile technology has made possible the creation of virtual exhibitions (Ciurea *et al.* 2014). "Smart Exhibition", a practical mobile application, will be described in the next section.

Ideas and guiding material on developing OLVE can be found in various sources (Foo 2008; Foo *et al.* 2009; Kalfatovic 2012; Natale *et al.* 2012; DEWG 2014; Dumitrescu *et al.* 2014) and, consequently, will not be presented here. The only aspect that will be briefly addressed hereby is the economic one. As previously pointed out in (Filip 1996; Filip *et al.* 2001; Lester 2006; Foo *et al.* 2009), the OLVE could have a strong impact on various well-defined categories of people, stimulating them to visit in an increased number the buildings of those cultural institutions and to pay the entrance fee. At the same time, the micropayments in a *freemium* scheme for accessing the contents by ordinary consumers of culture and specialized organizations that offer information services or the royalties of the transformers of

cultural goods can be envisaged. All the above financial compensations are meant to secure the necessary financial resources for the survival and a sustainable evolution of the cultural heritage institutions (Foo *et al.* 2009).

4.2. The "Smart Exhibition" mobile application

"Smart Exhibition" (Ciurea *et al.* 2014; Ciurea, Tudorache 2014) is a software application that has the primary function to facilitate exploring physical cultural exhibitions by using a mobile device with the Android operating system. Three major *cases of using* the mobile application are distinguished, namely: a) viewing objects in an the art gallery, b) getting information about an object , and c) facilitating users' interaction to a greater extent (DEWG 2014).

The "Smart Exhibition" mobile application fulfils four *basic functions*: a) viewing of art collections by category, b) saving objects of interest as favorites to view them later, c) using the concept of augmented reality, and d) recognizing QR codes that may contain links to objects in the respective art collection.

The application architecture consists of *three components*: a) web platform for content management, b) web platform for the content presentation and c) mobile application for accessing the virtual exhibition. The final software product provides the following *characteristic features*: a) flexibility (virtual exhibition managers must be able to update its content any time without having to modify the structure of the mobile application), b) maximum accessibility (virtual exhibition can be accessed from anywhere, the internet connection is all the user needs to enter the virtual exhibition), c) mobility (to take advantage of the increasing popularity of mobile devices among users of any age).

Figure 3 presents the detailed flow for using the mobile application.

The first contact of users with the mobile application is the *splash screen* automatically followed by the application menu. The menu offers the choice for the following use scenarios: "Gallery", "QR Code Scanner" and "About".

The *JSON Parser* module parses the JSON (Java Script Object Notation) data generated by the web-service. The output of this module is used during the running of the application. The *Opener* module is meant to welcome users to the mobile application and contains two activities: *Splash* and *Menu*. The first activity is a preamble of the application which contains basic information about the mobile application. The *Drawer* module has an important purpose in usability and navigation. The user can visually swipe from the left edge of the screen to the center, and a menu component will appear on the screen. Here, the user can access different collections and its own favorite exhibits collection as well.

The purpose of the *QR Code Scanner* is to allow users to obtain more information about real objects from a real cultural exhibition, by scanning the QR (Quick Response) code which contains JSON data related to the exhibit. After scanning the QR code, using the photo camera, another activity based on the *Object Viewer* module appears on the screen with information about the object related to the scanned QR code.

