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Crowds, Ecosystems and Novel Technologies**

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Chapter 1

Future Museum Experience Design: Crowds, Ecosystems and Novel Technologies

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Abstract The museum world is rapidly changing from being collection-centred to being community-centred and for the public. Apart from broadening access to collections through, for example, digitisation initiatives, new ways of involving the public more meaningfully and at various levels have emerged. Experiences inside museums have become more engaging, by extending the experience beyond the physical visit, or by involving the public in various forms of crowdsourced stewardship of collections. In this book, we explore the design implications that go along with these developments, all concerned with diversifying and making the engagement of the public in museum experiences more rewarding. We focus on the design implications associated with museums reaching out to crowds beyond their local communities, on experimenting with novel technologies and on conceiving experiences embedded in connected museum systems and large institutional ecosystems. By looking at and reflecting on trends, we attempt to sketch a picture of how future museums will change and, particularly, how they will relate to their public as a result of responding to or embracing these trends.

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1.1 Trends in Museum Experience Design

In the museum world, a number of trends can be recognised that have an impact on museum experience design. For example, there is a development from museums being collection-centred to being community-centred and for the public. Additionally, the public has started to become involved in museum visits in more meaningful ways, for example, due to an increase in digitisation initiatives. This is achieved by deepening experiential engagement during the visit, by extending the museum experience beyond the physical visit or by involving the public in content generation, objects classification or other forms of crowdsourced stewardship of collections.

This book concentrates on the design of museum experiences that integrate some form of digital and networked media. However, and despite our focus on digital mediation, we acknowledge that visitor-centeredness and connected practices have been a concern for museums (or at least some museums) well before the large-scale integration of digital technologies. In a section suggestively titled ‘History repeats’ from their seminal work on visitor-centred practices in museums, Peter Samis and Mimi Michaelson (2017) point out that already in 1987, the Art Institute of Chicago commissioned a focus group study to gauge insights about visitor experiences, attitudes and expectations from the museum visit. The findings of that study are not less relevant today: visitors asked for more contextual information and particularly wanted to understand why an artwork is considered valuable and important for the museum. This is not very different from what museum visitors seek today. What changed, however, is the variety and complexity of forms by which museums can follow up on these expectations—not as one-way information transmission but through experiential engagements that may, for instance, accommodate creative inputs, appeal to various senses and promote collaboration and sharing of experience. Specifically, we have identified a number of trends in museum experience design: (1) dialogical engagement of the public; (2) diversifying and broadening audiences, including the nameless ‘crowd’; (3) the use of novel technologies, such as the Internet of Things (IoT) and Do-It-Yourself (DIY) technology; and (4) designing for museum systems and institutional ecosystems, rather than for individual museums only.

1.1.1 *From Visits to Continuous Dialogical Engagement*

Museums started off as institutions focusing on collecting and preserving objects, open for the public to come and watch. The primary purpose for visitors to come to the museum was to see the original objects. A first notable shift saw the museums move from a collection focus to a visitor focus and from a mission for objects preservation and access provision to a mission of offering meaningful engagements with the collection and rewarding learning experiences for their public. The concept

of ‘museum experience’ is the pinnacle of this historical shift, as it implies a focus on the visitor and connections between visitor and objects rather than a focus on collections. In the course of time, new types of museum experiences gradually emerged. The degree of sophistication and immersion increased exponentially when experiences started to be enhanced by the integration of interactive and digital media. In many science and technology museums, for example, visitor engagement and participation are uplifted through the use of new media (e.g. video games, interactive installations and other forms of edutainment) to encourage visitors to engage with the content on exhibit, to experiment with the techniques on show and to appropriate the visiting experience by making it meaningful and memorable. This trend is being adopted also by art museums, where it is by definition more difficult to let visitors experiment with the collections. Recent examples include the Rijksmuseum in Amsterdam, where an augmented reality app called *Paint Job*¹ (launched in 2012 by creative agency Brilliant After Breakfast) allows visitors to play with the paintings on display by ‘hijacking’ their content. By reappropriating the painting in this way, art gets closer to the individual and it acquires a meaning that is more personal and may, therefore, resonate longer in the visitor’s memory.

