

# Interactive Exhibitions Design - What Can We Learn From Cultural Heritage Professionals?

Laura A. Maye<sup>1</sup>, Fiona E. McDermott<sup>1</sup>, Luigina Ciolfi<sup>2</sup> and Gabriela Avram<sup>1</sup>

<sup>1</sup>University of Limerick  
Limerick  
Ireland

{firstname.surname}@ul.ie, e.g. laura.maye@ul.ie

<sup>2</sup>Sheffield Hallam University  
Sheffield  
United Kingdom  
l.ciolfi@shu.ac.uk

## ABSTRACT

Within cultural heritage, curators, exhibition designers and other professionals are increasingly involved in the design of exhibits that make use of interactive digital technologies to engage visitors in novel ways. While a body of work on the design and evaluation of interactive exhibitions exists in HCI and Interaction Design, little research has been conducted thus far on understanding how cultural heritage professionals engage in the design of interactive exhibitions in terms of their attitudes, process, expectations and understandings of technology. In this paper, we present the results from an interview study involving cultural heritage professionals and aimed at understanding their involvement in designing interactive exhibitions. Our findings could provide the HCI community with a better understanding of the strategies and aspirations of domain professionals regarding interactive exhibitions, and to identify new ways to engage with them - particularly as these professionals' knowledge and understanding of interactive digital technologies becomes more advanced.

## Author Keywords

Cultural heritage; interactive exhibitions; interview study; design strategy; expert community

## ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

## INTRODUCTION

This paper presents the results from an investigation into the design thinking, practices, and processes of cultural heritage professionals (curators, outreach and education officers, exhibition designers, etc.) involved in the design and realisation of museum exhibitions utilising digital interactive technologies. Within HCI and Interaction

Design, an established body of research examines the design, development and evaluation of interactive exhibitions in various heritage settings. However, there is little research that delves deeply into the design processes and practices embraced by cultural heritage professionals (CHPs). Museum and cultural heritage research within human-centred computing has tended to focus on the visitor experience of interactive exhibitions and on how this can be supported and enhanced, rather than on the design processes and practices used by CHPs who *create* interactive exhibits. In HCI and related research fields, literature exists that examines the design processes in creating interactive museum exhibits [6, 9], with several examples of work adopting user-centered or participatory design approaches [4]; there are also, albeit fewer, examples of work where curators are the end users, and the technology is designed to assist their activities in presenting heritage content to the public [2, 24].

However, the know-how of CHPs has been seldom studied in-depth and incorporated into the HCI body of knowledge regarding cultural heritage. In our view, the need to fill this gap and to provide empirical evidence on CHPs' design skills, strategies and aspirations is motivated by two main reasons: firstly, the approach to the design of interactive exhibits in HCI is becoming more and more open to the participation of various expert stakeholders, thus requiring a finer understanding of the expertise of CHPs in deploying design thinking and process; secondly, there is an increasing availability of "Do-It-Yourself" (DIY) technologies enabling non-experts to create interactive prototypes. The cultural heritage sector is increasingly focusing on the possibilities that such DIY platforms and tools offer institutions and professionals for creating complex interactive exhibitions either completely in-house, or substantially limiting the need to involve external design and development experts. Investigating CHPs' attitudes and strategies in interactive exhibitions design is key for HCI researchers and practitioners in understanding the new role that technology can play in museums and other heritage institutions (e.g. from "outside intervention" to "home-grown design") and the new challenges posed by these developments to our field of research. Furthermore, the way in which heritage holdings are being portrayed to visitors in cultural heritage institutions is becoming more diverse, going beyond the traditional visitors' role of observers of

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from [Permissions@acm.org](mailto:Permissions@acm.org).  
*NordiCHI '14*, October 26 - 30 2014, Helsinki, Finland  
Copyright 2014 ACM 978-1-4503-2542-4/14/10...\$15.00.  
<http://dx.doi.org/10.1145/2639189.2639259>

original museum objects that could not be touched nor questioned. As the visitors' role in the museum is becoming more hands-on, and as the importance of visitors' opinions and active involvement is becoming more apparent in exhibitions and museum activities [21], the role and attitude of CHPs in devising exhibits is also evolving to include strategies for designing engaging visitor experiences.

