# Advanced Museum Services

Maurizio Calderamo[1], Simona Ibba[2], Filippo Eros Pani[2], Francesco Piras[1]
and Simone Porru[2]

[1]SoSeBi Srl, Via dell'Artigianato, 9, 09122 Cagliari, Italy
[2]Department of Electrical and Electronic Engineering, University of Cagliari,
Piazza d'Armi, 09123 Cagliari, Italy
{calderamo, piras}@sosebi.it,
{filippo.pani, simona.ibba, simone.porru}@diee.unica.it

**Abstract.** The research project aims to develop a prototype of a web-based application specifically designed to improve both the management of and the dialogue between cultural heritage institutions, as well as providing cataloging and web publishing tools for museums, primarily focusing on user interaction. The main goal of the project is to build a product capable of understanding the future evolution of museum services, which can no longer ignore how technological developments are shaping and inspiring users' new habits, together with more advanced and diverse expectations and needs. This project is developed by the Department of Electrics and Electronics Engineering of the University of Cagliari and SoSeBi Srl. It is financially supported by the Autonomous Region of Sardinia with European local development funds.

## 1 Introduction

Typically, the cultural heritage sector shows an enormous potential for innovation, with astounding development prospectives. This evolution scenario is of particular interest to Italy, being it a country which owns a rich cultural heritage. Such heritage can also be relevant as an economic asset, with fairly interesting and diverse consequences and peculiarities.

Most software offered both in the Italian and international market almost always separate functions related to the description and preservation of artifacts from functions related to the presentation and sharing of the same artifacts with users, without much concern for usability and user experience.

We thus believe that there is more than enough room to introduce an innovative product that exploits the technology potential of web-based architectures.

In a globalized economic context cultural heritage is a strong element of attraction for a region; starting from it, and thanks to ICT, it is possible to trigger disruptive development dynamics.

The use of new technologies can offer a plethora of new opportunities for dissemination and access to cultural heritage, especially to museums. A modern museum can be seen as a complex ICT system, strongly interconnected, and responsible for a vast amount of data to manage. Museums have to be extremely dynamic because of time-changing temporary exhibitions, which are more frequently associated with highly-usable applications to increase visitors' involvement [1], [2].

Aware of the potential shown by ICT when applied to cultural heritage, the proponents aim to start an innovation plan with the objective of developing a prototype of a web-based application dedicated to the management and communication between museums, and to the cataloguing and publication on the web, including the interaction between users. In fact, ICT application to cultural heritage is particularly interesting because of the various innovation opportunities that can be specifically provided to this context.

The latest ICT technologies can trigger a disruptive evolution in a museum system, ranging from information management and communication systems to the creation of a new typology of interactive museum [3].

Thanks to the Internet and to the new means of interaction with information systems (e. g., immersive and natural means), the ways of enjoying a museum are multiplying. In the near future we will be able to think about a cultural space projected towards the external environment not only for pure management purposes, but also for entertaining and educating.

Nowadays, as we can witness the birth of a innovative museum model which is interactive, interconnected, multimedial, and more and more similar to a lively cultural space to the service of a everwider audience, the main goal appears to be that of studying and designing a unique software solution capable of providing the following functionalities:

- traditional cataloguing management for collections hosted in museums;
- management of the exchange of items between museums;
- online publication of the museum collections;
- augmented reality and user interaction (creation of virtual thematic paths with integrated digital information);
- semantic search and automated items cataloguing.

At the present day, museums in Italy are not provided with a single product capable of combining the accuracy requested by cataloguing activities with the user need of accessing museum items on the Internet. From a technological point of view, the software, as for the reasons previously stated, will be installed on a cloud computing web platform which will allow scalable access also for mobile devices.

This paper is structured as follows: the second section describes the prerequisites and motivations behind the proposed project; the third section describes the context of the research proposal. In the fourth section, the schedule of the project is outlined. The last section hosts our final observations about the project.

## 2 Project Prerequisites and Motivations

A number of national surveys indicate limited growth for museum software applications demand. It is possible to assert that the museum software market has reached the maturity stage. IT companies compete for a market share, economies of scale push for price reduction, and services value is rising. It is precisely to services that the project proponents will address most of their efforts in terms of investments.

