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AN INSIGHT INTO MUSEUM INNOVATION

THEORETICAL DEVELOPMENT AND EMPIRICAL STUDY IN THE CASE OF MUSEUMS FROM VALENCIA REGION OF SPAIN

TESIS DOCTORAL

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ABSTRACT

Scholars and policy-makers have been stressing the transformation of the competition model for state and regional development by innovation based on the cultural and creative industries in the recent years. As an important cultural heritage institution, museums can become a significant vehicle for innovation strategies to support social inclusion and regional development in Spain and the other Mediterranean region in the face of the challenges created by the recent economic crisis. However, the study of innovation in museums is still underdeveloped and the understanding of museum innovation is only nascent.

This thesis aims to expand our understanding of innovation by museum organizations by focusing on three basic questions: (1) What is museum innovation? (2) How do museums innovate in terms of cultural production? (3) What determines the outcome of museum innovation? This research is a theory-oriented study based on the empirical case of Spanish museums in the Valencia region.

The study develops a new theoretical framework to explain museum innovation in phenomenon, definition, taxonomy and determinant factors from a comprehensive perspective integrating a dichotomy of existing explanations. On the basis of theoretical development, further empirical studies are conducted and conclusions are drawn from a multitude of case studies, surveys and statistical approaches.

On the one hand, the study reveals that museums innovate by following three patterns – self-dependent, collaborative, and adoptive innovation – based on the domain of cultural production and the type of innovation. One the other hand, the study testifies that organizational characteristics (i.e. ownership, size, and geographic distance) and collaboration can enhance the outcome of museum innovation depending on the type of innovation, and the contribution of "collaboration" to the innovation outcome differs based on with whom museums collaborate. These conclusions have important implications for the academic sector, as well as management and policy development in relation to museum innovation. It is for this reason that this thesis presents recommendations directed at improving performance on these three levels.

RESUMEN

En los útimos años, tanto desde el mundo académico como entre los responsables políticos, se ha puesto énfasis en la transformación del modelo competitivo, para el desarrollo nacional o regional, a partir de la innovación basada en los sectores culturales y creativos. En este sentido, los museos, como instituciones contenedoras de patrimonio, pueden convertirse en un importante vehículo de transmisión de la innovación que apoye la inclusión social y el desarrollo regional, tanto en España como en las distintas regiones mediterráneas, ahora que se enfrentan a los desafíos provocados por la reciente crisis. Sin embargo, el estudio y la comprensión de los procesos de innvoación en los museos está todavía en sus fases iniciales.

Esta tesis pretende ampliar el conocimiento de la innovación por parte de los museos centrándose en tres cuestiones básicas: (1) ¿En qué consiste la innovación en el entorno de los museos? (2) ¿Cómo innovan los museos en el ámbito de la producción cultural? (3) ¿Qué determina el resultado de la innovación en los museos? La presente investigación es un estudio sustentado en una concepción teórica que se evidencia a partir de análisis empíricos para el caso de los museos en la Comunidad Valenciana.

El estudio desarrolla, integrando las explicaciones dicotómicas existentes, una nueva estructura teórica para explicar y entender la innovación en los museos, tanto como fenómeno, definición, taxonomía y sus factores determinantes. Partiendo de ese desarrollo teórico, se realizan un conjunto de estudios empíricos adicionales y se extraen conclusiones derivadas del análisis de mútliples casos de estudio, encuestas y análisis estadísticos.

Por una parte, el estudio revela que los museos innovan de acuerdo con tres tipos de patrones – innovación auto-suficiente, colaborativa y adoptiva – en función del área de producción cultural y del tipo de innovación. Por otra parte, el estudio evidencia que las características organizativas (es decir, propiedad, tamaño y la distancia geográfica) y la colaboración, pueden mejorar el resultado de la innovación en los museos en función del tipo de innovación. Además, la contribución que el factor “colaboración” hace a los resultados de la innovación difiere dependiendo de con quién colaboren los museos. Estas conclusiones

tienen importantes implicaciones para el sector académico, de gestión y político en relación a la innovación en los museos, por lo que la tesis plantea las recomendaciones necesarias para un major aprovechamiento a estos tres niveles.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF RESEARCH

The exploratory transformation of the competition model from manufacture to creative economy is an unignorable background to this research. In the context of the recent economic crisis that started in 2008, the conventional competition model of manufacture, based on increasing productivity and decreasing operational costs, has been challenged for its unsustainability; whilst the rapidly growing creative economy has become one of the most plausible vectors of European specialization in the global competitiveness (Rausell Köster & Abeledo Sanchís 2013) and one of the fastest routes to overcome the crisis (Rausell Köster 2013). This trend brings new opportunity and comparative advantage to those countries and regions that possess rich cultural and creative resources but relatively weak industrial bases, such as is the case with Spain and the Mediterranean region. As a response to tackling this emerging trend, several publicly-funded initiatives, such as *INNOVA* [1]*, 3c4 incubators* [2] *and Creative Med* [3], have been launched in the latest five years so as to strengthen the understanding of the influence of the creative economy on regional development, and to identify

[1] INNOVA (http://www.ub.edu/innovare) is a coordinated project funded by the Spanish Ministry of Economy and Competitiveness. It aims to address the complex problem of the socio-economic model for Spain in the aftermath of the economic crisis, through analyzing the influences of innovation, creativity and culture on regional development.

[2] 3c4 incubator (http://www.3c4incubators.eu) is a transnational project financed by European Union through the MED program, one major object of the project is to promote 3c (culture, creativity and clusters) as a factor of territorial development and an engine of economic and social innovation so as to support European cultural and creative SMEs.

[3] Creative Med (http://www.creativemed.eu) is an international project covering 12 Mediterranean regions with the support of the European Regional Development Fund. Its principle purpose is to leverage Mediterranean cultural capital to co-design new service and business models for the transformation of innovative and creative entrepreneurship ideas into economic well-being and prosperity of the Mediterranean region.

some specific sustainable socio-economic models based on the cultural and creative industries. At last, this transformation has called upon new competitive strategies and innovative strategies on the political agenda to support culture, innovation and regional development.

Museums are an important cultural heritage within the creative economy[1]. A museum is not only a social agent for cultural enlightenment and education but also an economic engine for regional growth through cultural tourism. Although museums suffered from the significant cuts in public and private funding during the crisis, the number of museum visitors did not decrease proportionally and instead, more people visited museums during the crisis. In Spain, for instance, the budget of central government on the museum sector decreased by 22.9% (Bustamante Ramírez 2013) but the total number of museum visitors increased by 6% during 2008 and 2012 according to the Spanish Ministry of Education, Culture and Sport. This may indicate that museums could make a consistent contribution to social and economic development. For this reason, the International Council of Museums (ICOM) appealed to the European Union and regional and local governments to support museum in the face of the crisis, and to build the future in the Lisbon Declaration 2013 [2].

In sum, museums may play a particular role in this process of

[1] Museum is identified as "heritage and cultural sites" group in the creative industries by most of classifications including OCED, Eurostat, KEA European Affairs, UNCTAD, Spanish (Boix & Lazzeretti 2012). However, the Department of Culture, Media and Sports (DCMS) of UK and WIPO excluded museums from their creative industries classifications. In the case of the DCMS, it is rare to neglect the economic contribution of its museum sector since there are a lot of museums and galleries like British Museum, National Gallery, the Tate and Victoria and Albert Museum so on that attract enormous number of local and international visitors every year, which directly contributes to tourism economy. So there exists a popular suspicion that might be due to political consideration that "it reflected the modernization drive of the Blair era to understand Britain in terms other than those of an 'old country'"(Flew 2012). As for WIPO classification, it mainly defined and classified creative economy in consideration of Copyright-based industries. WIPO didn't list the whole "heritage and cultural sites" group[1] in the classification because of the weak connections between these sites and copyright matters, but on the other hand, it specially identified museums in the partial copyright industries for their partial attribution to "works and other protected subject matters" (WIPO 2003).

[2] http://icom.museum/news/news/article/the-lisbon-declaration-to-support-culture-and-museums-to-face-the-global-crisis-and-build-the-future/

transformation through integrating culture, innovation and growth, particularly in the aftermath of the economic crisis. Two implications are derived from this: at the organizational level, museums should initiate the necessary innovative strategy to improve their management efficiency and operational performance for their survival and development; and at regional level, appropriate cultural policies should be on the agenda to strengthen the innovativeness and competitiveness of the museum system as a whole. Because of the vital contribution of innovation, both technological and socio-cultural, to the economic growth and social progress, many countries draw up policies to support their national and regional system of innovation, among which corresponding cultural policies are also on the agenda for encouraging innovation in museums and other cultural sector.

1.2 OBJECT AND QUESTIONS OF RESEARCH

This study focuses on innovation in museum organizations. Innovation, in brief, refers to something new and its commercialization (Dosi & Nelson 2010; Fagerberg 2006); in the mainstream of innovation studies, most of the literature concentrates on technological changes based on R&D activities in the private sector. Similarly, innovation in museum organizations, or museum innovation, can also be understood as new ideas and methods that are created and adopted by museums and diffused through intra- and inter- museum networks. But there exists a dichotomy of explanations for museum innovation in the existing literature.

The first explanation regards museums as a productive unit and museum innovation as a microeconomic activity of museum organization. By emphasizing the commonality with innovation in firms, museum innovation is seen as technology-orientation; the process of innovation is characterized by a technological push; and studies of museum innovation mostly focus on the management of the organization. Therefore, there is not much difference between museum innovation and firm innovation in nature, and same analysis paradigms for the mainstream of innovation studies also are applied to the study

of museum innovation. For example, many scholars analyze museum innovation in accordance with the taxonomy of technological (product and process) innovation and organizational innovation, which originated from firm-oriented Oslo Manual.

The second explanation views museum as a component of arts and cultural frameworks with emphasis on the peculiarity of arts and cultural organizations and how they differ from profitable enterprises. By addressing the difference innovation in profit enterprises and in arts and cultural organizations, they are seen as non-profitable organizations focusing on the generation of "meaning" and "symbol" and innovation by arts and cultural organizations, which are culture-oriented; the process of innovation is characterized by demand pull; and studies of museum innovation often concentrate on the curatorship in museographical works. Therefore, conventional analysis paradigms about innovation are not applicable in the study of museum innovation and instead, museum innovation is researched in terms of artistic and cultural dimensions with emphasis on the common characteristics including value creation, artform extension and audience development etc., which also are shared with other arts and cultural organizations.

The divergence of the two explanations mostly depends on different research perspectives. The first perspective usually exists in the cultural economics literature and the second one in the cultural and creative industries and museology literature. But neither of the two regard museum innovation as an independent object of research and instead, museums are treated as a case of either firm-like organizations, or arts and cultural organizations in the existing literature, which leads to the lack of systematic and in-depth explanation of museum innovation.

As a result, the understanding of innovation in museum organizations is often vague and fragmented. First, there is a lack of scientific definition of museum innovation. Because museum innovation often is studied under the paradigm of either technological innovation or cultural innovation by arts and cultural organizations, the characteristics of innovation with reference to museum organization per se tend to be neglected. Second, there is a lack of comprehensive classification of museum innovation, because most of the

taxonomies for innovation in museums are tactful so as to only facilitate analysis in the particular studies. As a result, most of the cultural economics studies identify technological and organizational innovation with the neglect of cultural innovation in museums; whilst many studies of the cultural and creative industries focus on artistic and cultural innovation without considering technological interference in museographical works. Third, there is little mention to the scarce literature of recent museum innovation. In consequence, there is a need for a clear and comprehensive understanding about innovation in museum organizations.

In order to response to such need, this thesis attempts to focus on three main questions. The first question is if it is possible to explore a third perspective on which museum innovation can be explained in an integrated manner. Not only the theory but the experience also tells us that innovation takes place in the realms of both technology and culture in museums. Therefore, the third perspective should involve an in-depth and comprehensive opinion that can assimilate and integrate above the dichotomous explanations. This study attempts to develop an integrated theoretical framework for the study of museum innovation on the basis of rethinking existing explanations. Such theoretical framework also constitutes the analytical basis of further empirical studies in the research.

Second, how do museum organizations innovate in the field of cultural production? This question is mainly based on the fact that the understanding of the process of museum innovation is obviously lagging behind the development of innovation models. The actual understanding still focuses on “technology-push” and “demand-pull” popularized during 1950s and 1980s (Rothwell 1994), but new explanations of innovation process have experienced a rapid development. To be exact, the impetus of innovation is evolved from R&D to knowledge; the mode of innovation has changed from a linear process to an interactive network; and the scope of innovation has expanded from closed organisms to open systems. In sum, “open innovation” constitutes a major characteristic of the current model of the innovation process. Peacock (2008) proposed, from a sciological perspective, that the process of museum innovation was a social construction by conversational interaction for the exchange of

internal and external flows of ideas. Where does such interaction take place? With whom does a museum interact? And how does interaction lead to innovation in the museum environment? This study tries to explain the process of museum innovation by seeking anwers to these questions beyond the conventional perspectives.

Third, what determines the outcome of innovation in museum organizations? Following on from the second question, the third question is put forward to identify some particular determinants of innovation in museums. Identifying influencing factors of innovation is one of the central topics of reseach in the cultural economics literature. Although many theoretical propositions about determinants of innovation by cultural organizations have been put forward by different scholars (e.g. Castañer & Campos 2002; Castañer 2014), only some of them have been tested by empirical studies. This study mostly concentrates on some factors relating to organizational characteristics and collaboration. On the one hand, if museums are supposed to become drivers of local development through innovative strategy, will such innovative strategies be affected by the organizational characteristcs of museum per se? On the other hand, if innovation processes are characterized by interaction, does collaboration contribute to a greater degree of innovation in museums? And how? These questions may provide clear implications to management and pocily-making in terms of supporting innovation in museum organizations.

1.3 METHODOLOGY

To answer the above questions, the empirical study has been designed on the basis of theoretical development. Museum organizations are the unit of study. Both qualitative and quantitative approaches are adopted in the study, depending on the type of question. A multiple case study and various statistical tests are applied to empirical data collected from museums registered in the Valencian Autonomous Community of Spain. Detailed methodologies can be described in the three dimensions of research design, data collection and data analysis. The flow chart of research methodology is illustrated in the figure 1.

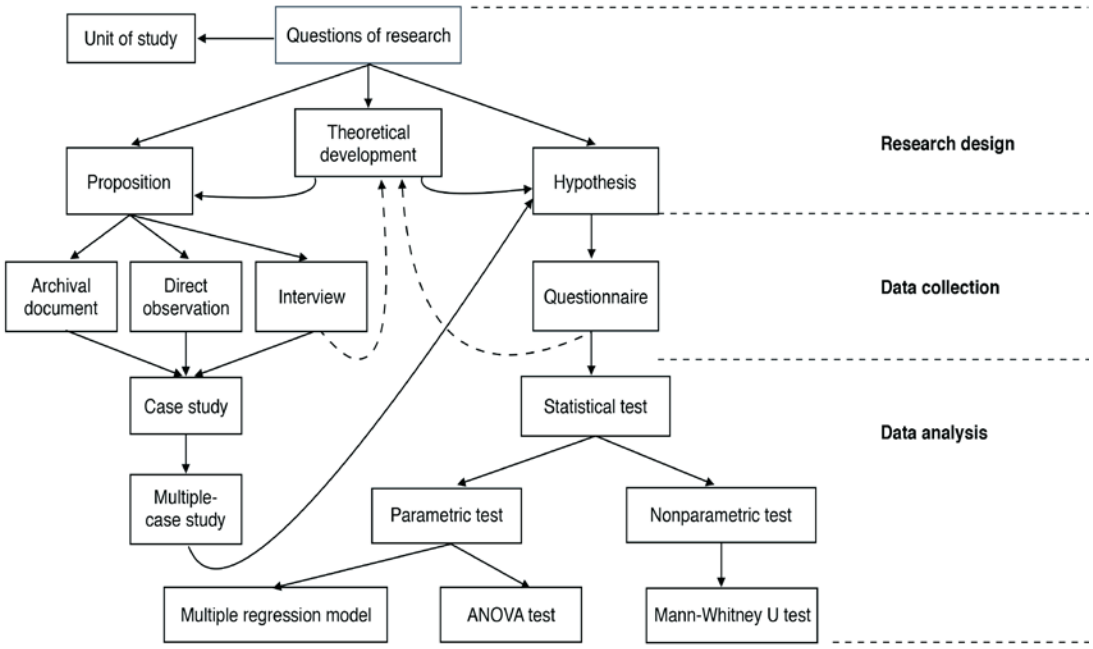


Figure 1 Flow chart of research methodology

Research design

Research design depends on the question being researched. The attributes of "who", "what", "where", "why" and "how" in the research questions are the key to decision-making about what particular research strategies to adopt (Yin 2009). Our questions can be characterized by the two attributes of "how" and "what" and thus, they are associated with two main strategies of analysis.

To be exact, the first question that how museums innovate is "how-oriented" and more explanatory, so the case study is a suitable strategy; the second question that what influences museum innovation is "what-oriented" and more exploratory, so a survey strategy is more appropriate (Yin 2009). Focusing on the innovation in the museum organizations, we regard museums as the unit of study in the research. Both case study and survey strategy are theory-based. Based on theoretical development, essential propositions and hypotheses are proposed firstly, followed by data collection and analysis.

However, the development of theory, propositions and hypotheses was not an overnight process and instead, it was the result of a continuous process of

revision and improvement involved in all stages of research. It wasn't a one-way process either; the process of data collection and analysis also gave useful feedback to our work for developing related theories, propositions, and hypotheses.

Data collection

Museum innovation faces a challenge in the collection of data. Firstly, there is neither common data elements and definitions nor the habit of data collection in museums (Wharton & DeBruin 2005); secondly, many museums are reluctant to share their managerial data, and the low response rate to the questionnaires sent out is an example; thirdly, not all countries publish statistics about their museums, and even if they are available, the indictors are mostly limited to general information such as infrastructure, personnel and visitors etc., which are hard to apply in innovation study; fourthly, existing innovation surveys exclusively focus on enterprises and don't involve arts and cultural organizations like museums. Therefore, the lack of data hinders the study of museum innovation, which may explain the relative scarcity of publications in this area.

In order to overcome the limitation of data collection, multiple processes of data collection have been designed to make good use of the existing accessible data sources, including semi-structured interviews, direct observation, archived records, questionnaires and official statistics.

- Semi-structured interview

Interviewing is the main method for collecting qualitative data; and semi-structured interviews take a place between structured and unstructured interviews, and usually consist of several key questions that help define the areas to be explored and allow the interviewer to diverge in order to pursue an idea or response in more detail. However, interviews are usually time-consuming and hence, interviews are mostly applied in a small sample but deliver deep insights. In this study, a total of seven museums (including pilot cases) were selected in terms of size, type and ownership, and geographic location. General directors or persons in charge from the selected museums were interviewed face-to-face. All interviews were conducted in the selected museums so as to offer the

interviewer chances to observe the objects on-site. All interviews usually began with some questions about cognition of museum innovation, such as their attitude to innovation, and then additional questions were raised according to actual replies, most of questions centered on four aspects of museum activities including conservation and restoration, curating exhibition, digital museum and visitor services.

- Direct observation

Direct observation is an effective method of collecting evaluative information, in which the researcher can watch the subject in their natural environment without altering that environment, so it has the strength of high external validity (Drury 1995). In our research, direct observations were conducted before or after the undertaking of interviews in the museums; they were quite an effective way to observe and evaluate the adoption of ICTs in the museum and verify the validity of the information offered by directors in the interviews objectively.

- Archived records

Some archived records such as work summaries and internal reports were supplied by some museums during the interview, they also constituted supplemental material for the author to understand some specific cases studies.

- Questionnaire

A questionnaire is one of the most widely used methods to collect quantitative data from a large number of respondents. Questionnaires have several advantages. First, they can gather standardized data and therefore, are easy to analyze; second, data can be gathered quickly from a large number of respondents; third, an online survey can be conducted at relatively inexpensively. On the other hand, its disadvantages are obvious too. First, a reasonable sample size is required to represent a population as a whole; second, responses may be inaccurate; third, response rates can be low in some cases, which may lead to the increase of sampling variance of estimates and bias of estimates in contrast to the target population.

Most questionnaires relating to museum innovation used to concentrate

on global museums as the target population, with a relatively poor response rate, i.e. an average response rate of 16%. This might have led to undercoverage and nonresponse bias. To overcome these problems, two alternatives were used in this study. One was to downsize the target population so as to decrease the risk of undercoverage; another was to increase the response rate in order to reduce the risk of nonresponse bias.

Because innovation is a regional phenomenon (Porter 1990, 1998; Breschi & Malerba 1997) and the Spanish museum system is regionalized (Gilabert González 2016), the study mainly focuses on the museums located and registered in the territory of the Valencian Autonomous Community of Spain. A questionnaire was firstly designed on the basis of developed theoretical framework on and the early case study of local museums; then it was revised after several discussions with the researcher's tutors and colleagues as well as a pretest with the deputy director of a local art foundation; lastly, a final questionnaire was sent out to a total of 121 museums through the online survey tool LimeSurvey, followed by telephone communication with respondents. After removing incomplete and repeated responses, it finally gathered 59 questionnaires. This suggested that the response rate was 49%. In sum, this survey had a small, definite population of 121 museums, a sample size of 59 means that confidence interval is ± 9 at 95% confidence level.

In addition, the author's long-term working experience as a curator and educator in the museum sector also provided a precious opportunity for participant observation and provided an insider perspective on innovation behaviour in museum organization.

Data analysis

Detailed analysis approaches are based on the nature of data, the type of question and the particular objectives of research. More specifically, to answer the "how" question, text and audio data were collected through interviews, direct observations and archived records, and a case-study technique was the most appropriate approach to data mining and analysis to arrive at exploratory conclusions. Meanwhile, statistical tests were utilized to deal with standardized numerical data so as to explore the "what" question by testing the difference in

innovation between different categories of factor.

- Case study

The case study approach is a research strategy entailing an empirical investigation of a contemporary phenomenon within its real life context using multiple sources of evidence, and is especially valuable when the boundaries between the phenomenon and context are blurred (Yin 2009). The case study approach is particularly relevant to the study of museum innovation for two reasons. On the one hand, innovative activities are a contemporary phenomenon that is strongly influenced by and embedded in the socio-economic system; on the other hand, innovation processes are involved in complex behaviour and the interaction of agents. Therefore, a multiple-case study was conducted for comparative analysis of various processes of innovation involved in four domains of cultural production among five museums by means of pattern-matching technique. Multiple-case study is more robust than single-case study, and the pattern-matching technique can greatly strengthen the internal validity of the study's results (Yin 2009).

- Statistical tests

A statistical test is a quantitative technique that provides information from which we can judge the significance of the increase (or decrease) in any result (Kanji 2006). For data reduction purposes, the principal component analysis was run on five indicators measuring cultural and organizational innovation. In order to determine the impact of organizational characteristics and collaboration on the outcome of museum innovation, both parametric and nonparametric tests are utilized in accordance with the distribution of data and type of variable. In detail, three multiple regression models were estimated to explore the relationship between predictor variables and innovation outcomes. ANOVA and Man-Whitney U tests were used to determine the difference in innovation outcomes between different categories of factors depending on whether assumptions of outliers, normal distribution, and the homogeneity of variance are met or not.

1.4 STRUCTURE OF THE THESIS

This thesis is structured around four main sections. The first section, corresponding to chapter 2, focuses on literature review about the existing studies of museum innovation. Based on 23 core and extended publications identified between 1989 and 2017, the reviews will concentrate on three pairs of dichotomous orientations of study induced from the existing literature to reflect the state quo of the research, followed by a critical conclusion that summarizes the limitations of the existing studies.

The second section, referring to chapter 3, focuses on the construction of a theoretical framework. Starting with the description of three cases of innovation in the museum community, the section attempts to explain museum innovation along the aspects of definition, taxonomy and determinants of innovation from an integrated perspective, on the basis of essential theoretical and empirical bases.

The third section, consisting of chapter 4 and 5, concentrates on the empirical analyses of the process and determinant facors in museum innovation, respectively. To be exact, chapter 4 aims to answer the question of how museums innovate for cultural production. By introducing the open innovation model and the discussion of the complexity of cultural production of museum organizations, a multiple-case study is conducted to identify innovation patterns involved in restoration, exhibition, digital museum and visitor service as four representative domains of cultural production in terms of knowledge base and value creation dimensions by the pattern-matching technique.

Chapter 5 aims at the determination of influencing factors of museum innovation by testing a set of hypotheses relating to organizational characteristics of museums and the frequency and object of collaboration based on the survey of museums in the Valencia region of Spain.

The fourth section, chapter 6, is the conclusion of the thesis. This chapter not only draws the main conclusions from the above theoretical and empirical studies but also discusses important academic, managerial and policy implications from findings and conclusions. Finally, it concludes stating the limitation of this study and of any further research in the future.

CHAPTER 2

LITERATURE REVIEW

Innovation is a newly emerging economic and social phenomenon to which much attention has been paid by both scholars and policy-makers in the last decades. Within its half-a-century history, the study of innovation has been increasingly explored and extended from an economics-centric subject to a new academic field on its own right (Fagerberg & Verspagen, 2009).

As early as the 18th century, many scholars have noticed human innovative practice in the production activities. At that time, innovation was mostly associated with invention and adoption of new machinery, science, and technology because of the emergency of the first industrial revolution. For example, Adam Smith argued that all the improvements in machinery were not the invention of those who had occasion to use the machines but the improvement of science as a whole (Smith 1776, pp 12-13); Friedrich List presented a broad agenda for the German government to address the importance of infrastructure construction to contribute to technical advancement (Lundvall 2007); Karl Marx emphasized the importance of the productive forces that determined the production relations in the innovation system and thus promoted the economic growth and all-around social progress; “science” and “technology” were important “forces of production” in his discourse (Rosenberg 1976, Lundvall 2007).

But special studies on innovation can date back to the beginning of the 20th century when Joseph Schumpeter first stated innovation to be the ultimate source of long-run economic growth in a Capitalist society. Schumpeter’s theory emphasized on innovation by innovation process in large companies as well as individual entrepreneurs and their efforts, where there were innovative activities that played the decisive role of “creative destruction” in the economic system because innovation in essence was a “source of energy within the economic

system which would of itself disrupt equilibrium that might be attained" (Schumpeter, 1937, quoted in Fagerberg & Verspagen, 2009). Later, his theory inspired many successors on the further study of firm-centric innovation; and Schumpeter, in this sense, is seen as the father of innovation study (Hall & Rosenberg, 2010).

However, Schumpeter's innovation theory didn't cause many repercussions because his innovative explanation for economic growth didn't agree with the mainstream of neo-classical economics at that time. He had few followers until after the Second World War when a relatively modest research effort began to emerge among the Rand Cooperation, Federation of British Industry and Paris-based Organization for Economic Co-operation and Development (OECD) etc. in the United States and Europe (Fagerberg, Martin, & Andersen, 2013). A landmark of innovation study was the establishment of the Science Policy Research Unit (SPRU) at the University of Sussex under the leadership of Christopher Freeman in 1965, which was the first academic unit devoting especially to the study of science, R&D, innovation and related policy issues in the world.

Since the revival of innovation study in the 1960s, scholars have intended to research science, R&D and innovation under multiple disciplines. For example, the SPRU was composed of a cross-disciplinary research staff with different academic backgrounds including economics, sociology, psychology and engineering from its formation, and it soon became the role model for many innovation research centers and institutes around Europe and elsewhere that were established subsequently. Multidisciplinary researches, on the one hand, contribute to rich literature on innovation in different contexts; and on the other hand, result in a more diverse understanding on the same subject with different perspectives.

Innovation study that concentrates particularly on the museum sector emerged quite a bit later. One of the earliest papers may date back to Noble (1989), who studied the impact of turnover of museum directors on a broad range of categories of innovation implemented by museums according to a sample survey of 400 museums and telephone interviews with 25 museum directors in the United States of America. But the museum community didn't draw much attention of innovation scholars as an object of study afterwards.

Innovation in cultural organizations has traditionally been a special interest of cultural economists (Castañer 2014); besides, it also has attracted the attention of museologists as a category of museum studies. On the base of literature searching, with particular emphasis on *the Journal of Culture Economics* and *the Museum Management and Curatorship*, we finally found 23 relevant publications during 1989 and 2017, which demonstrates that the literature on museum innovation is relatively scarce in comparison with innovation in other sectors, like for-profit enterprises.

Furthermore, we classify these articles into two categories of core literature – the content of study is about innovation in museums, and extended literature – the content of study overlaps with museum innovation and its finding can benefit greatly the understanding of innovation in museums. As summarized in table 1, there are only 12 core publications of the total relevant literature. Most of the core publications are the papers written under the cultural economics discipline and mostly focus on quantitative analysis about the relation between innovation, managerial methods, and operation performance through sample survey and statistical method, and major contributors are Camarero and her colleagues (Camarero & Garrido 2008; Garrido & Camarero 2010; Camarero et al. 2011; Camarero et al. 2015; Vicente et al. 2012; Camarero & Garrido 2012) from the University of Valladolid, Spain. Meanwhile most of the extended publications are based on museology discipline and concentrate on several themes such as changes in organizational and managerial modes, generation and diffusion of cultural meaning, and the exploration of ICTs through case study method, and contributors also are scattered.

The difference in the purpose and method of study owing to different disciplines finally leads to the divergence of the understanding about the nature, origin and drivers of innovation in museums, which can be analyzed from the following three aspects.

Table 1 The core and extended literature on museum innovation studies

Author	Innovation type	Highlight	Sample
Noble, 1989*	Eight broad categories in a museum setting	The impacts of turnover of museum directors on the kinds of innovation implemented by museums.	400 museums and 25 museum directors in the USA
Heilbrun, 1993	Artistic & technological innovation	Technological innovation provides an aesthetic opportunity and a source of competition for traditional forms.	Theoretical analysis
Wijnberg, 1994	Artistic innovation	The legitimacy of art policy based on art education and conservation and support for highly innovative art is discussed in terms of the dynamic, Schumpeterian, approach.	Theoretical analysis
Castañer & Campos, 2002	Artistic innovation	The testable propositions are developed as a comprehensive framework on the determinants of artistic innovation by arts organizations.	Theoretical analysis
Camarero & Garrido, 2008*	Technological & organizational innovation	Market orientation contributes to economic and social performance of museums through technological and organizational innovation.	135 Spanish and 141 French museums
Peacock, 2008	Technology-related organizational change	The possible approach is discussed to managing and sustaining technology-related change within museum organizations.	Theoretical analysis
Verbano, Venturini, Petroni, & Nosella, 2008	Technological innovation	The adoption of new technology in cultural institutions is determined by several factors, including collaboration and clients' demand.	100 Italian art restoration firms
Dawson, 2008*	The adoption of technology and product development	Reviewing broader business models of the nature of innovation and how organisations innovate, and how these models may be applied to a cultural institution.	Canada Science and Technology Museum Corporation
Corte, Savastano, & Storlazzi, 2011*	Discontinuous innovation involving technological, experiential and systemic innovation.	Service innovation in archaeological sites can be achieved by the use of ICT techniques and the enrichment of "integrated and complex" offers beyond existing goods.	Hercolaneum (Italy), Masada (Israel) and Petra (Giordania)
Lusiani & Zan, 2010	Managerial innovation	Analyzing and reconstructing managerial change at the organizational level in the case of Heritage Malta in comparison with British Museum and Pompeii cases.	The reform of Heritage Malta, especially its museum department
Garrido & Camarero, 2010*	Product, technological and organizational innovation	Analyzing the link between organizational learning orientation, innovation and performance for cultural organizations using museum size as the control variable	British, French and Spanish museums
Bakhshi & Throsby, 2010*	Innovation in audience reach; artform development; value creation, and business models.	Proposing a new framework of innovation in arts and cultural organizations and its implication of digital technologies for cultural and economic opportunities.	The National Theatre & the Tate Gallery

Camarero, Garrido, & Vicente, 2011*	Technological, organizational, and value creation innovation	The impacts of size and funding structure on innovation and performance of museums are conducted through survey and statistical analysis.	491 British, French, Italian and Spanish museums.
Camarero & Garrido 2012*	Organizational & technological innovation	Analyzing the different impacts of market orientation and service orientation on organizational and technological innovations implemented by museums.	491 British, French, Italian and Spanish museums.
Vicente, Camarero, & Garrido, 2012*	Technological innovation in management & in visitor experience, organizational innovation	The various impacts of cultural policies, mode of governance, modes of finance and size on museum innovation.	Art and history museums in France, Italy, Spain and the United Kingdom
Søndergaard & Veirum, 2012	Cultural-driven innovation	A joint venture model for culture-driven innovation in a public private consortium as a solution to overcome institutional barriers of cross-sector collaboration between museums, universities, and SMEs.	Danish museums in the northern Jutland region
Litchfiel & Gilson, 2013	The generation of creative idea	Regarding museum and curatorial activities in the shape, maintenance, and usage of collections as metaphor in the management of creativity and innovation.	Theoretical analysis
De-Miguel-molina, Hervás-oliver, & Boix, 2013*	Beautiful innovation as product and process innovations in the cultural and creative industries	Examining the drivers of beautiful innovation in artworks restoration by museums.	Restoration and conservation departments in 167 museums in 43 countries
Costa Barbosa, 2013*	Technological & organizational innovation	Examining how museums innovate by the use of ICTs in terms of a new typology of ICTs' use presented by author.	The selected Norwegian and Spanish museums
Castañer, 2014	Cultural innovation	Analyzing the determinants of cultural innovation by cultural organizations in terms of the sociological and economic perspectives.	Theoretical analysis
De-Miguel-Molina, Hervás-Oliver, De-Miguel-Molina, & Boix, 2014	Product, process, organizational and marketing innovation	Examining the proportion of four types of innovation in art, heritage and recreation industries.	Spanish firms in the arts, heritage and recreation industries
Camarero, Garrido, & Vicente, 2015*	Technological innovation	Exploring the relation between visitor orientation and performance in museums with emphasis on technological innovation and tradition as two alternative strategies to respond to visitor expectations.	491 British, French, Italian and Spanish museums.
Corte, Aria, & Del Gaudio, 2017*	Smart, open and use innovations	Examining the role of innovation in determining competitive advantage for museums and heritage sites.	23 global museums topping in the international ranks.

Note: * core literature: the content of study is innovation in museums; whilst extended literature: content of study overlaps with museum innovation and the finding benefit greatly the understanding of innovation in museums.

2.1 TECHNOLOGICAL ORIENTATION VERSUS CULTURAL ORIENTATION

What is the nature of innovation in the museum context? The existing literature gives quite opposite answers. The technology-oriented view tends to regard innovation in narrative content, which is close to the mainstream viewpoint that the essence of innovation is something relevant to the creation, application and diffusion of technologies and knowledge; and the number of R&D activities fundamentally affect the opportunities for technological innovation within a specific context (e.g. firm, industry, region, nation or global), which in turn determines the outputs of innovation and its performance (Becheikh et al. 2006).

Similarly, Camarero and her colleagues argue that the most common innovation in museums is "changes in certain service aspects and advances in the technology used" (Camarero et al. 2011). Innovative activities in museums are, to some extent, equal to the use of Information and Communication Technologies (ICTs) (Corte et al. 2011; Costa Barbosa 2013) on the purpose of improving exhibitions and scenography, making the museum more accessible to a wider audience, and attracting funds from donors and sponsors as well (Camarero & Garrido 2012). In some sense, technology itself becomes a synonym of innovation in the museum setting in the digital era.

Differently, the culture-oriented view emphasizes the artistic and cultural properties of innovation by cultural organizations. The conventional definition of innovation cannot be applied in the museum sector and instead, a new definition should be developed. For example, Noble (1989) asserted that:

> "It would be most inappropriate to attempt to apply definitions of innovation which focus almost exclusively on invention, new technology and commercial application in the marketplace to museums. Museums do not manufacture or market goods or products. Museums are not research centers devoted to the development of new technologies. Museums are service organizations. The field of social work provides a set of basic objectives that are not dissimilar to those found in a museum setting. The use of exhibits as a means of mass interpretation and education, as well as

> the activities of museum education departments in terms of promoting new techniques, new ideas, and promoting new programs" (Noble 1989)

Here, Noble distinguished museum innovation from innovation in manufacturing and other business sectors in terms of the nature of organization, but he also emphasized the possibility to redefine innovation in a museum setting because of the similarity in the diffusion of novelty in accordance with the objective of the organization.

Castañer and Campos (2002) referred in particular to innovation in art organizations by artistic innovation, which was defined as the introduction in the field (or market) of the newness of artistic outputs by the three referents of cosmopolitan, local, and individual perspectives. They can be further classified into two categories of content innovation – repertoire innovation as the programming of contemporary works, as well as form innovation – the new form of presenting both old and new works.

More recently, Castañer (2014) extended the scope of artistic innovation in cultural organizations and develeped the concept of cultural innovation, referring to "innovations in the goods or services offered by a cultural organization" with particular relation to repertoire or programming innovation. He also pointed out that most of the cultural innovations were adopted externally rather than generated internally in the cultural organizations, thus reducing the uncertainty greatly in the process of innovation (Castañer 2014).

Generally, most of the existing literature focuses on technological innovation. Not until very recently have some cultural economics scholars developed the concept of culture-related innovation. Their arguments can inspire us to understand artistic and cultural innovation by arts and cultural organizations beyond the technological dimension. But the definitions of both artistic and cultural innovation are closely associated with repertoire and programming because of their focus on theaters. This seems too narrative for us to cover the features of innovative activities involved in museums, because programming is essentially a managerial means of content innovation adopted externally by theaters (Castañer & Campos 2002; Castañer 2014) whilst most of the content innovations – exhibition, educational programs, collection catalogue as examples – are generated internally in and by museums, even most tour

exhibitions that a museum introduces from outside are generated by other museums too. Therefore, these definitions should be revised if they are applied in the museum context.

Culture-oriented innovation is also viewed from the development of cultural products and services. Product development in museums can be regarded as product innovation, which is "linked to providing new services, activities and improvements or variations in exhibited works" (Garrido & Camarero 2010); it, meanwhile, also refers to "extending the artform" and "value creation" (Bakhshi & Throsby 2010). Bakhshi and Throsby (2010) stated that "extending the artform" is a particular aspect of innovation relating to the development of new work that may influence artistic trends and lead to new artistic directions whist "innovation in value creation" means new ways of expanding cultural values of the arts not only in terms of economic profit but also by a wider range of community benefits so as to meet the needs of both visitors and society at large.

Bakhshi and Throsby's conception of cultural-oriented innovation is widely cited in museum innovation literature. But it needs to be mentioned that their findings are based on the case study of the Tate Gallery – one of the top art museums in England and the world, it is doubtful whether such findings are universal enough to be applied to the museum community as a whole, especially considering that a majority of museums in Europe are small and local museums (Vicente et al. 2012). A counter-example is that most history museums and ancient and classic art museums like the Louvre and el Prado may not innovate in extending the artform because they hardly collect or exhibit any avant-garde artworks.

2.2 TECHNOLOGY-PUSH VERSUS DEMAND-PULL

Innovation literature identifies the major drivers of the success in innovation as "technology-push" and "demand-pull" (Schmookler 1966; Mowery & Rosenberg 1979; Berkhout et al. 2006), which are also reflected in the existing studies about museum innovation.

On the one hand, many studies have emphasized the decisive role of

technology, particularly ICTs, in fostering innovation in organization, value creation, and cultural products and services in museums.

Peacock (2008) asserted that digital ICTs act as catalysts for change within museums. He analyzed theoretically the relation between technology and organizational change in museums from a social constructionism perspective. He pointed out that technology was not an external force leading to the organizational change by which museums resisted or accommodated the invasion of technology and instead, the impact of technology on museums were embodied in its involvement in "the everyday conversational interactions of individuals within the organization" (Peacock 2008), which stimulated technology-related innovation resulting from new ideas through such conversation about new possibilities offered by technology, and finally technology-induced innovation (the author called it "disruptive innovation") redefined organizational purpose and meaning and reshaped individual and organizational identities.

Corte et al. (2011) stressed the importance of the use of advanced technologies in value creation in the business sector and tourist involvement by analyzing the main forms of the utilization of technologies and technology-related investment in three cultural archaeological sites located in the Mediterranean area, and they argued that new technological applications encouraged a change in visitor roles as users were involved in interactive processes between visitors and museums, which in turn led to innovation in value creation.

More often the emphasis on technological push has been placed through the descriptive and analytical studies about the influence of technology in accordance with its effects on exhibitions (vom Lehn 2005; Ioannidis, Toli, et al. 2014), visitor experience (Camarero & Garrido 2008; Costa Barbosa 2013), and heritage conservation (Karp 2004; De-Miguel-Molina, De-Miguel-Molina, et al. 2014).

As Peacock (2008) mentioned, the impact of technology on innovation in museums hasn't been covered completely by existing literature. In most of the existing literature, technology is treated as an exogenous variable that naturally leads to innovation; innovation occurs when technology is incorporated into the development of new products or processes. This simplifies the decisive role of technology in initiating innovation and even mixes up innovation with technology.

We think technology itself is not innovation, and the diffusion of innovation and the adoption of technology are affected by many factors (Rogers 2003), which haven't been well studied in the museum context.

On the other hand, many studies also mention the demand-pull factor of museum innovation by highlighting the presumption that museums innovate so as to meet the needs of visitors and society. Museums confront two types of demand: private demand exerted by the visitors and social demand based on external effects and/or effects on markets (Frey & Meier 2006). With regards to private demand by visitors, many studies mentioned that museums were witnessing a fundamental transformation from a custodial orientation to a visitor orientation in recent years (Camarero & Garrido 2008; Camarero & Garrido 2012; Camarero et al. 2015). This means that understanding the needs and wishes of potential visitors is at the heart of the financial and social goals of a museum (Camarero & Garrido 2012), and this may constitute a certain link between museum innovation, visitor demands, and audience development in the museum practice.

For example, Heilbrun (1993) emphasized the positive impact of visitor preference on artistic innovations in museums. He argued that artistic innovation helped art museums to attract a younger audience because the young were more open than the elder to explore and appreciate new works of art. Camarero and Garrido (2012) emphasized the important role of private demand on museum innovation in an empirical study based on a sample of 491 British, French, Italian and Spanish museums, and they found out that visitor orientation had a positive impact on organizational innovation and it only impacted technological innovations when coupled with cooperation with other museums or leisure alternatives. But Camarero et al. (2015) arrived to the conflicting conclusion that visitor orientation had a positive influence on technological innovations in terms of the same sample of European museums. This paradox may be explained by the employment of different indictors or statistical methods in two studies.

However, this link between innovation and visitor’s demands is challenged by Castañer (2014), who stated that the impact of private demand on promoting innovation could be distorted by the political orientation of the governing party at any government level, he pointed out that public funders were reluctant to encourage innovation because publicly funded museums needed to serve the local

population as widely as it was possible and they were not supposed to offer experimental and innovative products for the sake of a small portion of population.

With regards to the social demand, innovation can be seen as a response by museums to social requirements or market pressure. Heilbrun (1993) asserted that artistic and technological innovation had become the means by which museums compete to attract a new audience with live forms such as symphonic concerts, dance, theatre and opera in his theoretical discourse about the relationship between art, technology, and innovation in the high arts.

Lusiani and Zan (2010) demonstrated that the introduction of New Public Management (NPM) in the public sector had brought the increasing call to museums and other public cultural organizations for innovation in organization and management on the purpose of decreasing operational costs, increasing output accountability, and strengthening competitive advantage in comparison with the private sector. They disclosed how government-dominated reform led to managerial change at the organizational level in the case of the transformation of Heritage Malta with a special focus in its museum department. They concluded that government-dominated reform wasn't a sufficient condition for the success of organizational transformation and financial autonomy in organization matters.

In addition to this, other scholars also noticed the dual impacts of technology advancement and social demands on innovation in the museum community. For example, Bakhshi and Throsby (2010) stressed the political orientation of Art funders and policymakers and the advancement of technology as the major impetuses of innovation in museums by identifying four major drivers in the changing environment that arts and cultural organizations have faced in the United Kingdom recently.

To what extent does demand drive innovative activities in museums? What is the mechanism by which museums respond to external demands of innovative activities? The existing literature hasn't given us any answer yet. But Lusiani and Zan's (2010) study does imply that social demand doesn’t constitute a condition sufficient for organizational innovation of museums. Considering that most of the existing literature regards technology-push and/or demand-pull as a precondition in their studies and limits it/them to the descriptive analysis, so this theme

deserves to draw more academic attention in future.

2.3 MANAGEMENT VERSUS CURATORSHIP

The orientation of the existing literature can also be classified as curatorship-centric and management-centric in terms of the domain in which studies focus. We regard management is an organization-based domains involving a set of issues about organizational management and marketing activities such as mission, value, purpose, work process, collaboration, new organizational forms, new business models, and new marketing strategies etc. Curatorship, on the other hand, is regarded as a collection-based domain embracing a series of functional works such as conservation, research, exhibition, and education in museums.

It is obvious that most of the cultural economic publications, which constitute the majority of the core literature, are management-centric literature that mainly concerns managerial, economic and institutional factors on which innovation are reliant within museums. These factors can normally be grouped into three dimensions of inputs, outputs, and outcomes along the process of innovation. In detail, inputs include managers, organization size, funding sources, organizational learning, marketing strategies etc.; outputs involve different types of innovation in various dimensions such as technology, organization, and value creation etc.; outcomes are composed of economic and social performance. These publications usually take advantage of sample survey and statistic methods to test correlations between inputs, outputs, and outcomes. Examples are the impact of size and funding on museums' innovation and performance (Camarero et al. 2011; Vicente et al. 2012), the correlations between market strategy and museum innovation (Camarero & Garrido 2008; Camarero & Garrido 2012), or the influences of knowledge bases and organizational learning on innovation of museums (Garrido & Camarero 2010; De-Miguel-molina et al. 2013).

Contrary to this, most of the museology publications are curatorship-centric literature, which places more attention on relationships between museological practices and technology, with particular emphasis on the changes in a museum's functional work like conservation techniques (Karp 2004;

Ioannidis, Toli, et al. 2014), interpretive methods (vom Lehn 2005; Pujol-Tost 2011), curatorial authorities (Kéfi & Pallud 2011) by the use of ICTs. These publications seldom use the term “innovation” directly but emphasize some new techniques, methods, procedures and designs of detailed museological works. Here the attention needs to be paid on the difference between “innovation” and “change” in the context by readers.

In some studies, such a dichotomy of orientation is regarded as an opposing factor that exerts different impacts on innovation. One example is about leadership in artistic organizations. It is assumed that curators and managers are two leaders with conflicting objects in the museum, wherein “curators seek autonomy from the boards to pursue research and acquire works that they themselves consider important” (Zolberg 1986) whilst managers aim at the achievement of organizational goals associated with profitability and effectiveness (Castañer & Campos 2002) and they always go against artistic innovation (DiMaggio & Stenberg 1985). As a result, Castañer and Campos (2002) proposed that managers with only managerial background were less likely to encourage artistic innovation than curators or managers with both managerial and artistic backgrounds.

Another example has to do with marketing strategies that museums may adopt. Camarero and Garrido (2012) classified museum marketing into market orientation and service orientation. They defined market orientation as the organizational philosophy with the highest priority on the profitable creation and maintenance of superior customer value and with the aim of meeting customers’ needs, and service orientation as curatorial philosophy valuing the high artistic quality of the exhibitions and social value of custodial works (Camarero & Garrido 2012). They found that the custodial orientation and visitor orientation had substantially different impacts on organizational innovation and performance according to an empirical study based on 491 British, French, Italian and Spanish museums, on the base of which, they concluded that curatorial philosophy only met the needs of elites and didn’t address the needs of the mass public, and thus its inability to attract a new audience finally affected the museums’ innovation and performance negatively (Camarero et al. 2015).

Such a dichotomous orientation may arouse in us a new question.

Considering that museology literature depicts many innovative practices relating to the functional work of museums from a curatorial perspective, why does cultural economics literature arrive to the opposite conclusion? This contradiction cannot be explained by differing perspectives because curatorship and management are two domains that co-exist and interplay, rather than mutually exclude each other within a museum. Instead, we think that a possible explanation is the utilization of different definitions and indictors used to understand and measure innovation in museums by different studies.

2.4 A CRITICAL CONCLUSION

In short, from the three aspects discussed above, it is clear that a binary discourse is pervasive in the existing literature in terms of different disciplines, methods and purposes of studies, which proves that there still is a lack of common understanding with regards to museum innovation. The limitations of existing literature are embodied in four aspects.

First, culture-oriented innovation is less developed in museum innovation literature. Museums are important cultural heritage institutions. It is no doubt that culture-related production and its outputs are major sources of cultural innovation in a museum. The use of technology can facilitate the process of cultural innovation, but technology doesn't equal to technological innovation. In addition, it is reasonable to believe that cultural and technological innovations are compatible rather than mutually exclusive in museums, and such coexistence has been ignored by the existing literature.

Second, there is a lack of detailed discussion about the influencing factors of innovative activities in museums. Most of the existing literature describes technology-push or demand-pull, or both, as a kind of background or prerequisite, which constitutes a starting point for their exposition. As some innovation literature shows, technology and demand exert different impacts on different types of innovation under different conditions (Schmookler 1966; Mowery & Rosenberg 1979). Therefore, such transcendetalism about the impact of technology and demand on museum innovation needs to be challenged. There is

no need to mention that mainstream innovation literature regards innovation as a dynamic and cyclical interaction beyond the traditional linear thinking of technology-push and demand-pull (Berkhout et al. 2006).

Third, there still is no clear answer to the question of how museums innovate, which is a vital theme of innovation study revealing the processes and mechanisms of innovation in a museum setting. Although some studies have tried to describe and analyze the process of change in organizational forms and business models from a resouce-based view (Dawson 2008; Lusiani & Zan 2010), as well as the creation of new ideas in curatioral works in museums from knowledge management perspective (Litchfiel & Gilson 2013), more effort should be made on the induction of the generalized explaination from these empirical cases.

Last but not the least, the absence of a systematic perspective is a drawback of the existing literature. Prior studies of museum innovation are limited to the organizational level and focus mostly on the internal factors of organizations. But mainstraim innovation literature shows that innovative activities are not isolated but integrated in an interactive system of innovation, which is composed of different actors, knowledge and institutions (Edquist 1997, 2005). Although some studies have noticed the importance of cross-sector collaboration between museums (Verbano et al. 2008; Søndergaard & Veirum 2012) and institutions (Vicente et al. 2012), more attention should be paid on the joint impacts of collaboration, organizaional learning and institutional factors on museums' innovation behavior by systematic approaches.

In conclusion, the limitations of prior studies about museum innovation imply an ugent need of a new anayalical framwork for innovation study in the museum sector, which at least includes (1) the integration of the cultural and technological dimensions of innovation, (2) the clear identification of the drivers/determiants of innovation in terms of museums' pecularities, (3) a generalized explanation to help the understanding of the processes and mechanisms of museum innovation, and (4) the employment of a systematic approach.

CHAPTER 3

WHAT IS MUSEUM INNOVATION? AN INTEGRATED PERSPECTIVE OF INNOVATION BY MUSEUM ORGANIZATION

As many scholars have noted, innovation is a pervasive phenomenon in today's society (Stoneman 2010; Fagerberg et al. 2013). Innovation is not limited to R&D and machinery production in the private sector, but it is pervasively embedded in all walks of life, such as arts and humanities research (Bakhshi et al. 2008), Non-profit organizations (Zimmermann & Mmermann 1999; Gorp 2012), and cultural and creative production (Stoneman 2010; Miles & Green 2008). As an important cultural heritage institution, museums are a non-profit making organizations engaged in cultural and creative sectors and, hence, the museum community, theoretically, also embraces a wide range of innovative activities.

The key issue is how to identify innovation in museums. As discussed above, not all newness is innovation; innovation is something new that can be adopted by the market and society successfully. Stoneman (2010) proposed two criteria to judge innovation; the first one was "novelty", and the second was the "significant content of change" to which the "novelty" led, and that was measured in terms of market impact, functionality, technology, or aesthetics. Similarly, other scholars have also stated that successful innovation depends not only on its profitability, measured by costs and benefits (Rogers 1983, 2003; Abrahamson 1991), but also on its institutional outcome, like legitimacy (Meyer and Rowan 1977; DiMaggio & Powell 1991; Scott 2014) and worthiness (Hatimi 2003).