We conducted an interview study involving a number of CHPs to highlight an array of contemporary practices in the design of interactive exhibitions in light of these changes and underlying trends. The study is part of, the Material Encounters with digital Cultural Heritage (meSch) project, with the goal of designing and developing a toolkit that will enable CHPs to create their own interactive exhibits merging digital content with tangible artefacts [18]. The interview study that this paper focuses on, contributes to bridging a gap within HCI and Interaction Design -as we outlined above- by uncovering the attitudes and practices of CHPs rather than just those of visitors, and by providing key insights regarding their design thinking and strategies when participating in interactive exhibition design projects.

In the following sections we will present a discussion of existing research related to the design of interactive exhibitions and designing for cultural heritage experiences. We will then present the methodology and practicalities of the study, followed by an analysis of the main findings that have emerged from it. We conclude the paper with a discussion of the key lessons that the study provided on how the design of interactive exhibitions by CHPs could be supported by HCI and Interaction Design research.

## RELATED WORK

### Designing Interactive Exhibitions

HCI has a long tradition of design, development and evaluation of technology for the cultural heritage domain, that extends from digital tour guides to educational aids through to learning technologies and interactive exhibitions. Here, we focus specifically on interactive exhibitions where digital technologies support the display of heritage artefacts and related content to visitors for access and interpretation. Much of the research on interactive exhibition design has focused on how technology can be created and used to enhance the visitor experience. For instance, early examples include Sparacino et al.'s explorations in using object and person tracking mechanisms to deliver digital content within interactive exhibitions [23].

Recent work in the field of HCI has focused on how different technologies can be used for interactive exhibitions, exploring particularly their effects on visitor engagement. For example, Hornecker's research at the Natural History Museum in Berlin has noted how two distinct technologies, the *jurascope* (a telescope-like device) and a large screen, had impacted on the visitors' engagement with the exhibition [14]. Further research has explored the effects that overlaying digital content with

physical displays has had on visitor engagement; such research includes the augmented reality experience at the "One Rock" exhibition [19] and the "Augurscope" [20].

A particular strand of HCI and Interaction Design research has studied how visitors can be involved as active protagonists and/or contributors of interactive exhibitions in museums. Examples of such include "Re-tracing the Past" [9], an interactive exhibition that allowed visitors to record their own opinions about museum objects that were never fully identified for other visitors to listen to. "Reminisce" was another exhibition that involved visitors of an open-air museum displaying buildings from the recent past, by contributing to a database of personal memories related to these [6]. Ecologies of visitor participation and of interpersonal interaction around exhibits that captured their presence and made them become part of the display have been studied in installations such as "Deus Oculi" [12] and "Ghost Ship" [13]. Other research has looked at how interactive technologies can become part of art installations themselves, and at how visitors perceive, react and interact with the exhibit and with others [11].

### Design Processes

The design processes applied in interactive exhibitions in HCI projects is also varied; however, the focus of many of these projects is to provide an effective visitor experience. Within a user-centred design frame, end-users (i.e. visitors) and other stakeholders are studied to glean design requirements, and evaluation is conducted by investigating visitor interactions and by gathering data on visitor reactions to the technology [9]. Other examples of work exist where the design approach is participatory. Recent participatory work explores the involvement of children in the design of interactive exhibitions [7]. Other examples see the inclusion of CHPs and visitors within the design team, providing expert advice on content, the curatorial goals of the institution and its educational mission [26]. Designerly approaches such as reflective practice and meta-design have also been adopted in interaction design research on interactive art exhibitions [10].