40

Studies and industries surveys predict an increasing demand for new high-technology services, whose valorization will possibly constitute a new source for revenues for all of those companies which will recognize the signs of this growth.

In order to fully satisfy the new needs of the reference market, the new product will be designed and developed exploiting the technological assets that web-based architecture offer, such as the QR code technology, and communication with the main players in the market, including Google. The software will also fulfill all the technical standards promoted by the Cultural Heritage Ministry through the dedicated web portal provided by "Cultura Italia"[1].

The technological innovation of the new product is threefold: quality enhancement, evolved performances, macro-functionalities integration.

The future scenario for cultural heritage in which museums will operate will feature an ever more central role of the web as a means to access knowledge, represented by the collections belonging to cultural heritage institutions. The web itself is facing a constant acceleration in technological innovation, thus offering more and more advanced and sophisticated virtual environment exploration capabilities to users. This makes more room for innovation in all of the contexts, and will deeply modify people lifestyle and interaction on the Internet.

Through virtual tours, cultural tourism will turn into a fundamental development opportunity for public institutions. New ways for accessing cultural heritage, enriched by an immersive user experience for the museum visitors, will be offered to the public. Semantic technology will allow for those software systems capable of effectively using the available assets described in both public and private institutions' repositories to cooperate on the web, at a global level.

The cooperation between these smart agents, together with their interoperability, will integrate all the cultural assets hosted by museums connected through the web, thus making for a more effective and easier to find cultural heritage for the final user, which is currently fragmented due to the vast plethora of technological-divided institutions.

Users will be all the more drawn to share their virtual tours experiences through social networks, thus opening new scenarios for interaction and museum exploration. In fact, those experiences will be shown and suggested to their friends and acquaintances with matching artistic taste. This will in turn create "emotional paths" mediated by their own network of online relationships.

In this scenario, proponents aim at realizing a prototype of a new software for museums, which will have the peculiar feature of integrating five macro-functionalities into a single application. Usually, those functionalities are provided by different software products.

The main goal is to design a product capable of fulfilling the needs originated by the new direction he Cultural Heritage sector is heading to. The application will not be indifferent to the technological developments demanded by the current users needs, whose expectations and demands are more and more advanced; they are also modeled and inspired by consumer technologies promoted by multinationals in the digital sector, such as Google, Apple, Facebook, Amazon. Moreover, the very same users expectations are to be found in entertainment exploration activities in museum environments, which is also an aspect that is gaining momentum because of the need to answer the request for new means of access by younger generations.

---

[1] Cultura Italia, www.culturaitalia.it

The resulting new generation application, characterized by an innovative view on the concept of museum automation application, is expected to be the pioneer of a general development trend in the museum sector, that is, it will be capable of anticipating and understanding the market evolution in the next years. The current Italian and international market landscape only offers applications which clearly distinguish functionalities that are used for describing and preserving cultural assets from those used for presentation and sharing among users. Less focus is then to be found on usability and user experience, thus making more room in the market for an innovative product featuring the integration of macro-functionalities, when associated with a market proposal as innovative as the product itself.

As a result, the final product will be a network-oriented software, entirely web-based. All the data management processes will be externalized into a Cloud Computing infrastructure, and offered to the users as a service (Software as a Service, or SaaS).

## 3  The Research Proposal Context

Most of the Italian museums build their peculiar features mainly on their historical background. Taken as a whole, Italian museums originated just after Italy was unified, to avoid losing the cultural heritage as a consequence of the transfer of religious buildings (e. g., churches) ownership to the central state. Therefore, Italian museums were not conceived as depositories for exotic masterpieces intentionally collected, but as places hosting heterogeneous objects, locally collected, and grouped out of necessity.

They were first created in a civic form, and placed inside buildings often of great worth. Italian museums are also more densely aggregated in central and, sometimes, northern regions.

Countless museum typologies exist, classified according to the sector they are concerned with and the objects they host.

There are art museums and historical museums, the latter often dedicated to the city where they are placed or to a main historical period or event, such as the Risorgimento museums or Resistance museums. Always belonging to this typology, there are also the archaeological museums, dedicated to the most ancient objects, and those concerned with a specific civilization, which collect historical and artistic items, such as the Egyptian Museum in Turin, or the various museums dedicated to the Etruscan civilization in Tuscany and Lazio.