Over the course of time, visitor involvement mechanisms have given more space to visitor agency and creative intention, reaching out to models in which visitors are involved as consultants or partners in co-designing museum experiences or even museum exhibitions. For example, in 2010 the Kröller-Müller Museum in the Netherlands experimented with involving a younger audience and launched *Expose: My favourite landscape*,² curated by children who chose the artworks to be exhibited from a sample preselected by the museum. These types of initiatives gradually have increased the involvement of visitors in museums as well as the level of social engagement among participants. One of the more recent trends goes even further than this. It focuses on a sustained engagement of people with museums and fosters connectedness between museum practice and the everyday personal experiences of those visiting the museums. For example, the project *Digital Natives* conducted by the Center for Digital Urban Living at Aarhus University, Denmark, invited young people to express their culture and everyday practices in the creation of an exhibition (Iversen and Smith 2011). Another example is Forces of Change 1960–1975,³ an exhibition at the Oakland Museum of California in which people worked with museum staff and teaching artists to curate the objects to be exhibited through the use of both personal objects and pieces from the collection. The rich exhibition material was meant to represent the diversity of cultures and lifestyles in California from 1960 to 1975. The participative ways in which visitors interact with museums also open up new models and ways of learning about and understanding heritage and museum content. Participatory

¹<http://theinspirationroom.com/daily/2012/rijksmuseum-paint-job/>.

²<http://editie2.kmmexpose.nl/>.

³<http://museumca.org/forces-of-change>.

approaches mark the transition from museum-led interpretation (under the authority of curators) to two-way conversations around heritage (e.g. McLean and Pollock 2010) and towards a conversational learning approach (Baker et al. 2002).

In terms of designing for museum experiences, the question is what are the implications of this shift towards conversational learning and continuous dialogical engagement. The experiences to be designed have changed from ‘experiencing the encounter with an object’ to ‘experiencing interactive exhibits’, and now beyond that towards designing platforms that enable two-way dialogues, multi-user content creation, collaborative activities and social learning practices. Museum experiences are thus broadened to include, for example, direct user interactions with such platforms and communication across platforms as well as more diverse ranges of activities (e.g. creative, contemplative, visual and observational) performed through digital mediation. A noteworthy development is the shift from designing short experiences within the museum towards designing long-term dialogical relationships between the museum and its audiences. Such a shift also raises issues on how to deal with curation and control, finding the right balance between the needs of the museums and the needs of public audiences.

1.1.2 From a Focus on Individuals to a Focus on Crowds

Nowadays, it is widely admitted that the desire to establish social relationships and to be actively engaged in informal learning processes are among the main expectations according to which people decide to visit a museum (e.g. see visitor categories, such as explorers, as identified by Falk 2009). However, this realisation took time to crystallise, just like it took time for museums to distinguish among and engage differently with diverse types and categories of audiences. In the early days of museum practice, ‘the visitor’ was an undifferentiated individual, at most with some form of distinction conferred to scholars as a special type of audience. In time, various types of (social) groups, such as families and school classes, were distinguished, with the acknowledgement that each of these comes to the museum with different needs, interests and agendas. Local communities around museums gained attention as important audiences with which museums gradually started fostering better connections for strengthening their identity and anchoring it in the local territory.