According to this criterion, some new museological concepts and methods should be excluded from the recognition of museum innovation because they are

still not out of the picture. A good example is an “exit price” or “pay as you go pricing” (Frey & Steiner 2012) charging visitors when they leave museums. Besides, many periodical marketing and educational events like free entrance during International Museum Day, or weekend concerts in museums cannot be identified as museum innovation because these events lack novelty value although they manage to attract many visitors to the museum.

By exploring the question of what is museum innovation, this chapter aims to re-think innovation in museums as an independent object of research so as to build a new theoretical framework from an integrated perspective. The chapter starts with the description of three observed cases of innovation in the museum community, which brings us some perceptual knowledge about museum innovation. On the basis of such perceptual knowledge, we attempt to analyze museum innovation by the three parameters of definition, taxonomy, and drivers of innovation. The explanation of each aspect is based on essential empirical and theoretical bases.

3.1 THE OBSERVATION OF THREE INNOVATION CASES IN THE MUSEUM COMMUNITY

It will be easy to approach a whole picture of museum innovation by some observation of innovation cases in the museum community. In this section, three cases of museum innovation – computerization and digitalization, the development of new museology, and the introduction of new organizational structures in the museum community – are to be described, respectively, thus displaying some important features of museum innovation in terms of technological and non-technological dimensions. From these cases, some clues may be extracted to help us understand innovation phenomenon in museum organizations.

3.1.1 Computerization and digitalization: technological innovation in museums

The museum community has been traditionally regarded as a generation behind

the pace of technological development considering the fact that museums are labor-intensive (Piekkola et al. 2014) and most museum professionals don't have an affinity with science, technology, or an engineering knowledge base. But museums also benefit from the spillover effect of technical progress so that they can keep pace with the changing social demands placed on them (Bakhshi & Throsby 2009). The history of technological adoption in the museum sector can be summarized by a brief timeline of the last few decades of development:

> "The first adopters of 'automation' (as it was then called) in the 1960s; the emergence of standards and professional bodies related to museum information management in the 1970s; the rise of local networks, multi-media and microcomputing in the 1980s; the advent of the Web, interoperability and mass digitization in the 1990s; and the evolution of the mobile and social media at the start of the new century" (Parry 2010).

Generally, innovation characterized by technological adoption in museum sector can be classified into two categories: computerization and digitalization. The ***computerization*** of museums was the consequence of the consistent development of computer technology from mainframe computers to microcomputers, then minicomputers. Although the first automatic digital computer was invented in 1941, not until the 1960s – two decades after its invention – did the museum community start to utilize computers in their operations. In the United States, the very first adopters were leading museums with large collections. They attempted to make use of computers to manage the collection information system considering that these museums couldn't deal with the increasing requirements on the maintenance and management of collection data with the growing objects in museums (Williams 1987). But this practice wasn't widely spread among museums just because "mainframes" computers – the early equipment in 1960s – were "very large and costly and required the services of highly trained data-processing operators, programmers, and systems analysts" (Williams 1987). In addition to the constraint of computer hardware, software is another important factor influencing the successful adoption of computers in the museum sector. Some computer-oriented projects failed mostly because of the lack of suitable software to meet the needs of museums.

During 1960s and 1980s, there were four major projects focusing on software development of museum information management systems, including *Self Generating Master (SELGEM)* created by the Smithsonian Institution, *General Retrieval and Information Processor for Humanities Oriented Studies (GRIPHOS)* initiated by the Indexing and Retrieval Division of the United Nations and endorsed and diffused by New York-based Museum Computer Network, *Arizona State Museum's Interactive Registration System (REGIS)* developed for Arizona State Museum, as well as *Detroit Arts Management Information System (DAMIS)* as a business program package published in the early 1980s, all of which played a vital role in the popularization of computers, particularly in the field of collection information management system, among museums in the United States.

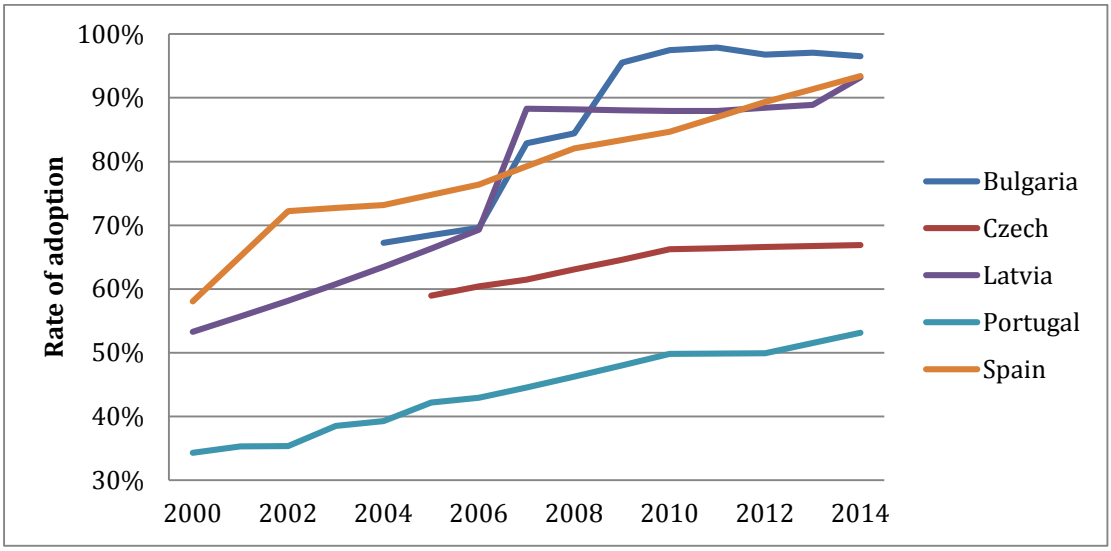


Figure 2 Adoption of computers in the museum sector by countries (2000-2014)

Source: European Group of Museum Statistics (EGMUS)

In contrast to traditional paper-based practices, computer-based system for information management can store unlimited collection data easily, update records of the location of objects at any time, cross-refer the lists of objects for research and exhibition flexibly, and save time in registration so as to allow registrars, curators and administrators to spend more time on other activities. This encouraged more and more museums to adopt computers for their daily work. Figure 2 illustrates the rate of adoption of computers in European

museums and shows a rising tendency in the adoption of computers over the last two decades, although the content for which museums make use of computers varies bewteen countries, among which Bulgaria, Latvia and Spain enjoy an extremely high adoption rate close to one hundred percent whilst only half of all Portuguese museums use computers.

The ***digitalization*** is the extension of the computerization of museums because it is deeply reliant on the popularization of computer equipment and the development of Information and Communication Technologies (ICTs). The first attempt at digitizing in the heritage institutions emerged in the early 1990s. In 1991, the International Council of Museums (ICOM) established the International Committee for Audiovisual and New Image and Sound Technologies (AVICOM) with the purpose of promoting knowledge in the technology used in museums; in 1992, the United Nations Educational, Scientific and Cultural Organization (UNESCO) launched the Memory of the World Program to advocate and support the digitalization and preservation of cultural heritage; in the same year, Apple Computer released the first virtual museum of the world, which was a CD-ROM allowing users to move from room to room and to select any exhibit in a room for more detailed examination (Miller et al. 1992).

The digitalization of museums embraces at least three major practices: (1) digitalizing heritage, focusing on the conservation and use of cultural heritage through digital techniques; (2) constructing the virtual museum, concentrating on the distribution and sharing of museum information through the World Wide Web; (3) utilizing social media for the purpose of marketing, and to strengthen the interaction between museums and their audiences.

The earliest physical museum to digitize its cultural heritage was the Museum of the History of Science in Oxford, in the academic setting of Oxford University, which inaugurated a virtual exhibition with detailed collections-based content and high-resolution images of artifacts in 1995 (Bowen 1998); besides, the Smithsonian Institution’s National Museums of Asian Art was the first museum to digitize its entire art collection (Taboh 2015), and the Brooklyn Museum in New York was the first museum to produce crowdsourcing-oriented contemporary art exhibitions by means of digital networks, particularly through social media (Chae & Kim 2013).

Like in the case of museum computerization, there are obvious obstacles preventing museums from developing digital practices further. The EU's report *The Cost of Digitising Europe's Cultural Heritage* (Poole 2010) described the obstacles as the high cost of digitalization, the complexity of scanning and reproduction, and the difficulty in batch-processing for the creation of metadata. In other words, the digitalization depends mostly on the financial, technical and human resources to which a museum can have access.

As a consequence, the pioneers in the digital era are few and of a large size, as well as partnerships between museums and technological enterprises (e.g. Google Art Project [1]) for greater financial and technical leverage. Meanwhile, a large number of small museums, which are either commercially independent or supported at a local or regional level, are lacking in necessary resources for digitization (Poole 2010). Considering that museums and high-tech enterprises partnerships only develop for digitizing masterworks and well-known museums, this usually excludes most small museums, and hence, the diffusion of digitization among them is mostly reliant on international or national digital project funding initiatives, such as the Europeana program in the Europe Union, or National Survey of Movable Cultural Relics in China [2].

Figure 3 shows the evolution of digitalization in terms of the use of databases for electronic inventory in four European museums between 2002 and 2014; it reveals that the rate of adoption of digital heritage is relatively low overall, even in industrialized countries like Finland and Spain, less than 50% of the museums digitalized their collection whilst the high rates of adoption in Eastern European countries like Bulgaria and Latvia may be more the consequence of the small number of the museums in those countries. The report *The Cost of Digitising Europe's Cultural Heritage* (Poole 2010) estimated that the

[1] The Google Art Project (https://www.google.com/culturalinstitute/project/art-project) was launched on 1 February 2011 by Google, in cooperation with 17 international museums, including the Tate Gallery, the Metropolitan Museum of Art, and the Uffizi. Up to January 2016, the partner museums / cultural institutes have been expanded to 744.

[2] First National Survey of Movable Cultural Relics (http://web.wwpc.net.cn/gjwwjgzw/) FNSMCR is China's national initiative for surveying and digitizing cultural heritage during 2012 and 2016, it covers over one hundred million objects from 1.5 million public agencies including all public museums in Mainland China.

percentage of digitalized collections was still small, only accounting for 20% of all collections in European museums by 2010. In consequence, they both illustrate that museums' digitization activities are still at an early stage.

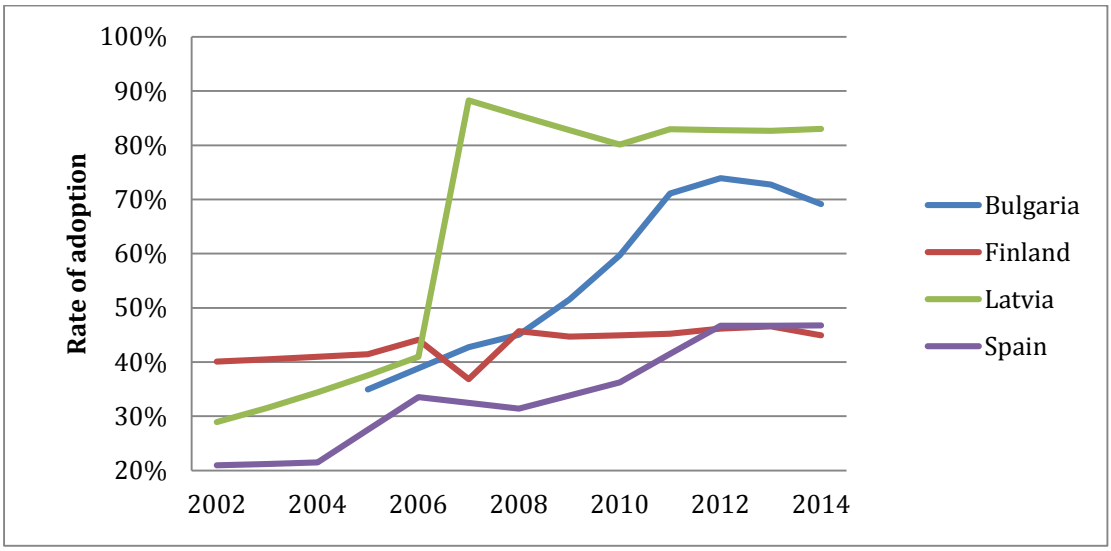


Figure 3 Adoption of digital heritage in terms of database for electronic inventory by countries by countries (2002-2014)

Source: European Group of Museum Statistics (EGMUS)

3.1.2 The birth and diffusion of new museology: museum innovation in arts and humanities fields

Museums have experienced three revolutions. The first revolution took place around the year of 1900 with the advent of the institutionalization and professionalization of museums; the second revolution happened in the 1970s, when the collection-based museums were replaced by function-based museums (Mensch 1992); the third revolution occurred more recently, with museum practices as a tool for social development (Heijnen 2010). Among the three revolutions, the second may have a more far-reaching influence on the museum community because it re-positioned the nature and role of museums through advocating a new approach to museology.

The early 1970s witnessed a series of social crises characterized by uneven development between countries and the increasing tension between cultural development, economic growth, urbanization, and scientific and

technological progress. How the museum community responded to the challenges created by the social crisis was at the core of discussion among a group of Latin American museologists at *the Round Table on the Role of Museums in Santiago* (Chile) in 1972. Their discourse was based on the argument that the awareness of the problems of the rural environment, of the urban environment, of scientific and technological development and of lifelong education should be strengthened in Latin American society, the solution of such problems relied on the understanding by the community of the technical, social, economic, and political aspects involved, and hence, museums could and should play a decisive role in the education of the communities to assist in the creation of such awareness.

The Round Table of Santiago gave rise to a series of further discussions and practices about the linkage between museums and the community, which finally led to the emergence of *new museology* as a new museological approach. New museology emphasizes a museum's social relevance in its objectives and basic principles, with priorities such as the identity of a society and community, tackling problems and devising possible solutions, and achieving the integrated development of a region and its population (Hauenschild 1988).

ICOM played an active role in the diffusion of the new museological approach. Following the Santiago Round Table (Chile) in 1972, ICOM sponsored a series of international conferences to develop the theme of new museology for further discussions and practices throughout the world, such as the 1st International-Ecomuseums/New Museology Workshop in Quebec (Canada) in 1984, the Oaxtepec Meeting (Mexico) in 1984, and the Caracas Meeting (Venezuela) in 1992. In addition, ICOM also legalized *International Movement for New Museology* (MINOM) as its affiliated organization in 1985.

The new museology theory contributed to the emergence of new types of museums, like the "ecomuseum", "integral museum", and "community museum" (Santos Primo 2007). These new types of museums were established in pursuit of the application of the new museology approach, which distanced themselves from the traditional museums, as summarized in table 2.

The diffusion of new museology also aroused different interests and concerns about museums' social roles among different regions of the world:

inequality and injustice in Latin America, the sustainable development agenda and social inclusion policies in the UK, emancipation movements in North America, and the growing multiculturalism in Europe (Santos Primo 2007; dos Santos 2010), which in turn formed different dependent paths to tackle these concerns and develop possible solutions. For example, the Latin school gave priority to development, i.e. heritage as a tool for empowerment whilst the British School emphasized "an awareness-based institute" to broaden the audience, access, participation and social inclusion as its focus points (Heijnen 2010).

Table 2 Comparison between new museums and traditional museums in terms of the adoption of new museology

	New museum	**Traditional museum**
Objectives	Coping with everyday life Social development	Preservation and protection of a given material heritage
Basic principles	Extensive, radical public orientation Territoriality	Protection of the objects
Structure & organization	Little institutionalization Financing through local resources Decentralization Participation Teamwork based on equal rights	Institutionalization Government financing Central museum building Professional staff Hierarchical structure
Approach	Subject: complex reality Interdisciplinary Theme orientation Linking the past to the present and future Cooperation with local/regional organizations	Subject: extract from reality (objects placed in museums) Discipline-oriented restrictiveness Orientation to the object Orientation to the past
Tasks	Collection Documentation Research Conservation Mediation Continuing education Evaluation	Collection Documentation Research Conservation Mediation

Source: Hauenschild 1988

In Asia and other regions where the new museology movement was relatively less active, the new model of museums was initially spread through international cooperation. The early ecomuseums in China, such as Soga Qingmiao Ecomuseum, Zhenshan Buyi Ecomuseum, Tang'an Dong Ecomuseum and Longli Han Castle ecomuseum, resulted exclusively from the Sino-Norwegian cooperative cultural project between 1997 and 2004, where the Norwegian government provided the initial funding and professional support of ecomuseum, and the Chinese government provided the following funding to continue to develop them. But even this ecomuseum project witnessed the divergence of the concepts and methods among stakeholders: the European professionals aimed to preserve traditional culture in the face of industrial development; the Chinese government regarded it as a component of an economic policy for developing living conditions of locally diverse ethnic groups; and local villagers saw it as economic resource to improve living standards (Jin 2011).

Nowadays, new museology has more and more influence on the museum community. Some regional and national museum associations, such as in Latin America and Spain, list the promotion of new museology as a major mission; other museum associations advocate social value and the social role of museums more prominently. For example, American Alliance of Museums (2008) talked about trends and potential futures of museums in the geopolitical and economic landscape. The Netherland Museum Association (DSP-groep 2011) emphasizes five types of value including collection, connection, education, experience and the economy as the social significance for museums. The Museums Association (2013) in the UK highlights the increased impact of museums and propose to adapt museum contributions to contemporary life.

But the influence of new museology is not straightforward. The new museological approach and model doesn't replace the traditional roles and functions of museums and instead, an element of tension persists in the museum's daily routines between the new model and the traditional one in terms of professional and hierarchical differentiation, organizational and managerial limitations, ambiguous policy discourses and effectiveness of implementation, and the practical application of new museology is reliant on the value and status that a museum works hold and how they act at the ground level (McCall & Gray

2014).

In any case, the far-reaching influence of new museology on museums, governments, and political agendas for regional development is largely responsible for inspiring the third revolution of museums.

3.1.3 Designated Manager's System in Japanese public museums: an organizational innovation

Japan has been experiencing a severe economic stagnation since the early part of the 1990s. As a result, the Japanese government has suffered increasing pressure to reduce its large budget deficit. The Hashimoto Government (11 January 1996 – 30 July 1998) introduced a New Public Management (NPM) reform for the public sector with the aims of downsizing government, slashing spending and improving management performance (Yamamoto 2003). The NPM reform affected the museum community by introducing the Designated Manager's System (DMS) to the public museums system at the beginning of the 21st century.

According to Japan's Social Education Act, public museums are the museums founded by local governments at prefecture and municipality level, so on. Public museums used to be directly managed by local governments or by the external organizations of local governments, and private managers couldn't be employed by public museums.

Because local governments had been facing increasing fiscal deficits and local cultural facilitates were regarded as a heavy burden on public finances, it was expected that the introduction of DMS would reduce costs and maximize the utilization of the facilities by overcoming these bureaucratic defects. The DMS allowed private managers to be designated to manage public museums through the partial revision of *the Local Autonomy Law* in 2003. Local governors and councillors had the right to make decisions about whether they adopted DMS or kept the direct management of the local governmental museums and about how to designate private managers if DMS was adopted. The introduction of DMS proceeded at a rapid pace in the first two years after the act came into effect. A relevant survey based on 479 museums showed that the rate of adoption doubled from 11.5% of public museums in 2004 to 28.8% in 2006 (Science

Council of Japan 2007). The Social Education Survey conducted by the Japanese Ministry of Education, Culture, Sports, Sciences and Technology (MEXT) also demonstrated that Japanese public museums experienced consistent growth in both the number and the rate of the adoption of DMS in public museums over the last decade, as showed in figure 4.

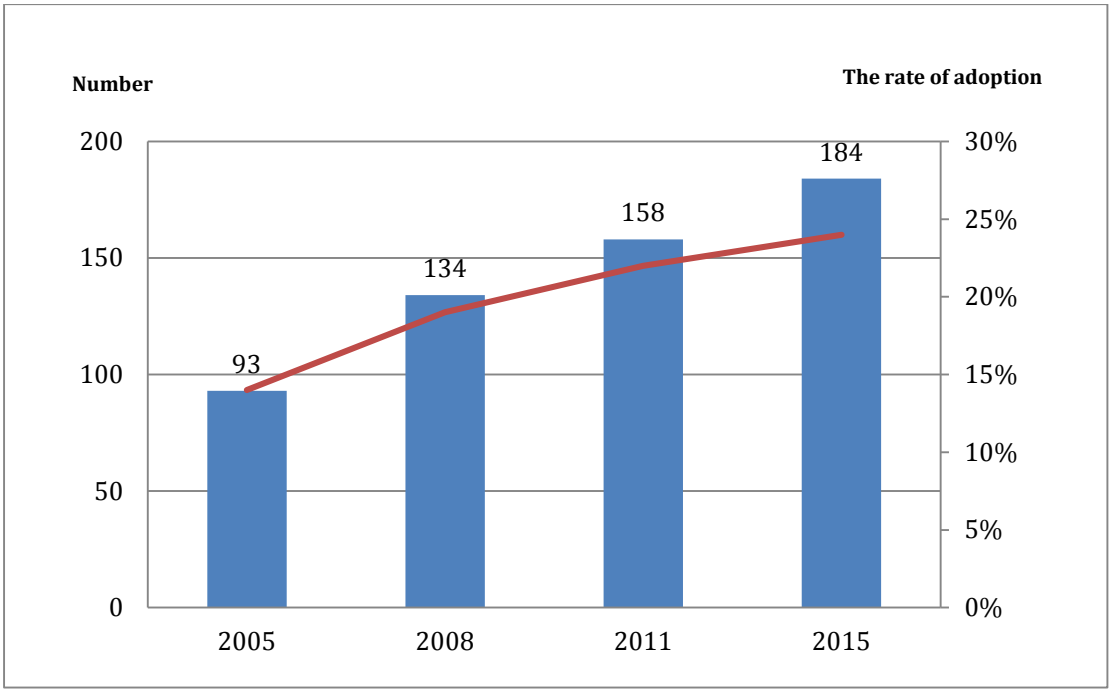


Figure 4 The number and percentage of Japanese public museums adopting DMS

Source: Social Education Survey, MEXT. Japan

The relevant study showed that DMS improved the productivity and efficiency of museums under certain conditions, including (1) the designated managers were selected through an open recruitment process, and (2) the designated managers were deeply engaged in the planning of museums (Taniguchi 2016). As a top-down organizational innovation dominated by local governments, the adoption of DMS strengthened the political legitimacy of museums; on the other hand, however, it also brought museums a lot of uncertainty because of asymetric information and the building of trust between local government and designated manangers, which, in turn, induced some museums to take several makeshift measures to avoid sudden institutional changes (Science Council of Japan 2007).

3.1.4 What do these cases show?

It is commonly accepted that today's museums innovate through the use of computers and Information and Communication Technologies (Costa Barbosa 2013; Bakhshi & Throsby 2010). As a whole, the museum community really has greatly changed the way it works in terms of administrative tasks, in the restoration and conservation of collections, in exhibition technique, as well as in marketing through the adoption of Office Automation System, Collection Information Management System, polymer materials and X-ray detection technologies, Virtual Reality (VR), Augmented Reality (AR) technologies, Instantaneous messaging (IM) and Social media. Therefore, innovation through the adoption of existing techniques and technologies has become an important characteristic of museum innovation.

Moreover, museums innovate through research in the related arts and humanities fields. Research is one of the basic functions of a museum. An important mission of a museum is to expand the artistic and humanistic knowledge by investigating, exhibiting and promoting its collection of objects. This knowledge may embrace a wide range of disciplines, such as art, language, history, anthropology, archeology and museology, and so on, which, in turn, nourishes our cultural existence and inspire creative behavior, as well as innovative goods and services" (Bakhshi et al. 2008). As a result, this kind of innovation leads to significant change in aesthetics or meaning by its institutional context. However, many outputs of arts and humanities research like exhibitions, conferences and even movements are a "specific articulation of the pre-reflective, non-conceptual content of art", which is not formal knowledge but invites "unfinished thinking" (Borgdorff 2011). Therefore, such kind of innovation is mostly "hidden" (Miles & Green 2008), and the significance of innovation can only be observed in the long term. A typical example is innovation in museology – the birth and adoption of new museology – that has greatly changed the social role of museums during the last half century.

Lastly, many innovative activities also are embodied in the changes of organizational structures in museums. Organizational innovation usually happens when the existing organizational structure of a museum cannot be

adapted to changes in external conditions. Large-scale organizational innovation occurring in the Russian state museums during the period of economic transition (Chekova 2004) is a typical example. These innovative activities involved broad adjustments in organizational settings, including the establishment of new departments, project-oriented multi-skilled teams, advisory councils, virtual management, museum franchising, as well as multi-organizational structure in the form of museum societies and foundations, which greatly improved efficiency and decision-making, generated revenues, and diversified museum activities. Moreover, some top-down reforms in the public sector also contribute to organizational innovation in the public museums. For instance, the introduction of Designated Manager's System (DSM) in Japanese public museums can be seen as the consequence of a broad response of the New Public Management (NPM) initiated in the Japanese public sector.

Furthermore, the above cases also contain some important clues that may give rise to further probe into museum innovation. First of all, with regards to the type of innovation, it is clearly that museum innovation can be comprised of technological innovation, and innovation in arts and humanities research, and in organizational change. Most innovation studies that focus on museum organizations in relation to the use of technology neglect the non-technological dimension, such as cultural innovation and production. Considering that museums are cultural heritage institutions, innovation in cultural production should be regarded as important as technological innovation in the museum sector.

Second, regarding to the level of innovation, it is demonstrated that museum innovation occurs at multiple levels; it includes at least individual, organizational, and systematic levels. For example, innovation in new museology theory was firstly initiated by individual thinking of researches, and innovations in technology adoption and in organizational changes were mostly determined by the decision-making of museums at organizational level. But the success of innovation and its diffusion are greatly reliant on the interaction between individuals, museums, professional associations and the government, as well as the interplay of economic, social and institutional factors at the systemic level.

Third, adoption is an important means of innovation in the museum

community. Adoption is not a simple imitation process, but a process of learning, assimilating, and re-innovating according to the particular needs of a museum. The case of computerization has showed that the simple introduction of technology hardware doesn't lead to technological innovation in museums, the development of software related to museological work is a necessary condition for the success of innovation; the divergent recognition and application of new museology in different regions also implies that the content and implications of artistic and humanistic innovation are transformed during the adoption process.

Fourth, organizational factors may influence a museum's capacity for innovation. The cases show that innovations usually take place first in large museums in respect of technological innovation because of their relative advantage in terms of financial strength, techniques and skilled workforce that thet have over small museums. Inter-museum organizations (e.g. ICOM and Museum Computer Network), museum and enterprise partnership (e.g. Google Art Project) and governmental agenda (e.g. EU's Europeana program, China's National Survey of Movable Cultural Relics and Japan's NPM movement) also play vital roles as facilitators in the introduction and disemination of innovation in the museum community, through financial support, collaborative R&D engagement, and by formulating standard, and so on.

3.2 THE DEFINITION OF MUSEUM INNOVATION

There are few words like *innovation* that are so widely used without a broad social consensus about its meaning. The word *innovation* is often mentioned as a synonym of novelty and change in the business model, industrial policy, and even daily conversation around us, but it is also thought of too broad and ambiguous to be defined by people when they are asked what innovation is. This dilemma mostly results from the fact that innovation is an emerging field in social science, in which different disciplines are involved, including economics, engineering, geography, management, history, humanities, sociology, psychology, and science and technology studies, and so on. Each discipline has its particular academic perspective and there is a lack of an integrated paradigm on innovation study, yet

some scholars don't regard themselves as innovation researchers even if their area of work relate to innovation (Fagerberg & Verspagen, 2009).

3.2.1 A brief introduction to innovation

In its simplest terms, innovation briefly refers to a new method, idea or product. As early as Schumpeter, the father of innovation study attempted to define innovation from its characteristic of "newness". In his influential book Business Cycles (1939), Schumpeter wrote that innovation could be defined with reference to both the production function and monetary cost. In terms of the production function, innovation was the development of a new commodity, a new process, a new form of organization, opening up of new markets and new source of supply; In terms of monetary cost, innovation destroyed the old total or marginal cost curve and put a new one in its place where "whenever a given quantity of output costs less to produce than the same or a smaller quantity did cost or would have cost before" (Schumpeter 1939).

However, not all new methods, ideas or products are innovations. First, innovation should be distinguished from invention. Invention is the first occurrence of new methods and ideas while innovation is the first commercialization of them (Dosi & Nelson, 2010; Fagerberg, 2006), so innovation emphasizes the reaching market of invention. Second, innovation is also different from imitation. Innovation is an introduction of a truly novel item whilst imitation is the adoption of an existing item in the market. The novel item can be "new to the organization", "new to the industry", and "new to the world" as well (Castañer & Campos 2002). An innovation at organizational level could also be an imitation at the industry and the world levels. Therefore, Greenhalgh and Rogers (2010) argued that being "new to the organization" was not a sufficient test for innovation but a "diffusion of innovation". However, Stoneman (2010) viewed innovation as a dynamic process and it was no longer one of the elements of three stages, namely, invention, innovation, and diffusion of technological change in Schumpeter's literature, but a term now widely used to encompass all stages of this process and everything involved in it. As a matter of fact, innovation has various practical explanations; "new to the organization" also is treated as innovation to its broad sense while "new to the industry" and "new to the world"

as innovation in the narrative sense. Further, many innovation studies set organizations as the unit for empirical study (OECD & Eurostat 2005).

Truly, innovation has been understood in different contexts. After the revival of innovation study in the second half of the 20th century, more definitions have emerged to express particular interests in the innovation phenomenon by researchers from various perspectives. For example, Kimberly (1981) defined innovation with reference to the type of innovation: "there are three stages of innovation: innovation as a process; innovation as a discrete item including products, programs or services; and innovation as an attribute of organizations." Van de Ven (1986) emphasized the novelty of innovation: "as long as the idea is perceived as new to the people involved, it is an 'innovation' even though it may appear to others to be an 'imitation' of something. Damanpour (1996) stressed innovation as a mechanism for "change", he stated that "innovation is conceived as a means of changing an organization, either as a response to changes in the external environment or as a pre-emptive action to influence the environment". Plessis (2007) saw innovation as the creation and diffusion of knowledge, he noted that "innovation as the creation of new knowledge and ideas to facilitate new business outcomes, aimed at improving internal business processes and structures and to create market driven products and services". Rogers (1998) argued that innovation shouldn't be identified until it had been implemented or commercialized in some way, thus the creation of abstract knowledge, or the invention of new products or processes was only considered innovation if it had been productively incorporated into the enterprise's activities.

It may well be said that these different definitions together offer a new opportunity to present a panoramic picture of innovation. Based on the content analysis on a representative pool of literature about organizational innovation between 1934 and 2008, Baregheh, Rowley and Sambrook (2009) concluded with an integrated definition of innovation: "the multi-stage process whereby organizations transform ideas into new/improved products, service or processes, in order to advance, compete and differentiate themselves successfully in their marketplace". In sum, "novelty" and "successful commercialization" are always emphasized as two necessary conditions of innovation (Dosi & Nelson

2010; Fagerberg 2006).

3.2.2 Defining museum innovation

The word *innovation* is often used together with other attributes to convey some particular conception of innovation under a specified domain. For example, open innovation refers to the innovation that occurs beyond a company's boundaries (Chesbrough 2003a); soft innovation means the innovation based on aesthetic and intellectual activities in the creative industries (Stoneman 2010); social innovation stresses the innovation that combats social problem in the societal structure (Phills et al. 2008); or local innovation emphasizes the innovation that origins from, and delivers its benefits at local and community levels (Moulaert et al. 2005).

Similarly, ***museum innovation*** is used to stand for innovation in the museum sector in various studies. For instance, Camarero et al. (2011) defined museum innovation as "changes in certain service aspects and advances in the technology used (digital catalogues, virtual visits or web publications)"; De-Miguel-molina et al. (2013) viewed it as changes in the aesthetic context, specially in the restoration and conservation of artworks; Costa Barbosa (2013) stressed museum innovation as technological changes in organization, management and visitor experience to meet current requirements of the public. In short, existing studies have quite diverse definitions of museum innovation, but nevertheless contribute to the understanding of innovation from different angles, which reveals that innovation is closely associated with an aesthetic significance, the service sector, and has a public orientation.

On the basis of this discourse, we tend to define museum innovation as the transformation of ideas, theories or approaches into new or improved cultural products, services or processes by museum organizations in order to advance, compete and differentiate themselves successfully in the market and in society.

This definition can be understood through the following elements. First, the subject of innovation is museums, which implies that innovation is an organizational behavior. This doesn't deny the fact that some innovative activities can begin at individual or sectorial level, but emphasizes its adoption and

application at the organizational level. For example, the initiative of new museology, which was initially proposed by a group of museologists, but didn't become innovation until the museum community accepted their idea and put it into practice.

Second, the object of innovation is cultural products, services and processes. Museums are important cultural heritage institutions; the peculiarity of cultural organizations, which distinguish themselves from other types of organizations, is that they exist to produce and provide cultural and emotional goods that develop and nourish a community's culture and sense of identity, as well as to generate emotions in those who are exposed to them (Castañer 2014). The focus on "cultural products and process" highlights the nature of museums as cultural organizations.

Lastly, the targets of innovation are "both (to) market and (to) society". This mostly corresponds to the dual demands placed on museums, which means that a museum has both private demand exerted by visitors and a social role going beyond the consumption of museum visitors themselves and creates social value, which cannot be expressed in monetary terms (Frey & Meier 2006).

3.3.3 Characteristics of museum innovation

As discussed above, the scarce literature offers little valuable information about the characteristics of museum innovation. Here we propose that the domain of museum innovation should be viewed as the intersection of innovation study and museum study, which is illustrated in figure 5. As a widespread phenomenon, innovation in the museum sector is characterized by both the unspecificity of innovative activities in common and the particularity of a museum itself as a heritage institution. The unspecificity determines the nature of museum innovation as the creation, application and diffusion of new technologies and knowledge in the museum sector, whilst the particularity embodies and reflects the unique connection between innovation and cultural organizations, cultural and creative industries, and non-profit organizations (NPOs), which in turn shape and consolidate the source, type, process and diffusion of museum innovation.

From the perspective of the relationship between cultural organizations

and innovation, the external adoption of the generated innovation is regarded a major source of innovation in cultural organization (Castañer & Campos 2002). There are two types of external innovation that cultural organizations can adopt. The first is artistic and cultural innovation, most of which doesn't take place inside formal organizations and, instead, are led by individuals who usually keep cultural organizations at arm's length (Castañer 2014). Examples are plays for theaters, novels for publishing, music for recording companies, and artworks for museums, and so on. The other is managerial and technological innovation (Castañer 2014). Cultural organizations have neither internal R&D nor manufacturing teams, and they innovate through "organizational adoption of external innovation" (Damanpour 1991; Castañer & Campos 2002).

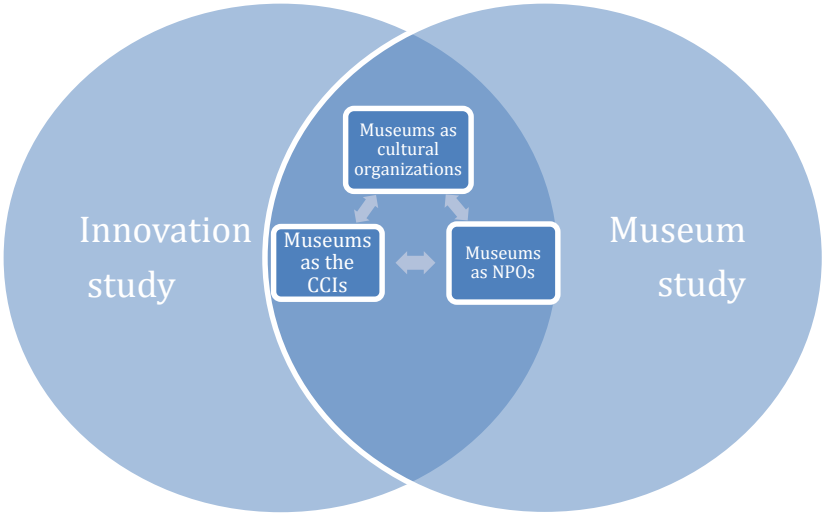


Figure 5 Museum innovation as interaction of innovation and museum

From the perspective of the relationship between the cultural and creative industries and innovation, non-technological innovations are emphasized to capture the peculiarity of "creativity" in the cultural and creative industries. The distinction between the cultural and creative industries from the rest is creativity, and the generation or communication of symbolic meaning involved in mass production (Galloway & Dunlop 2007). On the one hand, symbolic products enjoy both economic value and additional cultural value, which can be

deconstructed into a series of components, including aesthetic, symbolic, spiritual, historical, social and educational value (Throsby, 2001); on the other hand, the "first use" of symbolic goods and services is the communication of ideas rather than a functional value (Bilton & Leary 2002). Therefore, innovation in cultural and creative industries displays special features as opposed to the technological and functional dimensions. These features can been summarized as (1) "content creativity" (Handke 2004) – the special case of innovation in the creative industries, wherein creativity and other modes of innovation may feed into each other; (2) "hidden innovation" (Miles & Green 2008) - the innovation that isn't registered by traditional innovation indicators and is reflected, mostly, in external product design, organizational forms or business models, novel combinations of existing technologies and processes, and innovative problem-solving; and (3) "soft innovation" (Stoneman 2010) – the innovation in goods and services that primarily impact upon the aesthetic or intellectual appeal rather than how it performs at a functional level.

From the perspective of the relationship between NPOs and innovation, the "not-for-profit" characteristic has important implications for decision-making in innovation. NPOs, also known as the "third sector", are found between market and government (Zimmermann & Mmermann 1999; Gui 1991), whose emergence is considered to fill the gap between market failures and a shortfall in the supply of public goods by the government such as social service, health, culture and the arts. The nature of NPOs determines that they are not profit-maximizing institutions and, instead, they have a multiplicity of objectives, outside the joint maximization of output and quality of output, subject to a break-even budget constrain (Throsby & Withers 1979), a continuum between audience maximization and quality maximization (Hansmann 1981), to a spectrum ranging from service maximization to budget maximization (Steinberg 1986). Because the organizational objective is closely linked to innovation behavior in NPOs (McDonald 2007), the characteristic of "not-for-profit" challenges the traditional discourse about innovation as a means to improve economic performance (Rogers 1983, 2003; Abrahamson 1991). Institutional researchers assert that innovation decision-making is determined by socially constructed institutions, outside the rational calculation of a firm's profitability

(Meyer and Rowan 1977). In detail, these social institutions include "legitimacy" (Meyer and Rowan 1977; DiMaggio & Powell 1991; Suchman 1995; Scott 2014), "worthiness" (Hatimi 2003), or the Scott-called institutions defined by regulative, normative and cultural-cognitive dimensions (Scott 2001).

From the integrated perspective discussed above, we can summarize several characteristics of museum innovation as follows:

- As cultural organizations, museums adopt externally generated innovation as an important source of innovation. In the artistic domain, museums may innovate in extending the artform by exhibiting new artworks created by artists outside of the museum rather than by the museums themselves, or by hosting a new temporary exhibition produced by other museums. In the technological domain, museums in the digital era are active in developing conservation and display techniques, new ways of managing visitors and organizing displays, and in information and communication by the use of new ICTs. In the organizational domain, museums innovate through adopting similar managerial methods by drawing lessons from the New Public Management reform in other public sectors, such as government.
- As creative institutions, museums innovate in the "content creativity" and "soft" dimensions in a "hidden" manner. Many product and process innovations by museums are based on the production of content and creativity, such as new theoretical viewpoints in art history and museology, new storytelling in exhibition and education programs, new scientific findings and popular discourse in publications and communications, and so on. It is obvious that these innovative activities are aesthetic-oriented rather than function-oriented, and thus they belong to soft innovation in a certain sense. In addition, most of them refer to the problem-solving innovation embedded in the production process, and therefore, it can also be viewed as hidden innovation.
- As not-for-profit organizations, museums innovate in pursuit more of social value than economic value. A museum has at least four levels of objectives including executing basic functions, achieving social goals, consolidating organizational legitimacy, and increasing management

efficiency (Asuaga & Rausell Köster 2006). These multiple objectives determine the factors that guide decision-making in innovation, which are largely reliant on social institutions, such as strengthening legitimacy, pursuing organizational notoriety, enriching the cultural supply etc. than on profitability (it may also matter considering the budgetary pressures that museums face and the increasing percentage of total funding that needs to be generated as revenue).

3.3 THE TAXONOMY OF MUSEUM INNOVATION

Innovation varies based on sector (Schumpeter 1943; Hauknes 1998; Zimmermann & Mmermann 1999; Martin & Moodysson 2011), content (Galenson 2008; Stoneman 2010; Castañer 2014), and measurableness (Miles & Green 2008); therefore, Castañer (2014) suggests that, first, it is necessary to make a precise taxonomy for a better understanding of museum innovation.

3.3.1 Theoretical and empirical bases for classification

There are two types of classification that are mainly utilized in current innovation studies concerning museums. In terms of value chain of innovation, some studies classify museum innovation as product, process and organizational innovation (Camarero et al. 2011; Costa Barbosa 2013; De-Miguel-molina et al. 2013; De-Miguel-Molina, Hervás-Oliver, et al. 2014). This taxonomy can date back to the Oslo Manual (OECD & Eurostat 1996, 2005), which aimed to define, classify and measure innovation by collecting and interpreting innovation data. According to the Oslo Manual (OECD & Eurostat 2005), four types of innovation can be differentiated:

- Product innovation, which is the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses, including technical specifications, components and materials, incorporated software, user friendliness or other functional characteristic;
- Process innovation, which is the implementation of a new or significantly

improved production or delivery method, including changes in techniques, equipment and/or software;

- Organizational innovation, which refers to the implementation of a new organizational method in the business practices, workplace organization or external relations;
- Marketing innovation refers to the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing.

This type of taxonomy has obvious drawbacks for classifying and measuring museum innovation. First, the Oslo Manual was aimed at business enterprises alone, and it is dubious that it can be applied effectively to non-profit cultural organizations like museums; second, a major concern is given by the Oslo Manual to "technological product and process (TPP) innovation", which completely neglects the symbolic, aesthetic and/or emotional significance involved in the value chain of cultural goods (Throsby 2001), not to mention the measurement of "first use" of cultural goods and services, besides their functional value (Bilton & Leary 2002); last, the precision of the measurement is also in doubt because this taxonomy cannot capture the fundamental feature of innovation in cultural and creative organizations.

In addition to this, the amount of contradicting arguments summarized by innovation studies relating to museums on the basis of product innovation (Kloosterman 2008), process innovation (Hull & Lio 2006), and organizational and marketing innovation (De-Miguel-Molina, Hervás-Oliver, et al. 2014) demonstrate that such taxonomy of innovation may lead to conflicting and confusing conclusions concerning museum innovation. Truly, Lewandowski (2015) tends to compensate for this deficiency by introducing three additional types, namely functional, cultural, and perception innovations, on the basis of the Oslo Manual taxonomy, but without providing empirical verification.

In terms of the object of innovation, museum innovation is also classified into different categories by listing diverse domains in which innovative activities are embedded. Noble's (1989) probe into innovation in the United States of America's museums by classifying museum innovation into eight broad categories, can be summarized as innovations in the following areas:

- Administration;
- Collections management;
- Exhibits/Security;
- Education or interpretation;
- Fund-raising and revenue generation;
- Public relations/marketing;
- Trustee and volunteer recruitment, training and relations;
- Facilities maintenance/management.

Similarly, Bakhshi and Throsby (2010) typified innovation in arts and cultural organizations (museum and theater in particular) along four domains: (1) innovation in audience reach, (2) innovation in artform development, (3) innovation in value creation, and (4) business model innovation. Furthermore, technology is an exogenous variable that overcomes the traditional constraints imposed by physical location so as to expand audience reach, to develop the artform, to create new economic and cultural value, and to spur new business models.

Such taxonomy relying on the domain listing also has its limitations. First, the taxonomy is incomplete. It is hard to give a complete list of innovation in the museum sector. For example, innovation also exists in the domains of "enhancing visitor experience" (Camarero et al. 2011; Costa Barbosa 2013; Ioannidis et al. 2014) and "archiving and preservation" (Kokalj et al. 2013; Ioannidis et al. 2014; De-Miguel-Molina et al. 2014) as well. Second, innovation per se is a dynamic concept (Baregheh et al. 2009), so any classification method should take this dynamic factor into consideration. This taxonomy is just a reflection of what museums innovated in the past rather than what museums can innovate in the future and thus, the list needs to be enlarged from time to time to reflect the state of the art. Last, such taxonomy is too inaccurate, to some extent, to be applied in all types of museum. For example, not all museums have innovation in artform development; many ancient and classic art museums like the Louvre and el Prado seldom collect or exhibit artworks of living artists, which means that they are more likely to take innovation in "artmemory" rather than "artform".

We propose a new taxonomy of museum innovation in accordance with

the knowledge base on which innovative activities rely. This method is based on learning theory of innovation and a knowledge-based approach. Learning theory argues that innovation is a learning process (Lichtenthaler 2013). Learning is the acquisition of knowledge or skills, and it encompasses two meanings: (1) the acquisition of "know-why", which implies the ability to articulate a conceptual understanding of an experience; and (2) the acquisition of "know-how", which implies the physical ability to produce some actions (Kim 1993). Many scholars point out that R&D and product innovation processes themselves are, essentially, incremental learning processes because they have a primary role in generating new knowledge and distributing the knowledge throughout the organization, where the development and accumulation of knowledge is synonym of learning (Carlsson et al. 1976; Nelson & Winter 1982; Harkema 2003; Gieskes & van der Heijden 2004). Successful innovation requires efficient knowledge management, wherein knowledge is acquired, absorbed, assimilated, shared and used with the aim of creating new knowledge, which stresses the importance of the "cognitive aspect of people" rather than only procedural aspects (Harkema 2003). This is, somehow, consistent with economic thinking. Economists also regard learning as an internal and microscopic mechanism of production. As a result, knowledge constitutes a critical input and a primary source of value underlying the production function at any moment (Arrow 1962) and thus, they lay emphasis on the knowledge dimension of innovation and production.

A knowledge-based approach classifies knowledge into three bases – analytical, synthetic, and symbolic knowledge – in terms of the diversity of professional and occupational groups and competencies that are involved in different modes and phases of the innovation process in the cultural and creative industries (Asheim et al. 2007; Asheim & Hansen 2009). Analytical knowledge refers to the development of new knowledge about the natural system, and is scientific; synthetic knowledge refers to the application or combination of existing knowledge in new ways, and is problem-solving; symbolic knowledge refers to creation of meaning, desire, aesthetic, qualities, affect, intangibles, and symbols. Take for example restoration and conservation: analytical knowledge includes chemistry, physics and biology etc.; synthetic knowledge includes engineering etc.; and symbolic knowledge includes fine arts, art history, history

and photography etc. (De-Miguel-molina et al. 2013). Synthetic and analytical knowledge relate to the scientific and technological component of innovation whilst symbolic knowledge relates to creative process.

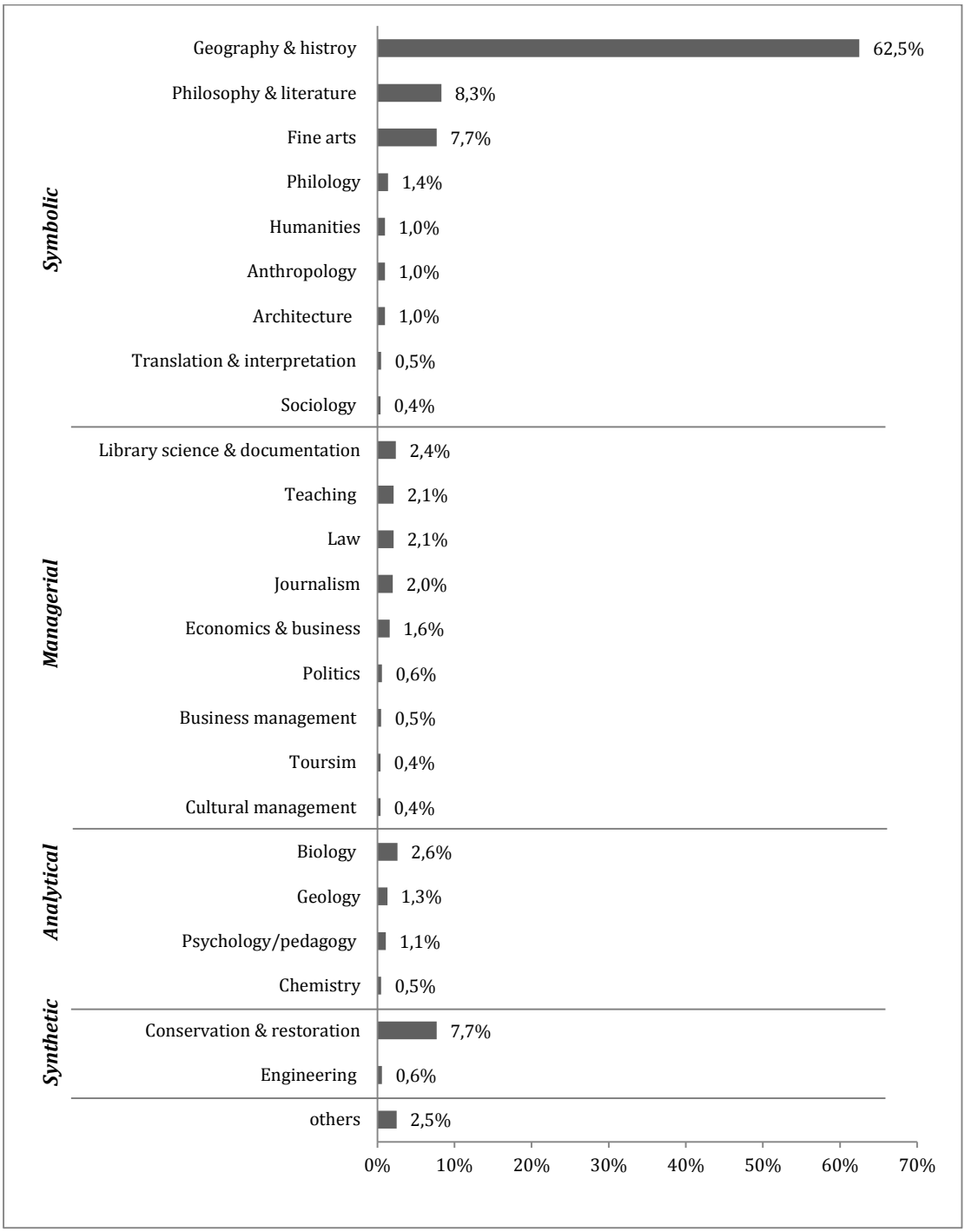


Figure 6 Knowledge bases of Spanish museums

Source: Spanish Ministry of Education, Culture and Sports (https://sede.educacion.gob.es/publiventa/los-profesionales-de-los-museos-un-estudio-sobre-el-sector-en-espana/museos/14316C)

Note that any innovation is based on specific routines, procedures, mechanisms and structures of an organization. The knowledge-based view of the firm (Grant 1996) considers organizations as knowledge-integrating institutions, which integrate the specialized knowledge possessed by a number of individual professionals. This means that synthetic, analytical and symbolic knowledge contribute to innovation only when they can be integrated efficiently by the necessary collaboration mechanism under certain organizational structure, wherein coordination can be best achieved through the direct involvement of specialist coordinators who have specific knowledge (Grant 1996), like curators and exhibition managers in the museum community. Yet, this kind of knowledge is not characterized by synthetic, analytical or symbolic bases and instead, it specializes in the organizational management; and hence, can be regarded as the *managerial knowledge base*.

As a matter of fact, these four types of knowledge bases exist pervasively in the museum sector. Figure 6 depicts percentages of analytical, synthetic, symbolic and managerial knowledge bases in Spanish museums in terms of the qualifications of the professionals employed. It shows that a majority of knowledge stock in museums is symbolic knowledge (76.1%), followed by managerial (12.1%), synthetic (8.3%), and analytical (5.5%) knowledge. This distribution of knowledge bases is mostly consistent with the nature of museums as cultural productive organizations (Johnson & Thomas 1998).

