GIADA CERRI

Shaking Heritage

Museum Collections between Seismic Vulnerability and Museum Design

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A reworked version of the photo *Serie Depositi*, 2016 by Marco Lanza.

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MAGNIFICENT COUNTRY IN A FRAGILE SETTING

Francesco Collotti
DIDA | Department of Architecture, University of Florence

You will begin to wonder that human daring ever achieved anything so magnificent.
John Ruskin, *Mornings in Florence*, 1875

Ruskin's quote describes a magnificent country, Italy, envied and loved by the whole world. Unfortunately, this to-be-admired and to-be-preserved heritage locates on a fragile palimpsest. Seismic activity, hydrogeological instability, and human faults (negligence, conflicts of competence among public institutions, lack of dedicated finances and of suitable projects) are leading threats of the Heritage.

In Italy, some preventive actions against earthquake effects have been taken on in the last decades. They usually focus on buildings, including museums, the so-called culture containers. The latter must fulfill their task of conservation and preservation of cultural goods. Therefore, besides structural anti-seismic solutions, the museum's efforts focus on objects conservation, environmental control, and visitors' impacts on expositions.

From the museum design perspective, excellent architects have designed unique architectures and set up scenographies hosting outstanding collections. Their effort was to match architectural and cultural programs. The past century marked a profound transformation in museum culture. Instead of constructing contemplative and cultural products for selected intellectual audiences, museums and temporary exhibitions became intermediaries of mass education and mass entertainment. The publics changed, so did museums and exhibitions.

Among the assorted families of buildings marking the city experience of the last two centuries, the museum building seems to constitute a recognizable architectural type, a consolidated one. The relation between the museum ad the city changed. In some instances, the museum serves as a tool for the regeneration of abandoned factory workshops. In others, the collections find a place in the so-called *objects trouvés*, old palaces, or churches. The use of a building as a museum changed or reinterpreted the original destination. In Italy and Europe, environmental or historic preexistences host museums, characterizing the exhibit setting.

Regarding the collections, the protection of a vast and multifaceted heritage from dangers and risks seems an impossible mission. Each time we see images of injured museum

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collections caused by earthquakes, we think: "we could have prevented that." As Stefania Viti suggested (Viti 2018), each museum should recognize, evaluate, and know its collections' vulnerability. Indeed, RESIMUS, RESIlience MUSeums research project by DIDA, Department of Architecture, University of Florence, is devoted to the seismic vulnerability of the museum collections. Since the beginning, the RESIMUS collective work stressed a non-original conclusion: we cannot afford to maintain separate skills and knowledge focusing on museum and exhibit design. RESIMUS is the chance to connect different pieces of knowledge and skills that might raise the safety of the collections and promote the enhancement of the museum heritage.

Giada Cerri's book *Shaking Heritage* is part of the RESIMUS research framework. It completes three years of dense activity. Theoretical studies and applications express the urgent need to preserve the collections through an integrated strategy. The proposed Approach shows an attempt to foster the museum design culture by including the anti-seismic solution in museum collections and setups. Due to internal and external complexities, the museum choices might collide with the best practices for seismic safety. Cerri's work does not hide these difficulties and focuses on the criticality of the resulting project. Evaluating the different points of view, trying to get close to various questions and follow-up analysis, recomposing the so-called art of extending (*arte del porgere*), the research represents a precious first step in museography and seismic assessment of the museum collection field.

The RESIMUS research highlights that seismic protection of museum collections is a constructive process. That is necessary, possible, and, above all, we cannot postpone it.

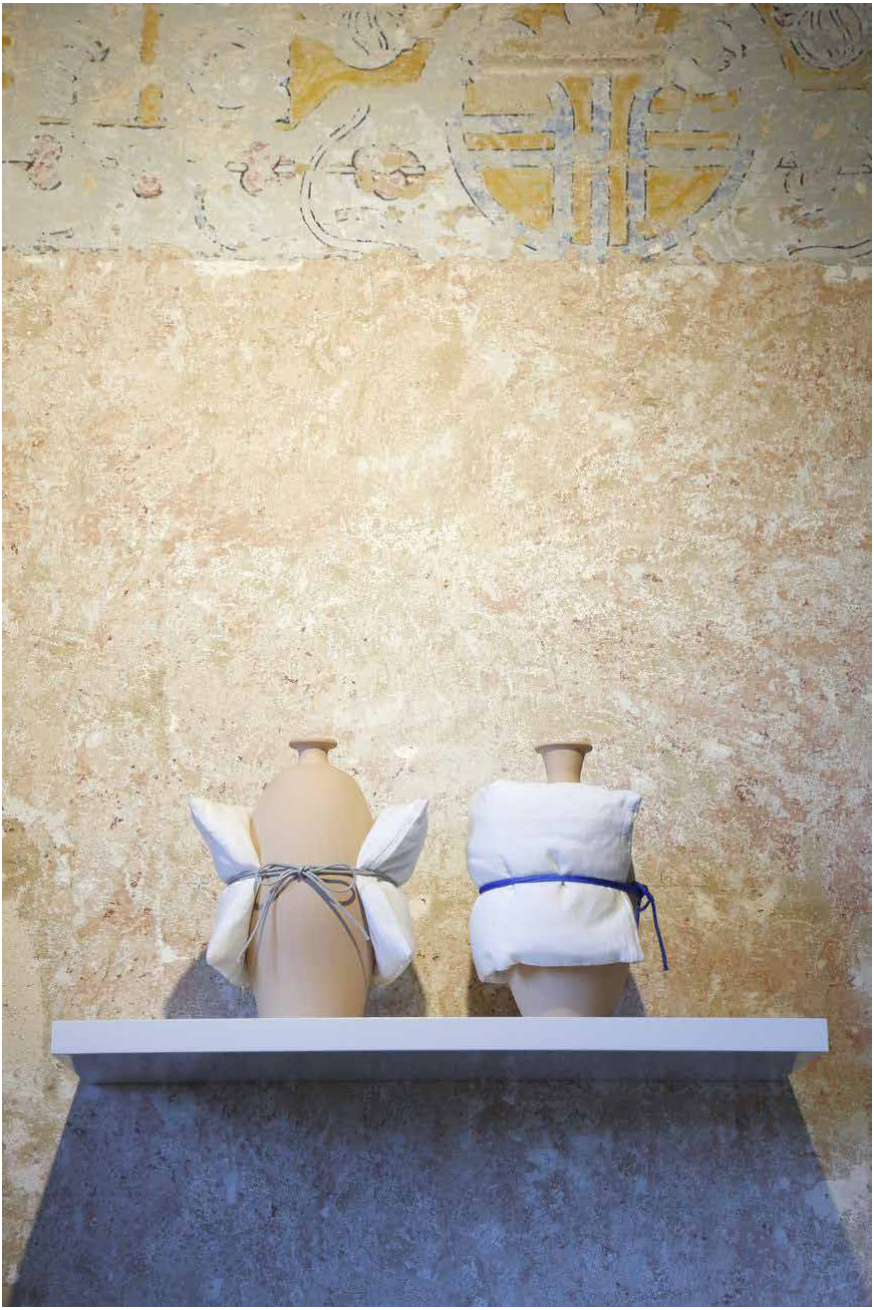

Fig. 1
Ornaghi & Prestinari, *Prove di volo*, 2018, ceramic, fabric, lacquered wood, 35x70x30 cm.

Any moment the earth can shake, but we do not know when or where.

As beautiful as fragile, Italy is continuously chasing urgent situations and fixing damages provoked by earthquakes and other natural and human disasters. As the news cyclically reports, the tremors compromise the integrity of artworks and museum objects, emphasizing the vulnerability of both movable and immovable heritage. Even medium-low intensity tremors might represent a colossal risk, and, given the higher frequency of minor earthquakes in specific geographical locations, all institutions should be committed to heritage seismic protection. Fortunately, the general awareness on preventing and protecting the built heritage against the seismic hazard is slowly increasing, and there are significant advancements in theoretical and applied research on earthquakes and their effect on the built heritage.[1] However, that pertains almost exclusively to the container, not the content (UN 2015). In fact, there are no shared methodologies or standards for museum settings comparable to the anti-seismic norms for buildings.[2]

As a result, the seismic safety of collections is a duty transferred directly to single museums, charging the staff of huge responsibilities. Running a museum is a complex and multidisciplinary task. Museum buildings shield treasures and wonders. Here, the collections are stored, preserved, and coherently exhibited. It means managing goods and people, unraveling between laws and prescriptions, scheduling scientific programs and activities, and caring

[1] In Italy, there is a debate about the limited acknowledgment of the topic, considered only for experts (Fiore and Ottaviani 2018). A pervasive and diffuse action to protect the built heritage is possible by informing and sharing suitable instruments among the public opinion. Historical public architectures are often monitored. The collaborations among countries, universities, and private donors are fundamental. The application of anti-seismic solutions links to financial availability. Although not pervasive enough, some initiatives increased awareness among the Italian population, for example, the so-called *Sisma Bonus* promoted by the Italian Revenue Agency (*Agenzia delle Entrate*). It dedicates to taxpayers who carry out interventions to adopt anti-seismic measures on buildings and deducts part of the expenses incurred from income taxes <https://www.agenziaentrate.gov.it/portale/web/guest/aree-tematiche/casa/agevolazioni/sisma-bonus> (11/2021). Private and public bodies sponsor other initiatives, like the *Seismic Prevention Days* promoted jointly by professional associations <https://www.giornataprevenzionesismica.it/> (11/2021).

[2] Italian Technical Construction Regulation – NTC *Norme Tecniche per le Costruzioni* prescribes a set of mandatory norms to public buildings (NTC 2008).

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about the public (Bollo 2008, Watson 2007, Macdonald 2006, MacLeod 2005, Ambrose and Paine 1993, Hooper GreenHill 1992). Rarely, the staff includes personnel with specific knowledge about seismic vulnerability, or with cognizance of available quantitative and qualitative instruments for the seismic assessment of collections.

That said, if a museum located in a seismic area wanted to do something against earthquake risk and if it wanted to know the seismic vulnerability of its collections, from where would it start? Whom could it turn to for a consult? Among thousands of pieces, how does it understand the most vulnerable ones? Moreover, among limitless setting configurations, which are the safest from the seismic perspective? Once evaluated the vulnerability of objects and settings, what are the preventive measures against damages? These preliminary questions lead to aspects relating to the exhibit design: can a museum display be both safe and coherent according to updated exhibiting criteria? Can museography integrate with seismic preventions and museum policies? How can safety solutions and exhibit design be combined into existing setups (historical museum rooms, musealized setups) or temporary exhibitions? Considering the ever-changing museum trends, the publics' multiple necessities, and the museum institutions' internal dynamics, how do exhibit design, safety, and economic sustainability combine?

The book Shaking Heritage attempts to answer these questions. As part of the general research RESIMUS, RESILience MUSeums, developed with some colleagues at the Department of Architecture, University of Florence, this study proposes a novel approach to rank the vulnerability grade of museum collections and setups. It investigates the application of anti-seismic and coherent museographic proposals. The goals are to determine the seismic risk assessment of museum setups and collections and encourage anti-seismic display solutions.

The book is organized in four parts. The first introduces the general setting and the RESIMUS research. In particular, it presents the novel approach named RESIMUS Approach. It aims to rank the vulnerability of existing museum setups and foster anti-seismic solutions. The proposed methodology composes of three phases: Analysis, Design, and Installation. The Analysis Phase includes the development of survey models, the RESIMUS Forms (RF), used to rank the vulnerability of the museum setups. The Design Phase focuses on developing design proposals to combine anti-seismic devices and coherent museographic solutions. The Installation Phase is the realization or the prototyping of design speculations. The second part of the book introduces the application of the RESIMUS Approach to two cases: a permanent museum setting, into detail, the redesign of the Majolica and the Trecento Rooms of the National Museum of Bargello in

Florence, Italy, and a temporary exhibition, *di Tutti i Colori. Racconti di ceramica a Montelupo dalla «fabbrica di Firenze» all'industria e al design*, held in Montelupo Fiorentino, near Florence, in 2019. The cases illustrate the limits and the potentialities of the Approach. The third part sums up findings and comments, and discusses the next steps of the research. The last part of the book, the Appendix, contains supplementary materials, as the RESIMUS Forms and a sample list of exhibit mounts. In addition, five short thematic contributions written by five RESIMUS group members enrich the volume. Each of them focuses on specific aspects of the research, stressing the matter of the multidisciplinary study. Stefania Viti's contribution introduces the research RESIMUS and its implication in the seismic assessment of art collections. Marco Tanganelli presents the applied analytical studies on museum objects. Alessandro Brodini explores the museographical dynamics and the cultural scene in the aftermath of the Second World World in Italy that qualified the Italian exponents internationally as masters of museum design. Giorgio Verdiani's essay sums up the digital tools for the survey and documentation. Marino Marini resumes the main steps leading to the formation of the Majolica collection at the National Museum of Bargello. With Francesco Collotti, preface's author, all of them are part of the RESIMUS research project.

Methodological Framework

Movable Heritage at Risk: an Overview

The protection and preservation of cultural heritage are primarily acknowledged as a civic duty. The heritage represents or embodies the memory and the traditions of communities, groups of people, or individuals. It is a substantial element of life. Cultural heritage is a broad definition and includes several elements. A rough identification can be made between tangible and intangible heritage. Tangible heritage comprehends objects, sites, and monuments, therefore movable and immovable assets. As the word suggests, the movable set includes a wide variety of goods.[1] They can be private and public, conserved in their original environment or displaced somewhere else, exhibited to a public or kept in storage. The care of movable cultural items, which implies their conservation and enhancement, involves various actors. Among these, by statute, museums are in charge of protecting their collections from natural and human-made disasters (ICOM 2013 art. 1.6 and 2.21). The patrimony needs to be preserved and transmitted to future generations. Its wounds and injuries might determine instability and disorientation among the people (ICCROM 2016).

Obviously, all tangible goods are exposed to risks. Some threats are intrinsic, depending on materials (for example, paper, wax, wood) and physical configurations (balance of volumes, mixed elements). It is well known that time and climatic conditions affect all objects. Among these, some are more fragile than others. Consequently, to preserve essential specimens, established procedures and measures are established to avoid or limit damaging risks. The conservation field works to avoid any damages to the cultural assets. Preventive actions pertain to the ordinary duties of museums and cultural institutions. Like people and buildings, movable cultural heritage is also exposed to extreme events, as natural disasters or wars. Worldwide, the occurrence and recurrence of disastrous events fostered the constitution of international networks and offices dedicated to the care of cultural goods. They helped in providing adequate rescue solutions and responses. Such emergency experiences built up

[1] <http://www.unesco.org/culture/en/natlaws/db/database_glossary_e_2009.pdf> (11/21).

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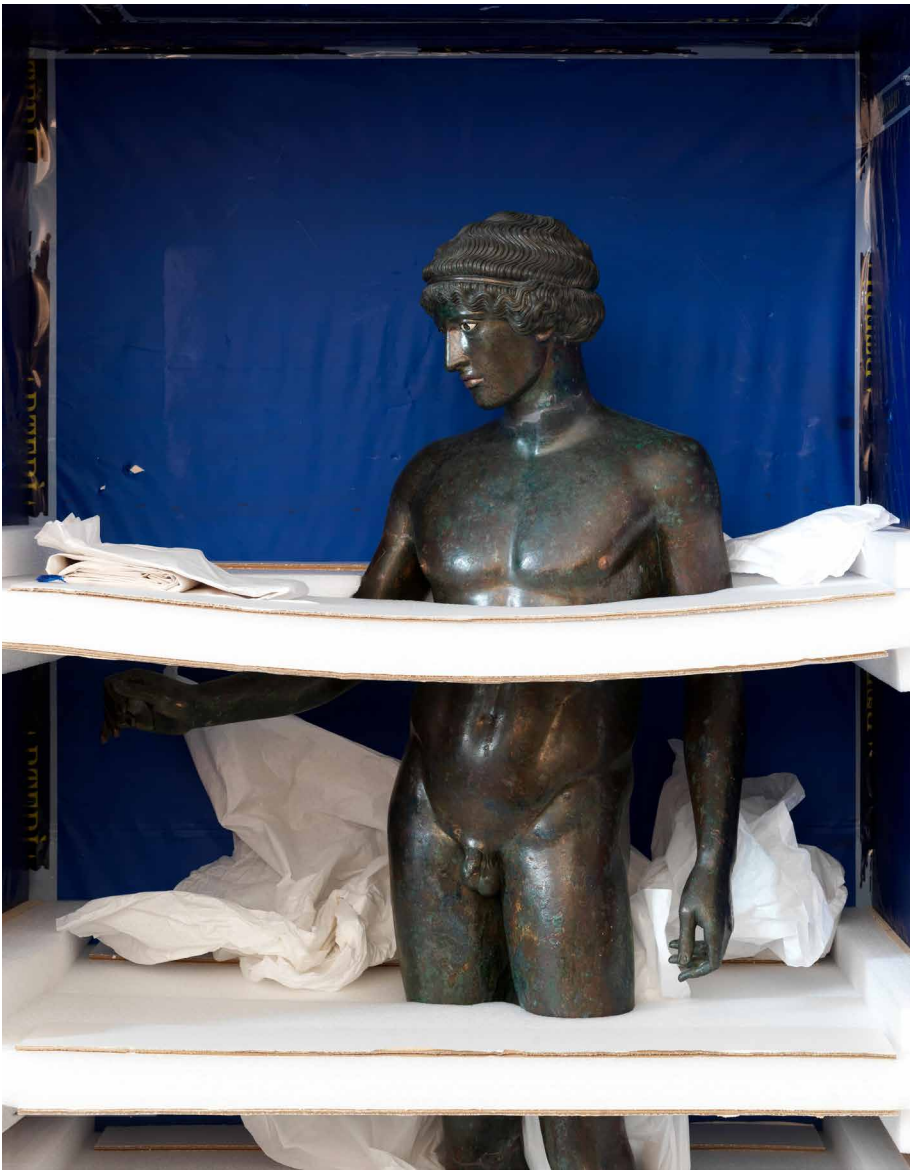
skills in the management of crises. They also taught that prevention is the only practical tool that can lower losses and damages of patrimony. The core of a preventive culture is the application of disaster risk reduction policies. Unfortunately, these are too often only on paper. According to the UNDRR-United Nation Office for Disaster Risk Reduction, the disaster risk is defined as "the potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific time, determined probabilistically as a function of hazard, exposure, vulnerability, and capacity."[2] Dedicated international organizations, experts, and researchers work to sustain and cooperate with local bodies in disaster risk management. They work to prevent the risks and assist the hit communities during emergency crises. UN-United Nation, with UNESCO–Educational, Scientific and Cultural Organization, is on the front line to protect cultural heritage. Its relevance is stated in the statute of the organization and marked by its daily activity. The Sendai Framework for Disaster Risk Reduction 2015-2030 (UNISDR 2015) "outlines targets and priorities for action to prevent new and reduce existing disaster risks."[3] The protection of cultural heritage is part of the document (roadmap). As also stated in earlier conference documents (IDNDR 1999, HFA 2005), the UN encourages local initiatives among the signatory nations and supports those committed to disaster risk reduction, such as cultural heritage institutions, NGOs, non-profit associations, disaster risk management-dedicated institutions, and also organizations or group of citizens (Clarke et al. 2018). Besides the UN, other international actors have divisions committed to the protection and conservation of cultural goods, as in the case of ICOM–International Council of Museums, ICOMOS–International Council on Monuments and Sites, and ICCROM–International Centre for the Study of the Preservation and Restoration of Cultural Property. These bodies, including some museums and cultural institutions with internal research departments, as the Smithsonian Institution and the Getty Research Institute, are devoted to protecting the cultural patrimony. They work both alone and as part of international networks.

Despite all the efforts to spread the prevention culture and the involvement of renowned and relevant international bodies, practical applications limit to few examples. The outcomes of the international commitment are mostly documents: suggesting planned actions for prevention and recovery, codifications of best practices originating from on-field experiences, guidelines, conferences, workshops, and exchange programs. For example,

Fig. 1
Marco Lanza, *Serie Depositi*, 2016.

[2] About the terminology, see UNDRR web portal Prevention Web <https://www.preventionweb.net/terminology/view/51753> (11/21).
[3] <https://www.undrr.org/implementing-sendai-framework/what-sendai-framework> (11/21).



the ICOM Code of Ethics for Museum (2013) focuses on protecting the collection of objects. They are general and dedicated to every museum. It derives from the Iraqi field experience. Previous editions of ICOM handbooks focusing on museums and collections were

already issued in 1981 (ICOM 1981) and others in 1993 (Liston 1993). Part of the ICOM guidelines also benefit from others' experiences, for example, the *Smithsonian Guidelines for Cultural Protection Resources* (1983) and the *Emergency Disaster Plan* by US National Park Service. In 1999, ICOMOS activated the Heritag@Risk program, publishing reports concerning both the recovery and the prevention of crisis scenarios.[4] It also released the *First Aid to Cultural Heritage in Times of Crisis Toolkit* (Tandon 2018), an instrument to lead the museum staff before, during, and after catastrophic natural events. Endangered Heritage Emergency Evacuation of Heritage Collections (Tandon 2016), published by ICCROM and UNESCO, suggests preventive measures against human acts in war or critical zone, foreseeing the guidelines for evacuation and temporary storage of collections. Again dedicated to war zones, a broad collaboration network example is the Blue Shield International, conceived initially as a Red Cross of heritage. The international network is "committed to the protection of the world's cultural property, and is concerned with the protection of cultural and natural heritage, tangible and intangible, in the event of armed conflict, natural- or human-made disaster." (Article 2.1, Blu Shield Statute).[5] Disaster risk reduction also comprehends biological hazards. The Covid-19 pandemic devastated the health and wealth of individuals and communities. The effects also impact cultural heritage and worsen their level of fragility (UN 2020, UNESCO 2020).

Fig. 2
Marco Zeppetella, *The depot of Santo Chiodo*, Spoleto, Italy. The depot hosts 4500 cultural, librarian and historical assets from 82 different sites and buildings hit by the 2016 earthquake in Central Italy.

Seismic Risk Mitigation of Museum Collections

Interpreting the ICOM's Museum Definition[6] (2017), museums are the keepers of our memory, often identified in various object collections. These have to be carefully

[4] About the reports see <https://www.icomos.org/en/what-we-do/risk-preparedness/heritage-at-risk-reports> (11/21) and Pica 2018.

[5] "The work of the Blue Shield is underpinned by international law – in particular, the 1954 Hague Convention on the Protection of Cultural Property in the Event of Armed Conflict and its two Protocols of 1954 and 1999, which are considered to be part of international humanitarian law (IHL). IHL, also known as the Law of War or Law of Armed Conflict, is a set of rules which seek, for humanitarian reasons, to limit the effects of armed conflict on people and property. This primary context is also set by several international legal instruments, international cultural protection agenda introduced by the UN and UNESCO, and international initiatives regarding environmental disasters, such as the Sendai Framework for Disaster Risk Reduction. Although the 1954 Hague Convention and its two Protocols refer to cultural property cultural property, recognizing the developments in our understanding of culture across the world and the different ways it manifests, the Blue Shield deals with the broader concept of cultural heritage. The 1954 Hague Convention designates an emblem for the cultural property that should be protected, and for identification of those working to protect it – the blue shield." <https://theblueshield.org/about-us/what-is-blue-shield/> (11/21).

[6] "A museum is a non-profit, permanent institution in the service of society and its development, open to the public, which acquires, conserves, researches, communicates, and exhibits the tangible and intangible heritage of humanity and its environment for the purposes of education, study and enjoyment." Current definition of Museum according to the ICOM Statutes, adopted by the 22nd General Assembly in Vienna, Austria, on August 24, 2007 (ICOM Statutes 2007) <https://icom.museum/en/resources/standards-guidelines/museum-definition> (11/21).

protected, stored, and exhibited. There is a vast literature about preserving the museum's movable heritage (Mairesse and Desvalées 2011), comprehending guidelines issued by both National and International organizations.[7] Such documents derive from expertise and fieldwork related to the different typologies of the assets. The conservative actions vary according to the object's characteristics and the related context. For example, a Renaissance painting has to be monitored and kept in a controlled space, where temperature, humidity, and light respect defined parameters. Besides, the collections are exposed to human threats, such as vandalism, accidental damages, and theft. According to the object typology, dedicated solutions might change if they are on show, kept in the museum warehouse, or traveling, depending on the site location and conservation condition. Natural disasters represent other rare but possible menaces.

Like other natural disasters, the seismic risk is rated as unavoidable. Again, preventive actions are the only measures limiting damages and losses. Despite the efforts in protecting the cultural heritage (GAR 2015; ICOM 1993), the recurrence of the seismic events (Valensise

[7] For example, ICOM-Committee for Conservation is the largest internal ICOM's committee, "including member form worldwide from every branch of the museum and conservation profession. ICOM-CC aims to promote the conservation of culturally and historically significant works and to further the goals of the conservation profession." <http://www.icom-cc.org/15/about/#.X_Q1pOlKjOQ> (11/21).

2018), and the dissemination of Disaster Preparedness and Response topic (Waller 2003, 1995), a lack in preventive culture persists. The urgency of safeguarding measures arises only when at least a medium shake affects an area. Most of the actions still concentrate on the aftermath of an earthquake instead of focusing on prevention. Besides, there is often a missing transition from intention to practice, emphasizing the argument's complexity, and sharing and disseminating past experiences is a lacking habit.[8]

The inauguration of the research on seismic risk assessment of museum collections started in the early '90s. Its advancement has been possible thanks to the efforts of virtuous institutions and researchers. In 1983, the J. Paul Getty Museum in Los Angeles, California, notoriously a high seismic risk area, started investing in the seismic mitigation of its collections. First, in 1984, they examined the building, commissioning the analysis to Lindvall, Richter, and Associates. Then, Agbabian, Masri, and Nigbor (1991, 1988) began testing art objects' behavior in case of seismic events. The Getty staff immediately understood the complexity of such analysis and the need for consequent practical acts. An important step was the publication of the book *Emergency Planning Handbook* (Podany 1988), initiating a specific field of research (Podany 2017; 2015; 2009; 2008; 1996, 1991). The study spread globally, fostered by collaborations and applications (Baggio et al. 2018, Parisi e Augenti 2013, Erdik et al. 2008, Spyrakos and Nikolettos 2005, Augusti and Ciampoli 1992). In these years of testing, the dialogue between academic research and museum practice produced exciting results. Since the Getty Museum began installing anti-seismic devices in 1987 (Schoettler and Stavridis 2008, Stavridis et al. 2006, Podany 1987), other museums followed its example. For instance, the Tokyo National Museum, Japan, has displayed ancient potteries on a large isolator base, and the Archaeological Museum of Olympia, Greece, has installed a four friction pendulum system for Praxiteles' Hermes statues. In New Zealand, the Christchurch Art Gallery Te Pan o Waiwhetu has isolated the entire museum, as in Los Angeles with the Getty Villa. In Italy, the new MUNDA-Museo Nazionale d'Abruzzo (National Museum of Abruzzo) in L'Aquila embeds the most recent and sophisticated anti-seismic solutions, and the permanent setup uses anti-seismic devices. The Quanzhou Museum, China, rebuilt part of its setup after the 2019 earthquake. The new setting embeds anti-seismic devices (isolated showcases) and installs seismic monitoring terminals (Jie Qin et al 2020). Most of the theoretical studies investigate the behavior and the hazard of single objects in case of a seismic

[8] There are example of guidelines and initiatives towards the safety of museum collections, like those edited by the Greek Ministry of Culture after Athens earthquake of 1999 (Ghiossi et. al. 2002, OASP 2000) or the study issued by the State administration of Cultural Heritage in China (WU Laiming et al. 2015). Unfortunately, they are in the original language only, limiting their actual dissemination.

event (Wittich 2016), like those on the David (Borri 2006) and the Prigioni by Michelangelo (Berto et al. 2012, De Canio 2012), similarly, most of anti-seismic devices are applied on outstanding examples, as on the Riace Bronzes (Caliò and Marletta 2003) and the Fountain of Neptune in Messina (Koumosis 2017). With some exceptions (Jie Qin et al 2020, Spyrakos 2006), expensive engineering systems are installed on singular objects or entire buildings. Such technological anti-seismic solutions integrate with numerical analysis and digital models to determine the object condition (Pascale and Lolli 2015) and test anti-seismic advanced technological devices or materials. The outcomes are often pendulums and anti-seismic bases (Wittich 2015, Baggio 2015, Koumosis 2012). Although essential, these bound to single isolated objects (freestanding statues) without considering neither the possible presence of close elements (works of art, objects, lighting) nor the whole setting. As a matter of fact, only a few museums can afford such solutions.

Such limits have been understood first by the Getty team. They were aware that most museums and cultural institutions have a limited budget. Forced in prioritizing the spendings, they can rarely afford sophisticated anti-seismic solutions. The Getty started testing alternative anti-seismic solutions without limiting to isolator units for giant statues. They tested, for example, clips or stops anchoring medium vases to the bases, custom interfaces for objects with an uneven base or with a few points of contact, and contour mounts to sustain objects with particular shapes (Podany 2008). Such trials demonstrated that also low-cost solutions can potentially lower the vulnerability of museum settings. Unfortunately, similar approaches have not been applied by many other museums. Podany (2017) denounced the lack of collaboration among institutions and invites researchers and museum professionals to raise awareness on seismic risk and to the dissemination of best practices. Podany's complaint is confirmed by facts. Currently, there are no shared standard solutions to mitigate the museum collections seismic hazard. As Podany suggests, even simple actions may be sufficient to prevent uncountable losses. A shared anti-seismic culture needs to be spread and applied.

The RESIMUS Project

The issues about prevention, first aid, and management of the seismic emergency connect to the resilience of urban centers. The Oxford Dictionary[9]defines the current use of the word 'Resilience' as "the ability of people or things to feel better quickly after something unpleasant, such as shock, injury, etc.," and as "the ability of a substance to return to its original shape after it has been bent, stretched, or pressed." The term appeared first in the paper 'Resilience

[9] See <https://www.oxfordlearnersdictionaries.com/definition/american_english/resilience> (11/21).

and stability of ecological systems' by Holling in 1973, with an ecology study concerning the adaptive cycle of systems. In parallel, the psychology literature started making extensive use of the term (Woodley et al. 2018). Then, it appeared in several subjects and disciplines, like psychology, urban studies, risk management, internal development, business, and organizational health. The UN defines resilience as

> the ability of individuals, households, communities, cities, institutions, systems, and societies to prevent, resist, absorb, adapt, respond, and recover positively, efficiently, and effectively when faced with a wide range of risks while maintaining an acceptable level of functioning and without compromising long-term prospects for sustainable development, peace and security, human rights and well-being for all[10] (FAO 2018).