With the emergence of the Internet came initiatives for involving citizens in museum affairs. Citizen involvement was not only seen as a way to give voice to communities and enable them to have a say in the way museum exhibits were interpreted but it was also a way to link the collections to the personal experience of these communities. For example, several museum initiatives focused on engaging local communities in telling stories about objects on display or the historical period from which objects originated (see for instance the *Object Stories* project at the

Portland Art Museum⁴). The emergence of new forms of communication and collaboration over the Internet and the exponential growth of social media has made the potential outreach of museums even bigger; indeed, so big that recently some museums have started exploring the possibility of engaging the crowd—people unrelated to the museum, the geographical area or the community in which it is embedded. The potential is there for museums to no longer address only local communities and on-site visitors but to become museums ‘for the global citizen’, as is stated in the 2020 Strategy of the British Museum (The British Museum 2015). The focus on crowds can be seen in terms of one-way or bidirectional communication (through growing communities around museum social media sites) and culminates in crowd involvement in processes that were once exclusively carried out by institutions. Museums worldwide have already experimented with various forms of crowdsourcing: from social tagging, labelling and transcribing manuscripts through crowd involvement to co-curated experiences and exhibitions. Crowdsourcing practices are rewarding on many levels: they enrich interpretive layers for museum collections, they strengthen relationships between museums and their publics and they make audiences feel more connected, more empowered and closer to culture and the arts. Yet, existing projects show that the breadth of these phenomena is not always enough to reverberate in long-lasting or significant impacts. Indeed, some studies indicate that crowd involvement and the outcomes of their participation are oftentimes reduced to just a handful of enthusiastic or dedicated participants (Eveleigh et al. 2014). The challenge for museum experience design is to find the right balance between seeing the crowd as an undifferentiated mass and taking into account a multitude of influential factors and a number of unknowns, especially with respect to the tastes, wants, needs and interests of a diversity of audiences.

1.1.3 From Printed Labels to DIY Technology and Internet of Things

Not so long ago, objects displayed in museums were labelled with printed boards. Subsequently, displays were introduced providing general information about parts of exhibitions, audio guides to guide visitors along displayed artefacts and, gradually, also iPads as interactive labels next to exhibited objects. The Internet of Things (IoT) movement (where objects, such as those in people’s daily lives, become networked) can also be expected to lead to museum experiences that become integrated in people’s daily practices—at home, in offices and schools, leisure environments and elsewhere: iBeacons are already used to augment the museum experience by merging the physical and the digital: social media to share museum experiences or to contribute impressions and even ideas and content for

⁴<http://objectstories.org>.

exhibits design (e.g. Iversen and Smith 2011); appropriation of paintings that are printed on mugs or T-shirts is now made easier by cheaper printing technology; 3D printing is already being used for making replicas of museum artefacts as tangible memorabilia (e.g. in the British Museum and the New York Metropolitan Museum). Yet another development is the inclusion of DIY technology, such as Arduinos (e.g. Calvi and Vermeeren 2015), allowing for both museum-organised and grassroots initiatives of citizen involvement to create museum experiences. What new opportunities arise with the advent of these new technologies? How much are they empowering grassroots initiatives compared to the pre-existing ones (like blogging or video sharing)? How can we design for museum experiences that become embedded in people's everyday practices and foster more enduring connectedness between museums and their publics? These are just a few of the questions museums are confronted with by the advent of new technologies.

1.1.4 From Designing Individual Displays to Designing for Museum (eco) Systems

Originally, museums were collections of objects on display. At a certain point in time, more attention started to be paid to the way objects were displayed or to interactive possibilities around the objects. However, the design focus remained at the level of individual objects. Later on, more integral approaches were needed to better market museums and attract new audiences. Museums needed to be branded; unique identities needed to be created for them. Thus, a start was made to design experiences around the museum as a whole, instead of around individual objects only. Thereafter, the trend evolved and shifted, moving from single museums to connected museums or to museums as part of large institutional ecosystems. Looking at current EU-calls in the field of cultural heritage, there is a striking focus on museums as part of systems of connected institutes. Partnerships and networks among museums and between museums and universities, libraries, archives or community organisations have a rich potential for spearheading innovative practices and broadening the outreach and public engagement in such practices. At institutional level, they open up unique opportunities for knowledge exchange and cross-fertilisation, enabling institutions to work in convergence for identifying social needs and priorities for growth and innovation and then proposing innovative ways to meet them.