Empirically, relevant studies have demonstrated that different types of knowledge exert a different impact on innovation. For example, De-Miguel-molina et al. (2013) revealed that technological processes and product innovation in artwork restoration are positively correlated with the number of specialists in restoration technologies in the museum. DiMaggio & Stenberg (1985) found that the educational background of decision-makers in the art organizations played a decisive role in the mode of innovation: directors who only had managerial knowledge would exhibit higher conformity levels, whilst those who had an artistic background were more likely to be engaged in artistic innovation (Castañer & Campos 2002). These results offered us empirical evidence about the existence of a close connection between knowledge bases and the type of innovation seen in museums.

3.3.2 Three types of museum innovation

On the basis of knowledge bases discussed above, we tend to classify museum innovation into three types: cultural innovation, technological innovation, and organizational innovation, and each type of innovation further involves more dimensions, as illustrated in figure 7.

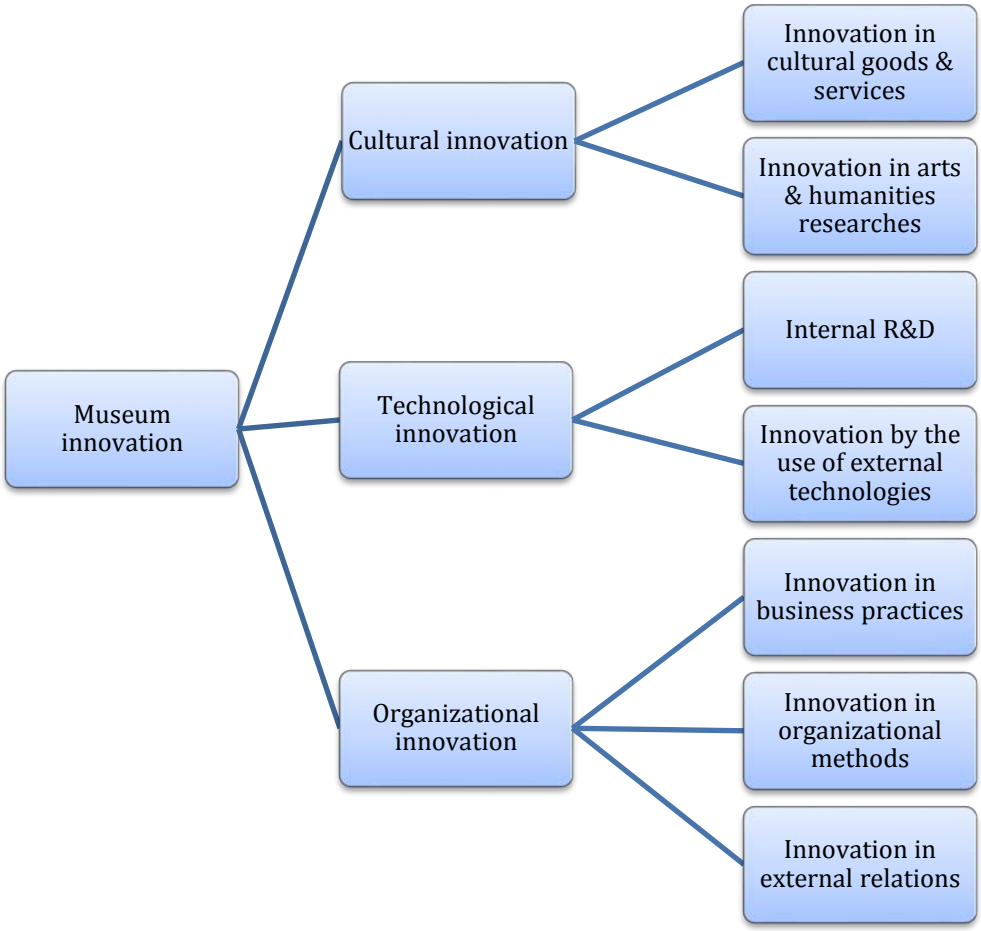


Figure 7 The taxonomy of museum innovation

Cultural innovation

Cultural innovation is the innovation that relies on the symbolic knowledge base and leads to significant changes in the aesthetic and symbolic aspects of cultural production and outputs in museum.

Cultural innovation in museums is comprised of two dimensions. The first dimension is innovation in cultural goods and services. Museums are culture

producing organizations (Johnson & Thomas 1998), which produce broad categories of cultural goods and services, including exhibitions (permanent and temporary exhibitions, on-going and out-going exhibitions etc.), research (scientific and popular articles etc.), publications (catalogues, magazines, journals, manuals, brochures etc.), education activities (educational programs, courses, conferences, workshops, concerts etc.), digital-born resources (texts, images, audios, videos etc.) and visitor services (guided visit, catering services, museum shops etc.).

Cultural goods and services are characterized by "creativity" and "the generation of symbolic meaning" (Bilton & Leary 2002), which distinguishes them from ordinary commodities and physical manufacture by the additional cultural values embedded in cultural products.

Cultural value can be deconstructed into a series of components, including aesthetic, symbolic, spiritual, historical, social and educational value (Throsby 2001). This is consistent with the knowledge-base view, which argues that cultural production is a creative process and cultural products are reliant on symbolic (art) base (Asheim & Hansen 2009).

The "first use" value of cultural products, which is different from other commodities (Galloway and Dunlop 2006), implies that the novelty of cultural goods and services should not be measured by functional changes but by changes in symbolic and aesthetic elements. Such changes have been explained in many empirical studies by the introduction of "stylistic", "aesthetic", "formal", "content" and "soft" innovations (Cappetta et al. 2006; Alcaide-Marzal & Tortajada-Esparza 2007; Handke 2004; Bianchi & Bortolotti 1996; Stoneman 2010). Yet, the symbolic and aesthetic elements are embedded in the content and form of cultural products. Thus, innovation in cultural goods and services can be further observed through, at least, two dimensions: innovation in content and in form. According to Castañer's (2014) defintion, content innovation is the new combination of different existing components (or genres) that have not been previously combined, or that deviated from existing genres; while form innovation is the new way of presenting the contents. Some examples are given below:

- Innovation in the content of cultural product
  - The curating and inauguration of a new exhibition with different

collection objects;

- The development of educational programs with new knowledge that has not been discussed before;
- The publication of new collection catalogues or updated volume of journals with new images and articles;
- The adoption of a new visual identity by a museum;
- The creation and uploading of digital-born texts, images, shape and color in the website.

- Innovation in the form of cultural products
  - The development and adoption of a new storytelling approach for an exhibition;
  - The launch of a new visiting routine for existing exhibitions.
  - The new artistic design of museum souvenirs based on, or inspired by collection elements.

The second dimension is innovation in arts and humanities research. According to ICOM's definition, research is a basic function of museums. Many museums employ fulltime conservators, researchers and curators to undertake scientific, arts and humanities research on collection objects in museums, among whom the vast majority are arts and humanities researchers with symbolic knowledge bases, spanning various disciplines from history and literature to fine arts, photography, anthropology and architecture, as shown in Figure 6.

Much of arts and humanities research is often characterized as an individualistic process, but collaborative projects inside and outside museums are getting more and more common (Bakhshi et al. 2008). Furthermore, symbolic knowledge emerges from the interpretation of cultural content, form, phenomenon and value to enrich creativity and innovativeness, so the fruit of arts and humanities research neither entirely depends on large-scale accumulation of knowledge, as are required in the scientific research nor necessarily supersedes existing knowledge in arts and humanities (Bakhshi et al. 2008). This implies that the cost of arts research in museums is not as high as the cost of R&D in for-profit private enterprises and, hence, innovation in arts and humanities researches is present in most museums.

In large museums, the research responsibility is divided by categories of museum collection and by researchers specialized in different subjects. For example, the British Museum has ten curatorial and research departments in accordance with geographic distribution and types of its collection[1]; in small museums, the research responsibility is often undertaken through simple division of labor among a limited member of museum staff, which means that research tasks are fulfilled by individuals and research activities usually are exhibition-oriented. On the other hand, museums also collaborate with external scholars and researchers from other museums, universities and research institutions, or even independent curators in developing arts and humanities research projects, especially in small museums that are not equipped with full time researchers.

Innovation in arts and humanities research concludes in research findings, which can be either scientific or popular articles available to the general public in publications like scientific journals, magazines, books, newspapers and museum websites; or can become internal reference as "intermediate product" facilitating other cultural production.

Technological innovation

Technological innovation is innovation that depends on analytical and synthetic knowledge bases and contributes to functional changes involved with cultural production in museums.

Although museums are, typically, not technology-intensive organizations according to the distribution of knowledge stock in the museum sector shown in figure 6 – only 14% of the professionals have a technology-related educational background with the specific focus on "conservation and restoration" (7.7%) and biology (2.6%) disciplines, the essential analytical and synthetic knowledge bases still determine technology-related activities that a museum is able to perform by defining its internal R&D capability and absorptive capacity for

[1] Ten curatorial and research departments of the British Museum are (1) Africa, Oceania and the Americas; (2) Ancient Egypt and Sudan; (3) Asia; (4) Britain, Europe and Prehistory; (5) Coins and Medals; (6) Conservation and Scientific research; (7) Greece and Rome; (8) Middle East; (9) Portable Antiquities and Treasure; and (10) Prints and Drawing.

external technological innovation (De-Miguel-molina et al. 2013).

For this reason, technological innovation in museums can be further classified into two dimensions: innovation based on internal R&D and innovation by the use of external technological inputs. With regard to a museum's internal R&D, a major proportion of "conservation and restoration" devoted to technological knowledge bases implies that the conservation and restoration department is a major R&D section in the museum. According to De-Miguel-molina et al. (2013), internal R&D activities may span the following fields:

- Methods and instruments used to examine and analyze art objects;
- Products and reagents used to examine and analyze art objects;
- Techniques or procedures used in restoration;
- Tools or instruments used in restoration;
- Consumables (glazes, solvents, biocides, etc.) used in restoration;
- Displaying artworks in exhibition halls (in terms of the microclimate, light, mounting or substrate, etc.);
- Storing artworks in climate-controlled storage facilities;
- Transporting artworks.

Additionally, a museum's internal R&D may be also responsible for the development of software aiming at fulfilling particular needs and functions in the museum's operations in order to facilitate the adoption and integration of external technologies, techniques and equipment. For example, the software of a museum's information management system developed by some leading museums, like the Smithsonian Institution and Arizona State Museum, played a decisive role in the computerization of American museums, as shown in the section 3.1.1.

In reality, not all museums can afford internal R&D activities because of the lack of necessary financial, knowledge and human resources. In most cases, leading museums at national and regional levels mostly engage in internal R&D as a formal function inside the organizations, wherein the output of R&D not only benefits cultural production per se, but also exerts spillover effects in surrounding museums. Sometimes, the R&D function isn't homed in the museum directly and, instead, is performed through independent and publicly funded

professional institutions specialized in heritage restoration and conservation, which are at the service of the museums located in the same administrative regions. Examples include the Instituto Andaluz del Patrimonio Histórico (IAPH) established by the Andalucía regional government (Junta de Andalucía) (Castro-martínez & Fernández-baca Casares 2012) and the Instituto Valenciano de Conservación y Restauración established by the Valencia regional government (Generalitat Valenciana) (Li et al. 2016) in Spain.

In comparison with internal R&D, the use of external technologies is the most common means and forms of technological innovation in the museum sector. Museums are typical "technology users" (Evangelista 2000) or belong to the "supplier dominated sector" (Pavitt 1984). The open innovation view argues that it is cheaper and better to "buy" R&D outcomes than to develop them internally because of the enormous cost of internal R&D (Chesbrough 2003b). Museums tend to adopt existing technologies through market mechanisms if the relevant technology is available in the market and if the purchase cost is less than the cost of developing it internally. This explains why internal R&D isn't pervasive in the museum community and why most of the R&D activities in museums concentrate in the highly specialized fields of heritage restoration and conservation that usually is unavailable in the market whilst the technologies that museums adopt are commercially available, such as the ICTs.

Image 1 The Collection Wall as digital device integrating digital objects and digital networks for enhancing digital experience

Source: The Cleveland Museum of Art (http://www.clevelandart.org/gallery-one/collection-wall)

ICTs are the key technologies in the latest decades. Many empirical studies have shown that the use of ICT brings museums into an inexhaustible realm of

possibility in terms of technological innovations for heritage conservation, communications and visitor experience enhancement (Karp 2004; Pujol-Tost 2011; Kéfi & Pallud 2011; Costa Barbosa 2013). Table 3 summarizes the categories, alternatives, descriptions and examples of popular ICTs utilized in the museum sector. As seen, we tend to define "the use of ICTs" by identifying four categories in terms of the object of innovation.

- **Digital object**. It focuses on the digitization of a certain object, i.e. digital surrogate (Parry 2007). Digital imaging is a typical "digital surrogate" by digitally capturing artifacts (Dean 2003), and is a widely adopted alternative for museums to archive their collection. Many museum professionals, however, consider that digital objects cannot replace original objects for preservation because a digital copy can hardly bear the artistic, historical or scientific value of actual physical heritage (Häyrinen, 2012).
- **Digital network**. It emphasizes platform construction for connecting stakeholders including museum staff, visitors, and communities etc., and distributing and sharing information among these stakeholders by means of the ICTs. The intranet is a typical internal network, aiming at maintaining an open communication flow, easier sharing of information and knowledge, coordination of operations among departments within a museum (Anderson 1999). Digital/virtual museum, social media, Apps are popular external digital networks at the service of visitors for information sharing, museum marketing and educational objectives (Russo et al. 2007).
- **Digital experience**. It refers to the augmentation of visitor experience via the right digital solutions for that experience. These solutions include tridimensional imagery, holography, virtual reality and augmented reality, and so on. For example, the interactive digital storytelling[1] first tested at the Acropolis Museum in Athens (Greece) not only showed what visitors

[1] One of the most successful real world uses of interactive digital storytelling is augmented reality (AR). One of the successful applied projects is the EU-funded Chess project that takes digital storytelling much further and plans to make interactive content such as games and augmented reality available to the entire museum sector. The website of the Chess project is http://www.chessexperience.eu.

chose but also sent visitors additional relevant information based on what they had shown an interest in (Ioannidis, Balet, et al. 2014).

- **Digital device.** It works as both on-site and portable carriers of programmed digital information and contents. Traditional devices are information stations, kiosks and docks, and Personal digital assistants (PDAs) and audio guides. Personal mobile devicess such as smartphones and tablet computers are rapidly becoming the preferred option for the public when wandering in a museum, accompanied by the use of QR codes that give from basic information and direct links to Apps and web pages by scanning a bi-dimensional barcode detected by some digital mobile appliances.

Nowadays, the digital devices with the integration of digital objects and digital networks are becoming an emerging tend for innovative museums to offer visitors an enhanced digital experience. The Collection Wall in the Cleveland Museum of Art is the best example that not only facilitates discovery and dialogue with visitors as an orientation experience but also allows visitors to download existing tours or creates their own to take out into the galleries on their smartphone or tablet as an interactive app.

Image 2 A touch screen player is utilized for audio guide in the Museum
Source: Museum of Fine Arts, Boston (http://www.mfa.org/exhibitions/goya**)**

Table 3 Category, alternatives, description and examples of innovative digital heritage solutions for museums

Category	Alternative	Description	Example
Digital object	Media art	Media as an essential part of the creative or presentation process. Connections are emphasized between changes in technology and the artistic practices using those technologies.	Film, video, digital arts and new media arts.
	Digital imaging	The digital capture of the artifact.	High-resolution images of paintings, or 3-D scanned model of a vase.
	Webpage	Web document for the World Wide Web and the web browser to inform visitors about practical information surrounding the museum and its exhibitions.	Conference information in the Prado Museum on the webpage. (https://www.museodelprado.es/actualidad/actividad/georges-de-la-tour/d17fb102-ae70-4d48-a903-275a2c88cbc2)
Digital network	Intranet	An internal network system for maintaining an open communication flow, easier sharing of information and knowledge, coordination of operations among departments within a museum	Intranet system of the Guggenheim Museum (https://intranet.guggenheim.org)
	Digital/virtue museum	An information network service system that is constructed for collecting, preserving, managing and utilizing information resources of human cultural/natural heritage, including digital footprint of a physical museum and born digital.	Website of the Prado Museum (https://www.museodelprado.es) Europeana as a born digital museum (http://www.europeana.eu)
	Social media networks	Platforms that combine with many of the technologies treated previously with the intention of promoting full communication with the public and the environment, as well as to reach and create new groups of users and even new market possibilities	Facebook, Twitter, LinkedIn, Tumblr, Wechat, Weibo, and blogs.
	Apps	An software program designed to perform a specific function directly in the smartphones and tablets for the user, it serves as pocket-size docents, guiding visitors through exhibits and crowded halls, offering audio tours, expanded information about particular works and helpful maps.	The application of the Prado can be downloaded at App Store: https://itunes.apple.com/es/app/museo-nacional-del-prado./id623358752?mt=8

Digital technology	Tridimensional (3-D)	Geometric models created based on the real context where it can reproduce width, length, and depth of the chosen object in order to conserve or allow manipulation while protecting the real object. It is used both to create a model based on a physical object, and to visualize dimensional levels in graphics and images.	3-D models of collections in the National Palace Museum in Taipei. (http://tech2.npm.edu.tw/da/3d/en/intro.htm)
	Holography	2D projection of light in space, which the human eye can see and understand as 3D projections without the use of special apparatus like 3D glasses.	Holographic Studios gallery in New York city. (http://www.holographer.com)
	Virtual reality (VR)	It collects real world information to compose synthetic tridimensional contexts in which the public can better understand and experience what sometimes can be hard to interpret merely with conventional methods.	Science Museum in London preserves Shipping Gallery by virtual reality. (https://www.youtube.com/watch?v=gDTbFhFZl9I)
	Augmented reality (AR)	The combination of virtual reality (synthetic) and original (real) imagery and elements put together to complement each other for a full experience.	Exhibition “Ana Juan, Dibujando al otro lado” (http://unitexperimental.com/web_unit/AnaJuan.html)
Digital device	Information stations, kiosks, and docks	Information appliances that often are installed in the reception hall of museums to offer simple programmed information and interaction with audience by joysticks, keyboard, and touch screens etc.	Image 1 & 2
	PDAs, tablet, audio guides	These devices work as interlocutors for visitors in search of extra knowledge on the way and inspire interplay and stimulation.	Image 3
	Digital mobile appliances	Digital mobile appliances that allow the public to acquire complementary information and create a customized navigation through the museum, according to their interests.	Smart phone, tablet, laptop etc.
	Quick Response code	QR codes give from basic information to direct links to applications and webpages through scanning bi-dimensional barcode detection of an image by digital mobile appliances.	

Organizational innovation

Organizational innovation is innovation that is reliant on managerial knowledge base and is expressed as organizational changes that improve organizational and business management performance. Organizational change is a broad concept, which is always linked to organizational structure (routines and procedures), administrative practices, strategic planning, human resources, internal communications, external relationships, and business models (Damanpour 1996; Miles & Green 2008; Peacock 2008; OECD & Eurostat 2005).

Museums are well stocked with managerial knowledge, second only to symbolic knowledge; a museum's managerial knowledge base spans from library management, teaching, law to business management, cultural management and tourism as well (see figure 6), which constitutes the prerequisite for the success of organizational innovations.

Following the Oslo Manual (OECD & Eurostat 2005), we can identify organizational innovation as the implementation of new models and methodologies in museum's business practices, workplace organization and external relations. Thus, it distinguishes organizational innovation from ordinary organizational changes through an emphasis on the introduction of new models and methodologies that had not been adopted by museum managers before. Yet, the objective of organizational innovation is to improve museum performance by reducing administrative costs, increasing productivity, facilitating internal collaboration (learning by doing) and external cooperation (learning by using and by interacting).

Organizational innovation in business practices refers to the implementation of new methods for organizing routines, procedures and tactics in administrative and marketing tasks [1]. Innovative activities in administrative tasks include, for instance, the implementation of new methods to strengthen the

[1] Marketing innovation was included in the organizational innovation in the second edition of Oslo Manual (1996), and is identified as a separate innovation type in the third edition of Oslo Manual (2005). Considering that most museums are publicly financed and have traditionally been less exposed to market principles in comparison to firms (Kawashima 1998), so it is suitable to consider marketing innovation within the organizational domain.

capability building of museum staff (e.g. training programs) and to improve interactive mechanisms for learning and sharing knowledge and experience (e.g. project-based teamwork). Examples of innovative activities in marketing tasks are the introduction of new methods for expending the audience base (e.g. audience-based services) (Bakhshi & Throsby 2010), as well as for increasing operational revenues (e.g. charging for entrance, itinerant exhibitions, lending activities etc.) (Frey & Steiner 2016).

Innovation in workplace organization refers to the implementation of new methods for re-designing division of labor among workers as well as for re-constructing the structure of organizations and their governance. An example of re-designing division of labor is the introduction of the "visitor-oriented approach" (Kéfi & Pallud 2011) that encourages managers to become involved in the process of decision-making for programming exhibitions, which is traditionally dominated by curators (Camarero et al. 2011). Another example of re-construction of organization and governance structure is the introduction of the Designated Manager's System (DMS) in Japanese public museums described in chapter 3.

Organizational innovation in external relations means new approaches implemented to develop organizational ties with other firms or public institutions. Examples include the establishment of museum-private enterprises partnerships (e.g. Google Art Project), museum-university collaborations (e.g. museum internship for collaborative universities), association for the interaction between museum and visitors (e.g. museum's friends club), franchised museums (e.g. Guggenheim museums in New York, Venice, Bilbao and Abu Dhabi), and cooperation for inter-museum's ticket-sales revenues (e.g. city tourism card).

3.3.3 Relationship between three types of museum innovation

There are both differences and connections between cultural, technological and organizational innovations in the museum context. Detailed discussions are given as follows.

Differences between cultural, technological and organizational innovation

In some cases, technological innovation is easily confused with cultural and organizational innovation because the use of technology is pervasive in the productive and managerial processes of museums, which is liable to blur around the boundaries between the technological, cultural and organizational domains.

In regards to the differentiation between technological and cultural innovation, the former concentrates on the change in the means and form by which cultural content is organized and presented while the latter refers to the emergence of cultural content, by which new meaning and symbol are expressed and communicated. In the museum context, digital heritage may be the most confusing item, which deserves to be clarified. Any digital heritage is composed of a digital form and heritage content. The digital form can be varied and includes any media of digital technology, such as texts, databases, still and moving images, audio, graphics, software and web pages; heritage content embraces words, shape, color, design, symbol, meaning and other qualities that are intrinsic to the original object and contain certain historical, artistic or scientific value. Therefore, cultural innovation is to a large extent linked to the change in the heritage content whilst technological innovation is mostly associated with the change in the digital format.

More precisely, digital heritage is classified into two types: born digital and digital surrogate (Häyrinen 2012). “Born digital” is the type where “there is no other format but the digital object” (UNESCO 2003), which means that it is created directly by digital means without the need for an original analogue resource. Born digital objects place more emphasis on the symbolic meaning; they are created mostly for the communication of ideas, just like other cultural products, and hence, the creation of born digital should be identified as cultural innovation. Examples are World Wide Web resources in the museum website, digital content existing exclusively in the virtual world that do not have a physical copy existence in the material world.

On the contrary, a “digital surrogate” converts an existing analogue resources into digital form(Parry 2007), which refers to a digital copy of an original resource. A “digital surrogate”, which lacks the change in aesthetic and

symbolic dimensions, is often created for the purpose of heritage conservation with the emphasis on copy, share and reuse functions (Parry 2007). Therefore, the introduction of digital surrogates should be considered as a technological innovation. Examples include a digitalized collection or exhibitions, a high-resolution image of a painting, a 3-D scanned model of a vase and a virtual representation of a relic.

In terms of distinguishing technological innovation from organizational innovation, the former stresses the change in techniques and equipment on which managerial processes rely, whilst the latter refers to the change in managerial methods, routines and procedures per se. Take for example the collection management system of a museum. The effective operation of collection management systems is based on the integration of computer hardware and networks, software programs and organizational methods. Among which, the substitution by computer-based collection management systems of traditional paper-based practice can be seen as organizational innovation, whilst the adoption of hardware and necessary software development and the attending development of the necessary software are technological innovation.

Lastly, the difference between cultural and organizational innovations can be further clarified by distinguishing cultural innovation from innovation culture. The construction of an organizational culture that favors innovation has drawn much attention among scholars and practitioners in recent years. An innovation culture usually refers to a certain organizational context shared in the workplace that influences employees' behavior and value towards innovation (Valencia et al. 2010); cultivating a culture of innovation often requires the intention to be innovative, new infrastructure to support innovation, new behaviours necessary to influence a market and value orientation, and a new environment to implement innovation (Sharifirad & Ataei 2012). Contrary to this, cultural innovation is essentially what could be called a product and process innovation embedded in the dimension of cultural production. Therefore, innovation culture belongs to the category of organizational innovation instead of cultural organization.

The connection between cultural, technological and organizational innovation

Cultural, technological and organizational innovations are three dimensions of museum innovation; they are often interwinded and interplay with each other in practice. For example, the execution of an exhibition may embrace the three dimensions of museum innovation all at the same time – the new combination of collection objects that a museum exhibits is an cultural innovation; the introduction of new lighting equipment can be seen as technological innovation; and the collaborative teamwork structure of international curators that the museum adopts belongs to organizational innovation.

In terms of technological and cultural innovation, many studies have shown that new technologies, especially the utilization of ICTs, "provide an aesthetic opportunity" (Heilbrun 1993), and contribute to new product development and facilitate the research into arts and humanities (Karp 2004; Pujol-Tost 2011; Bakhshi & Throsby 2010; Costa Barbosa 2013). A notable example of technology stimulating the arts is the emergency of media art exhibition, by which media art became the focus of contemporary art exhibitions as an important art form evolved from the early 20th century because of the development of multimedia technologies in the creation of arts (McCarthy & Ondaatje 2002). On the other hand, arts and cultural innovation also inspires to a certain extent technological innovation(Castañer 2014). For example, visitor's and social demands of fresh content of cultural products and novel visitor experiences spur museums to adopt new technologies to meet their needs, especially in the digital era (Ch'ng et al. 2013).

With respect to technological and organizational innovation, empirical studies show that they can be mutually reinforcing. As Camarero and Garrido (2011) concluded in an innovation survey on European museums, technological and organizational innovations are positively correlated, which is explained by the argument that:

> "Adopting a fresh organizational approach that is more open to new ideas is a prerequisite to the adoption of technical innovations: the greater the presence of business management skills among museum managers, the

> greater the use of innovative technologies. Moreover, when a museum wishes to acquire and use new technologies unrelated to its ongoing activity, it must develop absorptive capacity and investment in human capital becomes critical."(Camarero & Garrido 2012)

The evidence is also given by the interrelated growth of technological and organizational innovations at the Canada Science and Technology Museum, which witnessed how integrated strategic planning, process improvement, and new technology and product development interplayed to facilitate innovative activities in the museum (Dawson 2008).

As far as cultural innovation and organizational innovation are concerned, a more effective organizational structure resulting from organizational innovation may provide an appropriate channel for interaction and knowledge-sharing, which contributes to the creation of variety in content and knowledge, thus it may exert an indirect impact on cultural innovation. A vivid example of this can be observed in the Danish North Jutland consortium as a innovative public-private consortia between museums, universities, and SMEs that lead to the renewal of the museum's cultural capital (intangible heritage) by eliminating institutional barriers to external cooperation and strengthening the capacity for learning by interacting (Søndergaard & Veirum 2012). Garrido and Camarero (2010) also state that organizational innovation is the basis to undertake product development, and they prove a positive correlation between organizational and product innovation through an empirical study encomposing 386 Spanish, French and UK museums.

3.4 DETERMINANT FACTORS OF MUSEUM INNOVATION

Factors that determine the decision-making of innovation and the extent to which innovation take place vary depending on the sector and type of innovation. But Damanpour (1991) suggests that the effects of innovation determinants in organizations do not vary greatly across different studies, which indicates that it is possible to develop a relevant theory about determinant factors of innovation in certain type of organizations, such as museums, through evidence

accumulation based on reliable literature.

The relevant literature about determinant factors of museum innovation is, unfortunately, limited and concentrates mostly on the impact of resource and market-oriented variables – such as size, ownership, funding structure and marketing strategies – on technological innovation of museums at the micro level (Camarero et al. 2011; Camarero & Garrido 2012; Vicente et al. 2012; De-Miguel-molina et al. 2013). But determinants of museum innovation are more than micro variables; they range from micro- to meso- and macro- environmental factors (Castañer and Campos 2002), many of which have been tested by empirical studies focusing on cultural and not-for-profit organizations, and the creative sectors. These findings, we think, may also constitute to a large extent reliable references to understand the factors affecting museum innovation according to the characteristics of museum innovation identified earlier. Therefore, we tend to identify a wider range of potential determinant factors of museum innovation on the basis of a review of both museum innovation literature and the relevant literature regarding cultural organizations, NPOs, and the creative sectors.

An important consideration is what approach should be adopted to classify these factors. Castañer and Campos (2002) suggested that macro, meso and micro environmental factors should be identified to distinguish different dimensions of determinants. But such classification seems to overlap in some variables such as organizational size and funding structure in their discourse. This might be the reason why Castañer (2014) turned to identifying determinants of innovation in cultural organizations by internal and external factors in a recent study. We tend to classify the determinant factors along individual, organizational, and systemic levels; each level is summarized into several major categories; and each category is composed of a range of factors. This is akin to Kimberly and Evanisko's (1981) method, which identified individual, organizational and contextual factors as determinants of technological and administrative innovations in hospitals in the United States. They believed that such method allowed researchers to examine the separate and combined effects of individual, organizational and contextual variables on organizational innovation (Kimberly & Evanisko 1981).

Clearly, the influence of factors varies depending on the type of innovation. We firstly discuss the impact of variables in the aggregate with special notes on the type of innovation at which the relevant literature is aimed; and then followed by an additional discussion about the impact of the determinants factors on the types of innovation.

3.4.1 Determinant factors at individual level

The individual level focuses on the individual factors that may influence the decision-making and the execution of innovative activities in a museum. There are two main factors identified among the relevant literature: leadership and professionalism.

Leadership

Leadership measures the power, willingness and ability of decision-makers to initiate and/or adopt innovation. As Anderson (2004) asserted, "strong leadership is critical for leading a museum through any degree of institutional change, and visionary leadership is essential for leading a museum through fundamental change". The studies on the impact of leadership on innovation in museums focus exclusively on the duration of leadership of leadership and the characteristic of leaders.

a. The duration of leadership

On the basis of an empirical survey of 400 museums and 25 museum directors in the United States, Noble (1989) examined the impact of turnover among museum directors on the kinds of innovation implemented in museums. He found that there was a curvilinear correlation between the length of service of museum directors and the rate of innovation. Medium-term stayers (4-6 years) tended to innovate more than short-term Stayers (1-3 years) and long-term stayers (7-10 years). Short-term stayer tended to innovate less whilst long-term stayers showed a decreasing tendency in the number of innovations. This phenomenon can be explained by innovation theory from a learning perspective. Innovation is an incremental learning process, wherein learning has a primary

role in generating new knowledge and disseminating that knowledge throughout the organization (Carlsson et al. 1976; Nelson & Winter 1982; Gieskes & van der Heijden 2004). Knowledge is accumulated with time. New directors have less knowledge on which to base innovation, and hence, they innovate less. This is also observed in our investigation – a new museum director who was appointed only five months before being interviewed commented:

> "I have been committed to technological innovation since I have been in charge of the museum. We are working on a pilot experience with an APP for the museum, but it isn't available yet. I have had some meetings about working with digitalization, 3D and augmented reality. Maybe the next few years (the museum will adopt these techniques)."

Meanwhile, the learning curve exerts a diminishing marginal utility once it has passed a certain point. Considering that innovation is an incremental conception that emphasizes "new arrival" (Castañer & Campos 2002), this diminishing marginal utility is embodied in the decreasing rate of innovation among long-serving managers.

Furthermore, the duration of leadership also affects the type of innovation. According to Noble's (1989) research, short-term stayers were more likely to innovate in Education/Interpretation, Administration, and Exhibits/Security areas whilst long-term stayers innovated more in the areas of Fund-Raising/Revenue Generation, Public Relations/ Marketing, Trustee and Volunteer Recruitment, and Training and Relationships. This can also be explained in terms of the learning perspective. Because of the lack of knowledge accumulation, museum innovation is characterized by radical innovations, such as the adoption of external innovation, arts and humanity research, and new product development that isn't strictly reliant on accumulated knowledge. On the contrary, museums in the long term tend to turn to incremental innovation based on problem solving and the accumulation of knowledge as individual and organizational learning over time.

b. Characteristics of leaders

Additionally, some studies suggest that the characteristics of key

organizational players should not be overlooked as a factor correlated to innovation (Kimberly & Evanisko 1981; DiMaggio & Stenberg 1985; Castañer & Campos 2002). It has been observed that many cultural organizations like theaters have dual leadership structure – with the coexistence of an administrative director and an artistic director, both of whom are key decision-makers in the arts organizations. Administrative directors, typically are in charge of the management of the organization, are more likely to innovate in pursuit of improved organizational efficiency and profitability, whilst artistic directors, who are responsible for artistic activities, are more interested in innovations that enrich artistic quality and form. As a consequence, such arrangement of dual authorities result in conflicting goals, which further influence innovation within organizations. DiMaggio and Stenberg (1985) attributed this to the relative power that different directors enjoy. They stated that the greater the power of the administrative director over the artistic director, the less the theater innovated. But Castañer and Campos (2002) tended to explain this by the educational background and past experience that leaders had. They proposed that leaders who have primarily a managerial background were less likely to engage in artistic innovation than those who had an arts background, or both, artistic and managerial background.

It is reasonable to think that this explanation is also applicable in the museum context. Many museums also have dual leadership structures in day-to-day operations although the organizational structure of a museum is different from that of a theater. A typical museum can be divided into three divisions by functions, namely collections, activities and administration (Lord & Lord 1998, p40). Collections (research, conversation and documentation) and activities (exhibitions, education and publications) are key functions akin to a theater's artistic activities that relate to cultural production, which reflected in the *parallel structure* adopted by the Metropolitan Museum of Art in New York, whereby collections and activities are under the supervision of a director and the administration is the responsibility of the president (Chekova 2004). Such division of power is also reflected in the division of labor between museum managers and curators seen in other literature (Zolberg 1986; Camarero et al. 2015). To this end, the weight of power, educational background, and past

experience of decision-makers is regarded as an important factor in museum innovation. It is proposed that the greater the power of decision-makers from the administration division (i.e. president or managers) over the that of the decision-makers in collections and activities divisions (i.e. director or curator), the less the involvement of a museum in cultural innovation; decision-makers with a preeminently managerial background and skills are less likely to engage in cultural innovation than those with an arts or humanistic background, or with both, arts and humanistic and managerial background.

Professionalization

Professionalism measures the capacity of museum staff to implement innovation. From the knowledge-based perspective, knowledge creation is an individual activity and the primary role of a firm is to integrate the specialized knowledge possessed by individuals into the production of goods and services (Grant 1996). Because innovation can be viewed as a process of creation of knowledge (Carlsson et al. 1976; Nelson & Winter 1982; Gieskes & van der Heijden 2004), individuals constitute the subjects of innovation and organizational innovation is essentially reliant on innovative activities by individual professionals. The extent to which an organization innovates depends on the extent to which this organization can integrate the specialized knowledge of its individual employees.

This deduction is corroborated by an empirical study conducted by De-Miguel-molina et al. (2013) on the identification of drivers of technological and cultural innovation involved in the restoration department of 167 museums throughout the world. They confirmed that the variety and combination of technologies and knowledge bases were positively correlated with the number of innovations. But they argued that the impact of the diversity of knowledge on innovation was indirect because museum size determined the amount and diversity of knowledge that a museum hosted. Therefore, they thought that size was the decisive factor. The impact of size on innovation is to be discussed in more detail below.

However, it is plausible that the influence of size on the diversity of knowledge base is over-estimated. This is because size is not a sufficient and necessary condition for diversity in knowledge. Firstly, the stock of knowledge

that a large museum hosts may be homogeneous rather than diverse; secondly, training can also improve the diversity of knowledge base by learning different technologies and knowledge without increasing the number of museum staff. For this reason, it is proposed that there is a positive correlation between the diversity of knowledge and the extent to which museums innovate; training programs can improve the diversity of knowledge, thus indirectly affecting the number of museum innovations.

3.4.2 Determinant factors at organizational level

Organizational level concentrates on the organizational factors that affect a museum's willingness and capacity to innovate. There are three categories of organizational factors summarized as characteristic of organization, management, and market.

Characteristics of organization

Museums can be classified as large or small depending on the size of the organization, or as public or private museums in terms of the ownership. Many studies show that innovative activities vary depending the characteristics of museums, among which size and ownership are key.

a. Size

The size-innovation relationship is one of the key elements that innovation literature has utilized to describe how organizational size influences on the degree to which innovation occurs in a museum. The size of a museum is often measured by the number of employees in most research literature [1]. There have been several empirical studies showing that the size of a museum has a significant effect on innovative activities in that museum. For example, both

[1] Some scholars also measure the size of museum by the number of visitors, such as Garrido and Camarero (2010). Meanwhile the amount of visitors is often utilized to measure museum performance as well in other studies(Camarero et al. 2011; Camarero & Garrido 2008). This will lead to problem in the case of the impact of organizational size on museum performance because visitor number cannot be used as both dependent and independent variables at the same time. So we incline to measure museum size with the number of employees to avoid the potential problem.

Camarero et al. (2011) and De-Miguel-molina et al. (2013) concluded that a museum's organizational size had a positive impact on the degree of technological and organizational innovation on the basis of statistical analysis of sampling surveys in museums from different countries.

This relationship can be attributed to several reasons. First, large museums have more potential to realize the economies of scale in internal R&D and the adoption of technologies (Kimberly & Evanisko 1981); second, larger museums have more financial, human and symbolic resources, essential for innovative activities, than smaller museums (Camarero et al. 2011); last, large museums are usually divided into a number of subunits according to functional activity; functional differentiation within the organization is also regarded as a key driver of innovation (Kimberly & Evanisko 1981).

This raises the question of whether the degree of innovation in a museum is directly related to the size in the museum in question. In other words, is the proposition that the larger a museum is, the more it innovates, true? Camarero et al. (2011) argued that there was a curvilinear correlation between museum size and the degree of innovation, which implies that growing museums require more resources to keep equivalent paces in innovation. A recent publication by Corte et al. (2017) also showed that some superstar museums such as the Louvre and State Hermitage Museum were not as innovative as they were supposed to be in relation to their size when compared to other museums.

Although some discourses argue that flexibility allows small firms to adapt and improve more easily, as well as accept and implement changes more readily so that small firms show a proportionally higher degree of innovation than larger ones in relation to their size (Camisón-Zornoza et al. 2004), this proposition has not been proved yet by existing literature in museum innovation. On the contrary, Verbano et al. (2008) regarded the limitation in size as a resistance factor to innovation in arts organizations. They found out that smaller arts organizations were less likely to adopt external technologies than larger ones according to an empirical survey on Italian art restoration firms.

This observation is consistent with the implication of "cost disaster" (Baumol & Bowen 1966). Considering the fact that museums usually face quite a high fixed cost in maintaining facilitaties, exhibitions and personnel salaries in

any case, but relatively low variable and marginal costs. Small museums may suffer from the heavy burden of fixed costs and increasing salaries with little growth in productivity over time so that they don't have sufficient resources and the motivation to innovate.

b. Ownership

Ownership describes the ownership situation of a museum, which is often closely associated with the explicit mode of governance of the museum. Modalities of museum governance vary from country to country. For example, there are four modalities: "Line department", "Arm's length institutions", "Private ownership", and "Not-profit-making or Charitable organization" among European museums (Vicente et al. 2012); while Japanese Museums are divided into "registered museums", "museum-equivalent facilities", and "museum-like facilities" by the Museum Act (Japanese Association of Museum 2008). Although there are different modalities of museum governance, they are usually classified into two categories: public and private museums, in accordance with the ownership of the museum.

Researchers believe that the ownership of museum determines the extent of innovation by affecting the aspiration and willingness of a museum. According to the bounded rational hypothesis, decision-makers can only seek to arrive to a satisfactory solution because of the lacking of the ability and resources to arrive at the optimal one (Simon 1959). Similarly, museums are subject to a bounded rational and pursue satisfacty rather than optimal solutions. The decision-making of a museum in terms of innovation depends on weighing up current performance and organizational aspiration. A museum tends to be engaged in innovative activities if it is aspires to achieve better than current performance while it is less likely to be innovate if current performance is close to, or higher, than organizational aspiration (Castañer & Campos 2002). Furthermore, Castañer and Campos (2002) argued that private museums were more profit-oriented than public ones, and thus displayed higher economic aspiration and lower artistic aspiration.

Therefore, it is supposed that private museums are more engaged in technological and managerial innovation than public ones. This proposition is

partially evidenced by the empirical study of Vicente et al. (2012), who discovered that private museums invested much more in new management technologies than public ones, among arts and history museums in France, Italy, Spain and the United Kingdom. Further, they discovered that private ownership encouraged museums to develop more varied approaches to their functional tasks beyond exhibition display and to apply new technologies more actively in management and interaction (Vicente et al. 2012).

On the other hand, the primary role of public museums is to provide the population and community more cultural goods and services; and hence, public museums have a higher cultural aspiration than private ones. Therefore, it is proposed that public museums are more likely to engage in cultural innovations.

Management

In most cases, success in innovation is inseparable from effective management within the organization. Favorable managerial practices may facilitate innovation by creating incentives and efficient routines. The existing literature focuses on three factors of (1) clarity of organizational mission, (2) market orientation, and (3) custodial orientation with regard to management.

a. Clarity of organizational mission

Organization theory states that the mission of an organization is influential in developing and adopting innovation in the nonprofit organizations (McDonald 2007). Different from profit enterprises, that pursuit the maximization of profit, non-profit organizations have multiple objectives in terms of the sectors in which they are located (Throsby & Withers 1979; Hansmann 1981; Steinberg 1986). Therefore, a clear and motivating mission is an important driver for non-profit organizations to allocate scarce resources on the activities that support their missions. Based on the empirical study of non-profit hospitals in the United States, McDonald (2007) confirmed that a clear organizational mission contributed to innovation by helping organizations focus their attention on the development and adoption of innovations that will support their mission.

In more detail, the influence of the organizational mission on innovation can be attributed to three aspects (McDonald 2007). First, the clearer mission an

organization has, the more easily it identifies and concentrates resources on innovative activities that are more likely to achieve its mission; second, it also creates a favorable climate in the organization that allows innovation to succeed; last, a clear and motivating mission is beneficial to the recognition of organizational members, which will prevent distractions caused by obstacles in the process of experimentation and innovation and lead them to their objective successfully.

Museums often have a broad range of missions from maximizing visitor numbers to affirming social identity, promoting cultural tourism, regenerating urban area, and so on (Asuaga & Rausell Köster 2006). Each concrete mission can vary from museums over time. For example, a flashship museum in a big city may aim to be the city's landmark to attract more tourists, while a small-scale museum in a remote town may be at the service of local citizens by strengthening community identity. Perhaps the mission in a museum also changes as director changes. Therefore, it is important for a museum to make sure that there is clarity in its mission. But we shouldn't take a clearly defined mission for granted. Some museum professionals interviewed commented that they didn't know exactly what missions their museums had. This suggests that there are some museums that do not have clear missions or whose missions are not known by their staff.

In sum, as non-profit organizations, museums should also pay close attention on their missions, which are supposed to be a major driver of museum innovation. A clear and motivating mission will help the museum to focus its limited resources on the innovative activities that support that mission, and vice versa.

b. Market orientation

It is widely considered that there is a close relationship between market orientation and innovation in the firms (Atuahene-Gima 1996; Grinstein 2008; Ozkaya et al. 2015). This relationship can also be applied to the museum sector. The impact of market orientation on museum innovation focuses mostly on "visitor orientation" and "donor orientation" (Camarero & Garrido 2008; Camarero & Garrido 2012; Camarero et al. 2015). Visitor orientation means that

a museum's financial and social goals are based on visitors' needs, and museum's activities are aimed at satisfying the needs and wishes of visitors (Camarero & Garrido 2012). Therefore, visitor-oriented museums tend to not only improve service quality by facilitating access to collections and establishing a visitor-friendly environment (Reussner 2003), but also offer value-adding goods and services through educational and recreational programs (Welsh 2005). Potential donors of a museum include private individuals, foundations, businesses and public administrations, and donor orientation stresses the priorities set by the expectations and demands of donors who constitute a vital source of museum funding (Camarero & Garrido 2012). As a consequence, donor-oriented museums lean towards the programs and activities that are considered valuable by their donors, such as adopting new managerial methodologies to improve economic performance (Camarero & Garrido 2008) and incorporating ICTs in functional area to show the innovativeness that their donors expect (Bakhshi & Throsby 2010).

Such relationship is in evidence in the empirical studies conducted by Camarero and Garrido (2008, 2012), who argued that market orientation was a starting point for innovation because it was in the spirit of doing something new or different to respond to changeable market conditions (Camarero & Garrido 2008). They further detailed the different impact of visitor orientation and donor orientation on technological and organizational innovation respectively. According to the examination of a sample of 491 European museums, they concluded that a donor orientation had a positive impact on both technological and organizational innovations whilst a visitor orientation had a positive effect on organizational innovation but didn't affect technological innovation unless external collaboration existed between the museum and other actors.

Following the logic and conclusion stated above, it is deduced that a market-oriented strategy will lead to demand-pull innovation, which starts with the recognition of private demand (i.e. visitors) and social demand (i.e. donors) and ends with the implementation of new methodologies that satisfy these demands identified by museums. In the process of such innovation, the interaction between museums and their visitors and donors plays a vital role in the transformation of relevant information and knowledge. Innovation theory

states that innovation is a process of interaction between producers and users (Lundvall 1988; Freeman et al. 1982: 124). Market orientation can contribute to successful innovation by focusing on knowledge regarding the needs of potential users through learning by using (Rosenberg 1982). On the other hand, innovation theory points out that intra-firm collaborations can share the costs and rewards of innovative activities, thus decreasing the uncertainty resulting from innovation (Bureth et al. 1997). Considering that both internal R&D and the adoption of external technologies may incur a large amount of financial expenditure and uncertainty for a single museum, it makes sense that a visitor orientation doesn't result in technological innovation without collaboration from other institutions.

c. Custodial orientation

Opposite to market orientation, custodial orientation means that museums are more committed to artistic, historical, and scientific missions than market demands and the service rendered to society (Camarero & Garrido 2012). Custody-oriented museums usually focus on the heritage significance of their collections, and the academic quality of exhibitions, which is mostly for the benefit of a small number of students, arts professionals, museum lovers and other elite communities instead of ordinary visitors. For this reason, custodial orientation is regarded as the opposing side of visitor orientation (Camarero et al. 2015). This is consistent with the discourse of Hauenschild (1988), who distinguished new museums from traditional ones in terms of the adoption of new museology and argued that traditional museums were custody-oriented whilst new museums usually were visitor-oriented.

Although Camarero et al. (2015) assumed custodial orientation as the antithesis of innovation, there is no empirical evidence showing that there is any negative correlation between custodial orientation and innovation (Camarero & Garrido 2012). On the contrary, the emphasis on artistic, historical, and scientific missions will encourage museums to allocate more resources to research in arts and humanities, spur new scientific publications, new exhibitions, and so on. From a knowledge-based innovation perspective, a museum’s investment in symbolic meaning and knowledge domain will constitute an incentive to

innovation in symbolic goods and services. As a result, it is proposed that a custodial orientation may also underpin cultural innovation in museums.

Market

Market forces and market structure are regarded as important factors of innovation in arts and cultural organizations by cultural economists (Castañer & Campos 2002; Castañer 2014). Market forces refer to the demand and supply factors that affect museums. The demand-supply model is a basic framework to probe into the productive activities of firms in microeconomics. Market structure usually refers to the competitive environment in which firms operate; it also is associated with collaboration in the case of cultural organizations (Castañer 2014).

a. Demand

It is widely accepted by economists that innovation is a function of market demand (Mowery & Rosenberg 1979; Kleinknecht & Verspagen 1990), especially local demand, that determines the pattern of innovation generation (Fabrizio & Thomas 2012). The cultural economics perspective is concerned with the impact of market demand in terms of innovation in arts and cultural organizations in relation to private and social demands (Castañer & Campos 2002; Castañer 2014).

In regard with private demand, more attention has been paid to the features of local population in terms of demand, and a strong emphasis has been placed on how the size and educational level of population influences artistic innovation in cultural organizations and the performing arts field in particular (Pierce 2000; Castañer 2014). Such theoretical linkages, however, are tenuous and not supported by empirical evidence. In the museum sector, practitioners often emphasize the aging of a population as a changing context that requires museums to take action to address such change (Hsieh 2010; Hamblin & Harper 2016). We think that the aging of population gives rise to a special demand to museums by the elders, which may affect innovative activities when museums adopt visitor-oriented strategies, but there is less evidence supporting the idea that the proportion of the elderly in a population is a determinant factor of

innovation in museums.

As far as social demand is concerned, cultural economics literature focuses on the financial structure of museums and examines how the sources of funding influence innovative activities of museums. Generally speaking, the sources of funding are composed of own revenue, public subsides, endowments and sponsorship (Vicente et al. 2012), which are grouped into two types of funding: public and private. It used to be believed that privately funded museums were more likely to engage in innovation because private funding is often linked to a market orientation that spurs innovation, whilst publicly funded museums were reluctant to innovate because public funding didn't provide any incentives for museums to take risks such as the introduction of new technologies (Frey & Meier 2003; Camarero et al. 2011) and, worse, even prevented museums from implementing changes in managerial methodologies and organizational forms (Camarero et al. 2011).

However, such opinions may over-simplify the impact of financial structure on innovation in the museum sector. On the one hand, most museums have multiple sources of revenues, comprising both, public and private funding, which means that the financial structure usually has a mixed effects on the mode of innovation in museums; this is partially evidenced by the findings of Camarero et al. (2011), who found that "museums that depend too much on private funding or too much on public funding have greater difficulty innovating than those that have access to both". On the other hand, the impact of funding on innovation may be indirect because private funding contributes to both technological and organizational innovation only when museums adopt market-oriented or business-liked approaches (Vicente et al. 2012). Therefore, the funding-innovation relationship actually implies the assumption that museums are donor-oriented and that a museum's behaviour depends on the expectation of their donors. This logic can be contributed to Castañer (2014), who argued that a consequence of private funding was associated with the type of corporation that sponsored a museums: high-tech companies and companies in the distribution sector may contribute to innovation differently, whilst the influence of public funding is exclusively determined by political orientation of governing parties at a given governmental level.

Nevertheless, the empirical studies have shown a significant correlation between private funding and technological and organizational innovation (Frey & Meier 2003; Camarero et al. 2011; Vicente et al. 2012); European museums show that public funding does support investment in the digitalization of works and catalogues, the computerization of day to day operations, as well as educational and training programs (Vicente et al. 2012), which are mostly related to a museum's functional function, with an emphasis on heritage conservation and citizen learning. For this reason, it is proposed that the higher the proportion of private funding museums rely on, the more museums engage in technological and organizational innovations; while the higher the proportion of public funding museums have, the more they innovate in the cultural and technological domain.

b. Supply

Cultural economists study supply in museums from the perspective of the market structure in which museums operate. Some scholars argue that museums are situated in a highly competitive market, wherein not only visual arts that museums exhibit have to compete with other art forms such as symphony concerts, concerts, dance and opera (Heilbrun 1993; Throsby 1994), but also compete with other leisure activities such as going to the cinema, shopping, sports and theme parks (Message 2006). However, other scholars believe that many art organizations like museums are monopolistic suppliers, which are not affected by overall demand conditions, espcially in small and medium-size cities (Castañer & Campos 2002).

