

# Design processes for enhancing museums through the use of technology and the involvement of local communities

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## ABSTRACT

The present contribution aims to present three different models that describe how a design process can advance a territory by enhancing its cultural heritage through museum exhibition systems. The models were developed starting from the analysis of four case studies: Museo Audiovisivo della Resistenza, Museo Storico Italiano della Guerra, Atlantic Wall and Coordinamento delle Case Museo dei Poeti e Scrittori di Romagna. These case studies were selected and described on the basis of the characteristics they share: a strong connection with the territory, its history and its residents, the use of technology to improve the visitor experience and a participative approach to the design and development of the exhibition. The result of the case study analysis leads to the identification of three models: the first model is based on an interactive museum with custom technologies, the second on an interactive museum with a customizable system, and the third on an interactive museum with an open-source approach. In particular, the three models show that a greater degree of openness contributes to a greater involvement of local communities and a systemic enhancement of the territory.

*Keywords:* Design Model, Museum Enhancement, Cultural Heritage, Open-Source, Local Communities

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## INTRODUCTION

The cultural heritage of a territory consists of a plurality of subjects that constitute a system in which knowledge, history, culture and people coexist. The museum can be considered to be both the material expression and narrative of this complex system, by collecting traces and testimonies of what is considered more culturally significant and by promoting the identities and values of residents and their territory (Mairesse, 2018; Sandahl, 2019). These local systems can be strong and healthy, but in most cases, they have scarce economic resources and lack personnel. They need to expand and diversify their audience, engaging visitors in different ways, but they do not always have the capacity to self-organize to

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enhance their own heritage (Lupo & Trocchianesi, 2013; Irace, Ciagà, Wolf & Trocchianesi, 2014; King, Stark & Cooke, 2016).

Communities and cultural heritage could behave as symbiotic elements. On the one hand, local communities can be essential in the revitalization of a territory by advancing its cultural heritage; on the other hand, the cultural heritage could be strategic to the growth of the community itself (Bosco, 2019; OECD/ICOM, 2019; Not & Petrelli, 2019). For this reason, despite the scarcity of resources, the cultural heritage of local territories can be a potential treasure if properly enhanced.

Starting from these considerations, design can act as a “process activator” or connector (Bassi, 2017) between different stakeholders – residents, civic organizations, local administrations, entrepreneurs, professionals, researchers, financial partners – and different design disciplines. Design can act as a driver of change and development by observing, studying and interpreting specific contexts with related data.

The idea of the designer as a connector, as an activator or more generally as a catalyst of projects, people and knowledge is not new. For example, Ratti and Claudel claim that: “The responsibility of the Choral Architect is less oriented towards object-building than orchestrating process. She is not a soloist, not a conductor, not an anonymous voice among many. The Choral Architect weaves together the creative and harmonic ensemble” (Ratti & Claudel, 2015, p.118).

The potential of a systematic approach to enhance the cultural heritage can vary according to the type of tools and processes used by the designer. Different starting conditions, goals, museum board or professionals involved, or different choices made during the design process, can lead to specific results. Openness can be a strategic keyword in this field. It can be interpreted in different ways (Gasparotto, 2019).

To be open, the heritage must be accessible, which means that it must be displayed, contextualized and understood by a different kind of audience public, in terms of communication, comprehension, age or ability.

The direct participation of visitors and the involvement of the community are other possible ways to open up the cultural heritage of a territory. In the first case by creating different kinds of interactions between the visitors and the object, in the second case, by gathering together a group of people motivated by the same values and aims.

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Finally, another way to implement an open approach to design in the field of cultural heritage is to use open- source technologies to create tools that enable interactive systems or installations related to the preserved heritage.

The use of open-source and the IoT can literally shape heritage communication by transforming it into physical form (Ciolfi & Bannon, 2002; Bowers et al., 2007; Parry, 2007).