Regarding resilience and risk management, OECD – Organization for Economic Co-operation and Development proposes a road map to accomplish a resilient system analysis. It articulates in three steps: analysis of the context, exploring assumptions and hypotheses for changes in the future, assessing evidence for future change. The limit of this approach is its complexity, link to the diversity and expertise of the operators, teams, and participants, the trustfulness of the data collected, the quality of the risk analysis.[11] It is not a surprise that, despite the term's popularity, the concrete applications in seismic risk management are few (Vona 2012). Still, the purpose of such an approach might provide valuable inputs into museum policies, strategies, and programs, emphasizing strengthens and weaknesses of a system (OECD 2014). The *Charter of Rome on Resilience of Art Cities to Natural Disaster* (2016) moves in this direction, highlighting the necessity of including heritage in the resilience discussion and of the active involvement of the global network of academies.

The international attention and support to resilient systems and the necessity of fostering the enhancement and the seismic safety of museum collections lead to the inauguration of the line of research on seismic risks, museum collections, and resilience. RESIMUS – RESIlience MUSeums is the research developed by the DIDA, Department of Architecture, University of Florence, and involves a group of scholars and professionals coming from different fields, such as museography, engineering, seismic studies, geology, survey and 3D representation, history of architecture, museology, and management.[12] The

[10] Other definition by UNISDR (2017) on the web site page *Terminology*, <https://www.unisdr.org/we/inform/treminology#letter-r> (11/21). A general framework is developed by UN in a document of 2020 (working document), while about the resilience of building see: UNDRR 2020 and previous publications (inserting into the Sendai Framework Program).

[11] About the articulation of the systems, the definition of cities, and the community related to resilience, see: Glaeser 2011, Murgante et al. 2012; Alberti et al. 1994.

[12] The DIDA RESIMUS research group, leaded by Viti, includes Tanganelli, Collotti, Verdiani and others. The

study of resilient museums is the long-run objective of the research, whose expected outcomes are to preserve the movable cultural heritage and raise awareness about seismic hazards in museum collections and museums.

The line of research presented in this book tries to answer Podany (2017) call for an easy and standardized tool for the seismic risk assessment of museum collections. However, this must not disregard museographical aspects: they are an integrative part of any museum. Reviewing the international literature, we could not find a suitable framework integrating seismic and museographical aspects into museum collections.[13] We thus felt necessary to build a novel methodological approach. We called it the RESIMUS Approach. This includes a set of instruments to analyze the seismic vulnerability of collections and setups to be integrated with a coherent museum design.

The RESIMUS Approach

The construction of the RESIMUS Approach benefitted from the contributions of several actors with specific knowledge. Curators, museographers, restorers, engineers was equally involved and worked as a team. The mix of competencies allowed a global vision of the problem and the circulation of different procedures.[14]

The RESIMUS Approach articulates into three operative goals:

- GOAL 1: understanding the fragilities and rating vulnerability of museum collections and exhibitions
- GOAL 2: proposing solutions that integrate both coherent museographical design and anti-seismic devices
- GOAL 3: progressive improvement of the museum display settings (as preventive measures, updating the existing setups, or replacing them).

RESIMUS research has been possible thanks to a grant issued by the Florentine bank foundation *Fondazione Cassa di Risparmio di Firenze*.

[13] Operating in Italy, we started examining Italian experiences. The latter mainly concentrates on the cultural built heritage. The Italian Technical Construction Regulation (NTC 2008) prescribes a set of mandatory norms to public buildings, clearly focusing on the buildings only. The AeDES Form records on-site assessment, damages of injured constructions (AA.VV. 2014), as the so-called CLE Analysis, *Condizione limite per l'emergenza* – Limit condition during the emergency times (Bramerini and Castenetto 2014). The Vademecum STOP (C.N.VV.F. 2008) recommends provisional works for the safety of built structures. To our knowledge, comparable prescriptions for the movable Italian Heritage do not exist, despite the earthquakes of L'Aquila, 2009, Emilia, 2011, and Center Italy, 2016-2017 caused severe damages to the movable heritage. Available documents discussing seismic threats to movable heritage limits to general suggestions (Jalla 2015, MIBAC 2001). For example, the set of guidelines for the vulnerability reduction of non-structural elements issued by the Civic Protection Department (Dipartimento della Protezione Civile) after the L'Aquila earthquake (AA.VV. 2009) is not specific for movable heritage. We considered also previous international experiences. The Getty Museum and the Getty Institute, Malibu, USA, are considered the pioneer in the field (Podany 2017; 2015; 2009; 2008; 1996, 1991, 1988).

[14] However, a richness of know-hows, matching the complexity of the museum environment, has to operate on common ground. Even when academics and professionals speak the same idiom, they could not "understand" each other because they use their specific vocabulary. Therefore, it was necessary to build up a shared basic knowledge and establish a common lexicon.

To fulfill each goal, we divided the investigation into three consecutive phases:

A) Analysis Phase (to fulfill goal 1)

This phase combines two aspects: the use of the so-called 'RESIMUS Forms' (RF) to rate the seismic vulnerability of the collections and the development of supplementary in-depth analysis. The RF is the original survey tool providing a preliminary seismic risk assessment of the collection. Its development benefits from reference studies and field experiences. The forms are surveying sheets to be used by non-experts. Their outcomes are helpful to rank the vulnerability of the museum setups and objects. They can help to prioritize additional investigations accomplished by experts (e.g. seismic behavior models of big objects or buildings, 3D survey, geological scan, etc.) and concerns specific aspects of the museum settings.

B) Design Phase (to fulfill goal 2)

It consists of proposing exhibit solution designs. It benefits from the analysis results, integrates with the institution's requests and plans, and refers to the study of the museographic references. This step bases on a "research by the design" methodology. The outcomes are exhibit proposals.

C) Installation Phase (to fulfill goal 3)

It is the actual realization of a design. It can be the realization of a brand new proposed design or the improvement of an existing setup. The project implies temporary and permanent exhibitions.

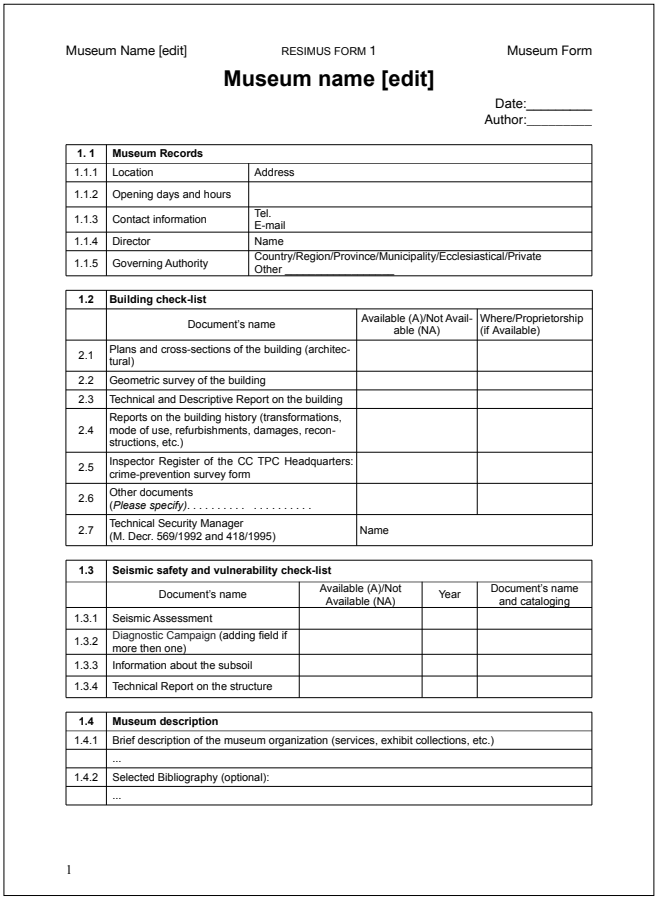
Fig. 3
The RESIMUS Forms, extract.

A) The Analysis Phase

The RESIMUS Forms

Observing the variety, specificity, and quantity of museums, internal dynamics, and contingency factors, we thought an easy-to-use instrument would have been a winning solution to accomplish Goal 1 (understanding the fragilities and rating vulnerability of museum collections and exhibitions). Such an instrument should have allowed a preliminary seismic risk assessment of the collections. It should also have answered the research questions on how to identify and rank vulnerable museum settings. Its outputs should have been relevant to understanding the general safety level of movable objects and planning and organizing in-depth analyses.

The results should have been a guide in the development of possible anti-seismic interventions, as the exhibit design of a museum room. For example, if a museum plans a wing refurbishment, it might start from the most vulnerable room. Finally, assuming the correct use of the forms by a consistent group of museums of a geographic area, we could



Museum Name [edit] RESIMUS FORM 1 Museum Form

Museum name [edit]

Date:_____
Author:_____

1. 1	**Museum Records**	
1.1.1	Location	Address
1.1.2	Opening days and hours	
1.1.3	Contact information	Tel. E-mail
1.1.4	Director	Name
1.1.5	Governing Authority	Country/Region/Province/Municipality/Ecclesiastical/Private Other _____

1.2	**Building check-list**		
	Document's name	Available (A)/Not Available (NA)	Where/Proprietorship (if Available)
2.1	Plans and cross-sections of the building (architectural)		
2.2	Geometric survey of the building		
2.3	Technical and Descriptive Report on the building		
2.4	Reports on the building history (transformations, mode of use, refurbishments, damages, reconstructions, etc.)		
2.5	Inspector Register of the CC TPC Headquarters: crime-prevention survey form		
2.6	Other documents *(Please specify)*.		
2.7	Technical Security Manager (M. Decr. 569/1992 and 418/1995)	Name	

1.3	**Seismic safety and vulnerability check-list**			
	Document's name	Available (A)/Not Available (NA)	Year	Document's name and cataloging
1.3.1	Seismic Assessment			
1.3.2	Diagnostic Campaign (adding field if more then one)			
1.3.3	Information about the subsoil			
1.3.4	Technical Report on the structure			

1.4	**Museum description**
1.4.1	Brief description of the museum organization (services, exhibit collections, etc.)
	...
1.4.2	Selected Bibliography (optional):
	...

1

have traced and ranked the global museums' vulnerability of that area thanks to the combination of these results.

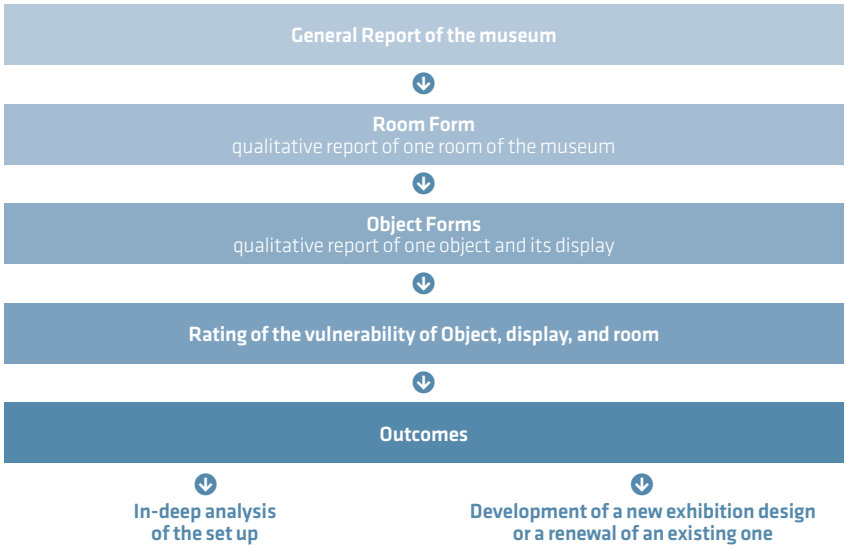
To design the RF, we started looking for existing forms with some definite features: i) being potentially comprehensive and applicable everywhere, ii) simple to use by museums and similar actors, iii) helpful to analyze the museum settings and rank the seismic vulnerability of exhibition. We first analyzed comparable existing forms related to the seismic assessment of the objects. Agbabian and colleagues (1990) proposed a synthetic classification model based on the exhibition design's possible configurations and the objects' position. The classification structure has been later resumed and boosted by Podany (2017) in its field tests.

Liberatore (2000), Ciampoli and Augusti (1992), Ertürk and Sungay (2004) worked on Agbabian's classification to find a method to easily classify the level of fragility of the museum objects and settings. None of these proposals fully satisfied our necessity, being too simplistic, limited to a single object or addressed to experts only. Nevertheless, we profited from these valuable previous experiences. Second, we considered examples of expeditious analysis.[15] Although devoted to built heritage, we studied the NTC, the forms released by the Italian Fire Service after L'Aquila and Center Italy seisms. Third, we included assessment forms elaborated by international committees and organizations, like UNESCO, ICOM, ICCROM, and ICOMOS, directly or indirectly linked to seismic risks. We observed their structure and usability. In the end, since the aim was to build up a form dedicated to non-experts in earthquake engineering, we studied other typologies of forms, like those dedicated to museums but not related to the effects of earthquakes or other natural catastrophes. For example, the Italian regions Tuscany and Marche have forms dedicated to the analysis of museum institutions. Yearly, Tuscany asks museums and eco-museums sited in the Region to fulfill a questionnaire (l.r. 21/2010). The annual report summarizes all information, such as visitor numbers, available facilities, offered services, and monitors and checks on museums. Those museums fulfilling defined parameters are awarded the title *Musei di qualità* (Quality Museums).[16] In 2011, Marche launched a monitoring campaign. It asked its museums to complete a self-assessment questionnaire. Detailed and specific, the form contains several descriptive fills, helping describe the museum in a synthetic way and emphasizing strengths and weaknesses.[17]Of a different sort, the form released by the Nucleo Tutela Carabinieri (a Carabinieri military corp specialized in heritage protection) was also helpful to our goal. The effects of human threats (theft, robbery, vandalism, explosions, attacks) on collections shared some similarities with those caused by the earthquakes. Thus, the form customized on such risks can easily be converted for the anti-seismic ones. The forms articulate in four levels of analysis:[18]

- RF1 – Museum Form: general report of the building and the museum context. It collects the general descriptions of one museum in a precise moment.

Fig. 4
Flowchart of the Analysis Phase.

[15] In the engineering field, expeditious analysis is an on-field survey. It is characterized by the quick answer and easy-to-use modality of application. It can include assessment forms: a type of sheet guiding the compiler through the survey.
[16] The awarded museums can access to dedicated calls for funding. The title has to be renewed each year. The competition's goal is to raise the average level of museums.
[17] <http://wsausei.cultura.marche.it/Informazioni/LinkClick.aspx?fileticket=v0sMVOycKb8%3D&tabid=38> (11/21).
[18] See Appendix I. RESIMUS Forms.



- RF2 – Room Form: a qualitative report for each room of the museum.
- RF3 – Object-Setting Form: a qualitative report for one selected object and its display, kept in the previous analyzed room (RF2). It describes the intrinsic qualities of the object-setting couple. In the case of one big display furniture containing several items, we consider it as one object describing the general typology of the content and the most used mounts (if any).
- RF4 – Object-Setting Identification Risks Form: the vulnerability assessment of the current arrangement, focusing on the settings' possible behavior. It guides the compiler in the determination of the weaknesses of one object and its setting. The results are summed up in the final grid, determining the level of vulnerability of that room.[19]

The analysis proceeds progressively, from general (the museum) to particular (the object). The RF1 is a global description of the museum. It needs to be completed at the beginning of the process and one time only. The RF2 relates to each exhibition room. The RF3 and RF4 include descriptive and qualitative charts assessing the vulnerability and referring to the configurations of the single objects. Some parts require handmade sketches or diagrams of the settings. Given the possibility that one might not be able or confident in drawing, it is possible to utilize pre-printed schemes of the museum plan to facilitate the compiler. The forms

[19] According to the room's number of objects and settings, RF3 and RF4 can be applied multiple times.

are ready-to-use instruments that every museum staff member can use. By extension, even privates inside their houses might use some parts to assess the vulnerability of movable items. The results might be used then to schedule in-depth analyses or to plan anti-seismic interventions (see figure 5).

Fig. 5
Moment of a photogrammetry survey. This survey campaign was needed to create the 3D model of Giambologna's Oceano kept in the Bargello courtyard.

The current interface is an adjustable chart. Future developments include the conversion of the forms into a software application. The objective is to build a free app available on app distribution platforms. This solution would ease the data collection by the RESIMUS group and facilitate the use of the form, thanks to an interactive interface. With the future digital support (app), the user will have the possibility to upload the sketches or draw them directly. This technology would potentially allow the RESIMUS group to store and process the results coming from various museums. This solution would facilitate the control of the data acquisition process, help in considering possible supplementary analysis, and create a sort of map of museum collection vulnerability.

In-depth Analysis

The forms help understanding the most likely vulnerable objects or setups but do not lead to certainty. If, on the one hand, these on-site quick analyses have the benefit of being fast, easy-to-use, cheap, and non-invasive, from the other, the gathered information is not exhaustive. They give an overall framework but are forcefully incomplete. Further in-depth studies are needed to get definitive answers on seismic vulnerability. For example, one might investigate the container, gather information about its static and dynamic behavior, the conservatory state, and the soil response spectra. The studies imply teams of experts, specific equipment for survey and analysis, appropriate software, and possible invasive testings. Some campaigns, for example, had to be accomplished on-site during the closing hours. The acquired data need to be elaborated, analyzed, presented and discussed. Overall, these time-consuming operations can last several months, and the coordination and agreement between the operational teams and the institutions are mandatory. Structural engineering calculation software, 3D modeling software, and specific technological instruments can be used to test, simulate, monitor, and survey objects and setups. For example, one might simulate the seismic behavior of an object, reconstruct its geometric configuration, or record the conservatory condition. Within the RESIMUS studies, some in-depth analysis has been pursued on significant isolated sculptures (Viti et al. 2020, Pintucchi et a. 2019, Mattoni and Tanganelli 2018, Cerri et al. 2018) using 3D geometrical models acquired during laser scanner campaigns (Tanganelli et al. 2019, Verdiani et al. 2019, Verdiani and Fantini 2012). The seismic responses

of the subjects derive from analyses pursued on Finite Element Model (FEM), by computing different dynamic analyses, using a spectrum-compatible ground motion, implying specific computer codes and assumptions, and considering both material behavior (linear and non-linear) and arrangement among the elements (e.g., base and object).[20]

A further reflection has to be made on the container, i.e. the building, even if is a well studied topic. In particular, we must consider typology of construction and its vulnerability. In Italy, museums are often hosted in historical buildings (Gregotti 1990). Reinhorn and Viti (2019) consider the built Italian panorama and question the hazards linked to monumental buildings. They identify in these sites, which should preserve the collections, the primary source of hazard. Historic masonry constructions with wooden slabs are sensible to vibrations and are usually located in the historical city center. This status classifies this architecture as fragile. As for collections and settings, the old constructions present unique singularities. To investigate the building's seismic behavior, we need a specific and specialistic analysis. Besides, one has to consider the boundary conditions, soil analysis, seismic maps, and various studies about the neighborhood (building fabric, urban density, activities, etc.). The collection of all the data allows the construction of a general picture of the whole context.

[20] See Focus A by Viti and Focus B by Tanganelli in this chapter.

The in-depth analyses might allow an overall understanding of the museum setting. The technical, technological, and practical aspects, their costs, the timing, the availability of professionals, and the schedule outlines represent barriers to completion. The RF can be an ally to plan future analysis, actions and to optimize time and money, being a preliminary, affordable, lightweight, and easy-to-use tool. The use of the forms does not exclude applied studies, rather represent the first step to the complete coverage of the seismic assessment of a museum system.

THE RESIMUS PROJECT

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The research project "RESIMUS" was aimed at assessing the seismic safety of the artifacts on exhibit within museums and historical buildings, i.e., site-specific museums.

In these years, many studies have been devoted to analyzing the seismic performance of artworks. Most of them were focused on the seismic response of specific case studies that were investigated through various methods, differing from each other for the quality of provided information and the required computational effort. Whichever method is selected for the seismic analysis, a complete check of the entire content of an art museum is difficult to achieve.

The need to consider a large number of items, usually with limited resources, led to develop quick methods for the assessment. The Getty Museum (Malibù, California) has been the first one to deal with a systematic classification of artifacts shown in museums based on their seismic vulnerability (Podany 2017), followed by various other institutions all over the world.

The RESIMUS project activated many studies and projects involving many researchers belonging to different fields, which started working together and producing many relevant contributions. As regards the assessment of the seismic vulnerability of the art collections, the attention has been focused on some of the collections exhibited at the Museum of Bargello in Florence (Italy); it is a precious case study since it contains a large variety of collections, each of which of a great artistic value. Special attention was paid to the role of the staging in such vulnerability. The staging devices, indeed, plays a crucial role in the seismic response of the exhibited items, potentially changing their seismic response.

The Museum of Bargello presents a large variety both in the collections and in the staging devices (see Figure 1); some of them have become essential components of the Museum asset; for this reason, they cannot be considered as simple containers, which can be replaced, but they need to be assumed as artifacts to protect.

The main results on the seismic assessment of the collections achieved within the project can be divided into three main issues:

- the quick assessment of the Museums' collections,
- the numerical analysis of the seismic response of single artifacts
- the determination of the seismic acceleration to consider for the seismic assessment.

The quick assessment of the art collections is a need of most of the Museum's managers, which have to deal with the systematic inadequacy of the economic resources for their

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Fig. A Some windows for collections staging at the National Museum of Bargello.

maintenance. The need to monitor a large number of artifacts with the availability of limited economic resources has encouraged the development of qualitative evaluation methods. In Italy, this approach has been extensively adopted to check the seismic vulnerability of buildings, both for preventive surveys (GNDT/CNR) and for post-earthquake interventions (AeDES), and, more recently, even to cultural goods (Ciampoli and Augusti 2000).

The numerical analysis of single artifacts is the research branch which collected the most efforts. The knowledge of the seismic response of – at least – some of the artifacts is an essential step even for the calibration of simplified prevision approaches. The proper type of analysis to perform should be chosen based on the most probable collapse mechanism of the object. It is strictly related to the restraint assumed at the artifact base and to the interaction between its base and its pedestal (Wittich and Hutchinson 2016). The most popular numerical approaches for artworks consist of the rigid block and the Finite Element Method (FEM) procedures. The rigid block analysis has been introduced in the 60s by Housner. Thanks to its simplicity, it is still and widely used, even though it can provide information regarding the system's motion only. The adoption of FEM to artifacts is a recent achievement allowed by the digital scanner 3D technology and by the increased computational effectiveness

of computing devices. FE analysis effectively provides information both on the motion of the system and on its stress level, and it can describe different collapse mechanisms, depending on the assumptions made for the material behavior and the interface conditions. Its effectiveness is strictly related to the mechanical behavior assumed for the material, and the friction assumed at the artifact base (Monaco et al. 2014). Within the RESIMUS project, both methods have been applied to some of the marble statues of the Bargello Museum's collections (Viti and al. 2020).

Finally, specific investigations have been made to determine the amount of acceleration expected by the item exhibited at the Museum as a function of their position within the building and the mechanical properties of the foundation soil. To this purpose, a capacitative electric tomography (CET) has been performed. It is a non-invasive test that has provided interesting information on the most superficial soil layers. The propagation of the acceleration from the foundation level to the items' position, instead, has been checked through proper seismic stations placed at the street level and the various areas of the Museum, and by performing an automatic identification procedure via Enhanced Frequency Domain Decomposition (EFDD), which led to evaluate the modal properties of the building.

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FOCUS B

THE SEISMIC SAFETY OF ART WORKS

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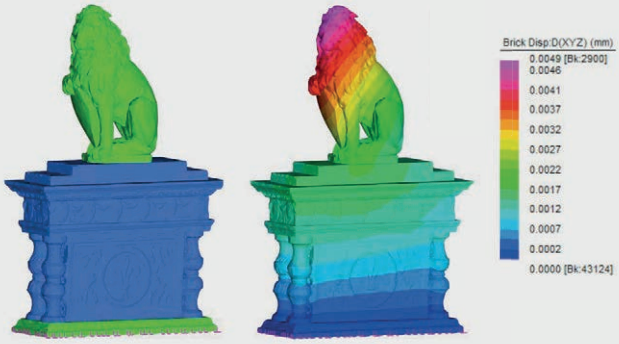

Fig. B FEM (FiniteElement Method) applied on the 3D model of Donatello's Marzocco: static analysis for vertical loads

In the last years, a special attention has been paid to the conservation of cultural heritage. Due to both natural and anthropic hazards, many damages have occurred to the art works. New codes and guidelines have been dedicated to monumental and artistic goods, introducing proper procedures for their analysis and providing the needed thresholds for their safety assessment.

With the increase of attention paid to the vulnerability of the cultural heritage, the analytical procedures able to provide the structural response of artistic goods subject to various loading conditions have been largely developed. The assessment of a safety level requires comparing the response of the investigated item under the assumed loading condition with the corresponding safety requirement.

Besides the Technical Codes' adequacy, the reliability of the safety assessment of artworks depends

- on the quality of the performed analysis,
- on the experimental knowledge at the basis of the modeling assumptions,
- on the technology used for the diagnostic of the items.

The best results in terms of safety assessment have been achieved by combining diagnostic, experimental campaigns, and modeling. Such a comprehensive approach provides a so-called knowledge path, which takes advantage of many different fields. It collects the available information on the artworks, including the changes, the moving, and the interventions determining their creation.

The experimental survey made on material samples or entire items is fundamental to obtain the correct values to assume for performing the numerical analyses. The numerical procedures are the most general and effective approach for the seismic assessment of the artworks. They can be applied

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to items with different features and seismic responses. They are quick, without requiring specific investment.
In these last years, the Finite Element Method (FEM) has been widely developed due to the improvement of the geometrical survey and the introduction of the laser-scanner technology (Wittich et al. 2016, Bagnéris et al. 2017, Verdiani et al. 2019). Such technology leads to acquiring detailed geometrical models, which can be easily arranged and used for structural purposes. Moreover, the FE methods are very versatile. They can be differently set in order to account for specific properties of the represented system, such as the geometrical and mechanical non-linearity, or the possible sliding/rocking mechanism related to the description of the interface between the object and its support.
This analytical approach has been widely used. It has been applied to Michelangelo's David (Borri and Grazini 2006), whose safety has been checked referring to dynamic excitations, seismic and not. Many other studies regarding statues made in the Renaissance or the Roman ages and archeological ruins have been made (Berto et al. 2012, Viti et al. 2020). The FE methods can easily represent systems' behavior, despite their geometrical complexity and the type of loading they are subjected to. However, the reliability of FEM needs to be checked by comparing the obtained results with some more straightforward analytical approaches or – even better – with an experimental comparison. Indeed, the high complexity of FEM could provide misleading results if the model is not correctly set.

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B) The Design Phase

General Remarks

Given the information acquired with the forms, the second phase consists of improving an existing exhibition setup or designing a new museum setting. We try to address the questions linked to the museum setups through the design project: can museum displays be safe and coherent, according to updated exhibiting criteria? Can museography integrate with seismic prevention and museum policies? How? We can answer these questions through the exhibition design, holding together: consistent curatorial program, anti-seismic devices, and a coherent museographical project.

We started from the principle of displaying. The act of showing is simple only in appearance and has to be cautiously solved. As Newhouse (2015) stated, it is a powerful gesture. A display project is or should be made by pondered decisions. After all, the art of displaying starts before the birth of museums. Over the centuries, the arrangement of statues and paintings in a space has changed according to different tastes, religious and symbolic meanings, political messages, and social contexts. Before the birth of museums, the objects' position (we do not speak of works of art yet) followed political or personal basis. We can think about the path to the Acropolis with the position of statues and the sacred architectures (Le Corbusier 2008),[21] the debate about the arrangement of Michelangelo's David into the Signoria square (Wittkower 1998), and the interior layout of the Renaissance *Studioli*, like the one of Francesco I de' Medici in Florence. With the establishment and opening of public museums, the staging of the spaces has started to follow different principles. The displays follow curatorial directions, determining objects' grouping, order, and spatial distribution. Positioning an artifact in the space requires a careful study, ranging from architecture to environmental psychology, from ergonomic solutions to museum anthropology, from curatorship to communication. A non-recent document, edited by the French Ministry of Culture in 1986 (AA.VV. 1990), suggests some helpful exhibit guidelines for museums. It expresses a few basic but still topical museographical principles, for example:

> A wrong codification of the display could lead to serious dangers. One risk is the standardization of museums in a rigid way and the trivialization of the museographical display. A mistaken approach would destroy one of the richest quality of museums, their uniqueness.

[21] About the Acropolis, it is worth mentioning also the landscape work by Dimitris Pikionis (1954-57) (Ferlenga 2014).

The text enhances the importance of the object and its location:

> In general, everything should start from the object, and everything should be put at the service of the object and its display. The exhibition general program has to be integrated with the evaluation of the "spatial potential" of each piece and its presence in the general scenography.[22]

To these passages, we add the importance of the specificity of the site (Pirazzoli 2013, 2011), the link between object and place, the respect for diversity, the necessity of previous studies involving the comparison of the possible design solutions and study of the references, and the necessity of a scientific program and prior detailed study of the site and the collections. Multidisciplinary teamwork has to take into consideration several variables. Moreover, introducing just anti-seismic devices to a museum setup, whether permanent or temporary, is not enough. Our goal is to consider the whole collection hosted in one room instead of the single object or a specific exhibition device and hold together all the aspects of an exhibition design.

Methodology

Among the disciplines that equally contribute to foster the museum safety and preventive measures there is museography, or museum practice. That can be defined as the art of displaying,[23] following the design and the organization of the spaces. Although sector-based,[24] museography is characterized by a cross-sectorial approach and by the research of a constant dialogue with other disciplines, in and out the academia (Collotti 2017, Basso Peressut 2005).

Museum practice determines the organization and the layout of a setting, allowing the presentation and the preservation of the contents. It is part of the Interior Architecture field and, as Museum Studies, is not considered an exact discipline. Interiors and museography are not based on scientific research, nor are purely artistic activities (Postiglione 2012). They do not fit a priori into a methodological framework. Instead, the research on museum design can be described as a mix of various approaches, based on observations, the study of the sources,[25]

[22] Translated by the author from the Italian edition. The French original version *Faire un musée. Comment conduire une opération muséographique? h*as been presented in 1986 and edited by La Documentartion Français.