As a consequence, the impact of supply on innovation has transformed the question of which market structure is more likely to stimulate innovation: a monopolistic market or open competition However, the relationship between competition and innovation, especially technological innovation, is the subject of intense debate (Tang 2006). For example, Schumpeter (1943) stated that temporary monopoly provided an incentive for innovators because it could protect innovation from being imitated so that innovators collected monopolistic profits from their innovative activities temporarily. But monopoly power is also an obstacle that can hinder innovation in other firms (Weinberg 1992). On the

other hand, competition can stimulate innovation by increasing the cost to those that fail to innovate and, at the same tie reduce the incentive to innovate because of its negative effect on post-innovation profits (Gilbert 2006).

These arguments and findings, however, do not apply to the museum sector because neither monopoly nor competition constitute economic incentives for museums to innovate considering their non-for-profit nature. This is consistent with Castañer and Campos's (2002) viewpoint that the market perspective is not an appropriate way to model the innovation behaviour of arts and cultural organizations because there is little empirical evidence to supports any clear impact of the market structure on artistic and cultural innovations by cultural organizations.

Even so, it is possible that the relation between competition and innovation in museums is demonstrated through other factors, for example, the difference in geographical location. As discussed above, monopolistic museums are usually scattered at small and remote cities whilst most of the competitve cultural organizations including museums are concentrared in large and metropolitan cities (DiMaggio & Stenberg 1985). There may be some linkages observed between geographic location and innovation in the empirical evidence, which is the subject of later discussion.

c. Collaboration

As a matter of fact, cultural economists believe that relationships between cultural organizations is best characterized by collaboration rather than competition (Liao et al. 2001; Castañer & Campos 2002; Camarero & Garrido 2008). In comparison with competition, it is clear that collaboration promotes innovation, because (1) innovation is a process of interaction (Lundvall 1988) and collaboration constitutes a major means of direct interaction by an organization with external individuals and organizations (Bureth et al. 1997); and (2) innovation is reliant on the transfer and creation of knowledge through organizational learning (Harkema 2003), and collaboration is an important source of knowledge flows and exchange through inter-organization interaction (Martin & Moodysson 2011).

Empirically, the beneficial role of collaboration has drawn attention to

some researchers such as Camarero and Garrido (2012), who found that unless museums collaborate with other museums in joint leisure and cultural activities, visitor-oriented strategies did not have a significant correlation with technological innovation.

In the museum community, there are many types of visible collaborations with individuals and institutions, like cultural organizations, universities, profit enterprises and the government. For instance, cooperating with independent curators to organize museum exhibitions; borrowing artworks from other museums and private collectors is a usual practice to improve the quality of exhibitions; promoting museum cooperation with the local tourist office and travel agencies; incorporating new technologies in the museological works with the help of high-tech companies etc. Such collaborations usually make up for a particular deficiency in terms of technology and knowledge bases, on which museums depend for the improvement of existing products and methodologies or the development of new products. Based on the reasons discussed above, it is proposed that the more active collaboration in which a museum is involved, the greater extent to which it will innovate.

3.4.3 Determinant factors at systemic level

From a systemic perspective, innovation is not an isolated activity, but part of a complex "socio-economic" system, in which a group of private firms, public research institutes, and several other facilitators of innovation interact within an institutional framework (Beije, 1998, cited in Schrempf, Kaplan, & Schroeder, 2013). Therefore, innovation is determined not only by the internal factors discussed above, but also by external factors such as boundaries of the system, and institutions. The existing literature identifies geographic proximity and cultural policy as two major determinants of innovation in the museum sector.

Geographical proximity

Innovation literature emphasizes the importance of geographic factors in the system of innovation by addressing the potential relationships between regions, clusters, and innovation demonstrated in the empirical observation. On the one

hand, innovators are geographically concentrated (Breschi & Malerba 1997); on the other hand, innovative activities are embedded in regional and local systems, based on clusters (Porter 1990; Porter 1998), such as biotechnology and ICTs in "Silicon Valley" in California, or new media in Hollywood, Los Angeles and "Silicon Alley" in New York (Cooke & Memedovic 2003). A similar phenomenon is also visible in the museums sector. A good example is the so-called Golden Triangle of Art of the Prado Museum, the Reina Sofía Museum, and the Thyssen-Bornemisza Museum gathered around the Paseo de Prado in the historical center of Madrid. Another example is Berlin's Museum Island embracing five world-renowned museums on the banks of the River Spree in the heart of Berlin.

Based on such observations, scholars tend to attribute local innovation and economic development to geographical proximity. Malmberg and Maskell (1997) pointed out that product innovation, new forms of organization or new skills are involved in interactive processes within industrial systems embedded in a broader and space-based cultural and institutional context, whilst shared spatial embeddedness such as proximity, affinity and trust, in turn, contribute profoundly to the success of innovation. They further argued that the modern development of transportation and telecommunication could not replace the persistent, regular and direct face-to-face contact on which information and knowledge exchange are based. Therefore, the more tacit knowledge is involved, the more important is geographical proximity between actors who partake in the interaction. Generally, the shorter the spatial distance between participants, the less costly and smoother is the interactive collaboration, and the more probable that innovation succeeds.

Perhaps proximity matters in arts and cultural organization because cultural innovation and production are greatly reliant on symbolic knowledge (Asheim & Hansen 2009) that is embodied in the arts and humanities knowledge and skills, which are deeply tacit and must be accumulated and transferred gradually between individuals (Bakhshi et al. 2008). In the case of museums, both arts and humanities research as well as the development of new cultural products, and the adoption of external technologies require frequent interaction with suppliers (e.g. high-tech companies and universities) and users (e.g. visitors and community), which can grow in intensity if these suppliers and users are

close to the museum geographically. This explains to some extent why many arts and cultural organizations, such as Italian art restoration firms, display positive correlations between the number of innovation and the distance to their suppliers/distributors as well as the extent of the collaboration with universities and research centers (Verbano et al. 2008).

On the basis of the above, we may propose that geographical proximity is positively correlated with the extent of innovation in museums; the closer a museum is to relevant researcher centers or technological suppliers, the more it engages in innovative activities.

Cultural policy

The impact of institutions on innovation can be explained with two arguments. From the micro perspective, institutional scholars view innovative activities, like R&D, as an institutionalized category of organizational activity that has meaning and value in many sectors of society (Meyer and Rowan 1977); therefore, decision-making with regard to innovation within the firm is determined by institutional factors (Hatimi 2003). On the basis of Scott's (2001) institutional framework, empirical studies were conducted to test the relationships between institutional forces and innovation. The results demonstrated that regulative, normative and cognitive institutions contributed to the choice of innovation and performance of various items from different individuals, organizations and sectors (Shane 1993; Shane et al. 1995; Berrone et al. 2007; Alexander 2012; Lee & Pan 2014).

From the macro perspective, Schumpeterian scholars place the emphasis on the institutional network in the production and innovation systems, in particular the National System of Innovation (Álvarez & Marín 2010). This network of institutions embrace the whole complex of factors ranging from industrial policy and science policy to basic education, industry structures, taxation systems and wage incentives, which shape a series of interactions within the system such as the inter-firm cooperation in research clubs, the integration of research, design and production in cooperative relations between the divisions within a firm, or the firms within a keiretsu (Dore 1988). Through a series of comparative studies on industrialized counties, these scholars arrived to the

conclusion that it was favorable institutions that benefited industrial competition and economic performance through innovation at national, regional, or sectorial levels (Freeman 1987; Lundvall 1992; Nelson 1993; Breschi & Malerba 1997; Cooke et al. 1998)

Cultural economics literature concerns itself with institutional forces of museum innovation by concentrating on the impact of different modes of cultural policy on technological and organizational innovations in museums across countries. In detail, cultural policies related to museums can be classified into the continental European model and the Anglo-Saxon model in terms of the nature and extent of governmental intervention in the cultural management, and in terms of the role that the State plays in terms of funding (Vicente et al. 2012). Museums under the Anglo-Saxon model (e.g. British museums) enjoy a high degree of managerial and financial autonomy, as well as multiple sources of funding, whilst museums under the continental European model (e.g. French museums) are controlled to a large extent by the government at various levels and rely mostly on public funding.

An empirical study shows that there is a significant difference in the degree of museum innovations in European countries, among which the British museums exhibit the highest level of innovation in both, the technological and organizational domains whilst the French museums show the lowest (Vicente et al. 2012). Lusiani and Zan (2010) gave particular emphasis to the high degree of autonomy in managerial decision-making and budgeting of surplus funding as a necessary condition for the success of organizational innovation in the cultural sector. These findings may suggest that a favorable cultural policy for innovation could be benefit from reduced governmental intervention and increased organizational jurisdiction in both management and finance.

3.4.4 Different impacts of determinant factors on different types of innovation

It is expected that the impact of individual, organizational and systemic factors on museum innovation vary according to the type of innovation although we primarily focus on such impact of variables in the aggregate. As the “dual-core

model" of organizational innovation (Daft 1978) implied, the differentiation between administrative and technical innovation is important because they are embedded in different processes of decision-making and associated with different facilitating factors. On the contrary, Damanpour (1991) points out that there is no statistically significant difference in the effects of organizational determinants on different types of innovation on the basis of a meta-analysis on the relevant literature published between 1960 and 1988. However, the relevant discussion in the aforementioned literature is mostly based on the classification between administrative and technological dimensions, and innovation is neglected at its artistic and cultural dimensions. So the effects of determinants in terms of the types of innovation are still ambiguous when cultural innovation is considered.

As far as museums are concerned, we think that the difference in the effects of relevant determinant factors on different types of innovation are mostly embodied in the extent to which they may affect rather than the direction of the effect (i.e. positive or negative) because of the fact that cultural, technological and organizational innovations are interlinked and interplay with each other, as is discussed above. Summarizing, different impact of determinant factors on different types of innovation call for further empirical research.

Table 4 Summery of determinants of museum innovation

Category	Factor	Explanation / proposition
	Individual level	
Leadership	Duration of leadership	There is a curvilinear correlation between the length of service of museum directors and the rate of innovation; mid-term stayers (4-6 years) innovate more than short-term Stayers (1-3 years) and long-term stayers (7-10 years)
	Characteristic of leader	Innovation is related with the background of decision-maker; leaders with managerial background are less likely to be engaged in cultural innovation than those with arts and humanistic background.
Professionalism	The diversity of knowledge	Museum innovation is reliant on staff capacity of innovation in terms of knowledge to which museums have access. The more diverse knowledge stock of a museum is, the greater extent to which the museum is engaged in innovation.

	Organizational level	
Organizational characteristics	Size	Staff number of museum has a positive influence on the amount of technological and organizational innovation by museums.
	Ownership	Ownership determines the degree of innovation by affecting the aspiration and willingness of museums. Private museums display higher economic aspiration and lower artistic aspiration, so they are more active in technological and managerial innovation, and less active in cultural innovation than public museums.
Management	Clarity of organizational mission	A clear and motivating mission helps museums to focus their scarce resources on the innovative activities that support its mission.
	Market orientation	Market-oriented strategy leads to demand-pull innovation, which starts with the recognition of private demand (i.e. visitors) and social demand (i.e. donors) and ends up by the implementation of new methods that will satisfy these demands identified by museums.
	Custodial orientation	The emphases on artistic, historical, and scientific missions encourage museums to allocate more resources on the arts and humanities researches, new scientific publications, and new exhibitions, thus spurring cultural innovation.
Market	Demand	Social demand affects museum innovation; museums relying on a higher proportion of private funding are more likely to be engaged in technological and organizational innovation; and those depending on public funding are more likely to innovate in cultural and technological dimensions.
	Supply	Supply of museum is related to monoply and competition in the context of market structure. The impacts of market structure on innovation are multiple and complex, the economic motives behind monopoly and competition are not applicable in museums.
	Collaboration	The relationship between museums is characterized by collaboration more than competition. The more collaboration in which museums are engaged, the great extent to which they will be of innovation.
	Systematic level	
Geographic proximity	The distance to suppliers and research centers	Geographic proximity benefits the interaction of museums; the closer the location of a museum to its technological suppliers or research centers nearby, the more extent to which it is engaged in innovation.
Cultural policy	Models of museum governance	A favorable cultural policy for innovation should be beneficial to reducing governmental intervention and increasing organizational jurisdiction at both managerial and financial dimensions; the Anglo-Saxon model is more favorable for museums to innovate than the continental European model.

3.5 CONCLUSION

Museum innovation, or innovation by museum organizations, refers to how museums transform ideas, theories or approaches into new or improved cultural products, services or processes in order to advance, compete and differentiate themselves successfully in the market and society. It is an emerging field that can be viewed as the intersection of innovation and museum studies and stand to benefit from additional innovation studies relating to cultural organizations, the NPOs, and the cultural and creative industries.

Museum innovation is a global phenomenon that is pervasive in the museum community throughout the world. The computerization and digitization of museums in the United States, the emergence and diffusion of new museology in Europe and the Latin America, and the reform of the Designated Manager's System in Japan's public museums are some observed cases that show the universality and diversity of innovation in the museum sector. This also means that museum innovation deserves to be treated as an independent object of research.

It is clear that museum innovation may take place at multiple levels. On the basis of learning theory of innovation and the knowledge-based approach, museum innovation can be classified into three types: cultural innovation, technological innovation and organizational innovation. Cultural innovation involves innovation in cultural goods and services and innovation in arts and humanities research; technological innovation includes internal R&D within the museum organization and the adoption of external technologies from outside of the organization; organizational innovation, among which we include the digital object, digital network, digital experience and digital device are four main categories of ICTs by means of which museums innovate; organizational innovation refers to innovation in business practices, in workplace organization, and in external relations. There are both differences and connections among the three types of innovation.

The determinants of museum innovation are multiple and complex, and can be identified from an individual, organizational, and systemic perspective based on existing theoretical propositions. As table 4 summerized, from an

individual perspective, the characteristic and duration of leadership as well as the diversity of knowledge that museum professionals possess are important factors that may influence the degree of museum innovation. From an organizational perspective, the organizational characteristics (size and ownership), management features (clarity of organizational mission, market orientation and custodial orientation) and market attributes (demand, supply and collaboration) constitute vital conditions that determine the extent to which museums will engage in innovative activities. From a systematic perspective, geographical proximity is the basis of collaboration and interaction of inter-agents in the system of innovation, and favorable cultural policies also support innovation by reducing governmental intervention and increasing organizational jurisdiction at both, managerial and financial dimensions.

CHAPTER 4

HOW DO MUSEUMS INNOVATE? A MULTIPLE-CASE STUDY OF THE INNOVATION PROCESS IN FOUR DOMAINS OF CULTURAL PRODUCTION IN MUSEUM ORGANIZATIONS

How do museums innovate? The existing literature has offered little to answer this question. Many scholars argue that museum innovation is characterized by technology-push in terms of "the organizational adoption of external technologies" (vom Lehn 2005; Corte et al. 2011; Costa Barbosa 2013; Karp 2004; De-Miguel-Molina, De-Miguel-Molina, et al. 2014) in the museum sector. Others emphasize the role of demand-pull in stimulating innovation from the perspective of the social mission of museums to meet private and social needs (Heilbrun 1993; Camarero & Garrido 2008; Camarero & Garrido 2012; Camarero et al. 2015). Both streams take such technology and demand-driven innovations for granted, and thus neither pays much attention on the analysis at the core of this question, i.e. what is the way in which innovation developes in museums.

Generally, most studies into innovation process focus on technological development and industrial R&D in manufacturing by linking innovation process to technological change (Cooke & Memedovic 2003). Although early models of innovation process saw innovation as a linear consequence of functional activities: either advent of new technology from R&D pushes its application and refinement to the marketplace, or else change in market needs exert pull for the arrival of new solutions to a problem or new market opportunity (Tidd 2006), the recent stream of innovation process literature mostly emphasizes "open innovation model" (Chesbrough 2003a; Berkhout et al. 2006; Du Preez et al.

2010), by viewing innovation as an open system in which both, internal and external ideas and technology contribute to innovation through networking and collaboration between and within organizations.

Nevertheless the cultural sector has drawn little attention from innovation scholars to study the innovation process in cultural organizations. Aoyama and Izushi (2003), Zukauskaite (2012), Castro-martínez and Fernández-baca Casares (2012), and Castro-Martínez et al. (2013), among others, have attempted to understand innovation in the cultural and creative industries under the open innovation perspective by placing the emphasis on various forms of interaction and collaboration between cultural organizations, industry, and universities in knowledge transfer and new product development. This indicates the existence of a close relationship between open system and successful innovation in the cultural and creative industries as well. In the case of museums, Peacock (2008) proposed that the process of museum innovation was a social construction by conversational interaction of individuals with the museum by focusing on internal and external flows of ideas and perspectives as a source of innovation through daily conversation. His argument is more or less consistent with the viewpoint of open innovation in accordance with the common emphasis on interaction, thus going beyond technology-push and demand pull perspectives. But the term conversation as the means of interaction, to which Peacock attributed innovation, seems to be too abstract and parochial to explain the process of innovation.

This chapter aims to describe and analyze innovation processes in museum organizations from the open innovation perspective by focusing on the knowledge base, learning processes and interaction modes embedded in the innovation system. To achieve this objective, we firstly introduce the open innovation model in the context of the dynamic innovation process, then we stress the complexity of cultural products and innovation in museum organizations by identifying four domains in terms of the production input and value creation dimensions. This complexity asks for an in-depth exploration of the innovation process by matching four production domains with corresponding innovation types, followed by the description of four selected functional activities of museum organizations including “restoration”,

"exhibition", "digital museum", and "visitor service" to represent the above four domains. On this basis, a multiple-case study is to be conducted to compare the process of innovation in five museums in the city of Valencia, and to identify different innovation patterns involved in the domain of cultural production by the pattern-matching technique.

4.1 DYNAMICS OF INNOVATION PROCESS AND OPEN INNOVATION MODEL

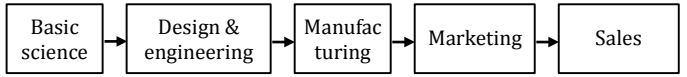
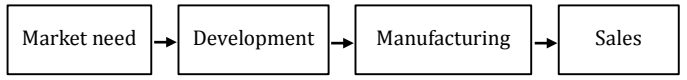
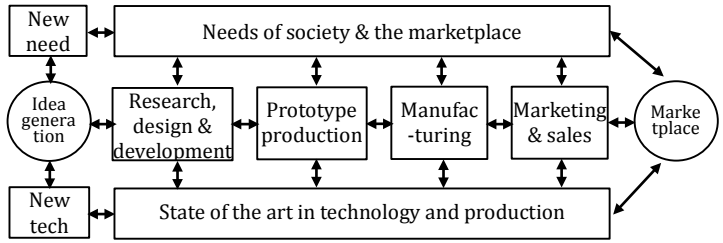
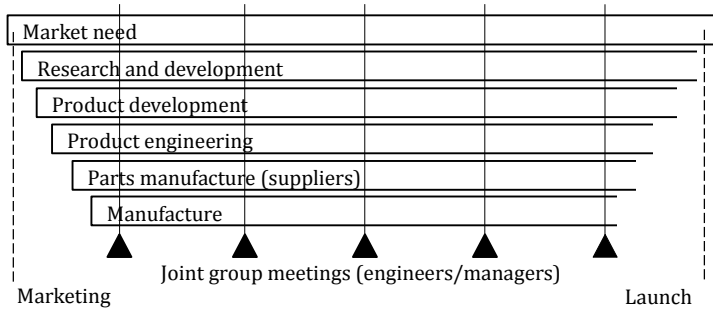
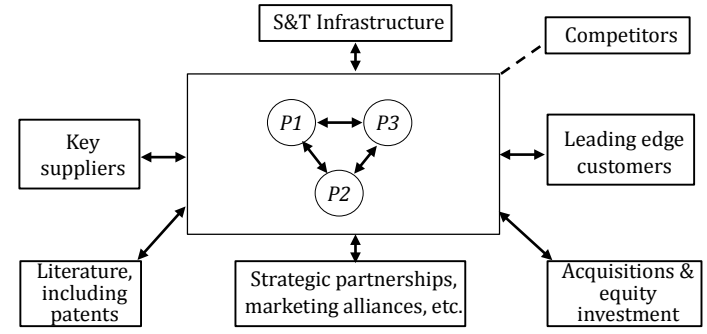
Innovation process is defined as "the sequence of events that unfold as ideas emerge, are developed, and are implemented within firms, across multi-party networks, and within communities" (Garud et al. 2013). This definition implies that innovation is a development process rather than an accomplishment at one stroke. The development here can be understood in terms of three aspects. First, innovation is perceived as a consequence of functional activities (Tidd 2006); second, the consequence of functional activities often involves multiple stages, covering invention (i.e. the creation of new ideas), development (i.e. the elaboration of the ideas), and implementation (i.e. the widespread acceptance of the innovation)(Garud et al. 2013); third, the set of stages might be either one-way and sequential, or looped and cyclic in terms of innovation process models (Berkhout et al. 2006; Rothwell 1994).

Innovations are developed at multiple levels – including individual, organizational and systemic level. "Schumpeter Mark I" innovation focuses on the role of the entrepreneur and its individual effort in innovation (Schumpeter 1912), which is viewed as "the outcome of continuous struggle in historical time between individual entrepreneurs, advocating novel solutions to particular problems and social inertia" (Fagerberg, 2006). Successful innovation refers to the translation from new discoveries into commercial practice, which is mostly determined by entrepreneurial skill and capacity. Furthermore, "Schumpeter Mark II" innovation concentrates on the importance of large firms with research laboratories in technological innovation (Godin 2008). Large corporations are seen as innovating firms engaged in the process of "creative destruction"

proposed by (Schumpeter 1937) and organized research and experimental development (R&D) activities become a synonym of this cooperative entrepreneurial work (Fagerberg, 2006). Additionally, today's Schumpeterian economists stress the influence of institutions on political economy of innovation in national system of innovation, wherein innovation is the consequence of interactive learning and collaborative networks shaped by nationwide institutions (Freeman 1987; Nelson 1993; Lundvall 1992). Path dependence and divergent outcomes of innovation can be concluded from historical processes in different countries and economies (Edquist 1997).

Innovation is a complex process. The understanding of innovation processes evolves with social and economic development as well as with in-depth exploration of the innovation phenomenon. Rothwell (1994), a key researcher at the SPRU of the University of Sussex, identified five generations of models of innovation – a widely cited classification in the innovation literature. According to Rothwell (1994), the first generation is "technology push model", which regards innovation as a linear process from basic research, the preparatory phase of production, manufacturing, marketing to final sale in chronological order; the second generation is the "demand pull model", which stresses market pull as the starting point followed by single chronological phases including developing, manufacturing and final sales; the third generation is "coupling model", which emphasizes that successful innovation is essentially based on feedback loops and interaction with market needs and state of the art technology; the fourth generation is "integrated model", which concentrates on knowledge as a necessary prerequisite for successful innovation that involves coordinated and parallel processes with the integration of research links, and the external research environment; the fifth generation is "system integration and networking model", which focuses on the role of an integrated, flexible and open-end collaboration of external research facilities and cooperation with the marketing area in the process of innovation by means of IT and networking methods. Table 5 summarizes the background, basic features and graphic models of five generations of models of innovation process. In sum, the evolution of innovation process models is embodied in the dynamics of its characteristics.

Table 5 Five generations models of innovation process

Generation	*Background*	*Description*	*Model*
1st generation Technology push model (1950s – mid-1960s)	The post-war period witnessed economic growth largely through rapid industrial expansion and new technological opportunities. The market was simply a place where outcomes of research and development were captured, i.e. customers only bought what firms offered currently.	It assumed that "more R&D in" led to "more successful new products out". Therefore, innovation was understood as a linear process from basic research, the preparatory phase of production, manufacturing, marketing to final sale in chronological order.	
2nd generation linear market pull model (mid-1960s – early-1970s)	It witnessed increasing manufacturing productivity and industrial concentration while manufacturing employment was relatively static. Firms began to face the rising pressures from competition and diversity. New products were introduced mainly based on existing technologies, so customer's needs became very important for firms to capture more market shares, thus market and its need constituted a determinant in decision making of firm innovation.	Different from the first generation model, the second generation stressed on the function of "market pull", which was the starting point followed by single chronological phases including developing, manufacturing and final sales in this linear model.	
3rd generation coupling model (early 1970s – mid-1980s)	The western economy suffered from high rates of inflation, saturation of the market and growing structural unemployment since 1970s. Companies had to adopt strategies of consolidation, rationalization, cost control and reduction. It was clear that neither "technology push" nor "market pull" strategies were sufficient to deal with innovation successfully; instead the further detailing of the phases and the implementation of feedback steps were needed.	It combined technology push and market need pull models, stressing that knowledge about both technology and market needs was required throughout the innovation process; in order to obtain this knowledge networks were formed with internal and external partners. Successful innovation process was essentially based on feedback loops and interaction with market needs and state of the art technology.	
4th generation integrated model (early 1980s – early 1990s)	This period featured economic resurgence. Much attention had been given to strategic management of firms, which concentrated on core business competence and technologies, emphasized the importance of technological accumulation. Because of the shortening of product lifecycle, time-to-market became more important; organizations tended to adopt team-based and project-based structure; strategic alliance between companies and external networking also became new focuses of firms.	Knowledge was integrated in all phases of the innovation process from marketing to manufacture (but mainly in the research phase) and, therefore, considered as a necessary prerequisite for innovation; successful innovation involved coordinated and parallel processes with the integration of research links and external research environments. Coordinated processes referred to the system integration of innovation network of partners from key engineers to sales managers; parallel processes referred to the involvement of multiple actors so as to increase development speed.	
5th generation system integration and networking model (mid-1990s – early 2000s)	Globalization is the characteristic of this period; the advent of Information and Technology (IT) facilitated the diffusion of knowledge cross companies, sectors and even countries than ever before. Companies remained committed to technological accumulation and strategic networking, and speed to market remained of importance. IT methods such as Computer Aided Design (CAD) and Computer-aided engineering (CAE) was widely adopted for internal databases (e.g. manufacturing) and external data link (e.g. customer interface) in companies.	It essentially extended the parallel development of the fourth-generation by the emphasis on the role of IT methods in the innovation processes, it stressed that innovation processes should be more integrated, flexible and open-end by collaboration of external research facilities and cooperation in the marketing area; networking was of importance with the involvement of both vertical linkage with suppliers and customers, and horizontal linkages in a variety of forms such as joint venture and alliances along the whole innovation process.	

First, the impetus on which innovation relies evolves from R&D to knowledge. The early models linked innovation processes exclusively to technological change with particular emphasis on the fundamental effects of the amount of R&D activities on the opportunities for technological innovation in large firms and industry (Freeman & Soete 1997). For example, both technology push and demand pull models regarded R&D activities as a key intermediate stage of the innovation process. On the contrary, later models dedicated some effort to broaden the concept of technology and product by introducing knowledge in its widest sense and treating knowledge – both codified and tacit – as an important input in innovation and production (Berkhout et al. 2006).

Second, the mode by which innovation is developed evolves from linear process to an interactive network. Early models emphasized the lifecycle of an innovation "from the initial idea or opportunity through to the exploitation of the new innovation in the market"(Du Preez et al. 2010) by identifying the stages of innovation (e.g. Utterback & Abernathy 1975; Rogers 1983). Even through the coupling model and the integrated model developed the concepts of "loop" and "cycle", the looped and cyclic interactions took place within and between different stages of the innovation process. While the later system of the integration and networking model updated conventional recognition of the chronological phases by interactive network through integrating widespread linkages of the firm with users, suppliers, joint-ventures and alliances along the whole innovation process. Interactive networks instead of sequential chains also imply that the innovation process is characterized by the creation of a variety and selection of behaviors owing to interaction and collaboration (Rothwell 1994) rather than lifecycle of product development.

Third, the scope in which innovation is fostered evolves from closed organism to open system. The early models emphasizing internal R&D, and focused mostly on how innovation is developed by organizations themselves, or through cooperation of inter-departments within an organization. While the fifth-generation model turned to more integrated, flexible and open-ended collaboration with external research facilities and cooperation as the sources of innovation and, thus, broke the organizational boundary of the innovation process established by the earlier models and regarded innovation as an open

system.

4.1.1 The emergence of the open innovation model and its application to cultural organizations

The open innovation model was an attempt at modelling the process of innovation at the beginning of the 21st century. Although the generation of innovation scholars have attempted to identify various models to capture changing innovation environment and new approaches to innovation, most of the emerging models involve the common feature of "open innovation" (e.g. Berkhout et al. 2006; Du Preez et al. 2010), or can be summarized as "open innovation model" (Chesbrough et al. 2006; Brant & Lohse 2014).

The concept of open innovation dates back to Chesbrough (2003a; 2003b), who defined it as "the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively" (Chesbrough 2006). Open innovation is supposed to be an antithesis of "closed innovation", which emphasizes internal innovation based on all knowledge and R&D activities produced internally by the employees of an organization (Chesbrough 2003a). On the contrary, open innovation places particular emphasis on external ideas commercialized by deploying through external paths to the market, or on external channels through which internal ideas are commercialized in order to generate value. Although such approach of the open-closed dichotomy gives rise to debate because it over-simplifies the complexity of the innovation process and disregards cooperation and partnership between companies in the closed innovation paradigm (Marques 2014), it has attracted academic and practical attention to open innovation by tackling the open property of industrial R&D and market exploration in the process of innovation.

The Open innovation model emphasizes the combination of both internal and external ideas and paths to market so as to advance organizational innovation, and it is relative to the earlier closed networks of innovation resting mostly on internal generation of knowledge and internal market channels; hence, open innovation is regarded as a new generation of innovation process model.

Figure 8 depicts the open innovation model with a clear picture of inflows and outflows of ideas and technology that are acknowledged by the organization with the aim to multiply opportunities in the market. Networking and collaboration are at the center of open innovation processes. Making use of external sources of knowledge and external paths of market requires the participation of the organization in essential collaboration or innovation networks, such as crowdsourcing, open souring and R&D clusters. Such collaboration furthers the division of labor and specialization in R&D, which in turn reduces time and labor costs as well as innovation while improving absorptive capabilities and innovation processes (Brant & Lohse 2014). Moreover, it also calls for open logic and strategies for innovation by (1) emphasizing an early interaction between knowledge and business; (2) consolidating intensive networks with specialized suppliers and early users; (3) integrating both hard and soft knowledge about technology and markets (Berkhout et al. 2006).

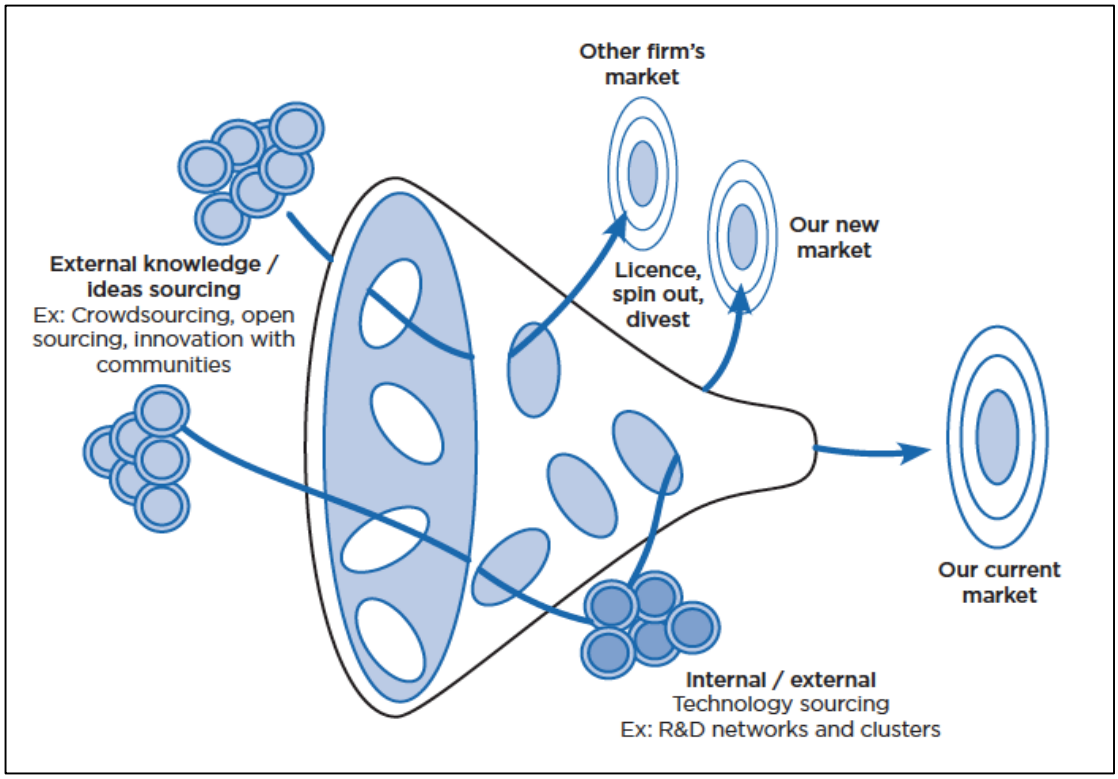


Figure 8 The illustration of open innovation model

Source: Brant & Lohse 2014

In the cultural and creative sectors, the open innovation model is employed by empirical studies to analyze the framework and structures of networks and collaborations that promote learning and cultural production innovation within, and across cultural organizations (Aoyama & Izushi 2003; Jaw et al. 2012; Castro-martínez & Fernández-baca Casares 2012; Castro-Martínez et al. 2013). For example, Aoyama and Izushi (2003) pointed out that the emergence of a successful video game industry in Japan was the consequence of the combination of creative resources originating in popular cartoons and animation sector and technological knowledge from the consumer electronics industry. Castro-martínez and Fernández-baca Casares (2012) described and analyzed the knowledge bases and interactive collaboration involved in the innovation process of a Spanish heritage restoration institution arriving to the conclusion that knowledge-sharing through the interaction of professionals in the sector was a necessary condition of innovations in both, the technological and symbolic dimensions. Castro-Martínez et al. (2013) stressed the interaction between creativity and scientific knowledge in the cultural industries through the analysis of interactive collaboration and learning process in the innovation system of the music industry, and they reached the conclusion that the interactions among cultural heritage entities, universities and other knowledge production organizations should play an institutional role in improving innovation processes in the cultural industries.

These examples emphasize the importance of interaction and collaboration in cultural production and innovation by cultural organizations. Most of the studies view the integration of art and the ICTs as an important characteristic of innovation process in cultural organizations. As a result, the external knowledge that cultural organizations seek is mostly science and technology-based knowledge; and the mode of interaction mostly goes to the combination of creativity and scientific and technological knowledge. But the nature of cultural production also prompts researchers to take the importance of symbolic knowledge in the process of open innovation into consideration.

4.1.2 Knowledge forms, learning process and innovation modes in the open innovation model

Many scholars state that different forms of knowledge are associated to the difference in the modes of learning and innovation (Asheim & Coenen 2005; Jensen et al. 2007). Knowledge can be identified as different forms in terms of differing perspectives, such as explicit and implicit knowledge, codified and tacit knowledge (Polanyi 1967; Jensen et al. 2007), global and local knowledge (Jensen et al. 2007), analytical and synthetic knowledge (Asheim & Coenen 2005), and so on. Such dichotomy doesn't mean that different forms of knowledge are in opposition and instead, they are complementary because tacit knowledge is a prerequisite for interpreting explicit knowledge (Howells 2002). In many cases, knowledge may embrace both implicit and explicit elements at the same time.

In addition, different forms of knowledge are mutually dependent. For example, most analytical knowledge is codified and explicit because it is based on scientific knowledge resulting from deductive processes and formal models, whilst most of the synthetic knowledge is tacit and implicit because it rests on the application of existing knowledge through interactive learning with clients and suppliers (Asheim & Coenen 2005). Furthermore, codification makes knowledge more explicit so as to enhance the ability to share it with society at large, thus becoming more or less globally accessible, whilst tacit knowledge is often rooted in local experience and implicit significance is only acquired through practical works and interactive collaboration at local level (Jensen et al. 2007).

From a knowledge-based view, innovation can be understood as a learning process (Lichtenthaler 2013), involving both the transfer of knowledge and the creation of knowledge (Harkema 2003). On the one hand, R&D and new product development are rational plans, and organizational learning is a predictable and controllable process wherein most of the learning takes place before the execution phrase of new product development (Brown & Eisenhardt 1995; Gieskes & van der Heijden 2004). On the other hand, R&D and product innovation processes themselves are, essentially, incremental learning processes

because they have a primary role in generating new knowledge and distributing the knowledge throughout the organization that knowledge development and accumulation is synonym with learning (Carlsson et al. 1976; Nelson & Winter 1982; Gieskes & van der Heijden 2004).

"From whom to learn" and "how to learn" are two basic issues related to the learning process. With respect to the first issue, knowledge can be learnt by oneself or from others. Concerning the former, R&D laboratories of large industrial firms have been a major source of developing knowledge about artefacts and techniques right up until today (Jensen et al. 2007). In respect of the latter, knowledge is often acquired from external sources by monitoring, mobility and collaboration. According to Martin and Moodysson (2011), knowledge is sourced in the following manners:

- **Monitoring**, searching for knowledge outside the organizational boundaries of the firm without direct interaction with these external sources, including primary source (e.g. competitors, suppliers, and users, etc.) and secondary sources (e.g. scientific journals).
- **Mobility**, retrieving knowledge inputs through the recruitment of key employees from external organizations, like university and firms.
- **Collaboration**, gathering knowledge through the exchange between actors by direct interaction. These actors can be individuals or organizations.

Regarding how to learn, the existing literature identifies three approaches to learning process, including learning by doing, by using, and by interacting. They are described as follows.

- **Learning by doing**, also known as "on-the-job-training", is regarded as important as schooling in the formation of human capital (Lucas 1988). Learning by doing emphasizes that the acquisition of knowledge is associated with the accumulation of production experience by a firm (Arrow 1962) . It implies the importance of experience that influences the incentives to innovate. Knowledge is the by-product of production experience; a firm may gather information about product performance and production processes during manufacture; and this, in turn, helps the firm to improve the quality and production process of the next generation

of products.

- **Learning by using**, as a term, goes back to Rosenberg (1982), who argued that "the performance characteristics of a durable capital good often cannot be understood until after prolonged experience with it" (p.122), which stresses that knowledge and experience are involved in the utilization by the final user rather than production processes. A firm can learn from the feedback provided by final users regarding their experience, which helps the firm to innovate with the purpose of better meeting user needs.
- **Learning by interacting** focuses on the interaction between producers and users in the innovation process (Lundvall 1988). The process of learning should be two-way rather than unidirectional. Lundvall (1988) assumed that innovation was reliant on knowledge from both producers and users; producers had strong incentives to monitor what was going on in user units to acquiring information about user needs and their receptiveness to adopting new products; meanwhile users also needed detailed knowledge from producers given that new and in-use value characteristics relate to their specific needs.

Linking to knowledge forms and learning processes described above, Jensen and his colleagues (2007) identified two modes of innovation. The first mode is the Science, Technology and Innovation (STI) mode, which is based on the formal processes of R&D in order to produce explicit and codified knowledge. The other is the Doing, Using and Interacting (DUI) mode, which relies on experience-based learning from informal interaction so as to strengthen competence-building. Therefore, knowledge forms, learning processes, and innovation modes are connected under the open innovation model. As discussed above, open innovation model integrates internal and external sources of ideas, technology, and market paths of innovation processes. We assume that internal sources in the open innovation model mostly create global, codified, explicit and analytical knowledge through internal R&D processes, thus relating to the STI mode of innovation; meanwhile external sources of the open innovation model concentrate on local, tacit, implicit and synthetic knowledge sourced by

monitoring, mobility and collaboration through informal learning processes, including learning by doing, by using, and by interacting; and hence, it is related to the DUI mode of innovation (see table 6).

Table 6 Knowledge forms, learning process and innovation modes in open innovation

Open innovation	*Knowledge forms*	*From whom to learn*	*How to learn*	*Innovation mode*
Internal sources	Global, codified, explicit, analytical.	By itself	Formal R&D process	STI mode
External sources	Local, tacit, implicit, synthetic	Monitoring, mobility, collaboration	By doing, by using, by interacting	DUI mode

Source: elaborated by author

It is worth noting that this assumption is based on an ideal model for facilitating our understanding in terms of the principles that Chesbrough (2003a) raised to distinguish open innovation from closed innovation (Marques 2014). In reality, the relationship between open and closed innovation, further between external and internal sources of knowledge in the open innovation model, is more like a continuum. For example, internal R&D activities belong to the scope of closed innovation, but R&D also benefits from social interaction to create opportunities to exchange thoughts, ideas and opinions (Marques 2014). It is the same with arts and humanities research. Although arts and humanities researchers have long been perceived as "lone scholars", currently they keep abreast of the times by working increasingly in collaborative teams inside and outside academia to solve complex societal problems (Bakhshi et al. 2008).

4.1.3 Interaction, institution and innovation system

Innovation, to a large extent, is an interactive process in accordance with the fact that, nowadays, many innovative activities are involved in interactions among innovation agents in both intra- and inter-firm collaborations. First, in an economy characterized by vertical division of labor and by ubiquitous innovative activities, a substantial part of innovative activities take place in unites separated

from the users of innovation whilst a successful innovation must be based on knowledge about the needs of potential users (Lundvall 1988; Freeman et al. 1982: 124). Second, the cost of R&D is enormous, and it is often cheaper and better to "buy" R&D outcomes than to develop it internally and, on the other hand, many firms patent their Intellectual Property and profit from others using that technology through licensing agreements, joint ventures and other arrangements (Chesbrough 2003b). Third, inter-firm collaborations can help share the costs and rewards of innovative activities, and thus decrease the uncertainty surrouding from innovation (Bureth et al. 1997).

Such marked changes from closed to open innovation evidence the opinion that the scope of innovation is beyond the boundary of any single firm nowadays (Chesbrough 2003a), which, in turn, consolidates the importance of interaction in promoting innovation. The existing literature identifies two modes of interaction. The ***user-producer interaction*** mode, first proposed by Lundvall (1988) in the discourse about the interactive aspect of innovation processes as a micro-foundation of a national system of innovation, stresses the interaction between producers and potential users of innovation so as to transmit information about the in-use value of the new characteristics of a product to the final users of the innovation. He argued that both process and product innovations were reliant on user-producer interaction if they were within user units or at user level. Producers need information about potential users for demand-pull innovations and for monitoring their willingness and capacity to accept these innovations, whilst users require direct cooperation with producers to receive the necessary services during the pre-, in-, and after-sales phases, as well as for establishing "trustworthiness" so as to reduce uncertainty owing to asymmetric information on products. This two-way interaction constitutes Arrow's (1974) so-called channel and code of information where a flow of knowledge can to take place and learning by interacting can increase the effectiveness of the process of innovation.

The ***supplier-producer interaction*** mode, which dates back to Dyer's (1996; 1997) cross-country comparisons of industrial development and competition patterns in the United States and Japan, focuses on the peculiar network relations underlying supplier-producer interactions that may lead to

technological advantage and influence the co-evolution of innovation and market structures (Malerba & Orsenigo 2009). The suppliers in the interaction can be component producers and R&D institutions (such as universities and research institutions). According to Dyer (1997), an effective supplier-producer interaction can simultaneously achieve the twin benefits of higher productive efficiency and lower transaction cost through (1) repeated transactions with the same suppliers, (2) high volume of exchange between transactors, (3) extensive information sharing reducing asymmetric information, (4) the use of non-contractual, self-enforcing safeguards for an indefinite time horizon, and (5) joint investments in co-specialized assets. Under the supplier-producer perspective, particular emphases have been given on such inter-firm transaction arrangement in both upstream and downstream industries and the vital role of the integration of production, education and research in the national system of innovation that has been proven by the Silicon Valley model (Chesbrough 2003a).

Interaction furthers a variety creation process by creating opportunities for information sharing between innovation agents. Effective channels and modes of information benefit the smooth transmission of information and prevent the opportunistic behavior resulting from asymmetric information. Therefore, a prerequisite for successful supplier-producer and user-producer interactions is to set up certain institutions that guarantee effective channels and modes of information. Both Lundvall (1988) and Chesbrough (2003a) argued that purely hierarchical relationships – e.g. unequal cooperation in view of financial power and scientific and technological competence, or contact constraints – were inefficient and, instead, trustworthiness was necessary to overcome the uncertainty and opportunistic behaviors involved. But establishing mutual trust will lead to extra setup cost in terms of time and finance and hence, user-producer interaction and supplier-producer interaction play more efficient roles in rapid and radical technological changes and in the long-term time horizon (Dyer 1997).

But institutions relating to innovation aren't limited to trust at organizational level. Innovation system literature points out that such interactions are shaped and influenced by a wide range of institutions at macroscopic and systemic level. In a study of Japan's industrial competition and

economic performance during the 1970s and 1980s, for example, Freeman (1987) attributed Japan's economic surge in the post-war period to a set of successful institutions ranging from industrial policy and science policy to basic education, industry structures, tax systems and wage incentives, which greatly favoured the inter-firm cooperation in research clubs, the integration of research, design and production in cooperative relations between the divisions within a firm, or the firms within a keiretsu (Dore 1988). Nelson (1993) also pointed out that nationwide institutions determined the interaction of firms, universities and governments within a national innovation system with a number of case studies based on 15 prominent and large market-oriented industrial countries and regions. Even in the cultural sector, Vicente et al. (2012) found, in a cross-country comparison of innovation in European museums, that different cultural policies influenced the innovation output of museums by altering their incentives to collaborate. In short, the innovation system viewpoint argues that interaction constitutes an exclusive environment where innovation takes place, successful systems of innovation are reliant on the existence of an environment of continuous knowledge production, knowledge use and innovation whilst institutions will shape the interaction of actors within the system of innovation by which favourable institutions will benefit the existence of innovative activities (Edquist 1997).

4.2 CULTURAL PRODUCTION AND INNOVATION IN MUSEUMS

As Sundbo (2009) pointed out, product innovations vary from sector to sector but innovation processes and their general characteristics are more or less similar accross sectors. Therefore, it is possible for researchers to describe and analyze the process of innovation in museum organizations on the basis of the open innovation model by focusing on the settings of knowledge form, learning process, interactive networks and innovation modes embedded in the course of cultural production by museums.

We concentrate on cultural production in museum organizations as the unit of analysis in guiding the process of innovation. The process of production

and the process of innovation are closely dependent (Lundvall 1988). Production is a repetitive process on the base of certain routines developed through prior innovation. On the one hand, innovations usually take place in the process of production; on the other hand, innovation is the single most important factor that restructures the system of production (i.e. process innovation) and reforms the outputs of production (i.e. product innovation) (Lundvall 1988). This also signifies that our study will mostly focus on technological and cultural innovation rather than organizational innovation. Different domains of production, in essence, require different production inputs and involve different approaches to learning and interaction, thus corresponding to different modes of innovation. Our effort is therefore to match innovation types with production domains that differentially embrace the combinations of knowledge base, learning process and interaction types. In order to enable this matching, we begin by analyzing the complexity of cutural production with reference to product inputs and value creation mode with emphasis on the four dimensions of analytical/synthetic knowledge, symbolic knowledge, production and experience in museum context; we then identify four domains of cultural production in terms of the dimensions of product inputs and value creation; finally, we select and describe four concrete functional activities as illustrative samples.

4.2.1 Complexity of cutural production by museum organizations

The cultural production process is more complex in museum organizations when compared to the manufacturing sector, or even to other cultural organizations. This complexity is embodied in both production inputs and value creation modes.

As far as production input is concerned, scholars regard museums as labour and knowledge- intensive organizations (Friedman 1994; Järvenpää & Mäki 2002). We think that labour and knowledge are two sides of the same coin. Labor is the purveyor of knowledge; knowledge embodies the capacity for learning and production of labourers. From a resource-based view, museum's production relies on a larger amount of labor accompanied by other production

essentials such as money and technology. From knowledge-based view, knowledge is the major input in museum production (Grant 1996), wherein symbolic knowledge constitutes a large proportion of the knowledge stock in museum organizations whilst analytical and synthetic knowledge represents a smaller proportion but is still necessary for cultural production as well, as has been evidenced in figure 6.

The innovation process differs greatly among various industries and sectors whose innovation activities are based on specific knowledge bases (Asheim & Gertler 2005). On the basis of the classification of analytical and synthetic knowledge (Asheim & Coenen 2005), Asheim et al. (2007) expanded this dichotomy by adding the symbolic knowledge base, equivalent to "the creation of meaning and desire, as well as in the aesthetic attributes of products, producing designs, images, and symbols, and in the economic use of such forms of cultural artifacts" (Asheim & Hansen 2009). To be precise, museums are symbolic knowledge-intensive organizations, whose cultural meaning does not only originate from certain historical, artistic or scientific value that the original objects of museum collection contain, but is also created by the interpretation that how museum staff define specific meaning to an object as well as by the translation from defined meaning of objects to understood meaning by audience during the interaction of visitors with exhibits themselves, and with guides and educators in the museum (Kéfi & Pallud 2011). This is because "symbolic knowledge is characterized by a distinctive tacit component and is usually highly context-specific" (Asheim & Hansen 2009). As a result, the creation and diffusion of symbolic knowledge is reliant on informal and interpersonal (face-to-face) interaction in the professional community.

Analytical and synthetic knowledge is different from symbolic knowledge on account of their scientific and engineering attributes. As table 7 shows, analytical knowledge is scientific knowledge that explains the natural world, and that comes from theoretical studies of universities and research teams; therefore, it is highly codified and universal. Synthetic knowledge is engineering-related knowledge that applies to, or combines with existing knowledge in new ways, which often results from applied studies aimed at problem-solving through interactive learning with supplier and customers; and hence, it is partially

codified and strongly tacit. In the museum context, analytical and synthetic bases of knowledge stock are relatively scarce. Analytical knowledge is demanded mainly by those specific museums relating to science and technology. For example, many natural science museums require that their staff should have a biology background. Synthetic knowledge is intensive in the restoration and conservation departments of museums. Heritage restoration and conservation require museums to seek and apply existing knowledge and techniques in new ways whenever possible so as to enable the recovery and maintainance of the original status of heritage as well as to reduce the risk of damage to heritage pieces owing to inadequate storage or exhibition. In many circumstances, it is necessary to incorporate symbolic knowledge in the restoration of artworks when symbolic meaning and cultural value that artworks contain should be considered (De-Miguel-molina et al. 2013).

Table 7 The comparison of three bases of knowledge

Analytical knowledge (Science Based)	Synthetic knowledge (Engineering Based)	Symbolic knowledge (Arts Based)
Developing new knowledge about natural systems by applying scientific laws; know why	Applying or combining existing knowledge in new ways; know how	Creating meaning, desire, aesthetic qualities, affect, intangibles, symbols, images; know who
Scientific knowledge, models, deductive	Problem solving, inductive, custom production	Creative process
Collaboration within and between research units	Interactive learning with customers and suppliers	Learning by doing, in studio, project teams
Strong codified knowledge content, highly abstract, universal	Partially codified knowledge, strong tacit component, more context specific	Importance of interpretation, creativity, cultural knowledge, sign values, implies strong context specificity
Meaning relatively constant between places	Meaning varies substantially between places	Meaning highly variable between place, class, and gender
Drug development	Mechanical engineering	Cultural production, design, brand

Source: Asheim & Hansen 2009

The scarcity of analytical and synthetic knowledge doesn't imply the rejection of science and technology by museum organizations. On the contrary, today's museums incorporate technology, particularly ICTs, to a large extent, in their day-by-day works (vom Lehn 2005; Ioannidis, Toli, et al. 2014; Karp 2004; De-Miguel-Molina, De-Miguel-Molina, et al. 2014). The exploitation of ICTs also creates more opportunities for museums to innovate by taking advantage of technological advances (Bakhshi & Throsby 2010; Costa Barbosa 2013). But the limited analytical and synthetic bases of knowledge employed by museums reveals that such technologies are seldom developed through internal R&D by museums and, instead, they are mostly imported from other industries and sectors through external sourcing, which requires museums to participate in interactive networks and collaboration with their suppliers. Furthermore, many studies focus on technological innovation as the unit of their studies (Camarero & Garrido 2008; Camarero et al. 2011; Camarero & Garrido 2012; Camarero et al. 2015), but little concern has been given to the extent to which museums innovate by the utilization of ICTs. The report *How Arts and Cultural Organizations in England Use Technology* (Digital R&D Fund for the Arts 2013) disclosed that museums were less engaged with digital technologies compared to other art and cultural organizations. This suggests that technological innovation in museums by the use of external technology might be overestimated.