Beyond the design of interactive exhibitions, CHPs may also outsource the design of interactive exhibits to external designers who often specialise in designing for cultural heritage institutions [5, 22]. Such external companies collaborate with CHPs to various degrees, including gathering design requirements and receiving feedback on design concepts. External design experts follow a variety of approaches to developing design ideas, including insights from storytelling and dramaturgy [27], and museum studies' insights on the museum experience [16, 8]. Larger institutions may also have in-house staff hired specifically to design, deploy and maintain interactive installations [5].

### Cultural Heritage Toolkits

As mentioned earlier, the overall motivation for our research is to develop a toolkit for CHPs to create

interactive exhibitions merging digital content with tangible artefacts without specialised technical knowledge. There is a small body of research on the development of cultural heritage toolkits and CHPs as end-users of an interactive system; however, no existing HCI project has yet focused on tangible exhibitions. For example, toolkits have been developed for the creation of virtual interactive exhibitions, such as ARCO [25], screen-based exhibitions, including ‘Curator’ [24] for table-top exhibitions and more recently, a toolkit for the creation of tablet-based guiding tools [2]. While these examples illustrate the growing interest in involving CHPs as designers of interactive exhibits, they do not offer comprehensive insights on their practice and experience of creating interactive exhibitions.

Our literature review has identified a significant gap in relation to the know-how of CHPs in the development of interactive exhibitions, their attitudes towards technology and their design motivations. Although an abundance of research is being conducted in the design of exhibitions from a HCI perspective, the design thinking and perspectives of CHPs when creating and running interactive exhibitions are rarely discussed.

In the following section we introduce the interview study we conducted with CHPs. We provide background information on the interviewees and describe the details of how the study and data analysis were planned and executed.

## PLANNING AND CONDUCTING THE STUDY

### About the study

The study, conducted between July and November 2013, took the form of semi-structured interviews. It involved 23 CHPs from 18 museums in five European countries (see Table 1). An interview was also conducted with three exhibition designers from a specialist exhibition design consultancy company. All names were changed to preserve anonymity. The interviewees were recruited through personal contacts, social media and a mailing list of CHPs.

The overall aim of the study was to gain insights into the varied forms of the CHPs’ practice; our motivation was to be able to identify the challenges that they might face in the future and the strategies deployed to tackle them. As part of the interviews, we questioned participants on a range of themes relating to CHPs’ practice concerning exhibition-making, including design methods, authorship, co-operative relationships and technology. Some preliminary results from the interview study outlining the opportunities and challenges faced by CHPs have previously been discussed elsewhere [17]. However, further interview analysis has also highlighted interesting findings relating to the CHPs’ experience with interactive exhibitions and the design process. Therefore, here we concentrate our analysis on the data pertaining to this theme.

Name	Role	Country	Org. Type/Size
Franz & Hugo	Deputy Director & ICT Manager	Netherlands	Science & Technology 50 +
Clyde	Digital Media Curator	UK	Science & Technology 5 - 50
Flora	Exhibition Researcher	Ireland	Science & Technology 5 - 50
Carol	Manager	Ireland	Science & Technology 5 - 50
Cathy	Assistant Director	Germany	Literary >5
Bart	Curator	Ireland	City Museum >5
Eleanor	Curator	UK	National Museum 50+
Bernard	Curator	Ireland	City Museum >5
Emer	Archival Assistant	Ireland	City Museum >5
Dorothy	Education Officer	Ireland	History >5
Martina	Manager	Germany	Literary >5
Ursula	Manager	Ireland	Literary >5
William	Curator	Netherlands	Archaeology 5 - 50
Amanda	Curator	Italy	History 5 - 50
Nicole	Exhibition Co-ordinator	Ireland	History >5
Nadine	Curator	Ireland	Contemporary Arts >5
Justine	Archivist	Ireland	Archives >5
Jane	Curator	Ireland	History >5
Michael & Oliver	Technicians	Netherlands	Science & Technology 50+
Clodagh	Research Director	Ireland	History >5
Eric	Curatorial Assistant	UK	Creative Arts 5 - 50
Martin, Paul & Ray	Exhibition Designers	Ireland	Exhibition Design >5

