

P / REFERENCES OF DESIGN

DATA-DRIVEN DESIGN FOR THE DESIGN HERITAGE.

Alessandra Bosco^a, Fiorella Bulegato^a, Lucilla Calogero^{*a}

^a Università Iuav di Venezia, Italy

^{*} lcalogero@iuav.it

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ABSTRACT | The integration of digital technologies in museums has instigated a transformative shift in various facets of museum practices, reshaping acquisition, preservation, communication, and exhibition processes. This evolution has given rise to a hybrid physical-digital nature within heritage institutions, where analog, surrogate, and digital dimensions coexist while retaining their distinct identities.

Within this dynamic context, digital data has emerged as a pivotal design material, fundamentally altering the operational landscape of museums. The field of “digital cultural heritage design” provides tools and processes to develop solutions that bridge preserved heritage with practices enhancing visitor experiences both on-site and online. This exploration of digital technologies and diverse media has led to three main types of intervention: datafication, representation, and narration.

Identifying design heritages as a field that due to its peculiarities can benefit manifold from these practices that open up new perspectives on the enhancement and understanding of collections, the paper investigates data-driven design approaches for design museums geared toward promoting innovative forms of heritage fruition and knowledge sharing.

The research identifies the designer’s role, outlining objectives, target beneficiaries, competencies required, and associated deliverables for data-driven design approaches in museums. Envisioning a “process interface museum,” the research suggests that data serves as a resource for study, research, exhibitions, and a foundation for a shared production of design history. It anticipates a future where museums seamlessly integrate physical and digital elements, leveraging data to enrich visitor experiences and contribute to the collaborative construction of cultural and design history.



1. The Museum's Digital Transformation

Museums encourage and stimulate the spread of knowledge by contributing to the preservation of a society's memory and the construction of its history through methods, processes and practices which characterise the social, cultural, and technological context in which it was conceived. Their Collections, presented in both temporary and permanent exhibitions through a specific didactic apparatus resulting from historians' and curators' in-depth studies, elaboration and interpretation, have been until recently the main instrument for the diffusion of cultural heritage. (Parry, Ortiz-Williams & Sawyer, 2007)

The introduction of digitalisation indeed marked a major departure from the consolidated practices of acquisition, conservation, filing, research, communication and exhibition of said heritage (ICOM, 2022) triggering an overall process of change that still today produces and requires epistemological, cultural and social reflections on the functions of the museum institution as well as on the hybrid physical-digital nature that increasingly characterises heritage. (Parry, 2007) Not only that, the refinement of renewed digital collection management systems demonstrates the intensification of opportunities for museums to interrogate, interconnect and share data. It basically amounts to two different forms of data, first made official in 2003 (UNESCO, 2003), namely *digital surrogates*, visual reproductions of analog artefacts created through standardised methods and techniques (Marras et al., 2020), and *digitally born*, artefacts existing merely in the digital format.¹

The inclusion of digital surrogates and digitally born heritage by museums – e.g. by London's V&A, Washington's Smithsonian Institution and New York's MoMA – has made possible the broadening of the collections' boundaries with digital materials including digital texts; organisational and personal records of activity; transactions; correspondence; datasets collected to record or analyse scientific, geospatial, spatial, sociological, demographic, educational, health, environmental and other phenomena; learning objects; software tools such as databases; models; simulations and software applications; digitally-generated artworks and documentary photographs; scans, still and moving images; audio recordings; graphics; web sites; blog posts; social media pages in a wide and growing range of formats.

This increase in museum heritage has been accompanied by the expansion of digital-driven modes of fruition and specific personal devices and technological apparatuses (Lewi et al., 2019), enabling museums to offer plural narratives, conveyed by physical and digital devices, and to disseminate knowledge to a broader public that, when involved, relates directly to the artefacts. Digital data can in fact take on two functions: on the one hand, they convey the content of the narrative associated with the physical artefacts; on the other, they constitute the information carrier integrated with the artefacts and represent both the useful tool for conveying communication and part of the potentially communicable content.

Regardless from the will and possibilities of the various museums, this introduction to the digital dimension, in view of obvious benefits, has fuelled a broad debate on the planning and adoption of strategies to face this historic transformation, which has, with the *OpenGlam* movement (<https://openglam.org>) come to prefigure ethical open access to cultural heritage.

On the one hand, through an agenda promoted by dedicated international organisations, among which the International Council of Museums (ICOM, <https://icom.museum/en>), the International Committee for Audiovisual, New Technologies and Social Media (AVICOM – ICOM, <https://avicom.mini.icom.museum/>), and, in Italy, the *Commissione tematica Tecnologie digitali per i beni culturali* (<https://www.icom-italia.org/commissione-tecnologie-digitali-beni-culturali-icom-italia/>).²

¹ The former corresponds to the operations of digitalisation of historical documents, while the latter to the production of digital material.

² A body that, while taking care of AVICOM's work on a national level, develops initiatives for the activation of a dialogue between experts and institutions in the field of digital technologies for the conservation, documentation and communication of cultural heritage. Retrieved 2 August, 2024, from [hjcjhttps://avicom.mini.icom.museum/](https://avicom.mini.icom.museum/).

On the other hand, through activities by organisations/networks – among which the Museum Computer Network (MCN, <https://mcn.edu/>), the Museums Computer Group (MCG, <https://museumscomputergroup.org.uk/>), and the Network of European Museum Organisations (<https://www.ne-mo.org/>).

In the different occasions promoted in these contexts, since 2017 the discussion between professionals and institutions has covered multiple aspects: from the introduction of new forms of communication, fruition and participation, to the connection and relationship between institutions, from the accessibility of heritages and technologies to the development of an evaluation model for European museums, with a specific focus on the measurement of social impact (MOI - Museum of impact <https://www.museumsofimpact.eu/en/museums-of-impact>). Last but not least, the question of the relationship between the material essence of the artefact and the immateriality of the digital surrogate (Drucker, 2013). Indeed, the process of abstraction that characterises the acquisition of artefacts transforms the relationship between user and heritage, which, being more accessible and shared, nevertheless loses its qualitative-sensorial material dimension with the consequent reduction of values, at least from the point of view of perception. (Cameron, 2021, p. 105)

2. Data and Dataset in the Museum, from the Functional Role to the Social One

In a nutshell, the historiography of museum computing identifies in the 1960s in the United States the first initiatives of automated cataloguing of collections (Parry, 2007) that, by replacing paper instruments and the curators' memory with the primordial electronic documents provided the first systems of data search and retrieval (Sartori, 2016, p. 3). The continuation of catalogue automation processes goes in the following decade through the introduction of “new standards, a control of terminology and a systematisation of data entry” (Parry, 2007, p. 51), associated with the development of relational database management systems based on interconnected data tables (Sartori, 2016, p. 4). This production of information, at first only functional for the optimisation of the cataloguing and management of museum collections, becomes in the next phase one of the main goals and tasks of the museum, reconfiguring it as a repository and transmitter of information within society (Parry, 2010). George MacDonald and Stephen Alsford explain the influence of this transition in 1991:

“Indeed, we must define “information” broadly. It may be intellectual, aesthetic, sensory, spiritual or emotional in nature or, more likely, an experience involving some combination of these elements. Culture is learned as a set of “messages”, each of which includes various types of information. Culture is expressed not only through objects, but also through processes, ideas, feelings, personalities and so on.” (MacDonald and Alsford, 1991, p. 308)

This idea of the museum as an “information utility”, in which artefacts, didactic apparatus, audiovisual materials, databases, staff experiences, oral histories, re-enactments and live performances are understood as complementary, layered and overlapping communicative resources (MacDonald & Alsford, 1991), comes into being at the beginning of the Millennium with the spread of the World Wide Web, which allows for an enormous expansion of the relationships between multimedia, hypertexts, hypermedia and the Internet itself (Cameron, 2007). The discussion started even before the advent of the Internet era and the Graphic User Interface, and it focuses on shared/searchable databases; re-using research and data; visualising geographical and architectural contexts for museum objects; enhancing learning environments by adding multimedia capabilities; creating immersive galleries and virtual tours; and solving usability issues through interface design. (Farrelly, 2016, p. 172)

Underlying this transformation is the shift in the role of information technology from being a mere support for the internal management of collections to becoming an instrument of communication to the outside world, making information– and thus the collections themselves – accessible not only to the museum community but to the wider public. The structure of the museum is therefore assimilated to an indexed

collection of information, designed for archiving and retrieval, and identified through a reading of the objects systematised according to predefined and shared rules in a multi-layered information system and with the goal of clarity promoted by the desire to be informative.

Is the museum therefore a database? This provocative proposal by Mike Pepi (2014; 2019) picks up on Manovich's observation that "the database is the symbolic form of the post-industrial era" (1999, p. 2) and alludes to Parry's studies for which not only has the database become "the metonym of the museum" but, on the contrary, "the database itself [...] is endowed with the qualities traditionally associated with the museum". (Parry, 2007, p. 51)

On the other hand, the overlapping of the term "museum" with "library", "collection" or "archive" has now made the boundaries of these institutions increasingly blurred and sometimes ambiguous (Lupano, 2013), both in the structure they bring to mind and in the roles connected to it, all the more so when, moving out of the almost exclusively public dimension, they represent entire collections of materials that could be acquired by almost any Internet user in the more or less recent past (Schnapp, 2008).

Beyond definitional and terminological disputes that are beyond the scope of this paper, it is however clear that in just a few decades, as mentioned so far, the digital dimension has profoundly altered the structure and nature of the museum, highlighting both the possibility of considering different forms of expression and the connective properties of data as foundations on which to base museum practices and the need for interdisciplinary approaches and skills to govern the "new museum". (Manoff, 2004; Clement, Hagenmaier & Knies, 2013)

3. The Case of the Design Museum

Between two traditional museological models, synthetically referring to the isolation of the art object or to the exhibition of the functionality of the technical object, the design museum constitutes a category of exhibition and research structures, sometimes elusive due to the history of the institutions that deal with it, the different types of artefacts it contains, or because the same artefacts are often kept in museums dedicated to something else. (Dalla Mura, 2010)

Even in this museum "category", the debate, besides highlighting specificities and critical issues, has raised the question of its expansion through digital interactivity. (Farrelly & Weddell, 2016) In 2016 the scholar Liz Farrelly thus predicted: "An examination of some moments in the pairing of museums and 'hypertextual connectivity' reveals the digital online museum as a site for the production of meaning and points towards innovations that might push the ubiquitous website beyond the current paradigm" (2016, p. 171), and since then design museums have also experimented with digital modalities to avoid the risks of dispersion of materials, facilitate new perspectives of study and "animate" their collections.

As far as collections are concerned, the digital transition has had at least two significant effects. Firstly, it has highlighted the importance of new types of heritages previously overlooked as media artefacts, pieces that can offer, among other things, a representation of new fields and professions in the field of design, and of modes of interaction between person and object. It is no coincidence that in 2012 Paola Antonelli, Senior Curator of the Department of Architecture and Design at MoMA, by acquiring 14 videogames stated that she "kicked off a new era for the collection". (MoMA, 2012)

Exhibitions such as *Decode: Digital Design Sensations* in 2009 at the V&A in London, co-curated by Louise Shannon, curator of Contemporary Programmes, and Shane Walter, director of the digital media agency Onedotzero, or *Talk to Me: Design and the Communication between People and Objects* in 2011 also at the MoMA, where Antonelli, with Kate Carmody, Curatorial Assistant of the Department of Architecture and Design, "tested" the combination of the physical exhibition of pieces and its web version containing official and online materials, have indeed contributed to generate the current collections. For example, the online catalogue of the V&A currently shows a total of 302 pieces, of which 32 are in the "Design, Architecture and

Digital Collection” (<https://www.vam.ac.uk/collections>) under the heading “software”, while MoMA and the Cooper Hewitt Smithsonian Design Museum include 88 and 60 artefacts respectively, dating from 1966 onwards and distributed among digital fonts, digital posters, smartphones, videogames, interactive visualisation and much more (<https://www.moma.org/collection/>; <https://collection.cooperhewitt.org/search>).

The second aspect concerns the possibilities offered by the combination of heritage digitisation and data interoperability, which, by allowing the analysis of masses of materials belonging to different conservators, from institutional to individual users, can, on the one hand, contribute to the reconstruction of processes by connecting the contents of different collections – i.e. by exploiting the potential of using Linked Open Data (LOD) technology in creating relationships inside and outside the archive (Listo, 2019) – and on the other hand extend and renew narratives. These enormous digital datasets open up new perspectives on the understanding and valorisation of design collections by prompting one to reason about quantitative parameters and metrics such as occurrences of formal patterns that can reveal stylistic trends and cultural influences, or chronological links that show the evolution of artefacts over time, or even semantic relationships between different elements of collections that allow conceptual and thematic connections to be identified.