Such partnerships and networks present unique opportunities but also challenges, especially as they operate beyond the comfort zones of routine practices and processes. For instance, as part of the YOUmedia Learning Lab network,⁵ the Dallas Museum of Art and the Perot Museum of Nature and Science teamed up to establish a learning lab for teens, following the principles of connected learning

⁵<http://youmedia.org>.

(Ito et al. 2013) and emulating the early model initiated by the YOUmedia Chicago learning lab, at the Harold Washington Public Library in Chicago (see Sebring et al. 2013). This partnership between an art and a science museum encouraged innovative explorations of convergences between art and science education. At the same time, it also meant that staff from both institutions were exploring unknown terrain and had to learn on the go how to create an experiential space for teens that enabled exploration of science and art confluences. One of the innovative approaches taken was that the Dallas Learning Lab was designed and implemented through the involvement of teens. The founders launched a survey to hear their views and collaborated with a Teen Advisory Council throughout the whole design phase, and further after the lab came into being. This example shows that partnerships between museums are deeply rewarding for multilateral thinking and innovation. Yet, designing for out-of-the-box informal learning experiences that cross disciplinary boundaries also requires out-of-the-box ideas as institutions are moving into unknown territory. In terms of designing for museum experiences, this trend implies that designers need to think further and beyond the visitor's experiences before, during and after a museum visit. Design needs to be rooted in a holistic vision that locates visitor experiences within a system of connected institutes without, however, losing sight of the museum's role within this system. The examples above show only some of the challenges this vision poses to museum experience design processes; more examples will be explored and discussed in this book.

1.2 Developing the Book Structure

A workshop was conducted at the CHI 2016 conference⁶ to discuss viewpoints on the central theme of the book—how museum experience design practices are changing at present and which are the most influential factors that impact upon these changes in practice. A call for position papers (Vermeeren et al. 2016) was launched to invite potential chapter authors to submit position papers inspired by the trends discussed in Sect. 1.1. From the position papers, four themes emerged that were taken as inspiration for developing a brainstorm game to stimulate discussions among the various workshop participants. The themes were:

1. *Engaging the public*: this is about investigating the diverse modalities of engagement that museums can put forth for their visitors to make their visit (or related interaction with the physical and web presence of the museum) a memorable experience;
2. *Crowds—diverse audiences*: broadening the focus on the diverse types of museum audiences to include a more heterogeneous and somehow undifferentiated mass of people—the crowd;

⁶<http://chi2016.acm.org>.

3. *Opportunities through technology*: shifting the focus from the audience to the technology that museums might use to engage them;
4. *Museums as part of an ecosystem*: a further broadening of the design focus to address the ecosystems museums are part of.

1.2.1 Future Museum Experience Game: A Structured Brainstorm Game

A card game was developed as a participatory design tool to be used during the workshop for engaging participants in developing museum experience ideas. The card game was intended to inspire participants to reflect on and discuss the themes of the book as a means to better align their contributions for later inclusion in the book. Through the game, we aimed to achieve the following four goals:

1. Discuss issues related to the main topic of the workshop;
2. Highlight some crucial topics and interpret them through different filters and from diverse points of view;
3. Trigger dialogue and exchange ideas and impressions among participants;
4. Envision metaphors and scenarios around new possible ways for extending cultural experiences to a wider audience.

We used the game to mediate analysis processes through discussion and reflection. The participatory and novel dimension of designing cultural experiences can be fostered by collaborative approaches such as those used in the designed game. McGonigal (2011) notices that collaboration in games is a hard task that requires three distinct efforts: cooperation, coordination and co-creation. The first effort describes a collective action towards a common goal (i.e. developing museum experience ideas), the second means sharing resources (in this case a set of shared requirements) and synchronisation, while co-creation is a generative act, aimed at creating something that is not achievable alone (i.e. inspiring each other to come up with creative ideas for museum experience design that fulfil the complex set of requirements posed in the game).