[23] Mairesse and Desvalées (2010) offer three more definitions. The first says: "Currently museography is essentially defined as the practical or applied aspect of museology, that is to say, the techniques which have been developed to fulfill museum operations, in particular about the planning and to fit out of the museum premises, conservation, restoration, security, and exhibition. In contrast to museology, the word museography has long been used to identify museums' practical activities. The term is regularly used in the French-speaking world but rarely in the English-speaking one, where museum practice is preferred." pp. 52-53

[24] Museography is part of the Interior Architecture discipline.

[25] Postiglione (2012) highlights the matter of the sources in the Interiors. He stresses the necessity of knowing the sources, divided into primary (original documents, interview, and the possibility of working directly with the object) and secondary (documents, essays, pictures, relief, re-drawings). The study of the references, the sketching, the maquette, the digital modeling, and the objects' survey are all instruments used for our research.

design practice (composition), prototyping, and, eventually, realization and observation of the results in a given time. Lupo and Trocchianesi (2012) identify some methodologies: the scientific method used to observe and understand "how things are" (De Groot 1972; Popper 1959); the "building knowledge by design," theorized by Richard Foqué (2010) as an experimental method playing with the models and practice, and by Sevaldson (2010) as explorative research; the "research through design," according to the point of view by Archer (1995) and Frayling (1993), seen as a method "where the practice serves as research purpose" (Rust et al. 2007).

The design process is a knowledge procedure.[26] The several passages, from the study of the sources (comprehending archive and book research, the visit of the site) and of the references (analysis of coherent case studies) to the investigation of the subject, from the study of possible alternatives (composition, materials, technology) to the development of a prototype or standard layout, lead to the concretization of a formula that is not a design per se but is a solution proposing an answer to a given problem. The results are then published and promoted inside the scientific community. The design is the fruit of a multidisciplinary approach and the active collaboration among the several professions and actors included in the process. Therefore, the design results from a dynamic dialogue among different actors leading to various disciplines.

Fig. 6
Gallery of the Palazzo Abatellis, Palermo. View of the exhibition rooms designed Carlo Scarpa and portrayed by Paolo Monti in 1961.

Fig. 7
Gallery of Palazzo Bianco, Genoa. Franco Albini's exhibit design photographed by Paolo Monti in 1963.

Fig. 8
Castello Sforzesco, Milan. Detail of the setting developed by BBPR, picture by Paolo Monti in 1963.

Fig. 9
Castello Sforzesco, Milan. Detail of the setup of the first floor of the Art Gallery designed by BBPR shot by Paolo Monti in 1956.

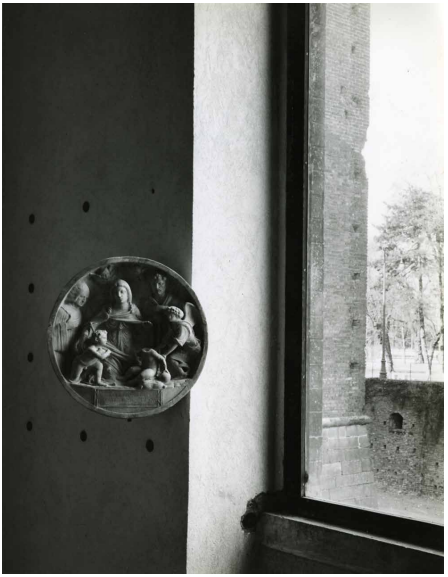
The Design Phase articulation

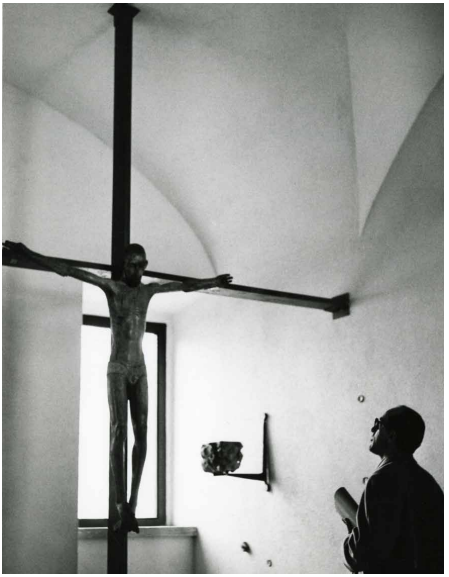
The Design Phase is conducted only by experts and articulates in two steps: a-museographical analysis and b-set design.

a) The museographical analysis comprises the study of the references. It is necessary to develop a coherent and accurate museum plan that integrates with the curatorial project, the technological anti-seismic suggestions, and all the required safety elements. The choice and study of the references relate to the site, the kind of collection, the curatorial program, and connect to the museum's requests and needs.

The study of museum spaces and their setups, the references, is a fundamental aspect of both research and practice in museum design. It can be conducted by studying books and texts, redrawing examples, and visiting cultural sites. In learning from the past and looking up to the future, we have to check for some remarkable case studies, providing

[26] "Research by design is essentially practice-based and is the key to the development of a theory that can be applied in a practical situation. This theory is essentially pragmatic, necessarily dynamic and relative to the practice situation" (Foqué 2010, 153). Further, a practice-based theory "is typically not about explanations and justification (knowing why), but rather about establishing facts (knowing what) and instructions for actions (knowing how)" (Grand 2008, 401).





critical analyses and drawings of selected museum references, and studying anti-seismic museum solutions. Such a study helps identify the available range of solutions and understands others' work (Collotti 1994). The study can be pursued at several levels, from general composition to a technological and digital solution, from graphics to space management. The investigation helps to identify the available range of solutions. As said, redrawing existing subjects is a way to understand architecture. The act of sketching is a crucial element in this phase. By tradition, it is an instrument of both research and design (Collotti 2014). The in situ fast representations of the spaces and settings help freeze concepts, understand the spaces' articulation, and analyze volumes. The transfer of the signs on paper forces a specific kind of reasoning, different from taking pictures. The drawings might synthesize and illustrate some morphological aspects that a text or a chart might not efficiently communicate (Cerri 2018). Learning upon the references has a dual scope: learning from others' experiences and ideas, and understanding if prominent examples satisfy the current safety levels. References need to be also contextualized. From a museum design point of view, we have to consider the Italian masters, like Albini, Scarpa, Michelucci, BBPR, and Castiglioni. They contributed to developing an essential cultural operation. They confronted themselves with historical architectures and the requests of the setting of invaluable collections. As a solution, they used the museum exhibition as an experimental field. These are valuable examples from which we can learn, with all due differences. Today, modest budgets and tight deadlines bound the space for experimentations, limiting the involvement of highly skilled artisans.

b) As the name suggests, the set design step is the actual designing part. It considers previous analysis (phase1), the study of the references, the museum requests and needs, and develops together with other disciplines and professionals. The projects have to include new variables, such as audience development analysis, marketing strategies, mass tourism, blockbuster exhibitions, a new modality of visit, use of multimedia and technology, and the presence of other communication platforms. At the same time, the design has to respect or follows museum regulations and safety standards. Given the lack of anti-seismic measures, the design becomes a way to test safety solutions and hypothesize best practices and guidelines. Such a process of hypothesis and testings is comprehended in the "research by design" methodology. The outcomes describe a path of findings that might be presented in publications and scientific conferences.

Seismic Safety of Objects on Display: Regulations, Guidelines, and Protocols

The Design Phase must consider guidelines, standards, and shared protocols to protect museums and museum collections from various risks delineated by International committees, museums, and cultural institutions. *Museum Security and Protection, A handbook for cultural heritage institutions*, by ICOM and ICMS (1993), is a general textbook with international standards and necessary security procedures. Later, other texts have been released. We already mentioned *Running a Museum: A Practical Handbook* (2005) by ICOM: a compact manual born to be a reference book to those working in Iraqui museums. Given the universal interest of the topic, this has been customized to be an introductory book dedicated to all the people working in museums. Other texts came along (Jalla 2015), sharing the necessity of setting standard basic parameters and procedures to protect, preserve, and enhance cultural goods. Like the Smithsonian Museums, Canadian museums, and the Metropolitan Museum of New York, some prominent museums set up a series of guidelines and regulations about conserving and protecting their collections. In Italy, the text elaborated jointly by MIBACT, ICOM, and Carabinieri Art Squad (Carabinieri Nucleo Tutela Patrimonio Culturale) (2015) updated a document in the field of protection. Though dedicated to the protection against theft, vandalism, terrorism, and smuggler, it proposes practical measures and suggestions on the risk assessment of the museum settings.[27]

Preventive and protecting measures concern both temporary and permanent setups. In organizing temporary exhibitions, both lender and hosting institution have to follow some procedures and restrictive protocols regulated by the *London Agreement* (IEO 2002) and following revisions (IEO 2009). Among the several documents,[28]the *Facility Report* is one of the most important. It consists of a form describing the hosting institution's venue. The loaning institutions will give their clearance to proceed only after verifying that the spaces of the hosting museum satisfies the mandatory conditions. The Facility Report lists all the existing safety measures, but the anti-seismic devices are not required as they have not yet been coded. This document lists the requested safety and conservation measures, like alarming cases, hygrometric environment, and light temperature. The documents are precious and necessary, but none of them specify ad hoc normative about the seismic hazard. Other documents are dedicated to the single objects, as the Loan Form (and or a Loan Agreement). An ID identifies

[27] The Carabinieri Command for the Protection of Cultural Heritage, Carabinieri TPC, is in charge of the crimes against art and antiquities. General Ferrara founded it in 1969. It was the first special police force in the world of this kind, anticipating the UNESCO convention on the Means of Prohibiting and Preventing the Illicit Import, Export and Transfer of Ownership of Cultural Property (1970).

[28] The essential documents are: the scientific program of the exhibition, the Loan Form and/or Loan Agreement, the Facility Report of the hosting structure. As the name law declares, in Italy, the DM 330 30/06/2016 establishes "the criterion to open to the public, the surveillance, and the safety of museum and cultural sites."

every object and a correspondent form collects all the information related to each traveling piece. The loan must be validated by a double agreement between the two institutions by stipulating an insurance policy on loans. Although ICOM and UNESCO's documents are mainly devoted to emergencies and the recovery after a natural disaster (Sendai 2015; ICOMOS 2014; HFA 2013, 2007), they do not contain advice about prevention against earthquakes. By now, common sense, practice, and high expertise of the museum staff are the most effective preventive measures.

C) Installation Phase

The last step is the realization of the design and includes the executive plans. Analysis and speculations bring to this step, in which finally what has been envisioned can be realized. It is worth noticing that the application can be both heavy or light. Let us take the Getty example. Its staff approached the seismic safety of the collections in two ways: by applying non-invasive solutions without modifying the general asset of the exhibition (light intervention) and by reorganizing the interior articulation of the rooms (heavy intervention). There are substantial differences between the two outcomes: costs, general complexity, and actors involved. Still, both solutions work according to a general museographic plan and increase safety level of the museum. Once at this stage, the project should be documented and shared, so to foster the construction of best practices and guidelines, and becoming potential references to other's work.

POST-WAR MUSEOGRAPHY IN ITALY

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In the aftermath of the Second World War, the devastation caused by the bombing left a severely damaged architectural heritage in Italy. At the same time, it offered the extraordinary opportunity to rethink the world of the museum. During the fascist regime, twenty years before, the country closed itself entirely to the innovations that were changing the face of the prominent foreign museums. Such elements had been disseminated by the Mouseion magazine (founded in 1927) and discussed during the significant international conference on museography, held in Madrid in 1934.

By paradox, during Italy's fascist era, many Italian architects, looking at the European artistic Avantgardes (especially Bauhaus, De Stijl, and Russian Deconstructionism), acquired substantial experience in the temporary exhibition field. This experience proved to be fundamental in the post-war period. The propaganda exhibitions were used by the regime to celebrate their majesty and to persuade the masses, such as the famous "Exhibition of the Fascist revolution" (Mostra della rivoluzione fascista, Rome, 1932) or the Exhibition of the Italian Aeronautic Show (Esposizione dell'Aeronautica Italiana, Milan, 1934), the expositions organized by the Triennale of Milan and the trade fairs in Milan and Bari. They also played pivotal roles. Precisely during these events, defined by Giuseppe Pagano as "intelligent shacks" in 1941, the architects proved themselves in an extraordinary hybridization of languages. The experimental nature characterized each setup, conveying architecture, graphics, designs, light designs, and sometimes sounds.

The intersection among several artistic languages constituted the ground on which some exhibit solutions developed in the aftermath of the war. However, the most extraordinary results in museography were achieved thanks to the new generation of superintendents and museum directors. Well-educated and illuminated, they shared with the architects the social vision of the museum, which has now reached and taught a wide range of the public. Once limited to the cultured *élites* and devoted to the conservation of the works of art only, this secular institution is now appointed to educate in art, making visitors understand that what they are observing is part of their life and cultural roots. The report Musei e gallerie d'arte in Italia (Museums and Art galleries In Italy), published in 1953 by Guglielmo de Angelis d'Ossat, General Director of Antiquities and Fine Arts, restates such a conception. It aims to present the guidelines that characterized the new arrangement of 150 Italian museums. Museums are usually hosted inside historic

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Fig. C Museum of Palazzo Bianco, Genoa. The exhibition setup by Franco Albini.

buildings, born to be something else (like noble palaces and monasteries). Peremptorily, they need to be modernized according to the updated museographic criteria. The first operation of this renewal, shared by curators and the architects, was a strict selection of the pieces on show to narrow the number of objects squeezed into the exhibition rooms. The un-framed paintings, meaning canvases freed from the non-original frames, are arranged on a single level, at eye height. They stand out on light walls, without oppressive wallpaper or dark shades, and without fake style decors. Heavy wooden furniture and other display cabinets are usually substituted by crystal vitrines held up by slender metallic supports. They allow the work to be viewed from any angle. The new museums banish the half-light from the exhibition rooms. These are flooded by controlled natural light during the day, thanks to several devices, or animated by different artificial lights; light design starts developing in this period.

The architects of this great season are fine connoisseurs of the History of Art. They are convinced that exhibiting means exalting the peculiarities of the single work of art, creating a modern space around it, and making the piece understandable to the visitors. Exceptional examples are both temporary and permanent exhibitions, such as the

various works by Carlo Scarpa (the several editions at the Venice Biennale and other exhibitions, the Gallerie dell'Accademia in Venice, the Palazzo Abatellis in Palermo, the Canova Gypsotheca in Possagno, the Castelvecchio Museum in Verona); Franco Albini's Museums in Genoa (Palazzo Bianco, Palazzo Rosso, and the Treasure Museum of San Lorenzo); BBPR's Museum of Castello Sforzesco in Milan. The contribution of these architects starts from the premise that the museum is an evolving organism. Inside, the works can be exhibited in turn, and flexibility is the banner under which these setups are imagined. Each exhibition design is conceived exactly for that specific artwork in that specific space. Therefore, the setup itself becomes a concluded work of art. Implying that if one changes one detail, the existing equilibrium crashes, losing its initial meaning as recent restoration has unfortunately demonstrated.

Going back to the Vienna Secession's experimentations and the European Avant-Garde movements, the temporary setups and the Italian Museum refurbishments, realized during the Fifties, propose themselves as models for a new conception of the exhibition setting. They would soon spread all around Europe.

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FOCUS D

DIGITAL SURVEY AND MUSEUMS: USEFUL TOOLS AND LESS USEFUL TOOLS FOR HUMANITY 5.0

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Digital tools for survey and documentation today offer options of significant interest and great potential for any museum setup. For management, protection, and dissemination, creating a digital copy of the collections is a crucial step that interests permanent and temporary exhibitions, museum collections, and entire museum locations. Thanks to their progressive popularization over the last twenty years, the tools to carry out this transformation are now available to heritage managers, scholars, and more and more often to every visitor in front of what is exposed. From 3D laser scanner units to contemporary photogrammetry, to components implemented in personal devices, the ease of producing digital copies is now getting faster and faster and is progressively improving in terms of quality. The many recent experiences confirm the widespread digital innovation in the reality of museums and collections (Collotti et al., 2021). In the context of the digital innovations at the base of humanity 5.0, that is defined as "a society of intelligence," in which physical space and cyberspace are strongly integrated" (Salgues, 2018). The renewal of a museum design needs to consider the digital innovations at all levels, from the tools allowing the passage from reality to digital to the digitalization of museum architectural spaces or museum collections.

Main technologies

3D laser scanner: It is the fastest and reliable solution. It is the best approach available today to create a digital twin, from the urban and architectural scale to the single items. The units available on the market allow getting large areas covered with a high level of detail. The speed in processing and the quality of the results create all the conditions for having a fully trustable base for any evaluation or producing base drawings. Originated on restoration needs, new design interventions and enhancement works may find the correct references, reducing any possible issues connected to misinterpretation of complex architectural shapes. The recent enhancements in this technology are making it possible to exploit the most recent laser scanner 3D units for the creation of virtual environments usable even out of the "technical" environments like it is for the solutions suggested by Matterport (Shults et al., 2019) and increasing the automatization of the survey procedures.

Photogrammetry: The increase in performance and quickness of "creating a model out of pictures" in the last years pushed

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Fig. D The variety of tools for digital survey allows today to extend the digital documentation to real tasks for creating multimedia contents, digital twins, and tools for diagnostic and monitoring aims. In the pictures: a VR camera with automatic image stitching, two 3D laser scanner units at work on architectures, photogrammetric operations, and thermographic pictures of architectures.

in the realm of the incredible users of photogrammetry. It passed from an old, complex, challenging, and all "high-quality equipment" based processing to a new, fast, and spectacular way of processing the data. Thanks to the increase of computer computation power, the efficiency of the communication speeds, and the miniaturization of lenses, sensors, and cameras, the present scenario allows operating the creation of a 3D model with texturing using from a smartphone camera to a high-quality professional DSRL with noticeable results since the beginning. Besides, the recent "push" produced by introducing the "Lidar" solution in the Apple High range smartphones is moving this practice to be more and more accessible by anyone. Such an evolution, under development since the early years of this century, is changing the approach to creating 3D models and creating extensive digital collections that document the real collections in short times and low costs. The level of quality may vary, but the popularization of the process is a factor in need of extreme attention (Pucci, 2013).

Virtual Reality cameras: Another tool with a past balance depending on long processing times, but even those times seem gone. A large number of cameras are now available for creating good to high-quality panoramic scenes with minimal effort from the operators. The image can be mounted according to "virtual tours" logic and can be easily shared using many online possibilities. The option for implementing these panoramic tours with multimedia content makes this solution extremely interesting, with a high level of customization. The possibility of bringing to the public those spaces with difficult accessibility is a fascinating option. With a display in situ or online, using a personal device, the visitor may

access "forbidden" rooms and sectors of a site or a museum. A fragile fresco, an underground chapel, or a transformed artifact may be seen in all aspects, making the visit more inclusive, and expanding the possibilities of teaching and learning.

Diagnostic and inspecting tools: The enhancements in the field of diagnostic and monitoring have significantly increased in the last years, reducing the weight and size of the tools. Better portability made them easier to use and more affordable. In most cases, the simplification of the procedures and the possibility of having an instant report about the results allow a better understanding of the actual situation and immediately plan the following operations. Thermography (Sfarra et al., 2016), UV photography, endoscopy, X-Ray, and Georadar devices and software have increased their efficiency, bringing the whole set of diagnostic procedures to the digital environment.

The creation of digital twins from tangible elements is a revolutionary innovation of the digital revolution. The challenge seems not only one of the levels of details, of the accuracy in the reconstruction of the performance of the process, but it also seems a mandatory opportunity for the integration of additional information, bringing the options for visualizing "invisible" and intrinsic characteristics of the real object as an easily accessible part of the digital twin. Such enrichment may bring the digital twin to represent an enhanced version of the actual object, suitable for monitoring, diagnostic, and presenting to the public a series of different datasets according to their curiosity or interest. While this integration is still at the first steps, the consistency of the digital heritage brings extended options to the public and is a challenge for any museum or exhibition to exploit, according to their needs and available resources. The digitalization of the collections, or a part of them, and the creation of virtual tour connecting the models from the collection to a digital representation of the space of the museum can be a first step that offers at least three main possibilities: a remote visit as an alternative to the real one, a remote visit before the real one, a preliminary preparation to a better experience of the museum, and the one after the real one, to go back and get even more information and re-experience the interest of the visit. In this, the quality of the contents is fundamental, no one can replace high-quality content with poor digital models, and a virtual tour made of low resolution or blurry images would be just a shame. However, looking around at all the famous digitalization experiences and museums, it seems clear that quality is always present and gradually increasing.

The digitalization of a museum and its collections needs two essential elements to succeed:

1. proper infrastructure to host all the digital contents and people capable of managing it. Whether part or external to the museum structure, the digital product should be online, available, and visible in the shortest time, or it will be a missed opportunity for people interested in the subject.
2. digital data need proper management in time, updates, maintenance. The risk is rapid obsolescence of expensive contents that are not entirely understood as valuable, even though they belong to the "digital heritage" category.

The last decades have seen the progressive rise of the digital revolution, with all the

transformations in procedures, methods, and forms of communication and understanding that it involves. The last years, strongly characterized by the Pandemic event, have accelerated the digital transposition of many cultural spaces and places. The multiplications of contents and the increment in the available solutions for creating online content, exhibitions, meetings, and debates are visible. The results are varied, but this is an ever-changing environment, and many rules about "how to build" the digital heritage are things yet to come. Any figure operating in cultural heritage, from the scholar to the traditional visitors, is now potentially moving in an expanded context of new complexity, where the technological preponderance imposes rules that are not always easy to grasp by all the participants, but for which, sometimes, the real possibilities of use may be something yet to be discovered. The risk of missing the target is more than tangible. The massive production of digital content is nothing without proper infrastructure and data maintenance, and the data gathering for monitoring and diagnostic is nothing without processing, analysis, and understanding. Although obvious, this broad and rich context highlights a fundamental need that at times still seems at risk of neglect, namely that of coherence and content, of the realization of reasoned and proper projects that allow effective results. It is a scenario in which digital twins inevitably play an important and strategic role, a concrete and profitable benefit in using multimedia projects for Cultural Heritage. It is also a scenario that needs correct and well-prepared players, otherwise it will remain at risk of being a significant waste of resources and a collection of missed occasions.

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Case Studies

This section presents the RESIMUS Approach applied to two case studies located in the metropolitan area of Florence: a permanent museum installation and a temporary exhibition. The first case is the National Museum of Bargello. Here, we completed the first two RESIMUS Phases: Analysis and Design. This case has particular relevance to the global research, serving as a trial test for the RESIMUS Forms. The second case is the temporary exhibition *di Tutti i Colori, Racconti di ceramica a Montelupo dalla «fabbrica di Firenze» all'industria e al design,* organized in Montelupo Fiorentino, Florence, in 2019. Here, the Analysis Phase limits to the general setting of the rooms. The prominent part is related to the Design and Installation Phases. It is worth mentioning that some aspects of the RESIMUS research, which include surveys and in-depth investigations, have also been pursued in other museums of Tuscany.

CASE 1

THE APPLICATION OF THE RESIMUS APPROACH TO A PERMANENT EXHIBITION: THE NATIONAL MUSEUM OF BARGELLO, FLORENCE, ITALY

Why the National Museum of Bargello

Given the link of the Department of Architecture of Florence with the territory and the local stakeholders, we focused on the Florentine area. We looked for a relevant museum. Among several possible candidates, the National Museum of Bargello has been chosen because of its past collaborations with DIDA. In 2017, the research "RESIMUS – RESilience MUSeum" (Viti 2018) started.[1] In 2018, the research grant "*Giovani Ricercatori Protagonisti*," promoted by Fondazione Cassa di Risparmio di Firenze, financed the author's research, 'Flo-RESIMUS: The evaluation of the museum resilience from the Florentine territory through a short system of classification'[2] (Flo-RESIMUS. *La valutazione della resilienza nei musei del territorio fiorentino attraverso un sistema sintetico di classificazione*). Flo-RESIMUS is connected to the RESIMUS research.

The Bargello in a Nutshell

The National Museum of Bargello is one of the most important Florentine museums, a must-see of the city center. Before the COVID-19 pandemic, each year, around 150 thousand people visited it. The building occupies an entire block, standing on Piazza San Firenze, via del Proconsolo, via Ghibellina, and via dell'acqua (Fig. 4). It locates in a strategic position between Palazzo Vecchio and the Cathedral, and not far from Santa Croce church. The museum is one of the most significant statuary Italian museums; Michelangelo, Donatello, Cellini, Della Robbia's works are here. It is also well-known for its outstanding fine arts and coins collections.

[1] The activities of RESIMUS includes: publications, on field surveys and analysis, workshops with DIDA students, seminars, a.a.2017-2018 and 2018-2019 (Zaffi and Viti 2021), and the International Conference ARCO – Art Collections: Cultural Heritage, Safety & Innovation, Florence, Italy, September 21-23, 2020 (Collotti, Brodini, Verdiani 2021 and Tanganelli and Viti 2020).

[2] The research has been financed by the project "*Giovani Ricercatori Protagonisti*," promoted and financed by the Fondazione CRF with the University of Florence, on the theme "Enhancing the resilience of the Florentine territory: prevention and monitoring of the emergencies" (*Aumentare la resilienza del territorio fiorentino: prevenzione e monitoraggio delle emergenze territoriali*, *Area tecnologica*). Every year, the grant supports under 35 years old researchers of the University of Florence.

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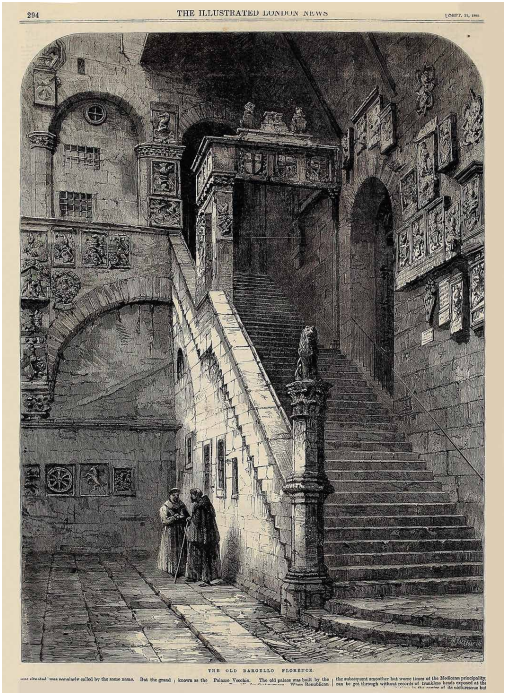
Fig. 1
The Bargello tower, the so-called *Torre Volognana*.

The Bargello Palace was founded around 1250. According to tradition, the design is ascribed to Lapo Tedesco, but the attribution is debated (Paolozzi Strozzi 2014). The *fabrica* (yard) lasted until the half of the XIV century and underwent extensions and modifications. The building was first the headquarters and residence of the *Podestà* (chief magistrate) and then a prison. In 1857, when the jail was transferred to the so-called *Murate* district, the palace was destined to become a museum. According to the then Neo-gothic fashion, the building endured heavy changes and restorations. The goal was to mirror as much as possible an ideal medieval setting. The refurbishment works were part of the cycle of transformations of the city. Elected as the new Capital of the Italian Reign in 1865, the interventions intended to transform a provincial town into an elegant and modern capital. On June 22, 1865, a royal decree established the Bargello as the first Italian National Museum. Like other Italian museums, it is hosted in a historical architecture. The current interior and exterior aspects still derive from the XIX century refurbishment (Paolozzi Strozzi 2014, 2004). Despite some necessary updates, the building has been almost unchanged. The oldest unit develops on two levels and includes the bell tower. The subsequent expansions articulate on three levels and allow the creation of a central courtyard, from where the several additions are easily recognizable (Fig. 5). The main entrance locates at the bottom of the tower, via del Proconsolo, where the services (ticket office, cloakroom, and bookshop) concentrate. The ground floor also hosts four exhibition spaces: two rooms dedicated to temporary exhibitions, the Michelangelo's Room

Fig. 2
The Old Bargello, Florence. Illustration for The Illustrated London News, 21 September 1861.

Fig. 3
Palazzo del Podestà o Bargello, Lithography of 1894.



and Renaissance sculpture collections, and the courtyard. Inside the latter, big-sized marble masterpieces characterize the space, and stone emblems of the chief magistrates that had inhabited the palace cover the vertical surfaces. On the first floor, the must-see rooms are the Donatello Room, the Verone, the Bargello's chapel. The second floor hosts seven permanent exhibition spaces, while the offices are located in the inward area of the palace. Overall, a unique location and outstanding collection combination distinguish the Bargello as one of the most important places to see in Florence. However, the historic palace articulation limits the museum functions and does not satisfy the needs of contemporary museum spaces. For example, bookshop, ticket office, auditorium, café, now considered central in the economy and functioning of a museum, at the Bargello are minimal or absent. Presently, all the collections are kept in the palace. The storage limits to a portion of the attic, meaning that most of the museum collections are forcefully on show.

The scientific program and the museographic organizations changed through the years due to curatorial choices and emergency causes. Globally, the museum collections count about 40.000 pieces.

The current organization of the artifacts follows thematic criteria, such as authors, materials, historical periods, and origin. The visiting path starts and ends from the courtyard, and there are no instructions for following a precise route. A guide on sale at the bookshop, dedicated to the museum masterpieces, might facilitate the visit (Paolozzi Strozzi 2014).