It should also be considered that what closely links this category of museums to the opportunities offered by the digital transformation is one of its distinctive features with respect to other museum categories and an expression of one of the contemporary interpretations of design, namely the possibility of making its process dimension evident (Bulegato & Scotti, 2024): “The design museum – design being the whole process between project and product – cannot be a place where only the finished product can be observed, because this is ‘only’ the result and the point of arrival of a long journey. In order to be aware of this path, one must have knowledge of all the actors and all the actions necessary, and indispensable, for its completion”. (Cecchi & Pirola, 2022, p. 336)

This historiographical and museological approach (Huppertz, 2020) has characterised the realisation of two recent structures, questioning, among other things, those historiographical readings and curatorial practices of acquisition, cataloguing and display that have by now been canonised and consolidated. The renovation of the Design Museum in London in 2016 in which the permanent collection, *Designers, makers and users*, explores the history of design through extensive materials documenting and explaining the interconnections between the three subjects: creator, producer and consumer. (Newson, Suggett & Sudjic, 2017)³ Similarly, in 2021, the ADI Design Museum in Milan, the newest of the Italian design museums, exhibited its permanent collection, *Il cucchiaino e la città* (The spoon and the city), dedicated to the Compasso d'oro⁴ awards using heterogeneous documents – sketches, drawings, models, prototypes, products, communication artefacts, photographs, documents, publicity and so on – generated by the various parties involved in the project-production-sales-consumption-disposal process – client, designer, model-maker, printer, entrepreneur, factory technician, graphic designer, copywriter, distributor, consumer and so on – with which the design process can be summarised.⁵

4. The Museum as an Interface

The elaboration by Petrina Foti, Professor in Museum Studies at the Rochester Institute of Technology, helps precisely to frame the role of data in the museum context. Reasoning about possible display modes for computer history collections, Foti (2022) questions the characteristics of data. In the proposed matrix (fig. 1), the data, an informational unit, is expressed in six different forms (bits, evidence, lens, tool, object,

³ The digital catalogue is more or less non-existent and the printed one only partially includes the many exposed pieces.

⁴ *In progress*, as the prize is still active.

⁵ There still isn't an archive in which the exhibited materials are accessible, while a printed catalogue is currently in the works.

story subject) which correspond to contexts of use (discipline, objective analysis, contextualisation, historical preservation, professional practice, interpretation) represented within the museum by different outputs and practices of research and knowledge restitution. The datum as bit expresses the minimum unity of the scientific discipline being exhibited; the datum as evidence constitutes evidence and traces in a process of objective analysis; the datum as lens is a functional device for contextualisation; the datum as object is an artefact to be preserved; the datum as tool is the subject of multiple professional practices; and the datum as story subject is the protagonist of an interpretation. (Foti, 2022, p. 26)

<i>Data is INFORMATION</i>	<i>Due to DEFINITION</i>	<i>This is expressed in a variety of way, such as Bits; Evidence; a Lens; an Object; a Tool; a Story Subject.</i>
<i>Data is seen as ...</i>	<i>Due to ...</i>	<i>Is this expressed in the museum's research interests and outputs? If so, where and how?</i>
<i>... bits</i>	<i>Discipline</i>	
<i>... evidence</i>	<i>Objective Analysis</i>	
<i>... a lens</i>	<i>Contextualization</i>	
<i>... an object</i>	<i>Historical Preservation</i>	
<i>... a tool</i>	<i>Professional Practice</i>	
<i>... a story subject</i>	<i>Interpretation</i>	

Table 1: The Synthesis Matrix

Figure 1. Petrina Foti, The Synthesis Matrix, 2022.

A further effect of the digital transition is the consideration of new skills and approaches for the orientation and management of a new living and adaptive museum. There is no uniquely defined digital heritage professional or scholar. The figures who come together in the renewed context are technologists, computer scientists, archivists, academics, historians, designers, curators who are called upon to be part of an interdisciplinary dialogue the effects of which also reverberate on each of their relevant communities. (Parry, 2010, p. 3) In the context of this dialogue, particular importance is assumed by professionals such as interaction designers, visual designers, exhibition designers and science communicators, as they are active in contexts that require cross-sectoral skills that facilitate the integration of tools and the mediation of contents. (Vane & Davis, 2020)

The design of the museum thus approaches that of an interface capable of integrating physical and digital dimensions “that delimits a cultural space within which a specific set of relationships can occur” (Hookway, 2014); an interface that conditions the production and circulation of information and meanings based on its spatial arrangement, connectivity, depth, responsiveness and reconfigurability. The museum understood as an interface for knowledge recalls the research hypotheses put forward by Kathleen Pirrie Adams (2018), Professor of New Media at Ryerson University, who clearly propose the connections between the physical and digital dimensions, the “enriched space” that, as theorised by Elisa Bonacini (2020, p. 55), is the paradigm on which the museum reframes its characters.

In particular, Adams' conceptual framework of the museum system is defined through a vocabulary that draws on the language of computer science and interface design where the terms “asset”, “platform” and “affordances” accompany and extend museum practices metonymically. Adams identifies “collection” with the term “asset”, with which she highlights the coexistence of a variety of quantitative and qualitative data: objects, texts, images, media and records of intangible culture. (Adams, 2018, p. 296)

The artefact, brought from a material dimension towards a more informational one (Adams, 2018, p. 294) and placed in a system of dynamic and plural connections, contributes to the production of an “exhibition” that defined as a “platform” brings associations with shared space, multimodality and multimedia to mind. Interpretation – historically a monopoly of the museum and its curators – is in turn renamed “affordance”, recalling a term imported from the field of user experience design that frees it from subjectivism by bringing out objective and relational aspects.

5. “Digital Cultural Heritage Design” for Design

Starting from Foti's theoretical framework and Adams' metonymies, considering physical and digital data, whether surrogate or digital born, as plastic and adaptive resources, this paper investigates design-driven practices for design museums, aimed at promoting original forms of heritage fruition and knowledge sharing.

Even in the case of this category of museums, design practices for museums are based on the in-depth study of content that encourages dialogue with curators and cultural heritage professionals, and on the consideration of technologies, tools and languages with which to enhance the specificities of the heritage while taking into account issues related to infrastructure and economies available at the time of setting up and in later periods, when use and management make maintenance necessary.

Design for the enhancement of the museum heritage uses the potential of digital to highlight, superimpose and integrate the visitor's experience also through the use of quantitative and qualitative data in its different expressions (Foti, 2022), according to different media. As claimed by Mason and Vavoula (2021), this is “digital cultural heritage design”, an

“Activity system where a disciplinarily diverse team of staff and partners engages in the (co)creation of knowledge about how to design in ways that are specific to and appropriate for the museum and its audiences; in terms of the network of actions and actors that constitute the practice; in terms of the design methods and representations that catalyse the design activity system; and in terms of the design knowledge assets that grow out of and feed back into the system.” (pp. 406- 407)

Digital cultural heritage design is therefore the project serving digital cultural heritage, which in this research is applied to design museums. It is concerned with relating the specific preserved heritage to practices that enhance the visitor's experience of knowledge on site and online by exploring digital technologies and different media.