> **Proposition 1**: the more a museum, or a department in a museum, utilizes symbolic knowledge inputs, the more tacit, implicit and local knowledge flow they involve, the more extensively their employees engage in close and intensive interaction with other actors. The more a museum, or a department in a museum, use analytical knowledge inputs, the more codified, explicit and global knowledge flows they embrace, the more extensively their employees focus on internal R&D activities or collaborate with universities or research institutions.

As far as the value creation process is concerned, museums are characterized by dual properties – on the one hand, a museum is a productive unit (Johnson & Thomas 1998) that produces manufactured products by which consumers can construct distinctive forms of individuality, self-affirmation and

social display (Scott 2004); on the other hand, a museum is a public experience institution (Sundbo 2009) that supplies experience consumption concentrating on entertainment, edification and information (Scott 2004).

As productive units, museums produce by means of transforming inputs into outputs. Museum production relies on a wide range of inputs, including human capital (e.g. general, speciliazed, auxiliary and voluntary staff etc.), financing capital (e.g. funding and revenues etc.), knowledge (e.g. museolgical discourse), and technology as well as the necessary infraestructure for production (e.g. building, equipment, installation and collection objects etc.). Here we delimit outputs of production to tangible outcomes of a museum's functional activities, such as digitized imagery, exhibitions, educational programes, catalogues, scientific articles, and so on. Each has its own in-use value; but their first value is "communication" as cultural products (Bilton & Leary 2002). Thus it can be seen that production is the crucial phrase of the creation of both functional value and "communication value" in cultural products and services.

As experience institutions, museums supply the public with intangible outputs, i.e. experience. According to Sundbo (2009), experience is an intangible and immaterial service sold on the market, or produced and provided freely by the public sector. Experience is co-produced by consumers through their involvement in the process of consumption and thus, it is characterized by its "ephemeral" nature and "co-terminality" of production and consumption (Hauknes 1998). The experience takes place in the mind (Sundbo 2009); therefore, it is mental consumption. In the museum context, experience is mostly embodied by intangible services [1] such as visiting exhibitions, joining educational events, museum shops and catering services, both online and on site. For example, an exhibiton is a cultural product [2], but visiting the exhibition is an

[1] Experience can be seen as a particular form of service. Although scholars distinguish experience from service by emphasizing its peculiarities in terms of supply domination, consumption sites and technology density (Pine & Gilmore 1999; Sundbo 2009), we tend to focus on the common characteristics of experience and service and view them as two sides of the one thing – service is discussed from the side of producers, and experience from the side of consumers.

[2] Exhibition is a cultural product on accounts of the fact that (1) exhibition's production

experience consumption because the process of visiting usually is a "mental journey", reaping new knowledge or simple spiritual pleasure. Therefore, the utility of experience is often evaluated at the individual level, depending on whether his or her needs were met or not. This requires suppliers of experience, i.e. museums, to offer different services to different types of visitor, such as a peaceful environment to appreciate exhibits, extra information to understand the exhibition's background, opportunities for interaction to make visiting enjoyable, or easy access to exhibition sourvenirs, and so on. In sum, the utility of experience is a function of the quality (not quantity) of experience, which is linked to value-adding services that the public service department can offer by targeting different social groups.

Production and experience reflect different components of cultural production; they are not of conflict but are two sides of the museum. Production and experience can be seen as two functions of museums, whose boundaries are more or less embodied by different functional activities in the museum organization. Conservation, exhibition, research and education are functional activities relating to production, whilst communication and public service are associated with experience. Production and experience have different implications for innovation as well. If innovation in production is more or less similar to that in manufacturing, innovation in experience is, in contrast, quite different in some aspects. According to Sundbo (2009), innovation processes in experiences are mostly based on quick ideas and employee and customer involvement and based on customer-oriented problem-solving rather than R&D or curator-oriented new product development. The increasing importance of experiences also may influence the process of innovation in production. A market orientation strategy encourages museums to transform conventional curator-oriented production to visitor-oriented production (Camarero & Garrido 2012), thus strengthening the vital role of user-producer interaction in fostering innovation in cultural production.

> **Proposition 2**: In museum organizations, the production function is embedded in the restoration, conservation, research, exhibition and education domains; the experience function is embedded in the

is separated from its consumption, and (2) exhibition is tangible and lasting.

communication and public service domains.

4.2.2 Matching production domains with innovation types

On the basis of the above discussion, we can deconstruct cultural production into four major domains – i.e. (1) analytical/synthetic knowledge-driven production, (2) analytical/synthetic knowledge-driven experience, (3) symbolic knowedge-driven production, and (4) symbolic knowledge-driven experience – in terms of kowledge input of production and modes of value creation. Each domains further contains different functional activities in museums respectively, as exhibited in table 8. But it doesn't mean that these functional activities grouped in the same domain are totally homogeneous in the utilization of knowledge and the pattern of value creation. On the contrary, they are scattered in the domain according to where they fall along the spectrum of the two dimensions, illustrated in figure 9.

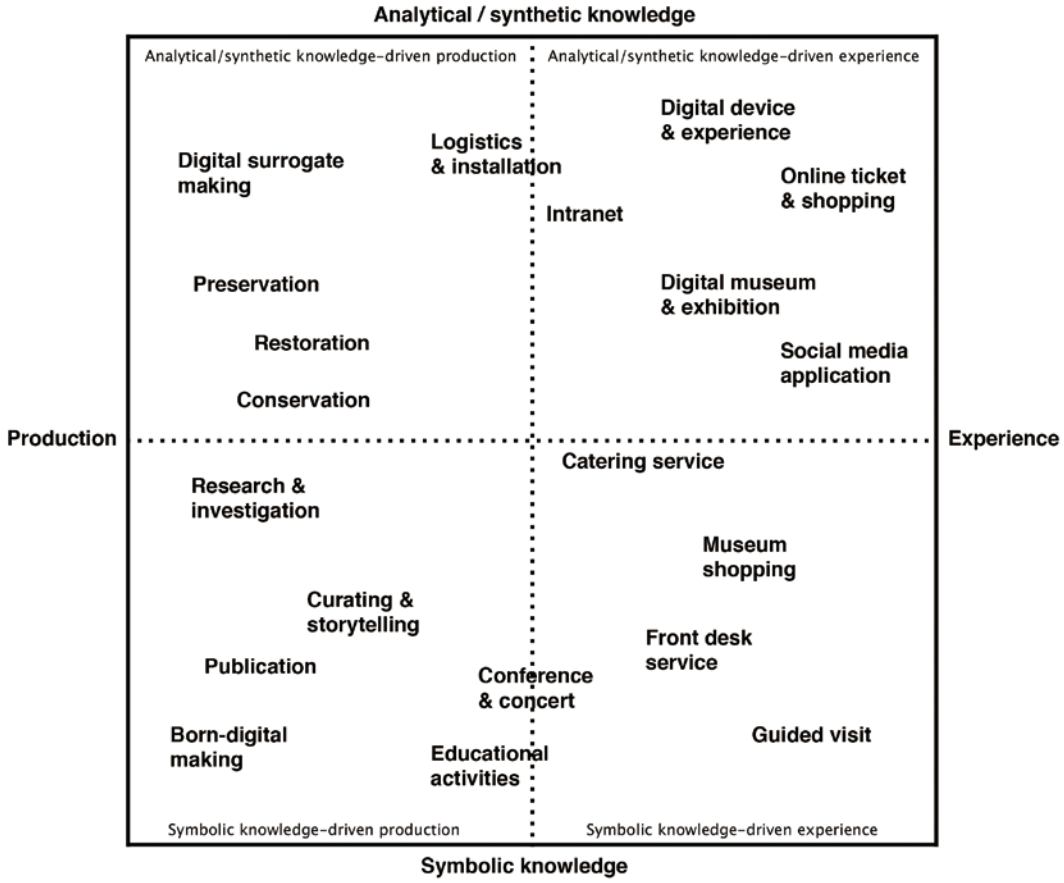


Figure 9 Four domains of cultural production in terms of knowledge bases and value creation

Furthermore, knowledge base is the theoretical basis and starting point to classifying the type of museum innovation in our study, technological innovation is defined in terms of anaytical and synthetic knowledge bases and cultural innovation is defined in accordance to symbolic knowledge. Therefore, It is reasonable to match the four production domains that we have identified above with their corresponding types of innovation – i.e. technological innovation takes place in analytical/synthetic knowledge-based production and experience domains, whilst cultural innovation in symbolic knowledge is based on the production and experience domains, as shown in table 8.

Table 8 Marching production domains with innovation types

		Value creation	
		Production	*Experience*
Knowledge base	*Analytical/ synthetic*	Production-based technological innovation • Conservation • Restoration • Preservation • Logistics & installation • Digital surrogate making	Experience-based technological innovation • Intranet • Digital museum & exhibition • Digital device & experience • Social media application • Online ticket & shopping
	Symbolic	Production-based cultural innovation • Research & investigation • Curating & storytelling • Publication • Educational activities • Born-digital making	Experience-based cultural innovation • Front desk service • Guided visit • Catering service • Museum shopping • Conference & concert

It is worth to stress that our objective is not to match cultural production domains with innovation types, but to analyze the innovation process by focusing on specific domains where different types of innovation take place with the help of such matching. To achieve this objective, we further select four concrete functional activities – restoration, exhibtion, digital museum, and visitor services – as our unit of analysis.

4.2.3 Four functional activities in the museum organization

Restoration

Restoration, which refers to the repair and reconstruction of precious objects, has been a core activity in a museum's responsibility for the care of its artefacts in the last one hundred years (Michalski 2004). Restoration is usually in the charge of a collection management department or unit of the museum. In large museums, there are full-time restorers dedicating to restoration work; in small and medium-size museums there are just different roles of registrar, conservator and restorer that one or two people share; in museums that don't have a conservation department or team, restoration is also available by contract of independent specialists or, in some countries such as Spain and Italy, by state sponsored conservation facilities.

Restoration involves actions that are taken to modify the existing material and structure of an object in order to return it to a new or original condition [1]. Such material and structure include "color, form, signs of aging and de-coloration, content of salts and contaminations, biodegraders, damage and deformation, and signs of usage" [2], which cover a wide range of analytical knowledge, such as physics, biology and chemistry. The process of restoration also relies on the application of synthetic knowledge base such as would be laser technology and high power microscopes. In short, restoration is an anyaltical and synthetic knowledge-intensive activity.

A restoration process aims to revert an object to a known earlier condition with minimal intervention, which requires, in essence, to develop options for improvement by employing new knowledge and resources. De-Miguel-molina et al. (2013) defined innovation in restoration as "beautiful innovation", which is embodied in three aspects: (1) the development of a new intermediate product that facilitates or enhances examination, analysis, and

[1] See the Help Sheet about restoration defined by the government of South Australia, available at http://community.history.sa.gov.au/files/documents/conservation-restoration-preservation-definitions-pdf.pdf

[2] Detailed information of conservation and restoration is available at Committee for Conservation of the ICOM, available at http://www.icom-cc.org/330/about-icom-cc/what-is-conservation/conservation:-who,-what-amp;-why/#.WJg5LXeZNE5

restoration; (2) an increase in the speed of examination, analysis, and restoration; and (3) an increase in the quality or accuracy of the examination, analysis, and restoration process. Yet, the original condition of objects often contains aesthetic or historical value, thus incorporating symbolic knowledge in the process of restoration (De-Miguel-molina et al. 2013). But the significance of restoration is not to create new meaning or value, and symbolic knowledge is used to provide restorers the necessary background for restoration. Therefore, innovation in restoration is characterized by production-based technological innovation.

Exhibition

Exhibitions are one of the most remarkable cultural products of museums at the service of the public and society in which they are located. The making of an exhibition is a complex process that includes planning, research/interpretation, design, production, and installation stages based on the division of labour involving the whole museum. In large museums, the making of exhibition is usually reliant on project-oriented collaboration between different departments or professionals, such as the administrator (e.g. board member, director and exhibition manager), specialist (e.g. curator, conservator, designer, and educator, etc.), techniacians (e.g. photographer, lighting engineer, and sound engineer etc.), and craftpeople (e.g. preperators, electricians, security guard, and mounting team etc.) (Herreman 2004). In small and medium-size museums, curators may take a more comprehensive role including different degrees of administrative, academic and developmental responsibilities. Additionally, some museums also engage independent curators to produce exhibitions for their institutions.

The fundamental nature of a museum exhibition is storytelling (Bedford 2001) although technologies and techniques also play important roles in the production and installation of exhibitions. In view of its nature and definition, an exhibtion is “a communication medium based on objects and their complementary elements, presented in a predeterminated space, that uses special intepretation techniques and learning sequences that aim at transmission and communication of concepts, values and/or knolwdge” (Herreman 2004). This emphasizes the cultural properity of exhibitions. New exhibition

development refers to new concepts, values and/or knowledge transmitted and communicated on the basis of new projects exhibited in terms of new storytelling approaches rather than the adoption of new technologies. The introduction of new technologies in an existing exhibition may improve the visitor experience, but it doesn't alter the nature of the exhibition because technologies cannot create meaning and value. For this reason, innovation in exhibition can be delimited as a production-based cultural innovation, which is mainly embodied in the generation, development, and application of storytelling in the making of the exhibition, in which curators are the key person to undertake or facilitate innovation in exhibitions.

Digital museum

The digital museum is an emerging domain of museographical works made possible by the advancement of ICTs and the popularization of computers in the last twenty years. Because digital technologies can help museums provide accessibility to otherwise inaccessible museum collection across a wide demographic (Ch'ng et al. 2013), the digital museum practice has played an increasing role in delivering cultural services in museum organizations. In the narrow sense, digital museum refers to the digital footprint of a physical museum, an example is the website of a museum; in the broad sense, it means the digitalization of museums, which stresses the integration of digital heritage and digital techniques with functional activities to facilitate communication and enhance the visitor experience, for instance. In some large and pioneering museums like the Tate museum [1], there are full-time digital specialists and even a digital department in charge of the overall digital strategy for the development of specialized digital solutions and services in the museum; in some small and medium museums, they tend to outsource all digital works to external IT providers.

Digital museum is at the intersection of cultural heritage and digital media (Parry 2007) and hence, it is characterized by scientific and technological

[1] See *Tate Digital Strategy 2013–15: Digital as a Dimension of Everything,* available at http://www.tate.org.uk/research/publications/tate-papers/19/tate-digital-strategy-2013-15-digital-as-a-dimension-of-everything

features beyond the cultural domain (UNESCO 2003). Innovation in digital museum practice is mainly encapsulated by the development and utilization of digital objects (e.g. digitalized objects), digital networks (e.g. website construction), digital experience (e.g. 3D and VR in display), and digital devices (e.g. information station and QR in visitor service) with the aim of narrowing the distance between museums and their actual and potential visitors, physically and intellectually, as well as enriching the visiting experience. Therefore, it can be regarded as an experience-based technological innovation.

Visitor services

Visitor services refer to the provision of an informative, pleasant and comfortable visit to museum goers in the physical, intellectual and social sense (Woollard 2004). In its broadest sense, any part of a museum, where staff can meet the public face to face on a regular basis, belongs to visitor services, including, but not limited to, front desk service, guided visits, the catering service, museum shop, and other special events such as conferences and concerts.

Visitor services place quality and accessibility at the center of every experience. Good visitor experience allows visitors to enjoy the exhibitions and events without becoming frustrated, uncomfortable or fatigued. Well-designed accessibility allows visitors to have easy access to the museum's facilities at physical and social and cultural levels. In order to improve quality and accessibility of visitor services, museums have to investigate actual and potential visitors, understand their needs, and provide differente services that are adapted to different visitor groups.

Visitor services involve a large amount of daily interaction between museum staff and visitors; therefore, they are viewed as a symbolic knowledge-intensive domain in any museum organization. Many museums collect relevant information about visitor structure and needs through direct questioning of visitors during their interaction. On this basis, museums innovate in visitor services by improving experience quality and by enhancing audience reach on the basis of the local, tacit and symbolic knowledge acquired from visitors.

4.3 COMPARISON OF INNOVATION PROCESSES IN THE FOUR DOMAINS OF MUSEUM PRACTICES: A MULTIPLE-CASE STUDY

In this section, a detailed description and comparative analysis of innovation processes in four domains of museum practice is conducted: restoration, exhibition, digital museum, and visitor services, on the basis of a multiple-case study, which is regarded as more robust than single-case study (Yin 2009).

4.3.1 Case, data and methodology

In multiple-case study design, the selection of cases is based on theoretical interests and follows a replication logic rather than statistical sampling (Kauremaa et al. 2009). In this study, five museums were selected in terms of size, type and ownership, and geographical proximity. As table 9 summaries, all museums are located in the city center of Valencia, which can eliminate the impact of geographical factors on the cases; all museums are small and medium-size, this is consistent with the fact that a majority of museums are small and medium in scale. Meanwhile the cases are classified into public and private categories, which can facilitate the cross-cases study in terms of ownership impact.

Table 9 Summary of interviewed museums

	Museum			**Interview**	
Case	*Type*	*Ownership*	*Staff*	*Interviewee*	*Length*
C1	Natural history	Municipal	2	Director	40 min.
C2	Ethnology	Municipal	24	Director	120 min.
C3	Contemporary Arts	Private	2	Deputy director	40 min.
C4	Specialized	Private	10	Director	110 min.
C5	Fine arts	National/Regional	17	Director	70 min.

Data is collected by three sources: (1) direct observation by visiting the selected museums and their websites; (2) interviews with museum directors; and (3) archived records supplied by some interviewed directors after interviews. All interviews were conducted between July of 2015 and January of 2017, including four pilot interviews with a museum director, a conservator, a

quality evaluation specialist and an independent curator respectively because pilot interviews are effective in seeking information about relevant questions for a specific field, and about the logistics of the field of inquiry (Yin 2009).

Relying on theoretical propositions is regarded as the first and preferred strategy for analyzing case study evidence (Yin 2009). Therefore, our analysis is theory-oriented; the open innovation model guides the analysis to focus attention on evidence about innovation process patterns in four functional areas in each case, to the detriment of other data. Then pattern-matching technique is utilized to compare empirically based innovation patterns with theoretically guided patterns. This technique can greatly strengthen the internal validity of study results (Yin 2009).

4.3.2 Single case descriptions

Case 1: A small municipal science museum

C1 is a municipal science museum dedicated to conserving and exhibiting the history of the natural world. It has over 90000 pieces in its collection, ranging from dinosaur fossils to animal and plant specimens. However, the museum only has two staff, one of whom is a contact worker from a private company; therefore, the director actually has multiple roles as registrar, conservator, and curator. In order to overcome the lack of manpower, the museum makes full use of internships and collaborations in almost all functional activities. Students from local universities with academic backgrounds in biology and museology are the main source of trainees for the museum, and are important in assisting museum staff in restoration, digitizing, guided visits, and other technical assignments. But the collaboration with universities and public heritage facilities plays a decisive role in some technique-intensive activities such as restoration. The museum's restoration work is exclusively reliant on support from relevant faculties of local universities. Upon the director's requests, a temporary restoration team is assembled, with university professors and students, and will undertake specific restoration work. The team will provide several repair plans and corresponding experiment results to the museum; the director, together with the head of the university's team, has to make decisions about the selection of the final solution,

techniques, and materials of restoration.

The museum is very active in updating its permanent exhibitions and organizing new temporary ones. There are, on average, ten temporary exhibitions every year. These exhibitions have a broad range of themes, such as climate change, nature and art, and sustainable society, and so on, most of which are planed and curated by the director herself on the basis of her own interests, learning and research. But the making of the exhibitions involves frequent interaction with other cultural institutions, especially in collection rental and exhibits on loan. Additionally, the museum also hosts some exhibitions produced exclusively by external organizations.

Although the director emphasizes the importance of virtual museum as an innovative means to bridge the collection and the public, there isn't much application of ICTs in the museum except some outdated multimedia machines installed in the exhibition hall. For example, the museum doesn't have an independent website – the actual webpage (not website) is hosted within the website of municipal government and only provides brief visitor information; the digitized collection is not accessible to the public either. Conversely, the museum delivers an element of interactive experience onsite by encouraging visitors to "touch" particular high-stimulation exhibits to get a real sense of the experience, developed by the company Olorama. Regular satisfaction surveys, and face-to-face communication with visitors, are two major channels for the museum to evaluate visitor needs in order to improve service quality. The director often talks to visitors in person so as to canvas opinions among the visiting public. But she has to sift through suggestions and recommendations because the quality of the information varies and decision-making should be only based on useful information.

Case 2: A medium-size municipal ethnology museum

C2 is a municipal ethnology museum concentrating on collecting, restoring, studying, and exhibiting audiovisual resources, documentation, and other objects reflecting popular and traditional society and culture in the Valencian region. There is a total of 24 members of staff, nearly half of which are conservators working in the restoration and investigation departments. Although the two

departments have a different focus, they usually play complementary roles and collaborate for conservation and exhibition. Considering the fact that conservation work requires a high level of specialization and each conservator specializes in his/her field of collection and knowledge, the museum still suffers from an understaffing of restorers, especially when faced with a large amount of restoration work and approaching deadlines, for example, only days before the inauguration of an exhibition. Therefore, the museum tends to outsource a part of its work to other professional restoration companies so that all the necessary work can be completed in time.

The museum director considers innovation an important strategy for the development of the museum, and the development of new formats for value transmission for its neighborhood and society. At the museums, exhibitions, among others, are an important format where to innovate. According to the director, innovating in exhibitions is embodied in content innovation through the exchange of exhibitions and collections of between museums. Meanwhile, technology is regarded as an efficient means for value transmission. But the adoption of ICTs in the museum is modest, only limited emphasis is given to the interactive experience in their website. For instance, the museum released an interactive game about traditional herbal remedies with the help of a local technology partners.

In the museum, the objective of higher quality in cultural products and visitor services is pursued through innovation. In order to conduct quality evaluations, the museum adopts two main approaches. The first one is to collaborate with an independent consultancy for the introduction ISO 9001:2008 Quality Management Systems to the museum. Another is to interact directly with visitors to track their preferences and needs by means of the formal claims and suggestion system.

Case 3: A small contemporary art museum affiliated to a private foundation

C3 is a small-sized contemporary art museum affiliated to the first private art foundation in the city. The staff is composed of five members who are in charge of direction, administration, exhibition, communication, and institutional relations, respectively. Because the museum is focused on contemporary arts, the

restoration of contemporary arts is not so complicated as that of antiques. The museum doesn't have any full-time restorer; it hires an external one as independent restorer temporarily when objects need to be restored. But their longstanding cooperation started in 2005 when this museum was inaugurated and hence, such employment relationship has achieved a high degree of mutual trust.

The museum aims to disseminate and promote its collection by organizing collection-based exhibitions under different themes. In the museum, curating an exhibition is mostly done as a curator's solo effort rather than a team effort. The sole curator, who is responsible for the planning and development of exhibitions in the museum, compared his work to mental mapping:

> "When you read books and the Internet, or visit exhibitions and artists, you draw what you find interesting at just like a conceptual map; then you can arrange these ideas in your own manner through such mental diagrams; after making more of an effort, you might change all that you planned theoretically and get new ideas which are totally different from the original" (cited from the interview).

In addition, the museum also hosts one or two roving exhibitions every year. In this case, the role of the curator is more akin to that of a coordinator of the installation of the exhibitions with the external producer.

The museum views the adoption of ICTs as an innovative strategy to reach to a wider audience, with particular emphasis on the role of the digital platform (e.g. website and blog) and virtual exhibition in strengthening online visitor engagement. An ongoing digital project is the development of 3D-oriented virtual exhibitions aiming to conserve and disseminate physical exhibitions physically sited in the museum, with the help of an external IT provider. In fact, the museum team has outsourced all IT-driven work to external technology providers.

Lastly, the museum also emphasizes the importance of interaction in the service to its visitors. On the one hand, the museum has developed a so-called "dynamic visits" (Visitas dinamizadas) approach to strengthening visitor engagement by encouraging debate during the guided visits. On the other hand, the museum also evaluates and improves the quality of visitor services in an

interactive manner by means of surveys and a suggestions box.

Case 4: A medium-sized private specialized museum

C4 is a private specialized museum displaying a private collection of toy tin soldiers. Although the museum has a total of ten staff on different types of contracts, the collector – who is also the director, curator, and restorer of the museum – plays a decisive role in the management of the museum. Because the museum's funding is mostly reliant on revenue from ticket sales and private sponsorship from the collector's family, the museum emphasizes particularly operational performance through innovative collection preservation and marketing. In respect to the preservation, the carbonatization of toy tin soldiers owing to the ambient humility, temperature and wooden structure of the building is the main risk that the museum faces. As a marginal subject, techniques involving the restoration of tin soldiers are totally different from those in the restoration of paintings, sculpture and other ordinary heritage objects; and there are no prior experiences to learn from. In consequence, the museum had to invent specific solvents and custom-made bathtubs for the restoration by learning relevant chemical knowledge, and by their own trial and error with experiments. In respect to marketing, it was the first museum in Valencia to utilize social media (e.g. Facebook and Tweet) and YouTube for self-promotion and to attract a younger generation of visitors. Due to his working experience at an IT company during the 1990s, the director has an in-depth knowledge of the application of digital technologies to his museum. He not only constructs and maintains the museum's digital networks (e.g. website and social media platforms) by himself, but also liased actively with the Vodafone Foundation to install wireless infrastructure to offer visitors free access to a Wi-Fi service within the museum.

In addition to exhibiting an antique collection, the museum is also engaged in developing new exhibitions responding to social demands. An example is the ongoing Silk Road project. Differently from collection-oriented exhibitions in traditional museums, the new exhibition in development here is characterized by the design and production of a new "package" that is composed of new tin figures and new scenes with the purpose of reproducing scenes under

different civilizations, historical times, and regions. Therefore, the core of curating the new exhibition typically consists of historical research about fashion, customs, social outlook, and so on. In most cases, the director works as a typical "lone scholar" immersed in books. On occasions, he also asks for advice from professors and novelists with whom he has a longstanding relationship.

Concerning visitor service, the collector thinks that he is familiar with visitor-oriented trends in the museum community and is confident to know what different groups of museum visitors need on the basis of his personal knowledge. Besides, the museum also attempts to collect feedback through online and onsite interaction between the museum and its visitors.

Case 5: A medium-sized art museum under the joint management of the national and regional governments

C5 is a state-owned art museum under the administration of regional government. Such "two in one box" system complicates decision-making and management of the museum greatly. The museum director regards innovation as a transformation of knowledge through artistic collection, which can improve the mediation between museum collections and the public. But demotivation and negative attitudes torwards the bureaucratic system have become serious impediments to innovation in the museum. According to the director, the obstacles are best exemplified by three aspects. First, all staff are civil servants; and "civil servants are an inconvenient (factor) to museums" (cited from the interview); second, in theory, there are a total of 17 staff working at the museum, but some are hard at work and some are slack in work, "the museum is kept alive because of eight or ten civil servants who still work here" (cited from the interview); third, the museum doesn't have a clear mission and workers are demotivated, "(their) work is always substandard, they go there in a trance and the time seems to be eternal" (cited from the interview). As a result, the museum is less active in producing new exhibitions, in developing the digital agenda, or in interacting with visitors to improve service quality.

On a more positive note, the museum has a rich and high-quality collection of artworks, as befits a fine art museum of national caliber. The advantage that the museum has is its strength in restoration, with an especial

focus on painting restoration. Even so, the demands placed by some essential analytical techniques utilized in restoration work still requires the museum to collaborate with other research institutions like universities and Cultural Heritage Institute of Spain (IPCE). In sum, the museum director faces the big challenge of overcoming the deficiencies in the system and to fostering an environment favourable to innovation.

4.3.3 Results of cross-case analysis

On the basis of these five cases, different patterns of innovation processes can be described and summarized in a matrix of categories in terms of innovation typologies (see table 10). This table reveals that innovation process patterns vary from types of innovation. Innovations relating to different domains of cultural production are comprised of different knowledge basses, learning processes, interaction modes and, thus correspond to different innovation modes.

In the analytical/synthetic knowledge-driven production domain, taking restoration as an example, innovation relies on both internal and external knowledge. Restoration is a scientific and technology-intensive activity with a high degree of specialization, so restoration work in the museum always requires specialists who are highly qualified specialist. Closed innovation only takes place in museums that have their own restoration department or who have a team of restorers. But even museums that are directly employ restorers are not limited to closed innovation; they also engage in learning by doing and by interacting through processes of collaboration with external agents, including universities and public restoration facilities. Case C2 and C5 are two examples. This phenomenon can be explained by the following (1) staff is limited, existing restorers cannot cope with all the restoration work; and (2) knowledge is limited, the actual stock of knowledge in the organization is insufficient to deal with all restoration work. In those museums that do not have a term of restorers, restoration work and innovation in restoration still exists, which has been ignored by the previous literature (for example, De-Miguel-molina et al. 2013). In this case, open innovation through directly adopting external sources of knowledge seems the optimal option. These resources may include independent specialists, restoration companies, universities and public restoration facilities.

Generally speaking, closed innovation in restoration is characterized by cumulative innovation based on problem-solving in the context of regular restoration work; whilst open innovation is more likely to be more radical in terms of utilizing new materials, techniques and approaches, and by taking advantage of the technical strength of external institutions.

In the symbolic knowledge-driven production domain, the planning and interpretation of exhibitions, for instance, innovation may take place in both, open and closed modalities concurrently. Generally speaking, in the museum community, new exhibition development takes two forms: self-produced exhibitions and imported exhibition. In most museums, self-produced exhibitions are the main form of new exhibition development, which is mostly characterized by closed innovation. Although relevant literature stresses that the creation and dissemination of symbolic knowledge depends on interpersonal interaction (Asheim & Hansen 2009), our cases show that planning and interpretation of exhibition is a process of codifying tacit symbolic knowledge through a specific storytelling approach and museum curators are akin to “lone scholars” (Bakhshi et al. 2008). This process usually involves arts and humanities research and attaches great importance to the utilization of the results of the research for visual presentation. Although the making of an exhibition may also contains the necessary collaborations with collectors (e.g. private collectors, galleries, and other collection institutions) and services (e.g. logistics, insurance, and installation), they aren’t symbolic knowledge-based activities and they often occur in the production and installation phrases of the exhibition, meaning that they are outside the scope of this study. As a result, new exhibition development is similar to new product development in manufacturing, whereby formal R&D processes (i.e. arts and humanities research) in the laboratory (i.e. library) plays a fundamental role. Definitely, arts and humanities research doesn't equal to scientific and technological research because the former isn’t an absolute and closed process, but often involves external knowledge sourced from “monitoring” through interview, bibliometric studies and other study methods dependant on the nature of the disciplinary in question (Bakhshi et al. 2008). In the final analysis, the planning and interpretation of an exhibition is mostly based on the curators’ sole effort, which may belong to Science Technology (Symbol)

Innovation mode, i.e. ST(C)I mode. On the other hand, an imported exhibition is an important source of open innovation because it allows museums to program new exhibitions by plugging an existing exhibition directly from other museums or cultural organizations, such as an itinerant exhibition.

Furthermore, both supplier-producer interaction and user-producer interaction are observed in the process of innovation. In most cases, supplier-producer innovation takes place when curators interact with university professors, artists and other intellectuals to ask for advices. User-producer innovation occurs when curators plan and develop an exhibition to meet the special requirements or needs of their clients. The clients are often museum organizations, and also visitors in a few cases. Our cases show that exhibition making is still primarily curator-oriented in most museums, although the visitor orientation strategy is highlighted by scholars (Camarero et al. 2015). This is also evidenced by Herreman (2004), who argued that the clients of an exhibition were museum directors rather than visitors.

In the analytical/synthetic knowledge-driven experience domain with the example of a digital museum, innovation is reliant on both internal and external source of knowledge. The existing literature has emphasized open innovation in museums by the use of ICTs developed in the other industries (Costa Barbosa 2013). This is evidenced in the case study. Most of the museums, no matter whether they are equipped with IT staff or not, tend to collaborate with external technology suppliers to investigate new digital solutions. For those that don't have IT engineers, monitoring (e.g. a contracted independent IT engineers) and collaboration (e.g. collaborating with IT companies in a concrete project) are the main channels to gain access IT-related knowledge. For those that have full-time IT engineers or staff with IT knowledge, they tend to develop and maintain basic digital museums (e.g. website and social media) by themselves, out of economic consideration (C4 is an example); but they still need to collaborate with external IT suppliers to develop advanced digital devices (e.g. Free Wi-Fi infrastructure) and digital experiences (e.g. 3D and VR), rending collaboration a very important means to acquire new technologies and update knowledge stock through learning by interacting in the supplier-producer interaction.

Table 10 The matrix of innovation process patterns in terms of innovation type

	Production-based technological innovation		Production-based cultural innovation		Experience-based technological innovation	Experience-based cultural innovation
Domain	Analytical/synthetic knowledge-driven production		Symbolic knowledge-driven production		Analytical/synthetic knowledge-driven experience	Symbolic knowledge-driven experience
Example	Restoration		Exhibition (planning & interpretation)		Digital museum	Visitor services
	With restorers	No restorers	Self-produced	Imported		
From whom to learn	By oneself (C2, C4, C5) Collaboration (C2, C5)	Mobility (C1, C3) Collaboration (C1)	By oneself (C1, C2, C3, C4) Monitoring (C3, C4)	Collaboration (C1, C2, C3)	By oneself (C4) Mobility (C1) Collaboration (C1, C2, C3, C4)	Monitoring (C1, C2, C3, C4) Collaboration (C2)
How to learn	R&D process (C2, C4, C5) Learning by doing (C2, C4, C5) Learning by interacting (C2, C5)	Learning by interacting (C1, C3)	R&D process (C1, C2, C3, C4) Learning by doing (C1, C2, C3, C4)	Learning by interaction (C1, C2, C3)	Learning by doing (C1, C4) Learning by interacting (C1, C2, C3, C4)	Learning by using (C1, C2, C3, C4) Learning by interacting (C2)
Interaction mode	Supplier-producer (C2, C4, C5)	Supplier-producer (C1, C3)	Supplier-producer (C1, C2, C3) User-producer (C4)	Supplier-producer (C1, C2, C3)	Supplier-producer (C1, C2, C3, C4)	User-producer (C1, C2, C3, C4) Supplier-producer (C2)
Innovation mode	STI, DUI	DUI	ST(C)I	DUI	STI, DUI	DUI

In the symbolic knowledge-based experience domain, taking visitor services as an example, innovation depends mainly on external knowledge. On the one hand, monitoring through interpersonal user-producer interaction (e.g. satisfaction survey and service processes) is the commonest channel to access information from final users (i.e. visitors) to improve service quality in museums. On the other hand, collaboration with independent consultants through supplier-producer interaction is an alternative source of knowledge for innovation employed by some museums, like C2. Because visitor services innovation reflects process innovation, the former may improve service processes by allowing museums to acquire useful information about deficiencies in users experience highlighted by visitor's feedback given during visits, i.e. learning by using, which is also consistent with the proposition of experience innovation theory (Sundbo 2009); whilst the latter facilitates museums to improve service processes by assessing the actual norms and routines in the services in terms of the specific standard introduced from outside, i.e. learning by interacting.

Do institutions matter to museum innovation?

Many studies emphasize that institutions are an important actors that influence museum innovation. Good institutions spur innovation and bad institutions discourage innovation. For example, different cultural policies have different effects on museum innovation; museums under the administration of the Anglo-American cultural policy model are more likely to innovate that those under the continental model (Vicente et al. 2012). In the continental model, the government takes full responsibilities for the management of museums and staff in public museums, meaning that bureaucratic rules strongly restrict creativity and innovation in museums (Frey & Steiner 2016).

This proposition is brought to light in our case study, in which it can be observed that workers in public museums, and the civil serving system may lead to demotivation and negative attitudes to work, which in turn prevents public museums from innovating according to case C5. But it isn't clear yet to what extent demotivation and negative work exist in the public museums in terms of this case study, considering the fact that this problem was only highly

stressed by one of three public museums in the interview.

Furthermore, according to the cross-cases study, it is observed that private museums engage more in active digital museum innovation through the use of ICTs than public museums, which might be explained by the fact that private museums face more operating pressures than the public ones, meaning that they are more likely to innovate in museum marketing; on the contrary, public museums have more innovative activities in the area of restoration than private museums, the reason for this might be that public museums have more human and knowledge capitals, and thus results in more innovation in comparison to private museums. This implies that the influence of institutions on museum innovation is complicated; the extent to which control by a certain institution has an effect varies from museum to museum, and/or the type of innovation.

4.4 CONCLUSION

The multiple cases study clearly shows that innovation in cultural production by museum organizations relies on both internal and external sources of knowledge, and thus museum innovation can be explained by the open innovation model. In practice, museums innovate in three ways in terms of knowledge sources. The first way is **self-dependent innovation** based on internal knowledge; for instance, new exhibitions are developed through internal R&D process (i.e. arts and humanities research and storytelling approaches) within the museum. The second way is **collaborative innovation** based on external knowledge; for example, museums collaborate with universities and public restoration facilities to seek new methods for restoring artworks. The third way is **adoptive innovation** by directly importing external innovation; itinerant exhibitions and many IT techniques like QR codes, belong in this category.

Indeed, the open innovation model emphasizes both open and closed innovation components that feature in different processes of innovation. In museum both, cultural innovation and technological innovation, may take place

in closed and open formats, mostly depending on where innovation occurs. As far as cultural innovation is concerned, new cultural products can be developed by both closed self-dependent innovation and open-ended adoptive innovation whilst cultural experience relies mostly on open-ended collaborative innovation. In respect to technological innovation, open-ended collaborative innovation plays an active role in both, the production and experience domains. Besides, internal R&D is an importance source of production-based technological innovation and direct adoption is also pervasive in experience-based technological innovation.

The choice of innovative manner, we think, can be attributed to the difference in costs relating to innovation. As shown in the above cases, open innovation is usually adopted in technology-related or demand-oriented innovation, wherein the cost of related knowledge and technology is much lower through the acquisition in external markets than generated by museums themselves; the closed manner is employed in problem-solving or highly specialized innovation, where there is a lack of supply in the market or the opportunity cost of communication and coordination in inter-institutional collaboration is higher than that of internal generation by the museum itself.

Additionally, the case study evidences that the civil servant system used in public museums may lead to demotivation and negative attitudes to work, which have a negative influence on museum innovation. But further research is needed to evaluate such impact on public museums as a whole.

This conclusion contains three implications. First, the process of museum innovation is characterized by an open innovation system rather than linear process. Therefore, a systematic approach should be employed in the study in order to attach importance to both factors and their linkages. Second, collaboration matters in the open innovation environment, collaboration with both, individuals and institutional organizations, like universities, public heritage facilities and technology companies should be encouraged to facilitate innovation in the museum community. Third, capacity building, particularly focusing on symbolic knowledge, is at the core of strengthening the cultural innovation ability so as to enrich cultural goods and services, which is a fundamental task of museums and other cultural organizations.

CHAPTER 5

WHAT AFFECTS MUSEUM INNOVATION? EXPLORING EMPIRICAL EVIDENCE OF THE DETERMINANT FACTORS OF INNOVATION FROM THE STUDY OF VALENCIAN MUSEUMS IN SPAIN

This chapter aims to explore the factors that influence innovation by museum organizations on the basis of an empirical study of museums in the Valencian Community of Spain. The focus of the study is on "what" and "how" organizational characteristics and collaboration affect technological innovation, cultural innovation and organizational innovation in the museum sector.

Scholars have proposed that certain organizational factors, such as size, ownership, and geographical location, were determinant in arts and cultural organizations, and museums (Vicente et al. 2012; Camarero et al. 2011; Verbano et al. 2008). These propositions are based on empirical analyses of either global museums, or other cultural organizations. It is clear that museum innovation differs from country to country, and depending on cultural policies (Vicente et al. 2012), so some determinants that work in one country do not necessarily have the same impact in another country, let alone a different type of organization. In addition to this, chapter 4 has revealed that collaborative innovation has a wide spread pattern in the domains of cultural production of museums, on the basis of the multiple-case study. Therefore, it is of significance to test such influencing factors because they may provide a solid basis for museum strategies and policies for innovation.

This study concentrates on museums in the Valencian Community of Spain as the object of study, which is based not only on geographical

convenience but also on geographical boundaries by taking the innovation system of museums into account. As mentioned above, innovation varies from country to country; Spanish museums are less innovative than those in Britain, but more innovative than French and Italian ones (Camarero et al. 2011). On the other hand, the cultural decentralization brought by recent cultural policies have led to the regionalization of museum systems as well as the localization of museum interaction in Spain. To this end, museum innovation is also a regional phenomenon (Porter 1990, 1998; Breschi & Malerba 1997). As a result, it is appropriate to study the influencing factors of museum innovation on the basic regional location, as is the case in this study.

Although this study emphasizes innovation by museum organizations located exclusively in a region in Spain, in order to probe the determinants of innovation under a common cultural policy, and to give an insight into the innovation practices of local museums, the findings are not limited in their applicability to the region of Valencia and, instead, it also has significance for reference for museum in other regional territories as well.

This chapter is organized as follows: firstly, it starts with the description of museums in the Valencia region of Spain as the population of study and the description of essential hypotheses following the characterization of population; secondly, it continues with a detailed discussion on data collection and analytical methods, as well as sequential results based on statisitical analyses; lastly, essential conclusion and further discussion are presented.

5.1 MUSEUMS IN THE VALENCIAN COMMUNITY OF SPAIN: POPULATION AND HYPOTHESIS

Spain is well known for its splendid cultural heritage in the world and museums are an important part of its cultural heritage. According to the Spanish Ministry of Education, Culture and Sports, Spain has a total of 1522 museums and museographical exhibitions, which employ nearly 14,000 people and received over 58 million visitors in 2014.

The Valencian Community (Communitat Valenciana), located along the

Mediterranean coast of eastern Spain, is the fourth most populated region, with near five million inhabitants, and only overtaken by Andalusia, Catalonia and Madrid. The Valencian Community, which is composed of the three provinces of Alicante, Castellón, and Valencia, is one of 19 Autonomous regions in Spain, with its capital sited in Valencia – the third largest city in the country.

This region is rich in its museographical resources. In terms of the related statistics published by Spanish Ministry of Education, Culture and Sports, there are a total of 191 museums and museographical exhibitions located in the territory of Valencia, only behind Castilla y León (196) and Castilla-La Mancha (193), and 2.5 times more than average for the country; a total staff count of 1473 work in Valencian museums and museographical exhibitions, which doubles in the average number of employees at regional level; this region also welcomed 4,792,135 visitors in 2014, which was higher than the average amount of visitors received by other Spanish regions. The comparison by museum's number, personnel and visitors between the Valencian Community and the national average is depicted in figure 10.

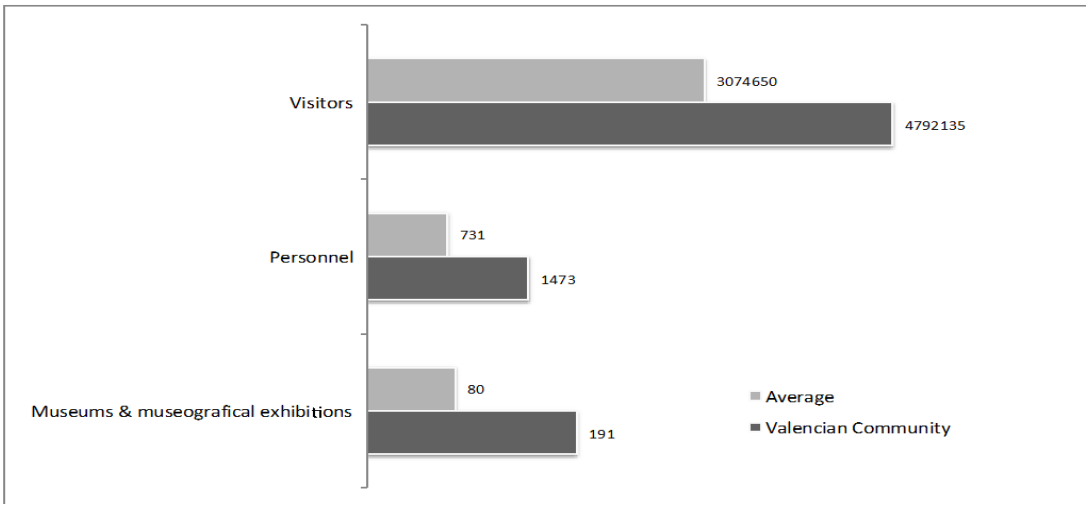


Figure 10 The comparison of Valencian Community and Spain's average level in visitors, personnel, museums and museographical collections on the year of 2014

Source: Spanish Ministry of Culture. Museum and exhibition statistics.

5.1.1 Basic characteristics of museum organizations

To concentrate exclusively on the museum facilitates of the Valencia Community, essential data was mined from the records of directors of museums and permanent museographical exhibitions supplied by the regional government (Generalitat Valenciana). After eliminating the records corresponding to permanent museographical exhibitions, the data of all museums registered in the Valencian Community was collected, which also constituted the target population of this study. A detailed description of the population is given in table 11.

Table 11 Population description

		Total	Alicante	Castellón	Valencia
Type	Archeology	46 (38%)	23 (45.1%)	7 (36.8%)	16 (31.4%)
	Ethnography & anthropology	23 (19%)	13 (25.5%)	3 (15.8%)	7 (13.7%)
	Arts	23 (19%)	7 (13.7%)	5 (26.3%)	11 (21.6%)
	Science & technology	13 (10.7%)	4 (7.8%)	3 (15.8%)	6 (11.8%)
	Natural sciences & natural history	9 (7.4%)	2 (3.9%)	1 (5.3%)	6 (11.8%)
	History	3 (2.5%)	0 (0%)	0 (0%)	3 (5.9%)
	House-museum	2 (1.7%)	1 (2%)	0 (0%)	1 (2%)
	Specialized	2 (1.7%)	1 (2%)	0 (0%)	1 (2%)
Ownership	National	3 (2.5%)	0 (0%)	0 (0%)	3 (5.9%)
	Regional & provincial	11 (9.1%)	1 (2%)	2 (10.5%)	8 (15.7%)
	Municipal	74 (61.2%)	36 (70.6%)	13 (68.4%)	25 (49%)
	Private	8 (6.6%)	5 (9.8%)	0 (0%)	3 (5.9%)
	University	5 (4.1%)	1 (2%)	0 (0%)	4 (7.8%)
	Association	7 (5.8%)	5 (9.8%)	1 (5.3%)	1 (2%)
	Foundation	7 (5.8%)	3 (5.9%)	2 (10.5%)	2 (3.9%)
	Ecclesiastical	5 (4.1%)	0 (0%)	1 (5%)	4 (7.8%)
	Consortium	1 (0.8%)	0 (0%)	0 (0%)	1 (2%)
Geographical distance (min. spent from town to provincial capital by car)	Maximum	93	72	89	93
	Minimum	0	0	0	0
	Mean	31	39	33	24
	Median	30	37	24	19
	Mode	0	30	0	0
	Standard Deviation	23	17	24	26
	Total	121 (100%)	51 (42.1%)	19 (15.7%)	51 (42.1%)

Source: Generalitat Valenciana, elaborated by author.

According to table 11, there are totally 121 museums registered in the Valencian Community; among which 51 museums are in the province of Alicante, 19 in the province of Castellón, and 51 in the province of Valencia. As far as museum type is concerned, museums are categorized into eight types [1], most of whom are "archeology", "ethnography & anthropology", and "arts" museums, making up 76% of institutionas considered, followed by "science & technology" and "natural science & natural history" museums, which account for 18.1% of the total, whilst "history", "specialized", and "house-museums" museums only constitute a small proportion at 5.9%.

There hasn't been any clear evidence yet that the degree of innovation varies depending on the type of museum under consideration. Camarero et al. (2011) argued that, all else being equal, science museums wouldn't be more innovative than art museums. However, the assumption of a dichotomous classification between art and science seems an over-simplification. In our case, museums can be further categorized into at least, three other sub-types in terms of the similarity of fields in which they specialize, including:

- Arts and history category, including types of "arts", "history" and "house museum";
- Archeology and ethnography category, including types of "archeology" and "ethnography and anthropology";
- Nature and science category, including types of "science & technology", "natural science & natural history" and "specialized".

Different categories of museum may involve different bases of knowledge, thus contributing to the diversity of knowledge, and the integration of knowledge and technologies. For example, natural science museums often require staff to have a background in biology, whist archeological museums prefer to archeologists, thus natural science museums always have a higher proportion of analytical knowledge in their knowledge stock than archeological museums. From a knowledge-base perspective, De-Miguel-molina et al. (2013) pointed out that the variety of knowledge, and the combination of knowledge and technologies, had a positive affect on the amount of innovation in museums

[1] The type of museum is listed according to the registration.

on the basis of an empirical study about the restoration departments of 167 museums throughout the world. This finding might suggest some certain relationship between the type of museum and the degree of innovation. In order to explore further a potential relationship, it is deposited that:

H1: All other things being equal, nature and science museums tend to engage more in technological innovation (H1a), cultural innovation (H1b), and organizational innovation (H1c) than archeology and ethnography museums and arts and history museums.

In respect of the ownership of museums, it clearly shows that a majority of museums are under the administration of governments at all levels, among which municipal and local museums constitute near one-third of all museums, whilst 20.6% of museums are affiliated to universities, associations, foundations, churches and consortia, and only 6.6% of museums are private. In terms of geographical distribution, all national museums, most of the regional and provincial museums and museums affiliated to universities and the church are concentrated in the province of Valencia whilst most of the association-run museums are located in the province of Alicante.

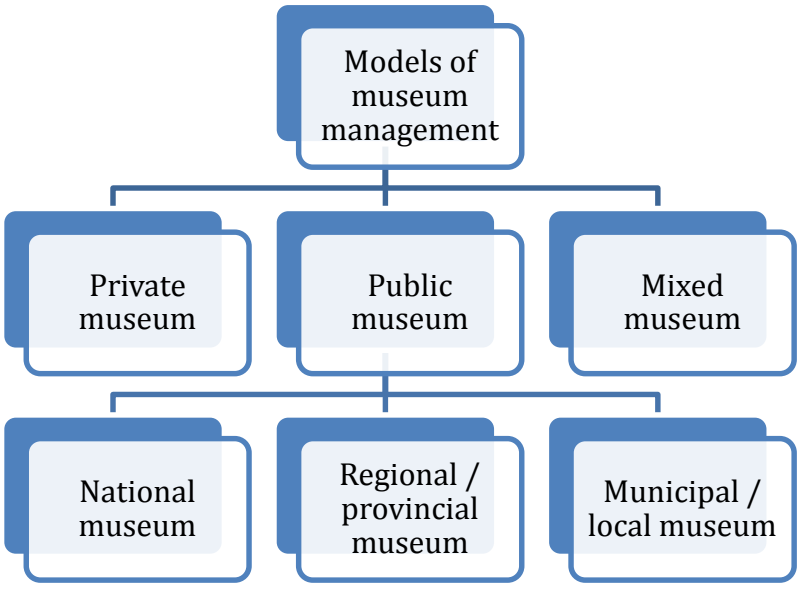


Figure 11 The ownership of Spanish museums

Source: Gilabert González 2016

Generally speaking, Spanish museums can be characterized as conforming to the continental European model, which emphasizes the major financial involvement of governments in funding public museums, as well as the strong intervention of governments on the management of museums (Gilabert González 2016). Although more recent cultural policies have stressed the decentralization of cultural undertakings in Spain, most Spanish museums are still public and run through direct management by governments at all levels, and financed primarily with public funds (Vicente et al. 2012; Albi Ibáñez 2003). According to figure 11, the ownership of Spanish museums can be classified into three categories in terms of models of museum management (Gilabert González 2016), as follows:

- **Public museums**, which are exclusively comprised of those museums directly controlled by national, regional, provincial, municipal and local governments;
- **Private museums**, which enjoy a high degree of autonomy in management and decision-making as well as economic independence;
- **Mixed museums**, which are found somewhere between public and private museums.

According to the above classification, university-run museums can be regarded as mixed museums; museums affiliated to the church or a consortium are private museums; association and foundation-run museums may be grouped into either private museums or mixed museums depending on the degree of their managerial autonomy and economic independence.