**Table 1: Participants in the interview study**

The majority of interviews took place at the participants’ workplaces. Most were on a one-to-one basis; although, there were three occasions when this was not the case. On one occasion, two of the authors conducted a two-on-two interview; on another occasion, one of the authors conducted a one-on-two interview; in another instance, three of the authors conducted a three-on-three interview. In all instances, the interview was conducted with professionals from the same institution. The interviews lasted between 40 and 90 minutes. The participants were encouraged to speak about a particular exhibition that they had designed, usually as part of a team. All of the cases concerned original exhibition designs - bar one case where a previously designed exhibition originally held at another institution was then adapted for the participant’s museum.

### Background of Participants

Twenty-four interviewees were long-term employees or members of a institution, while two of the interviewees occupied temporary positions. The participants worked in different roles at their respective organisations, including curation, education, management, digital media and

research. All of them had experience of working on exhibition design projects, most commonly as part of a larger team. We involved professionals from a variety of institution types, including science and technology centres, local history museums, national museums, exhibition design companies, literary and archaeological collections. The participants ranged in age between 20-65, and their educational backgrounds varied: some were educated in areas relating to history and archaeology; others in areas relating to art and craft; others in areas such as marketing; and others in technological fields. Excluding the external exhibition designers interviewed, only one CHP had been trained in exhibition design. The majority of the CHPs interviewed had a background in the humanities and had 'fallen' into the profession of curation and exhibition design practice. In some cases, the CHPs have adapted well to using technological tools, for example for cataloguing and maintaining online content. In the case of science and technology institutions, the staff had a higher level of technical understanding and ability in comparison to staff from other institutions. One of the science and technology institutions also had access to highly skilled technical staff, as a result of being connected to an affiliated research unit.

### Analysis Method

The interviews were transcribed and analysed using a thematic approach: through repeated readings of transcriptions, the project team members individually generated codes, which were shared through a qualitative data analysis software, and subsequently discussed collaboratively to consolidate the interpretation of the data. Some of the significant insights that emerged concerned the varying degree of resources available, which depended on the size of the institution: some institutions employ a small number of staff and staff members typically take on multiple roles (i.e. management and curation); other larger institutions have dedicated technical staff and professionals assigned to specific curatorial activities (i.e. applied arts curator; education curator; etc.). Some of the biggest challenges encountered were related to the unavailability of the technology, the expertise and appropriate budgets.

The participants varied in terms of their experience with designing digital interactive exhibitions: some individuals regularly designed digital interactive exhibitions; others had commissioned one-off digital interactive exhibitions and had played a team role in their design and development; others had no experience of designing digital interactive exhibitions. For the purpose of this study, we focus mainly on data pertaining to the first and second groups. However, we will also draw upon the experiences of the third group to highlight the challenges that they felt must be overcome if they are to design digital interactive exhibits in the future.

The analysis of the interview data highlighted five significant emergent themes with regards to the participants' design thinking of interactive exhibitions: the range of reasons why CHPs include technology in such

exhibitions; the opinions CHPs have on personalized experiences in interactive exhibitions; the CHPs' attitudes toward interactivity and museum technologies; the design affordances connected to working with digital technology in the heritage context; and the expectations regarding design tools for CHPs. We will illustrate these themes in more detail in the following sections.

### WHY INCLUDE INTERACTIVE DIGITAL TECHNOLOGIES IN EXHIBITIONS?

The CHPs expressed diverse views on what they felt the purpose of technology was when designing an exhibition, and gave a variety of reasons and intended outcomes for including interactive digital technologies in exhibitions. These reasons ranged from simpler motivations such as using technology as a means to attract audiences, to more complex goals linked to the potential interactional capabilities of digital technologies for educational, engagement and participatory purposes. Not all of those interviewed had used digital technology for the creation of interactive exhibitions; of those who had, a wide variety of hardware and software technologies were involved. The former included display screens and gesture based technologies, the latter digital games and augmented reality applications.