Applying the prefigurative vocation of design to the field of museum studies and orienting research toward the production, interpretation and fruition of cultural datasets, the authors identifies three main types of intervention: datafication, representation, narration.

For the sake of clarity and coherence, it was decided to formalise the framework of interest of each intervention according to predefined parameters. For each typology we choose to indicate the objective pursued, beneficiaries to whom the action is addressed, design solution, services and competences required of the designer, tangible or intangible deliverable to which forms of expression of the data and context of use with reference to the matrix elaborated by Foti (2022) are associated. In support of the proposed framework, exemplary cases of design museums that give concrete expression to its potential will follow.

Table 1. Data framework.

	Datification	Representation	Narration
Data expressive form	bit / object	evidence / lens / tool	story subject
Context of use	discipline, historical preservation	objective analysis, contextualization, professional practice	interpretation
Objective	to promote the queryability of the collection; move beyond the punctual research key; use of metadata as a means of aggregation, grouping, filtering and retrieval.	to organize the complexity of information by promoting its understanding; to share the complexity of an issue; to create public engagement; to highlight relationships; to reveal aggregations.	to offer adaptive content, personalized narratives, and systems that can combine and transmit knowledge and expertise, making explicit the narratives inherent in an artifact; to elicit emotion and involvement; to transfer individual and collective memories between generations; and to foster connections between institutions and heritage, individuals and communities.
Solutions	search and retrieval system; data-driven hub	reading and orientation system, lens for clustering content	interpretation system
Competences	product and service design strategy; user research; UX, UI, brand design, front back-end development, impact monitoring	analyzing, cleaning and formatting data; UI; UX	UX; UI; user research; content management; engagement strategy
Deliverables	websites, content archives, digital platforms, online exhibitions	static and dynamic data visualizations	integrated physical-digital systems and applications; digital platforms
Beneficiaries	researchers, students, online visitors, curators	researchers, students, on site e online visitors, non-specialistic public	researchers, students, on site e online visitors, non-specialistic public

5.1 Datafication

With datafication interventions, the designer proposes the development of research/retrieval systems that are configured as data-driven hubs for research exploration and planning and are aimed at facilitating the queryability and usability of the collection.

The museum as interface emphasises the multifaceted identity of the artefact as a complex of information/attributes. The transformation of artefacts into data is not a mere transposition of the physical object/document into digital, nor is it its reproduction on another medium; it is a translation process that by standardising the heterogeneity of formats, through the production of metadata, facilitates the possibility of connection, interconnection making relationships between different artefacts, collections and digital environments, possible.

This lays the foundations for overcoming the punctual access to information traditionally guaranteed by the “search field” – which Mitchell Whitelaw (2015) defines as a “stingy interface” – in favour of a fruition in which the “generous interface” allows the user to have a contextualised view of the content searched in the archive-museum through aggregations and filtering.

Among the metadata associated with resources, tags “identify and classify” artefacts with non-specialist language. This opportunity bridges the “semantic gap” between cultural heritage professionals and the

public using less specialised terminology, laying the groundwork for reinventing ways and practices of using collections that stimulate different public use and understanding. (Whitelaw, 2015)

Interface and metadata constitute devices that can organize and manage complex cultural datasets by facilitating access to the data for an extended audience. If the focus shifts from access to analysis, the adoption of AI and in particular machine learning models, can function as a multiplier of data processing capacity, for example to perform recon on massive cultural datasets that with generous interfaces produce research on aggregated connected domains. Indeed, algorithms for mining, shaping, and representing large datasets play a key role in several stages of the so-called “data processing pipeline,” for example, in operations involving digitization, transcription, pattern recognition, simulation and inferences, preservation, and curation. (Kaplan, 2015, p. 3)

Good examples are the Triennale di Milano Online Archive (<https://archivi.triennale.org/archive/archivi>) and the V&A Archive of Art and Design (<https://www.vam.ac.uk/info/archive-of-art-and-design>). Particularly interesting is also the online platform of the Cooper Hewitt Smithsonian Design Museum archive, which houses the collections of the different departments. The file of each artefact shows: tag (these tags connect diverse objects from across the collection: they represent themes that extend over time and across the different museum departments), timeline (year of production, year in which it was reproduced photographically, year of acquisition, exhibitions in which it was exhibited), metadata (type, producer, materials, production process, donors – connected to its collection), number of images available, the place where it is exhibited, other related artefacts selected by the curators from those present in the archive, size, colour palette. The use of the IIIF framework⁶ (Rodighiero et al., 2023) extends the queryable holdings to all objects held by the Smithsonian institutions.

⁶ The International Image Interoperability Framework (IIIF), is an interoperable protocol for publishing high quality images on the web and sharing them. It was created for sharing images between digital libraries, is open source and has several levels of APIs (authentication, annotation, search, presentation) to be able to build and implement different services.