In all the cities that count among their past inhabitants a famous person (artist, intellectual, historic character, etc.) it is possible to find a house museum, that is, a museum placed in the very same space where they had worked or lived.

In addition, there are anthropological and ethnographic museums, dedicated to different human civilizations and to their artifacts and endeavours. Besides local history museums, Italy offers many other museums, such as those on rural traditions, traditional craftsmanship (e. g., tailoring and dressmaking, marble and wooden artifacts, pottery), or to a specific food (e. g., chocolate, citrus fruits, olive oil, cheese).

Considering natural science, we must mention the natural history museums, which host collections of animals, plants, minerals, and reconstructions of natural environments; also science and technology museums, documenting the evolution of human discoveries in science.

In Italy, as well as throughout the world, capitals and other major cities are home to the great state museums which arose mainly in the nineteenth century, and that host countless objects and artifacts, mostly from earlier private collections. In recent times, a number of museums specialized on many different topics have sprung up even in small towns, aiming at valorizing and promoting the most peculiar local traditions and finest local products.

There are also museums that have been founded thanks to donations from private collectors. They usually focus on a certain objects typology, such as dolls, toys, stamps, and so on. Recently, in Italy as well as in different parts of the world, a novel museum typology has been established, one specifically designed for children, which offer itineraries and laboratory activities designed for educating children. This kind of museum has become particularly popular among schools and families. Museums and similar institutions are, to a considerable extent, true cultural centers, capable of combining the basic functions of safeguarding cultural heritage, research, and exhibition, with those related to the promotion of educational activities, discussion, information exchange, exhibitions, and contemporary art production, that is, those concerning the entertainment of local communities. In a statistical study published in 2013, ISTAT[2] conducted a survey in collaboration with the Ministry of Heritage and Culture, where regions and autonomous provinces were throughly analyzed to list not only all the Italian museums, but also similar institutions, that is, museum-like institutions, either public or private, either managed by the public administration or not.

## 4 Research Project Description

The new ICT technologies can radically improve a museum system starting from the information management and communication systems, so as to finally shape a new type of interactive museum. Thanks to the Internet and the new forms of interaction with computer systems now available, users can now choose among different ways of enjoying a collection hosted inside a museum: in the near future, it will be possible to think of an outward-looking cultural area, with more and more recreational and educational services combined with the more usual informational ones.

The expected product will be a modern application with an innovative vision of the concept of automation of museum services, that is, a pioneer software capable of following the current development direction that the museum sector is taking, anticipating and taking advantage of market trends in the years to come.

Our aim is to create a product that can anticipate the direction in which the museum and cultural/artistic heritage sector is evolving. That is a sector that can no longer ignore the technology development fueled by users' new habits, expectations, and needs, which are in turn shaped by consumer technologies coming from multinational companies in the digital industry.

Such expectations interest different aspects, namely game-like exploration of museum space, which is becoming popular to address the learning style of young users.

---

[2] Istituto Nazionale di Statistica, www.istat.it

The software will be designed for the Internet, as it will be entirely web-based, while the management of all data will be outsourced to a Cloud Computing infrastructure, and will be provided to clients as a service (Software as a Service). The platform will have the distinctive and innovative feature of integrating five macro-functionalities (which are usually managed via different software products) in a single application:

1. traditional management of collections hosted in museums: cataloguing, digitization of museum collections, etc.;
2. management of the exchange of objects between museums: development of an application to explore the entire cultural heritage belonging to each museum;
3. online publication of museum collections: development of a "front-end web portal" for the exhibition of museum collections, which can increase and facilitate the access by a multi-target user base;
4. user interaction and augmented reality: use of QR code to create virtual cultural paths, customized and thematic, according to the new technological paradigm of augmented reality;
5. semantic search: automated items classification in separate categories on the basis of formalized taxonomies or user-generated folksonomies, which will be possible through the interpretation of their descriptive content.

The homogeneous integration of the above functionalities will be an original feature of the software platform. The application will address two different types of users: museums end users and museum curators, which will also be able to easily handle loan requests in order to improve the exchange of items between the various museum institutions.