Museums and their heritage can be enhanced by technology, with due regard to their existing museological and museographic condition. Projects can improve the visitors' experience and their appreciation of the museum's cultural values defined in the new contents (Dal Falco & Vassos, 2017). Interactive experiences involving both the visitor and the professional generate new immersive environments without the distractions inherent in the interaction with extraneous devices, apps, and touch screens (Villeneuve, 2013; Bannon, 2005; Hornecker & Stifter, 2006).

The use of technology makes the museum flexible and engaging, but as a result the material used for the exhibition becomes more susceptible to maintenance and obsolescence.

This article aims to analyze the use of technology in cultural heritage in order to identify approaches, methods and stakeholders that can trigger a process to enhance the museum and its territory. The involvement of the people and the consequent building of a community will ensure continuity in the management and the transformation process.

## 1. METHODOLOGY

Within the ample landscape of approaches to the advancement of the cultural heritage, we have chosen to analyze four paradigmatic case studies that rely on digital technology for the design of interactive systems in exhibition contexts.

We selected four examples that involve direct interaction between the user and the object on display. In all cases, the experience, which is immersive, takes place within shared exhibition spaces in which the visitor interacts with the technology using simple and intuitive gestures, at one with the context.

A further discriminating factor in the choice of case study was their belonging to a territory and a community with which they have a historic, cultural and geographical bond.

The description of each case study is followed by an examination of the technology it adopted and its relationship with the territory. More specifically, would be useful to highlight: in the first case, the type of technology, license, medium (physical interface), and

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how the content is implemented; in the second case: relevance for the territory, visitor experience in relation to the territory, subjects involved in the first phase of the project.

Finally, for each example, we examined the development processes, the actors involved, and the results achieved in relation to the type of technology that was chosen: closed technology, open technology without releasing the project as open-source, open technology with project released as open-source.

The data for each case study was collected through the study of the scientific literature, of articles and videos available online, as well as direct design experience.

## 2. RESULTS

In this analysis, we will consider four case studies that, due to their importance within the Italian and European context, represent four principal design approaches for the development of participatory design practices in museums. To analyze the context we are dealing with, it is important to make a preliminary distinction between an open project and an open-source project. The term “open” refers to those cases which preserve intellectual property rights and copyright but may be modified over time by others who are not part of the original design team. By “open-source” projects, we refer to those cases that share the development sources of the final outcome allowing anyone to contribute to the growth of the project.

The interactive installations created for museum exhibitions from the late 1990s to the most recent current installations, are the result of cutting-edge experimentation with language and technology as applied to museum exhibitions, which brought innovation and indeed transformed the exhibition system. Many of these works which, due to their strongly experimental component, may be considered fragile, are slowly disappearing as the result of technological obsolescence, which will prejudice their viability over time.

The first design approach under examination was the *Museo Audiovisivo della Resistenza*<sup>1</sup> at Fosdinovo in the province of Massa-Carrara (Italy) designed in the year 2000 by Studio Azzurro<sup>2</sup> (Rosa, 2011). This small museum dedicated to the memory of the Partisan commanders Alessandro Brucellaria and Flavio Bertone, is located in the mountains of the Alpi Apuane, which during the struggle for the Liberation were the theatre of hard-fought battles between the Partisan and German formations at the end of World War II. The museum grew out of the volunteer work of former Partisans and local citizens in a participated project between institutions and private citizens.

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The exhibition space consists of one room and the interaction with the multimedia content is made possible by a series of sensors that are activated when the visitor touches physical elements on a table lit by projectors from above. This simple gesture activates the narrative process inside the exhibition space and triggers the projection of the video accounts on the vertical screens.

This museum is one of the few permanent installations developed in those years by Studio Azzurro, in which the exhibition, preserved and still operational, remains faithful to the original project. In order for these works to be preserved and remain a viable experience for the public, they need, in a certain sense, to be frozen in the moment in which they were designed. The museum in Fosdinovo is one of the most striking examples of its kind. Though many years have gone by since this installation was created, it still works and may be experienced thanks to the volunteers who run it, and search piece by piece for compatible hardware components to keep both the computers that manage the screenings and the sensors that activate the videos running. The software developed at the time by Studio Azzurro and its collaborators remains a closed element restricted to a specific hardware configuration that admits no upgrades or changes unless the entire system is recreated with contemporary technology, which might in part alter the exhibition experience.