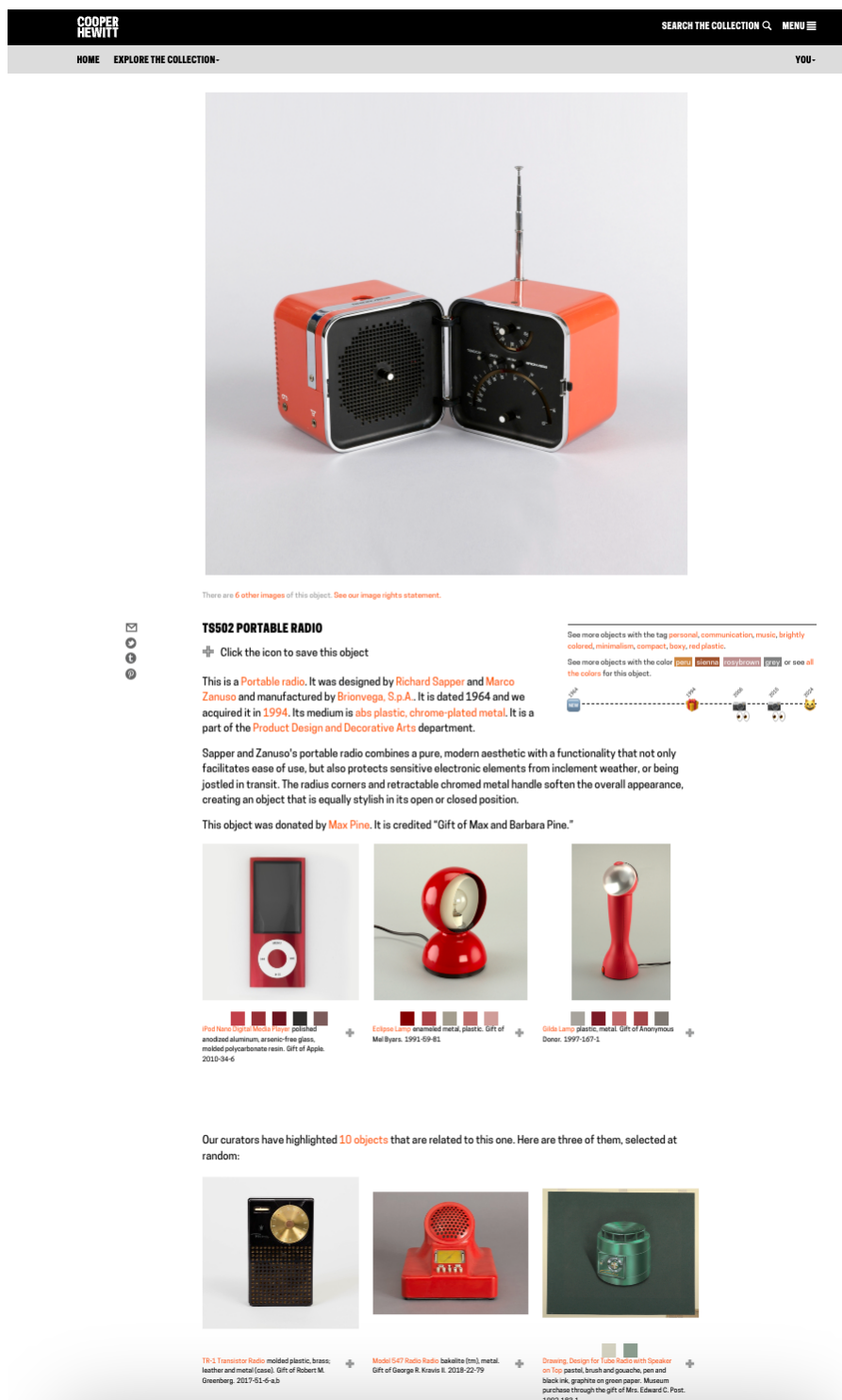


Figure 2. TS502 ts502 Portable Radio; Designed by Richard Sapper (German, 1932 - 2015), Marco Zanuso (Italian, 1916 - 2001); Manufactured by Brionvega, S.p.A. (Italy); Italy; abs plastic, chrome-plated metal; H x W x D (open): 13 x 33 x 16.5 cm (5 1/8 x 13 x 6 1/2 in.) H x W x D (closed): 13 x 22.5 x 13 cm (5 1/8 x 8 7/8 x 5 1/8 in.); Gift of Max and Barbara Pine; 1994-59-3. Retrieved 2 August, 2024, from <https://collection.cooperhewitt.org/objects/18648915/>.

5.2 Representation

With representational interventions, the designer, through practices of analysing, cleaning and formatting of extended datasets, proposes the development of orientation systems for the in-depth study, visualisation, sharing and dissemination of complex content in museum contexts.

Visualisation, a crucial intermediary between the digital archive and its big data, functions both within galleries and beyond their physical location as networked access (Kenderdine, 2021). The extent and heterogeneity of the preserved and digitised materials require the structuring of static and dynamic reading systems; interfaces to aggregate, filter and group the stored data that allow both “distant” and “close reading”. (Drucker, 2017; Kaplan, 2015; Kenderdine, 2010; Moretti, 2005)

Visualisations foster multi-level readings by highlighting relationships and revealing associations that, through interaction, can extend the experience from the screen to the physical setting (Windhager et al., 2019) opening up the museological heritage to exploration both within and beyond the institutional walls. This type of intervention sees designers and digital humanists working on the qualitative dimension of the data often in a parallel way, the former focused mainly on the design of physical and digital interfaces for expanded access to information – approach that finds in the use of AI driven tools the possibility of expanding, refining and updating research outcomes over time by reiterating the data query against the acquisitions made –, the latter rather more on analysis through visualisations as research tools and methodology.

The activity is aimed at diverse and broad audiences, involving experts as well as non-specialists. Three main approaches have been identified by Sarah Kenderdine (2021), professor of Digital Museology at the École polytechnique fédérale de Lausanne: collections visualisation, embodied visualisation and spatial and temporal visualisation.

An example of the most widespread practice, collection visualisation, is the work of Olivia Vane, researcher and data-visualisation designer (<https://www.oliviavane.co.uk/cooper-hewitt-tags>) who, wanting to narrate the breadth of the Cooper Hewitt Smithsonian Design Museum's collection, worked on the tagging system of artefacts by identifying in morphology and colour search attributes that multiplied by the numbers of artefacts in the collection highlight hidden narratives, surprising even museum staff. “Organising the data into timelines makes it possible to trace how a concept or idea has been visually expressed across time. Bringing objects from very different places together in these visualisations encourages serendipity and unexpected juxtapositions” (Vane & Davis, 2020, p. 29). In this case, the dynamic representation of specially designed digital data exploits and enhances the basic powers of human perception and supports the understanding of large-scale information (Card, 1999). In this way, user interaction highlights patterns and trends that are difficult to detect with point-in-time research.



Figure 3. Personal environmental control timeline: a dry juxtaposition of these decorated fans against modern Nest thermostats. Olivia Vane, <https://www.oliviavane.co.uk/cooper-hewitt-tags>.

The *Surprise Machines* project (<https://mlml.io/p/choreographic-interface/>), developed in 2022 by metaLAB Harvard FU Berlin (<https://mlml.io/>) for the Harvard Art Museum is an example of embodied visualisation. Part of the temporary exhibition *Curatorial A(i)gents*, *Surprise Machines* is a data visualisation designed using AI algorithms that maps more than 200,000 digital images and shows them in an interactive installation enriched by “a choreographic interface” (Rodighiero et al., 2022) which allows visitors to understand the vastness of the collection by interacting through a camera that captures body gestures.



Figure 4. Surprising Machines, Harvard Art Museum, 2022 . Retrieved 2 August, 2024, from <https://mlml.io/p/curatorial-aigents/>.

Inscribed in the “spatial and temporal visualisation” typology, *The Room of Change* (<https://accurat.it/work/broken-nature>) is the environmental installation designed by the studio Accurat on the occasion of *Broken Nature: Design Takes on Human Survival* at the XXII Milan Triennale curated by Paola Antonelli. The room is empty and the walls are covered with a wallpaper that incorporates visual patterns derived from the processing of extensive datasets on global issues such as world population density, energy consumption and variation in average temperatures. These patterns represent environmental changes in the past, present and future. The wall is a device for conveying content through interaction with a mobile application that offers keys to interpreting the visual codes used. Following Giorgia Lupi’s approach of “giving human life to data” (Lupi, 2014, p. 62), this project combines research and data design. The aim is to go beyond traditional data visualisation codes, incorporating cognitive studies on perception to make the project accessible to a wider audience, including non-specialists.