As discussed in the section 3.4.2, the impact of ownership on museum innovation depends mainly upon organizational aspiration. It is believed that private museums are more profit-oriented and display strong economic drive and lower artistic aspiration than public museums (Castañer & Campos 2002); this is also evidenced by the findings of Vicente et al. (2012), which revealed that private museums invested more in new technologies for management and functional works than public ones. Therefore, it is supposed that private museums are more engaged in technological and managerial innovation than public ones. Contrary to that, the primary role of public museums is to provide

the population and its surrounding community with a range of cultural goods and services; so public museums have higher cultural aspirations than private ones. Thus, public museums are supposed to engage more in cultural innovation than private ones.

Therefore, it is hypothesized as follows:

H2: All other things being equal, private museums engage more in technological innovation (H2a), and organizational innovation (H2C), but less cultural innovation (H2b) than public museums.

With respect to geographic distance, table 11 shows that the distance, measured in driving time, that separate museums from their corresponding provincial capitals ranges from 0 to 93 minutes [1], with an average of 31 minutes. Concerning provincial difference, the average time that museums spend is 39 minutes in the province of Alicante, 33 minutes in the province of Castellón, and 24 minutes in the province of Valencia. This means that museums are scattered throughout the territory of the Valencian Community. In general, museums are closer to the capital city in the province of Valencia than in the other two provinces while most museums in the province of Alicante are situated in relatively remote towns that are far from the provincial capital.

In innovation literature, geographic proximity is thought to be of one of the most important determinants of innovation and it has a positive influence on innovation because (1) innovators are geographical concentrated (Breschi & Malerba 1997), and (2) geographic proximity benefits knowledge exchange and interaction involved in the process of innovation (Malmberg & Maskell 1997). Such proposition was evidenced in the arts and cultural organizations by an empirical study, disclosing that there is a positive relationship between laser adoption and proximity to research centers and suppliers/distributors (Verbano et al. 2008). In the Valencia region, the three provincial capitals – Alicante, Castellón de la Plana, and Valencia – are the regional centers for culture, education, science and technology, and play host to the majority of universities and suppliers/distributors of technology and cultural resources.

[1] 0 minutes means that the museum is located in the capital city.

Therefore, geographical proximity can be evaluated with regards to the distance between a museum's location and the corresponding provincial capitals. So the hypothesis is expressed as follows:

H3: The closer to the provincial capital that a museum is located, the more it will engage in technological innovation (H3a), cultural innovation (H3b), and organizational innovation (H3c).

Additionally, museums also vary in size; size is an explicit characteristic of museum organizations. Museum size can be measured either by the number of staff (Camarero et al. 2011; Vicente et al. 2012) or by the amount of visitors (Camarero & Garrido 2012). The size-innovation relationship is still controversial in organization studies. For example, some scholars believe that large firms are more innovative than small ones because large firms enjoy an advantages in terms of the economies of scale and functional differentiation over small firms (Kimberly & Evanisko 1981); others argue that small firms innovate more easily than large ones because small firms are more agile and flexible in terms of organizational structure, and can adjust to changes more quickly (Camisón-Zornoza et al. 2004).

In arts and cultural organizations, however, there it is not controversial to say that large organizations are more likely to innovate than smaller ones because of two things: on the one hand, large organizations enjoy a resource advantage over small organizations (Camarero et al. 2011); on the other hand, large organizations are better able to bear increasing cost than smaller ones taking into account "cost disaster" in arts and cultural organizations (Baumol & Bowen 1966). Although we don't know the distribution of the size of museums in the Valencian Community from table 12, it doesn't hinder us from developing the following hypothesis on the basis of existing theoretical propositions:

H4: The larger a museum is, the more it will engage in technological innovation (H4a), cultural innovation (H4b), and organizational innovation (H4c).

5.1.2 System of innovation in museums

According to the findings of the multiple-case study about innovation process

in the chapter 4, collaborative innovation is a widespread pattern involved in various domains of cultural production among Valencian museums. From the systemic perspective, such collaboration in which museums are involved constitutes an important form of interaction in the system of innovation in museums.

According to Edquist (1997), innovation can be accounted explained by the interaction between museums and other organizations, and individuals, and with institutions that shape such interaction in the system of innovation. The boundary of the system of innovation in museums can be set at national and regional dimensions in terms of the scope in which institutions operate (Cooke & Memedovic 2003). As an institution, cultural policy is one of vital factors that influence innovation in museum organizations in Europe owing to the fact that different cultural policies require different degrees of public interventions, and of economic independence (Vicente et al. 2012).

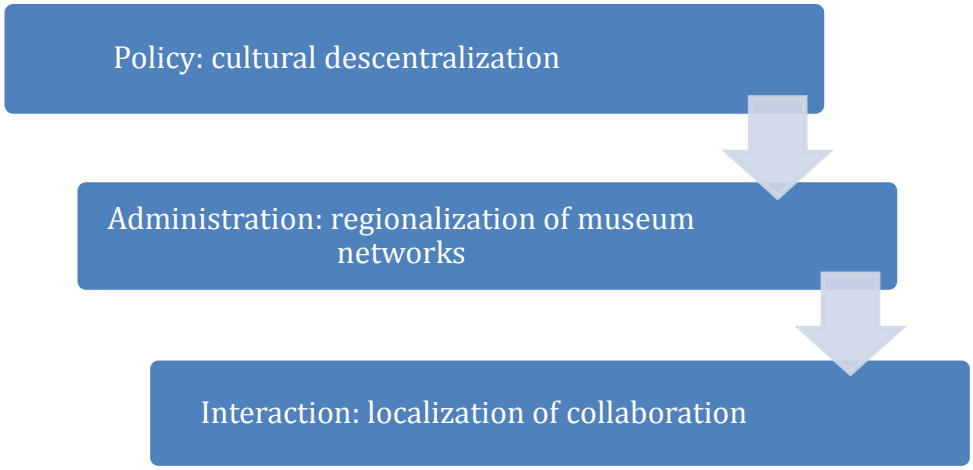


Figure 12 The characteristics of the system of innovation of museums in the Valencia region

Cultural policies vary from country to country, and Spanish museums are less innovative than British museums, but more innovative than French and Italian ones, to be exact (Vicente et al. 2012). In Spain, as figure 12 shows, the system of innovation in museums can be explained by three aspects in terms of the impact of the more recent cultural policies applicable to the museum sector. First of all, the recent cultural policy gave greater importance to "cultural

decentralization", which started a process of gradual de-centralization by the state government over culture undertakings (Vicente et al. 2012). The state focus is now limited to large cultural institutions that reflect the culture, value and identity of the nation, and delegates control over other cultural institutions to local administrations (Gilabert González 2016). This led directly to the regionalization of museum systems.

Second, the regionalization of museum systems is characterized by two dimensions. On the one hand, regional and local governments conducted a large program of investments in the museum sector torwards the end of the 20th century and the beginning of the 21st century. The typical example is the establishment of a series of modern art museums such as the Valencian Institute of Modern Art (IVAM, 1989) and the Valencian Museum of Enlightenment and Modernity (MuVIM, 2001). Meanwhile, local museums also witnessed a rapid growth in number. For instance, regional, provincial and municipal museums account for a proportion of 70% of all museums in the Valencian region according to table 11. On the other hand, the juridical and normative frameworks for museums were established on a regional basis rather than at a national level. Examples include the Valencian System of Museums [1], the National System of Museums of Euskadi [2], the System of Museums of Navarra [3], and Gallego System of Museums [4], and so on (Gilabert González 2016). This finally gave rise to the localization of museum interaction in the system of innovation.

Lastly, the localization of interaction means that the interaction and collaboration in which museums engage usually takes place within regional and local limits rather than national boundary owing to both geographical and administrative proximity. For example, many communication and technology companies, with which museums interact, are local companies run by municipal governments. Museums also tend to collaborate with local universities located in the same province and cross-regional collaboration is

[1] http://www.ceice.gva.es/web/patrimonio-cultural-y-museos
[2] http://www.euskadi.eus/gobierno-vasco/centro-de-museos/
[3]https://www.navarra.es/home_es/Temas/Turismo+ocio+y+cultura/Museos/museos.htm
[4] http://museos.xunta.gal

uncommon. In the questionnaire conducted during this research, over 76% of museums responded that it was easier to collaborate with other museums under the same administrative structure.

All aspects point to the fact that the system of innovation in museums is based at regional level in Spain. This indicates that it is appropriate and necessary to explore museum innovation at a regional level with further empirical studies.

The analysis on interaction is at the center of the system of innovation approach. Interaction matters because innovation itself is an interactive process (Lundvall 1988). Museum innovation is mostly open innovation, which relies on external sources of knowledge, and the market for innovation by means of interaction and collaboration. The case study has already revealed that collaborative innovation is an important pattern on which museums rely, and is widespread in almost all the domains of cultural production in museum.

Although the beneficial role of collaboration has drawn the attention of some researchers like Camarero and Garrido (2012), who found that unless museums collaborated with other museums in the joint leisure and cultural activities that they undertook, the visitor-oriented strategies did not show significant correlation with technological innovation in museums, and most discussions about the collaboration-innovation relationship still remain theoretical propositions in the arts and cultural organizations. To explore the potential impact of collaboration on museum innovation, the hypothesis is developed as follows:

H5: The greater the number of collaborations in which a museum is involved, the more that it will engage in technological innovation (H5a), cultural innovation (H5b), and organizational innovation (H5c).

However, the number of collaborations cannot capture the diversity of collaboration in which museum may engage. The actors in the system of innovation are diverse rather than monotonous. In the Valencia region, a system of innovation in museums may consist of various agents ranging from organizations to individuals (Li et al. 2016). On the basis of interviews with

museum directors, we identify six main types of agent with which museums collaborate, which are as follows:

- **High-tech firms**, dedicated to provide ICT solutions to museums, such as website development, digitalization, Augmented Reality, and so on;
- **Museography-oriented firms**, which are at the service of museums by concentrating on complementary areas of work, such as logistics, insurance, and restoration of heritage and artworks;
- **Universities and research centers**, which are not only training institutions that supply manpower, but also important sources of knowledge and technologies that museums adopt for innovation;
- **Museological associations**, which make up a network within which museums and staff connect for knowledge sharing and capacity building;
- **Individual specialists**, who are either from universities or research centers, and offer research-oriented consultancy, like curators for art exhibitions, or self-employed workers specializing in some professional jobs, like restorers and conservators of ancient architecture and cultural heritage.
- **Museums and cultural institutions**, which usually complement one another in museographical resources, such as collection rental and collaborative investigation.

Although there isn't any empirical evidence about the influence of particular agents on museum innovation, it is assumed that museums can enhance their innovation by collaborating with other agents, considering the importance of interaction and collaboration in the innovation system. Therefore, to explore such influence, six hypotheses are expressed as follows:

H6: Collaborating with high-tech firms helps museums to enhance technological innovation (H6a), cultural innovation (H6b), and organizational innovation (H6c).

H7: Collaborating with museography-oriented firms helps museums to enhance technological innovation (H7a), cultural innovation (H7b),

and organizational innovation (H7c).

H8: Collaborating with universities helps museums to enhance technological innovation (H8a), cultural innovation (H8b), and organizational innovation (H8c).

H9: Collaborating with museographical associations helps museums to enhance technological innovation (H9a), cultural innovation (H9b), and organizational innovation (H9c).

H10: Collaborating with individual specialists helps museums to enhance technological innovation (H10a), cultural innovation (H10b), and organizational innovation (H10c).

H11: Collaborating with other museums helps museums to enhance technological innovation (H11a), cultural innovation (H11b), and organizational innovation (H11c).

5.2 DATA AND METHODS

5.2.1 Data collection and sample characteristics

The data collection is based on the records of museums and museographical exhibitions registered in the territory of the Valencian Community, which are provided by the regional government of Valencia (Generalitat Valenciana). As the study focuses on museum organizations, only registered museums were selected from all records. A questionnaire was sent to the directors of all registered museums through the online survey tool LimeSurvey. This questionnaire was firstly designed on the basis of the early case study of local museums; and then it was revised after several discussions with the researcher's tutors and colleagues, as well as a pre-test with a deputy director of a local art foundation; at last, a final questionnaire was sent to a total of 124 museums. At the same time, telephone communication was attempted to conduct with each museum in order to seek elicit cooperation of potential respondents. Such communication helped the researcher greatly in understanding the status quo of Valencian museums, after talking with museum staff on the phone. There were 20 museums that didn't answer phone

calls and, at least, three museums that had been closed for more than a year. This means that the actual number of museums is fewer than the number listed by the regional government.

Table 12 Sample description (1)

		Total	Alicante	Castellón	Valencia
Type	Archeology	22 (36.7%)	12 (44.4%)	3 (33.3%)	7 (30.4%)
	Ethnography & anthropology	13 (21.7%)	8 (29.6%)	1 (11.1%)	3 (13.0%)
	Arts	11 (18.3%)	2 (7.4%)	3 (33.3%)	6 (26.1%)
	Science & technology	5 (8.3%)	2 (7.4%)	2 (22.2%)	1 (4.3%)
	Natural sciences & natural history	5 (8.3%)	2 (7.4%)	0 (0%)	3 (13.0%)
	History	1 (1.7%)	0 (0.0%)	0 (0%)	1 (4.3%)
	House-museum	2 (3.3%)	1 (3.7%)	0 (0%)	1 (4.3%)
	Specialized	1 (1.7%)	0 (0.0%)	0 (0%)	1 (4.3%)
Ownership	National	1 (1.7%)	0 (0%)	0 (0%)	1 (4.5%)
	Regional & provincial	3 (5.2%)	0 (0%)	1 (11.1%)	2 (9.1%)
	Municipal	39 (67.2%)	20 (71.4%)	7 (77.8%)	12 (54.5%)
	Private	4 (6.9%)	3 (10.7%)	0 (0%)	1 (4.5%)
	University	1 (1.7%)	1 (3.6%)	0 (0%)	1 (4.5%)
	Association	4 (6.9%)	3 (10.7%)	0 (0%)	1 (4.5%)
	Foundation	2 (3.4%)	1 (3.6%)	1 (11.1%)	0 (0%)
	Ecclesiastical	4 (6.9%)	0 (0%)	0 (0.0%)	4 (18.2%)
	Consortium	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Staff	Maximum	35	19	12	35
	Minimum	1	1	1	1
	Mean	6	5	5	9
	Median	4	4	5	6
	Mode	3	4	5	6
	Std. Deviation	6	4	4	8
Geographical distance (min.)	Maximum	72	72	54	65
	Minimum	0	0	0	0
	Mean	30	39	28	20
	Median	32	36	25	9
	Mode	0	34	25	0
	Std. Deviation	21	16	16	24
	Total	59 (100%)	27 (45.8%)	9 (15.3%)	23 (39.0%)

Source: elaborated by author

After removing incomplete and repeated responses, this study finally gathered 59 questionnaires, representing an actual response rate of 49%. This response rate is much higher than that of other studies focusing on similar goals. In a few words, this study has a small, definite population of 121 museums with a sample size of 59, signifying that the margin of error for p=q=0.5 at 95% confidence level is ± 9.2 %. The period of data collecting lasted from July 2016 to January 2017. The detailed description of the sample is reported in table 12.

5.2.2 Measurement of variables

Technological innovation is measured by the extent to which museums utilize ICTs in their daily functioning, following the approach proposed by Vicente et al. (2012). We first listed a series of potential solutions for digital objects, digital networks, digital technology and digital devices, which are summarized in the table 13, to enquire if museums had adopted said technologies or not; then an index of the sum of innovation was created on the basis of measuring the number of technologies used in each domain, which actually reflected the adoption rate of different technologies in the museum sector. This index, we think, not only measured the number of innovations but also represented the degree of innovation in terms of different technological domains. The higher the adoption rate is, the lower degree to which innovation is involved. So we further weighted identified technologies with five scales in accordance with their adoption rates, so as to reflect the relative degree of innovation that different solutions represent. Finally, technological innovation is measured as the weighted sum of the number of ICTs that each museum adopts.

Cultural innovation is presented through three indicators concerning the number of permanent and temporal exhibitions, educational programs and activities, as well as academic and professional articles written by museum staff. Cultural innovation is measured as the average of the values of the three indictors.

Table 13 Indicators of technological innovation

	Frequency	Percentage	Weight
Digital object			
Web page	49	83.1%	1
Digitized collection	26	44.1%	2
Digital network			
Intranet	32	54.2%	1
Social media	31	52.5%	1
App	10	16.9%	3
Digital or virtual museum	7	11.9%	3
Digital technology			
Augmented reality	4	6.8%	3
3-D	2	3.4%	4
Virtual Reality	1	1.7%	5
Digital device			
Quick Response code	18	30.5%	2
Audio guide	6	10.2%	3
Information station	2	3.4%	4
Others			
Video Mapping	1	1.7%	5
Diorama	1	1.7%	5

Organizational innovation is represented against a scale of two indicators that evaluate the degree of changes in organizational structure and culture that support innovation in museums, and the degree was measured on a five-point Likert scale, where 5 indicates “strongly agree” and 1 indicates “strongly disagree”. This method has been widely used in the existing studies to measure organizational innovation in the museum sector (Camarero & Garrido 2008; Vicente et al. 2012).

Furthermore, a Principal Components Analysis (PCA) was run on five indicators measuring the innovative activities of museums. The suitability of PCA was assessed prior to the analysis. The correlation matrix showed that all variables had at least one correlation coefficient greater than 0.3. The overall Kaiser-Meyer-Olkin (KMO) measure was 0.526, which is above “unacceptable” meaning, according to Kaiser (1974), whilst the individual KMO measure of the variable ORG_STRU was only 0.467, representing a low KMO measure, readers should consider this indicator with caution. Bartlett's test of sphericity was

statistically significant ($p < .0005$), indicating that the data was suitable for PAC. Finally, PAC exhibited two components with eigenvalues greater than one, which explained 39.1% and 27.9 of the total variance, respectively. The result of PAC demonstrated it feasible to reduce five indicators into two components as cultural innovation and organizational innovation.

Descriptive statistics and reliability of PCA for cultural and organizational innovation are reported in table 14; correlation matrix of PCA is reported in table 15; total variance explained is reported in table 16, and rotated component matrix is reported in table 17.

Museum type is classified in three categories, whereby "arts", "history" and "house museums" are grouped into the first category as "arts and history museums"; "archeology" and "ethnography and anthropology" are grouped into the second category as "archeology & ethnography museums"; and "science & technology", "natural science & natural history" and "specialized [1]" are grouped into the third category as "nature & science museums".

Museum ownership is classified into three categories as "public museums", "private museums" and "mixed museums" according to the identification of Gilabert González (2016). Respondents had to choose in the questionnaire to which category their museums belonged so that private and mixed museums could be clearly identified.

Museum size is measured in terms of the number of staff. The variation ranges from 1 to 35, which means that all museums are small and medium size. Some studies have shown that the size-innovation relationship is curvilinear rather than linear (Camarero et al. 2011); therefore, a logarithmic transformation should be applied to the number of employees. This also might give rise to concerns such as that the logarithmic transformation is not necessary because of the narrow variation in size in this case. In this study, the size variable was transferred by logarithmic transformation because of the violation of homoscedasticity if size wasn't transferred in the analysis of multiple regression.

[1] The only specialized museum in the sample is chocolate-related museum, which can be seen as something about food engineering, so it is categorized into "nature and science" museum.

Table 14 Descriptive statistics and reliability of Principal Component Analysis for cultural and organizational innovation

Indicators	Mean	SD	KMO
Cultural innovation			
The number of permanent & temporal exhibitions inaugurated by the museum on 2015 (EXP)	3.800	4.425	.523
The number of educational programs & activities executed by the museum on 2015 (ACT)	17.051	38.632	.534
The number of academic and professional articles published by museum staff on 2015 (PAP)	2.420	4.044	.532
Organizational innovation			
Generally speaking, significant changes have been introduced in organizational structure of the museum in the latest years. (ORG_STRU)	2.588	1.4748	.467
Generally speaking, an open and collaborative organizational culture has been formed in the museum to support creative and innovative activities in the latest years. (ORG_CULT)	3.185	1.3022	.552
Note: KMO of Sampling Adequacy = 0.526; Bartlett's Test of Sphericity: Approx. Chi Square = 62.163, Sig. = .000			

Table 15 Correlation matrix of Principal Components Analysis

		EXP	ACT	PAP	ORG_STRU	ORG_CULT
Correlation	EXP	1.000	.317	.144	-.125	.089
	ACT	.317	1.000	.695	.006	.253
	PAP	.144	.695	1.000	-.001	.195
	ORG_STRU	-.125	.006	-.001	1.000	.454
	ORG_CULT	.089	.253	.195	.454	1.000

Table 16 Total variance explained for Principal Components Analysis

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.956	39.127	39.127	1.956	39.127	39.127	1.866	37.326	37.326
2	1.399	27.981	67.108	1.399	27.981	67.108	1.489	29.782	67.108
3	.881	17.612	84.720						
4	.485	9.695	94.415						
5	.279	5.585	100.00						

Table 17 Rotated component matrix for Principal Components Analysis with Varimax Rotation

Items	Rotated Component Coefficients		
	Component 1	Component 2	Communalities
ACT	**.895**	.150	.824
PAP	**.828**	.141	.705
EXP	**.550**	-.166	.330
ORG_STRU	-.160	**.869**	.780
ORG_CULT	.227	**.815**	.716

Geographical distance is measured by the time it takes to drive from a museum's location to its corresponding provincial capital. Exact minutes were recorded by means of a search using Google Maps. The variation ranges from 0 minute to 72 minutes with an average of 30 minutes and a mode of 0 minute, which implies that most of the museums in the sample are located at or around the capital cities.

The degree of collaboration is measured by the amount of actors with whom museums collaborated in the past 12 months before the survey. Furthermore, "actors" can be subdivided into six categories including (1) high-tech firms, (2) museography-oriented firms, (3) individual specialists, (4) universities, (5) associations, and (6) other museums. Each is treated as a binary factor with one of two options, i.e. collaborating = 1 and not collaborating = 0.

5.2.3 Data processing

First of all, three models were estimated by the multiple regression approach to explore the relationships between predictor variables and innovation outcomes. To improve model fit, the logarithmic transformation was applied to "size", "geographic proximity", "technological innovation", and "cultural innovation" variables. Keene (1995) also argued that a log-transformed analysis was preferred to an untransformed analysis for continuous positive data measured on an interval scale. Considering that museum type and ownership are two polytomous variables, dummy coding was conducted and another four dichotomous variables were constructed, i.e. mixed museum (yes = 1; no = 0), private museum (yes = 1; no = 0), arts and history museum (yes = 1; no = 0), natural and science museum (yes = 1; no = 0).

To apply the multiple regression approach, the related assumptions were tested. In each estimated model, there was independence of residuals, assessed by a Durin-Watson statistics of 2.329, 1.785, and 2.205, respectively; there was linearity assessed by partial regression plots and plots of studentized residuals against the predicted values; the assumption of homoscedasticity was met, as tested by the inspection of plots of studentized residuals against unstandardized predicted values; there was no multicollinearity because none

of the independent variables had correlations greater than 0.7; all tolerance values were greater than 0.; all studentized deleted residuals were less than ±3 standard deviations, no leverage values were greater than 0.5, and values for Cook's distance were below 1; the residuals was normally distributed according to Q-Q Plots of the studentized residuals. All three models of multiple regression were significantly estimated, F_1 (7, 51) = 4.016, $p_1 < .01$, *adj.* R^2 = .267; F_2 (7, 51) = 3.974, $p_2 < .01$, *adj.* R^2 = .264; F_3 (7, 51) = 2.453 $p_3 < .05$, *adj.* R^2 = .149. Corresponding data and models are reported in table 18 - 22.

Then one-way ANOVA and Mann-Whitney U tests were carried out to determine if there were differences in innovation outcome between museums that collaborated with indiviudal actors and museums that didn't collaborate afterwards. Parametric tests are often more robust than non-parametric tests (Cotton 1994, p112). To verify the validity of the parametric analysis, three tests were further conducted to determine if the assumptions of the one-way ANOVA method was met, and nonparametric analysis was conducted in the case of the violation of assumptions of one-way ANOVA. Similarly, "technological innovation" and "cultural innovation" variables were transferred by logarithmic transformation.

First, the inspection of boxplots is assessed for outliers in each group of all factors. Most of the outliers were modified by replacing their values with ones that were less extreme (Ghosh & Vogt 2012), except for the outliers involved in technological innovation data for "university" and "museum" factors. The existence of these outliers didn't change the results after the comparison of results based on one-way ANOVA with and without the outliers as well as on Man-Whitney U test.

Second, the Shapiro-Wilk test of normality showed that the data of technological and cultural innovation was approximately normally distributed whilst the majority of organizational innovation data violated the assumption of normality. Therefore, the Mann-Whitney U test was utilized to test the difference of organizational innovation based on "high-tech firm", "museography-oriented firm", "individual specialist", "university", and "museum" factors.

Table 18 Descriptive and collinearity statistics for multiple regression

	Mean	Std. Deviation	Tolerance	VIF	N
Mixed museum	.08	.281	.639	1.565	59
Private museum	.19	.393	.731	1.368	59
Art and history museum	.2373	.4291	.584	1.714	59
Nature and science museum	.1864	.3928	.553	1.809	59
Size (log) [a]	1.4736	.8020	.737	1.356	59
Geographical distance (log) [b]	2.7725	1.5898	.587	1.705	59
Collaboration	5.0169	4.4159	.690	1.450	59
Technological innovation (log) [a]	1.6437	.6373			
Cultural innovation (log) [a]	1.5979	.9750			
Organizational innovation	2.8867	1.1849			

Note: a. ln (x) transformation is used.

b. ln (x +1) is used considering that value of geographical distance variable includes zero.

Table 19 Correlations for multiple regression

		Mixed museum	Private museum	Art museum	Science museum	Size (log)	Geographical distance (log)	Collabor -ation	Technological innovation (log)	Cultural innovation (log)	Organizational innovation
Correlation	Mixed museum	1.000	-.146	-.027	.479***	.181	-.128	-.071	.325**	.227*	.226*
	Private museum	-.146	1.000	.244*	.106	-.118	-.128	-.211	.114	-.244*	.161
	Art museum	-.027	.244*	1.000	-.267*	.091	-.435***	.198	.057	.094	.023
	Science museum	.479***	.106	-.267*	1.000	.118	-.192	.058	.141*	.248*	.079
	Size (log)	.181	-.118	.091	.118	1.000	-.399**	.372**	.260	.486***	.099
	Geographical distance (log)	-.128	-.128	-.435***	-.192	-.399**	1.000	-.353**	-.174	-.265*	.112
	Collaboration	-.071	-.211	.198	.058	.372**	-.353**	1.000	.354**	.283*	.174
	Technological innovation (log)	.325**	.114	.057	.141	.260*	-.174	.354**	1.000	.243*	.272*
	Cultural innovation (log)	.227*	-.244*	.094	.248*	.486***	-.265*	.283*	.243*	1.000	.135
	Organizational innovation	.226*	.161	.023	.079	.099	.112	.174	.272*	.135	1.000

Note: Sig. (1 tailed)
* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$

Table 20 Model summary for multiple regression models

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin - Watson
1	.596	.355	.267	.54564	2.329
2	.594	.353	.264	.83642	1.785
3	.502	.252	.149	1.09298	2.205

Table 21 ANOVA for multiple regression models

Model		Sum of Squares	df	Mean square	F	Sig.
1	Regression	8.370	7	1.196	4.016	.001
	Residual	15.184	51	.298		
	Total	23.554	58			
2	Regression	19.461	7	2.780	3.974	.002
	Residual	35.679	51	.700		
	Total	55.140	58			
3	Regression	20.512	7	2.930	2.453	.030
	Residual	60.925	51	1.195		
	Total	81.437	58			

Table 22 Estimated models

	Model 1 Technological innovation (log)					Model 2 Cultural innovation (log)					Model 3 Organizational innovation				
	B	SE_B	Beta	t.	Sig.	B	SE_B	Beta	t.	Sig.	B	SE_B	Beta	t.	Sig.
Control variable															
Mixed museum (No=0, Yes=1)	1.138	.319	.502	3.567	.001	-.062	.489	-.018	-.127	.900	1.657	.639	.393	2.592	.012
Private museum (No=0, Yes=1)	.598	.213	.369	2.804	.007	-.682	.327	-.275	-2.084	.042	1.119	.427	.371	2.618	.012
Art museum [a] (No=0, Yes=1)	-.253	.219	-.170	-1.156	.253	.461	.335	.203	1.376	.175	-.062	.438	-.023	-.142	.888
Science museum [b] (No=0, Yes=1)	-.351	.245	-.216	-1.431	.158	.728	.376	.293	1.937	.058	-.363	.491	-.120	-.739	.464
Size (log)	.065	.104	.082	.625	.535	.486	.159	.400	3.049	.004	.125	.208	.085	.599	.552
Geographical distance (log)	.011	.059	.028	.192	.848	.006	.090	.010	.067	.947	.258	.118	.346	2.185	.034
Collaboration	.071	.020	.492	3.637	.001	.005	.030	.022	.160	.874	.102	.039	.382	2.617	.012

Note: B = unstandardized regression coefficient; SE_B = standard error of the coefficient; Beta = standardized coefficient

a. It represents arts and history category

b. It represents Nature and science category

Table 23 Sample description (2)

Factor	Group	N	Technological innovation (log)		Cultural innovation (log)		Organizational innovation	
			Mean	SE	Mean	SE	Mean/mean rank	SE/Sum of ranks
Province	Alicante	28	1.5212	.1363	1.3776	.1421	2.9877	.1949
	Castellón	9	1.6299	.1317	1.8235	.3472	3.1312	.4177
	Valencia	22	1.7689	.1152	1.7860	.2489	2.6582	.2876
High-tech firm	No	48	1.5308	.0837	1.6511	.1530	29.03	1393.50
	Yes	11	2.1364	.2013	1.3374	.0725	34.23	376.50
Museography-oriented firm	No	42	1.6053	.1055	1.6081	.1691	28.63	1202.50
	Yes	17	1.7386	.1237	1.5727	.1468	33.38	567.50
Individual specialist	No	37	1.6299	.9634	1.4513	.1395	25.26	934.50
	Yes	22	1.7288	.1272	1.7309	.1977	37.98	835.50
University	No	19	1.2658	.1150	1.3158	.1887	27.18	516.50
	Yes	40	1.8232	.0981	1.7032	.1515	31.34	1253.50
Association	No	48	1.5867	.0927	1.3960	.1189	2.9962	.1623
	Yes	11	1.8924	.1739	2.4358	.3295	2.4091	.4146
Museum	No	7	1.0481	.2510	1.0637	.4180	17.79	124.50
	Yes	52	1.7239	.0826	1.6546	.1252	31.64	1645.50

Table 24 Shapiro-Walk Test of Normality

Factors	Groups	df	Technological innovation (log)		Cultural innovation (log)		Organizational innovation	
			Statistic	Sig.	Statistic	Sig.	Statistic	Sig.
Province	Alicante	28	.974	.688	.975	.724	.952	.217
	Castellón	9	.884	.175	.944	.630	.960	.801
	Valencia	22	.924	.091	.936	.163	.916	.062
High-tech firm	No	48	.961	.107	.969	.241	.939	.015
	Yes	11	.890	.141	.936	.473	.931	.418
Museography-oriented firm	No	42	.964	.205	.953	.086	.945	.044
	Yes	17	.924	.174	.951	.466	.924	.172
Individual specialist	No	37	.957	.160	.963	.244	.938	.040
	Yes	22	.952	.349	.967	.645	.926	.104
University	No	19	.945[a]	.319	.930	.177	.911	.078
	Yes	40	.956[a]	.119	.966	.276	.941	.036
Association	No	48	.966	.173	.968	.216	.954	.058
	Yes	11	.958	.744	.928	.386	.856	.052
Museum	No	7	.972	.913	.904	.358	.746	.012
	Yes	52	.961[a]	.085	.962	.095	.951	.033

Note: a. Outliers are remained; the results don't change before and after removing outliers based on one-way ANOVA test and Mann-Whitney U test.

Table 25 Test of Homogeneity of Variances

Factor	df1	df2	Technological innovation (log)		Cultural innovation (log)		Organizational innovation	
			Levene Statistic	Sig.	Levene Statistic	Sig.	Levene Statistic	Sig.
Province	2	56	1.534	0.225	2.221	0.118	1.706	0.191
High-tech firm	1	57	0.296	0.589	10.352	0.002	0.075	0.785
Museography-oriented firm	1	57	0.885	0.351	3.400	0.070	0.268	0.607
Individual	1	57	0.003	0.958	0.063	0.803	0.688	0.410
University	1	57	1.107	0.297	0.816	0.370	0.550	0.461
Association	1	57	0.090	0.765	1.679	0.200	2.441	0.124
Museum	1	57	0.049	0.826	0.732	0.396	0.000	0.999

Table 26 ANOVA and nonparametric test results

Factor	Technological innovation (log)		Cultural innovation (log)		Organizational innovation	
	F	Sig.	F	Sig.	F / U	Sig.
Province	.695	.503	1.383	.259	.988	.379
High-tech firm	6.838	.011	3.433[a]	.069	217.500[b]	.362
Museography-oriented firm	.525	.472	.016	.901	299.500[b]	.332
Individual specialist	.387	.536	1.397	.242	231.500[b]	.006
University	11.665	.001	2.297	.135	326.500[b]	.382
Association	2.908	.153	1.679	.001	2.172	.146
Museum	7.744	.007	2.512	.119	267.500[b]	.043[c]

Note: One-way ANOVA is used unless otherwise specified.

a. Asymptotically F distributed of Welch's ANOVA test.

b. Mann-Whitney U test.

c. Exact sig. (2 sided test)

Third, Levene's test showed that the assumption of homogeneity of variances was met, with the exception that variances of cultural innovation were not equal for the groups of “high-tech firm” factor. As a result, the Welch ANOVA was used to test the differences of cultural innovation between groups of “high-tech firm” factors on cultural innovation.

Table 23 displays the corresponding description of the sample. The Shapiro-Wilk test was reported in table 24. Levene’s test is reported in table 25. The results of ANOVA and nonparametric tests are described in table 26.

5.3 RESULT AND DISCUSSION

Before testing the hypotheses, we checked the impact of the provincial factor on innovation outcomes, ANOVA result exhibited that there was no difference in technological, cultural and organizational innovation between Alicante, Castellón and Valencia provinces.

Hypotheses are tested by observing three estimated models based on the multiple regression (see table 22) as well as the difference between groups based on one-way ANOVA and Mann-Whitney U test (see table 26). According to the estimated models, hypotheses H1a, H1b and H1c are refused, there is no evidence to prove that nature and science museums engage more in technological, cultural and organizational innovation than archeology and ethnography museums or arts and history museums. There might be two possible explanations for this result. This first possibility is that the difference in variety of knowledge and the combination of knowledge and technology is not so remarkable as to affect innovative activities in Valenican museums. The second is that the type of museum doesn't affect innovation outcomes, as affirmed in another empirical study by Camarero et al. (2011).

Hypotheses H2a, H2b and H2c are accepted. Private museums do display a higher degree of technological innovation and organizational innovation, and they engage in a lower degree of cultural innovation in comparison to public museums. When taking mixed museums into consideration, it clearly shows that both mixed and private museums are more innovative than public museums with

regard to the adoption of new technologies and the exploration of new organizational structures and culture. Furthermore, all things being equal, the contribution of mixed museums to the degree of technological innovation is 2.59 times greater than that of private museums [1], which implies that mixed museums make a much greater contribution to technological innovation than private museums.

This demonstrates that private museums have higher economic aspiration and lower artistic aspiration and therefore, they are more likely to invest in new technologies and adopt new organizational methods so as to improve their performance than public museums; but private museums usually don't have the same cultural aspiration and social mission as public museums and, conversely, they have lower engagement in the development of new cultural goods and services. Considering mixed museums, they have even more advantage over private museums in terms of technological innovation; this might be because mixed museums enjoy a higher degree of administrative autonomy than public museums while at the same time being more consistently funded than private museums, which is also evidenced by the finding that a mixed financial structure is more beneficial to spurring technological innovation than structures that depend too much on either public or private funding (Camarero et al. 2011).

All hypotheses H3a, H3b and H3c are refused. Proximity to the provincial capital doesn't lead to a greater degree of technological, cultural or organizational innovation. On the contrary, the results reveals that the farther away from the provincial capital a museum is, the greater extent to which engage in organizational innovation. Geographical distance instead of geographical proximity is a driver of cultural innovation in museums.

The geographical distance, we think, is a doble-edged sword – the negative side being that, being located farther away from centers for education and technology hinders museums' access to opportunities of supplier-producer interaction; on the positive side, a greater distance also encourages them to create more favorable organizational strategies and environments for

[1] The contribution of mixed museum to the degree of technological innovation is 212% ($e^{1.138} - 1$); the contribution of private museum to the degree of technological innovation is 82% ($e^{0.598} - 1$).

networking and interacting in order to make up for their geographic deficiency. It seems that the advantages trump the disadvantages in our case, which may explain the positive impact of geographica distance on organizational innovation.

Concerning the size-innovation relationship, hypothesis H4b is accepted. The larger a museum is, the more it will engage in cultural innovation. Particularly, the model estimates that a 10% growth of the number of employees in the museum can increase the outcome of cultural innovation by 4.7% ($= e^{0.468 \cdot \log(1.1)} - 1$) at 95% confidence level. However, H4a and H4c are refused. Large museums are no more innovative than smaller museums in the technological and organizational dimensions.

The growth in terms of employees helps museums to increase their knowledge stock – especially symbolic knowledge, thus leading to greater focus on arts and humanities research, and more development of new cultural products. But staff number won't influence the adoption of external technologies and organizational changes, which coincides with the argument of Camarero et al. (2011). This might be because (1) technological innovation relies more on external knowledge than on internal knowledge, (2) the expansion of employees won't lead to a proportional increase in analytical and synthetical knowledge, and (3) decision-making about organizational changes usually depends on the joint influence of stakeholders.

Considering the impact of collaboration on innovation outcomes, hypotheses H5a and H5c are accepted. Collaboration can enhance the outcome of technological innovation and organizational innovation by museums; the more collaboration in which a museum involved, the more likely it is that the museum will engage in technological innovation and organizational innovation. The higher frequency of collaboration can lead museums to more innovation in the technological and organizational dimensions because collaboration is a means of expanding sources of knowledge flow and exchange by establishing external relations through inter-organization interaction. However, H5b is refused, as the frequency of collaboration doesn't appear to contribute to the outcome of cultural innovation. This might be explained by the particular pattern of cultural innovation in Valencian museums, where most of the new product development is dependent on closed innovation based on internal knowledge, which was

discovered, as described above in this thesis.

By comparing the impacts of size and collaboration on innovation outcome, it is obvious that museum size and collaboration can constitute complementary drivers of innovation so as to achieve a greater degree of overall innovation in the museum. This can also be explained from the perspective of innovation processes, i.e. most technological innovation takes place in collaborative and adoptive manners whilst cultural innovation mostly takes place in a self-dependent way in the production domain of museum organizations.

The impact of collaborative partners on museum innovation is tested on the base of a set of binary variables, depending on whether museums collaborate with a particular actor (= 1) or not (= 0). For high-tech firms, hypothesis H6a is supported. Technological innovation differs significantly between the two groups, F=6.838, p=0.011. This means that high-tech firms do help museums to enhance technological innovation. But hypotheses H6b and H6c are rejected. Neither cultural innovation nor organizational innovation witness significant difference between the two groups.

For museography-oriented firms, hypotheses H7a, H7b and H7c are rejected. None technological innovation, cultural innovation or organizational innovation differs in their means between two groups. This means that collaboration with museography-oriented firms doesn't enhance innovation in museum organizations.

For individual specialists, hypothesis H8c is accepted. According to Mann-Whitney U test, distributions of organizational innovation values for two groups are not similar, as assessed by figure 13, and organizational innovation values for collaborating with individual specialists (mean rank=37.98) and not collaborating with individual specialists (mean rank=25.26) are significant, U=231.500, p=0.006. This means that collaborating with individual specialists does help museums to improve their organizational innovation. But hypotheses H8a and H8b are rejected. There isn’t any significant difference in the means of technological innovation or cultural innovation between the two groups.

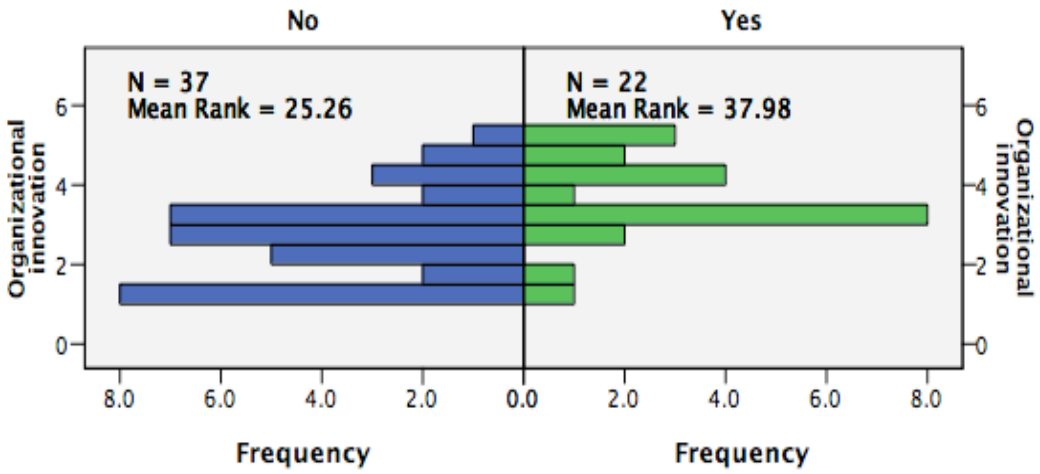


Figure 13 Independent-Samples Mann-Whitney U test for individual specialist factor

For universities, hypothesis H9a is supported. As the ANOVA result reveals, there is a significant difference in the mean of technological innovation between the two groups, F=11.665, *p*=0.001. Collaborating with universities helps museums to enhance technological innovation. H9b and H9c are rejected. Neither cultural innovation nor organizational innovation differs whether there is collaboration with universities or not.

For museological associations, hypothesis H10b is supported. The difference in cultural innovation is significant between the two groups in terms of the mean, F=1.679, *p*=0.001. Collaborating with museological associations does help museums to improve their cultural innovation. At the same time, H10a and H10c are rejected. Neither technological innovation nor organizational differs significantly between the two groups, which means that there is no evidence to support the hypotheses that collaborating with associations will enhance technological and organizational innovation by museums.

Finally, for museums themselves, both H11a and H11c are supported. As the ANOVA result shows, the difference is significant between the two groups in terms of the mean of technological innovation, F=7.744, *p*=0.007. In accordance with Mann-Whitney U test, the distribution of organizational innovation values for the two groups is not similar, as assessed by figure 14, and organizational innovation values for collaborating with other museums (mean rank=31.64) and not collaborating with individual specialists (mean rank=17.79) are significant,

U=267.500, p=0.043, using an exact sampling distribution for U (Dinneen & Blakesley 1973). Both results evidence that collaborating with other museums does helps museums to enhance both technological innovation and organizational innovation. However, H11b is rejected. Cultural innovation doesn't differ significantly regardless of whether museums collaborate with each other or not.

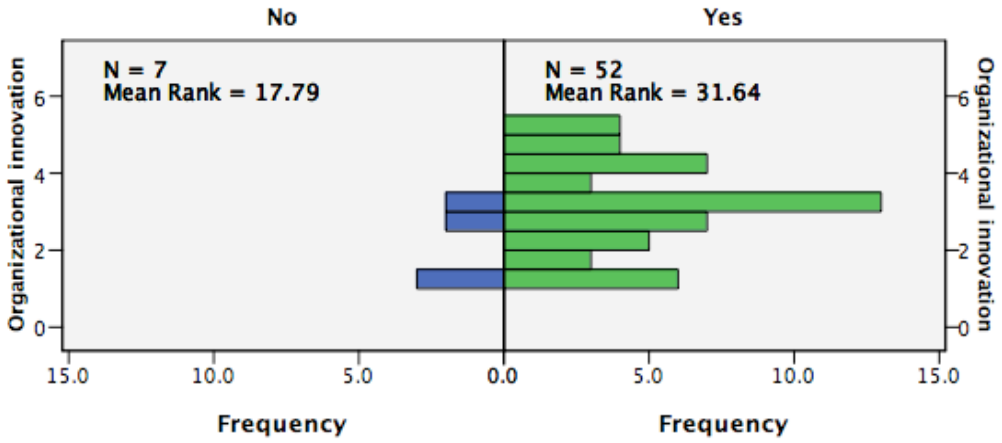


Figure 14 Independent-Samples Mann-Whitney U test for museum factor

The influenceing factors relating to collaborative partners can be discussed in terms of the type of innovation. First of all, both high-tech firms and universities constitute essential R&D institutions and technology suppliers involved in the supplier-producer interaction in the system of innovation, thus promoting technological innovation overall. Yet, museums themselves, as an important factor enhancing technological innovation, signify that inter-museum interaction is an important channel for the diffusion of technological innovation in the museum sector.

Second, museological associations are not suppliers to museums and, instead, they serve as intermediary institutions for networking among museums and museum professionals so as to strengthen capacity building of cultural innovation through wider and easier access to external channels of knowledge, and the market.

Third, the degree of organizational innovation only depends on the factors of individuals and museums themselves. Individual specialists are neither the

main forces behind R&D activities nor insiders on whom self-dependent innovation can rely, but constitute important supplementary manpower, especially for the museums that lack essential human resources and cannot recruit more owing to staffing restrictions, while most of the inter-museum collaborations are institutionalized as certain alliances under the same administration, and thus are an extension of formal organization.

Last, the result relating to museography-oriented firms evidences our theoretical proposal that service suppliers such as logistics, insurance and installation firms only play an auxiliary role in symbolic knowledge-based production in museums and thus, are not a determiant factor in the outcome of innovation.

5.4 CONCLUSION

This chapter attempted to identify some determinant factors that influence museum innovation from a systemic perspective. Considering that innovation is a regional phenomenon (Porter 1990, 1998; Breschi & Malerba 1997) and the extent to which museums innovate differs based on country and institutional context (Vicente et al. 2012), this empirical study focused exclusively on museums in the Valencian region of Spain so that the impact of factors on museum innovation was studied whilst keeping cultural policy constant. Aiming at the main question put forward at the beginning of the chapter, eleven hypotheses were suggested on the basis on existing theoretical propositions, and then tested through multiple regressions, ANOVA and Mann-Whitney U tests based on sample data collected from the questionnaire.

Our findings can be summarized in the following aspects. First, the result clearly shows that organizational characteristics and inter-organizational collaboration determine the outcome of museum innovation in small and medium-size museums. Organizational characteristics include ownership, size, and geographical location, and inter-organizational collaboration covers the frequency and object of collaboration.

Second, the impact of these determinant factors on museum innovation

differs based on the type of innovation. For example, organizational size just determines the outcome of cultural innovation; geographic distance only drives organizational innovation; the frequency of collaboration merely affects technological and organizational innovations. This finding coincides with Daft's (1978) argument, which stressed the differentiation between administrative and technical innovation in terms of the impacts of facilitating factors on them. In other words, technological, cultural and organizational innovation may be associated to different influencing factors in museum organizations.

Third, some determinant factors identified by prior studies based on cross-country sample don't exert anticipated influence on museum innovation. For example, both Camarero et al. (2011) and De-Miguel-molina et al. (2013) pointed out that organizational size determined the degree of technological and organizational innovation based on sampling surveys of museums located in various countries. But our study discovered that organizational size only had a positive relationship with the outcome of cultural innovation rather than technological or organizational innovation in Valencian museums. Besides, geographical proximity is not a determinant factor of innovation to local museums. These conflicting findings may imply that regional and institutional diversity also affects the mechanism of how innovation drivers execerise in the museum community.

In sum, these conclusions contain important academic, managerial and policy implications, which is the subject in the following discussion. .

CHAPTER 6

CONCLUSION AND IMPLICATION

This research is a theory-based study focusing on the empirical case of museums in the Valencia Region of Spain. Innovation by museum organization is the object of study. The study centers on three main questions. First, is it possible to develop a new perspective that explains innovation in museums so as to overcome the limitations of conventional perspectives? Second, how do museums innovate in the domains of cultural production? And third, what determines innovation outcomes in museum organizations?

Conventionally, museum innovation used to be studied from a dichotomy of perspectives, focusing either on technological innovation within productive units or cultural innovation by arts and cultural organization. In chapter 3, a third perspective on museum innovation is proposed by integrating the first two perspectives on the basis of essential empirical observation and theoretical development. Museum innovation is reformulated into an independent object of study in a comprehensive and integrated manner by exploring the four aspects of phenomenon, definition, taxonomy and determinants of innovation. This constitutes the theoretical basis of the empirical study in the research.

Chapter 4 concentrated on the explanation of innovation processes in museums on the basis of the open innovation model. By focusing on the cultural production processes of museum organizations and their complexity, four domains of cultural production were identified in terms of knowledge base and value creation dimensions, each domain was further matched with a particular type of innovation so as to facilitate the identification of the knowledge form, learning process and innovation mode in four domains. By means of a multiple-case study and pattern matching technique, different patterns of innovation were derived based on functional activities embedded in the domain of cultural

production.

Chapter 5 focused on the identification of influencing factors in museum innovation by way of a survey approach and statistical tests. On the basis of theoretical propositions discussed in the chapter 3, and the findings of the case study in chapter 4, the study first proposed a series of hypotheses concerning the potential influences of organizational characteristics and collaboration on innovation outcome, and then each hypothesis was accepted or refused on the basis of the results of the statistical tests.

On the basis of theoretical construction and empirical analyses, the answer to the questions is quite clear. It is not only possible but also necessary to explain museum innovation from the third perspective that integrates conventionally dichotomous explanations. Museum innovation is an open innovation, which follows various patterns for innovation based on the domain of production and the type of innovation. Yet, some basic organizational characteristics of museums and collaboration factors can affect the outcome of museum innovation in different ways.

6.1 MAIN CONCLUSIONS

Three main conclusions can be extracted from the answers provided to the questions that motivated this study.

First of all, museum innovation can be explained in an integrated manner. This manner includes at least three dimensions. The first dimension is *the integration of intension* of museum innovation. To museum organizations, innovation means the transformation of ideas, theories and approaches into new/improved cultural products, services and processes so as to advance, complete, and differentiate museums successfully in the market and society. Museum innovation is complex; museums both innovate in “content creativity” and “soft” dimensions in a “hidden” manner, and adopt externally generated innovation as an important source of innovation. Successful innovation should be valued not only by its functionality and market impacts, but also by aesthetics and institutional outcomes in the museum community.

The second dimension is *the integration of extension* of museum innovation. Museum innovation is a complex phenomenon that involves both technological and non-technological components. From a knowledge-based approach, museum innovation can be classified into three types: technological innovation, cultural innovation, and organizational innovation. Technological innovation embraces internal R&D and the adoption of new external technologies; cultural innovation includes arts and humanities research and new cultural product development; organizational innovation covers a range of innovations in business practices, workplace organization and external relations.

The third dimension is *the integration of determinants* of museum innovation. Theoretical propositions about the influence of different factors on innovation by museum organizations can be summed up along individual, organizational and systemic levels. The existing literature discloses that leadership, professionalization, organizational characteristics, management features, market attributes, geographical proximity and cultural policy may contribute to innovation outcomes in varying ways.

Second, museum innovation is an open innovation involving various patterns for innovation based on the domain of production and the type of innovation. As open innovation, museums often rely on both internal and external knowledge for innovation. In small and mid-size museums, as shown by our case study, the dependence of innovation on knowledge sources varies based on different domains of cultural production. In general, there are three ways in which innovation can take place, i.e. self-dependent innovation, collaborative innovation, and adoptive innovation. In particular, most innovation relies on open-ended sources of knowledge; external knowledge based on supplier-producer interaction is an important condition for successful innovation in experience domains, such as digital museums and visitor services. Internal knowledge through internal R&D, however, usually matters more in production domains, such as restoration and exhibition. As far as innovation process pattern is concerned, most technological innovations take place either in a collaborative pattern or by direct adoption of external innovation; while production-based cultural innovation often focuses on self-dependent innovation through internal arts and humanities research, but this doesn't prevent museums from

introducing new cultural products created outside as a complementary pattern of innovation; and experience-based cultural innovation normally follows a collaborative pattern with the emphasis on user-producer interaction. The case study also shows that the civil service system in public museums may lead to demotivation and negative attitudes at work, in turn, acting as a barrier to innovation in public museums. But the breadth and depth of demotivation and negative work seen in public museums is not clear, which calls for further study.