The second design approach we wish to examine is the European project meSch<sup>3</sup> coordinated by Daniela Petrelli of Sheffield Hallam University, and developed by a consortium of public and private entities with funding from the European Community (Petrelli et. al., 2013). The project produced an online platform<sup>4</sup> and hardware architecture that make it possible to develop interactive systems for exhibition spaces, and covers a wide range of interaction typologies. The system developed by the project consortium is not open-source, but it can be used by others who are not part of the initial consortium and is available to the territory to create and manage interactive content for exhibitions. The system is highly flexible and because the development process is based on open hardware devices, it can be maintained over time thanks to the support guaranteed by the participants in the initial consortium funded by the European Community.

Applications of this project include experiments developed in Italy for the *Museo Storico Italiano della Guerra* in Rovereto (Italy) between October and November 2015. This collaboration with the project led to the development of three applications of the technology in the project: the first inside the museum which provides tangible interaction with the artefacts on display to expand the visitor experience with an array of audio and video content; the second experiment which has now become a permanent installation titled

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“Voices from the Past in Fort Pozzacchio” in the Artillery Section of the museum, and relies on an object containing an NFC tag to activate the multimedia content; and the final application, along the World War I trenches, that relies on two interactive artefacts to provide audio content along the open-air visitor itinerary (Zancanaro et. al., 2015).

The second application of the meSch project that we considered is the Atlantic Wall, a temporary exhibition organized at the *Museon* in Den Haag in April 2015, with the goal of testing the technology developed by the individual partners. All the installations were co-designed by the exhibition curators with the developers who used the systems created by the research consortium.

The *Atlantic Wall* was a line of defence built by Germany during World War II to defend the boundaries running 5000 km along the Atlantic coast to the North Sea, from Spain to Norway, with an articulated system of bunkers and anti-tank barriers. The exhibition concentrated on the border at Den Haag. The situation in this seaport was rather complex. Because its harbour was one of the major outlets to the sea during the conflict, it was essential for the defence of the city. A second line of defence was therefore created across the city and much of the city's population was forced to leave its homes. The exhibition illustrates the conflict from three different points of view: a German soldier, a collaborator or a Dutch civilian. The stories about the people on the different fronts are based on original sources such as interviews, documents from the archives and newspapers. The interactive approach adopted for the project is the opposite of the experiments conducted at the *Museo Storico Italiano della Guerra* in Rovereto. In this case the visitor must choose an initial point of view and an “avatar” object and will be exposed to different content during his experience of the exhibition depending on whether he has chosen to identify with a German soldier, a collaborator or a Dutch civilian (Not & Petrelli, 2019).

In short, the interesting aspects of the meSch project which make it so original from a methodological point of view, are primarily linked to the approach recommended for the development of the interactive stations. Relying on pre-established solutions known as “recipes” and a series of illustrated guides and tutorials, experiences in co- design may be developed between the various professional figures that concur in the development of a contemporary museum system (Zancanaro et. al., 2015).

A solution very similar to the previous one, but completely different in terms of approach and typology, is the openMuseum platform<sup>5</sup> created within the research project “New Integrated Systems for the Exhibition Experience in Historic House Museums” developed by