The prototype will be developed leveraging open source technologies in accordance with the need of the Public Administration for using free software, and, at the same time, to follow recent market trends that testify how FLOSS software is gaining popularity also thanks to the greater social value it offers (especially if compared to proprietary software).

The platform will be integrated with the most widespread social networks to enlarge the targeted customer segment and gather feedback. A new type of visitor is in fact becoming common in museums as well as in most cultural spaces. These visitors want to communicate, and report their experience in a non-conventional way through their smartphones or tablets. Comments and opinions, carried through social channels, will be monitored and analyzed with techniques coming from sentiment analysis and opinion mining, in order to obtain a qualitative confirmation of the appreciation felt towards the museum and its web application by users.

## 4.1 Project Subdivision

The project officially began on October 1, 2015, and its conclusion is estimated to be on September 28, 2018.

The project covers a number of operation stages. Every stage of the working plan is organized in Work Packages (WP), parallel phases in which operative objectives are reached with a work group activity, through the production of expected results and products and the application of a specific methodology.

The WP included in the projects are five:

44

WP 1 - Traditional management of museum collections
WP 2 - Management of the exchange of items between museums
WP 3 - Semantic search
WP 4 - Online publication of museum collections
WP 5 - User interaction and augmented reality

Below is a brief description of each phase of the project development.

### 4.1.1 WP 1 - Traditional Management of Museum Collections

Ensuring compliance with both the current Italian and international industry standards is a fundamental requisite for developing a software capable of dealing with a scientific collection of museum resources. Assuring compliance with standards will allow for a correct and consistent cataloging of items belonging to collections, also according to the legislation of other countries. For this reason the first activity SoSeBi will have to perform is a survey on standards and metadata to apply to the cataloguing and digitization of museum collections in compliance with national and international laws. In addition, with regard to this activity, it will be necessary to perform a survey also on the assets and cataloguing management methodologies for museum collections, again at both national and international level.

Concerning technologies and software development tools used in this project, the proponents intend to undertake, within WP 1, a survey to investigate the possibility of diversifying software production, as currently this process is strictly linked solely to the technological paradigm related to proprietary programming languages. In contrast, the investment through a special consulting activity aims at investigating the possibility of introducing in the production process also Open Source technologies, assessing weaknesses and strengths of open source software development tools and their specific relevance to the realization of the software prototype.

The main proponents goal will be to define the application and the innovative features of the Management Module. On the one hand, the macro-management capabilities developed for collections will be an easy and effective means for the museum operator to manage the descriptions of museum resources and the connections between them. On the other hand, it will offer to the visitor the best and most effective way for enjoying all the museum collections. This macro-functionalities allow for controlling all management activities requested by museums, in a modular way with respect to exchange, publication, interaction, and semantics. To achieve these results, a graphical interface driven by a uniform and consistent operating logic will be employed, thus allowing the back-end operators to make use of the different functionalities without having the feeling of using different software products.

The web interface of the back-end addressed to museum operators provides a customizable dashboard, specifically designed for focusing on the most used functionalities. For example, an operator will have the opportunity to highlight the cataloguing functionalities, whereas the museum director will have easier access to staff management features or statistical data. On the dashboard, all the software functionalities will be easily accessible. Their layout and activation will fully depend on the level and type of the operator and the tasks assigned to them.

Another goal is the creation of a macro-functionality capable of providing the museum curator to aggregate information on the nature, extent, and structure of the

assets hosted by the museum. The application will allow for the management of the information associated to each resource according to a paradigm based on the concept of complex networks, integrating "atomic" information (intended as referring to the individual item, thus according to traditional cataloguing) with another type of information associated with the connections between the various resources constituting the assets of the museum (gallery, exhibition, etc.). This second type of information is of a "topological" nature [4].

The application will be capable of generating, from the information contained in the catalog, a complex network where the assets and their reciprocal relationships will be made clearly observable (in aggregate form and at different levels of granularity). This presentation will also be visualizable in a schematic form easily and immediately explorable, and will investigate the complexity of the existing relationships between items.

The proposed network is, in fact, a mathematical model on which to apply various algorithms for network metrics detection, and perform analysis of a statistical nature. For instance, it will be possible to obtain information on the nature and strength of the connections between the assets through the use of clustering algorithms, or community detection algorithms. The temporal evolution of the hosted resources will be observable, and it will be possible to compare information on the resources with information of other nature (e. g., geographical information). It will also be possible to filter network elements on the basis of different parameters (period of history, style, author, etc.), and then perform analysis only on subnets of interesting elements.