Last, basic organizational characteristics of museum and collaboration constitute important determinant factors that influence the outcome of museum innovation in different manners. All other things being equal, both private and mixed museums engage in more technological innovation and organizational innovation than public museums, but private museums undertake fewer arts and humanities research projects and new cultural product development, than public museums. Comparing mixed museums with private museums, the contribution of the former is much greater than that of the latter to the outcome of technological innovation. The impact of geographical proximity on museum innovation is weak; museums don't gain any advantage by way of their proximity to the corresponding provincial capital cities, and render neither a benefit in terms of technological innovation nor in cultural innovation; on the contrary, a greater distance may spur museums to implement changes in their organizational structure and methods to make up for the deficiency of collaborative opportunities, thus achieving a degree of organizational innovation. As far as museum size is concerned, the number of employees is only positively correlated with cultural innovation; the increase in the number of employees can strengthen a museum’s capability for innovation in arts and humanities research and new product development. Considering the factors relating to collaboration, both the frequency and diversity of collaboration may affect the extent to which museums innovate. The more a museum is involved in collaboration, the more likely it is to engage in technological and organizational innovation. Furthermore, the contribution of collaboration to museum innovation differs based on with whom museums collaborate. Technological innovation can be enhanced by collaborating with high-tech firms, universities and other museums; organizational innovation can be achieved through collaborating with individual

specialists and museum organizations; yet joining museological associations helps museums to arrive to a higher degree of cultural innovation.

6.2 IMPLICATIONS FOR ACADEMICS, MANAGEMENT AND POLICY-MAKING

A set of implications can be inferred on the basis of above findings and conclusions. They reflect upon possible academics, management and policy-making relating implications to museum innovation.

Academic implications

Academic implication can be discussed in two aspects of theoretical development and empirical study. With regard to theoretical development, museum innovation is becoming an emerging topic of innovation study that draws attention from scholars in recent years, but most of the existing studies only stress innovation by museums in a narrative and one-sided context. For example, Johnson and Thomas (1998) put forward innovation as the first agenda of the economics of museums with emphasis on technological innovation and its diffusion. Although such studies may give a deep insight on a specific feature – e.g. the utilization of ICTs – of museum innovation, it may to a great extent mislead readers to believe that museum innovation equals to the adoption of new technologies by museums. This is detrimental for the understanding innovation in museum organizations by the museographical professionals and the public. Our research shows that museum innovation can be explained in a more comprehensive way by integrating the dichotomy of research paradigms, thus providing a potential research path to expand the existing research paradigms and to make our explanation describe reality more closely. Such a research path involves at least four dimensions.

- **An integrated perspective**, innovation in museum organizations not only refers to technological innovation and its diffusion, but also stresses cultural innovation out of the attributes of arts and cultural organizations.
- **A complex process**, the way in which museums innovate is diverse and

varies from the type of innovation and the domain of production; it cannot take for granted "technology-push" and "demand-pull" as being the processes of museum innovation.

- **A systemic level**, museum innovation is more than an organizational process; it is embedded in the system of innovation in museums.
- **A regional basis**, the degree of museum innovation differs from countries and regions owing to the difference in cultural policies and infrastructure for educational, cultural and technological resources; the regional basis is of changeable extension practically in terms of the object at which the study aims (Doloreux & Parto 2005). For Spanish museums, it is preferable to analyze innovation at autonomous community levels; for global museums, it is better to probe into innovation at a national level.

As far as this empirical study is concerned, new findings that conflict with the prior propositions may imply some potential breaches deserving to be investigated further. For example, although the existing viewpoints regard both organizational size and geographical proximity as drivers of technological and organizational innovations according to the prior empirical studies based on global museums, our study reveals that such determinant impacts were weak or negligible among Valencian museums. The contradiction between theoretical proposition and empirical finding suggests that determinants of museum innovation are not absolute and, instead, their effect on innovation may change based on other factors, e.g. regional factors. Why does such contradiction occur? What factors lead to change in the effect of determinants on innovation outcome? How do some pre-identified determinants function in a particular region? These questions deserve more attention from the academic community.

Managerial implication

Museums and their directors attach importance to innovation management, but most of the managerial practices are based on a manager's individual experience and outdated theory. As a result, innovation management in the museum is often simplified as consisting of detailed behaviors such as constructing digital museums, expanding audience reach, or programming exhibitions and activities.

In essence, “technology-push” and “demand-pull” used to be rules of thumb widely adopted for innovation by the museum community. By emphasizing the open innovation model, this study discards conventional explanations about innovation based on the technology-push or demand-pull linear processes and stresses the significance of knowledge source, learning processes, innovation patterns and collaboration. Some managerial implications drawn from the findings may have a beneficial impact on innovation management in museums.

First, museum innovation has multiple dimensions ranging from technological and cultural, to organizational aspects, thus an assessment of museum innovation should also be based on multiple dimensions rather than a single outcome of technological or cultural innovation. This case study shows that the pattern of innovation is associated with the dimension of innovation and the domain where innovation takes place. Different types of innovation depend on different patterns of innovation (i.e. self-dependent, collaborative and adoptive patterns); and hence, particular types of innovation can be achieved by supporting the corresponding pattern through effective innovation management. However, the diversity of museum innovation doesn't mean that a museum should support all innovation patterns equally so as to enhance comprehensive innovation in the museum. On the contrary, it should prioritize certain types of innovation in museums owing to their organizational objectives and constricted resources. Therefore, clarity in a museum’s mission and objectives seems to be a requisite for effective innovation management (McDonald's 2007), which contributes positively to the organizational mission to innovate in NPOs.

Second, the mechanism of museum innovation is characterized by interactive network rather than linear processes, thus suggesting that conventional activities, including the acquisition of new technologies and identification of public and private demand, are important factors but do not constitue sufficient conditions for innovation. Besides this, the success of museum innovation is also reliant on knowledge management, organizational learning and inter-organizational collaboration that may affect interactive networks in which museums are involved. In particular, the “open” attribute of museum innovation signifies that external knowledge becomes more and more important in fostering innovation; and hence, expanding external sources for the

acquisition of knowledge from other institutions is the key to successful innovation by museums. This further relies on two aspects. The first is the establishment of external channels – inter-organizational collaboration can be an efficient institutional channel for maintaining a stable and lasting flow and exchange of knowledge and technology between museums and their suppliers/users; the second is the assimilation of external knowledge – learning by doing, using and interacting should be strengthened as essential learning capacity for innovation.

Third, internal knowledge also matters. The emphasis on external knowledge and inter-organizational interaction doesn't negate the importance of internal knowledge and instead, the generation of internal knowledge is the basis of production-based cultural innovation, like new investigation, exhibition, program and publications. Besides, the marked impact of museum size on cultural innovation suggests that internal knowledge could be associated with staff headcount in museums. At last, “human resource” is at the core of new product development in museum organizations; optimizing the allocation of resources and strengthening human capital are key elements to fostering cultural innovation.

Finally, all findings concerning innovation determinants can be made explicit, and practical guidelines for museum managers be produced to achieve both, particular and overall outcomes of innovation in museums. Together with the above managerial implications, some detailed managerial implications and practices may be summed up as follows:

- Formulating museum strategies for innovation as a practical guideline to innovation management in the museum, such innovation strategy should, at least, include: a) the objectives of innovation in accordance with the mission of organization; b) the type and domain of innovation on which the museum plans to focus; c) the pattern of innovation by which the museum plans to achieve the desited innovation.
- Optimizing the allocation of resources with an emphasis on the importance of human capital to cultural innovation. In the case of museums at full strength, internship program and short-term and project-oriented employment can be alternatives to strengthen innovation

capacity for new cultural product development by enlarging the number of employees in museums.

- Improving the organizational function of internal knowledge generation by enhancing individual learning capacity through creating sufficient opportunities for on-the-job training.
- Widening channels for acquiring external knowledge by promoting personal mobility and inter-organizational collaboration; establishing lasting and stable mechanism for the smooth exchange of knowledge and technology through seeking institutional agreements like internship agreements between museums and universities, partnerships between museums and enterprises, and trust-based outsourcing with technology and service suppliers.
- Intensifying the collaboration with universities and research centers, high-tech firms, and other museums to improve the museum's ability for technological innovation; participating in museological associations to enhance the museum's ability for cultural innovation; and strengthening contacts with individual specialists and museum organizations to better meet the objective of organizational innovation.

Policy implication

The implications from most of our findings are quite positive for policy-making. The first and most important implication is that it is possible for museums to take an active role as a social agent and economic engine in territorial development through an innovation strategy in times of crisis. Different from the "geographiccal proximity" effect on innovation in other creative industries (Martin & Moodysson 2011), the outcome of most innovation is less affected by geographical distance in the museum sector and, instead, such distance contributes to a higher degree of organizational innovation in museums. This suggests that museums could be a preferred vector, over other creative economy players, of Spanish specialization in global competition, based on an innovation strategy; a museum-based innovation strategy is a potential alternative to territorial development for those remote municipalities that embrace rich cultural and creative resources but have relatively weak educational and

technological infrastructures.

However, the above discussion doesn't infer that educational and technological infrastructures are not important. On the contrary, the findings relating to collaboration demonstrate it necessary and significant to establish intra and inter-sector connections and collaborations between museums and other sectors, including universities, research centers and high-tech industries because such collaborations can be beneficial to museum innovation by facilitating the acquisition of external knowledge and technology.

Besides, a higher degree of administrative autonomy and economic independence can be an institutional strength in museum innovation, which is implied by our finding that mixed museums perform better than both public and private museums overall in terms of innovation outcomes. Considering that a majority of museums in the Valencia region are public museums under direct management of public administrations, and with no financial independence whatsoever, it seems necessary to decentralize the current system of public museums and empower directors and management team responsible for the administration of the museums. On the other hand, the government also should adapt its policies and funding to better support private museums in order to give full play to their strength in technological innovation, and encourage their further engagement in cultural innovation.

Lastly, raising the number of employees can increase the ability of museums to support social cohesion and development. Many local governments assume that municipal museums will strengthen cultural identities, support social cohesion, and create cultural tourism through enriching cultural goods and services. But many municipal museums in the Valencia region suffer from an endemic shortage of manpower. Our finding clearly discloses that for a 10% growth in the number of employees in a museum the outcome of cultural innovation increases by 4.7%, at 95% confidence level, which shows that increasing museum staff in an appropriate and effective way to enhance cultural output.

In conclusion, some detailed policy implications can be summarized as follows:

- New regional strategies that include museums as vectors of specialization

and innovation should be on the political agenda for territorial development and global competition.

- Further cultural reform on the decentralization of regional systems for museums is necessary, with emphasis on empowering museum directors and management teams in charge of the administration of museum, loosening government intervention on museums and allowing for alternative sources for museum funding to be explored.
- Supporting the development of private museums; encouraging private museums to produce more cultural outputs based on the public's interests and needs by increasing political and financial supports for private museums.
- Promoting the integration of cultural heritage, education and technologies by facilitating the cooperation and collaboration between museums and research and educational institutions as well as attracting investment and sponsorship from technological industries to the museum sector.
- Increasing the number of employees in the museum sector to strengthen the sector's capabilities for cultural innovation, thus improving the impact of museums on social cohesion and local development.

6.3 LIMITATIONS AND FURTHER RESEARCH

This research recognizes the limitation that can be concluded from the geographical, content and research methodology aspects. First, this study focuses on museums in the Valencian Community of Spain, and the findings are mainly based on the empirical analysis of Valencian museums. As it has already been mentioned, museum innovation differs from country to country, and some results may be only applicable to Spanish museums and not so much to museums that are located in other regions, such as the United Kingdom, other continental European countries, America, Asia, Africa or Oceania, because of the differences in cultural policies, governance structures, innovation patterns, and so on.

The second possible limitation comes from the content of the study itself. Although this study has put forward a set of theoretical propositions about the

determinant factors of museum innovation, only some of the factors were tested by empirical data and statistical analysis in the study. Based on statistical results, some theoretical propositions are proved and the others should be revised. This implies the importance of an overall test on the residual propositions because some of them may also be rejected by further empirical study and may need to be revised further.

Lastly, there are the limitations imposed by the research methodology. First, the small size of sample in the study may affect negatively the reliability of the results by increasing the confidence interval at a certain confidence level. Second, the sample of the study doesn't cover large museums with reference to both the number of employees and prestige because there is a lack of the museums as large as the Prado Museum and the Reina Sofia Museum in the Valencia region, thus our findings may only apply to similar regions with small and mid-size museums. Third, the measurement of innovation in museum organizations is incomplete because of difficult access to related data; for example, the actual measurement of technological innovation is still limited to the adoption of ICTs without considering the internal R&D dimension.

In order to overcome the above limitations, further researches may need to be undertaken in several aspects. Considering the small size of the sample in this study, the next step would be to expand the current survey of museum innovation from the Valencian autonomous community to other regional territories and even into the whole country of Spain, so as to achieve a large size of sample with a wider range of museums in terms of size, type and ownership of museum.

Based on the expanded survey, an important theme deserving further research would be a cross-regional comparative study of museum innovation. A feasible plan of study might be a comparative analysis of innovation outcomes in museums from different autonomous communities in Spain. The possible findings could be of different significance depending on the comparison; some more generalized theories may be induced from the identification of the common characteristics shared by museums located in different autonomous communities, or some fundamental factors influencing museum innovation may be determined based on the difference in innovation outcomes of museums

between different regional territories.

Another possible research theme also relates to the measurement of museum innovation. The lack of standard measurements for innovative activities in museum organizations has prevented scholars from undertaking further empirical exploration of museum innovation, as well as cross-study comparisons based on existing literature. Therefore, it may be appropriate and urgent to develop a series of comprehensive and well-defined indicators to capture all dimensions and characteristics of museum innovation.

Finally, determinants of museum innovation also deserve to be further studied. This research may include both, further development of theoretical propositions based on multidisciplinary literature, and the test of extensive theoretical hypotheses based on an empirical survey and statistical analysis.

BIBLIOGRAPHY

Abrahamson, E., 1991. Managerial Fads and Fashions: the Diffusion and Refection of Innovations. *Academy of Management Review*, 16(3), pp.586–612.

Albi Ibáñez, E., 2003. *Economía de las artes y política cultural*, Madrid: Instituto de estudios fiscales. Available at: http://www.ief.es/documentos/recursos/publicaciones/libros/Est_hac_pub/Libros_estud_Hac_pub_EcoArtes_Indi.pdf.

Alcaide-Marzal, J. & Tortajada-Esparza, E., 2007. Innovation assessment in traditional industries. A proposal of aesthetic innovation indicators. *Scientometrics*, 72(1), pp.33–57.

Alexander, E.A., 2012. The Effects of Legal, Normative, and Cultural-Cognitive Institutions on Innovation in Technology Alliances. *Management International Review*, 52(6), pp.791–815.

Álvarez, I. & Marín, R., 2010. Entry modes and national systems of innovation. *Journal of International Management*, 16(4), pp.340–353.

American Association of Museums, 2008. *Museums & Society 2034: Trends and Potential Futures*, Arlington.

Anderson, G., 2004. Introduction: Reinventing The Museum. In G. Anderson, ed. *Reinventing the Museum: Historical and Contemporary Perspectives on the Paradigm Shift*. Lanham: AltaMira Press, pp. 1–9.

Anderson, M.L., 1999. Museums of the Future: the impact of technology on museums practices. *Deadalus*, 128(3), pp.129–162.

Aoyama, Y. & Izushi, H., 2003. Hardware gimmick or cultural innovation? Technological, cultural, and social foundations of the Japanese video game industry. *Research Policy*, 32, pp.423–444.

Arrow, K.J., 1962. The Economic Learning Implications of by Doing. *The Review of Economic Studies*, 29(3), pp.155–173.

Arrow, K.J., 1974. *The Limits of Organization*, New York: W · W · Norton & Company.

Asheim, B., Coenen, L. & Vang, J., 2007. Face-to-face, buzz, and knowledge bases: Sociospatial implications for learning, innovation, and innovation policy. *Environment and Planning C: Government and Policy*, 25(5), pp.655–670.

Asheim, B. & Gertler, M., 2005. The geography of innovation: Regional innovation systems. In J. Fagerberg, D. C. Mowery, & R. R. Nelson, eds. *The Oxford*

handbook of innovation. Oxford: Oxford University Press, pp. 291–317.

Asheim, B. & Hansen, H.K., 2009. Knowledge Bases, Talents, and Contexts: On the Usefulness of the Creative Class. *Economic Geography*, 85(4), pp.425–442.

Asheim, B.T. & Coenen, L., 2005. Knowledge bases and regional innovation systems: Comparing Nordic clusters. *Research Policy*, 34(8), pp.1173–1190.

Asuaga, C. & Rausell Köster, P., 2006. Un Análisis de la gestión de instituciones culturales: el caso específico de los Museos. *Revista Iberoamericana de Contabilidad de Gestión*, 4(8).

Atuahene-Gima, K., 1996. Market orientation and innovation. *Journal of Business Research*, 35(2), pp.93–103.

Bakhshi, H., Schneider, P. & Christopher, W., 2008. *Arts and Humanities Research and Innovation*, London: NESTA

Bakhshi, H. & Throsby, D., 2010. *Culture of Innovation: An economic analysis of innovation*, London: NESTA

Bakhshi, H. & Throsby, D., 2009. *Innovation in Arts and Cultural Organisations*, London: NESTA

Baregheh, A., Rowley, J. & Sambrook, S., 2009. Towards a multidisciplinary definition of innovation. *Management Decision*, 47(8), pp.1323–1339.

Baumol, W.J. & Bowen, W.G., 1966. *Performing Arts, the Economic Dilemma; a Study of Problems Common to Theater, Opera, Music, and Dance*, New York: Twentieth Century Fund.

Becheikh, N., Landry, R. & Amara, N., 2006. Lessons from innovation empirical studies in the manufacturing sector: A systematic review of the literature from 1993-2003. *Technovation*, 26(5–6), pp.644–664.

Bedford, L., 2001. Storytelling: The Real Work of Museums. *Curator: The Museum Journal*, 44(1), pp.27–34.

Beije, P., 1998. *Technological change in the modern economy: basic topics and new developments*, Cheltenham: Edward Elgar.

Berkhout, A.J. et al., 2006. Innovating the innovation process. *International Journal of Technology Management*, 34(3/4), pp.390–404.

Berrone, P. et al., 2007. *Can Institutional Forces Create Comprtitive Advantage? Empirical Examination of Environmental Innovation* (working paper no. 723), Barcelona: IESE Business School – University of Navarra

Bianchi, G. & Bortolotti, F., 1996. On the Concept of Formal Innovation. In *European Regional Science Association 36th European Congress ETH Zurich,*

Switzerland 26-30 August 1996 Giuliano. Zurich,.

Bilton, C. & Leary, R., 2002. What can managers do for creativity? Brokering creativity in the creative industries. *International Journal of Cultural Policy*, 8(1), pp.49–64.

Boix, R. & Lazzeretti, L., 2012. Las industrias creativas en España: Una panorámica. *Investigaciones Regionales*, (22), pp.181–205.

Borgdorff, H., 2011. The Production of Knowledge in Artistic Research. In M. Biggs & H. Karlsson, eds. *The Routledge Companion to Research in the Arts*. London: Routledge, pp. 44–63.

Bowen, J.P., 1998. Virtual Visits to Virtual Museums. In *Museums and the Web*. Toronto, Ontario, Canada, April 22-25, 1998. Available at: http://www.museumsandtheweb.com/mw98/papers/bowen/bowen_paper.html. [Accessed April 15, 2016]

Brant, J. & Lohse, S., 2014. *The Open Innovation Model* (Research paper 2), Paris: The world business organization.

Breschi, S. & Malerba, F., 1997. Sectoral Innovation Systems: Technological Regimes, Schumpeterian Dynamics, and Spatial Boundaries. In C. Edquist, ed. *Systems of innovation: Technologies, institutions and organizations*. London: Routledge, pp. 130–156.

Brown, S.L. & Eisenhardt, K.M., 1995. Product Development : Past Research , Present Findings , and Future Directions. *Academy of Management Review*, 20(2), pp.343–378.

Bureth, A., Wolff, S. & Zanfei, A., 1997. The two faces of learning by cooperating: The evolution and stability of inter-firm agreements in the European electronics industry. *Journal of Economic Behavior & Organization*, 32, pp.519–537.

Bustamante Ramírez, E., 2013. *España: La cultura en tiempos de crisis Fuentes financieras y políticas públicas*, Madrid: Fundación Alternativas

Camarero, C. & Garrido, M.J., 2008. The role of technological and organizational innovation in the relation between market orientation and performance in cultural organizations. *European Journal of Innovation Management*, 11(3), pp.413–434.

Camarero, C., Garrido, M.J. & Vicente, E., 2015. Achieving effective visitor orientation in European museums. Innovation versus custodial. *Journal of Cultural Heritage*, 16(2), pp.228–235.

Camarero, C., Garrido, M.J. & Vicente, E., 2011. How cultural organizations' size

and funding influence innovation and performance: the case of museums. *Journal of Cultural Economics*, 35(4), pp.247–266.

Camarero, C. & Garrido, M.J.M.J., 2012. Fostering Innovation in Cultural Contexts: Market Orientation, Service Orientation, and Innovations in Museums. *Journal of Service Research*, 15(1), pp.39–58.

Camisón-Zornoza, C. et al., 2004. A Meta-analysis of Innovation and Organizational Size. *Organization Studies*, 25(3), pp.331–361.

Cappetta, R., Cillo, P. & Ponti, A., 2006. Convergent designs in fine fashion: An evolutionary model for stylistic innovation. *Research Policy*, 35(9), pp.1273–1290.

Carlsson, B., Keane, P. & Martin, J.B., 1976. R&D Organizations As Learning Systems. *Sloan Management Review*, 17(3), pp.1–15.

Castañer, X., 2014. Cultural Innovation by Cultural Organizations. In V. A. Ginsburgh & D. Throsby, eds. *Handbook of the Economics of Art and Culture, Volume 2*. Elsevier, pp. 263–276.

Castañer, X. & Campos, L., 2002. The Determinants of Artistic Innovation: Bringing in the Role of Organizations. *Journal of Cultural Economics*, 26, pp.29–52.

Castro-martínez, E. & Fernández-baca Casares, R., 2012. *La innovación en patrimonio cultural: un espacio de confluencia de diversas bases de conocimiento* (Working paper no 2012/07), Valencia: Universitat Politècnica de València

Castro-Martínez, E., Recasens, A. & Jiménez-Sáez, F., 2013. Innovation systems in motion: an early music case. *Management Decision*, 51(6), pp.1276–1292.

Ch'ng, E., Gaffney, V. & Chapman, H., 2013. *Visual Heritage in the Digital Age*, London: Springer Verlag.

Chae, G. & Kim, J., 2013. Tagging Artworks: Crowd-Curated Contemporary Art Exhibition. *MW2013: Museums and the Web 2013*. Available at: http://mw2013.museumsandtheweb.com/proposals/tagging-artworks-crowd-curated-contemporary-art-exhibition/ [Accessed March 2, 2016].

Chekova, E., 2004. Organizational Structure of Russian State Museums: Recent Innovations. *International Journal of Arts Management*, 6(2), pp.44–53.

Chesbrough, H., 2006. Open Innovation: A New Paradigm for Understanding Industrial Innovation. In H. Chesbrough, W. Vanhaverbeke, & J. West, eds. *Open Innovation: Researching a New Paradigm*. Oxford University Press.

Chesbrough, H., Vanhaverbeke, W. & West, J., 2006. *Open Innovation: Researching*

a New Paradigm, New York: Oxford University Press

Chesbrough, H.W., 2003a. *Open innovation: The New Imperative for Creating and Profiting from Technology*, Boston: Harvard Business School Press.

Chesbrough, H.W., 2003b. The era of open innovation. *MIT Sloan Management Review*, 44(3), pp.35–41.

Cooke, P. & Memedovic, O., 2003. *Strategies for regional innovation systems: learning transfer and applications*, Vienna: United Nations Industrial Develpoment Organization

Cooke, P., Uranga, M.G. & Etxebarria, G., 1998. Regional systems of innovation: an evolutionary perspective. *Environment and Planning A*, 30(9), pp.1563–1584.

Corte, V. Della, Aria, M. & Del Gaudio, G., 2017. Smart, open, user innovation and competitive advantage: a model for museums and heritage sites. *Museum Management and Curatorship ISSN:*, 32(1), pp.50–79.

Corte, V. Della, Savastano, I. & Storlazzi, A., 2011. Service innovation in cultural heritages management and valorization. *International Journal of Quality and Service Sciences*, 1(3), pp.225–240.

Costa Barbosa, C., 2013. *Innovation in Museums through the Use of ICTs* (Master dissertation). University of Oslo, Autonomous University of Madrid. Available at: https://www.duo.uio.no/handle/10852/35928.

Cotton, J.W., 1994. *Experiment, Design, and Statistics in Psychology. Third Edition* Third edit., London: Penguin Books.

Daft, R.L., 1978. A Dual-Core Model of Organizational Innovation. *Academy of Management Journal*, 21(2), pp.193–210.

Damanpour, F., 1996. Organizational complexity and innovation: developing and testing multiple contingency models. *Management Science*, 42(5), pp.693–716.

Damanpour, F., 1991. Organizational Innovation: A Meta-Analysis of Effects of Determinants and Moderators. *The Academy of Management Journal*, 34(3), pp.555–590.

Dawson, B., 2008. Facilitating Innovation: Opportunity in Times of Change. *Museum Management and Curatorship*, 23(4), pp.313–331.

De-Miguel-Molina, B., Hervás-Oliver, J.-L., et al., 2014. Beautiful innovation: Understanding management innovation in the Spanish arts, heritage and recreation industries. In J.-L. Hervás-Oliver & M. Peris-Ortiz, eds. *Management innovation: Antecedents, complementarieties and performance*

consequences. Cham: Springer, pp. 91–103.

De-Miguel-Molina, B., De-Miguel-Molina, M. & Albors-Garrigós, J., 2014. Museums: Not Just Visiting Spaces but a Driving Force for the Use of Advanced S&T in the Restoration of Artworks. *Journal of Administrative Sciences and Technology*, 2014, pp.1–21.

De-Miguel-molina, B., Hervás-oliver, J.L. & Boix, R., 2013. Drivers of Beautiful Innovation: Artworks Restoration by Museums. In *35th DRUID Conference*. Barcelona.

Dean, J.F., 2003. Digital Imaging and Conservation : Model Guidelines. *Library Trends*, 52(1), pp.133–137.

Digital R&D Fund for the Arts, 2013. *Digital culture: how arts and cultural organizaciones in england use technology*, London.

DiMaggio, P.J. & Powell, W.W., 1991. Introduction. In W. W. Powell & P. J. DiMaggio, eds. *The New Institutionalism in Organizational Analysis*. Chicago: The University of Chicago Press, pp. 1–40.

DiMaggio, P.J. & Stenberg, K., 1985. Why Do Some Theatres Innovate More Than Others? An Empirical Analysis. *Poetics*, 14, pp.107–122.

Dinneen, L.C. & Blakesley, B.C., 1973. Algorithm AS 62: A Generator for the Sampling Distribution of the Mann-Whitney U Statistic. *Journal of the Royal Statistical Society*, 22(2), pp.269–273.

Doloreux, D. & Parto, S., 2005. Regional innovation systems: Current discourse and unresolved issues. *Technology in Society*, 27(2), pp.133–153.

Dore, R., 1988. Book review: Technology policy and economic performance; lessons from Japan: Christopher Freeman,. *Research Policy*, 17(5), pp.309–310.

Dosi, G. & Nelson, R.R., 2010. Technical Change and Industrial Dynamics as Evolutionary Process. In B. Hall & N. Rosenberg, eds. *Handbook of the Economics of Innovation*. Amsterdam: North-Holland, pp. 51–127.

Drury, C.G., 1995. Methods for direct observation of performance. In J. R. Welson & E. Nigel Corlett, eds. *Evaluation of human work. A practical ergonomics methodology*. London: Tylor & Francis, pp. 45–68.

DSP-groep, 2011. *The social significance of museums: more than worth it*. Amsterdam: Netherlands Museums Association.

Dyer, J.H., 1996. Does Governance Matter? Keiretsu Alliances and Asset Specificity as Sources of Japanese Competitive Advantage. *Organization Science*, 7(6), pp.649–666.

Dyer, J.H., 1997. Effective interfirm collaboration: how firms minimize transaction costs and maximize transaction value. *Strategic management journal*, 18(7), pp.535–556.

Edquist, C., 2005. System of innovation: perspective and challenges. In J. Fagerberg, D. C. Mowery, & R. R. Nelson, eds. *The Oxford Handbook of Innovation*. Oxford: Oxford University Press, pp. 181–208.

Edquist, C., 1997. Systems of Innovation Approaches - Their Emergence and Characteristics. In C. Edquist, ed. *Systems of Innovation: Technologies, Institutions and Organizations*. London: Pinter, pp. 1–35.

Evangelista, R., 2000. Sectoral Patterns Of Technological Change In Services. *Economics of Innovation and New Technology*, 9(3), pp.183–222.

Fabrizio, K.R. & Thomas, L.G., 2012. The Impact of Local Demand on Innovation in a Global Industry. *Strategic Management Journal*, 33(1), pp.42–64.

Fagerberg, J., 2006. Innovation: A Guide to the Literature. In J. Fagerberg, D. Mowery, & R. Nelson, eds. *The Oxford Handbook of Innovation*. Oxford: Oxford University Press, pp. 1–26.

Fagerberg, J., Martin, B.R. & Andersen, E.S., 2013. Innovation Studies: Towards a New Agend. In J. Fagerberg, B. R. Martin, & E. S. Andersen, eds. *Innovation Studies: Evolution and Future Challenges*. Oxford: Oxford University Press, pp. 1–17.

Fagerberg, J. & Verspagen, B., 2009. Innovation studies - The emerging structure of a new scientific field. , 38, pp.218–233.

Flew, T., 2012. *The Creative Industries: Culture and Policy*, London: SAGE Publication Ltd.

Freeman, C., 1987. *Technology, Policy, and Economic Performance: Lessons from Japan*, London: Pinter Publishers.

Freeman, C., Clark, J. & Soete, L., 1982. *Unemployment and Technical Innovation: A Study of LongWaves and Economic Development*, London: Pinter.

Freeman, C. & Soete, L., 1997. *The Economics of Industrial Innovation* 3rd ed., Cambridge MA: MIT Press.

Frey, B.S. & Meier, S., 2003. Private Faces in Public Places: A Case Study of the New Beyeler Art Museum. In B. S. Frey, ed. *Arts & Economics: Analysis & Cultural Policy*. Berlin: Springer Verlag, pp. 95–104.

Frey, B.S. & Meier, S., 2006. The Economics of Museums. In V. A. Ginsburgh & D. Throsby, eds. *Handbook of the Economics of Art and Culture, Volume 1*. Elsevier, pp. 1017–1047.

Frey, B.S. & Steiner, L., 2012. Pay as you go: a new proposal for museum pricing. *Museum Management and Curatorship*, 27(3), pp.223–235.

Frey, B.S. & Steiner, L., 2016. Towards More Innovative Museums. In I. Rizzo & R. Towse, eds. *The Artful Economist*. Springer, pp. 187–196.

Friedman, R., 1994. Museum people: the special problems of personnel management in museums and historical agencies. In K. Moore, ed. *Museum management*. London: Routledge, pp. 120–127.

Galenson, D.W., 2008. Analyzing Artistic Innovation: The Greatest Breakthroughs of the Twentieth Century. *Historical Methods: A Journal of Quantitative and Interdisciplinary History*, 41(3), pp.111–120.

Galloway, S. & Dunlop, S., 2007. A Critique of Definitions of the Cultural and Creative Industries in Public Policy. *International Journal of Cultural Policy*, 13(1), pp.1477–2833.

Galloway, S. & Dunlop, S., 2006. Deconstructing the concept of "Creative Industries." *Cultural Industries: The British Experience in International Perspective*, 1(May), pp.33–52.

Garrido, M.J. & Camarero, C., 2010. Assessing the impact of organizational learning and innovation on performance in cultural organizations. *International Journal of Nonprofit and Voluntary Sector Marketing*, 15, pp.215–232.

Garud, R., Tuertscher, P. & Van de Ven, A.H., 2013. Perspectives on Innovation Processes. *The Academy of Management Annals*, 7(1), pp.775–819.

Ghosh, D. & Vogt, A., 2012. Outliers: an evaluation of methodologies. In *Section on Survey Research Methods - JSM 2012*. pp. 3455–3460.

Gieskes, J. & van der Heijden, B., 2004. Measuring and Enabling Learning Behaviour in Product Innovation Processes. *Creativity & Innovation Management*, 13(2), pp.109–125.

Gilabert González, L.M., 2016. Economía y gestión: reflexiones sobre las políticas de los museos públicos en España. *Cuadernos de Arte de la Universidad de Granada*, 47, pp.147–164.

Gilbert, R.J., 2006. Competition and Innovation. *Journal of Industrial Organization Education*, 1(1), pp.1–23.

Godin, B., 2008. In the Shadow of Schumpeter: W. Rupert Maclaurin and the Study of Technological Innovation. *Minerva*, 46(3), pp.343–360.

Gorp, S.A. Van, 2012. *Innovation in the nonprofit organizational context : examining the strategic significance of systems trust and individual resistance*

to change (Doctorial dissertation). University of Iowa. Available at: http://ir.uiowa.edu/etd/3003.

Grant, R.M., 1996. Torward a Knowledge-based Theory of the Firm. *Strategic Management Journal*, 17, pp.109–122.

Greenhalgh, C. & Rogers, M., 2010. *Innovation, Intellectual Property, and Economic Growth*, Princeton: Princeton University Press.

Grinstein, A., 2008. The effect of market orientation and its components on innovation consequences: A meta-analysis. *Journal of the Academy of Marketing Science*, 36(2), pp.166–173.

Gui, B., 1991. The Economic Rationale for the "Third Sector." In A. Ben Ner & B. Gui, eds. *Annals of Public and Cooperative Economics (special issue), The Nonprofit Sector in the Mixed Economy*. Bruxelles: BOECK-Wesmael S.A. Publishers, pp. 59–80.

Hall, B.H. & Rosenberg, N., 2010. Introduction to the handbook. In B. H. Hall & N. Rosenberg, eds. *Handbook of the economics of innovation Volume 1*. Amsterdam: North-Holland, pp. 3–9.

Hamblin, K.A. & Harper, S., 2016. *The UK's Ageing Population: Challenges and opportunities for museums and galleries*, London. Available at: http://www.ageing.ox.ac.uk/download/173.

Handke, C.W., 2004. Defining creative industries by comparing the creation of novelty. In *Creative Industries: A measure for urban development?*. Vienna: Austrian Society for Cultural Economics and Policy Studies.

Hansmann, H., 1981. Nonprofit enterprise in the performing arts. *the Bell Jorurnal of Economics*, 12(2), pp.341–361.

Harkema, S.J.M., 2003. Learning in Innovation Projects: An Approach Based on Complexity Theory. In *The Fourth European Conference on Organizational Knowledge, Learning, and Capabilities*. Barcelona.

Hatimi, I.E., 2003. *Innovation Decision Making: Toward a Socio-economic Perspective* (Research Paper N ° 24-03), Montréal: HEC Montréal

Hauenschild, A., 1988. Claims and Reality of New Museology: Case Studies in Canada, the United States and Mexico. *Smithsonian Center for Education and Museum Studies*. Available at: http://museumstudies.si.edu/claims2000.htm#2. Elements [Accessed February 9, 2016].

Hauknes, J., 1998. *Services in innovation - Innovation in services*, Oslo: STEP Group.

Häyrinen, A., 2012. *Open Sourcing Digital Heritage: Digital Surrogates, Museums and Knowledge Management in the Age of Open Networks* (Doctorial dissertation). University of Jyväskylä. Available at: https://jyx.jyu.fi/dspace/handle/123456789/40157.

Heijnen, W., 2010. The new professional: Underdog or Expert? New Museology in the 21th century Wilke. *Sociomuseology III- Cadernos de Sociomuseologia*, 37, pp.13–24.

Heilbrun, J., 1993. Innovation in Art, Innovation in Technology, And the Future of the High Arts. In J. Heilbrun & C. M. Gray, eds. *The Economics of Art and Culture: an American Perspective*. Cambridge University Press, pp. 89–98.

Herreman, Y., 2004. Display, Exhibits and Exhibitions. In P. J. Boylan, ed. *Running a Museum: a Practical Handbook*. Paris: ICOM, pp. 91–103.

Howells, J., 2002. Tacit Knowledge, Innovation and Economic Geography. *Urban Studies*, 39(5–6), pp.871–884.

Hsieh, H.J., 2010. Museum lifelong learning of the aging people. *Procedia - Social and Behavioral Sciences*, 2(2), pp.4831–4835.

Hull, C.E. & Lio, B.H., 2006. Innovation in Non-profit and For-profit Organizations: Visionary, Strategic, and Financial Considerations. *Journal of Change Management*, 6(1), pp.37–41.

ICOM Europe & ICOM Portugal, 2013. *the Lisbon Declaration*, Available at: http://icom.museum/fileadmin/user_upload/pdf/Statements/ENG/Lisbon_Declaration_ENG.pdf. [Accessed July 3, 2016]

Ioannidis, Y., Toli, E., et al., 2014. Using ICT in cultural heritage, bless or mess? Stakeholders' and practitioners' view through the eCultValue project. In *EuroMed 2014, International Conference on Cultural Heritage, 3-8 November 2014*. Lemessos, Cyprus.

Ioannidis, Y., Balet, O. & Pandermalis, D., 2014. Tell me a story: augmented reality technology in museums. *The Guardian*. Available at: http://www.theguardian.com/culture-professionals-network/culture-professionals-blog/2014/apr/04/story-augmented-reality-technology-museums. [Accessed November 26 , 2016]

Japanese Association of Museum, 2008. *Present state of Museum in Japan*, Tokyo. Available at: http://www.mext.go.jp/component/a_menu/education/detail/__icsFiles/afieldfile/2012/03/27/1312941_1.pdf. [Accessed January 12 , 2017]

Järvenpää, E. & Mäki, E., 2002. Knowledge-Sharing in Networked Organizations.

In N. Bontis, ed. *World Congress on Intellectual Capital Readings*. Boston: Taylor & Francis, pp. 374–383.

Jaw, Y., Chen, C.-L. & Chen, S., 2012. Managing innovation in the creative industries – A cultural production innovation perspective. *Innovation*, 14(2), pp.256–275.

Jensen, M.B. et al., 2007. Forms of knowledge and modes of innovation. *Research Policy*, 36(5), pp.680–693.

Jin, L., 2011. The ecomuseum as an imaginary destination in China: The transition of the concept “ecomuseum” from France to China. In Paris: 1ères DOCTORIALES du Tourisme de la Chaire <Culture, Tourisme, développement>, 14-16 septembre 2011.

Johnson, P. & Thomas, B., 1998. The Economics of Museums : A Research Perspective. *Journal of Cultural Economics*, 22(22), pp.75–85.

Kaiser, H.F., 1974. An index of factorial simplicity. *Psychometrika*, 39(1), pp.31–36.

Kanji, G.K., 2006. *100 Statisitcal Tests. 3rd Edition* 3rd Editio., London: SAGE Publication Ltd.

Karp, C., 2004. Digital Heritage in Digital Museums. *Museum International*, 56(221), pp.45–51.

Kauremaa, J., Småros, J. & Holmström, J., 2009. Patterns of vendor-managed inventory: findings from a multiple-case study. *International Journal of Operations & Production Management*, 29(11), pp.1109–1139.

Kawashima, N., 1998. Knowing the Public. A Review of Museum Marketing Literature and Research1. *Museum Management and Curatorship*, 17(1), pp.21–39.

Keene, O.N., 1995. The log transformation is special. *Statistics in Medicine*, 14(8), pp.811–819.

Kéfi, H. & Pallud, J., 2011. The role of technologies in cultural mediation in museums: an Actor-Network Theory view applied in France. *Museum Management and Curatorship*, 26(3), pp.273–289.

Kim, H.D., 1993. The Link between Individual and Organizational Learning. *MIT Sloan Management Review*, 35, pp.37–50.

Kimberly, J.R., 1981. Managerial innovation. In P. C. Nystrom & W. H. Starbuck, eds. *Hand Book of Organization Design*. Oxford: Oxford University Press, pp. 84–104.

Kimberly, J.R. & Evanisko, M.J., 1981. Organizational Innovation: The Influence of Individual, Organizational, and Contextual Factors on Hospital Adoption of Technological and Administrative Innovations. *The Academy of Management Journal*, 24(4), pp.689–713.

Kleinknecht, A. & Verspagen, B., 1990. Demand and innovation: Schmookler re-examined. *Research Policy*, 19(4), pp.387–394.

Kloosterman, R.C., 2008. Walls and bridges: knowledge spillover between "superdutch" architectural firms. *Journal of Economic Geography*, 8, pp.545–563.

Kokalj, Ž. et al., 2013. Crossing Borders: A Multi-Layer GIS Mapping Framework for the Cultural Management of the Mundo Maya Region. In E. Ch'ng, V. Gaffney, & H. Chapman, eds. *Visual Heritage in the Digital Age*. London: Springer, pp. 327–348.

Lee, T.-P. & Pan, C.-H., 2014. Institutional factors and innovation diffusion: the diffusion of the Bookstart programme among township libraries in Taichung City, Taiwan. *Journal of Asian Public Policy*, 7(2), pp.154–168.

vom Lehn, D., 2005. Accounting for New Technology in Museum Exhibitions. *International journal of arts management*, 44(0), pp.1–19.

Lewandowski, M., 2015. Types of Innovations in Cultural Organizations. *International Journal of Contemprary Management*, 14(1), pp.67–78.

Li, C., Blanco Sierra, O. & Rausell Köster, P., 2016. Why Is Technological Innovation Emphasized More Than Symbolic Innovation in Art and Cultural Organizations? Analyzing the Sectoral System of Innovation in Museums. In *Young Reseach Workshop, 19th International Conference on Cultural Economics, 21st-24th June, Valladorid, Spain*. Valladolid, Spain. Available at: http://eventos.uva.es/file_manager/get_paper/6383. [Accessed October 12, 2016]

Liao, M., Foreman, S. & Sargeant, A., 2001. Market versus societal orientation in the nonprofit context. *International Journal of Nonprofit and Voluntary Sector Marketing*, 6(3), pp.254–268.

Lichtenthaler, U.L. and E., 2013. Innovation as a Learning Process: Embedding Design Thinking. *California Management Review*, 53(1), pp.154–170.

Litchfiel, R.C. & Gilson, L.L., 2013. Curating collections of ideas: Museum as metaphor in the management of creativity. *Industrial Marketing Management Curating*, 42, pp.106–112.

Lord, B. & Lord, G.D., 1998. *Manual de gestión de museos* Edición en., Barcelona:

Ariel.

Lucas, R.E., 1988. On the mechanics of economic development. *Journal of Monetary Economics*, 22, pp.3–42.

Lundvall, B.-Å., 1988. Innovation as an interactive process: from user-producer interaction to the national system of innovation. In G. Dosi et al., eds. *Technical Change and Economic Theory*. London: Pinter Publishers, pp. 349–369.

Lundvall, B.-Å., 2007. *Innovation System Research: Where it came from and where it might go* (Working paper no 2007-01), Saratov: Globelics.

Lundvall, B. -A., 1992. *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*, London: Pinter Publishers.

Lusiani, M. & Zan, L., 2010. Museum Management and Curatorship Institutional transformation and managerialism in cultural heritage: Heritage Malta. *Museum Management and Curatorship*, 25(2), pp.147–165.

Malerba, F. & Orsenigo, L., 2009. *User-producer relationships, innovation and the evolution of market structures under alternative contractual regimes* (Working paper no 01/2009), Milan: Università Commerciale Luigi Bocconi .

Malmberg, A. & Maskell, P., 1997. Towards an explanation of regional specialization and industry agglomeration. *European Planning Studies*, 5(1), pp.25–41.

Marques, J.P.C., 2014. Closed versus Open Innovation: Evolution or Combination? *International Journal of Business and Management*, 9(3), pp.196–203.

Martin, R. & Moodysson, J., 2011. Innovation in Symbolic Industries: The Geography and Organization of Knowledge Sourcing Roman. *European Planning Studies*, 197(October 2014), pp.1183–1203.

McCall, V. & Gray, C., 2014. Museums and the “new museology”: theory, practice and organisational change. *Museum Management and Curatorship*, 29(1), pp.19–35.

McCarthy, K.F. & Ondaatje, E.H., 2002. *From Celluloid to Cyberspace: The Media Arts and the Changing Arts World*, Santa Monica, CA: RAND Corporation.

McDonald, R.E.., 2007. An Investigation of Innovation in Nonprofit Organizations: The Role of Organizational Mission. *Nonprofit and Voluntary Sector Quarterly*, 36(2), pp.256–281.

Mensch, P. van, 1992. *Toward a methodology of museology* (Doctorial dissertation). Zagreb: University of Zagreb. Available at: http://www.emuzeum.cz/admin/files/Peter-van-Mensch-disertace.pdf.

Meyer, J.W. & Rowan, B., 1977. Institutionalised Organisations: Formal Structure as Myth and Ceremony. *The American Journal of Sociology*, 83(2), pp.340–363.

Michalski, S., 2004. Care and Preservation of Collections. In P. J. Boylan, ed. *Running a Museum: a Practical Handbook*. Paris: ICOM, pp. 51–89.

Miles, I. & Green, L., 2008. *Hidden innovation in the creative industries*,

Miller, G.S.P. et al., 1992. The virtual museum: Interactive 3D navigation of a multimedia database. *The Journal of Visualization and Computer Animation*, 3(3), pp.183–197.

Moulaert, F. et al., 2005. Towards Alternative Model(s) of Local Innovation. *Urban Studies*, 42(11), pp.1969–1990.

Mowery, D. & Rosenberg, N., 1979. The influence of market demand upon innovation: a critical review of some recent empirical studies. *Research Policy*, 8(2), pp.102–153.

Museum association, 2013. *Museums change lives*, London.

Nelson, R.R., 1993. *National Innovation Systems: A Comparative Analysis*, New York: Oxford University Press.

Nelson, R.R. & Winter, S., 1982. *An Evolutionary Theory of Economic Change*, Cambridge, MA: Harvard University Press.

Noble, D.R., 1989. Turnover among museum directors and some implications for innovation. *International Journal of Museum Management and Curatorship*, 8(2), pp.163–174.

OECD & Eurostat., 1996. Oslo Manual. *Guidelines for Collecting and Interpreting Innovation data, 2nd ed..* Paris.

OECD & Eurostat, 2005. *Oslo Manual: guidelines for collecting and interpreting innovation data*, 3rd ed.. Paris.

Ozkaya, H.E. et al., 2015. Market orientation, knowledge competence, and innovation. *International Journal of Research in Marketing*, 32(3), pp.309–318.

Parry, R., 2010. Introduction to Part One. In R. Parry, ed. *Museums in a Digital Age*. New York: Routledge, pp. 11–14.

Parry, R., 2007. *Recoding the Museum: digital heritage and the technologies of change*, New York: Routledge.

Pavitt, K., 1984. Sectoral patterns of technical change: Towards a taxonomy and a theory. *Research Policy*, 13(6), pp.343–373.

Peacock, D., 2008. Making Ways for Change: Museums, Disruptive Technologies and Organisational Change. *Museum Management and Curatorship*, 23(4), pp.333–351.

Phills, J., Deiglmeier, K. & Miller, D., 2008. Rediscovering social innovation. *Stanford Social Innovation Review*, Fall, pp.34–43.

Piekkola, H., Suojanen, O. & Vainio, A., 2014. *Economic impact of museums*, Vaasa: University of Vaasa, Levón Institute.

Pierce, J.L., 2000. Programmatic Risk-Taking by American Opera Companies. *Journal of Cultural Economics*, 24(1), pp.45–63.

Pine, J. & Gilmore, J.H., 1999. *The experience economy*, Boston: Harvard Business School Press.

Plessis, M.D., 2007. The role of knowledge management in innoation. *Journal of Knowledge Management*, 11(4), pp.20–9.

Polanyi, M., 1967. *The Tacit Dimension*, New York: Anchor Book.

Poole, N., 2010. *The Cost of Digitising Europe's Cultural Heritage: A Report for the Comité des Sages of the European Commission*, London.

Porter, M.E., 1998. *On Competition*, Boston: Harvard Business School Press.

Porter, M.E., 1990. *The Competitive Advantage of Nations*, New York: Free Press.

Du Preez, N.D., Louw, L. & Essmann, H., 2010. An Innovation Process Model for Improving Innovation Capability. *Journal of High Technology Management Research*, 3(12), pp.1–24.

Pujol-Tost, L., 2011. Integrating ICT in exhibitions. *Museum Management and Curatorship*, 26(1), pp.63–79.

Rausell Köster, P., 2013. Understanding the economics of culture as a way to overcome the crisis. *Economía de la información*, 22(4).

Rausell Köster, P. & Abeledo Sanchís, R., 2013. La cultura, la innovación y la creatividad como retos y oportunidades para el futuro de Europa. In A. (Cátedra U. Martinell (Ed.). In A. Martinell Sempere, ed. *Impactos de la dimensión cultural en el desarrollo*. Girona: Documenta Universitaria, pp. 101–126.

Reussner, E.M., 2003. Strategic management for visitor-oriented museums. *International Journal of Cultural Policy*, 9(1), pp.95–108.

Rogers, E.M., 1983. *Diffusion of Innovations, 3rd Ed.*, New York: The Free Press.

Rogers, E.M., 2003. *Diffusion of Innovations, 5th Ed.*, New York: Simon & Schuster

Ltd.

Rogers, M., 1998. *The Definition and Measurement of Innovation* (Working paper no 10/98). Melbourne: The University of Melbourne

Rosenberg, N., 1982. *Inside the black box: Technology and economics,* Cambridge: Cambridge University Press.

Rosenberg, N., 1976. *Perspectives on Technology*, Cambridge: Cambridge University Press.

Rothwell, R., 1994. Towards the fifth-generation innovation process. *International Marketing Review*, 11(7), pp.7–31.

Russo, A. et al., 2007. Social media and cultural interactive experiences in museums. *Nordisk Museologi*, (1), pp.19–29.

dos Santos, P.A., 2010. To understand New Museology in the 21st Century. *Sociomuseology III - Cadernos de Sociomuseologia*, Vol. 37, pp.5–11.

Santos Primo, J., 2007. To think museology today. *Sociomuseology*, 1, pp.63–90.

Schmookler, J., 1966. *Invention and Economic Growth*, Cambridge, MA: Harvard University Press.

Schrempf, B., Kaplan, D. & Schroeder, D., 2013. *National, Regional, and Sectoral Systems of Innovation – An overview*,

Schumpeter, J.A., 1939. *BUSINESS CYCLES. A Theoretical, Historical and Statistical Analysis of the Capitalist Process* Abridged,., New York: McGraw-Hill Book Company.

Schumpeter, J.A., 1943. *Capitalism, socialism, and democracy*, London: Routledge.

Schumpeter, J.A., 1989. *Essays on Entrepreneurs, Innovations, Business Cycles and the Evolutions of Capitalism.*,

Schumpeter, J.A., 1937. Preface to the Japanese Edition of "Theorie der Wirtschaftlichen Entwicklung". In R. V. Clemence, ed. *Theorie der Wirtschaftlichen Entwicklung*. New Brunswick, NJ: Transaction Publishers.

Schumpeter, J.A., 1912. *The Theory of Economic Development An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle*, Cambridge: Harvard University Press.

Science Council of Japan, 2007. *Statement to overcome the crisis of museums*, Tokyo.

Scott, A.J., 2004. Cultural-Products Industries and Urban Economic Development: Prospects for Growth and Market Contestation in Global Context. *Urban*

Affairs Review, 39(4), pp.461–490.