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a research group of the University of San Marino with the *Coordinamento delle Case Museo dei Poeti e degli Scrittori di Romagna* (Bosco, La Maida, Zannoni, 2019), with the contribution of the IBC in Emilia Romagna. The goal of the project was to develop a participated process with the eight museum institutions and the partner university, to enhance the historic house museums of these authors and poets and make the individual entities autonomous in the design and creation of their content and in the management of the multimedia installations. Devices were developed with the fablab of Castelfranco Veneto (Italy) to make the visitor experience interactive and expand it with voices that narrate the work of the authors and visual displays inside the spaces of the homes. The multimedia content is activated by a reader that locates the RFID tags positioned along the visitor itinerary and triggers the audio and video content that is streamed through Bluetooth audio speakers or mobile devices. The project's versatility lies in the fact that the system can interface with many open technologies for managing the lighting fixtures and on smartphones without using proprietary applications. During the project, the eight museums cooperated with the university in co-designing the exhibitions and were successful in designing their own visitor experiences independently. In some cases, the tour introduced lighting and tablet devices along the exhibit, in others the experience became a spatial narration of voices and light inside the spaces of the writer's home and outdoors around the house. The content they developed was recited by professional actors and in some cases integrated with videos made with photographs and film clips from the archives.

The tools created to develop the interactive devices were released as open-source and contemplate three typologies of digital systems: an online platform for handling multimedia content, a device that makes it possible to visit the historic house museums and integrate audio and video content into the visitor experience, a small hub for handling multimedia content and the control of interactive lights and a web-app to stream the content on smartphones and tablets. The entire project was built with hardware components that may be purchased by any museum and every installation is easy to replicate and adapt to different contexts. The return for the territory lies not only in the development of a process limited to eight house museums but was designed to involve schools and fablabs in the creation of interactive devices that can expose the students to these complex exhibition structures.

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### 3. DISCUSSION

Based on a description of the four case studies, with the purpose of delineating a categorization and consequently to visualize the three different process dynamics, it is important to extrapolate some of the key information and to order it within two summary tables. The first (Table 1) provides a synthesis of the data regarding the choice of technology in each of the case studies, the second (Table 2), concerns the relationship between the case studies and the territory.

**Table 1. Relationship between technology and case studies**

	<b>Museo audiovisivo della resistenza</b>	<b>Atlantic Wall at Museon</b>	<b>Museo Storico Italiano della Guerra</b>	<b>Coordinamento delle Case Museo dei Poeti e Scrittori di Romagna</b>
<b>Technology</b>	- x86 Windows platform - custom board interactive system	- Arduino - Raspberry Pi - Intel-Edison - BeagleBoard - Espressif - meSch technologies	- Arduino - Raspberry Pi - Intel-Edison - BeagleBoard - Espressif - meSch technologies	- x86 Windows platform - custom board interactive system
<b>License for the project</b>	- Proprietary software	- Proprietary software	- Proprietary software	- Proprietary software
<b>Medium (physical interface)</b>	- Haptic surface interaction	- Physical interaction	- Physical interaction	- Haptic surface interaction
<b>Content implementation</b>	- Local into the software	- Online platform	- Online platform	- Local into the software
<b>System implementation</b>	- Not implementable	- Customization of contents	- Customization of contents	- Not implementable
<b>Maintenance</b>	- By technical staff	- By technical staff	- By technical staff	- By technical staff



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**Table 2. Relationship between the territory and case studies**