### 4.1.2  WP 2 - Management of the Exchange of Items between Museums

Another objective to achieve will be the creation of an application macro-functionality allowing the operator to optimize the exchange of objects between museums, thus making it possible to easily organize thematic cultural events.

The application will suggest optimal time and date for the scheduling of thematic exhibitions on the basis of predefined constraints, such as the availability of the items pertaining to the chosen theme. Each work will be eventually associated to a cost comprising booking, transportation, and management. Date and place will be chosen on the basis of the solution to an optimization problem, whose performance index represents the potential profit deriving from the organization of the event.

The macro-functionality described within WP1 might find its best application in a scenario where access to museum objects were extended towards other entities than the museum, that is, for example, external users. In this context, the application will be designed so to be able to integrate topological information on the reference structure with those from other museums.

Starting from the information extracted from the local catalogue and those retrieved from the catalogues of other museums, the application will also be able to generate a complex network where all the items and the relationships between them will be clearly distinguishable (in aggregate form and at different levels of granularity) [5].

The curator will be able to assess the nature of the relationships between the artifacts kept in the institution where he works and those hosted in other institutions, in order to evaluate any opportunities for partnerships in the organization of events, of guided tours, or in drafting catalogues [6].

### 4.1.3 WP 3 - Semantic Search

This WP concerns the realization of a module whose objective is to automatically (or semi-automatically) generate a taxonomy starting from the available textual data on the museum resources.

The project will feature automated classification of catalogued assets in specific categories on the basis of taxonomies built through a detailed analysis over the textual description of the resources. This objective will be achieved through the correct interpretation of the related descriptive content.

Taxonomies are hierarchical structures aimed at organizing information; their use allows to improve the performances of information retrieval systems, such as vertical search engines. Vertical search engines typically use ad-hoc taxonomies which describe the domain of interest. This happens in cases where it is needed to provide a specific service (e. g., a service addressed to tourism) and/or a localized service (e. g., addressed to tourism within a specific region). Currently, the problem of the generation of ad-hoc taxonomies can be dealt with by using groups of experts which operate without the aid of automated tools [7], [8]. In addition to the long realization time this approach requires, it is also often difficult to assess the adequacy of the generated taxonomies, with a negative impact on the performances of the search engine which is using the taxonomies. It must be also considered that, as of today, the application domains are changing very quickly. Thus, employing a manual approach is not suitable for promptly updating the taxonomy. For these reasons, the study and the definition of automated (or semi-automated) solutions for taxonomy generation, specifically tailored to the domain of interest, is steadily increasing, due to the plethora of applications in which they could be exploited.

WP3 also aims to improve the relevance of the results given as a response to user queries. The most suitable way for effectively and efficiently finding relevant information on museum artifacts both for visitors and curators is using a vertical search engine, that is, a search engine focused on a particular area, able to get to the most detailed information about indexed items (in this case, museum artifacts) and quickly and effectively return the most relevant results to the user.

The main goal of the WP is then to define and develop suitable techniques and algorithms for automated or semi-automated taxonomy building, specifically tailored to the cultural heritage domain, and subsequently implement a vertical search engine on top of it.

### 4.1.4 WP 4 - Online Publication of Museum Collections

One of the main objectives within WP4 is the definition of the application features and the innovative functionalities of the Publishing Module. This objective is related to the definition and detailed description of the application functionalities, also with regard to the information exchange with the other application modules and the subsequent production of the document for the analysis that will reveal which information are necessary to identify the software development guidelines for the developers team.

Another objective within WP4 will be to pay attention, during the online publication phase, to the web interface provided by the application. It will be designed with a user-centric approach, to establish a connection between the observer and the observed object to make the individual the main protagonist in the interaction.

The web front-end implementation, which will follow an immersive logic, will present museum exhibitions as a open spaces, seamlessly integrated with the context of cultural heritage tourism, and asking for continuous user interaction.

Therefore, context, space, and time, acquire great relevance: the experiential interface is the place where relationships between individuals, places, historical periods, businesses, and museum artifacts, are established.