The literature about the collection, the museum, and the architecture is varied. About the palace architecture, Giorgi and Matracchi's essays (2006) focus on architectural conservation. The book *I 150 anni del Museo del Bargello. Una Storia per Immagini* by Ciseri and Marini (2015), thanks to a critical archive effort, narrates the changes in settings and interiors. Through photographs, most of which coming from the National Archive of Florence, the authors trace 150 years of changes: the exhibitions of the objects, the use of the spaces, the curatorial choices. The historiography of the palace and the early architecture is delineated by Yunn (2005). The book *The history of the Bargello, 1000 masterpieces to discover* (2005), written by the former museum director Beatrice Paolozzi Strozzi, describes the history of the building and the one hundred most essential pieces of the museum. The most comprehensive and updated guide is the *Official Museum Guide* (Paolozzi Strozzi 2014), presenting the museum and listing the pieces room by room. Other guides are cyclically edited (Bertelà 2013, Celani et al. 2010, Tomasello 1994). The literature dedicated to the single items or collections is vast and includes exhibition catalogs, monographs, and scientific articles. If one is interested in specific items, the complete catalog is only printed. The digital-online version is partial and hosted on the ministerial platform.[3]

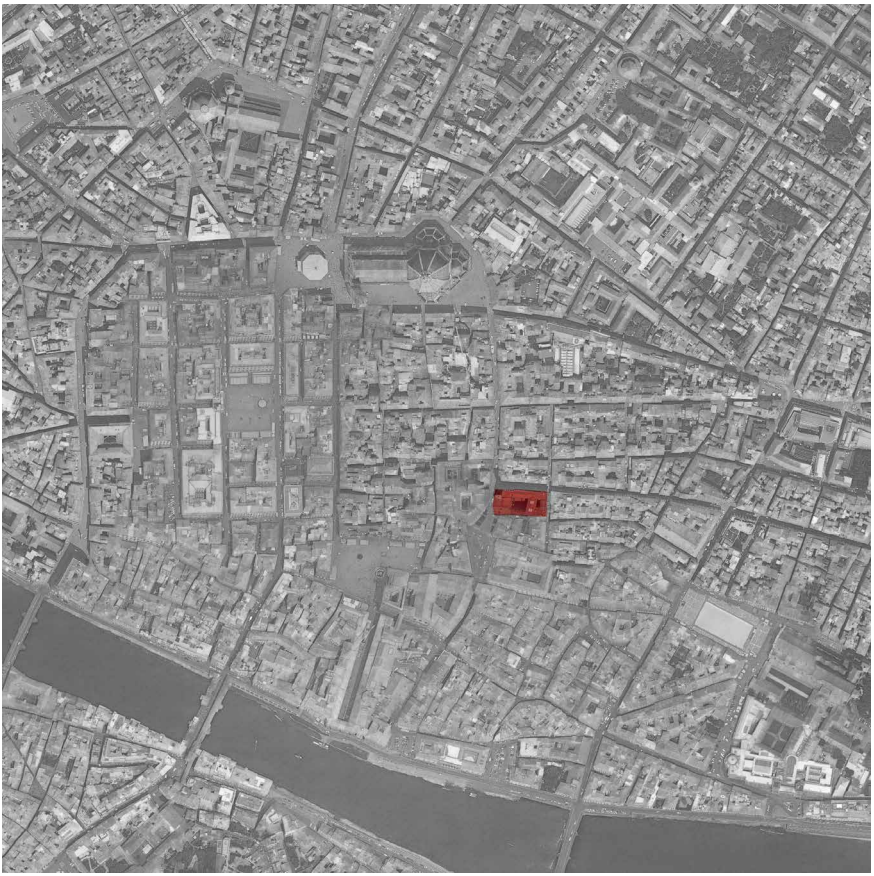
Fig. 4
Florence, location of the National Museum of Bargello.

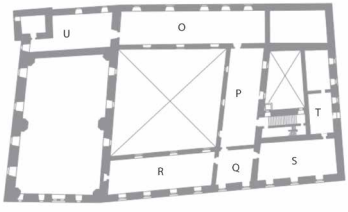
Fig. 5
Museum floor plans, National Museum of Bargello.

Toward a 'new' Bargello

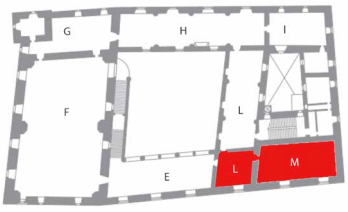
Since 2014, the museum reforms started reorganizing the Italian State Museum system (Casini 2019, 2016). The first act was the establishment of twenty, so-called, *Grandi Musei* (Big Museums). Compared to the past, each of them, with a newly appointed director,

[3] The complete database of the collection is on paper, waiting for a digital transcription. Only a portion of the collections is available on the online database hosted by the Ministry of Culture (MIBACT) websites. The online catalog is accessible through the Polo Museale di Firenze website <http://www.polomuseale.firenze.it/invsculturebargello/> (11/20). It reunites the collections of the former Florence Museum Hub (Polo Museale Fiorentino, Soprintendenza per i Beni artistico-museali di Firenze), reuniting all state Museum of Florence. Such institution have been modified by the Franceschini's Ministry Reform in 2014 (D.L. 106/2014). The reform involves state museums only. Since 2014, major museum institutions have individual administrative and managerial autonomy, as for the organization of their webspace. The Bargello does not include the consultation of its database in its web infrastructure, but the former Polo Museale di Firenze catalog is still available <http://www.polomuseale.firenze.it/invsculturebargello/inventari.asp> (11/20). Unfortunately, most of Bargello's records are on paper, and the website architecture does not facilitate the consultation. To gather specific information, one has to go to the museum and submit a formal consultation request.

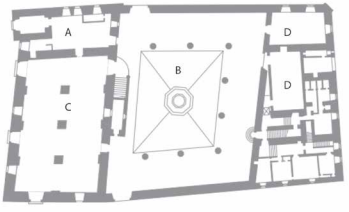




Ground Floor
A-Entrance (safety control, ticket office, bookshop, lookers); B-Courtyard; C-Michelangelo Room; D-Temporary exhibition rooms.



First Floor
E-Verone; F-Donatello Room; G-Islamic Room; H-Carrand Room; I-Chapel and Sagresty; L- Avory Room; M-Trecento Room; N- Majolica Room.



Second Floor:
O-Armoury; P-Giovanni della Robbia Room; Q-Andrea della Robbia Room; R- Bronzes Room; S-Verrocchio Room; T-Medal Table and Baroque sculpture Room; U-Storage area.

the Super Manager, gained extended autonomy in the managerial and administrative process. The Bargello is part of the group of museums called *I Musei del Bargello* (Bargello's Museums). It comprehends: Medici's Chapels, Orsanmichele Church, Museum of Casa Martelli, Palazzo Davanzati-Museum of the Old Florentine House. The co-presence of five museums to run implied the redefinition of several strategies. For example, there were the necessity of a new coordinated image, the necessity of new communication strategies, and a profound reorganization of the internal structures. The direction planned a series of interventions on the Bargello exhibition settings to accomplish during the director's term of office (2015-2019; 2019-2023).[4] Therefore, the RESIMUS research focuses on a portion of the museum that is already involved in the exhibition redesign plan hypothesized by the direction (Cerri 2021). After a preliminary survey, we selected the Majolica Room. We included later the so-called *Sala del Trecento* (Fourteenth century Room).

The Majolica and the Trecento Rooms

The two rooms are located on the first floor, on the south side of the building, via dell'Acqua and via della Vigna Vecchia corner. This exhibition area is not the most popular of the museum, although their extraordinary collections. Usually, other spaces or collections strike the visitors, like the courtyard and the *Verone*, the Donatello and the Michelangelo's Rooms, or the armory section. Still, the Majolica Room fascinates the public, who finds himself surrounded by ceramic decorations and precious details. On the contrary, the Trecento Room has neither special features nor a strong exhibition characterization, and it is a passing-by place.

The rooms through time

Through the years, the rooms varied both content and exhibition design and underwent several redesigns and changes. In 1865, the now-called Majolica Room appeared with Neo-gothic mural decorations (Ciseri and Marini 2015). Such ornaments are also visible in the pictures dated between 1873 and 1887 (Fig. 7, 8, and 9). Back then, the room was named Second Bronze Room (*Seconda sala dei bronzi*). Verrocchio's David, Giambologna's Mercury, and Donatello's Attis were in the center of the room. On Donatello's Exposition Year (1887), some of the statues sculpted by the celebrated author and others were moved to set up the current Donatello Room. A reverse shot allows us to see the rest

[4] The director is Elisabetta D'Agostino.

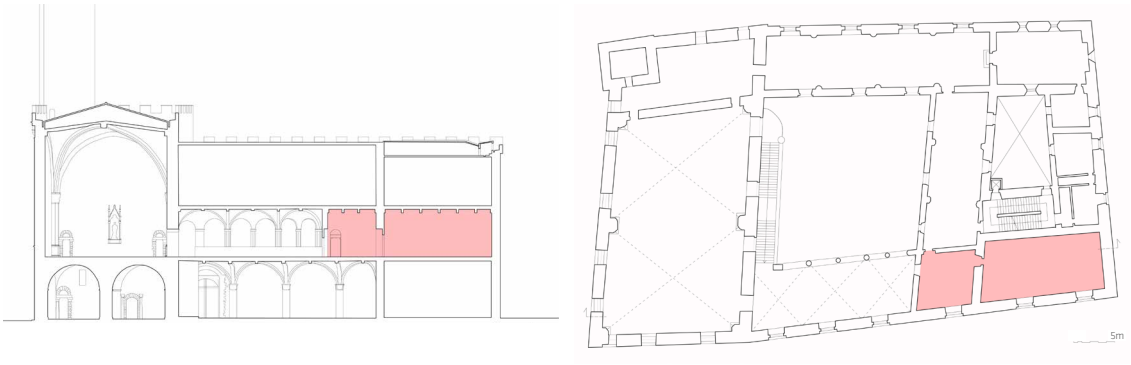
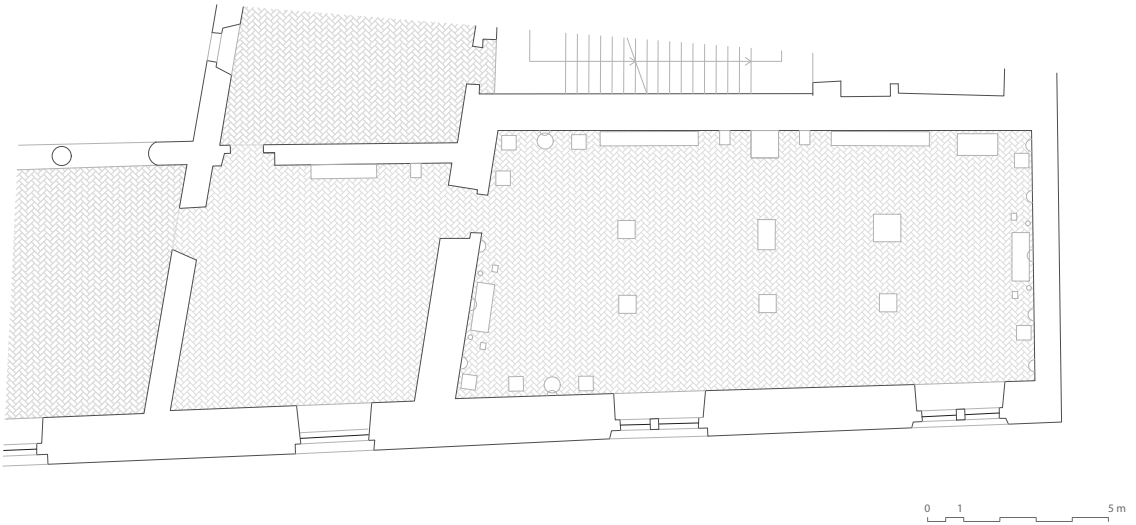


Fig. 6
Cross-section and first floor of the National Museum of Bargello.

of the room: a simple exhibit design, realized with display cabinets, wooden bases, hanging mounts, and little shelves. There is a lack in the photographic reconstruction between 1900 and 1950. We jump to 1953 (Fig. 10, 11, and 12). At that time, the then-Tuscan Goldsmithing Room (*Sala delle orificerie toscane*), now the Trecento Room, and the Majolica Room hosted a selection of the Carrand fabrics and of ceramics. A white plaster covered the mural decorations. The arrangement of the glass cases followed the long side of the walls, and some stools were placed in the center of the Majolica Room. In 1966, the Arno flood caused significant damages and losses to the museum. Consequently, the museum went through huge refurbishments, including a substantial reorganization of the collection positions.[5] As the picture from 1978 illustrates, such changes did not affect the Majolica Room. Few modifications are pictured in a 1983 shot, limiting to a partial restoring of the Neo-gothic decorations (Fig. 13, 14, and 15). The current setting of the Majolica Room dates back to 1983. Some recent adjustments limit to the technical systems (alarms, lights, heating). The Trecento Room underwent through modifications as well. Here, the exhibit design appears as a sum of unplanned arrangements.

[5] The ground floor was hosting the armory section and was severely damaged. What was saved was moved to the upper levels. The redesign of the museum allocated that space to Michelangelo's works. Carlo Cresti designed the exhibition setting.

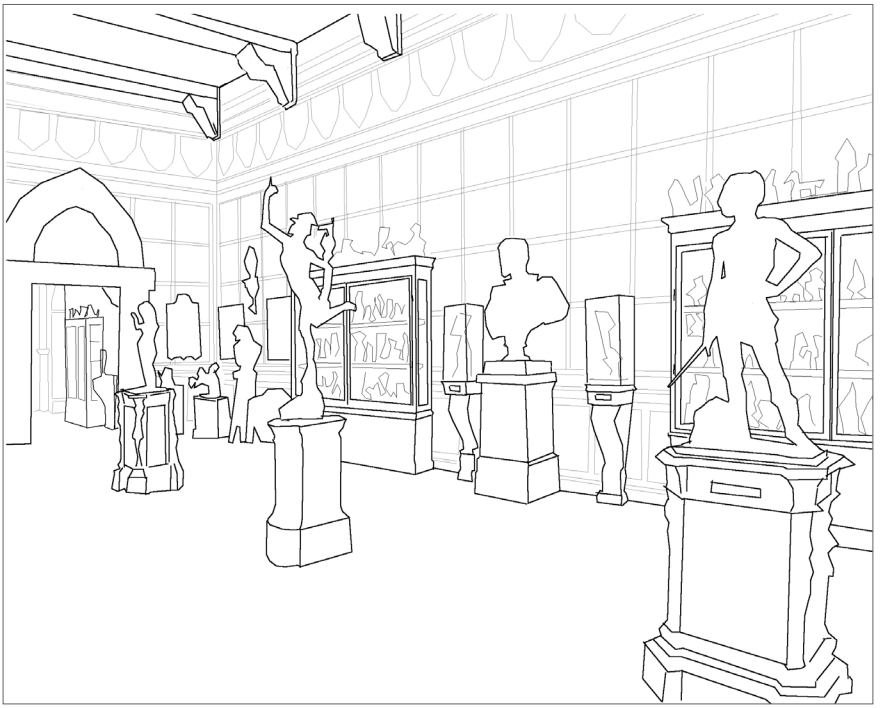


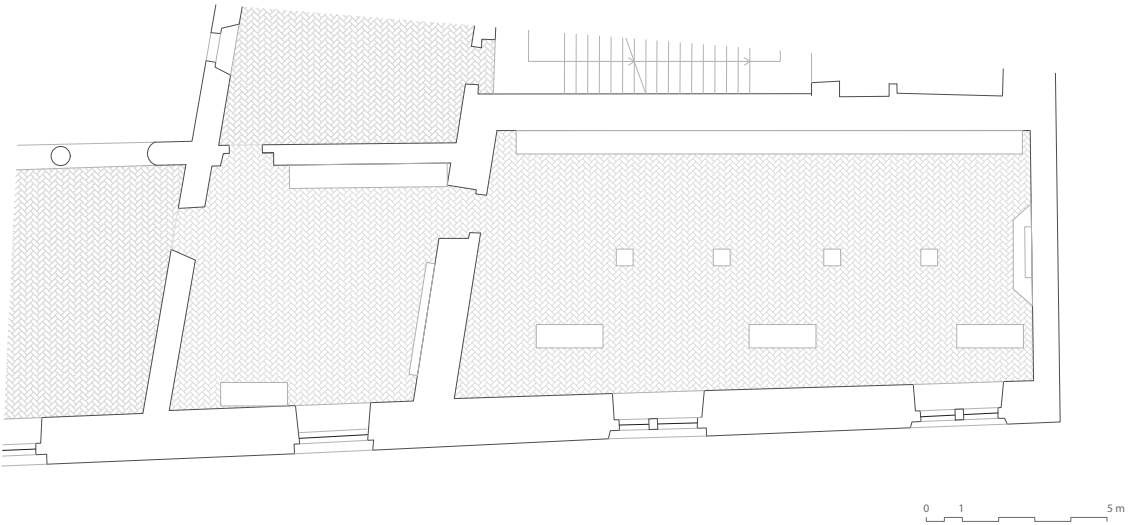
The rooms between 1873 and 1887.
Graphic reconstruction from Ciseri and Marini (2015).

Fig. 7
Plan.

Fig. 8
View of the Second Bronze Room.

Fig. 9
Other view of the Second Bronze Room.



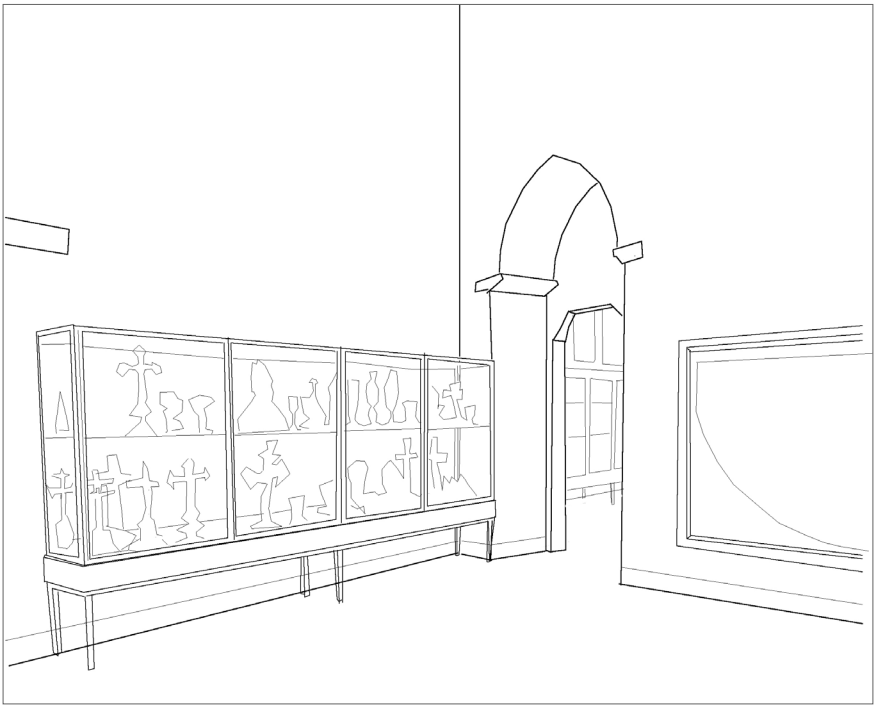


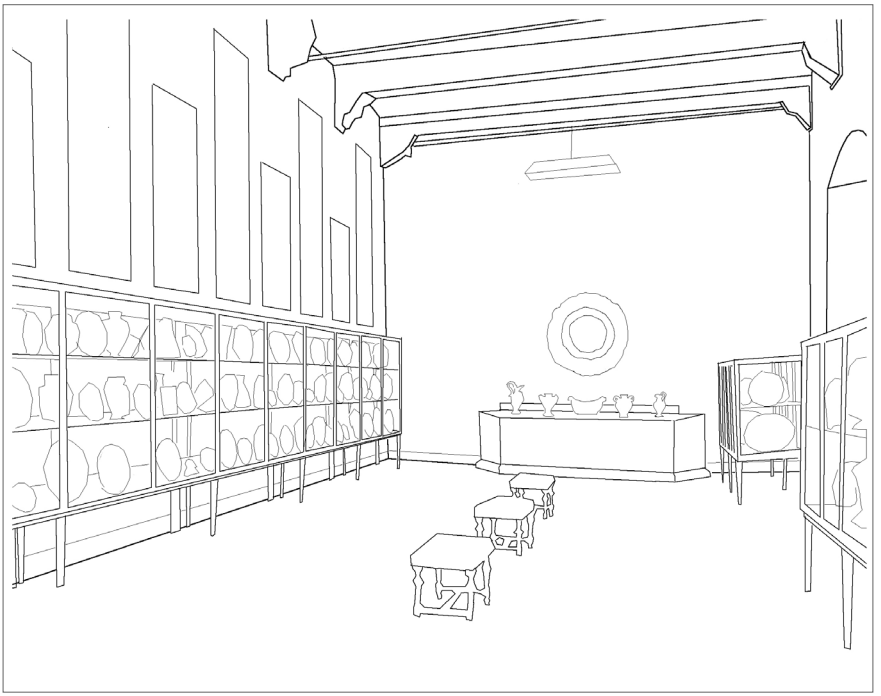
The rooms around 1953.
Graphic reconstruction from Ciseri and Marini (2015).

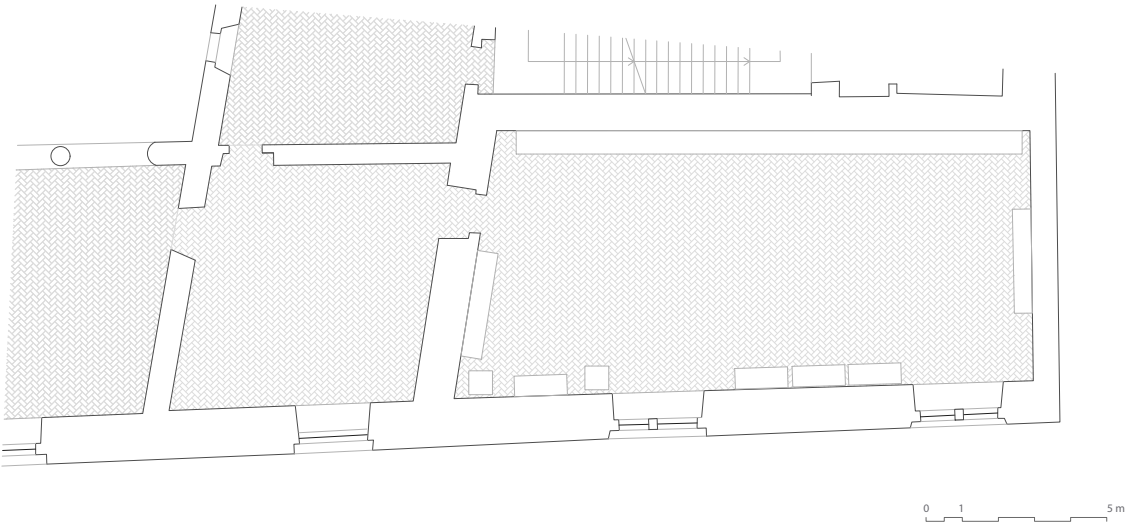
Fig. 10
Plan.

Fig. 11
View of the Tuscan Goldsmithing Room.

Fig. 12
View of the Majolica Room.





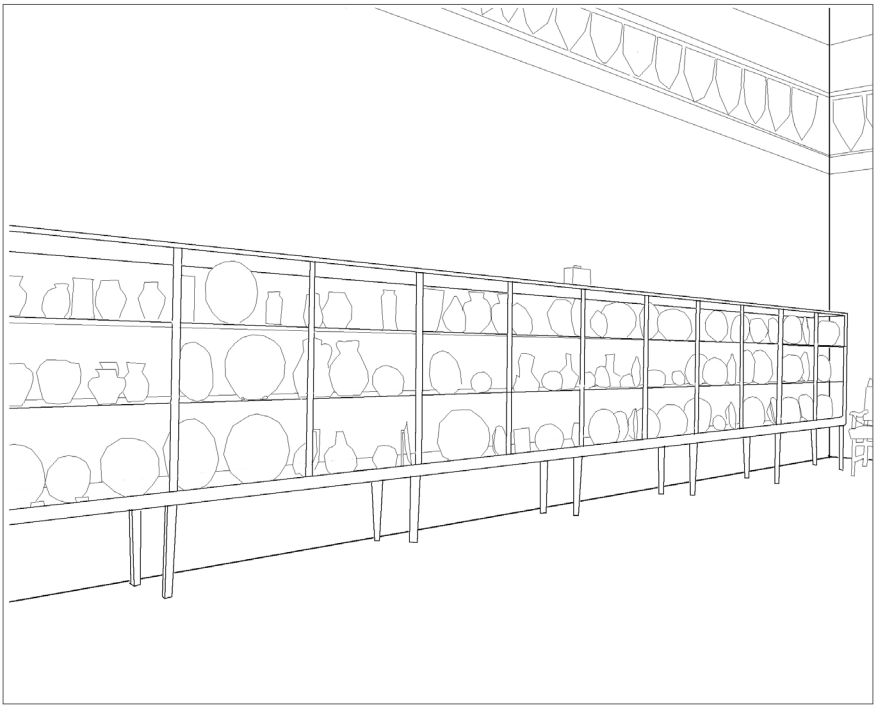


The rooms around 1983.
Graphic reconstruction from Ciseri and Marini (2015).

Fig. 13
Plan.

Fig. 14
View of the Majolica Room.

Fig. 15
Other view of the Majolica Room.



FOCUS E

THE MAJOLICA ROOM AT THE NATIONAL MUSEUM OF BARGELLO

Marino Marini
Senior Curator, MIBACT

The National Museum of Bargello is dedicated to the Reinassance sculpture and to the so-called Fine Arts. It was instituted in 1865, the first of its genre in Italy. In a short time, it saw flowing into its austere, recently restored, rooms a vast amount of works of art. These came from the Uffizi Gallery and from the suppressed religious institutions. Besides the famous Reinassance masterpieces, the majolicas from the Medici's palaces arrived at the Bargello. They created the first precious nucleus of ceramics of the newborn museum.

Right from their arrival, in 1865, the earthenware was placed in the so-called Duke of Athens Rooms (Sala del Duca di Atene – now Carrand Room). In 1891, the superb donation by Luis Carrand, a collector and ancients dealer from Lyone, arrived. On that occasion, a new arrangement of the rooms was applied. The majolicas moved to the room that still houses them today.

In the aftermath of WWII, significant refurbishment works started. More modern showcases substituted the old exhibition furniture. The actual exhibition design was realized in 1983. The showcases are distributed along the entire perimeter, hosting hundreds of majolicas donated by collectors, merchants, private citizens, together with state acquisition on the antique market.[1]

In the middle of the room, two wide showcases exhibit the majolica coming from the Uffizi Gallery that survived the repeated sales and robbery through time. The collection of ceramics and porcelain gathered by the Medici family, then inherited by the Lorena, is impressive, although it endured several scatterings between the XVIII and XIX centuries. The public sales realized in 1772 at Palazzo Vecchio confirm it. More than six thousand pieces, including Oriental and Medici porcelains, Italian Majolica, Mexican Buccaros, were ceded. Subsequent spoliations occurred during the French occupation. It is worth mentioning that several Medici family members dedicated to ceramics collectionism for more than two centuries. At first, they preferred exotic items. In a second moment, they favored the Italian ceramic workshops, like those located in Florence, Montelupo, Faenza, Urbino, and Venice.

In the current setup, Italian and Spanish Moresque majolicas are on show. The arrangement follows a chronological and

[1] To a chronological view of the arrangement of the museum, see the images in Ciseri and Marini 2015 (pp. 24, 56, 104, 123, 135, 144).

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Fig. E The ceramic collection.

geographical order, from the XIII to the XX century. Several specimens refer to donations in this sequence, a noble practice that has continued unchanged through time until today. Thanks to it, from 2011 until today, the collection has been increased by 170 pieces.[2] The public can enjoy both unedited and famous pieces. In the visiting path, one can admire important precious renaissance handicrafts, for example, those from Florence (as the pharmaceutical "zaffer" vases), Faenza, Valencia (large plates enriched by metallic shine), Castles of Abruzzo, Deruta, Cafaggiolo, the kiln located on the one side the famous Medici Villa, Montelupo, Venice, and the duchy of Urbino (polished decorated with historical figures from mythology, history, and bible). The path concludes with the production from the XVII-XVII centuries and the famous potters from modern times (Cantagalli, Chini, Fantoni).

[2] More than 70 philanthropists linked their name to that of Bargello, generously offering their ceramics. Some of them repeated the donations more than once through the years. On this theme, see Marini 2020.

The RESIMUS Analysis

Following the RESIMUS Approach, the first step is the application of the RESIMUS Forms (RF). As introduced in the previous chapter, RF1 synthesizes available museum features and gathers building and institution information. RF2 applies to the two rooms Majolica and Trecento and records the description of the rooms' architecture and collections. RF3 and RF4 apply to the pair settings-objects. In this case, the forms have been applied to one showcase focusing on the organization of the object (arrangement, mounts, components).

General museum survey (RF1-Museum Form)

The museum extends on 3.700 square meters; 3.000 of that are exhibit area, 150 deposit, 30 public services (bookshop, entrance, cloakroom), and the rest are offices and technical services. The museum hosts approximately 40.000 pieces (including coins and paper works). From the point of view of personnel management, the museum is understaffed. The staff number should consist of 55 people, while the actual employees are 32.[6] The number of visitors per year is around 150.000. Regarding the documentation about the building, the museum has limited access to documents. Plans, surveys, and reports are conserved in the general repository belonging to the Superintendency, a separated state body.

The architecture and interior design (RF2-Room Form)

The Majolica and Trecento rooms have irregular shapes. Tuscan Cotto tiles cover the floors, and a coffered ceiling with big timber beams characterizes the room. The doubled-arched windows have distinguishing stone seats.

The Trecento Room is one passing-through room with no blind walls: three contain passages (doors), and the fourth has one window. The collections are variably arranged in the space, on shelves, walls, historical furniture, and bases.

The Majolica Room has two blind walls. About the others, one houses the only access to the room and the other two windows. A series of display cabinets, made of glass, mirrors, and anodized aluminum, contains various ceramic objects. Over the cabinets, five big ceramic tondos are hanged to the walls.

[6] The number of employees includes internal staff (state employees MIBACT) and external personnel (contract companies), the latter usually destined to ticket, bookshop, cleaning operations.