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<b>Relevance for the territory</b>	<ul style="list-style-type: none"> <li>- Attraction value of the museum</li> <li>- Building shared memories</li> <li>- Attracting an interested audience</li> </ul>	<ul style="list-style-type: none"> <li>- Attraction value of the museum experience</li> <li>- First-hand understanding of different points of view</li> </ul>	<ul style="list-style-type: none"> <li>- Attraction value of the museum experience</li> <li>- Development of outdoor itineraries</li> <li>- Involvement of local developers</li> </ul>	<ul style="list-style-type: none"> <li>- Enhancement of the local material culture</li> <li>- Involvement of outside subjects such as: archives, FabLab, schools, cultural associations</li> </ul>
<b>Visitor experience in relation to the territory</b>	<ul style="list-style-type: none"> <li>- Learning from direct eyewitness accounts</li> </ul>	<ul style="list-style-type: none"> <li>- Profiled itineraries</li> <li>- Role-playing identification</li> </ul>	<ul style="list-style-type: none"> <li>- Immersive and empathic experience of the place and historical events</li> </ul>	<ul style="list-style-type: none"> <li>- Direct experience of literary contents</li> </ul>
<b>Subjects involved in the first phase of the project</b>	<ul style="list-style-type: none"> <li>- Researchers</li> <li>- Testimonials</li> <li>- Designers</li> <li>- Curators</li> </ul>	<ul style="list-style-type: none"> <li>- Curators</li> <li>- Designers</li> <li>- Developers</li> </ul>	<ul style="list-style-type: none"> <li>- Curators</li> <li>- Designers</li> <li>- Developers</li> </ul>	<ul style="list-style-type: none"> <li>- Curators</li> <li>- Personnel</li> <li>- Developers</li> </ul>
<b>Subjects involved in during the development of the project</b>	<ul style="list-style-type: none"> <li>- Curators</li> <li>- Designers</li> <li>- Developers</li> </ul>	<ul style="list-style-type: none"> <li>- Curators</li> <li>- Developers</li> </ul>	<ul style="list-style-type: none"> <li>- Curators</li> <li>- Developers</li> </ul>	<ul style="list-style-type: none"> <li>- Curators</li> <li>- Designers</li> <li>- FabLabs</li> <li>- Personnel</li> </ul>
<b>Subjects involved after the project is completed</b>	<ul style="list-style-type: none"> <li>- Cultural associations</li> <li>- Universities</li> <li>- Volunteers</li> </ul>	<ul style="list-style-type: none"> <li>- Curators</li> <li>- Designers</li> <li>- Technical staff</li> <li>- Developers</li> </ul>	<ul style="list-style-type: none"> <li>- Curators</li> <li>- Designers</li> <li>- Technical staff</li> </ul>	<ul style="list-style-type: none"> <li>- Curators</li> <li>- Designers</li> <li>- Developers</li> <li>- FabLabs</li> <li>- Schools</li> <li>- Universities</li> <li>- Open source community</li> <li>- Archives, foundations, libraries</li> <li>- Other institutions</li> <li>- Theater groups</li> </ul>
<b>Maintenance</b>	<ul style="list-style-type: none"> <li>- Attraction value of the museum</li> <li>- Building shared memories</li> <li>- Attracting an interested audience</li> </ul>	<ul style="list-style-type: none"> <li>- Attraction value of the museum experience</li> <li>- First-hand understanding of different points of view</li> </ul>	<ul style="list-style-type: none"> <li>- Attraction value of the museum experience</li> <li>- Development of outdoor itineraries</li> <li>- Involvement of local developers</li> </ul>	<ul style="list-style-type: none"> <li>- Enhancement of the local material culture</li> <li>- Involvement of outside subjects such as: archives, FabLab, schools, cultural associations</li> </ul>

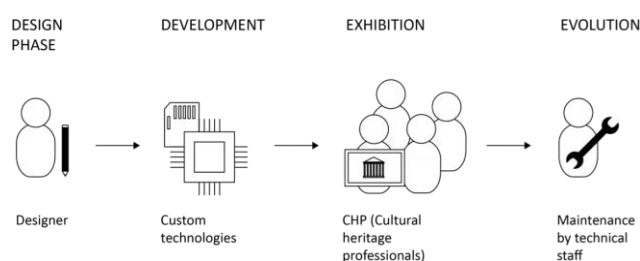
This initial analysis highlights three systems differentiated primarily by the type of technology that they use. The first, based on the Museo Audiovisivo della Resistenza, uses proprietary technology, the second, meSch, while using proprietary technology, allows content to be customized, the third applied to the Coordinamento delle Case Museo dei Poeti e Scrittori di Romagna, is based on a totally open system. It should be noted that, in addition to increasing the degree of openness of the system, the number of actors involved also rose, especially after the project was completed. The second part of the analysis proposes an

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extrapolation of the processes underlying each case study, which will be expressed and visualized in the elaboration of three theoretical models.