The game consisted of three stages: (1) selecting cards and choosing one item on each card (see Fig. 1.1); (2) developing museum experience ideas based on the selected cards and card items and (3) positioning museum experience ideas in diagrams presented on large sheets. In stages 1 and 2, participants worked in teams of two, three or four people, while stage 3 was a plenary activity, confronting all participants with the ideas of the other groups and then discussing and positioning these.

The development of the actual game cards was inspired by the four themes in combination with relevant literature. Cards were divided into six categories, each of which was identified by a unique colour and an icon (see Fig. 1.1). Each card contained a number of items to choose from, as well as space for creating an extra item if desired:



Fig. 1.1 The game cards set

1. ‘Types of museums’ cards (purple) provided examples of different types of museums to which the experience ideas can be applied. Each museum card contained the following items: general museums; natural history and natural science museums; science and technology museums and art museums.
2. ‘Cultural experience’ cards (orange) included four subcategories:
 - a. *paradigms or metaphors* that can be used as rhetoric narrative, containing the items: wunderkammer, game, collage, portrait, diary and time machine;
 - b. *narrative* approaches, with items: hypertextual, episodic, linear (sequential), open, didascalic, ludic, ironic, poetic;
 - c. *interaction modalities*, with items: multimedia, tangible, natural, bodily, performative;
 - d. *resulting experience realms*, as defined by Pine and Gilmore (1999, pp. 30–38), with items: escapist, aesthetic, playful, educational.
3. ‘Aims of engagement’ cards (red) included three subcategories providing examples of possible museum goals that imply:
 - a. *connecting what is inside the museum to something outside the museum*, with items: local territories, everyday activities, information in the wild, contemporary culture, learning aims in schools;
 - b. *connecting the crowds*, with items: creating transcultural and intercultural understanding, scalability from local communities to contexts beyond that community, connecting crowds to situated museum experiences;
 - c. *connecting the museums into an ecosystem*, with items: trajectories of cultural experiences through a network (coherency across various cultural

offerings), convergence of different cultural experiences within a network (e.g. art and science).

4. ‘Who to engage with’ cards (blue) included the three subcategories:
 - a. *audiences*, with examples: crowds across the world, non-specialist audiences, younger audiences, art lovers, various target groups at the same time;
 - b. *stakeholders*, with items: schools, care institutes, municipalities, heritage houses, maker spaces, design agencies;
 - c. *other museums* with whom the museum can engage thanks to the experience ideas, with items: identical museum types (e.g. art museums only), related museum types (e.g. science and education museums), very different museum types (e.g. art and natural history).
5. ‘Digital technologies’ cards (green) provided examples of inspiring emerging technologies: mobile technologies (including AR), wearable technologies (including VR), maker movement and Do-It-Yourself technology, Internet of Things.
6. ‘Ways of engagement’ cards (yellow) included three subcategories based on the classification of participatory activities given by Simon (2010). These provided examples of activities aimed at:
 - a. *collecting and sustaining the collection (contributory project)*, with examples: crowd involvement in preservation of digital heritage, crowdsourcing;
 - b. *using the collection (co-creative project)*, with items: using artworks as source of creativity, communicating through art;
 - c. and *spark dialogical engagement with crowds (collaborative project)*, with items: curation by the audience, audience determines arrangement of contents.

Each group checked one item per selected card and then positioned the cards on a template to create an overview of the starting points for their idea generation (Fig. 1.2; bottom-middle). In stage 2, each group used flip-over sheets for sketching their museum experience design ideas and then summarised the idea on sticky notes for use in stage 3 (Fig. 1.2; top-right and bottom-left). In stage 3, ideas of all groups were positioned on large sheets depicting two axes along which the ideas were to be positioned (Fig. 1.2; bottom-right).