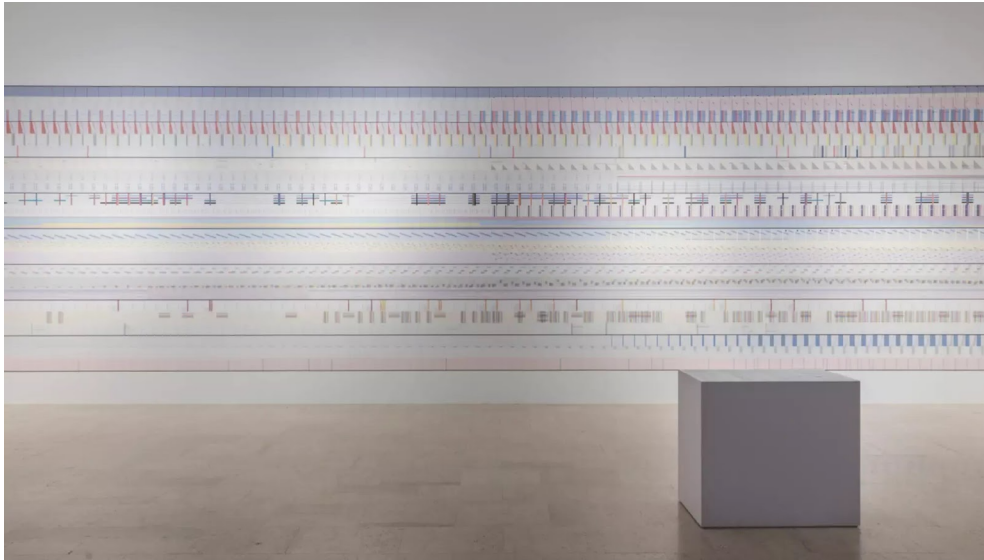


Figure 5. The Room of Change, Accurat, 2019. Retrieved 2 August, from <https://accurat.it/work/broken-nature>.

5.3 Narration

With storytelling interventions, the designer designs systems of multilevel interpretations aimed at combining and transmitting knowledge and expertise in order to: make the stories inherent in an artefact explicit; arouse emotion and engagement; transfer individual and collective memories between generations; and foster connections between institutions and heritage, individuals and communities (Bonacini, 2020). These systems include user customisation of content, the ability to offer adaptive content or customised narratives, and systems that can combine physical narratives with digital narratives (Poulopoulos & Wallace, 2022).

Variable, situated and dynamic interfaces are an expression of the expanded museum, a “living” organism with high complexity due to the variability of content aspects (Atzori et al., 2023, p. 38). Artefacts communicate themselves through their material properties but they also carry “other” and intangible stories concerning their contextualisation.

The contents that augment the artefact, whether created by museum professionals or ordinary people, or generated by AI give plasticity to the artefacts as they can be recalled on demand according to specific reading frames. These interventions also exploit the potential of hypertextuality and hypermediality as for the same content the narrative can take on different formats: text, audiovisual, images, links to collections or other.

The development of “augmented narration” systems requires the presence of a network infrastructure and connection systems for geo-localising information. Digital information is in fact made accessible through photographable two-dimensional codes (Qr Codes) or through various proximity devices (RfID tags, NFC, Beacons), or directly through GPS positioning (Bonacini, 2021).

The aforementioned exhibition *Talk to Me: Design and the Communication between People and Objects*, curated by Paola Antonelli and Kate Carmody (MoMa, New York, 2011) integrates information on the contextualisation of the artefacts on display through the use of Qr-codes. The installation proposes a “connective and amplified narrative” (Trocchianesi, 2015, p. 101) in which the flow of information unites and connects internal and external visitors and exhibits. Each piece in the exhibition has a QRcode – this is the first time this device has been used in an exhibition context – that allows visitors to access in-depth information on the designer, project specifications, as well as tweets (according to a real-time data retrieval dynamic) posted by other visitors connected to the same piece. Products, installations and constituent systems of the contemporary communicative sphere are on display: interfaces, interactive multimedia systems, robots,

mobile devices, monitors, screens, and the use of the QRcode allows further links to other works linked by thematic affinity. In this case, the construction of the narrative in the exhibition stems from the object itself, a harbinger of new codes, which integrates them and injects them into the relationships between objects, visitors and the exhibition design that arise during the course of the event.

Although not directly related to a museum institution, but nevertheless interesting as an example of renewing relationships with artefacts, *Teaching with Things*, an experimental research project (2013) developed at Harvard's metaLab under the guidance of Jeffrey Schnapp (2018) and aimed at restoring three-dimensional objects in a multimedia catalogue, integrated augmented storytelling through the three-dimensional representation of the object. In this case, the three-dimensional modelling of the object becomes not only a digital surrogate informational node, but also an access point to a library of additional information capable of proposing relations with other documents and user comments. The digital surrogate, represented within a navigable system of spatial coordinates and queryable with regard to its physical information such as size and weight, is associated with acoustic properties, component attributes and other significant usage details. Information is conveyed through audio, video and photos. As the first experimental version of an “artefactual interface”, the project proposes the transformation of an analogue object into an augmented version of it, where the integration of its attributes with those dictated by the users' annotations contribute to the “description of an object record, understood as an interpretative process that results in a multimedia composite”. (Schnapp, 2018, p. 430)

Finally, the narrative of *Analogous city*, a multimedia installation proposed by researcher Dario Rodighiero (2021), clarifies the sources through the use of augmented reality. The work is an Archizoom initiative protracted in collaboration with Bonnefanten in Maastricht, EPFL in Lausanne, and GAMeC in Bergamo.⁷ Placed within an exhibition context, Aldo Rossi's (1976) map of the *Città Analoga* takes the form of a collage that brings together drawings, images and extracts from artworks. Through a mobile application for tablets and smartphones, it is possible to frame parts of the work, which are recognised and give access to the respective augmented versions.

The augmented reality system graphically depicts touch points that, once selected, refer to bibliographic and iconographic references.

6. Conclusions

The study and analysis of datasets in a qualitative-quantitative key by the field of design supports processes of re-elaboration and signification of the heritage of design from the specificities of artefacts. This process, which is already in use in digital archives that go beyond the punctual search key through the use of metadata, favours the possibility of making the processual dimension of design evident as it makes the set of information supporting it explicit and more easily accessible.