### 1.1. A model for an interactive museum with custom technologies

The process model represented by figure 1 is a closed system that cannot be updated over time, in which the choice of technology and the content decided during the design process, become definitive. The local community or the curator entrust the project to the designer who develops it using “custom” technology. Once the project is complete, it is handed over to the curator and to the museum personnel. This context paves the way for the development of innovative installations that test new languages and experiment on design with tools that can interpret the new technologies. The professionals who manage the system are committed to preserving the heritage and maintaining the operational management system with the purpose of delaying the natural obsolescence of the technology applied to the project. Rather than a community dedicated to the implementation and transformation of the museum experience, it would be important to build a professional network and a network of technicians around the museum that can guarantee correct and satisfactory performance even after many years of use.



**Fig. 1. A model for an interactive museum with custom technologies (Silvia Gasparotto, 2019).**

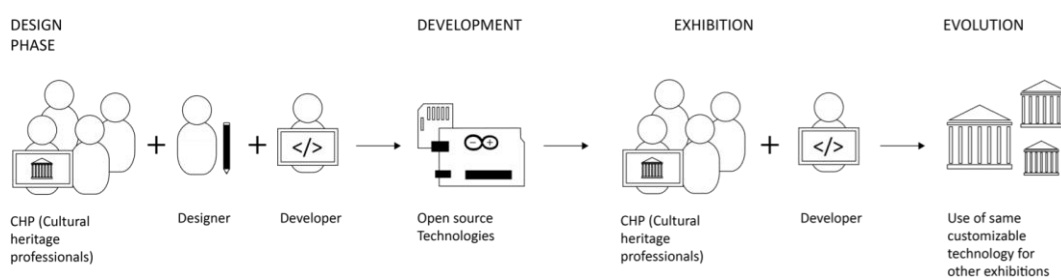
### 1.2. A model for an interactive museum with a customizable system

The model for the process represented in figure 2 makes it possible to update and redefine the content thereby allowing expansions of the proposed visitor experience. The choice of open-source hardware and software technology that can be customized for any specific context, can support different visitor experiences, based on the goals identified by the curators and cultural heritage professionals. The curators are involved in the project from the very beginning, both in defining the content and in the conception of the interactive experience. Intelligent physical objects interrelate to mediate the transmission of the multimedia content, with a simple and intuitive gesture by the visitor, or through the physical substance or multimedia environment of the designed system. The ability to build,

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update and articulate the content over time brings flexibility to the system, which can be configured and reconfigured based on a variety of factors. A focus on attracting new typologies of users can lead to the creation of educational and learning experiences for children, school groups, and tourists, or disciplinal experiences for scholars. A focus on offering immersive emotional experiences can generate opportunities for role-playing based on events from the past to transmit reconstructions of historic memories.

The content, uploaded onto an online platform, is managed directly by the curators and cultural heritage professionals, while the technical staff is called upon to supervise the operation of the interactive system – developed by expert professionals – that can potentially be extended to new stations. By redefining its content, a museum can be renovated, even though the collection, the exhibition design and the interaction experience were selected by curators and designers at the beginning of the process.



**Fig. 2. A model for an interactive museum with a customizable system (Silvia Gasparotto, 2019).**

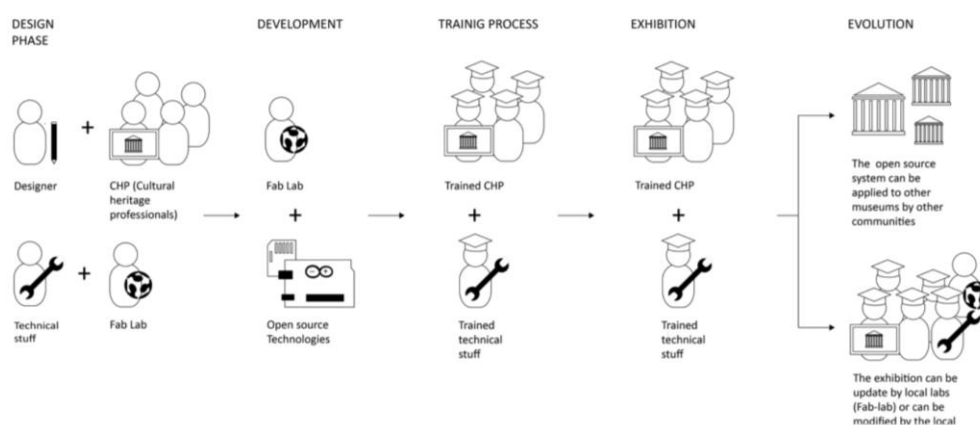
### 1.3. A model for an interactive museum with an open-source approach