When selecting the button that leads to the gallery opening, the screen displays a list of all the exhibits available at the time, For each exhibit the system displays a descriptive image, title, year of publication and the name of the country in which it appears.
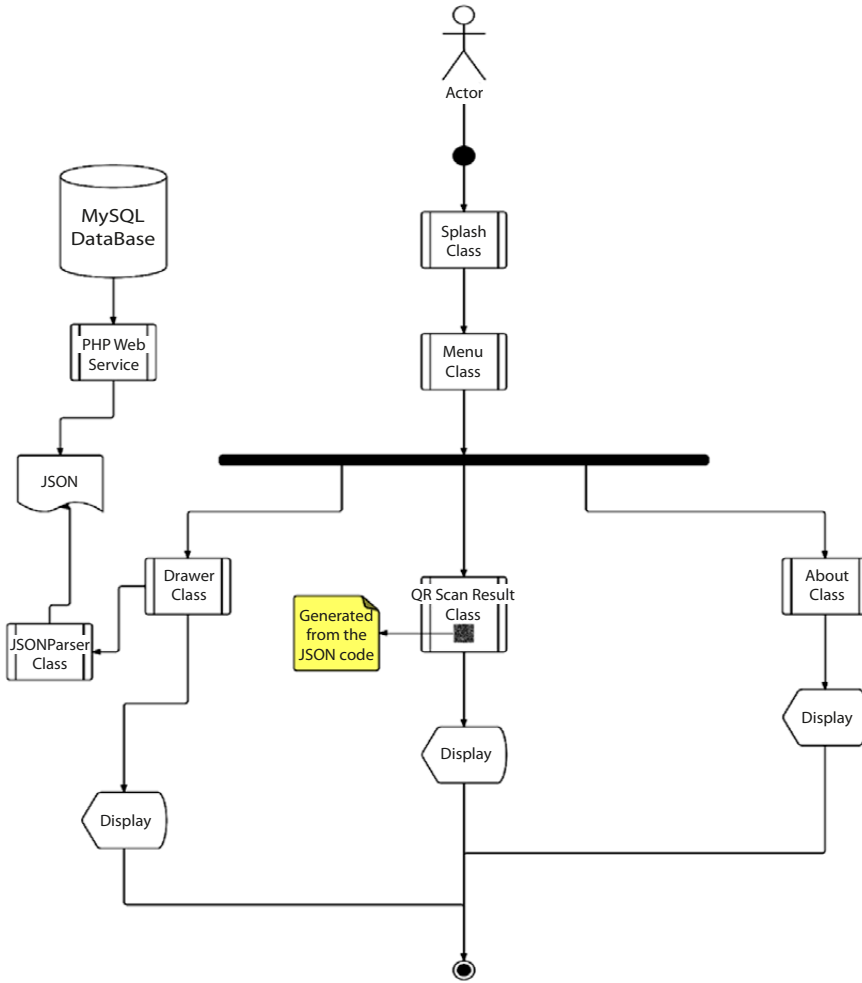
Fig. 3. Use-case flow of the application

In the *Gallery* activity the user can also access a secondary menu as a drawer, available on the left side of the screen by pressing a button located on the top bar of the interface, or by a swipe action from the left side of the screen inwards. From this submenu you can select one of the collections presented in the list. The user can *save his/her favorite collections* and can access them in a different page accessible through the main menu. Some images of the "Smart Exhibition" mobile application are available in Ciurea and Tudorache (2014).

In order to achieve modularity, the functions of the application are split into multiple edit modes. Equally, one of the essential characteristics of a virtual exhibition and possibly its greatest strength is its accessibility. It can reach a large audience that the physical counterpart never could. At the same time, a virtual exhibition stimulates users to access it and, ultimately, become visitors of the respective cultural institution through its user-friendly interfaces.

Conclusions

The paper has been meant to highlight several economic and technological aspects of the movement of making the cultural heritage more accessible and self-sustainable in a societal and economic landscape characterized by the ever more intensified competition, in a *win-win* pattern of interactions among various actors, such as: cultural heritage institutions, cultural and creative industries, governments and the public.

A particular attention was paid to virtual exhibitions. The origins of the term "virtual" can be found in Latin, "virtus" meaning, among others, "excellent quality" or "embodied power". It may also come from the Mediaeval Latin "virtualis" denoting "not physical existing as such, but made by software to appear to do so" (OD 2014). Indeed, to be effective, a virtual exhibition should be of an *excellent* quality: its creation requires the information technology as an essential technical enabler and possesses the power to create a competitive advance and a source of income for the organization. Further efforts will be made by the authors to develop and upgrade virtual exhibitions with a view to facilitating access to the national "cultural goods". Is is envisaged also the experimenting of the model presented in section 3.2 by using real data.

A final remark is worth making. As anticipated by Toffler (1980) in the description of the "Second Wave Society", characterized, among other things, by symptoms such as *mass* consumption, *mass* education, *mass* recreation, *mass* entertainment and so on, the culture consumer's role has been increased and diversified. In the specific milieu of the cultural economy, the "prosumer" – a term resulting from the combination of "producer" and "consumer", coined by Toffler in 1980 – influences ever more the evolutions of various interacting actors. He/she may participate by voluntarily and directly providing new digital objects to enrich the digital collections and virtual exhibitions. Consequently, *crowdsourcing* and *community engagements* are encouraged by governments and international bodies. At the same time, the *prosumer* may influence the content and the technical design of the virtual museums or exhibitions. The concept of "participatory culture" (Jenkins 2006, 2009) is stimulated and enabled by the ever more sophisticated and available ICT products.

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