The current exhibit design (Fig. 16-24)

As the name reveals, the Majolica Room is a thematic exhibition space. It is mainly devoted to the Italian ceramics realized from the XIV to the XVII century. The arrangement derives from an encyclopedic criteria: exposing all the possible specimens according to a given criterion to describe a subject. It contains medium and small ceramics plus five large ceramic tondos. The exhibition furniture of the Majolica Room sets along the four walls and in the center of the space. The room presents a recurrent solution: a big cabinet with several shelves containing many pieces. The Majolica's cabin module along the walls has a mirror as a back. If, on the one hand, the mirror has the benefit of letting admiring the back of the ceramics, from the other, it creates an odd combination of reflexes that might disturb the visitors. The shelves articulate the internal space. The mounts are made of different materials (metal or plastic) with several shapes. Some of them are customized for specific ceramics, and others are standard. The current exhibition utilizes various mounts to hold some open shapes (plates) in a vertical position. Instead, basins and vases lean directly on panes of glass. Compared to the current trends, the exhibition appears crowded and unreadable by the general public. The linear and repetitive arrangement of the objects creates a monotonous pattern. There are no emphasis spots or selected pieces catching the visitor's attention, nor masterpieces' or kids' corners. The object arrangement follows a chronological and geographical order (production place) but is not distinctly marked. The clockwise route to carry out is not immediately perceivable, making the visit unclear to a non-expert visitor. About the maintenance, the glass doors of the showcases have sliding openings. As testified by the museum staff, the opening system requires more than two people to cleaning operations.

The Trecento Room mixes sacred and secular objects, artifacts, furniture, sculptures, architectural fragments, and frames from the XIV century. It contains medium-size objects and one medium size mosaic fragment. The artworks, fixed on the bases or secured to the walls, testimony the Tuscan craftsmen's ability. Although the lack of storytelling involved both rooms, the Trecento Room has a less clear character, and the exhibition design is not remarkable. The pieces are variously scattered in the space. There is a broad sample of exhibit devices: old and recent wooden bases, wooden and in-stone shelves, historical pieces of furniture working as exhibit support, and different hooks and mounts. One sculptural architectural fragment, placed on a pedestal, marks the center of the space. Other sculptural pieces locate along the walls. Most visitors linger less than a minute in the room, going toward the Majolica Room, the Ivory Room, or the Verone.

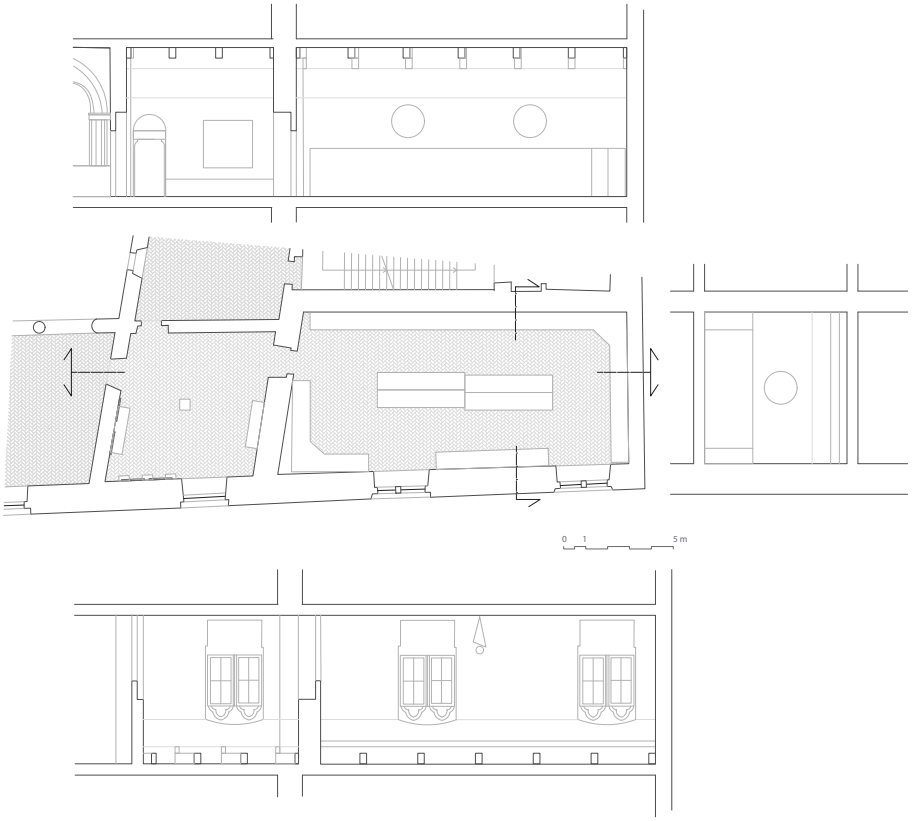
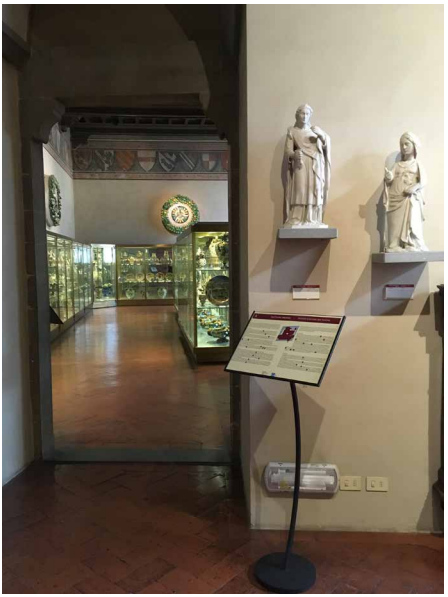


Fig. 16
Actual configuration of the Trecento Room and the Majolica Room: plan and cross sections.

Figg. 17-19
The Trecento Room in 2020.

About the lighting, both rooms have well-calibrated artificial light and benefit from the ray of sunlight. Nevertheless, the shadowing system is missing, and the risk of dazzle effects is probable in the morning.

The same graphic pattern repeats in the whole museum: an introducing stand at the entrance describing the room with few paragraphs about the collections, and eventually the room. Synthetic captions place near the referred pieces, containing name, origin, date, and related collection. In time, they have been modified or substituted. The differences in style and layout are undoubtedly visible (kind of paper, color, fonts, dimensions). The rooms, and the museum, address mainly to experts or enthusiastic. If one wishes to deepen some arguments, the option is to buy the official guide on sale at the bookshop located at the entrance.



The Vulnerability

Applying RF3 and RF4, we can derive the seismic assessment of a configuration (object and setting). Starting from the Majolica Room, we first examined one showcase module instead of the single pieces. The same module repeats, with minimum differences, along the walls and in the middle of the room. The internal display is always similar. Other considerations

Figg. 20-24
The Majolica Room in 2020.

concern the disposition of the modules, the external elements, and the interior elements and their disposal (mounts, background, suspended ceiling, internal lights). In the case of an earthquake, the main threat is linked to the arrangement of the modules. The "L" shape pattern may cause resonance problems, making the angle solution the most vulnerable portion. Unfortunately, we do not know if the modules are secured to the walls. We do know that the boxes are not fixed to the floor. There is an improper link between the ground and the furniture, consisting of electrical cables (lighting and alarm system). Therefore, stability refers to its weight (gravity). If we consider the container alone, its vulnerability grade is low. Geometry, dimension, approximate weight, material, and concentration of the mass determined it, despite the absence of information about the link between structure and floor. However, the stability of the shelves (safety glasses) is a weak point. The support surface limits, in fact, to four small metallic supports. Also, the suspended ceilings placed on the inner top side inside the cases are a further criticality. In case of an earthquake, they can fall one on each other.

Then, the analysis takes into consideration the modality of exposition of the singular object. A mixture of mounts supports various ceramics. Some are customized and belong to specific pieces; others are available in regular shops, some are in plastic, and others in metal. Given the absence of fixing points between mounts and shelves, the object might slide, rock, and overturn. Given the current concentration of the objects, the movement of a few pieces may compromise others' integrity. The tondos' vulnerability depends on the quality and efficiency of the hangs and the endurance of the built construction. About them, the results can only derive through invasive surveys (description of the hangs) and a dynamic identification and damage assessment of the masonry structure.

In the Trecento Room, the setting and the objects' vulnerability recall the presence of inadequate mounts (simple hangs, fleet mounts, disputable shelves). Unfortunately, documents about the installation project are not available. We have no information on the links between object and support, neither between support and wall or floor. Without such documents, a non-invasive analysis is not sufficient to determine the vulnerability rate. In this case, having

a definitive answer is necessary to pursue integrative analysis. Nevertheless, due to their geometrical characteristics, little statues and slim elements arranged on thin pedestals or limited surfaces (little shelves) might be identified as vulnerable.

In both rooms, the secondary risks are not high. The LED lights are secured to the chains, and other movable elements do not cause concerns, limiting to chairs, two standing panels, and the fire extinguishers.

To sum up, in the case of the Majolica Room, the analysis shows that the main issues are:

- the disposition of the cabinets – in particular in the correspondence of the angles;
- the fixing – the cabinets are not anchored to the floor, and we do not have information about the walls;
- the interior structure of the cabinets– the shelves are glass panels placed on fours metal vertexes;
- the arrangement of the objects and the mounts – types of mounts, disposal of the pieces, hanging objects.

The vulnerability grade is medium, with a medium priority of intervention.

In the case of the Trecento Room, the analysis shows that the main issues are:

- the lack of information about the link object-setting;
- the quality of the mounts.
- The high vulnerability grade is determined by the lack of information.

Final observations

Considering the form results, the Majolica Room has a medium risk from a vulnerable point of view. By applying some easy and low-cost operations, we can lower such grades. Overall, the weight, the shape, and the cabinets' disposition make the general configuration low vulnerable. On the other hand, the internal arrangement presents critical issues linked to the shelving system, the nature of the mounts, and the objects' disposition on the shelves. Furthermore, the material combinations of the showcases make them look aged. The combination of golden anodized steel, mirror, and glass might create reflexes, glares, stereoscopic effects, confusing and distracting the visitors. The embedded lighting (neon light) is not cost-effective, does not enhance the objects, and is not the safest option because of the suspended internal ceiling. There are also ergonomic and accessibility issues. The cases dimension is such that only a portion of the exposing volume is available to everybody. The pieces on the very top and on the bottom can be hardly accessible. A person in a wheelchair or a child cannot see the higher items, while a person with mobility issues might have a problem reaching the objects on the lower levels.

The Trecento Room risk grades cannot be evaluated without intrusive surveys. That is a circumstance where an expeditious analysis is hard to complete. If such, the setting is automatically classified as vulnerable. That emphasizes the limit of this kind of analysis.
From the museographic point of view, the Majolica Room's main issues connect to the embedded lighting (inside the cabinets), the communication display, the readability of the collections, and the difficulty in opening and cleaning the showcases. About Trecento Room, a museum design project is missing. The fruition of the space is not organic, worsen by the fact that various fluxes of people cross the room. The sum of these elements makes the current exhibition design organization inadequate comparing to the existing museum average.

Supplementary analysis at the National Museum of Bargello

During the development of the general research RESIMUS, specific analyses have been accomplished by part of the group. They comprehend the digital survey and site analyses on the building and on some artifacts. Azzara (2018) conducted a preliminary monitoring study on the Volognana Tower of the Bargello building. He analyzed the seismic ambient noise, meaning the vibrations that hit the building. The results, although partial, help to understand the dynamic behavior of the structure and can be integrated with punctual studies on big artifacts or setups. Sapia and his team (2018) acquired information about the subsoil of Bargello's site using non-invasive analysis. They tested CCR – Capacitively Coupled Resistivity on the museum's perimeter (along the streets), showing the potentiality and limits of such instruments in a historical city center. The goal is to construct a tridimensional model of the subsoil of the Bargello, using new analysis and old data. Verdiani conducted several digital campaigns inside the museum (2020, 2019, 2018). The survey focused on both architecture and artifacts. The result is the progressive digitalization of the interiors and of singular artifacts. We signaled for example the series of studies on the statuary complex by Ammannati, and on single objects like Giambologna's Oceano, and Donatello's Marzocco. The outcome is useful to the conservatory and numerical studies and as documentation and a source for digital installations or virtual expositions.

Fig. 25
Sant'Agostino Museum, Genoa. Paolo Monti's glimpse of the exhibition design conceived by Franco Albini.

Fig. 26
Gallery of Palazzo Rosso, Genoa. The cases for the Majolicas and Porcelains Room designed by Franco Albini.

Fig. 27
MUNDA, Museo nazionale d'Abruzzo, view of the temporary venue and exhibition.

The Design

The museum references

A standard procedure in the design process is the study of the references (Collotti 1994). We started considering the Italian masters's works, in particular Albini in Genoa and Scarpa in Palermo, who confronted themselves with significant architectures. We also investigated the works by Zumthor, in Colonia, Chipperfield, in Berlin, and Radic, in Santiago de Chile. They intervened in the refurbishment of historical architectures and the design of the exhibit systems with various outcomes. These architects' works are interesting to understand how they interpret the link between architecture and collections, site and architecture, how they develop the project, and how sophisticated technologies (e.g., lighting and temperature control) integrate with the arrangement of the collections. Most of the exhibit devices (cases, mounts, bases) are developed jointly with specialized suppliers. Today, the exhibition cases have high-level performances and need to fulfill the required certifications. The market leaders in exhibit furniture solutions are usually available to collaborate with the designers and developing custom-made pieces.
We compared and studied some museographical examples adopting anti-seismic devices or other compatible valid solutions, like the Getty Museum, Los Angeles, California, USA, the Anchorage Museum, Alaska, USA, and the Munda – Museo Nazionale d'Abruzzo, L'Aquila, Italia. Among the cases, the Munda, in L'Aquila, emphasizes the synergic work between professions and State Institutions. The hosting location changed after the earthquake of 2009. The museum moved to the former slaughterhouse, closed to the famous *Fontana delle 99 cannelle* (literally fountain of the 99 taps). The exhibition

design is anti-seismic and applied to most of the collections, but the venue is temporary. The institutions' goal is to recover the museum's former location, the Spanish Fortress, and to move the collections back there (Congeduti 2018). We repetitively mention the Getty Museum example as a pioneering case study. Getty's efforts bring to the realization of prototypes, introducing new approaches, opening dedicated research fields, and new collaborations with other institutions and professionals. The Getty benefits from the in-house research center, allowing the idyllic possibility of theorizing and in parallel testing hypotheses. The exhibit design of the new wings of the Anchorage Museum is an exemplary case study. The museum has the necessity of co-living with earthquakes. The new museum extension, designed by Chipperfield in 2010, is the part that hosts most of the collections and exhibitions. The structure enables installing customized suspended cases, only partially anchored to the floor, allowing the glass panels to move independently without opposing the two levels movements. Such configuration prevented significant damages. In 2019, a 7.1 magnitude seism hit the region. The museum endured only minor damages, mainly in the old wings. None of the objects was harmed. Several aspects guaranteed such a happy ending: the design of the museum setting, the cases, and the pole-and-bracket support system. Only

some glass panels partially cracked.[7] It is worth also saying that since 1992 the museum hosts the Smithsonian Institution's NMNH Arctic Studies Center, benefitting from the Smithsonian research structure. The Anchorage is an example of a successful collaboration among museum designers, engineerings, curators, researchers, conservators, and institutions.

Fig. 28
The Majolica and the Trecento rooms: new arrangement proposal.

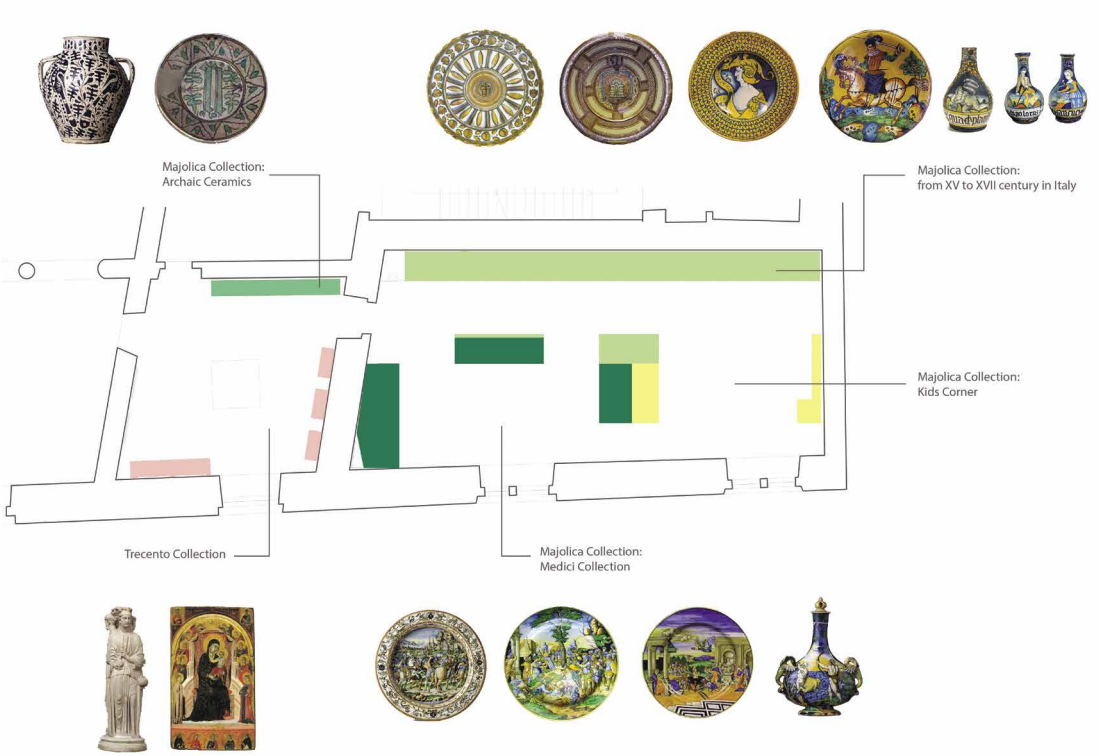
Other well-known examples are not part of the study because of the inconsistency with the research's criteria. It is the case of the new setting of the Michelangelo's *Pietà Rondanini* at the Castello Sforzesco, Milan, Italy (Cerri and Collotti 2019) and of the *Bronzi di Riace* at the MarRC – National Archeological Museum of Reggio Calabria, Reggio Calabria, Italy: they both concern only the arrangement of big objects. Although geographically distant, the chosen case studies share the same intervention modality involving several professionals and proposing resilient solutions. All the cases foresee upgrades, modifications, and changing through time. A monitoring and prevention plan is continuously renewed. The exhibit design plans and the mount-makers emerge as strengths. The design comprises both anti-seismic devices and a museographic approach: two elements with the same importance. The presence of a mount-maker is essential. He is a museum expert, collaborating with both designers and conservators, and is in charge of upgrading and customizing the mounts.

Since a consistent part of the project includes the exhibition of ceramic objects, we compared different exhibits to endure the several ways of showing this typology of objects, besides applying basic practices of displaying (Vaudetti and al. 2014). We studied the mount solutions, the possible furniture options, and their applications. The investigation pursues different museographical aspects, from the technological adopted solutions (e.g., arrangement of the objects, materials, light, arrangement of the communication part, graphics) to the fashion in the exhibit design. Such analysis confirms that there are endless ways of exposing and recurrent disposal systems.

Requests from the museum

With the museum staff, we discussed the requests about the expected new setting, the pro and cons of the current situations, the curatorial program, and the future museum goals. The appointed curator, Marino Marini, underlined the inefficiency of the showcases, regarding:

[7] https://www.anchoragemuseum.org/about-us/museum-journal/museum-journal-archive/earthquake-repairs-to-the-living-our-cultures-exhibition/#:~:text=Glass%20end%2Dpanels%20on%20three,before%20case%20repairs%20could%20begin.> (11/20)



- the opening operations – too much time to open them, the necessity of having at least two people to move the windows;
- the danger of the dust – abundant in the center of Florence filtering inside the cases;
- the cleaning – the high-priced cost of this services (linked to the previous point);
- the lighting – both artificial and natural present criticality.

He adds that, although the general lack of storage spaces, part of the showed ceramics might be reduced, placing it in a small internal deposit. He also manifested the need to re-labeling the ceramic collections. From a museographic side, the elements pointed out by Marini align with our survey. The museum's request concerns the necessity of installing performing display cases: safe and practical. The staff needs to be freely able to open and reorganize the cases with ease gestures and without spending additional money. It would profit from the new design, renewing the organization of the collections and replacing all the captions.

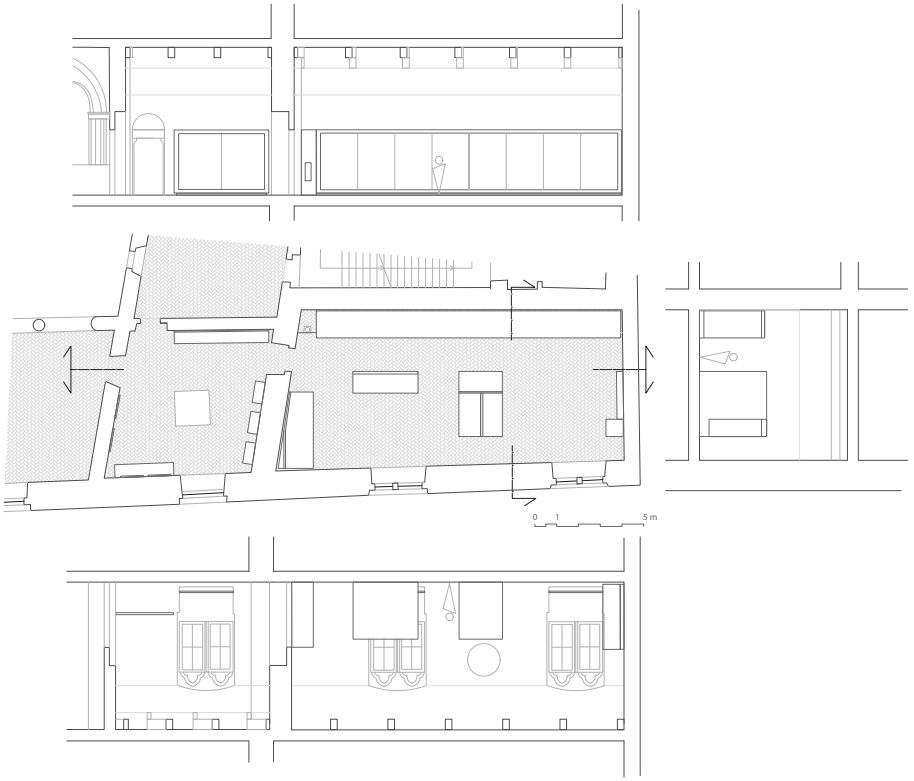


Fig. 29
The layout proposal, plan and cross sections.

The design solution

Given the analyses' results, earing the curator's requests and needs, and investigating comparable case studies, we moved forward, starting reasoning on a museographical proposal. The design considers the RESIMUS form results, the safety measures to adopt, the museum necessities, the available technologies, and the design analysis. The goal is to suggest an articulated feasible project: safe, accessible, sustainable, and coherent according to the recent museographical discussions. In light of the general situation generated by the Covid-19, we have also to consider the new possible kind of fruition and other

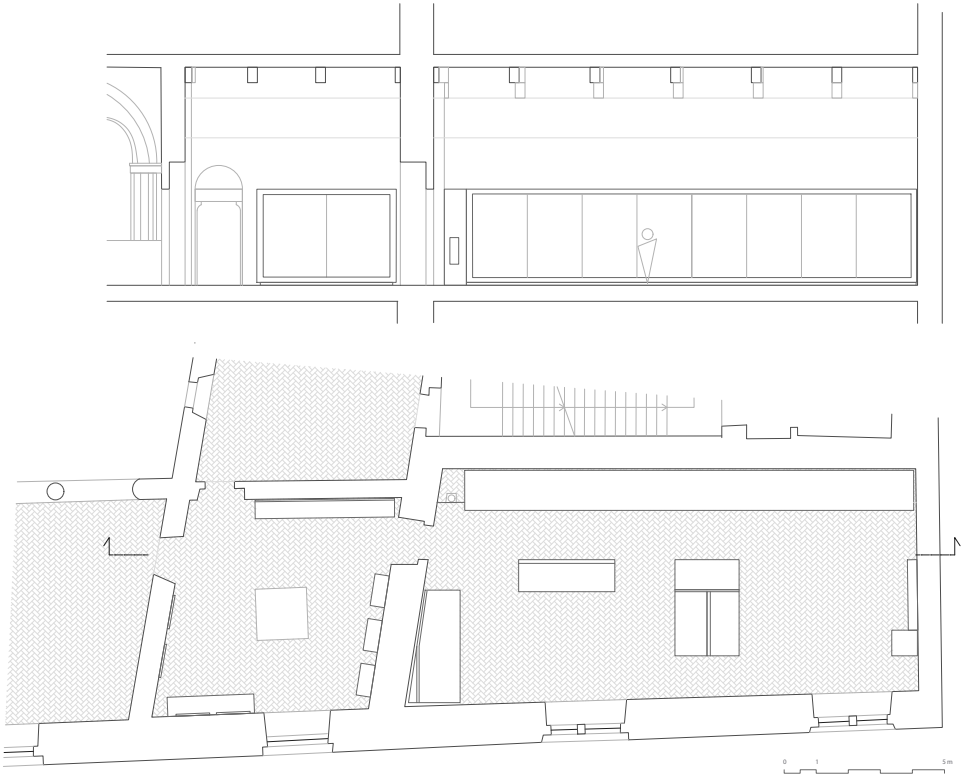


Fig. 30
The layout proposal, plan and one cross section.

upcoming ways of visiting the museum. Summing up the main field of discussion, the museographical design considers:

- Room redesign;
- New showcase exhibition design (furniture);
- Study of the mounts (anti-seismic solutions);
- Communication apparatus;
- Lighting system.

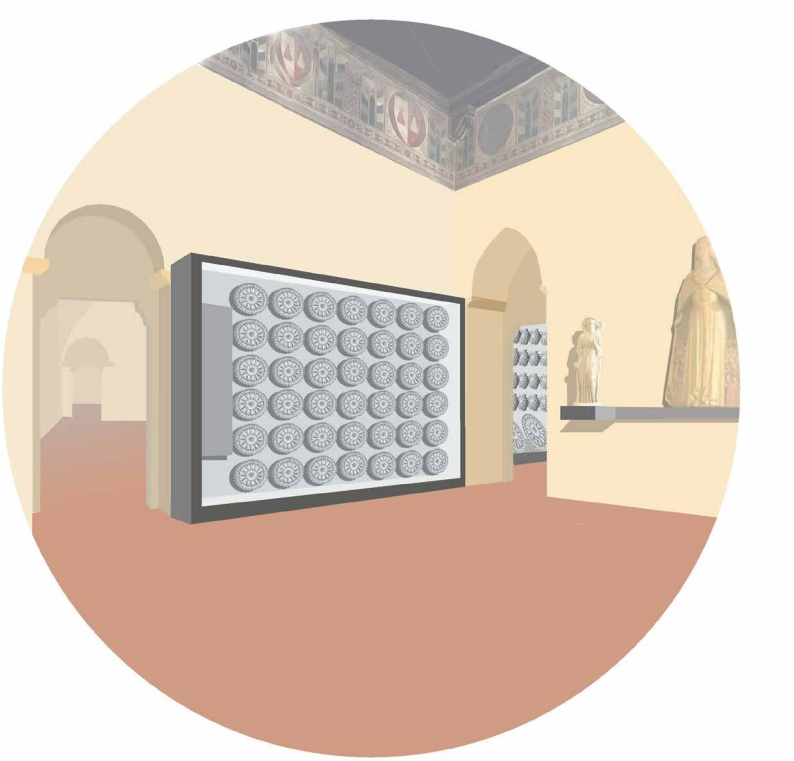


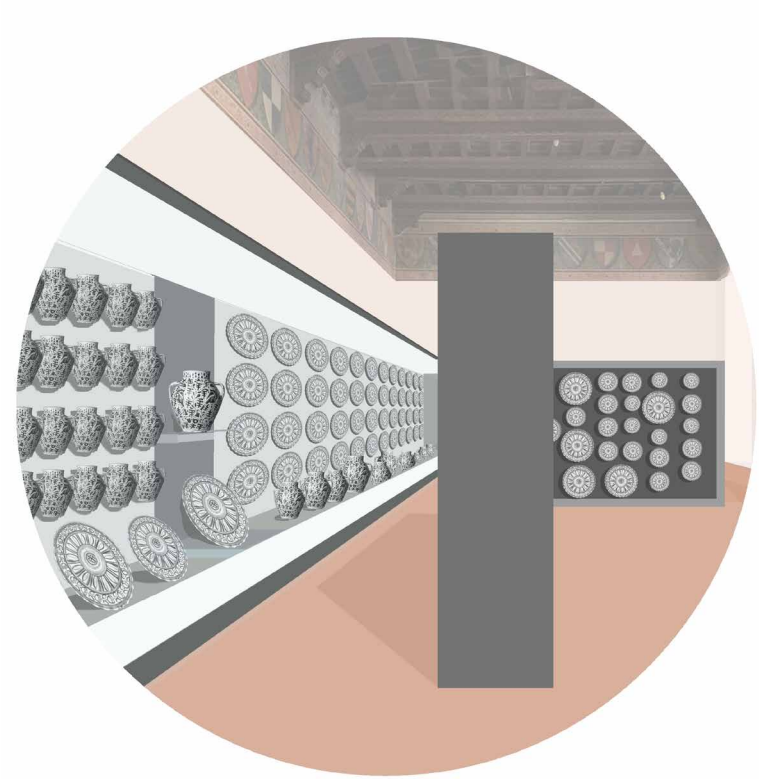
Fig. 31
Maquette of the Trecento Room.

Fig. 32
Maquette of the Majolica Room.

The design of the rooms

The project originates from the study of the rooms historical modifications and presents a synthesis of the requests and current needs. The two rooms, the Majolica and the Trecento, work together. The design idea is to improve the quality of the space organization, the visitors' experience, and arrangement of the collection. The necessity of having most of the pieces on show forces a solution that does not align with the general current museum trends: few displayed objects, persuasive narrative, and strong visual impact (Nielsen 2017). Due to the lack of storages, the reference of the arrangement is still the encyclopedic exhibitions. The ceramics are organized by year and production site. The museographical goal is to realize a safe solution, and to set a suitable space for the objects and a welcoming space.

The arrangement proposal (Fig. 29) considers the setting realized in 1887. The furniture position emphasizes the continuity of the two rooms with a visual and thematic connection. The ceramic collections are introduced already in the Trecento Room. The



showcase places along one wall and hosts the Medieval ceramic production (Central Italy Archaic Majolica). The same typology of furniture, with identical high and materials but different depth, continues, following the left wall, in the Majolica Room. This room is still entirely devoted to the ceramics collections. The furniture also subdivides the space into three areas. The corridor, with the chronological exhibition of the ceramics, already mentioned, and two delimitated spaces. The cases create two inner spaces. The first one dedicates to both adults and children. A special exhibition panel, anchored to the wall facing the entrance, hosts objects, multimedia devices, and traditional explanations. It is the only spot in this room integrating multimedia technology and traditional exhibit. The multimedia elements are tools to arouse curiosity and deepen some aspects of the ceramics' pre-industrial manufacture, such as production, shapes, decorations, and colors. In particular, it points at the digital users, those who, at any age, get used to interacting with digital content only. Concerning this point, with the Covid-19 pandemic situation, the traditional digital options are

Fig. 33
Mounts, some examples.