The model for the process represented in figure 3 illustrates a system that is completely open and allows the adoption and release of open-source hardware and software technology. In every phase of the process, the primary participants are involved from the very beginning: curators, designers and museum personnel. The understanding and awareness of being part of the entire process from the very beginning activates the parts towards common goals, established in workshops and meetings convened for this purpose. The museum system, which is flexible, can be updated by operators who insert content that they interpret and pursue strategies for communication and promotion, adopted at that specific moment. The curators may also solicit the contribution of regional institutions, such as archives, foundations and libraries, for the continuous transformation and implementation of the system of content. The technical development could involve workshops such as fablabs, for example. Other input may come from teachers, students and researchers who could, for

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example, propose different new typologies of interaction between visitor and heritage. The community involved in the project can also extend beyond the specific territory.

Researchers, designers and experts can, starting with the same hardware and software technology released in open-source, plan and design the enhancement of other museum systems.



**Fig. 3. A model for an interactive museum with an open-source approach (Silvia Gasparotto, 2019).**

#### 4. CONCLUSION

Based on the analysis conducted in this essay, we can highlight common design practices in all three models that develop learning activities and processes to enhance and advance the territory.

The first model makes it possible for existing communities to enhance their cultural heritage by collaborating with designers who will work with them throughout the museum development process. In this case the economic sustainability of the project depends largely on the choice of technology and the institution's capacity to guarantee personnel and funding to maintain an active relationship with the developers of the project.

In the second model, the project is developed in participated form and leads to the creation of systems fuelled by the experiences in the territory, thereby developing a two-way narration. The open architecture configured in this manner makes it possible for museums to continue to advance the cultural processes that emerge in the territory, based on the capacity of the curators to work in a synergic relationship with the designers. In this case, the sustainability lies in the continuous training within the process of figures who have worked with the design team.

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The third model is completely open, both in the processes of participated design, and in the development of the project. The multiplicity of professional figures involved in the various phases of the design process, who may be local or from a wider global context, open up an ample spectrum of collaboration that inevitably generates the development of new knowledge in the territory. This model appears as an egalitarian system in which all the subjects that concur in the development of the final project may reap benefit from their participation in the process. In this case sustainability lies in the ample supply offered by such an extensive pool of human resources at the service of museum institutions.

In light of these considerations on the three design models, we find in synthesis that the model based on an open- source approach, though not necessarily the most sustainable, is the one that focuses most specifically on the development and growth of the territory. Its capacity to foster growth in public and private subjects (businesses, fablabs and individual professionals) around a shared open project is a verifiable added value and a long-term resource in a greater planning effort to advance local museum systems.

To conclude, the study of the processes that are activated within open-source dynamics for the enhancement of the cultural heritage is a research theme that is currently open to debate and must be addressed by experimenting with and applying these practices to real projects in order to test their validity.

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## ENDNOTES

<sup>1</sup> Museo Audiovisivo della Resistenza. Multimedia installation project by Studio Azzurro, Milano. Fosdinovo (MS), 2000, [www.museodellaresistenza.it](http://www.museodellaresistenza.it)

<sup>2</sup> Studio Azzurro, <http://www.studioazzurro.com>

<sup>3</sup> The meSch Project (Material Encounters with Digital Cultural Heritage), <http://www.mesch-project.eu>

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<sup>4</sup> The meSch online platform, <http://www.mesch.io>

<sup>5</sup> openMuseum, <https://github.com/unirms/openMuseum>

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