Scott, W.R., 2001. *Institutions and Organizations 2nd Edition* 2nd ed., Thousand Oaks: Sage Publications.

Shane, S., 1993. Cultural Influences on National Rates of Innovation. *Journal of Business Venturing*, 8, pp.59–73.

Shane, S., Venkatarman, S. & MacMillan, I., 1995. Cultural Differences in lnnova tion Championing Strategies. *Journal of Management*, 21(5), pp.931–952.

Sharifirad, M.S. & Ataei, V., 2012. Organizational culture and innovation culture: exploring the relationships between constructs. *Leadership & Organization Development Journal*, 33(5), pp.494–517.

Simon, H.A., 1959. Theories of decision-making in economics and behavioral science. *American Economic Review*, 49, pp.253–283.

Smith, A., 1776. *An Inquiry into the Nature and the Causes of the Wealth of Nations*,

Søndergaard, M.K. & Veirum, N.E., 2012. Museums and culture-driven innovation in public–private consortia. *Museum Management and Curatorship*, 27(4), pp.341–365.

Steinberg, R., 1986. The Revealed Objective Functions of Nonprofit Firms. *The RAND Journal of Economics*, 17(4), pp.508–526.

Stoneman, P., 2010. *Soft Innovation: Economics, Product Aesthetics and the Creative Industies*, New York: Oxford University Press Inc.

Sundbo, J., 2009. Innovation in the experience economy: a taxonomy of innovation organisations. *The Service Industries Journal*, 29(4), pp.431–455.

Taboh, J., 2015. American Museum First to Digitize Entire Art Collection. *Voice of America*. Available at: http://www.voanews.com/content/american-museum-first-to-digitize-entire-collection/2595555.html [Accessed March 2, 2016]

Tang, J., 2006. Competition and innovation behaviour. *Research Policy*, 35(1), pp.68–82.

Taniguchi, M., 2016. The Impacts of the Introduction of New Public Management on Japanese Public Museums. In *19th International Conference on Cultural Economics, 21-24 June*. Valladolid.

Throsby, D., 2001. *Economics and Culture*, Cambridge: Cambridge University Press.

Throsby, D. & Withers, G.A., 1979. *The Economics of the Performing Arts*, London:

Edward Arnold.

Tidd, J., 2006. *A Review of Innovation Models* (Discussion paper), London: Imperial Collage London.

UNESCO, 2003. Charter on the preservation of digital heritage. Available at: http://portal.unesco.org/en/ev.php- [Accessed February 23, 2016].

Valencia, J.C.N., Valle, R.S. & Jiménez, D.J., 2010. Organizational culture as determinant of product innovation. *European Journal of Innovation Management*, 13(4), pp.466–480.

Van de Ven, A., 1986. Central problems in the management of innovation. *Management Science*, 32(5), pp.590–607.

Verbano, C. et al., 2008. Characteristics of Italian art restoration firms and factors influencing their adoption of laser technology. *Journal of Cultural Economics*, 32, pp.3–34.

Vicente, E., Camarero, C. & Garrido, M.J., 2012. Insights into Innovation in European Museums. *Public Management Review*, 14(5), pp.649–679.

Weinberg, J.A., 1992. Exclusionary Practices and Technological Competition. *The Journal of Industrial Economics*, 40(2), pp.135–146.

Welsh, P.H., 2005. Re-configuring museums. *Museum Management and Curatorship*, 20(2), pp.103–130.

Wharton, C. & DeBruin, T., 2005. *Museum Data Collection Report and Analysis*, Washington: Institute of Museum and Library.

Wijnberg, N.M., 1994. Art and Technology: A Comparative Study of Policy Legitimation. *Journal of Cultural Economics*, 18, pp.3–13.

Williams, D., 1987. A brief history of museum computerization. In D. Williams, ed. *A Guide to Museum Computing*. American Association for State and Local History, pp. 1–5.

WIPO, 2003. *Guide on Surveying the Economic Contribution of the Copyright-Based Industries*, Geneva.

Woollard, V., 2004. Caring for the Visitor. In P. J. Boylan, ed. *Running a Museum: a Practical Handbook*. Paris: ICOM, pp. 105–118.

Yamamoto, H., 2003. *New Public Management - Japan's Practice*, Tokyo. Available at: http://www.iips.org/bp293e.pdf.

Yin, R.K., 2009. *Case Study Research: Design and Methods (fourth edition)*, Los Angeles: Sage Publications.

Zimmermann, H. & Mmermann, H., 1999. Innovation in Nonprofit Organizations. *Annals of Public and Cooperative Economics*, 70(4), pp.589–619.

Zolberg, V.L., 1986. Tensions of Mission in American Art Museum. In P. J. DiMaggio, ed. *Nonprofit Enterprise in the Arts. Studies in Mission and Constraint*. New York: Oxford University Press.

Zukauskaite, E., 2012. Innovation in cultural industries: The role of university links. *Innovation*, 14(3), pp.404–415.

APPENDIX A
THE LIST OF MUSEUM IN THE VALENCIAN AUTONOMOUS COMMUNITY ACCORDING TO GENERALITAT VALENCIANA

AGOST	
MUSEU DE CANTERERIA D'AGOST	www.museoagost.com
ALACANT / ALICANTE	
MUSEU ARQUEOLÒGIC PROVINCIAL (MARQ)	www.marqalicante.com
MUSEU D'ART CONTEMPORANI D'ALACANT (MACA)	www.maca-alicante.es
MUSEU NOVA TABARCA	www.alicante.es/medioambiente/museono
MUSEU VOLVO OCEAN RACE	www.volvooceanrace.com/es/news.html
ALAQUÀS	
CASTELL PALAU D'ALAQUÀS	www.castell.alaquas.org
ALBAIDA	
MUSEU INTERNACIONAL DE TITELLES D'ALBAIDA	www.albaida.es/mita/mita.htm
MUSEU INTERNACIONAL DEL TOC MANUAL DE CAMPANES D'ALBAIDA	www.albaida.es
ALCOI / ALCOY	
MUSEU ALCOIÀ DE LA FESTA (MAF)	www.museualcoiadelafesta.com
MUSEU ARQUEOLOGIC MUNICIPAL CAMIL VISEDO MOLTÓ	www.alcoi.org/museu
ALMASSORA / ALMAZORA	
MUSEU MUNICIPAL D'ALMASSORA	torrello.museum.almassora.es
ALPUENTE	
MUSEO PALEONTOLÓGICO SANTA BÁRBARA (MUPAL)	www.museopaleontologicoalpuente.net
ALZIRA	
MUSEU MUNICIPAL D'ALZIRA (MUMA)	www.alzira.es
ASPE	
MUSEO HISTÓRICO DE ASPE	www.aspe.es/la-villa/patrimonio-historico-artistico/el-museo-historico-municipal
BANYERES DE MARIOLA	
MUSEU ARQUEOLÒGIC MUNICIPAL TORRE FONT BONA	www.portademariola.com/?pag=46&idioma=2
MUSEU VALENCIÀ DEL PAPER DE BANYERES DE MARIOLA	www.museuvalenciadelpaper.com
BEJÍS	
MUSEO MUNICIPAL DE ARQUEOLOGÍA Y ETNOLOGÍA DE BEJÍS	www.bejis.es/museos/etnologia-arqueologia

BENETÚSSER	
MUSEU HISTÒRIA DE BENETÚSSER	www.benetusser.net/museo.php
BORRIANA / BURRIANA	
MUSEU ARQUEOLÒGIC MUNICIPAL DE BURRIANA	www.mam.burriana.es/index.php?lang=ca
MUSEU DE LA TARONJA	www.museonaranja.com
BURJASSOT	
MUSEU DE GEOLOGIA DE LA UNIVERSITAT DE VALÈNCIA	www.uv.es/mguv
CALLOSA D'EN SARRIÀ	
MUSEU DE L' AIGUA	www.callosa.es
MUSEU ETNOLÒGIC DE CALLOSA D'EN SARRIÀ	www.callosa.es
CALP	
MUSEU D'HISTÒRIA DE CALP	www.aytocalpe.org
CANET D'EN BERENGUER	
MUSEU ETNOLÒGIC DE CANET D'EN BERENGUER	www.canetdenberenguer.es
CASTELLÓ DE LA PLANA	
MUSEU DE BELLES ARTS	www.dipcas.es/cultura/museos/
COCENTAINA	
MUSEU ARQUEOLÒGIC I ETNOLÒGIC DEL COMTAT	www.cecalberri.org
MUSEU MUNICIPAL DE COCENTAINA - PALAU COMTAL	www.cocentaina.es
CREVILLENT	
MUSEU ARQUEOLÒGIC DE CREVILLENT	www.crevillent.es/pagina/museo-arqueologico
MUSEU DE LA SETMANA SANTA DE CREVILLENT	www.semanasantacrevillent.com/introduccion2.html
MUSEU PINTOR JULIO QUESADA	www.enercoop.es/minisite/
CULLERA	
MUSEU MUNICIPAL D'HISTÒRIA I ARQUEOLOGIA	www.museoscullera.com
DÉNIA	
MUSEU ARQUEOLÒGIC DE LA CIUTAT DE DÉNIA	www.denia.es/es/informacio/cultura/arqueologia/index.aspx
MUSEU ETNOLÒGIC DE DÉNIA	www.denia.es/va/informacio/cultura/arqueologia/index.aspx
EL PUIG DE SANTA MARIA	
MUSEU DE LA IMPREMTA I DE LES ARTS GRÀFIQUES	www.cult.gva.es/dgpa/imprenta/index.htm
ELDA	
MUSEO ARQUEOLÓGICO DE ELDA	www.cult.gva.es/museus/m00068/
MUSEO DEL CALZADO	www.museocalzado.com
ELX / ELCHE	
CENTRO DE CULTURA TRADICIONAL MUSEO ESCOLAR DE	www.museopusol.com

PUSOL	
MUSEU ARQUEOLÒGIC I D'HISTORIA D'ELX ALEJANDRO RAMOS FOLQUES (MAHE)	www.visitelche.com/va/turisme-cultural/visitas/elche/museos/museo-arqueologico-y-de-hist oria-de-elche-mahe/
MUSEU D'ART CONTEMPORANI D'ELX	www.visitelche.com/va/turisme-cultural/visitas/elche/museos/museo-de-arte-contemporaneo/
MUSEU MUNICIPAL DE LA FESTA D'ELX	/
MUSEU PALEONTOLÒGIC D'ELX	www.cidarismpe.org
ENGUERA	
MUSEO ARQUEOLÓGICO DE ENGUERA	www.enguera.es
FINESTRAT	
MUSEU ARQUEOLÒGIC I ETNOLOGIC	/
GANDIA	
MUSEU ARQUEOLÒGIC DE GANDIA (MAGA)	www.magamuseu.org
GUARDAMAR DEL SEGURA	
MUSEU ARQUEOLÒGIC DE GUARDAMAR DEL SEGURA (MAG)	www.magmuseo.com
IBI	
MUSEU DE LA BIODIVERSITAT D'IBI	www.museodelabiodiversidad.es
MUSEU VALENCIÀ DEL JOGUET D'IBI	www.museojuguete.com
L'ALCORA	
MUSEU DE CERÀMICA DE L'ALCORA	www.museulalcora.es
L'ALFÀS DEL PI	
MUSEO DELSO	www.museodelso.com
MUSEU A L'AIRE LLIURE - VIL·LA ROMANA DE L'ALBIR	www.lalfas.es
LA VALL D'UIXÓ	
MUSEU ARQUEOLÒGIC MUNICIPAL DE LA VALL D'UIXÓ	www.lavallduixo.es
LA VILA JOIOSA / VILLAJOYOSA	
CASA MUSEU LA BARBERA DELS ARAGONÉS	www.fincalabarbera.com
MUSEU VALENCIÀ DEL XOCOLATE	www.valor.es/museo/museodelchocolate.asp
VILAMUSEU, MUSEU MUNICIPAL DE LA VILA JOIOSA	www.museusdelavilajoiosa.com
LLÍRIA	
MUSEU ARQUEOLÒGIC DE LLÍRIA (MALL)	www.lliria.es/va/content/museu-arqueologic-de-lliria-mall
MANISES	
MUSEU DE CERÀMICA DE MANISES	www.manises.es/manisesPublic/museo.html

MOIXENT / MOGENTE	
MUSEU ARQUEOLÒGIC MUNICIPAL	www.mogente.es
MONCADA	
MUSEU ARQUEOLÒGIC MUNICIPAL DE MONCADA	www.moncada.es
MONFORTE DEL CID	
MUSEO ÍBERO ROMANO	www.marqalicante.com/monforte
MORELLA	
MUSEUS DE MORELLA	www.morella.net/morella/conocenos/museus
NOVELDA	
MUSEU ARQUEOLÒGIC DE NOVELDA	noveldamuseoarqueologico.wordpress.com
NULES	
MUSEU DE MEDALLÍSTICA ENRIQUE	www.museoenriqueginer.org
OLIVA	
MUSEU ARQUEOLÒGIC D'OLIVA	www.oliva.es/arees/vida-cultural/museus/museu-arqueologic-doliva-2/
ONDA	
MUSEU D'ARQUEOLOGIA I HISTÒRIA D'ONDA	/
MUSEU DEL TAULELL D'ONDA MANOLO SAFONT	www.museoazulejo.org
ONTINYENT	
MUSEU ARQUEOLÒGIC D'ONTINYENT I DE LA VALL D'ALBAIDA (MAOVA)	www.turismo.ontinyent.es/val/museus/maova.htm
MUSEU FESTER DEL SANTÍSSIM CRIST DE L'AGONIA	www.festers.net
ORIHUELA	
MUSEO ARQUEOLÓGICO COMARCAL DE ORIHUELA	www.orihuela.es
ORPESA / OROPESA DEL MAR	
MUSEU D'ORPESA	www.oropesadelmar.es
PAIPORTA	
MUSEU DE LA RAJOLERIA DE PAIPORTA	www.paiporta.es/?s=lang/va/areas_municipales/cultura/museu.php&hl=va
PATERNA	
MUSEU MUNICIPAL DE CERÀMICA DE PATERNA	www.paterna.es/ca/municipi/cultura/museu-de-ceramica.html
PEDRALBA	
CASA-MUSEO PEDRALBA 2000	www.pedralbadosmil.es
PEGO	
MUSEU D'ART CONTEMPORANI DE PEGO	www.pego.org/cultura/museu_art.html

PENÍSCOLA / PEÑÍSCOLA	
MUSEU DE LA MAR	va.peniscola.org/ver/1345/Sobre-el-Museo.html
PETRER	
MUSEU ARQUEOLÒGIC I ETNOLÒGIC DAMASO NAVARRO	www.petrer.es/cas/monumentos_de_interes.html
PILAR DE LA HORADADA	
MUSEO ARQUEOLÓGICO-ETNOLÓGICO GRATINIANO BACHES	www.pilardelahoradada.org
REQUENA	
MUSEO DE ARTE CONTEMPORÁNEO FLORENCIO DE LA FUENTE	www.requena.es
MUSEO MUNICIPAL DE REQUENA	/
ROJALES	
MUSEO ARQUEOLÓGICO Y PALEONTOLÓGICO MUNICIPAL	www.rojales.es
MUSEO DE LA HUERTA	/
SAGUNT / SAGUNTO	
MUSEU ARQUEOLÒGIC DE SAGUNT	www.cult.gva.es/dgpa/sagunto/
SAN FULGENCIO	
MUSEO ARQUEOLÓGICO MUNICIPAL DE SAN FULGENCIO	/
SANT JOAN D' ALACANT	
MUSEU "FERNANDO SORIA"	www.museofernandosoria.es
SANT VICENT DEL RASPEIG	
MUSEU DE LA UNIVERSITAT D'ALACANT (MUA)	www.mua.ua.es
SEGORBE	
MUSEO CATEDRALICIO	www.catedraldesegorbe.es/museo.php
MUSEO MUNICIPAL DE ARQUEOLOGÍA Y ETNOLOGÍA DE SEGORBE	www.segorbe.org
SILLA	
MUSEU D'HISTÒRIA I ARQUEOLOGIA DE SILLA (MARS)	www.comsilla.org
TAVERNES BLANQUES	
MUSEU LLADRÓ	www.lladro.com
TÍRIG	
MUSEU DE LA VALLTORTA	museuvalltorta.com
MUSEU COMARCAL DE L'HORTA SUD	www.museuhortasud.com
TORREVIEJA	
MUSEO DEL MAR Y DE LA SAL	www.torreviejacultural.com
VALENCIA	
CASA-MUSEU JOSÉ BENLLIURE	www.museosymonumentosvalencia.com/v

	a/museus/casa-museu-benlliure/
INSTITUT VALENCIA D'ART MODERN (IVAM)	www.ivam.es
JARDÍ BOTÀNIC	www.uv.es/jardibotanic
MUSEO CATEDRALICIO DIOCESANO	www.catedraldevalencia.es
MUSEO DE CIENCIAS NATURALES PADRE IGNACIO SALA S. J.	/
MUSEO DE HISTORIA DE LA TELECOMUNICACIÓN VICENTE MIRALLES SEGARRA	museotelecomvlc.etsit.upv.es
MUSEO DEL VALENCIA CF	www.fundacionvalenciacf.org
MUSEO HISTÓRICO MILITAR DE VALENCIA	www.ejercito.mde.es/unidades/Madrid/ihycm/Museos/valencia/index.html
MUSEO NACIONAL DE CERAMICA Y DE LAS ARTES SUNTUARIAS GONZÁLEZ	mnceramica.mcu.es
MUSEO TAURINO	www.museotaurinovalencia.es
MUSEU D'HISTÒRIA	www.mhv.com.es/mhv/
MUSEU D'INFORMÀTICA DE L'ETSINF - UNIVERSITAT POLITÈCNICA	museu.inf.upv.es
MUSEU DE BELLES ARTS DE VALENCIA	museobellasartesvalencia.gva.es
MUSEU DE CIÈNCIES NATURALS	www.museosymonumentosvalencia.com/va/museus/museu-de-ciencies-naturals/
MUSEU DE LES CIÈNCIES PRINCIPE FELIPE - CIUTAT DE LES ARTS I DE LES CIÈNCIES	www.cac.es
MUSEU DE PREHISTÒRIA DE VALÈNCIA	www.museuprehistoriavalencia.es
MUSEU DEL CONJUNT HOSPITALARI DE SANT JOAN DE L'HOSPITAL	www.sanjuandelhospital.es/museo/
MUSEU DEL PATRIARCA	www.valencia.es
MUSEU MARIÀ (MUMA)	www.basilicadesamparados.org/museo_mariano.html
MUSEU VALENCIÀ D'ETNOLOGIA (MUVAET)	www.museuvalenciaetnologia.org
MUSEU VALENCIÀ D'HISTÒRIA NATURAL - FUNDACIÓ ENTOMOLÒGICA TORRES SALA	www.naturamuseo.org
MUSEU VALENCIÀ DE LA IL·LUSTRACIO I LA MODERNITAT	www.muvim.es
VILA-REAL	
MUSEU DE LA CIUTAT CASA DE POLO	www.vila-real.es
VILAFAMÉS	
MUSEU D'ART CONTEMPORANI VICENTE AGUILERA CERNI DE VILAFAMÉS	www.macvac.es
VILLENA	
MUSEO ARQUEOLÓGICO JOSÉ MARÍA SOLER	www.museovillena.com
XÀBIA / JÁVEA	
MVSEU ARQUEOLÒGIC I ETNOGRÀFIC MUNICIPAL SOLER BLASCO	www.ajxabia.com/ciutat/mvsev-soler-blasco
XALÓ	
MUSEU ETNOLÒGIC DE XALÓ	www.xalo.org
XÀTIVA	
MUSEU DE L'ALMODÍ	www.xativa.es/pagina-web/museo-lalmodi/museo-lalmodi.html

XIXONA / JIJONA

MUSEU DEL TORRÓ	www.museodelturron.com

APPENDIX B
OUTLIER FOR SEMI-STRUCTURED INTERVIEW

Interviewer: the auther

Interviewee: director or person in charge of the selected museums

Date and time: an appointment is required

Venue: the selected museum is preferred

1. Ask the director to introduce his/her museum in brief firstly; the introduction should include history, ownership, collection, and staff etc.;
2. Guid the director to give a detailed description about human resources, including staff number, job responsibility, and knowledge structure etc.;
3. Ask restoration work in the museum. It may begin with the inquiry about job responsibility of restoration department and restorers (if no restoration department), or about how the museum restores its collection (if neither the department nor restorer is available); then more questions can be raised based on the response of the interviewee, with emphasis on innovative activities;
4. Ask exhibition work in the museum. It may begin with the inquiry about permanent and temporary exhibitions in the museum and how curators work for the making of exhibition; then more questions can be raised based on the response of the interviewee, with emphasis on the generation of new idea and method in the process of story telling.
5. Ask digital museum work. It may start with the inquiry of a state-of-the-art utilization of digital museum and technologies; then more questions are put forward, depending on the response, with the focus of the source of technology and the channel of adopting technology.
6. Ask visitor service work. It may start with the inquiry about the services that the museum offers to the public; then more questions can be asked depending on the response, with the concentration of how the museum improves the quality of service.

APPENDIX C
INVITATION LETTER FOR PARTICIPANTS

Subject: Invitación para participar en la encuesta sobre la innovación y los museos

Estimado/a (participante)

Ha sido invitado a participar en la siguiente encuesta: «Las Actividades Innovadoras en los Museos Valencianos».

Sobre la encuesta
Se trata de una encuesta académica sobre la innovación de los museos en el territorio de la Comunidad Valenciana, bajo el marco del proyecto "Culture, creative and clusters for incubators (3C 4 incubators)" coordinado por Econcult de la Facultad de Economía de la Universidad de Valencia.

El objetivo de la encuesta es comprender el sistema sectorial de la innovación del sector de museos midiendo las actividades innovadoras con el fin de realizar una estrategia general para fomentar la capacidad innovadora de los museos valencianos. Los resultados de la encuesta beneficiarán tanto al output importante del proyecto "3C 4 incubators" como a la tesis doctoral del estudiante Chuan Li, que está realizando un doctorado y está trabajando como investigador no doctor en la misma universidad.

Le comprometemos que todos los datos serán guardados bajo la más estricta confidencialidad. Si tenga cualquiera duda, podria contactar con Señor Chuan Li para conseguir más información.

Contacto: Chuan Li
Móvil: ×××
Teléfono: ×××
Correo electronico: ×××
Dirección: Campus dels Tarongers, Facultat d' Economia - 2P05, Avda. dels Tarongers, s/n, 46022, Valencia, España.

Para hacerlo, por favor pulse en el siguiente enlace:

http://www.econcult.eu/surveys/index.php/313379?lang=es

Muchas gracias por su interés y colaboración.

Un cordial saludo.

Chuan

APPENDIX D
REMINDER LETTER FOR PARTICPANTS

Subject: Recordatorio para participar en una encuesta

Estimado/a (participante)

Recientemente se le invitó a participar en la encuesta de título «Encuesta sobre las actividades innovadoras de los museos».

Sobre la encuesta
Se trata de una encuesta académica sobre la innovación de los museos en el territorio de la Comunidad Valenciana, bajo el marco del proyecto "Culture, creative and clusters for incubators (3C 4 incubators)" coordinado por Econcult de la Facultad de Economía de la Universidad de Valencia.

El objetivo de la encuesta es comprender el sistema sectorial de la innovación del sector de museos midiendo las actividades innovadoras con el fin de realizar una estrategia general para fomentar la capacidad innovadora de los museos valencianos. Los resultados de la encuesta beneficiarán tanto al output importante del proyecto "3C 4 incubators" como a la tesis doctoral del estudiante Chuan Li, que está realizando un doctorado y está trabajando como investigador no doctor en la misma universidad.

Le comprometemos que todos los datos serán guardados bajo la más estricta confidencialidad. Si tenga cualquiera duda, podria contactar con Señor Chuan Li para conseguir más información.

Contacto: Chuan Li
Móvil: ×××
Telefono: ×××
Correo electronico: ×××
Dirección: Campus dels Tarongers, Facultat d' Economia - 2P05, Avda. dels Tarongers, s/n, 46022, Valencia, España.

Advertimos que aún no la ha completado, y de la forma más atenta queríamos recordarle que todavía se encuentra disponible si desea participar. Para hacerlo, por favor pulse en el siguiente enlace:

http://www.econcult.eu/surveys/index.php/313379?lang=es

Nuevamente le agradecemos su interés y colaboración.

Atentamente,

Chuan

APPENDIX E
QUESTIONNAIRE

Spanish version

I. Identificación del museo

1 **¿En qué provincia se sitúa su museo?**
Seleccione una de las siguientes opciones

- o Valencia
- o Castellón
- o Alicante
- o Sin respuesta

2 **¿De qué tipo es su museo ?**
Seleccione una de las siguientes opciones

- o Arte (bellas artes/ arte contemporáneo / arte decorativo)
- o Casa-museo
- o Arqueológico / de sitio
- o Histórico
- o Historia
- o Ciencias Naturales e historia natural
- o Ciencia y tecnología
- o Etnografía y antropología
- o Especializado
- o General
- o Otro: _____

3 **¿De qué titularidad es su museo?**
Seleccione una de las siguientes opciones

- o Pública - Administración general de estado
- o Pública - Administración autonómica
- o Pública - Administración local
- o Pública - Otros
- o Privada
- o Mixta
- o Otro: _____

II. Profesional y conocimiento

4 **Número total de personas que trabajaron en el museo en la última**

semana de mayo de 2016, las personas incluyen personal remunerado, no remunerado y voluntario, pero NO incluyen becarios ni estudiantes en practicas.
Sólo se puede introducir un valor entero en este campo.

Su respuesta _____

5 **Número de profesionales según áreas de trabajo en las que desempeña sus funciones.**
Sólo se pueden introducir números en estos campos.

Gestión y Administración _____
Exposicion _____
Programación de actividades _____
Documentación _____
Comunicación y marketing _____
Investigación _____
Conservación _____
Restauración _____
Otros _____

6 **Número de profesionales según titulaciones académicas en las que gradúa últimamente.**
Sólo se pueden introducir números en estos campos.

Conservación y Restauración _____
Bellas Artes _____
Filología _____
Humanidades _____
Traducción e Interpretación _____
Geografía y Historia _____
Gestión cultural _____
Filosofía y Letras _____
Antropología _____
Ciencias políticas _____
Sociología _____
Turismo _____
Ciencias económicas y/o empresariales _____
Adminnistración. y Dirección de Empresas _____
Magisterio _____
Derecho _____
Biblioteconomía y Documentación _____
Periodismo _____
Biología _____
Geología _____
Química _____
Ingeniería _____

Arquitectura _____
Psicología y/o pedagogía _____
Otros: _____

7 **¿Su museo ha ofrecido alguna formación complementaria para los trabajadores en los últimos doce meses?**

- o Sí
- o No

8 **Número de cursos de formación complementaria que han recibido los profesionales del museo según temas específicos en los últimos doce meses.**
Sólo se pueden introducir números en estos campos.

Archivos _____
Seguridad _____
Idiomas _____
Turismo _____
Accesibilidad _____
Informática _____
Bibliotecas _____
Museografía _____
Legislación _____
Propiedad intelectual _____
Gestión económico-financiera _____
Gestión de personas y equipos _____
Específicos relacionados con la colección _____
Estudios de público _____
Restauración _____
Marketing y Comunicación _____
Educación/Difusión _____
Gestión cultural _____
Gestión de colecciones _____
Conservación _____
Museología _____
Otros _____

III. La adopción de tecnología

9 **¿Hay alguno departamento o unidad de trabajo que especialmente se dedica a I+D en tecnología asociada a museología o al encargo de asuntos tecnológicos en el museo?**

- o Sí

- o No

10 **¿Cuántas personas asumen responsabilidad en tareas de Información y Telecomunicación?**
Seleccione una de las siguientes opciones

- o 0
- o 1-2
- o 3-5
- o 6-10
- o >10
- o Sin respuesta

11 **¿Cuántos cursos de formación complementaria en temas específicos asociados a tecnología ofreció el museo a su personal en los últimos doce meces?**
Seleccione una de las siguientes opciones

- o 0
- o 1-2
- o 3-5
- o 6-10
- o >10
- o Sin respuesta

12 **¿Qué porcentaje del presupuesto anual del museo se dedica a I+D en tecnologías relacionadas a museos en el año 2016?**
Sólo se pueden introducir números en este campo.

Su respuesta _____

13 **¿Qué porcentaje del presupuesto anual del museo se dedica a comprar maquinaria, equipo o tecnología a las empresas u organizaciones externas en el año 2016?**
Sólo se pueden introducir números en este campo.

Su respuesta _____

IV. Red y cooperación

14 **¿Su museo colabora con alguna empresa de telecomunicacion para ofrecer servicios de conexión inalámbrica al público y a los trabajadores?**

- o Sí
- o No
- o Sin respuesta

15 **Por favor, especifique el/los nombre/s de la/s empresa/s de telecomunicación**
Marque las opciones que correspondan

- o Movista
- o Vodafone
- o Orange
- o Yoigo
- o Otro: _____

16 **¿Su museo ha colaborado con alugna empresa de alta tecnología para cumplir las tareas de la Digitalización, Realidad Virtual, Realidad Aumentada, 3D u otras nuevas tecnologías?**

- o Sí
- o No
- o Sin respuesta

17 **Por favor, especifique las empresas de alta tecnología.**

1ª empresa _____
2ª empresa _____
3ª empresa _____
4ª empresa _____
5ª empresa _____
6ª empresa _____
7ª empresa _____
8ª empresa _____
9ª empresa _____
10ª empresa _____

18 **¿Su museo ha colaborado con alguna empresa especializada en museología, tales como almacenaje, climatización, logística, conservación preventiva y restauración en cualquier proyecto o actividad en los últimos doce meses?**

- o Sí
- o No
- o Sin respuesta

19 **Por favor, especifique las empresas especializadas.**

1ª empresa _____
2ª empresa _____
3ª empresa _____
4ª empresa _____
5ª empresa _____
6ª empresa _____
7ª empresa _____
8ª empresa _____
9ª empresa _____
10ª empresa _____

20 **¿Su museo ha colaborado con algun profesional, tales como los curadores independientes o expertos en conservación, en cualquiera tarea o proyecto en los últimios doce meses?**

- o Sí
- o No
- o Sin respuesta

21 **Por favor, especifique las ocupaciones de las individuales**

Comisario independiente _____
Investigador independiente _____
Artista para realizar las exposiciones o los talleres _____
Educador de los programas educativos _____
Autónomo en conservación _____
Autónomo en restauración _____
Otro _____
Otro _____
Otro _____

22 **¿Su museo ha colaborado con alguna universidad o institución académica en cualquier proyecto o tarea en los últimos doce meses?**

- o Sí
- o No
- o Sin respuesta

23 **Por favor, especifique las univesidades**
Marque las opciones que correspondan

- o Universidad de Alicante
- o Universidad de Valencia

- o Universidad de Politécnica de Valencia
- o Universidad Jaume I
- o Universidad Miguel Hernández
- o Universidad Internacional Menéndez Pelayo - UIMP
- o Universidad Cardenal Herrera- CEU
- o Universidad Católica De Valencia
- o Universidades de otras comunidades
- o Universidades internacionales
- o Otro: _____

24 **¿Su museo está vinculado con o asociado a alguna asociación profesional?**

- o Sí
- o No
- o Sin respuesta

25 **Por favor, especifique a las asociaciones**
Marque las opciones que correspondan

- o ANABAD. Confederación Española de Asociaciones de Archiveros, Bibliotecarios, Museólogos y Documentalistas
- o ARMICE. Asociación de Registros de Museos e Instituciones Culturales Españolas
- o FEAM. Federación Española de Amigos de los Museos
- o ICOM. Consejo Internacional de Museos
- o AEM. Asociación Española de Museólogos
- o APME. Asociación Profesional de Museólogos de España
- o Asociación de Conservadores Restauradores de Valencia
- o AGCPV. Asociación de Gestores Culturales del País Valenciano
- o AIP. Asociación para la Interpretación del Patrimonio.
- o AEGPC. Asociación Española de Gestores del Patrimonio Cultural
- o FEAGC. Federación Estatal de Asociaciones de Gestores Culturales
- o GEIIC. Grupo Español de Conservación
- o Otro: _____

26 **¿Su museo ha tenido algún intercambio, interacción o cooperación con otros museos en los últimos tres años?**
Marque las opciones que correspondan

- o Con otros museos estatales
- o Con otros museos autonómicos
- o Con otros museos locales
- o Con otros museos privados
- o Con otros museos extranjeros
- o No tiene ninguna relación con otros museos

27 **Según su experiencia, considera que es más factible establecer colaboración con:**

	1	2	3	4	5
Otros museos dentro de la misma institución gestora a la cual pertenece su museo	O	O	O	O	O
Otros museos fuera de la institución gestora a la cual pertenece su museo	O	O	O	O	O

5 = Totalmente de acuerdo
4 = De acuerdo
3 = Medianamente de Acuerdo
2 = En desacuerdo
1 = Totalmente en desacuerdo

V. Las actividades innovadoras

28 **¿Qué tipo de tecnologías se utilizan en el museo?**
Marque las opciones que correspondan

- o Colección digitalizada
- o Pagina web
- o Intranet (Red informática interna de organismo, basada en los estándares de Internet, en la que las computadoras están conectadas a uno o varios servidores web)
- o Museo digital o visual
- o Media social (e.j. Facebook, Tweeter, Instragam, Youtube, LinkedIn etc.)
- o Apps de museo para moviles o tablets
- o Tridimensional 3D
- o Holography
- o Realidad Visual
- o Realidad Aumentada
- o Estaciones de información, kioscos, y los muelles
- o Guias de audio
- o QR code
- o Otro: _____

29 **¿Cuántas exposiciones temporales y permanentes se realizaron por su museo en el año 2015?**
Solo se puede introducir un valor entero en este campo.

Su respuesta _____

30 **¿Cuántos programas de actividades se realizaron en su museo en el año 2015? (Las programas incluyen actividades educativas, conferencias, cursos/talleres/jornadas, pero NO incluye los conciertos.)**
Solo se puede introducir un valor entero en este campo.

Su respuesta _____

31 **¿Cuántos artículos académicos y/o profesionales se publicaron por los autores del museo en el año 2015?**
Sólo se pueden introducir números en este campo.

Su respuesta _____

32 **En general, en los últimos años, se han introducido cambios significativos en la estructura organizativa del museo.**
Seleccione una de las siguientes opciones

- o Totalmente en desacuerdo
- o En desacuerdo
- o Medianamente de Acuerdo
- o De acuerdo
- o Totalmente de acuerdo
- o Sin respuesta

33 **En general, en los últimos años, ha sido formado un ambiente abierto y colaborativo en la cultura organizativa del museo para favorecer las actividades creativas e innovadoras.**
Seleccione una de las siguientes opciones

- o Totalmente en desacuerdo
- o En desacuerdo
- o Medianamente de Acuerdo
- o De acuerdo
- o Totalmente de acuerdo
- o Sin respuesta

VI. Actitud innovadora

34 **¿Qué importancia tienen los siguientes objetivos sobre la decisión de innovar en tecnología y contenidos creativos?**

	4	3	2	1	0
Ejecitar las funciones básicas definidas por ICOM, tales como conservación, exposición, investigación y comunicación	O	O	O	O	O
Entretenimiento y la calidad de la vida(ej. enriquecer la vida intelectual de la comunidad local)	O	O	O	O	O
Difusión del conocimiento museológico	O	O	O	O	O
Democratización del acceso	O	O	O	O	O
Creación / Reforzamiento de valores simbólicos e identidad cultural	O	O	O	O	O
Regeneración urbana.	O	O	O	O	O
Turismo y City branding	O	O	O	O	O
Promoción del desarrollo de la economía regional	O	O	O	O	O
Prestigio y reconocimiento	O	O	O	O	O
Estabilidad/ seguridad recursos, autonomía financiera	O	O	O	O	O
Eficiencia de la gestión	O	O	O	O	O

4 = Muy importante
3 = Importante
2 = Poco importante
1 = Nada importante
0 = Sin respuesta

35 **Según su experiencia, ¿cuál es el nivel de incidencia de los siguientes obstáculos para el desarrollo de actividades innovadoras en su museo?**

	4	3	2	1	0
El coste de la adopción de nuevas tecnologías o la creación de los contenidos creativos es muy alto	O	O	O	O	O

El museo no tiene suficiente presupuesto para invertir en nuevas tecnologias ni iniciar nuevos proyectos de investigación exposición ni programas educativos	O	O	O	O	O
Falta de cursos financieros externos que apoyan actividades innovadoras	O	O	O	O	O
Falta de profesionales técnicos expertos en la aplicación de nuevas tecnologías	O	O	O	O	O
Falta de la formación necesaria para aumentar la capacidad de creatividad e innovación	O	O	O	O	O
No hay suficiente colaboración entre los trabajadores dentro del museo	O	O	O	O	O
No es fácil para el museo emplear un profesional clave desde fuera del museo	O	O	O	O	O
No hay certeza de que la aplicación de nuevas tecnologias pueda mejorar la eficiencia de la gestión	O	O	O	O	O
No es seguro que los resultados de nuevas investigaciones, nuevas exposiciones, o programas educativos serán aceptados por los públicos	O	O	O	O	O
El museo no tuvo muchas actividades innovadoras antes, así que tampoco es necesario que el museo innova ahora	O	O	O	O	O
Poca interacción y cooperación con las instituciones externas dificulta el intercambio y la difusion del conocimiento y la experiencia	O	O	O	O	O
El control burocrático excesivo limita la capacidad de la iniciativa innovadora	O	O	O	O	O
Los funcionarios públicos carecen del incentivo y la voluntad de innovación	O	O	O	O	O

4 = Muy importante
3 = Importante
2 = Poco importante
1 = Nada importante

0 = Sin respuesta

36 **Según su experiencia, ¿cuál es el nivel de incidencia de los siguientes factores en el desarrollo de actividades innovadoras en su museo?**

	4	3	2	1	0
El museo en sí mismo es un espacio creativo, donde la apertura y la variedad de conocimiento crean un medio ambiente favoreciendo la innovación.	O	O	O	O	O
La tecnología adquiere cada vez un papel más importante en la gestión del museo.	O	O	O	O	O
El director debería incrementar el rendimiento del museo a través de la innovación.	O	O	O	O	O
A la audiencia le gusta más la novedad, tales como las nuevas exposiciones, nuevos programas educativos, nuevo medios de expresión artística, o la aplicación de nuevas tecnologías.	O	O	O	O	O
El museo debería atraer público juvenil a través de la aplicación de contenidos digitales y la gestión de redes sociales ya que estas son parte importante del estilo de vida de los jóvenes.	O	O	O	O	O
El patrimonio digital es una tendencia global en las instituciones culturales, por lo tanto, el museo debe desarrollarlo también	O	O	O	O	O
La aplicación de los ordenadores ha aumentado bastante la eficiencia de la gestión del museo.	O	O	O	O	O
El patrimonio digital puede ayudar al museo a atraer más visitantes en línea y en sitio.	O	O	O	O	O
No es tan difícil integrar las tecnologías con los trabajos museológicos tradicionales en el museo.	O	O	O	O	O
Los políticos piden que el museo innove para obtener los apoyos políticos.	O	O	O	O	O

Los patrocinadores piden que el museo innove para conseguir los fundos públicos y privados.	O	O	O	O	O
La innovación incrementa el prestigio y reconocimiento del museo en el territorio nacional e internacional.	O	O	O	O	O

4 = Muy importante
3 = Importante
2 = Poco importante
1 = Nada importante
0 = Sin respuesta

VII. Número de visitantes

37 **Número total de visitantes al museo**
Sólo se pueden introducir números en estos campos.

en 2015 _____
en 2014 _____

38 **Número de visitantes con tarifa reducida**
Sólo se pueden introducir números en estos campos.

en 2015 _____
en 2014 _____

39 **Número de visitantes con entrada gratuita**
Sólo se pueden introducir números en estos campos.

en 2015 _____
en 2014 _____

English version

I. Identification of museum

1 **In which province does your museum situate?**
Choose one of the following options

- o Valencia
- o Castellón
- o Alicante
- o Sin respuesta

2 **Which type does your museum belong to?**
Choose one of the following options

- o Art (fine arts/ contemprorary art / decorative art)
- o House-museum
- o Architecture / site
- o Historic
- o History
- o Natural sciences and natural history
- o Science and technology
- o Ethnography and anthropology
- o Specialized
- o General
- o Other: _____

3 Which ownership does your museum belong to?
Choose one of the following options

- o Public – State genenral administration
- o Public – Autonomous administration
- o Public – Local administration
- o Public - Others
- o Private
- o Mixed
- o Other: _____

II. Profesional and knowledge

4 **Total number of personnel who worked in the museum in the last week of May 2016, the personnel includes paid, no-paid, and voluntary personnel, but NOT include interns or students in practices.**
You can only enter an integer value in this field.

Your response _____

5 **Number of professionals according to areas of work in which they perform their functions.**
You can only enter an integer value in this field.

Management and administration	_____
Exhibition	_____
Activity programme	_____
Documentation	_____
Communication and marketing	_____
Investigation	_____
Conservation	_____
Restoration	_____
Others	_____

6 **Number of professionals according to academic degrees in which they graduate lately.**
You can only enter an integer value in this field.

Conservation and restoration	_____
Fine arts	_____
Philology	_____
Humanities	_____
Translation and interpretation	_____
Geography and history	_____
Cultural management	_____
Philosophy and letters	_____
Anthropology	_____
Political sciences	_____
Sociology	_____
Turism	_____
Economics and/or business sciences	_____
Business administration and management	_____
Teaching	_____
Law	_____
Library and documentation	_____
Journalism	_____
Biology	_____
Geology	_____
Chemistry	_____
Engineering	_____
Architecture	_____
Psychology and/or pedagogy	_____
Others:	_____

7 **Do your museum has offered any complementary trainings for professionals in the last12 monthes?**

- o Yes
- o No

8 **Number of additional training courses that museum profesionals have received according to specialized subjects in the latest 12 months.**
You can only enter an integer value in this field.

Archives	_____
Safety	_____
Language	_____
Tourism	_____
Accesibility	_____
Computering	_____
Library	_____
Museography	_____
Legislation	_____
Intellectual property	_____
Economy – financing management	_____
Personnels and team management	_____
Specifics related to collection	_____
Public study	_____
Restoration	_____
Marketing and Comunication	_____
Education and diffusion	_____
Cultural management	_____
Collection management	_____
Conservation	_____
Museology	_____
Others	_____

III. The adoption of technology

9 Is **there any department or working unit that specially dedicates to R&D in technology associated with museology or in charge of technological theme in the museum?**

- o Yes
- o No

10 **How many staff take responsibility of information and telecomunication tasks?**
Choose one of the following options.

- o 0
- o 1-2

- o 3-5
- o 6-10
- o >10
- o No response

11 **How many additional training courses in specific subjects related to technology has the museum offered to its staff in the last 12 months? Choose one of the following options.**

- o 0
- o 1-2
- o 3-5
- o 6-10
- o >10
- o No response

12 **What percentage of the annual budget of the museum is dedicated to R&D in museum-related technologies in 2016? You can only enter an integer value in this field.**

No response _____

13 **What percentage of the annual budget of the museum is dedicated to purchase machinery, equipment or technology from external companies or organizations in 2016? You can only enter an integer value in this field.**

No response _____

IV. Network and cooperation

14 **Do your museum collaborate with any telecommunication companies for offering wirless connection services to the public and staff?**

- o Yes
- o No
- o No response

15 Please **specify the name(s) of the telecommunication companies. Mark the corresponding options**

- o Movistar
- o Vodafone
- o Oranger
- o Yoigo

- o Others: _____

16 **Has your museum collaborated with any high-tech companies for complish the tasks of digitization, Virtual reality, Augmented reality, 3D or other new technologies?**

- o Yes
- o No
- o No response

17 **Please mark the high-tech companies.**

1st company _____
2nd company _____
3rd company _____
4th company _____
5th company _____
6th company _____
7th company _____
8th company _____
9th company _____
10th company _____

18 **Has your museum collaborated with any company specialized in museology, such as storage, air conditioning, logistics, preventive conservation and restoration in any project or activity in the last 12 months?**

- o Sí
- o No
- o Sin respuesta

19 Please **specify the speicalized companies.**

1st company _____
2nd company _____
3rd company _____
4th company _____
5th company _____
6th company _____
7th company _____
8th company _____
9th company _____
10th company _____

20 **Has your museum collaborated with any professional, such as independent curators or conservation experts, on any task or project in the last 12 months?**

- o Yes
- o No
- o No response

21 **Please specify the occupations of the individual**

Independent curator _____
Independent investigator _____
Artist for the achievelent of exhibition or workshop _____
Educator for the educative progaramme _____
Freelance for conservation _____
Freelance for restoration _____
Other _____
Other _____
Other _____

22 **Has your museum collaborated with any university or academic institution in any Project or task in the last 12 months?**

- o Yes
- o No
- o No response

23 **Please specify the university**
Mark the corresponding options

- o University of Alicante
- o University of Valencia
- o University Politechnical of Valencia
- o Jaume I University
- o Miguel Hernández University
- o International University of Menéndez Pelayo - UIMP
- o Cardenal Herrera University - CEU
- o Catholic University of Valencia
- o Universities of other Autonomous Communities
- o International universities
- o Other: _____

24 **Is your museum linked to or associated with any professional association?**

- o Yes
- o No
- o No response

25 **Please specify the profesional associations**
Mark the corresponding options.

- o ANABAD. Spanish Confederation of Associations of Archivists, Librarians, Museologists and Documentalists
- o ARMICE. Association of Registers of Museums and Cultural Institutions of Spain
- o FEAM. Spanish Federation of Friends of Museums
- o ICOM. International Council of Museums
- o AEM. Spanish Association of Museologists
- o APME. Professional Association of Museologists of Spain
- o Association of Conservators of Valencia
- o AGCPV. Association of Cultural Managers of the Valencian Country
- o AIP. Association for the Interpretation of Heritage
- o AEGPC. Spanish Association of Managers of Cultural Heritage
- o FEAGC. State Federal Associations of Cultural Managers
- o GEIIC. Spanish Group of Conservation
- o Other: _____

26 **Has your museum had any exchange, interaction or cooperation oith other museums in the last three years?**
Mark the corresponding options

- o With other state museums
- o With other regional museums
- o With other local museums
- o With other private museums
- o With other foreign museus
- o Without any relation with other museums

27 **According to your experience, consider which is more feasible to establish collaboration with:**

	1	2	3	4	5
Other museums with the same managering institution to which your museum belongs	O	O	O	O	O
Other museus out side of the managing institution to which your museum belongs	O	O	O	O	O

5 = Totally agree
4 = Agree
3 = Neither agree nor disagree
2 = Disagree
1 = Totally disagree

V. Innovative activities

***28 What* kind of technologies is utilized in the museum?**
Mark the corresponding options

- o Digitized collection
- o Web page
- o Intranet (Interbal computer network based on internet standards, in wihch computers are connected to one or more web servers)
- o Digital or visual museum
- o Social media (e.g. Facebook, Tweeter, Instragam, Youtube, LinkedIn etc.)
- o Museum App for mobilephone or tablets
- o Tridimensional 3D
- o Holography
- o Visual reality
- o Augmented reality
- o Information desks, kioscos, and docks
- o Audio guids
- o QR code
- o Other: _____

***29* How many temporrary and permanent exhibitions have been made by your museum in the year of 2015?**
You can only enter an integer value in this field.

Your response _____

***30* How many activities and programmes have been made in your museum in the year of 2015? (The programmes include educational activities, conferences, courses/workshops/seminars, but not include concerts.)**
You can only enter an integer value in this field.

Your response _____

***31* How many academic and/or profesional articles were published by the museum staff in the year of 2015?**
You can only enter an integer value in this field.

Your response _____

32 **In general, in the recent years, significant changes have been introduced in the organizational structure of the museum.**
Select one of the following options

- o Totally disagree
- o Disagree
- o Neither agree nor disagree
- o Agree
- o Totally agree
- o No response

33 **In general, in the recent years, an open and collaborative environment has been formed in the organizational culture of the museum to encourage creative and innovative activities.**
Select one of the following options

- o Totally disagree
- o Disagree
- o Neither agree nor disagree
- o Agree
- o Totally agree
- o No response

VI. Actitud innovadora

34 **What importance do the following objectives have on the decision to innovate in technology and creative content?**

	4	3	2	1	0
Exercise the basic functions defined by ICOM, such as conservation, exposure, research and communication.	O	O	O	O	O
Entertainment and the quality of life (eg enriching the intellectual life of the local community)	O	O	O	O	O
Diffusion of museological knowledge	O	O	O	O	O
Democratization of access	O	O	O	O	O
Creation / Reinforcement of symbolic values and cultural identity	O	O	O	O	O

Urban regeneration	O	O	O	O	O
Tourism and City branding	O	O	O	O	O
Promoting the development of the regional economy	O	O	O	O	O
Prestige and recognition	O	O	O	O	O
Stability / security resources, financial autonomy	O	O	O	O	O
Efficiency of management	O	O	O	O	O

4 = Very important
3 = Important
2 = little importante
1 = Not importante
0 = No response

35 **In your experience, what is the incidence of the following obstacles to the development of innovative activities in your museum?**

	4	3	2	1	0
The cost of adopting new technologies or the creation of creative content is very high	O	O	O	O	O
The museum does not have enough budget to invest in new technologies or start new research projects exhibition or educational programs	O	O	O	O	O
Lack of external financial courses supporting innovative activities	O	O	O	O	O
Lack of technical professionals who are experts in the application of new technologies	O	O	O	O	O
Lack of necessary training to strengthen the capacity of creativity and innovation	O	O	O	O	O
There is insufficient collaboration between the workers within the museum	O	O	O	O	O

It is not easy for the museum to employ a key professional from outside the museum	O	O	O	O	O
There is no certainty that the application of new technologies can improve the efficiency of management	O	O	O	O	O
It is not certain that the results of new research, new exhibitions, or educational programs will be accepted by the public	O	O	O	O	O
The museum did not have many innovative activities before, so it is not necessary that the museum innovates now	O	O	O	O	O
Little interaction and cooperation with external institutions makes it difficult to exchange and disseminate knowledge and experience	O	O	O	O	O
Excessive bureaucratic control limits the capacity of the innovative initiative	O	O	O	O	O
Public servant lacks incentive and willingness to innovation	O	O	O	O	O

4 = Very important
3 = Important
2 = little importante
1 = Not importante
0 = No response

36 **According to your experience, what is the incidence of the following factors in the development of innovative activities in your museum?**

	4	3	2	1	0
The museum itself is a creative space, where openness and variety of knowledge create a favorable environment for innovation.	O	O	O	O	O
Technology becomes increasingly important in museum management.	O	O	O	O	O

The director need improve the performance of the museum through innovation.	O	O	O	O	O
The audience prefer to novelty, such as new exhibitions, new educational programs, new means of artistic expression, or the application of new technologies.	O	O	O	O	O
The museum should attract youth audiences through the application of digital content and social media management because they have become a part of the lifestyle of the youth.	O	O	O	O	O
Digital heritage is a global trend in cultural institutions, therefore, the museum must also develop it.	O	O	O	O	O
The application of computers has greatly increased the efficiency of museum management.	O	O	O	O	O
Digital heritage can help the museum attract more visitors online and on-site.	O	O	O	O	O
It is not so difficult to integrate the technologies with the traditional museological works in the museum.	O	O	O	O	O
Politicians ask museum to innovate so that museums can obtain political support.	O	O	O	O	O
The sponsors ask museum to innovate so that museum can obtain public and private funds.	O	O	O	O	O
The innovation increases the prestige and recognition of the museum in the national and international territory.	O	O	O	O	O

4 = Very important
3 = Important
2 = little importante
1 = Not importante
0 = No response

VII. Visitor number

37 **Total number of museum visitors**
You can only enter an integer value in this field.

In 2015 _____
In 2014 _____

38 Number of visitors with reduced rate.
You can only enter an integer value in this field.

In 2015 _____
In 2014 _____

39 **Number of visitors with free entrance**
You can only enter an integer value in this field.

In 2015 _____
In 2014 _____