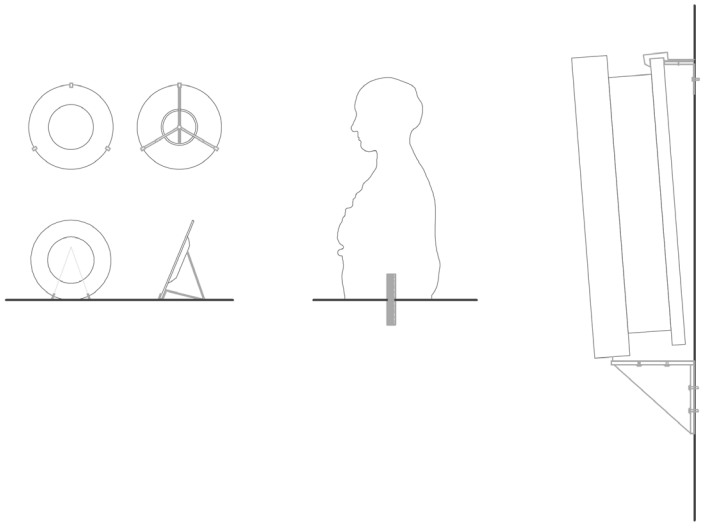
under debate.[8] The possible solution might be the fruition through the visitor's device or the interaction without touches. Both outcomes have pros and cons and different prices. However, the final result has to be linked to the contents that the curators want to propose. The second space dedicates entirely to the Medici Collection. These ceramics are considered the masterpieces of the room. The disposition of the furniture allows the presence of the exhibition on three sides. The window side is set with benches, to sit, admire, and rest. The inside space of the cabinet allows the proper distances among the pieces. It is possible to arrange the objects in various configurations: on the vertical plan (structural backward), using interior bases, placing movable shelves, and introducing new spaces for the graphics and the captions. Despite the permanent character of the proposal, such a solution allows the modifications of the internal disposition, the reorganization of the thematic sections, and even the creation of little internal temporary exhibition spaces (for example "the ceramic of the month"). The tondos stay in the Majolica Room, placed higher upon the showcases, and secured to the walls. Going back to Trecento Room, the right side hosts little sculptures, furniture, and pictures. The suggested design forces the narrative of the objects.[9] It tends to overcome the concept of the object as art pieces (Malraux 1947), favoring the interpretation of the origin of the object: altarpieces and their original locations, architectural fragments, original layouts. The arrangement depends on the reading and interpretation given by the curators.

All the windows are internally shaded. The natural light is scattered to avoid the risk of reflections and dazzle effects. The window steps become part of the design intervention, hosting movable benches. They have a double use as a resting spot and as an obstacle, blocking access to the windows for safety reasons. In general, the suggested setting does not subvert the current configuration of the spaces. The design is respectful of the place, does not cover the Neo-medieval restoration, and is coherent with the museum's general setup.[10] The exhibition design is the tool by which the objects are enhanced and shown to the public. Traditional exhibition and digital tools integrate into a constructive dialogue. The seismic safety devices are, let say, invisible, being an integral part of the exhibit solution.

[8] While we are writing, several calls for paper and online conferences are in progress. The international institutions, universities, and professionals promoted campaigns and focus groups questioning the ongoing situation. Reports and collective mapping of the digital initiatives have been traced in these months. (NEMO 2021, ICOM 2019, Zuanni 2020)

[9] The design option connects to the possibility of understanding the actual vulnerability grade of the exhibit devices. If the settings are safe from the seismic perspective, the design might conserve part of the current setting, working on little interventions and visual aspects.

[10] The museum's indication was to maintain a continuity with the current and general settings, although refurbishments are under construction).



The project in 7 keywords

1 | Safety

One of the most critical aspects of the research is to determine the seismic vulnerability grade of a setup and identifying the best suitable solutions. Safety pertains to the protection from various threats: fire, conservation, vandalic acts, thefts, and other natural disasters. The project follows the mandatory prescriptions on safety and conservation. In addition, it aims to decrease the seismic risk to the minimum possible level. The efforts focus on lowering the risk level according to an updated and coherent museographical approach (Knell 1994, Craddock 1992).

The RESIMUS Forms and the museographic analysis pinpoint the vulnerabilities and the strengths of an exhibit. The current display solution of the Majolica Room contains a cabinet typology that is still a valid option from the geometrical point of view. However, it need to be updated to the current safety and conservatory requirements (Realini 2016). The mandatory precautions are to avoid the corner position of the cases and to uncouple the showcases from the building architecture (Reihorhn and Viti 2020). When possible, the cases with heavy bases should be attached to the slab, limiting the risk of rolling and sliding of the structure. The back of the case should be detached from the wall but secured to it thanks to specific hooks (D'eredità 2016). The closing system has to follow safety prescriptions in terms of conservation and safety.

For this reason, we chose tested solutions developed by companies leader in the exhibition sector. Other safety improvements concern the mounts (Fig. 33). The design solution

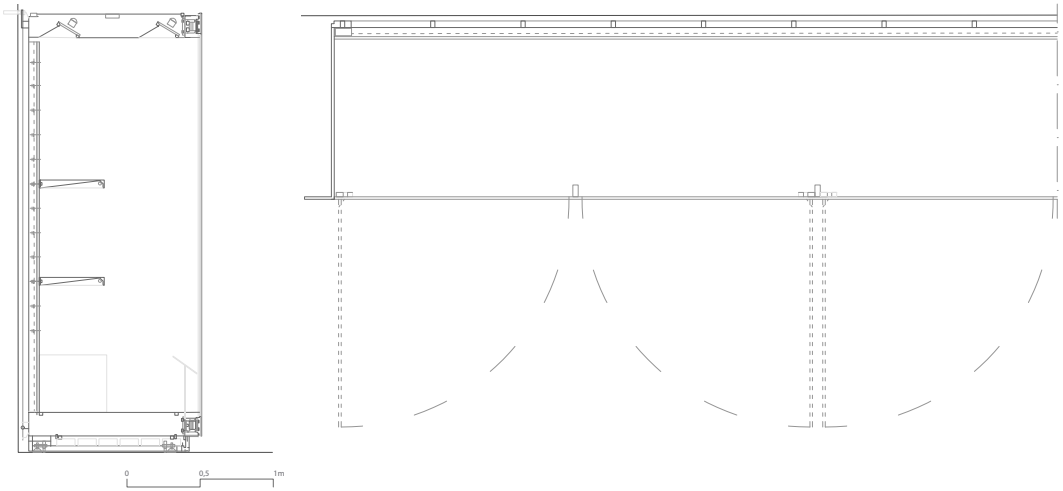


Fig. 34
Example of the showcase typology.

Fig. 35
Mounts taxonomy.

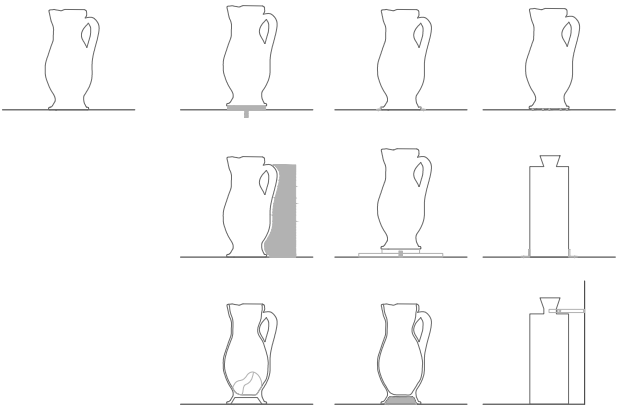
foresees that the objects can be placed horizontally on shelves or vertically with mounts. The specific solutions will follow the exhibition program. Each element is unique and often the safety devices need to be adapted, customized, or modified accordingly (see Appendix II-Mounts).

2 | Technology

For the Majolica Room, we opted to substitute the existing cabinets with other models. (Fig. 34). The presence of highly skilled companies on the market and the requested standards lead us in searching for the best suitable option. For the sake of the research, designing a new typology of a showcase from scratch would not have been a substantial contribution. On the contrary, a slight modification of existing examples appears as the wisest solution. The research has a concrete implication and building new tailor-made showcases is insanely expensive, time-consuming, and not cost-effective.

We selected a Goppion Technology showcase model. Goppion Technology is an Italian world leader company in museum display technology, and it is one of the suppliers of the museum. The examples of the Victoria&Albert Museum, London, the Metropolitan Museum, New York City, and the Brooklyn Museum, New York City, show some configurations similar to the one hypothesized in this project. Such solutions allow a wide variety of arrangements, giving us the opportunity of playing with the collections.

We choose the 'Qv7 push-and-slide model' with concealing mechanism, foreseeing some customizations and improvements in the mount choice. The vertical display cases



are freestanding and wall-standing. The model can have a drilled back, permitting the safe allocations of removable mounts, shelves, and graphic panels (as in the Museum Galileo in Florence). This kind of back allows quite freely arrangements of the pieces and modification of the layout (CNR 2016). The metal attic contains the apparatus of LED lighting, as well as the shelves. The freestanding cases, with sliding or hinged door opening, are lower with identical features.

3 | Mounts

The Getty experience teaches us that the mounts must have specific safety shapes. The mounts sustain the objects, prevent them from falling from the anchoring point and from crashing on others. Although similar, ceramics have different characteristics. The mount solutions might vary according to the exhibit position (vertical or horizontal), the object typology, and the shape (Fig. 35).

Inside the showcases, the objects can be exhibited on the vertical back or on the horizontal plans (shelf and bases). Open forms (plates), some vases, and little objects hang on the vertical surfaces, gaining exhibit space inside the cases. Customized metallic mounts secure the object to the vertical plane. Big vases, basins, and rounded forms lean on horizontal surfaces using different mounts. Big vases may have more than two hanging points. The objects, lying on horizontal surfaces and internal bases, and the plate-holders need to be fixed on the surfaces with a specific fixing wax (e.g., Microcrystalline Wax, Laefer et al. 2015). For other items, the solutions must be evaluated case by case (Lowry et al. 2007). They can be clips and

stops, internal mounts, and contour mounts. For example, objects with uneven bottom might need a cast interface, otherwise, to stabilize the vases one can place a weight inside the object to lower the center of the mass and the possibility of movement.
In the case of the tondos, we use wall mounting. The choice depends on the conformation of the back of the heavy ceramics and on the condition of the wall. There are various possibilities: steel frames, the combination of shelf support, interface and clips, special secured hanging hardware.
The statues and the painting exhibit in the Trecento Room have similar possibilities, helping by the fact that those elements are not very heavy nor monumental (except for the furniture). The suitable mounts could be contour mounts, clips, stops, and compression mounts for statues, a hanging system with secured hook and double wire for paintings, the combination of shelf support for architectural fragments.

4 | Timeless and Flexibility

One goal of the project is to design flexible spaces. The now necessities can be different tomorrow, and the trend in vogue can be old-fashioned in a few months. The aim is to combine a new design, updated to recent technology, and traditional museum solutions. So to have:

- a timeless design, refusing the yearly fashion trend in interior and museum design,
- a flexible setting, opened to some spatial modification and customization of the interiors of the showcases (internal organization, graphics).

We have to consider that the museum staff change through the years[11] and that the typologies of the public (international, local, passionate) are in continuous transformation. Brand-new alternative technologies can arrive on the market. New communicative strategies might be defined, and, unfortunately, other emergency global situations can occur. As a matter of fact, public museum sustainability usually founds on public money. That implies a careful consideration of goals, strategic plans, and museum mission. The protection of the movable heritage should always be part of the management plan. A permanent exhibition has to last and work: it must find the right balance between permanence and flexibility.

[11] The museum staff changes include different directors and turnover of internal museum staff and external services. According to the Franceschini's decree, the director of the so-called "big museums" has to be nominated by public competition, and the mandate is ten years as a maximum (5+5).

5 | Graphic design and communication

The design includes a new communication apparatus. The graphic design is consistent with the rooms' general layout and in line with the museum's graphic identity. The text sections and the graphics do not overwhelm the objects.

As in the rest of the museum, the captions are shorts, but some objects, the masterpieces or the must-sees, may have long descriptions. The goal is to have easy to remove and replaceable labels. The general graphic follows the curatorial plan, and the colors of the new exhibition design have a neutral tone palette. The latter enhances the colors of the ceramics, standing up in the background. The corners of the masterpieces can differentiate with different colors and graphics (Da Milano and Sciacchitano 2015). These catching solutions help and guide the visitor.

The internal mounts, shelves, and pedestals have not a fixed position. Thanks to this exhibition system (rear panel with perforated grid), any time the curator can change the order and the disposition. It also allows the possibility of rearranging the objects with minimum expenditure during restorations, loans, rotations. The interior articulation can be enriched by movable graphic panels.

Part of the communication display also includes multimedia content. Due to the limited amount of space, it concentrates in a single area. The best option should be a comprehensive design, mixing different tools and communication supports. The digital project should involve the whole museum, with a coherent communication strategy that includes all the media (in site communication, web, social, traditional media).

Due to the health guidelines against Covid-19, the multimedia cannot include touches. There are alternatives for multimedia devices, as the broad literature and experiences show (Colombo 2020, Van den Akker and Legêne 2016, Parry 2010). Besides the specific issues, the general discussion on multimedia and digital contents, inside and outside the museums, and the necessity of interaction between the public and the museum objects are central points. The pandemic situation stressed the demand for a broad consideration on museums and the public. It also forced a discussion at an international level on aspects like, the links between museums and community, the probable absence of mass tourism for a while, and the digital role.[12]

[12] Interesting initiatives promoted by the Policy Learning Platform, part of the Interregional Europe program of the European Union, <https://www.interregeurope.eu/policylearning/news/9060/digital-technologies-and-museums-post-pandemic-experiences/?no_cache=1&cHash=ac20f3f34bd14b8bf4a5c93ef6110f54> (11/20).

6 | Lighting, Natural and Artificial

The project maintains the general lighting system, consisting of eight LED spots hanged to the existing chains in the Majolica Room and six in the Trecento Room. The lights need to be moved and redirected. The new showcases embed dimmer and oriented lights (LED technology) located at the bottom and the top of the box and integrated in the shelves (Goppion 2018). Monitor sensors allow the possibility of turning on and off the lights when people visit the rooms, foreseeing a minimum light for safety reasons when no one is in here. The natural light coming from the windows is shaded by curtains, limiting the reflections on the glasses, the dazzle, and dark-light effects.

7 | Accessibility

To make a place accessible to everyone, we foresee some basics adjustments. The cases' position allows the passage of wheelchairs and strollers, and the objects' arrangement inside the showcases follows the prescriptions suggested by the document *Accessible Exhibition Design* by the Smithsonian Institute (1996). The colors, the lettering, and the way-finding follow the principle of being understandable by most people. The written text is bilingual, Italian, and English.

The goal is to make, step by step, a museum for all. The museum design should host, for example, readable materials for all visitors, including alternative formats and solutions for people who cannot read standard prints (e.g., Braille, audio, Language sign). The outcome could be possible only with a proactive collaboration among curators, museographers, sociologists, psychologists, graphic designers, and engineers.

The educational aspect is part of the accessibility category. Some studies (Andre et al. 2017, Watson 2007, Hooper-Greenhill and Moussouri 2000) emphasize the necessity of attracting young generations to museums and cultural institutions. According to them, this action has multiple benefits. First, it fosters a future potential public. Second, the museum can play a significant role in children's development, even in 0-3 years (Munley 2012). The design of the rooms is essential in making the museum welcoming for kids. In this setup, one area is dedicated to the target 'children.' Here, the communication apparatus and the object's position are arranged to a lower level.

CASE 2

THE APPLICATION OF THE RESIMUS APPROACH TO A TEMPORARY EXHIBITION: DI TUTTI I COLORI, MONTELUPO FIORENTINO, FLORENCE, MARCH 6-JULY 28, 2019

In general, the production of a temporary exhibition involves several professionals, combines different fields of knowledge, is the result of people's synergic work. Compared to permanent installations, temporary exhibitions give more space for experimentation and freedom of expression. That has to be coherent with the curatorial and scientific project, the recipient expectation, the budget, and the institution's general program.[1]

The following paragraph illustrates the realization of a temporary exhibition applying the RESIMUS Approach. Again, the collaboration among all the actors is fundamental to the operation's success but also the most delicate. One might encounter complications linked to administrative, procedural, financial, and policy aspects involved. In this temporary exhibition, the application of the RESIMUS Approach differentiates from Bargello's one in various aspects. First of all, regarding the Analysis Part, we applied only the RF1 of the RESIMUS Forms. We used it to study the general features and configurations of the venue. RF2, RF3, RF4 were not used in this case; there were not previous settings to analyze. Conversely, Design and Installation Phases were more accurate since the temporary exhibition was realized. The design benefitted from the theorization and the study developed during the RESIMUS research. The goal was to realize a coherent exhibition. It was conceived without distinction between compositional, technical, and engineering fields, and benefits of researching the seismic assessment of museum collections. The outcome was the combination of several aspects, in particular: the analysis of the site; the study of the objects on show; the definition of a coherent museographical program, resulting from the interpretation of the curatorial

[1] "The realization process goes under five main steps: I) Feasibility (Idea, Feasibility-cost, resources, etc., Purpose Statement); II) Preliminary Design (Assembling the Players, Communication Goals, Rough Schedule and Budget, Research/Front-end Evaluation; Storyline/Conceptual Design/Formative Evaluation, Design the conceptual design or layout of the exhibit area, Describe the look and feel of the exhibit); III) Detailed Design (Script/Final Design/Formative Evaluation, Cost Estimating and Design Revisions, Communication design); IV) Production Planning (Final Production Schedule and Budget, Construction and Specification Documents, Promotion of the event); V) Production (Fabrication and Installation, Opening, Maintenance, Summative Evaluation, Exhibit Redesign/Adjustments, Disassembling)." From: Smithsonian Institution 2002 <https://www.capitalheritage.ca/plan-design-exhibition/> (11/20); Eventually, there should be the sixth phase in the case the exhibition foresees a follow-up or animation during the time of opening.

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Fig. 36 Coordinated image of the temporary exhibition di Tutti I Colori, graphic design by G. Cerri.

intentions and its translation into the design; the adoption of safety measures, including anti-seismic solutions. Having a small budget, constraining the expenses was mandatory. Therefore, we used all the possible materials already possessed by the museum (bases and lights) to realize an original design. Thanks to the RESIMUS team's studies (numerical and virtual models, testing labs, and analysis of the literature review), the range of the possible safety solutions to apply was quite clear. The designed solution was simple, inexpensive, and seismically safe since its conception.

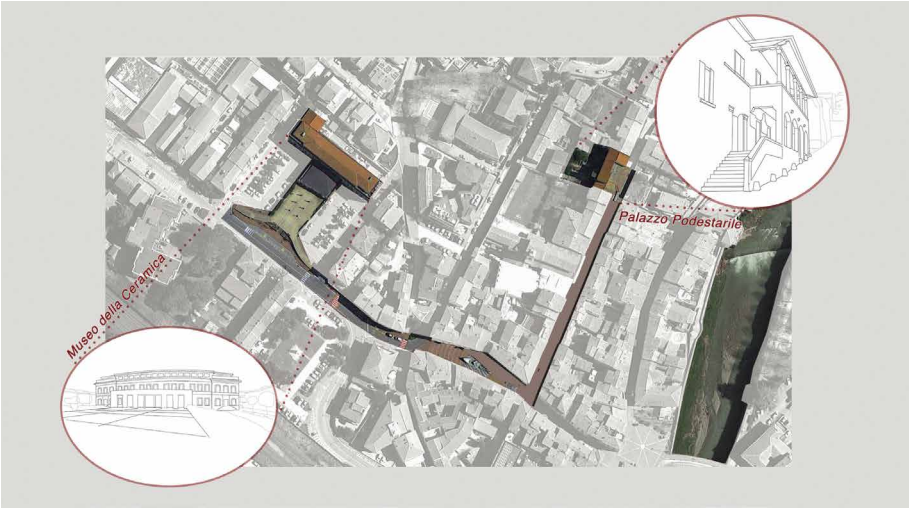
di Tutti i Colori, the Exhibition

The temporary exhibition *di Tutti I Colori. Racconti di ceramica a Montelupo dalla «fabbrica di Firenze» all'industria e al design* (All the colors. Tales of ceramics in Montelupo, from the "Florence factory" to industry and design),[2] produced by the Montelupo Museum Foundation in Montelupo Fiorentino, has been the occasion to test the RESIMUS Approach on a temporary exhibition (Cerri 2019).

Fig. 37 Exhibition venues.

The exhibition opened from March 6 to July 28, 2019. It was set up in two venues, at the *Palazzo Podestarile* (Chief Magistrate's Palace) and at the Ceramic Museum (Fig. 37). The first hosted the central nucleus of the show, the second presented a special section, a sort of follow-up of the exhibition with a focus on Renaissance Ceramics. The exhibition illustrated the history of local ceramics, from the XIII century to the current days (Mandolesi and Vignozzi 2019). Around 120 objects narrated the Montelupo ceramic district: history, innovations, new techniques, recent design experiences, successes and failures. The chosen narrative thread was the color, representing a distinguished element of this ceramics. The Podestarile exhibition was articulated in two parts: the ceramics created

[2] Credits: Curators: A. Mandolesi, M. Vignozzi Paskowski, with M. Marini (scientific collaboration); Exhibit design and Graphics: G. Cerri; Organization: Montelupo Museum Foundation; Set-up: ACME04; Multimedia: Unità C1 and IC Videopro; Press Office CLP Relazioni Pubbliche and Comune di Montelupo; Social Media: Comune di Montelupo.



from the XIII to the XVII century hosted at the ground floor, and, on the first floor, the production from the XVII century to present. The modern section included an area dedicated to the ceramics for the table from 1920 to 1980. In this volume, we illustrate only the exhibition project setup at the Palazzo Podestarile. The part developed at the Ceramic Museum, although scientifically relevant, has few innovative design aspects. Here the work concentrated mostly on scenography, reasoning on preexistences and new elements, and graphics.

The Spaces: Palazzo Podestarile

Palazzo Podestarile is a historical palace. The building used to be, in order, Podestà's residence, Municipal House, and Ceramic Museum. Now, it hosts temporary exhibitions and special projects curated by the Museum Foundation. The palace articulates on four floors. Two of them, ground and first floor, are exhibition spaces. The basement contains the services and the storages, the last floor hosts the modern ceramic archive.[3] The ground floor contains five exhibition rooms, differing by size and shapes, whit a constant heigh (around 6 meters). The first level articulates again in five rooms with a lower heigh. All floors are in Cotto tiles, and most of the window sides are covered by wooden walls. The lighting bases uniquely on an old artificial light system, waiting for a renewal. The several internal modifications erased the old medieval decorations, with one exception on the ground floor. Although there is no ban

[3] There is an ongoing refurbishment project involving the cultural sites of the city center. Such a long-term program also involves the Podestarile Area.

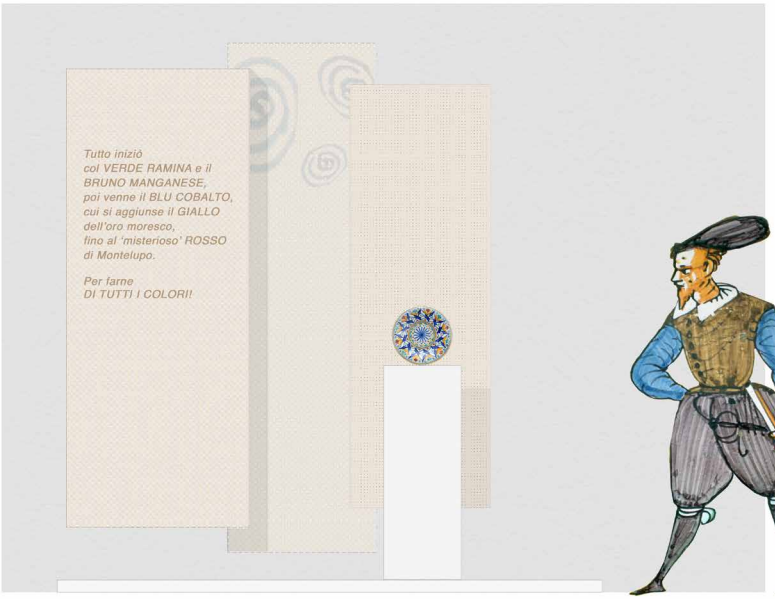


Fig. 38
The exhibit module: on a flat platform, bases and cases host the ceramics, the semitransparent hanging fabrics works as background and host the communication and graphic apparatus.

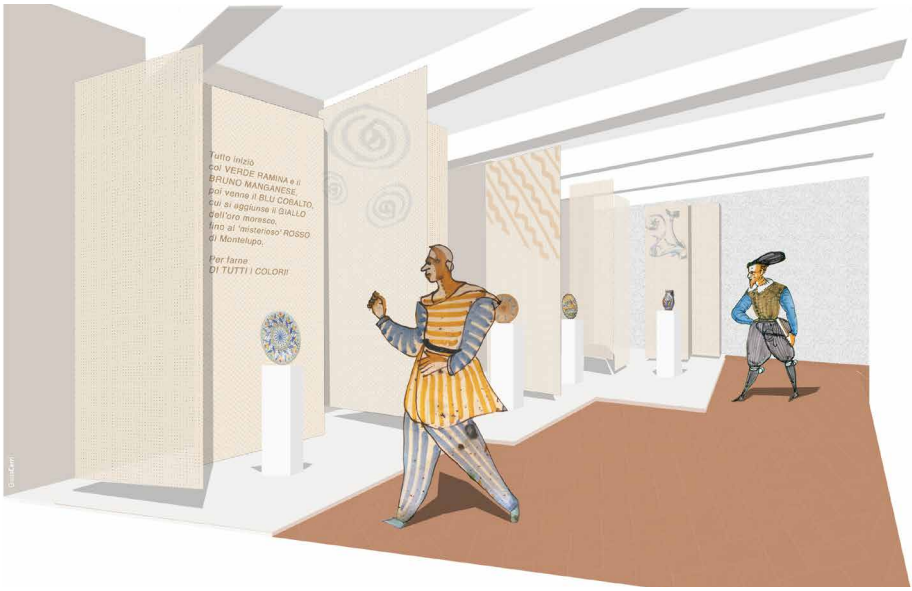
Fig. 39
Podestarile Palace, Maquette of the second exhibition room on the ground floor.

on painting the interior partitions, the historical walls cannot host heavy or invasive intrusive hanged installations. The organization of the temporary exhibitions relies on the Museum Foundation staff, limited to four people (scientific director, administrative director, conservator, secretary). This means that guardianship and reception activity is outsourced. Most of the time, it relies on no-profit voluntary associations, and the opening hours of this space limit to weekends. Exhibition design, graphics, and set up construction are assigned to external professionals and companies.

The Exhibit Concept

The whole design concept derives from the ceramics' narrative power, their colors, shapes, and decorations. The visit began with an immersive space. Here sounds, lights, and images transported the visitor in a suspended atmosphere. The colors marked the different periods, linking historical facts, stories of people, and places. Once passed the immersive introductory room, the so-called traditional exhibition started. The idea was to present the ceramics in a sort of suspended environment, where the bright colors of the objects stood out on the neutral tones of the background.

The exhibit solution design combined three elements: platform, plinth (base or case) positioned upon the platform, strip (Fig. 38). The plan foresaw a white platform, serving



to a series of functions: absorbing the vibration in case of an earthquake; being a braking distance, avoiding the necessity of vertical physical solutions, like barriers or chains; being a guiding element, the sequence of the platforms creates a continuous white path on which the cases are chronologically placed. The platform was designed to be 5 cm high with a variable extension, depending on site-specific location, room shape, and specificity of the objects on show.

The showcases, already possessed by the museum, were placed above the platforms. The project established that all the cases should have been fixed to the platforms, avoiding or mitigating the risk of rocking, overturning, and sliding. Although plates, jugs, mugs, and vases are relatively light objects, they needed to be fastened to the plinths to guarantee their adequate protection. To do so, one can use various solutions, depending on objects and setups' specific features. In the case of this exhibition, we foresaw removable wax, sacks filled with sand (weight to be inserted inside vases and mugs), and special easels. The oldest and more precious items were secured in transparent cases.

Hanging from the ceiling, the light semitransparent strips of fabrics were the leitmotiv of the design. They architectonically characterized the spaces and served as communicative supports. Texts and some illustrative images were printed on the material and carefully lightened (Fig. 39).

The Set Up

Unfortunately, some events modified the design project and its schedule. In particular, a work-in-progress budget review and mistakes in the general management caused significant delays. We ran close to the opening, and a series of cuts and simplification of the projects occurred. Although unpleasant, such situations are quite frequent in this kind of events, and the effort is to find possible compromises. The consequence of cutting costs was the reduction of the expenditures. We had to make some unexpected modifications to the design. For example, we reduced the material and the manufacturing work, like carpentry, so the platforms became flat panels. Due to delivery misunderstandings, some loans arrived early. When they arrived, the exhibition works were at the end but still ongoing. By law (DPCM 76/2019), once a loan is placed and locked, no one can touch or move it. Therefore, there was no time to fix the showcases and the bases to the flat panels (fig. 40).