An important finding was that many of the CHPs felt that the design of interactive exhibitions should not be driven by the technology: interactive exhibitions should be designed with the core concept in mind; the concept could be formed around stories, themes, museum objects or experiences that the exhibition aims to portray. As soon as the overall idea has been established, the CHP would have then decided on how technology, if at all, could support the portrayal of this concept. This was the approach usually followed at the science and technology museum where Michael and Oliver work as technicians and create a great deal of interactive exhibitions that includes digital technology. They explained the process that they followed for the design of a previous interactive exhibition: a studio showing the effects that humans have on climate change. The concept development phase occurred early on in the process and this was when the curators had formulated the core idea for the exhibition: Oliver described: *"first there's the very early concept phase and we're usually not involved or on the sideline. When they're a little bit further, they come to us with what could we do and if we could build something"*.

Furthermore, many of the CHPs stressed the need to use technology in ways that do not distract from the exhibition themes. Rather, digital technologies should support the best possible portrayal of the themes in the exhibition. William, director at an archaeology museum, shared this view; he had a lot of experience using digital technology as part of interactive exhibitions. He was experimenting with different technologies to identify what technology would best support visitors in exploring objects in an exhibition. While describing the use of a Leap Motion - a device that

senses a person's gestures - William commented on its aptness for helping visitors connect with museum objects: *"It's focusing on the object; it's technology that's helping you, it's one-to-one, and it's not distractive"*. William recognised himself as a director who is *"critical of what he sees"* and realised that the interactions the technology afforded would feel natural for visitors.

Some CHPs also noted that the technology used should support the visitor in learning from and engaging with the exhibition. Dorothy, an education officer with some experience of working with interactive digital technologies, highlighted this while describing the success of a high-tech piece at an exhibition in her history museum. The piece was an ornate-framed screen accompanied by a set of opera glasses. It was only through the glasses that a visitor could see the pictures of the objects displayed on the screen; the pictures were of objects in the collection that people sometimes overlook in the collection. She highlighted how this piece surprised visitors and how: *"the technology used deepened, you know, played a role in deepening the understanding by the visitor of the piece they were trying to engage with"*. She felt that the technology used in the exhibition assisted in conveying the overall concept: to highlight objects that would otherwise be unnoticed.

However, for some CHPs, the main reason for using technology in exhibitions was not driven by an exhibition theme. In some cases, the motivation to use technology in the design of interactive exhibitions was to attract visitors and to be seen as an institution that was "keeping up" with technological trends and research. Bernard, a curator at a small city museum with some experience of working with digital technology, was interested in increasing the visitor numbers. The museum he works at had acquired a virtual presenter from an external company to trial. Bernard felt this type of technology could provide the museum: *"with a great press release and get visitors through the doors"*. This might appear as a more "superficial" motivation; however, it is related to the actual difficulties that cultural heritage institutions (particularly smaller, local ones) have in attracting and engaging with the public.

#### **PERSONALISATION IN INTERACTIVE EXHIBITIONS**

For many of those interviewed, the ability to have multiple narratives and methods of engagement interwoven together through an interactive exhibition was a very desirable design outcome. Michael and Oliver held this view, particularly since the exhibition they were designing was targeted at a large visitor audience. The exhibition, which was focused on how humans have an effect on climate change, contained many ways for visitors to engage: for example, through a touch-screen interface where visitors could choose a video to play; through an editing interface where visitors could explore the videos in more detail and edit them themselves; furthermore, a fake camera that allowed young children to engage with the exhibition. Michael and Oliver also believed that visitors should have a

choice on what videos they want to see: *"People should be free to zip through your content and go from a to z - just big snippets - what you want, what you're interested in..."*.