Axes in the diagrams included:

- diagram 1: term on which the applied technology would be feasible (*now—5 years*) versus length of engagement (*one time experience—continuous dialogical engagement*);
- diagram 2: place of the experience (*single place experience—trajectory of related experiences through multiple institutes*) versus size and diversity of audience (*individual person as audience—various audiences participating together, including crowds*).

Based on the position papers and the discussions during the workshop, authors were invited to rework their position papers into book chapters for a specific part of the book, using the insights gained during the workshop.

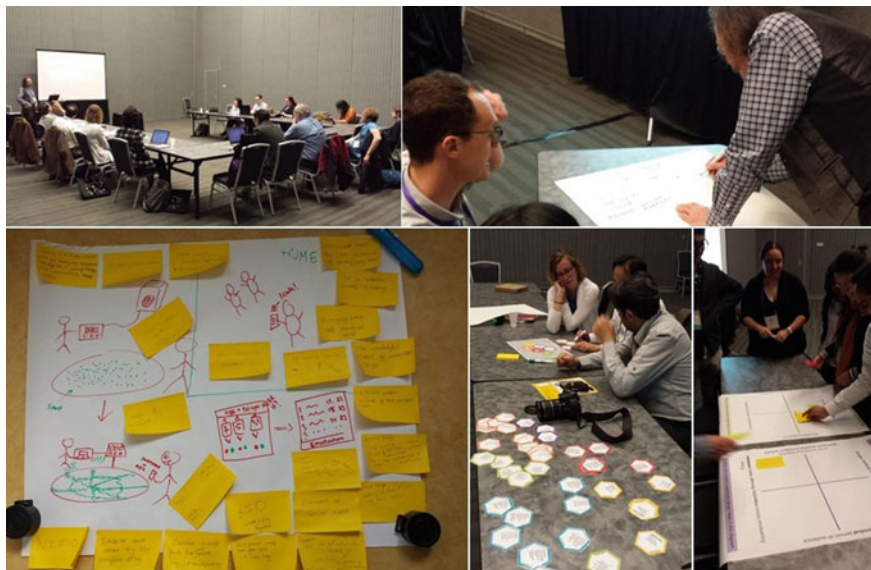


Fig. 1.2 Pictures of the workshop—top-left: short presentations of position papers; top-right: small groups developing museum experience ideas (stage 2); bottom-left: ideas developed by one of the groups (stage 2); bottom-middle: group selecting cards and checking items (stage 1); bottom-right: positioning ideas on diagrams (stage 3)

1.3 Book Structure

The 11 papers originally submitted to the workshop have been expanded and complemented by new contributions from several workshop organisers and from participants who took part in the workshop in different roles (as a keynote speaker or as attendee without a position paper).

The book is structured along the four themes, offering an inverted funnel view on trends in museum experience design, starting from the specific focus on the museum public and widening up to encompass museum ecosystems.

1.3.1 Part 1: Engaging the Public

In this part, the focus is on ways of engaging the public so as to make their visit to the museum a meaningful and memorable experience. Each of the three chapters focuses on different facets of museum experiences and diverse engagement and technology design approaches, ranging from learning through social engagement in gaming and virtual environments to inviting audiences to experiment, create and share with peers and visitors. The red thread in all the chapters is a preoccupation

with designing approaches and sociotechnical environments where audiences can connect in first person, not only with the collection but also with other visitors, and put through meaningful responses in interactive environments or through creative acts. Sociality, creation and sharing are three vectors proposed throughout the chapters as a means to further dialogical engagement with museum collections. In the first chapter, Apostolellis, Bowman and Chmiel propose the development of a framework to involve large groups of visitors to engage with complex educational material in museums. C-OLiVE is the simulation game they developed to validate their framework for orchestrated learning. Boonen, van der Heijden and Giaccardi discuss the notion of amateur practice as a way to engage the audience of novice visitors with the collection of the Design Museum in London. Sim, Cassidy and Read describe how children can be involved in designing museum experiences for their peers by using augmented reality (AR).