Regardless, the exhibition opened in the right term, received good critics and reviews, a fair amount of people visited it, and both the Foundation and the Municipality (the organizers) enjoyed the results. What did not fully work was the application of all the foreseen anti-seismic measures. It was a lost occasion to realize a complete anti-seismic temporary exhibition. Still, this trial application has been helpful for several reasons. First, it has emphasized that, unfortunately, seismic assessment is still perceived as superficial. Implying that anti-seismic solutions would be cut (to save money or hurry up). Delays, complications, obstacles, and errors frequently occur during the setting up. Usually, these are solved by applying contingency plans. That explains why it is crucial to have codified and shared guidelines about protecting the collections from earthquakes. Being aware of the elements that should be present inside the project, it should be easier to apply some anti-seismic devices. Second, it is the first attempted test of the RESIMUS Approach on temporary exhibition. It proposed and tested low-cost and straightforward solutions that every museum should adopt. Third, the exhibition was the occasion to start defining a selection of best practices to share among museum institutions and international museum bodies, like ICOM and UNESCO, to nurture the anti-seismic culture. The example of the temporary exhibition does not allow an exact comparable application of the forms as in the case of preexistence permanent exhibition. Finally, this was RESIMUS' first attempt to fill the gap in the museum policy framework (e.g., safety guidelines, emergency plans, etc.). The research by design approach allows the possibility of proposing doable and realizable solutions. Given the low level of acknowledgment of the seismic risk for movable collections, the process

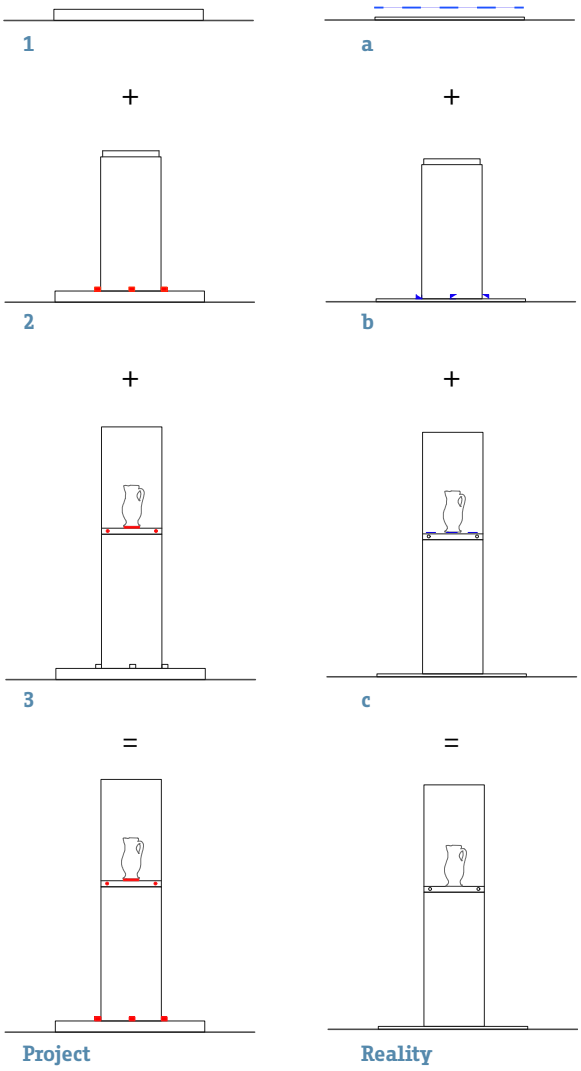


Fig. 40
Project vs. Reality.

The project foresaw three levels of safety:
1: a platform-5 cm;
2: join system between the platform and the case;
3: effective mount system solutions (wax, clips, weight).

The actual realization saw:
a: a flat panel-2 cm, instead of a platform;
b: the missing joint between the panel and the bases;
c: only some pieces had safety mounts installed (wax and weight).
Due to safety regulations, all the hats, in plexiglas or crystal, were sealed.

itself might raise it, fulfilling one of the research goals (Cerri 2020). The exhibition *di Tutti i Colori*, represented an important unique field of experimentation precisely because the project, has been realized, although partially, and because the museum institution has been forced to confront itself with the risk assessment topic.

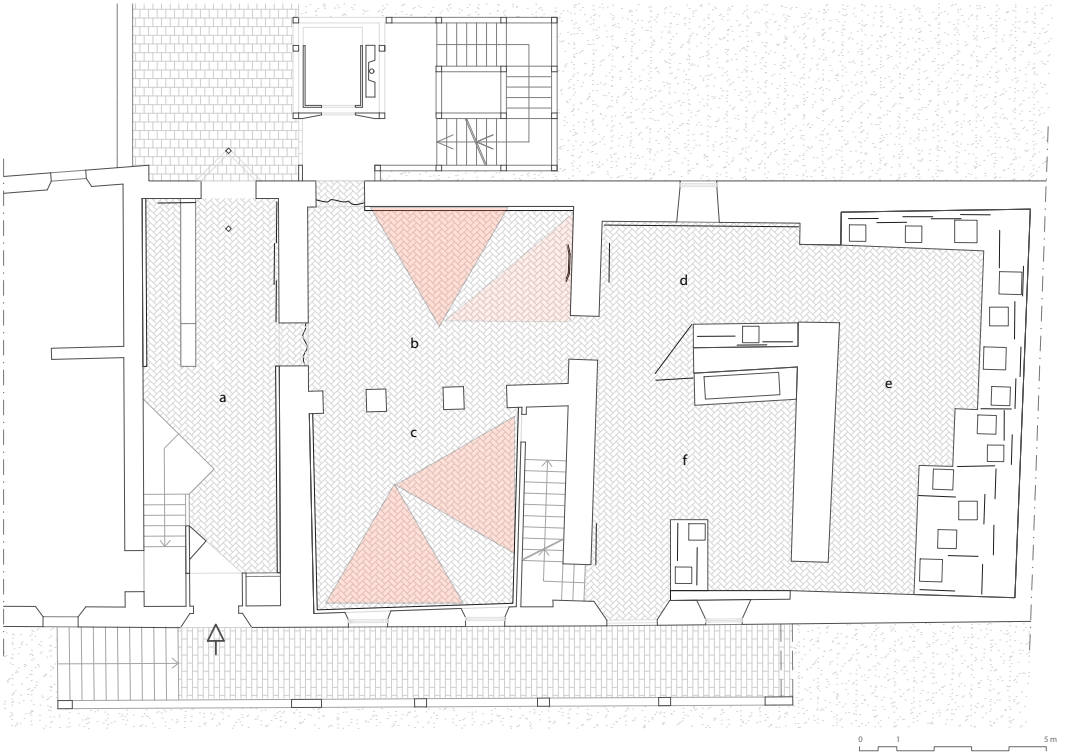
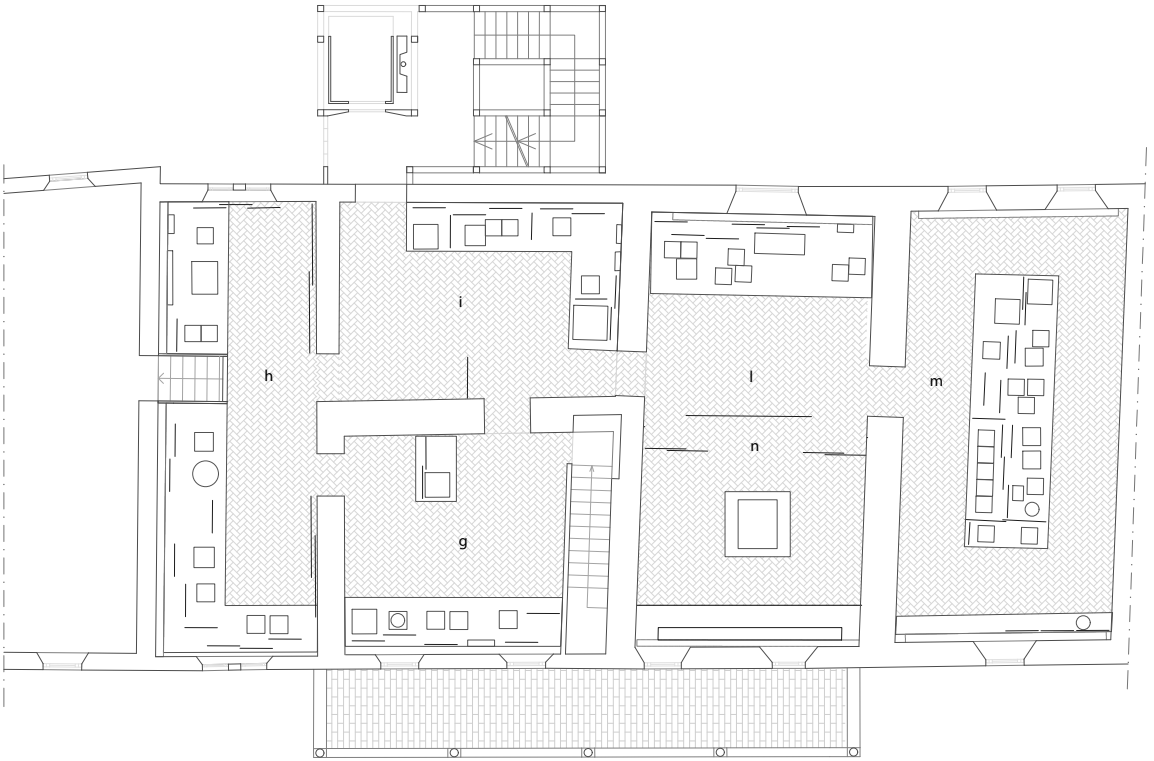


Fig. 41 Podestarile Palace, layout of the exhibition.

Ground floor:
a: entrance and ticket office; **b**: Colors and Time installation; **c**: Montelupo Ceramics installation; **d**: chronology and introduction; **e**: from XIV to XVI century, the Copper Green and Manganese Brown, the Cobalt Blue, the Golden Yellow, the so-called Montelupo Red; **f**: XVII and XVIII century, Rise and Fall, All the Colors and Brown.



First floor:
g: XIX century, the Brown Color and a slow rediscovery of the colors;
h: XIX century, Montelupo ceramic companies;
i: XX century, Montelupo ceramic companies;
l: XX century, art and ceramics; **m**: XX and XXI century, design and ceramics;
n: the ceramic for the table.

The Exhibition through Pictures

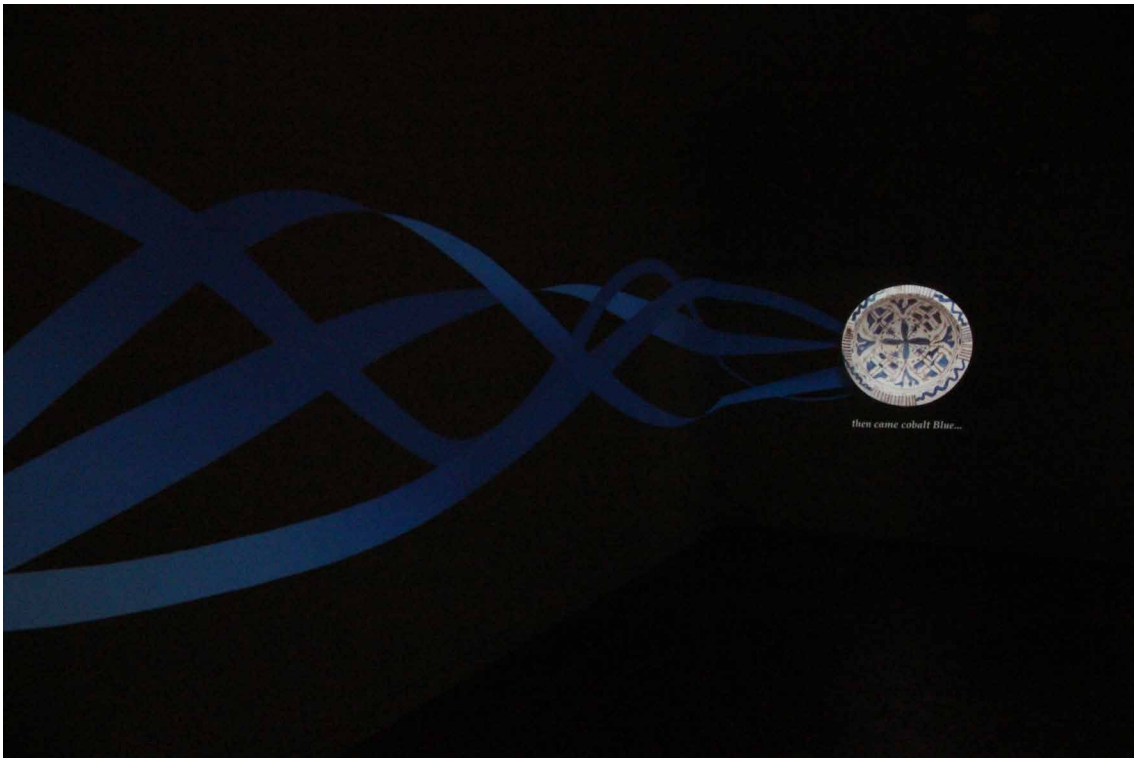


Fig. 42
Introductory Rooms. The first room (b) presented the installation Colors and Time. It summed up the exhibition concept in motion. Strings of colors waved on the walls and recreated the ceramic decorations on a giant plate. The sequence of colors, copper green and manganese brown, blu, yellow, all colors, brown, and all colors again, marked the chronological periods.

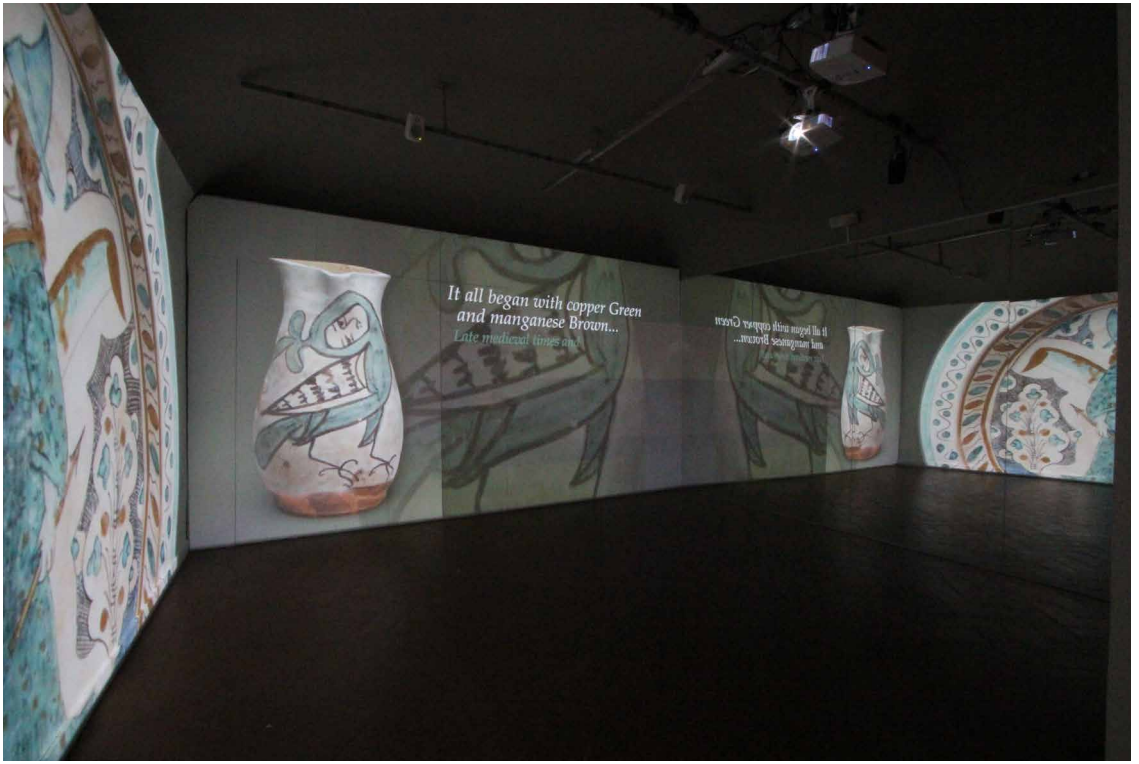


Fig. 43
The second immersive room (room c) was dedicated to Montelupo's history and territory. The sequence of images of ceramics, historical documents, and archival photographs was projected on two walls and reflected by one big mirror.

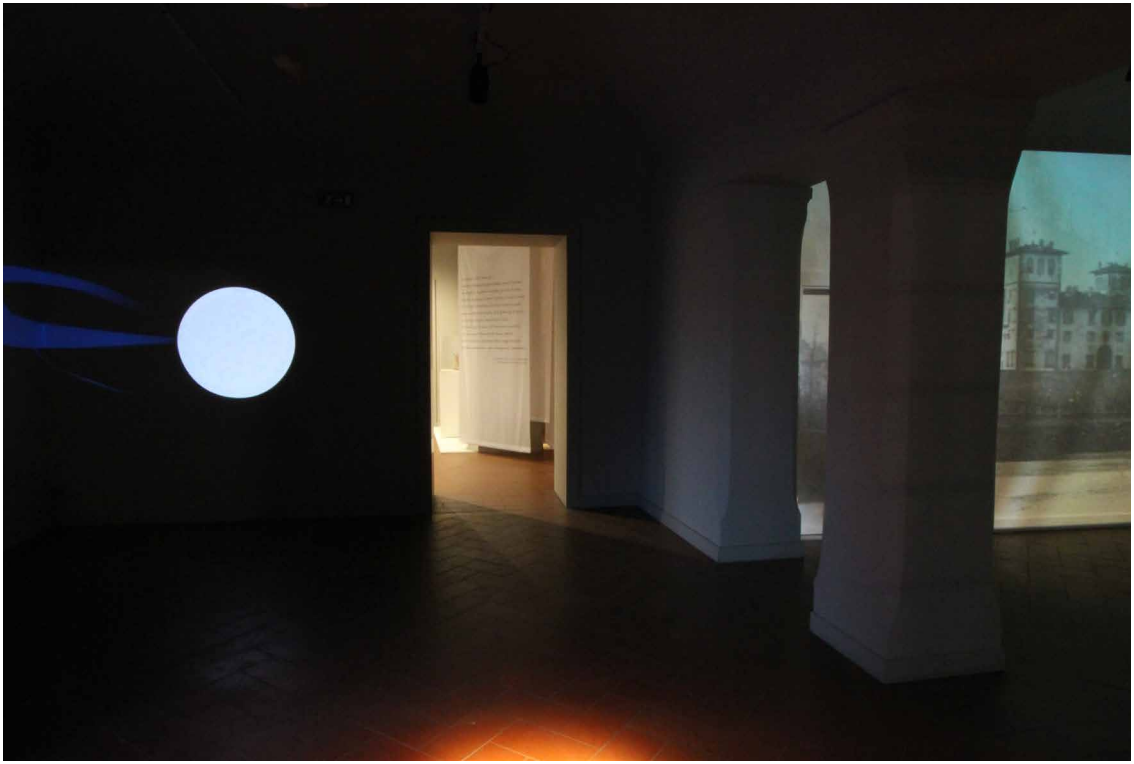


Fig. 44
The introductory rooms ensemble.
The immersive installation was realized by
Unità C1 visual environment and IC Videopro.

Fig. 45
The main room on the ground floor (room e) presented the ceramics from the XXIV to the XVI century. The pieces were ordered chronologically, therefore by color: copper green and manganese brown, blu, and yellow imitating gold.

Fig. 46
The Montelupo Red Color closed the main room on the ground floor. The white band on the floor (the flat base) and the hanging fabric, with texts and graphic elaborations, accompanied the visit.

Fig. 47
The last room on the ground floor (room f) was articulated in two parts.
In the background, the first part hosted the All the Colors section.
The so-called "Arlecchini plates" concentrated in a large case, placing vertically and sustained by hooks and easels. The colorful selection of plates dialogued with the fresco fragments of the Podestarile Palace, the only traces of the old frescos decorations. Close-up, the second part. The Brown was represented by the pitcher. It embodied the decline of the Montelupo ceramics during the XVII century. The configuration addressed toward the stairs to reach the first floor.

Fig. 48
On the first floor, modern and contemporary periods began (room g). The first piece represented the link between the past and the future. The colors and technics of the past were transmitted, rediscovered, and reinterpreted. The exhibition setting repeated with the same elements also on this floor. In addition, original hand-made drawings were shown in some sections.

Fig. 49
A view of the XX century collections (room i). The reduced dimension of the rooms forced to organize the pieces along the wall by using the same composition pattern: a flat panel, some bases or cases, and the fabrics.

Fig. 50
Art and craftsmanship (room 1)
characterized the XX and XXI century.

Fig. 51
Entrance to the special section dedicated to the table and the ceramics (room 1). The filter proposed an old picture of artisans and business people from Montelupo.

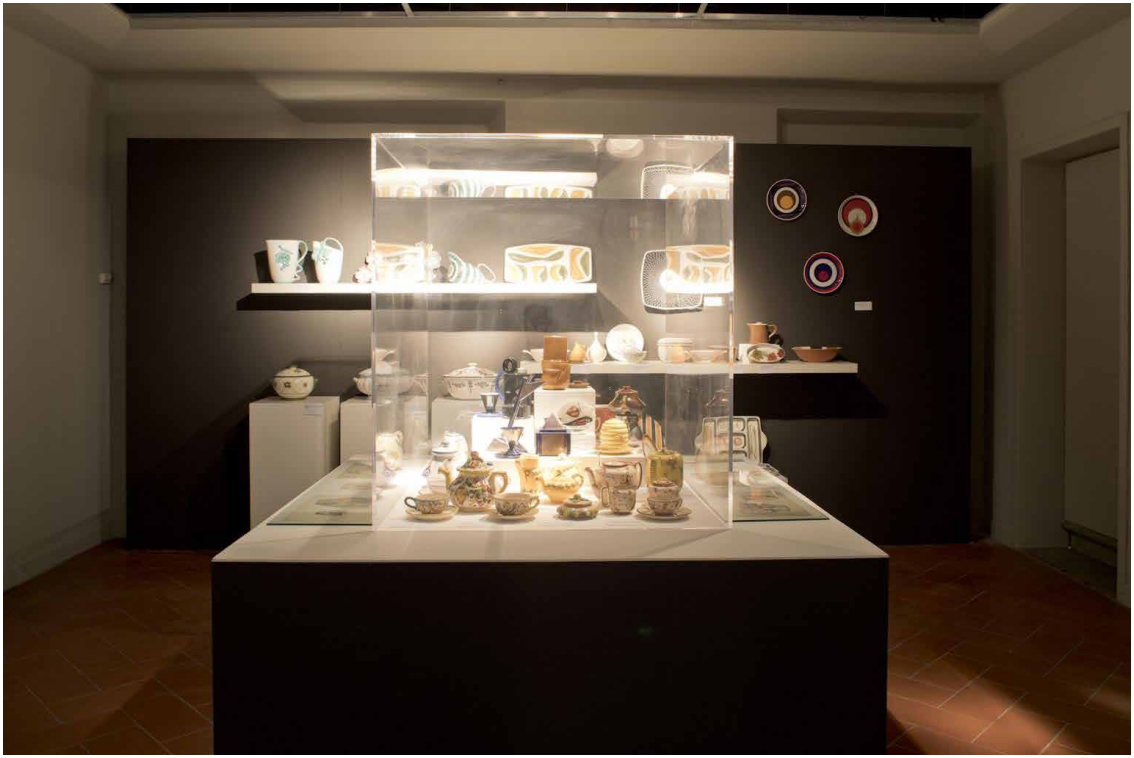


Fig. 52
The section was marked by the change of the colors. The large central case contained the little pieces, those along the wall were fixed with wax or special glue.

Fig. 53
The final room of the exhibition (room n). The pieces were arranged in the center, creating a rounded path and inviting the visitors back to the entrance. Entrance and exit were, in fact, coincident.

Fig. 54
The colors and the shapes of the ceramics stood out on the fabric, emphasizing the play between transparencies and layers. The pieces were secured with wax, special glue, or weights.

Fig.1
A view of the temporary exhibition di *Tutti I Colori*.

In the case of an earthquake, we have understood that preserving non-structural components and building contents is necessary to resilience. As for museums, the application of preventive measures also implies protecting tangible items that western culture considers the testimony of communities' memory and culture. Preventive actions link to the awareness about the anti-seismic risks in museums and cultural institutions and to the involvement of professionals and academics from different fields. The RESIMUS Research presents a synthetic way to assess the seismic risks for movable heritage and anti-seismic guidelines for museums and exhibitions. The book *Shaking Heritage* introduces some tools and discusses their application in two case studies. It fosters a discussion upon the fundamental topic of seismic vulnerability of museum collections and the improvement of their safety.

The RESIMUS Forms: Potentialities, Limits, and Following Developments

The RF proposes a synthetic method to rate the vulnerable settings and to indicate possible urgencies. It is a light instrument that anyone can use and is valuable to: record the situation of one museum at a specific moment, make a general survey of the museum's contents, evaluate the vulnerability and risk levels of the collections. The forms could work as strategic documents to address future decisions and plans. Their strengths is allowing a quick assessment of the settings by any staff member of a museum. Its main limit is a limited applicability. As the Trecento Room testifies, an external analysis might be not adequate to understand certain exhibit configurations. This implies a lack in the acknowledgment of the vulnerability grade. In that case the application of in-depth analysis is necessary.

Already tested at the National Museum of Bargello in Florence, the next step is the transformation of the RF in a software application for the apps market. That implies a review of the forms and customization according to the software architecture. The goal is to develop a free app for smartphones or mobile computers (tablets), integrating the simplified RF with Artificial Intelligence solutions. A chatbot might assist the users (museum staff) step by step. All entries would be collected in a shared platform and then processed by the RESIMUS staff.

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The app's realization implies the arrival of specific figures in the RESIMUS team, particularly computer and data scientists.
The digital version of RF would probably foster the diffusion of the RESIMUS Form among museum institutions. Such spreading would probably generate a discussion over the forms, allowing further improvements and fostering the involvement of international museums and scientific community.

Low-Tech Anti-Seismic Devices: Cheap and Easy to Apply.

The research addresses a series of elements necessary to develop coherent museum interventions. As shown by the temporary case study in Montelupo, the use of low-cost and easy-to-apply expedients can be helpful. In fact, as suggested and tested by the Getty Museum, the objects' safety level can also be raised thanks to the application of low-tech devices. That step has to follow the risk assessment of the museum collection. The outcome is that in some cases even little museums can afford them. A minimum expenditure can avoid inestimable losses. The research highlights the possibility of using also un-conventional anti-seismic devices and easy-to-find solutions, like wax, weights, and clips. Some safety measures conceived for other scopes can also serve as anti-seismic devices (e.g., anti-thefts). In that case, if a measure satisfies the anti-seismic criteria, a further dedicated anti-seismic device might be redundant. That has to be carefully pondered and evaluated case by case.
Besides, museography must integrate with other disciplines to foster the display setup. Exhibitions originates from collective work. They has to consider several points of view, various needs, diverse tasks, and priorities. The results benefit from the multiple viewpoints and richness of this dynamic.

Temporary and Permanent Setups: Same Approach, Different Outcomes

The RESIMUS Approach proposes a flexible tool. Permanent and temporary installations have various features, as different are the typology of museums, exhibitions, and collections. The outcomes will always be different although using the same approach (Analysis, Design, Installation).
Comparing the Bargello's case proposal and the exhibition *di Tutti I Colori* at Palazzo Podestarile, we can identify some differences in the design language, although the object typology is the same and both are installed inside historical locations. By nature, temporary and permanent exhibitions imply various approaches and solutions. A temporary museum design allows a higher level of experimentation, the application of a vast range

of materials, a specific tone of communication, and distinct graphic choices. It is an event devoted to a specific target, open for a limited amount of time, and happens in a specific place in a specific period. The permanent exhibition has to last. It aims at the people of today and tomorrow and a more general, but not unique, audience. It has to be timeless, although we know it is not.[1] In terms of safety, there are no sensible differences. Both have to guarantee the maximum level of safety. We observed that we can decrease the risks by using simple and low-cost solutions and that the institutions' support is mandatory.

Integration of Knowledge

As highlighted, the use of low-tech tools does not replace the application of advanced solutions. As observed by the authors of the thematic essays, each field of research provides some valuable and efficient tools. The topic of protection and preservation of museum collections is open. Advancement in technology, new materials, alternative ways of applying tools can lead to new directions of protecting and conserving things. It is crucial to monitor such advancements as well as keep an open dialogue among all disciplines. Studies upon resilience, hazard analysis, integrated techniques for the structural assessment of movable objects and immovable structures, soil characterization, digital survey, digital modeling, advanced numerical simulations, material science will all be part of this realm. Technical knowledge has to integrate with the, let say, humanistic approach, brought by curators, historians, and museum professionals, and in coordination with the museographical perspective.

Awareness: Spreading the Anti-Seismic Culture among Institutions and Professionals

The RESIMUS research is a little step forward in the seismic prevention culture. We repetitively emphasize that, given the complexity and articulation of a museum project, it is necessary to involve several professionals and foster the institutions' active participation. Each intervention inside a museum space implies time, money, and several administrative passages. Every change might imply agreements and validations. That is why to construct best practices and ad-hoc policies and to foster the work pursuing by international no-profit organization, like ICOM and UNESCO, the involvement of museum institutions is crucial. The temporary exhibition case emphasizes that the lack of existing norms and specific policies might affect the decision-making process. RESIMUS applications success and the diffusion

[1] Usually, the permanent design does not requested the "wow" feature (Greenblatt 2018). The latter might works (not always) in a temporary exhibition, but hardly in a permanent one. Permanent museum displays are set to be visited more than once in a person's lifetime.

of the results might foster the importance of the anti-seismic measures and sponsor the RESIMUS Approach among institutions.

Still, a successful museum project is the product of numerous women and men's efforts. People compose institutions. Among the best practices, this research wants to foster the importance of recognizing the museum workers' contributions at any level and task. The Bargello case suffered from a lack of support from the museum side. It was symptomatic of the museum's general situation. Being understaffed and with an increasing number of complexities and deliveries, it was hard for the personnel to actively participate in the project. Such lack enhances a condition shared with most Italian museums, National, civic, and private. Despite all these quite expected difficulties, this research could not be possible without the support and the availability of the museums and their staff.

Final Remarks

The research collects tangible and intangible achievements, tries to set up guidelines and best practices, and organizes results. The outcomes contribute to the dissemination of the research in the academic field and constitute a step forward in acknowledging the importance of the anti-seismic culture among museum institutions. It stresses the necessity of constructing shared guidelines and policies for the safety of the movable heritage. Before building up best practices, it is necessary to partake the findings with other international actors, including non-profit organizations, professionals, and, obviously, museum institutions. Such involvement outside the research centers is necessary to improve awareness among museums and enhance and encourage academic research.