The visitor is not a mere observer, as he interprets the object through an interaction that starts online, before he visits the museum: the approach toward the museum object is properly customized according to the visitor personal profile. Profiling allows for customized browsing of that content considered as the most attracting to the visitor, according to the user typology (e. g., school, critic, historian).

Through visual elements such as the front-end layout, multimedia, flash animations, and 3D, the user is fully involved and invited to experience the effects of his presence and actions when interacting with a museum exhibit or a single object. The object acquires more value as the frequency of the interactions with users grow. Digital information enhances the fundamental principles of any museum exhibition: socialization as shaped by the museum communication strategy; the full understanding of the real world which lays the foundations for a sensorial, practical approach to the observation of the exhibits, as opposed to a virtual approach; the vision of humanity as a multi-sensory experience able to enhance the human ability to relate to both the real and the virtual environment. The user physical presence is at the center of his online visit. The narrative associated to the various museum exhibits is thus made explicit through a series of both original and user-generated multimedia content (which are also highly integrated with the social platforms). The user experience generates strong expectations about the exhibit: the object is presented to the visitor not only as something esthetically enjoyable, but as an entity not separable from the context it belongs to, with a special meaning.

The integration of artifacts, historical content, and user-generated content is a innovative feature of the platform. The realization of the experiential interface requires leveraging a deepest know-how on various fields, even profoundly different ones. The achievement of the general and specific objectives of the project is possible only through cooperation of the best actors belonging to different sectors.

### 4.1.5 WP 5 - User Interaction and Augmented Reality

Another key objective will be the definition of the application features and the innovative functionalities of the interaction module. In addition, DIEE and SoSeBi will work together on the creation of a macro-functionality whose aim is enabling the visiting user to optimize their expendable time in a city of art or a large museum on the basis of their cultural interests and context constraints [9], [10].

First and foremost, each user will be able to include in their profile their preferences in terms of authors (painters, sculptors, architects, etc.) and will be constantly updated on exhibitions and potentially interesting events.

Second, each user will be allowed to ask for a detailed tour plan about visits to cities of art or great museums on the basis of a series of information the user provides to enrich their profile. For example, user will be able to maximize the time spent in a city, not only on the basis of the priorities he expressed, but also on constraints such as opening hours and distance. Similarly, the user can optimize their visits to museums on

the basis of the available time, their preferences, recommendations from other users, information from their previous visits, information on temporary exhibits, etc.

Another goal that will be achieved will be the creation of a social network composed by the system users wishing to exchange and share information with other users showing similar tastes and interests.

It will be possible to enhance the service quality of the user decision support system taking advantage from the social interaction between users. The users will be invited to establish relationships with other users properly selected by the system on the basis of the similarity ratio between profiles and experiences. This will be useful both to users who access the service as museum (or, more generally, cultural site) visitors, and users who access it as curators of events, exhibitions, or sites of various typologies.

The social dimension of the system allows for establishing direct relationships between new users and experienced users (i. e., those who have already enjoyed a given experience in a city) thus showing the latter's opinion on the visit and, eventually, receive immediate feedback and suggestions to improve their own experience.

The analysis of the interactions between the users and the information offered by social networks will be useful to the events/sites curators, as it will serve as a tool both for reviewing and validating their work, and for improving what future events will have to offer, social marketing, and expected data about tourists participation to a given event, on the basis of the activity recorded on social networks and the number of scheduled tours planned by the users.

The platform to be realized will be integrated with the most popular social networks in order to expand the reference customer segment and collect as much users feedback as possible. In fact, for museums, as well as for most of the cultural points of interest, a new visitor typology is starting to acquire relevance, that is, the visitor who wants to communicate and that, with the help of handheld devices such as smartphones or tablets, wants to relate their experiences in an innovative way. The comments and opinions conveyed through social media will be monitored and analyzed through the use of sentiment analysis and opinion mining techniques. This will allow for obtaining feedback about the perceived quality of a specific museum, together to that of the web applications it provides.