1.3.2 Part 2: Crowds—Diverse Audiences

In part 2, the focus is broadened: from the generic notion of ‘museum public’ to a more heterogeneous, though somehow undifferentiated mass of people, which we have identified as ‘the crowd’. Designing for the crowd does not always entail addressing unnamed, unknown audiences with unilateral messages and experiences. On the contrary, it implies diversifying and enriching the visiting experiences to appeal to and engage varied segments of visitors and users in situated, virtual or blended contexts. The chapters in here focus on diverse ways of involving crowds as audiences but also as co-creators and co-designers. What comes out as a shared concern is the importance to understand the crowd closely, even profile and segment it, so that the experiences designed for them—from digital fruition to crowdsourcing initiatives—can be meaningful and rewarding for all categories addressed.

In the first chapter of this section, Maria Mortati advocates the use of artistic experimentation and participatory practices that involve the museum, artists and the public to develop museum exhibits that cater for deeper and more meaningful visitor engagement and enable museums to reach a more inclusive visiting public. Through an exploration of a series of experimental projects, Mortati also shows how museums may find it beneficial to rethink preconceived notions of what an audience is and, on this basis, identify new frameworks and strategies for public engagement. Tonkin, Tourte and Gill propose the use of cultural media mining and social sensors to provide relevant and accessible descriptors for information objects that can support the preservation of digital cultural heritage.

Van der Lans, Ansems and Khan argue that crowdsourcing can be used by museums to craft digital experiences, all the way from concept generation and design to development and content production. They exemplify this with a study in which paid crowdsourcing was used to design and develop a museum app.

Based on the analysis of this study, they put forth a series of reflections and recommendations for museums that want to involve crowds in their experience design practices. A different stance on crowdsourcing is proposed by Wrigglesworth and Watts in the context of historical institutions. The authors propose that, beyond its immediate functional role, crowdsourcing activities have the potential to provide a meaningful experiential engagement for participants. By purposefully designing crowdsourcing experiences that are engaging and meaningful, museums also come closer to fulfilling their ethical mission. This is attained by positioning crowdsourcing not only as a way to cater for stewardship of collections but also for fostering public engagement and benefit. Their study singles out key elements that add to the meaningfulness of crowdsourcing experiences and discusses their implications for design.

Based on their long-term engagement in teaching cultural heritage and design to students and practitioners, Van der Veer, Consiglio and Uras bring a fresh perspective to museum experience design. The authors put forth a structured definition of experience, which encompasses cognitive and affective dimensions as well as attitudes and behavioural intentions towards cultural heritage. After indicating the centrality of the subjective or personal element when creating an experience, the authors discuss the importance of effectively dealing with diverse audience intentions, interests and needs during the design process.

1.3.3 Part 3: Opportunities Through Technology

In this part, the focus shifts from the audience to the technology that museums might use to mediate novel types of experiences. The array of technologies now used in museums is incredibly broad and diverse, and this part makes no attempt at a representative coverage. In the selection of the chapters, it rather aims for illustrative and diverse cases of using technology in empirical contexts, complemented by analytical and reflective contributions on the role of technology in museum experience design. Thus, three of the chapters focus, in turn, on technological mediation in diverse contexts: linking museums to external sites for enhancing experiences of intangible heritage; adoption of new technology for sociality and interactivity in museums; and novel ways of employing mobile technologies for science learning in museums. A reflective chapter complements these studies, and tackles the implications of adopting a certain design approach for the development of new museum technology and experiences.