As we have documented, existing data retrieval systems – for example those used at the Cooper Hewitt Smithsonian Design Museum – offer infrastructures and technologies capable of supporting the development of selection practices on which exhibitions can be based, capable of restoring the information content regarding the history of an artefact: the client's request, the conception, the choice of materials, the production technologies, the marketing strategies, communication and use, up to its obsolescence. The most recent design museums show some signs of openness towards this new approach but, although they interpret the logic of data (classifications, aggregations, filters, relations), they end up limiting themselves to the exhibition of analogue and digital artefacts and communication apparatuses, with limited bridges between the two.

⁷ In addition to these museums, the Map of the Analogous City has been exhibited at the Triennale of Milan and MAXXI in Rome.

Even the most virtuous experiences and in line with the idea of a “museum as interface of the process” for design, the proposed “augmented narratives” related to artefacts – also by means of digital – remain in fact confined to the physical space of the museum for the duration of the exhibition for which they were conceived. The transience that characterises such “narratives” on the one hand limits their wider and shared access and on the other hand does not provide for their preservation.

Despite the resources available and the knowledge of the advantages that the digital dimension of data offers (hypertextuality, hypermediality, interaction with the digital object and with the information resources connected to it) what is still missing is the project of dialogue and connection between the exhibition dimension, often still limited to the finished product, and the digital dimension on which historical and curatorial studies could be expanded, favouring new reconstructions and interpretations based on an extended network.

The network of the new design museums based on the idea of a “museum as interface of the process” prefigures itself as a giant global and shared archive, implementable and queryable by each institution and by any user, where data constitute the project material at the service of study and research but also of temporary and permanent, physical and digital exhibitions. The data, an authoritative resource for the construction of memory and knowledge, thus becomes on the one hand the foundation for a shared production of the history of the project based on sources and documents, and on the other hand a support for the process of expansion of participatory and shared culture.

References

Adams, K. P. (2018). Assets, platforms and affordances: The constitutive role of media in the museum. In *The Routledge Handbook of Museums, Media and Communication* (pp. 290–305). Routledge.

<https://doi.org/10.4324/9781315560168>

Atzori, I., Ballor, C., Barbuti, N., Bonacini, E., Paolo, C., De Bari, M., Faccini, M., Farroni, L., Fiore, F., Genova, G., Guerzoni, E., Magliano, V., Maniello, D., Mannucci, M., Marras, A., Pagano, A., Santagati, C., Schettino, P., & Tonelli, A. (2023). *Report dell'indagine pilota su Digitale e digitalizzazione nei musei italiani (2020–2021): Un'analisi e prospettive future*. ICOM Italia. <https://doi.org/10.5281/zenodo.8074816>

Bonacini, E. (2020). *I musei e le forme dello storytelling digitale*. Feltrinelli.

Bonacini, E. (2021). Storytelling digitale in ambito culturale e il suo ruolo in ambito educativo. *Culture Digitali*. <https://www.diculther.it/rivista/storytelling-digitale-in-ambito-culturale-e-il-suo-ruolo-in-ambito-educativo/>

Bulegato, F., & Scotti, M. (2024). Exhibiting design as a process. In F. Zanella et al. (Eds.), *Design! OPEN 2022, SSDI 37* (pp. 275–284). https://doi.org/10.1007/978-3-031-49811-4_26

Cameron, F. R., & Kenderdine, S. (Eds.). (2007). *Theorizing Digital Cultural Heritage: A Critical Discourse*. MIT Press. <https://doi.org/10.7551/mitpress/9780262033534.001.0001>

Cameron, F. R. (2021). *The future of digital data, heritage and curation in a more-than-human world*. Routledge.

Card, S. K., Mackinlay, J., & Shneiderman, B. (1999). *Readings in information visualization: Using vision to think*. Morgan Kaufmann.

Cecchi, M. A., & Pirola, M. (2022). Il Museo del Compasso d'oro. Ricostruzione teorica, storica e critica di un archivio da immaginare ed esporre. In F. Bulegato & M. Dalla Mura, *Design esposto: mostrare la storia/la storia delle mostre, Atti del V convegno AIS/Design* (pp. 334–347). Università Iuav di Venezia.

- Clement, T., Hagenmaier, W., & Knies, J. L. (2013). Toward a notion of the archive of the future: Impressions of practice by librarians, archivists, and digital humanities scholars. *The Library Quarterly*, 83(2), 112–130.
- Dalla Mura, M. (2010). *Design e musei fra storia e nuovi approcci: Il contributo dei musei di scienza e tecnologia* [Doctoral thesis, Università Iuav di Venezia].
- Davis, S. B., & Vane, O. (2020). Design as externalization: Enabling research. *Information Design Journal*, 25(1), 28–42. <https://doi.org/10.1075/idj.25.1.03van>
- Drucker, J. (2013). Performative materiality and theoretical approaches to interface. *Digital Humanities Quarterly*, 7(1).
- Drucker, J. (2017). Why distant reading isn't. *PMLA*, 132(3), 628–635. <https://www.jstor.org/stable/27037376>
- Farrelly, L. (2016). Museums online and digital: Some innovations and implications. In L. Farrelly & J. Weddel (Eds.), *Design Objects and the Museum* (pp. 169–179). Bloomsbury.
- Foti, P. (2022). Narrating information and data in museum environments. In S. Natale, R. Parry, & P. Foti (Eds.), *Circuits of Practice research report: Narrating Histories of Computing and Digital Media in Museum Environments* (pp. 24–36). Loughborough University.
- Hookway, B. (2014). *Interface*. MIT Press.
- Huppatz, D. (2020). Introduction to methodology: Virtual special issue for the *Journal of Design History* 2018. *Journal of Design History*, 33(1), 5–40.
- ICOM. (2022). Retrieved August 2, 2024, from <https://icom.museum/en/resources/standards-guidelines/museum-definition/>
- Kenderdine, S. (2010). Immersive visualization architectures and situated embodiments of culture and heritage. *Proceedings of the 2010 14th International Conference on Information Visualisation* (pp. 408–414). <https://doi.org/10.1109/IV.2010.63>
- Kenderdine, S. (2021). Experimental museology: Immersive visualization and cultural (big) data. In M. Achiam, M. Haldrup, & K. Drotner (Eds.), *Experimental Museology Institutions, Representations, Users* (pp. 15–34). Routledge.
- Kaplan, F. (2015). A map for big data research in digital humanities. *Frontiers in Digital Humanities*, 2, 1–7. <https://doi.org/10.3389/fdigh.2015.00001>
- Lewi, H., Smith, W., Vom Lehn, D., & Cooke, S. (Eds.). (2019). *The Routledge international handbook of new digital practices in galleries, libraries, archives, museums and heritage sites*. Routledge.
- Listo, T. (2019). Ramificazioni digitali del design come bene culturale. *MD Journal*, 8, 28–39.
- Lupano, M. (2013). L'archivio in mostra: Materialità documentaria e dispositivo visionario. In *Archivi e mostre, Atti del primo convegno internazionale* (pp. 206–219). La Biennale di Venezia.
- Lupi, G. (2015). The new aesthetic of data narrative. In D. Bihanic (Ed.), *New Challenges for Data Design* (pp. 57–88). Springer. https://doi.org/10.1007/978-1-4471-6596-5_3
- MacDonald, G. F., & Alsford, S. (1991). The museum as information utility. *Museum Management and Curatorship*, 10(3), 305–311. [https://doi.org/10.1016/0964-7775\(91\)90064-X](https://doi.org/10.1016/0964-7775(91)90064-X)