### 4.1.6 Protection and Exploitation of the Results

Protection and exploitation of the project results will be ensured via the following actions:

1. deployment of the new product, as the summary of the results obtained from basic and industrial research activities, and subsequent commercialization. It must be taken into account that the product is the tangible form of its intellectual content. As exploitable at different levels of research and engineering, its market penetration will be, especially from the company point of view, the most effective valorization effort for the content it represents;
2. generation of a momentum effect for the creation of even new experiences and acquired know-how through the activation of a networking mechanism, that is, the creation of a system built upon the relationships with research institutions within the region and the country (especially, with the University of Cagliari through the DIEE, and also with other companies operating in the ICT and cultural heritage sector);

3. production of scientific publications accounting for the results of the research effort performed by the proponents.

## 5  Conclusion

The future of cultural heritage, in which museums will be called to act, will see the web as an increasingly central means of access to knowledge and, more specifically, to artifacts hosted by museums and other cultural institutions. Even the web is experiencing a continuous multiplication of technology innovation processes, thus offering advanced and sophisticated opportunities for exploring virtual environments and for education.

To fulfill the new needs of the reference market (i.e., the customer segment addressed by public and private museums) we chose to design and develop a new generation software product, with an innovative vision on the very concept of museum automation program. This product could pave the way to a disruptive development trend in the cultural heritage sector.

The presented project is financed by the Autonomous Region of Sardinia with European funds (Single Programming Document 2007-2013 - P.O. FESR 2007-2013 – Line of Activity 6.2.2.d - Interventions to support competitiveness and innovation, under the Regional Committee Resolution no. 33/41 of 08/08/2013).

The creation of the platform will stem from the strategic partnership between SoSeBi Srl  and the Department of Electrical and Electronic Engineering (DIEE) of the University of Cagliari. The motivation behind this choice is to use the results obtained both from fundamental research and industrial research to elaborate an innovative prototype, that aims at being unique in the domestic market as for innovative features it will offer.

This project is coherent with the strategic objective of the regional planning in Sardinia, since it aims to implement innovative methods of the ICT sector in the library industry, and it complies with the objectives described in the Regional Strategic Document (Documento Strategico Regionale, DSR) 2007-2013  for Sardinia.

## References

1. Bartolini, I., Moscato, V., Pensa, R. G., Penta, A., Picariello, A., Sansone, C., Sapino, M. L.: Recommending multimedia visiting paths in cultural heritage applications. In: Multimedia Tools and Applications (2014), pp. 1-30, DOI: 10.1007/s11042-014-2062-7.
2. Bitgood, S.: An analysis of visitor circulation: Movement patterns and the general value principle. In: The Museum Journal (2006), Vol. 49, Issue 4, pp. 463-475.

50

3. Chianese, A., Piccialli, F.: Designing a smart museum: when Cultural Heritage joins IoT. In: Eighth International Conference on Next Generation Mobile Apps, Services and Technologies (NGMAST), IEEE (2014), pp. 300-306.
4. Newman, M. E. J.: The structure and function of complex networks. In: SIAM REVIEW (2003), 45:167-256.
5. Clauset, A., Moore, C., Newman, M. E. J.: Structural Inference of Hierarchies in Networks. In: Airoldi, E. M. et al. (Eds.), ICML, Lecture Notes in Computer Science 4503, Springer-Verlag, Berlin Heidelberg (2007), pp. 1-13.
6. Clauset, A., Moore, C., Newman, M.E.J.: Hierarchical structure and the prediction of missing links in networks. In: Nature 453 (2008), pp. 98-101.
7. Skinner, J.: Metadata in Archival and Cultural Heritage Settings: A Review of the Literature. In: Journal of Library Metadata (2014), Vol. 14, Issue 1, pp. 52-68. DOI: 10.1080/19386389.2014.891892.
8. Pani, F. E., Concas, G., Porru, S.: An Approach to Multimedia Content Management. In: Proceedings of the 6th International Conference on Knowledge Engineering and Ontology Development, KEOD (2014), pp. 264-271.
9. Kelly, L.: The Connected Museum in the World of Social Media. In: Museum Communication and Social Media: The Connected Museum, New York-London: Routledge (2014), pp. 54-71.
10. Rubino, I., Xhembulla, J., Martina, A., Bottino, A., Malnati, G.: MusA: using indoor positioning and navigation to enhance cultural experiences in a museum. In: SENSORS (2013), Vol. 13, Issue 12, pp. 17445-17471. ISSN: 1424-8220.