Bernard also supported the idea of having multiple narratives running through an exhibition. He described plans that he had for a future exhibition in his museum that may incorporate interactive technologies: an exhibition exploring what a life in a culture may be like in the coming years. Furthermore, he mentioned that it would be good if the exhibition was driven by personal preferences rather than a fixed, pre-selected narrative: *"It would be great to have a character-led exhibition, if it could feature a variety of different narratives...so that it's driven by personality"*.

The CHPs were aware that a unique narrative might not suit everybody; ideally, they would like to have the ability to deliver personalised content to different groups. Accommodating different perspectives, ages and interest groups was expressed by Amanda, curator at a history museum with no experience working with digital technology, as a major consideration for the redesign of an exhibition at her museum. Her goal for the exhibition was to share different stories of World War 1 (WW1); the stories highlighted the perspectives of different people affected by the war: *"Now, we have a common story of WW1 that everybody could recognize and we want to show that there are different stories: the story of a widow; the story of an orphan; the story of a soldier; and to portray the story of the different witnesses"*. She believed that, by portraying the stories in this way, there would be a story in the exhibition that everyone could recognise and relate to.

As well as the ability to tell different stories, some CHPs also noted the importance of delivering different types of interactive experiences for different people to engage with in an exhibition. Dorothy emphasised this, as she believed that a "one size fits all" exhibition will not be pleasing to every visitor. Dorothy highlighted that she liked to have a variety of methods for people to engage in her exhibitions. She believed that: *"People are different and so naturally react and be drawn to different objects. So I like having a variety of methods for people to engage with things. Not everything is going to work for everybody and I don't think that's a mark of success or failure"*.

#### **WHAT TYPE OF INTERACTIVITY IS DESIGNED FOR?**

When discussing technology in exhibition design, the interviewees had various ideas and meanings regarding what constituted "interactivity". For some curators, the distinction between mechanical and digital forms of interactive exhibits was very pronounced. In one particular case, Eleanor, curator at a city museum with no experience of designing interactive exhibitions with digital technology, stressed the advantages of mechanical interactive exhibits but dismissed digital interactive exhibits as having little worth or ability to communicate materiality. Materiality was something that Eleanor felt was at the core of a positive museum experience; she highlighted this was influenced by

her background in sculpture and the fact that she curates various physical objects such as costumes, metal and silver. She emphasized her preference for mechanical interactive exhibits when describing an exhibition that she had experienced in another museum, praising its analogue interactive features. She highlighted how its material qualities, the ceramic and the wood, helped visitors gain a better understanding of the exhibition: *"They are just knobs on the wall, but it's very effective and you do get a real sensation as opposed to a virtual one. I think most of our people here are keen on the real experience"*.

For Eleanor, the ability to obtain a "real" experience rather than a virtual one was an imperative part of the museum visit. Eleanor had also noted later in the interview that she likes to touch and carry the costumes to feel their material qualities and gauge their weight. When illustrating the limitations of digital exhibits for highlighting such features, she noted: *"And of course these are the details, the weight, the feel that can't be translated into a digital format"*.

The limitations of digital interactive exhibits were also discussed by Carol, a manager at a science and technology museum. Carol was part of a team working on an exhibition for telling the story of recent scientific discoveries and their impact on life in outer space. Carol explained that the exhibition originally consisted exclusively of digital interactive exhibits; however, she quickly learned that the digital components alone did not satisfy visitor engagement: *"We found that in the early years it is exciting for people to come here as the new centre but quickly we learnt that the human engagement element was lacking and that the standalone interactive multimedia element doesn't meet visitors expectations, they need human handholding through it"*. To address this problem, Carol and her team assigned guides to assist visitors exploring the exhibition.