The considerations on the vulnerability of a museum bring to include the pandemic events into these notes. The situation brings us reflecting on the issues generally related to the new modality of use of the cultural places, the so-called COVID solutions, and the available sanitary measures in case of a new similar event. Besides, it emphasizes as anti-seismic preventive measures are always needed, even during pandemic. The Zagreb earthquake demonstrate it. On April 2020, a shake hit the city during the first European peak of COVID-19.[2] The Museum of Arts and Craft, located in the XIX century expansion of the town, reported uncountable losses, like the Archaeological Museum and the Mimara Museum. Most of the museum buildings did not report irreparable structural damages and were not statically compromised. Nevertheless, the collections and settings have been severely damaged or lost. The ICOM Report 2020 on the Zagreb 2020

[2] A second, more intense, earthquake hit the country a few months later (December 29, 2020). The involved area was the center of the country (Petrinja).

earthquake stresses the importance of prevention and care, and its conclusions are pretty explicative:

> The initiative in 2013, which addressed EU governments by stressing how important museums are and that they should be properly financed even when crises hit, was such an attempt. It showed that the message does not have a proper impact if you are not persistent in continuously advocating museums. During recent conflicts in many parts of the world, we witnessed how museums can be exposed to various threats, from destruction to looting. After the COVID 19 pandemic, a more challenging financial breakdown is foreseen, and the steps should be taken now. Croatian example can serve to illustrate how damages can accumulate easily if problems are not tackled. A more decisive step has to be made in organizing education in risk management and prevention, too. ICOM is a global museum organization, and networking with other partners in the field can be helpful in strengthening the awareness among decision-makers and museum professionals. Disasters do happen, and when they strike consequences are huge. We are in constant learning how to mitigate risks and have to stay alert (Horjan 2020).

Shaking Heritage presents a work-in-progress project. This volume publishes in a particular period, with most of the cultural places closed or open with limitations. People "desire to live in a place with a sense of place, [is a] desire to develop a sense of identity" (Conn 2010), and the museums and cultural sites are fundamental contributors in building civic identities. Although the online presence is mandatory for museums, the possibility of opening the physical spaces is urgent and necessary. Museums need to reinterpret themselves, respond to the current pandemic, and be prepared in case of pandemic waves and other disasters. That implies developing a complex strategy and actions without forgetting the collections' seismic protection and coherent design solutions. We are still at the beginning of a long, challenging path.

Appendix

The forms are ready-to-use instruments to asses the seismic safety of a museum setting. The goal is to have a tool that every museum staff member can use. By extension, even private citizens might use some parts of them inside their houses.
The RF articulates in four parts. The analysis proceeds progressively, from general to particular, and includes descriptive sections and qualitative charts assessing the vulnerability.

RESIMUS Form 1 (RF1)

The first sheet concentrates on the general setting of the museum. It describes the museum at a given moment in time (each form requires the date). The RF1 proposes a descriptive analyses. The outcome considers and elaborates other sheet examples, particularly the Tuscan Form for Quality Museums, The Carabinieri form, and the NTC form.

RESIMUS Form 2 (RF2)

RF2 takes into analyses one selected room of the analyzed museum. Similar to the RF1, the form is descriptive. It records the current general features of such room. The form helps identifying the macroscopic characteristics of the room, as typology of the collections and general elements of the setup. In this case, the model bases on the Tuscan Form for Quality Museums, and the Marche Region Survey on Museums. It provides spaces for images and sketches.

RESIMUS Form 3 (RF3)

This form inspects one object-setting couple. It combines descriptive aspects and risk assessment. It relates to the intrinsic features of the couple and to their links (if any). The form combines RESIMUS analyses, Podany's suggestions (2018), and Liberatore's form

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(2000). The form grades the conservative condition of the objects, the safety of the object-setting couple, and classifies the couple's behavior. With the form, each compiler pinpoints one setting-object couple and identifies it with one univocal code (ID room+ID object). The numbering has to be coherent throughout the whole analysis.

RESIMUS Form 4 (RF4)

This part evaluates the vulnerability of both settings and objects. It weighs the probable behavior of the setting in the case of an external stress. It bases mainly on Podany's analysis and the form *Non-structural Risk Survey Forms* elaborated by Erturk and Sungay (2004).

The RESIMUS group is still working on the forms and on the evaluation process. Testing them at the Museum of Bargello, it came to light the need for modifications and changes. Such adjustments require developments to accomplish in collaboration with the museum staff and researchers. The current interface is an adjustable digital or on paper chart. The compiler has to complete it manually. The next step is its conversion into a software application. The objective is to build a free app available on app distribution platforms. In this scenario, each museum participating to the survey campaign should subscribe to the RESIMUS Research Program and download the app on their smartphones. With this system, all results and data acquired through the RF app will be collected and gathered in a cloud system. The app would facilitate the analysis development and minimize the risk of data loss.

Museum Name [edit] RESIMUS FORM 1 Museus Form

Museum name _____
Date _____
Author _____

1. 1	**Museum Records**	
1.1.1	Location _____	Address_____
1.1.2	Opening days and hours	
1.1.3	Contact information	Tel. E-mail
1.1.4	Director	Name
1.1.5	Governing Authority	Country/Region/Province/Municipality/Ecclesiastical/Private Other _____

1.2	**Building check-list**		
	Document's name	Available (A)/ Not Available (NA)	Where/Proprietorship (if Available)
1.2.1	Plans and cross-sections of the building (architectural)		
1.2.2	Geometric survey of the building		
1.2.3	Technical and Descriptive Report on the building		
1.2.4	Reports on the building history (transformations, mode of use, refurbishments, damages, reconstructions, etc.)		
1.2.5	Inspector Register of the CC TPC Headquarters: crime-prevention survey form		
1.2.6	Other documents (*Please specify*)_____		
1.2.7	Technical Security Manager (M. Decr. 569/1992 and 418/1995)	Name	

1.3	Seismic safety and vulnerability check-list			
	Document's name	Available (A)/ Not Available (NA)	Year	Document's name and cataloging
1.3.1	Seismic Assessment			
1.3.2	Diagnostic Campaign (adding field if more then one)			
1.3.3	Information about the subsoil			
1.3.4	Technical Report on the structure			

1.4	Museum description
1.4.1	Brief description of the museum organization (services, exhibit collections, etc.) ...
1.4.2	Selected Bibliography (optional): ...

1.5	Museum data	
	Building/Structure	
1.5.1	Total Area	(square meters)
1.5.2	Total Volume	(cubic meters)
1.5.3	Total floors	(quantity)
1.5.4	Exhibition Area	(square meters)
1.5.5	Public Area (e.g., bookshop, caffe, restrooms, lookers, etc.)	(square meters)
1.5.6	Storage Area (inside the building)	(square meters)
1.5.7	Service Area (e.g., warehouse, storage closet, etc.)	(square meters)
1.5.8	Staff Area (e.g., offices, changing room, etc.)	(square meters)
1.5.9	Other (e.g., library, conference room, etc.) Please specify	(square meters)
1.5.10	Open-air area	(square meters)
	Collections	Number of pieces
1.5.11	Total of the museum's objects	
1.5.12	In exhibition	
1.5.13	In storage	
1.5.14	Under restoration, long loans	
	Staff	Number of people

1.5.15	Total staff (external +internal employees, attach organizational chart if available)		
1.5.16	Internal employees		
1.5			
1.5.17	External staff		
1.5.18	Direction		
1.5.19	Scientific staff		
1.5.20	Administrative staff		
1.5.21	Custodians		
1.5.22	Voluntary workers/year		
1.5.23	Internship/year		
1.5.24	Temporary external professionals/year		
1.5.25	Security staff		
1.5.26	Other (specify)		
1.5.27	Total Required staff (globally)		
1.5.28	Daily Required staff		
1.5.29	Daily Actual staff		
	Visitors (last 3-year period)		
1.5.30	Total visitors	2021	
		2020	
		2019	
1.5.31	Payed visitors	2021	
		2020	
		2019	
1.5.32	Free entrances	2021	
		2020	
		2019	

1.5.33	Other entrances (specify)	2021	
		2020	
		2019	

1.6	**Other museum's locations and sites (optional)**	
	Name, Location, Use	Square meters
1.6.1	...	
1.6.2	...	
1.6. ...		

1.7	**Emergency plan** (please list the existing emergency plans)	
	Name	Year
17.1	...	
1.7.2	...	
1.7. ...	...	

Museum Name [edit] RESIMUS FORM 2 Room Form ID____

Room name **[edit]**
ID room (progressive)_____
Date _____
Author _____

2.1	Location of the analyzed room
Graphic, plan of the museum (upload)	

2.2	Room's plan
Graphic, plan of the room (upload)	

2.3	General Exhibition Design	
2.3.1	**Current setup**	
2.3.1.1	Room Name	
2.3.1.2	Year of the setup installation	
2.3.1.3	Designer	
2.3.1.4	Curator/Director	
2.3.1.5	Note and Bibliography	
2.3.1.6	Brief description of the current setup	

2.3.2	Previous setup	
2.3.2.1	Room Name	
2.3.2.2	Year of the setup installation	
2.3.2.3	Designer	
2.3.2.4	Curator/Director	
2.3.2.5	Note and Bibliography	

[Add other cells if needed]

Museum Name [edit] RESIMUS FORM 2 Room Form ID____

2.4	**Room description**			
2.4.1	Floor location			Notes:
2.4.2	Surface			
2.4.3	Volume			
2.4.4	High			
2.4.5	Number of windows			Notes:
2.4.6	Number of passages (doors)			Notes:
2.4.7	Ceiling typology			
2.4.7.1		Plafond		Beam, lacunar, or joist ceiling
		With system in view		False ceiling
		Integrated ceiling		Other (please specify)
2.4.7.2	Attachment (Optional)			
2.4.8	Lighting			
2.4.8.1	Typology		Quantity	Hook
2.4.8.2	Attachment (Optional)		*(lighting design and electrical system)*	
2.4.9	Fire Prevention System			
2.4.9.1	Typology		Quantity	Description
2.4.9.2	Attachment (Optional)		*(Escape path, position of the Fire Prevention devices, etc.)*	
2.4.10	Technological and electrical elements (e.g., projectors, monitors, alarms, other)			
2.4.10.1	Typology		Quantity	
2.4.10.2	Attachment (Optional)		*(Plan with the position)*	

2.5	**Summary, Exhibition solution** (macroscopic identification)	
2.5.1	Total number of museum objects in the room	
2.5.2	Total number of containers and supports (cases, bases, boxes, etc.)	
2.5.3	Total number of small bases/cases, containing 1 or max 3 little pieces	
2.5.4	Total number of medium cases, containing 4-10 medium- small pieces	
2.5.5	Total number of big cases, containing more than 10 pieces	
2.5.6	Total number of isolated objects	
2.5.7	Total number of hanged or suspended objects	
2.5.8	Other (Please specify number and description)	

Museum Name [edit] RESIMUS FORM 2 Room Form ID____

2.6	**Summary, Types of objects** (macroscopic identification)			
	(please specify the number of objects for each category)			
		Sculptures		Architectural/archeological fragments
		Paintings		Armory
		Decorative Arts, Ceramics		Books, Drawings, and Prints
		Decorative Arts, Metals		Numismatics/Philatelic
		Decorative Arts, Glass		Human and animal remains
		Decorative Arts, Woods		Ethnographic objects
		Decorative Arts, Textile		Composit
		Decorative Arts, Paper		Instruments (music, work, scientific, etc.)
		Decorative Arts, Other		Other _____

2.7	**Location of the objects** *(assign a number to each analyzed object or settings)*	
Graphic, plan of the room (upload)		
	Please list the objects, identification number (ID) and name (ID= ID of the room + progressive number of the object or ID of the room + ID of the object according to the museum cataloguing) N.B. the identification has to be consistent	
	ID	Name

2.8	**Additional information**	
2.8.1	Public	Usually very crowded
		Periodically crowded
		Usually not crowded
2.8.2	Presence of other elements in the room	Yes
		No
	If Yes, please specify number and typology (e.g., didactic elements, sofa and benches, screens, scenography, etc.)	

Museum Name [edit] RESIMUS FORM 2 Room Form ID____

2.9	Further qualitative observation about the room
2.9.1	Notes:
2.9.2	If substantial informative elements are lacking, please explain the reasons:

Museum Name [edit] RESIMUS FORM 3 ID___-_____

Room name [edit] - Objects
ID (ID Room-ID Object)
Date:_____
Author:_____

OBJECT

3.1	Object information		
3.1.1	Inventory no. (museum)		
3.1.2	Title		
3.1.3	Collection name (if available)		
3.1.4	OA form (or other cataloguing record)		
3.1.5	Governing Authority		
3.1.6	Author		
3.1.7	Origin		
3.1.8	Chronology		
3.1.9	Type of object		
3.1.10	Material		
3.1.10	Technique		
3.1.11	Grouping		Single
			Part of a group/collection

3.2	Photos of the object
(upload)	

Museum Name [edit] RESIMUS FORM 3 ID___-_____

3.3	General feature information*		
3.3.1	Dimension		Monumental (larger than 3 m. in any directions)
			Large (1 - 3 m in any directions)
			Medium (0,3 - 1 m in any directions)
			Small (0,05 – 0,3 m in any directions)
			Very Small (less than 0,05 m in any directions)
3.3.2	Weight		Very Heavy greater than 50 kg
			Heavy 25-50 kg
			Moderate 8-25 Kg
			Light 0,2-8 Kg
			Very Light less than 0,2 kg
3.3.3	Footprint		Square
			Round
			Oval
			Rectangular
			Triangular
			Geometric Complex
			Amorphous
			Amorphous Complex

3.4	Object Conservation Condition						
3.4.1	Conservation condition: Structure		Good		Medium		Poor
3.4.2	Conservation condition: Surface		Good		Medium		Poor
3.4.3	Number of pieces		Monolite		Several pieces, tight connections		Several pieces, loose connections
	Total						

Museum Name [edit] RESIMUS FORM 3 ID___-_____

3.5	Object Intrinsic Vulnerability					
3.5.1	Center of gravity		Lower than 1/3 height		Centered	Higher than 1/3 height
3.5.2	Weight dispersion		Lower than 1/3 height		Distributed	Higher than 1/3 height
3.5.3	Eccentric elements (projections, arms, etc.)		None		Little/Small	Some/Big
3.5.4	Proportions		Base larger than height		Base equal to height	Base minor than height
3.5.5	Type of bottom		Flat		Little unequal	Unequal/Not Flat/Unknown
3.5.6	Material Property		Flexible		Semi flexible	Rigid
Grading			**Good condition/ LOW vulnerability**		**MEDIUM vulnerability**	**Poor condition/ HIGH vulnerability**

SETUP

3.6.1	**Photos of the setup**
(upload)	

3.6.2	**Drawings of the setup** (plan and eventually cross section)
(upload 1) *(upload 2)*	

3.7	Setup general information			
3.7.1	Setup typology		None	
			Pedestal/plinth	
			Pedestal Case	
			Medium/big display cabinet	
			Wall mounted	
			Embedded in the building	
			Other	
3.7.2	Position in the space			
3.7.2.1	If freestanding (with None, Plinth, Pedestal case, and display cabinet solutions)	Minimum distance from the nearest wall or setup		__m
3.7.2.2		Number of the nearest objects		
3.7.2.3	If inside a case with other pieces	Minimum distance from the nearest objects		__m
3.7.2.4		Number of the nearest objects		
3.7.2.4		if present, specify type of mounts		

Museum Name [edit] RESIMUS FORM 3 ID___-_____

3.7	Setup general information		
3.7.3	Position of the object / Exhibition orientation		Vertical
			Horizontal
			Angled
3.7.3	Materials (main)		
3.7.4	Setup dimensions (maximum)		
3.7.4	Brief description		
3.7.4	Technical drawings (optional)	(upload)	

3.8	Mount and Restraints, safety						
3.8.1	Anti-seismic system or devices		Yes		ND		No
3.8.2	Anchor: Between object and setup, or Between object and building (If Yes, please fill table 3.10)		Yes		ND		No
3.8.3	Anchor: Between building and setup (If Yes, please fill table 3.11)		Yes		ND		No
Grading			**Good**		**ND**		**Poor**

3.9	If the setup typology is "Medium/big display cabinet" **Exhibition shelves**		
3.9.1	General Dimension		
3.9.2	Materials of the furniture (main)		
3.9.3	Anchoring between furniture and building		Yes
			No
			ND
3.9.4	If yes, please specify (to the wall, the ground, etc.)		
3.9.5	Internal shelves		Yes
			No
3.9.6	Materials		
3.9.7	Type of fixation	Please specify	
3.9.8	Other elements (e.g., suspended grid, internal lighting system, division panels, backboards, etc.)	Please specify	

Museum Name [edit] RESIMUS FORM 3 ID___-_____

3.9	If the setup typology is "Medium/big display cabinet" **Exhibition shelves**	
3.9.10	Disposition of the Objects	

3.9.10	**Exhibition shelves, safety**						
3.9.10.1	Density (quantity of objects in the same area)		None		Few pieces (number ___)		Many pieces (number ___)
3.9.10.2	Distance between the objects		Far from other objects		Not very close to other objects		Close to other objects
3.9.10.3	Mounts		Yes		Some		No
	If Yes or some, please fill the table 3.10 for each category of mounts present inside the content						
	Grading		**Good**		**Medium**		**Poor**

3.10	**Mount and Anchor: object and setup, or object and building**			
3.10.1	Type of mount or restrain: big and medium object		Type of mount or restrain	Quantity
			Base isolator	
			Clip	
			Inner mount	
			Compression mount	
			Contour mount	
			Wall Mounting	
			Other (please specify)	
3.10.2	Type of mount or restrain: small object		Interface cast	
			Weight	
			Wax	
			Monofilament lines	
			Stop	
			Clip	
			Contour mount	
			Inner mount	
			Plate holder	
			Other mount (please specify)	

Museum Name [edit] RESIMUS FORM 3 ID___-_____

3.10.3	Material		Unknown
			Known
		Please specify the main materials	
3.10.4	Material property		Stiff
			Flexible
3.10.5	Total Number of anchors		
3.10.6	Location of anchors	(Image Upload)	
3.10.7	Technical form Attachment (optional)	(Upload)	
3.10.8	Note (optional)		

3.11	**Mount and Anchor: setup and building**		
3.11.1.1	Type of restrain:		
3.11.1.2	Restrain applied to		big containers (Please specify the typology)
			medium containers (Please specify the typology)
3.11.2	Material		Unknown
			Known
		Please specify the main materials	
3.11.3	Material property		Stiff
			Flexible
3.11.4	Number of points of anchors		
3.11.5	Location of anchors	(Image Upload)	
3.11.6	Technical form Attachment (optional)	(Upload)	
3.11.7	Note (optional)		

Museum Name [edit] RESIMUS FORM 3 ID___-_____

SUMMARY

3.12	Identification Object category		
	Please sign one option		
		T1	Little object, flat base
		T2	Little object, not flat base
		T3	Standing medium-big objects (sculptures, vases, etc.)
		T4	Non standing medium-big objects (paintings, frames, etc.)
		T5	Suspended objects
		T6	Other

3.13	Fast classification based on the type of display						
Category	A				B	C	
	Object leaning on a horizontal surface					*Object hung or suspended*	
	A1	A2	A3	A4		C1	C2
	On the ground	*On a pedestal*	*Inside a case*	*On shelf or inside a display cabinet*	*Object fixed on a horizontal surface*	*To the wall*	*To the ceiling*
T1							
T2							
T3							
T4	-						
T5	-	-			-		
T6							

Museum Name [edit] RESIMUS FORM 3 ID___-_____

3.14	Object-Setup Evaluation							
	3.4 3.5	ObjectConserva-tion condition and Vulnerability*		Good condition/ LOW vulnerability		MEDIUM		Poor condition// HIGH vulnerability
	3.8	Mount and Restraints, safety		Good		ND		Poor
	3.9.10	Exhibition shelves, safety		Good		Medium		Poor
Grading		**T__- __ __**		**Good**		**Medium**		**Poor**

3.15	Qualitative observation on the current setting and on the object

Museum Name [edit] RESIMUS FORM 4 ID___-_____

Object and Setup
Risk Identification Form
ID (ID Room-ID Object)
Date: _____
Author _____

4.1	Brief information Summary	
4.1.1	Type of display (e.g., T3-A2)	T__- __ __
4.1.2	Room	
4.1.3	Object title	
4.1.4	Inventory no. (museum)	
4.1.5	Setup typology	

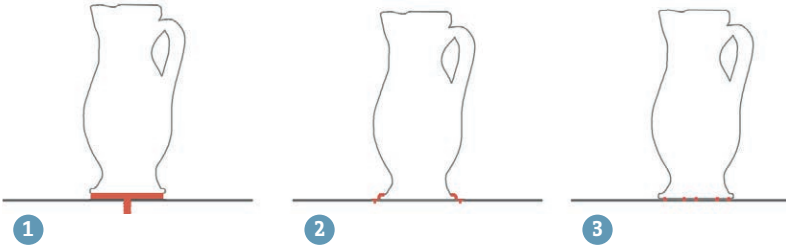
4.2	Vulnerability Assessment Object						
4.2.1	Restrain 1. If the setup configuration **does not have** a restrains, will it need one?		No		ND		Yes
4.2.2	Restrain 2. If the object **does have** a restrains, is it coherent/efficient?		Yes		ND		No
4.2.3	Movement (*Answer modality*) In how many directions the object might be able to move more than one possible answers)		None				Horizontally Vertically Tilt Rotate
4.2.4	Stability 1. Does it rock or wobble with slight pressure above its midpoint height?		No				Yes
4.2.5	Stability 2 (*Damage mechanism)* Estimated response to input forces (more than one possible answers)				Susceptible to stress damage		Slide Rocking Overturn
4.2.6	Threats to other objects		No		Medium		Yes
4.2.7	Threats to people around		No		Medium		Yes
4.2.8	Secondary threats (e.g., suspended grid, division panels, backboards, etc.)		No		Medium		Yes
4.2.9	Location. Is it easy to reach in case of an emergency?		Yes		With some difficulties		No
4.2.10	Relocation. Is the setup easy to change or to adapt?		Yes		With some difficulties		No
Total			**Low**		**Medium**		**High**

Museum Name [edit] RESIMUS FORM 4 ID___-_____

4.3	Vulnerability Assessment Setup						
4.3.1	Restrain 1. If the setup configuration **does not have** a restrains, will it need one?		No		ND		Yes
4.3.2	Restrain 2. If the setup configuration **does have** a restrains, is it coherent/efficient?		Yes		ND		No
4.3.3	Movement (Answer modality) In how many directions the setup configuration device might be able to move? (more than one possible answers)		None				Horizontally Vertically Tilt Rotate
4.3.4	Stability 1. Does it rock or wobble with slight pressure above its midpoint height?		No				Yes
4.3.5	Stability 2 *(Damage mechanism)* Estimated response to input forces (more than one possible answers)				Susceptible to stress damage		Slide Rocking Overturn
4.3.6	Threats to other objects		No		Medium		Yes
4.3.7	Threats to people around		No		Medium		Yes
4.3.8	Secondary threats (e.g., suspended grid, division panels, backboards, etc.)		No		Medium		Yes
4.3.9	Location. Is it easy to reach in case of an emergency?		Yes		With some difficulties		No
4.3.10	Relocation. Is the setup easy to change or adapt?		Yes		With some difficulties		No
Total			**Low**		**Medium**		**High**

4.4	Summary Results, Grading	T__- __ __					
4.4.1	Evaluation grade from RF 3		Good		Medium		Poor
4.4.2	Object Vulnerability Assessment		Low		Medium		High
4.4.3	Setup Vulnerability Assessment		Low		Medium		High
4.4.4	Vulnerability		Low		Medium		High
TOTAL: Priority of intervention			**LOW**		**MEDIUM**		**HIGH**
4.4.5	Notes on the results:						

4.5	Conclusion and Suggestions



As for the exhibition design, the typologies of mounts are potentially infinite. Below, a summary of the most common mount solutions for small-medium objects.

1 Interfaces

The use of interfaces is suggested by the topography of the bottom side of the object. In case this is uneven, the material offers better stability. It is usually a cast that can be in different materials (epoxy, plaster, etc.). It should be fixed to the flat support to foster its efficiency, avoiding horizontal movement (sliding).

2 Clips

The clips are elements that assure the connection of the object to a horizontal plane. They have a part holding and adjusting to the object (padding) and one fixed to the base (fastener). These can be made in various materials (like metal, plastic, wood, etc.), and cast to shape. The required clip numbers and material vary according to the object characteristics. They would change if the object is a ceramic vase, a glass vessel, or a medium marble statue. The correct installation of this solution prevents both horizontal and vertical movements.

3 Wax

This solution is suitable to object lower than 30 cm with a low center of gravity. It consists of applying the right amount of little ball of specific wax (microcrystalline wax or other variety). These are pressed on the bottom of the object and then fixed on the horizontal surface. The support has to be solid and stable. It is a simple, low-cost, reversible, and easy to apply solution. If the object is porous, the bottom part has to be sealed with a protective solution.

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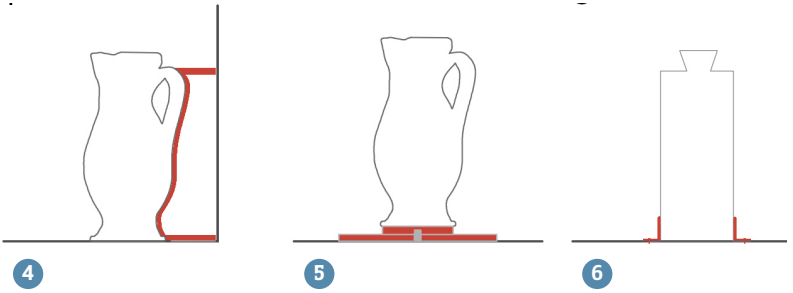


4 Contour Mount

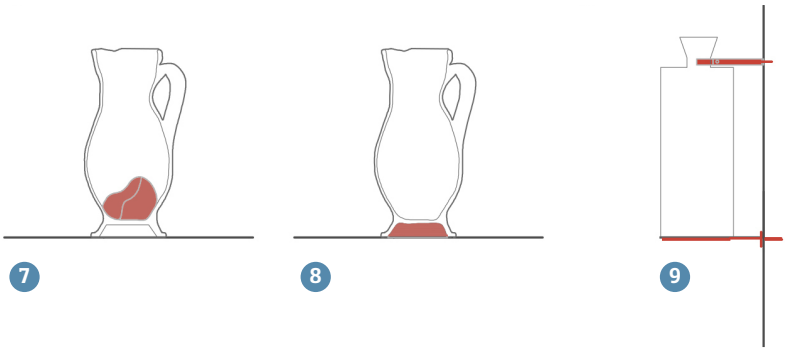
Sometimes called spine mount, this solution matches the object's profile and is usually applied to slim pieces or medium-tall pieces. It can be cast, shaped, or cut, and it is generally in metal or acrylic. This solution provides both support and motion restriction. The object can be fixed to a horizontal and/or vertical surface.

5 Plate+Interface/Clips/Contour Mount

If an object can not be fixed to a base, one option is to add flat support to increase the object's footprint. The plate can be combined with other mounts, like interface, clips, or others. The choice depends on the conservation state, geometry, and exhibition needs of the object.

6 Stops

The use of this kind of mount limits the sliding movement. Such a solution is suitable only for specific shapes, as cylindrical vases. To restrain the movements, they have to be hard enough to prevent their deformation and high enough to prevent the object's tilt. To be efficient, one has to install at least three stops. This solution usually has quite a strong visual impact.



7 Weight

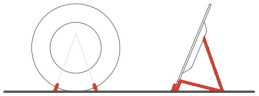
When possible, the easier and simpler action to lower the mass of a configuration is to add weight to the object, improving its stability. Obliviously, the efficiency of this solution depends on the shape of the object, its weight (adding a conspicuous weight to lower the center of mass could not always be the right solution) and its condition (if bad, this could not be a viable option).

8 Cast Interfaces

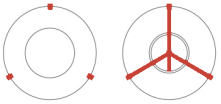
If the object has a cavity at the base, one can opt for a cast interface that occupies the void, providing a flat footprint.

9 Vertical Mounts+Shelves

Instead of installing tiny objects on horizontal planes or extended shelves, one can opt to anchor them to the vertical planes in combination to sustain serving as shelves. The object needs to be fastened in more points, usually top and base. It is a combination of interface or a cast, shelf mounts, plug, or collar.



10



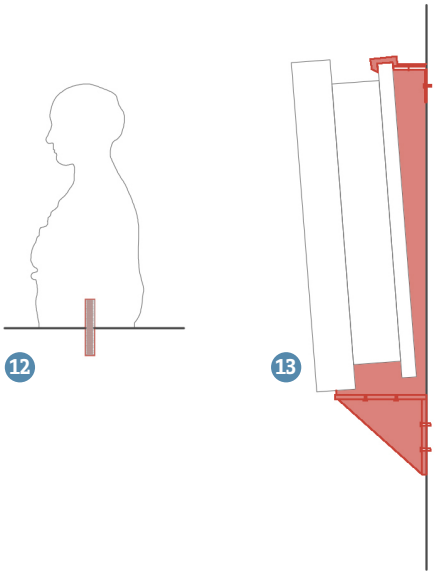
11

10 Easels

The standard solution to expose open shape ceramics (e.g., plates, basin, bowl) are little easels. These are usually in metal or acrylic and can be easily found on the market. Unfortunately, hand made shapes hardly accommodate in standard easels, determining instability. Furthermore, the footprint is usually tiny, and the sustains are light. The suggestion is to use customized easels with a larger footprint combined with wax or other mount solutions (the choice links to the specificities of the single piece, as weight, shape, state of conservation).

11 Vertical Mounts

In case of open shapes, adjustable mounting systems adapt to the different diameters of the pieces. Three or four points of contact are sufficient. The crucial passage is the connection to the vertical plane. In case of frames and paintings (light objects), hanging methods are commonly adopted. A double safety hanging hardware is suggested to decrease the weight on each wire and hang and limit to the swinging movement on the vertical plane.



12 Internal Mounts

If objects have holes or cavities, a sustain can be installed inside and fixed to a base, usually by a pin. This solution can be suitable for a medium object and sustain it from the interior.

13 Big Objects

About giant statues and heavy vertical objects, the anti-seismic solutions can be a base isolator. In the case of pieces, like architectural fragments, fresco segments, large paintings, and mosaic panels, to place vertically, the answer might be a wall mounting. Whether the object had a horizontal or a vertical position, the anti-seismic display solution is a technological advanced element. Implying that they have to be developed by a team of experts and that the outcomes are usually expensive.

To further information about mount making, see Podany (2017-pp. 131-197) or refer to the addresses of mount making services.

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