- Manoff, M. (2004). Theories of the archive from across the disciplines. *Libraries and the Academy*, 4(1), 9–25.
- Manovich, L. (1999). Database as a symbolic form. *Convergence*, 5(2), 80–99. Sage Publications.
- Mason, M., & Vavoula, G. (2021). Digital cultural heritage design practice: A conceptual framework. *The Design Journal*, 24(3), 405–424. <https://doi.org/10.1080/14606925.2021.1889738>
- Moma. (2012, November 29). Retrieved August 2, 2024, from <https://www.moma.org/magazine/articles/798>
- Moretti, F. (2005). *Graphs, maps, trees: Abstract models for a literary history*. Verso.
- Newson, A., Suggett, E., & Sudjic, D. (2017). *Designer maker user*. Phaidon.
- Parry, R. (2007). *Recoding the museum: Digital heritage and the technologies of change*. Routledge.
- Parry, R. (Ed.). (2010). *Museum in a digital age*. Routledge.
- Parry, R., Ortiz-Williams, M., & Sawyer, A. (2007, April 11–14). How shall we label our exhibit today? Applying the principles of on-line publishing to an on-site exhibition. *Museum and the Web*, San Francisco. Retrieved August 2, 2024, from <https://www.archimuse.com/mw2007/papers/parry/parry.html>
- Pepi, M. (2014). Is a museum a database? Institutional conditions in net utopia. *E-flux*, 60. Retrieved August 2, 2024, from <https://www.e-flux.com/journal/60/61026/is-a-museum-a-database-institutional-conditions-in-net-utopia/>
- Pepi, M. (2019, September). Is a database a museum? *The Canadian Centre for Architecture*. <https://www.cca.qc.ca/en/articles/69294/is-a-database-a-museum>
- Pietroni, E., Pessina, F., & Schettino, P. (2020). *Glossario digitale e tecnologie | ICOM Italia Commissione Tecnologie Digitali per il Patrimonio Culturale* (2020 version) [Computer software]. Zenodo. <https://doi.org/10.5281/zenodo.4319030>
- Poulopoulos, V., & Wallace, M. (2022). Digital technologies and the role of data in cultural heritage: The past, the present, and the future. *Big Data and Cognitive Computing*, 6(3), 73, 1–19. <https://doi.org/10.3390/bdcc6030073>
- Sartori, A. (2016). Towards an intellectual history of digitization: Myths, dystopias, and discursive shifts in museum computing. *Digital Scholarship in the Humanities*, 31(2), 428–440.
- Schnapp, J. (2008, August). Animating the archive. *First Monday*, 13(8). <https://doi.org/10.5210/fm.v13i8.2218>
- Schnapp, J. (2018). The intimate lives of cultural objects. In J. Sayers (Ed.), *Routledge Companion to Media Studies and Digital Humanities* (pp. 423–433). Routledge.
- Rodighiero, D. (2021). Extending museum beyond physical space: A data-driven study of Aldo Rossi's analogous city as a mobile museum object. *International Journal for Digital Art History*, 6(July), 3.34–3.47. <https://doi.org/10.11588/dah.2021.6.77681>
- Rodighiero, D., Derry, L., Duhaime, D., Kruguer, J., Mueller, M. C., Pietsch, C., Schnapp, J. T., Steward, J., & metaLAB. (2022). Surprise machines: Revealing Harvard Art Museums' image collection. *Information Design Journal*, 27(1), 21–34. <https://doi.org/10.1075/idj.22013.rod>

Rodighiero, D., Romele, A., Higuera Rubio, J., Pedro, C., Azzi, M., & Uboldi, G. (2023). Advanced interface design for IIIF: A digital tool to explore image collections at different scales. *Umanistica Digitale*, 7(16), 167–192. <https://doi.org/10.6092/issn.2532-8816/17230>

Trocchianesi, R. (2015). Design in mostra: Percorsi narrativi tra reale e virtuale. In *Design & Open Source for Cultural Heritage* (pp. 98–107). Alinea Editrice.

UNESCO. (2003). *Charter on the preservation of digital heritage*. Retrieved August 2, 2024, from http://portal.unesco.org/en/ev.phpURL_ID=17721&URL_DO=DO_TOPIC&URL_SECTION=201.html

Weddell, J., & Farrelly, L. (2016). *Design objects and the museum*. Bloomsbury Publishing. <http://digital.casalini.it/9781472577245>

Whitelaw, M. (2015). Generous interfaces for digital cultural collections. *Digital Humanities Quarterly*, 9(1). <https://www.digitalhumanities.org/dhq/vol/9/1/000205/000205.html>

Windhager, F., Federico, P., Schreder, G., Glinka, K., Dork, M., Miksch, S., & Mayr, E. (2019). Visualization of cultural heritage collection data: State of the art and future challenges. *IEEE Transactions on Visualization and Computer Graphics*, 25(6), 2311–2330. <https://doi.org/10.1109/TVCG.2018.2830759>

About the Authors:

Alessandra Bosco is an architect and PhD, is a Researcher at the Università Iuav di Venezia (Italy). She is the author of numerous contributions and publications and carries out research in the fields of Design for the enhancement of Cultural Heritage and Exhibit Design with a specific focus on collaborative approaches.

Fiorella Bulegato, PhD, is a design historian and Associate Professor at Università Iuav di Venezia. Her publications include "Michele De Lucchi: From Here to There and Beyond", with S. Polano (2005), "Il design degli architetti italiani 1920 –2000", with E. Dellapiana (2014).

Lucilla Calogero, PhD, is a Researcher at the Università Iuav di Venezia. She conducts research on the design of interactive digital systems in visual and multimodal communication, with a particular focus on data visualisation information design.

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