For those experienced in designing with technology, a set of "common" or "accepted" applications for digital interactive exhibits emerged from the data. Examples of such "common" applications included: access to objects on-demand (by means of digital representations), the augmentation of objects through digital content and the ability to make invisible data (for example, information stored in archives) visible to visitors. William was particularly interested in using digital technology, such as augmented reality, to enhance the museum objects; however, he also wanted to preserve the traditional museum design: *"We were looking for how things work out and how technology could help, but also the traditional museum design is also very important. So, we have good objects, we're focusing on these objects of course- that's why people come, and we use technology like this presentation or demo or iPads for augmented reality"*. The view of having digital technology complementing the traditional museum design also resonated with Dorothy; she felt the ornate framed screen, which highlighted objects that may be overlooked in the collection, really helped visitors engage with other

objects in the museum. She described the piece as one that provoked surprise and helped *"broadened the appeal of the objects that we have displayed for the past fifteen years"*.

Although these common applications were in place, many experienced CHPs were interested in exploring novel interactive possibilities involving digital technologies. For Nadine, an independent contemporary arts curator, it was important to push the boundaries of what is accepted as an "interactive exhibit". Nadine has designed many interactive exhibitions coupled with digital technology, including her most recent exhibition that explored the boundaries between online and offline technology. She felt that many interactive exhibits had become too formulaic, describing that *"they're just doing the same thing, but under different themes"*. She argued that interactive exhibits shouldn't be limited in application and that it is *"not just about standing and waving or hitting something and then something happens"*. For her, the way in which interactivity is applied to interactive exhibits could go beyond these preset ideas. In her own practice as a curator, she tries to *"put more focus on the concept, and not just the interaction"*, further commenting that she was trying *"to change the audience perception on what new media could be and can be"*.

#### **DESIGN AFFORDANCES OF DIGITAL TECHNOLOGY IN THE HERITAGE CONTEXT**

The participants articulated views on how digital technologies afforded not only a variety of visitor experiences, but also of curatorial/management activities, such as the ability to tweak, maintain and modify the design. The control CHPs had in the design, modification and maintenance of interactive exhibitions depended on several factors, including: whether the CHP had the specialised knowledge required to perform these tasks; the availability of technical staff that can be contracted to perform these tasks; whether the institution the CHP worked in had an in-house team with the relevant technical skill and whether the technologies used to design the exhibition were analogue or digital.

Some of those interviewed had access to in-house technical staff to design, modify and maintain exhibitions. In these cases, the CHPs were able to test the exhibition in context before the official launch. Hugo, ICT manager, and Franz, deputy director, both working at a science and technology museum had extensive experience of designing interactive exhibitions with digital technology. Furthermore, they had access to in-house staff that could test the exhibition and trial the technologies with a sample audience in context. However, their experience had also highlighted the main drawbacks of digital technology, further commenting that: *"the more interactive exhibits you have, the more maintenance required"*, which is an important concern when making design decisions regarding an exhibition.

Affording the time and mental space for innovation was another significant challenge mentioned by the participants. Martin, Paul and Ray, exhibition designers for a company

that works extensively with digital technology, had designed interactive exhibitions for various cultural heritage institutions. They noted that the biggest challenge was encouraging the CHPs to update and maintain the technology used in the exhibitions. All of them agreed that the CHPs not only underestimated the cost of updating and maintaining the technology, but also the time it would take to do so. However, in some cases, the CHPs interviewed understood the importance of allocating time for identifying new uses for previously used technologies. Some CHPs used initial experiments with new technologies to become familiar with them and to gather knowledge of how they could be used. This approach was common in the design of interactive exhibitions in the museum William worked in. This archaeological museum had access to various innovative digital technologies for experimentation; furthermore, they also had an in-house team for developing interactive exhibitions coupled with digital technology:

*"We have, on a permanent basis, laboratories where we experiment and research is done, and in this way, you can make it sustainable, because innovation is ongoing and you should be able - and that's maybe the critical point for museums, to make exhibitions - temporary exhibitions, you really need to find the resources, the people and maybe the space - maybe not physically, but the mental space to look ahead and to see how you can really adapt to these new possibilities and technologies".*

Unlike many of the CHPs interviewed, Nadine had the knowledge to fully maintain the high-tech pieces in the exhibition that she had curated without expert support. Due to her strong technical background, she felt that she understood the technological issues that the artists dealt with: *"Especially in terms of my practice, because all of the artists I work with, work with technology, I'm able to speak with them about that medium and I understand what their issues are and the types of concerns they might have in presenting their work within galleries"*. She further commented that her technical background had an influence on her curatorial approach, stating that her: *"practice is very sympathetic towards technology"*.