Effie Lai-Chong Law presents a case on the development of a location-based augmented reality app for an archaeological site in the UK, which aimed to connect the archaeological objects on display in a museum to the archaeological site a person was visiting. The broader issue of technology adoption by cultural institutions is discussed by Verona, Vivacqua and Campos, with a focus on how interactive and social technology can expand the outreach and social relevance of

museums in the Global South. They illustrate this with the specific case of Brazilian institutions. Rozendaal, Vermeeren and Issidorides discuss lessons learned from applying mobile technologies for on-site assessment of visitor experiences in a science museum.

To close this section, Amalia Sabiescu provides a critical reflection on the implications associated with adopting a certain paradigm for museum experience design. After examining museum usage of user-centred, participatory and lean and agile design approaches, she discusses the relations between long-term engagement with a certain design paradigm and institutional change.

1.3.4 Part 4: Museums as Part of an Ecosystem

In part 4, the focus is further extended to address the ecosystems that museums are part of and the opportunities and challenges posed by designing for museum ecosystems. These can be systems of connected cultural institutions but may also refer to the way museums are embedded in sociocultural and economic environments that need to be taken into account holistically when seeking to design comprehensive, enriching experiences for museum patrons. The chapters in this part draw on different design initiatives to illustrate diverse approaches in designing for museum ecosystems. In addition, they provide novel insights, ranging from recommendations and considerations to inform museum practice to more theoretical reflections to expand the body of knowledge on museum experience design.

Calvi and Hover discuss the complexity of dealing with museums as part of a multifaceted ecosystem in relation to the *Becoming Vincent* project and highlight the dilemmas that they had to tackle along the way to bring the project to a successful completion.

The ecosystem may also include everything that comes before or after the actual museum visit. This provides opportunities for designing new experiences around, but related to, museum interactions. This broadened perspective raises questions regarding viable ways by which a museum experience can relate to its embedding context, and how these can be effectively taken into consideration during the design process. These questions are addressed by Vermeeren, Shih, van der Laan, Calvi, Yoon and Keller through the design case of an application for the Mauritshuis museum in The Hague (the Netherlands). The chapter describes the design process and proposals for connecting museums to young adults.

Sabiescu and Charatzopoulou propose that ecological frameworks can inform and support the design of digital learning experiences in museums. Through a case study on the design of digital learning experiences in a cultural history museum, they draw attention to two sets of considerations that carry design implications: the embedding of digital learning experiences in the museum ecosystem and the role of the museum in a broader education ecosystem.

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Amalia Sabiescu is a communication scientist with an interdisciplinary research track at the interface between information and communication technology (ICT), culture and development studies. Her research explores the integration, use and impact of ICT in cultural and creative practice, community contexts, and intersections with issues around citizen voice, participation, and social inclusion. She is currently affiliated with the Institute for Media and Creative Industries at Loughborough University London.

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Dagny Stuedahl, dr. polit and Professor in Media Design at Oslo and Akershus University College of Applied Sciences, Norway. Stuedahl holds a MA in ethnology, and works within socio-cultural and socio-technical theoretical framework and with co-design methods on transmedia issues in the cultural heritage sector, science centers, and museums.

Elisa Giaccardi is Chair of Interactive Media Design at Delft University of Technology, Department of Industrial Design, where she leads the Connected Everyday Lab. She is one of the recipients of the TU Delft Technology Fellowship for top female scientists, and a speaker at TEDx on the Internet of Things. She is the editor of *Heritage and Social Media* (Routledge 2012) and author of the chapter "How memory comes to matter: From social media to the Internet of Things" (Routledge 2016). From her pioneering work in meta-design and participatory technology to the role of the non-human in the Internet of Things, her design research reflects an ongoing concern with design as a shared process of cultivation and management of opportunity spaces.

Sara Radice holds a PhD in design. She works in the cross field of design and cultural heritage, focusing on design strategies for audience participation in digital and physical settings. She has been involved consulting and teaching activities within public and private institutions, such as Politecnico di Milano, Historical Archive of Italian Psychology, metaLAB (at) Harvard, Santa Cruz Museum of Art and History.