However, not all institutions had access to staff with technical knowledge and in some cases, the exhibition design was commissioned to an external company. This also meant, however, that the museum staff would have limited knowledge or control to maintain and modify the exhibition. Carol mentioned that, with the science exhibition that she was working on, the main interactive element was commissioned to an external company to design and develop. The content created for the interactive elements had not changed since the exhibition had opened. Later in the interview, she had also explained that she tries to use platforms with which the in-house team was familiar with because they would have control over the content. Carol and her team were using WordPress - a blogging and content management tool - to create an app for visitors to

engage with the science exhibition: *"We would do the design in house and then we might ask an external web designer to join if required. We tend to work on platforms like WordPress so that we have control of our own content and uploads"*. This ability to edit, update and adapt exhibits (or parts of the exhibits) themselves was important to many of the CHPs as it allowed them to exercise a greater degree of authorship and control over the ultimate design outputs.

## DESIGN TOOLS FOR CURATORS

A significant theme that emerged from the interviews was the manner by which CHPs acquired inspiration for new interactive exhibitions. Often, inspiration came from visiting another interactive exhibition or through encountering material relating to another exhibition. On other occasions, the inspiration spawned from sci-fi or other media sources, or simply from the CHP's imagination. Many described the technologies in relation to what they liked about the experience and how they envisaged them in their museum. Cathy, an assistant director at a literary museum (with no experience designing with digital technology) described an exhibition she had encountered at another museum: *"In another museum I visited, as I walked from one room to another, I could listen to music or poems read out loud (running in a loop). It felt so harmonious! Everything belonged there! I liked that very much!"*

However, in some cases, the technology might not have been available to realise a concept into a design, may not have been applicable to a particular situation, or simply may not have been affordable. Jane, curator of an exhibition focusing on the life and living conditions of people at the beginning of the 20<sup>th</sup> Century, spoke about a "dream" technology that she would have liked to have used in the exhibition, although it was too ambitious to realise: *"We were hoping someone would come along and rather than use interpretative panels, that they would use holograms to represent the crowded nature of living in a tenement and the sub-division of rooms because a room in X street is vast and people don't understand that you might have had 50/60 people here and that the room was all subdivided"*.

Many interviewees also discussed their experience using tools for the design and deployment of interactive exhibitions. These tools included Content Management Systems to upload and manage content digitally; cataloguing software; audio recordings; and photo galleries. For example, although Jane had not much experience designing interactive exhibitions, she used the software Omeka to share and create online content. Many CHPs also suggested tools they could use as design aids for exhibitions. Flora, an exhibition researcher who had experience working with digital interactive exhibitions, was adapting an exhibition for a science museum themed around environment sustainability. The CHPs who previously worked on the exhibition did not archive the documentation properly and Flora needed this information to adapt the exhibition. Therefore, she used video resources that were

available from the previous exhibition as a guiding source: *“Then there was a video demonstrating each exhibit product. And this as a resource was really the most useful thing for me in planning the new exhibition”*.

## **DISCUSSION AND CONCLUSIONS**

The interviews allowed us to gain valuable insights on the understanding, design strategies, values and practices of CHPs with diverse experiences and expectations of participating in interactive exhibition design projects. In the previous sections we have presented significant themes that have emerged from the data, depicting a range of CHPs’ concerns and strategies in designing interactive exhibitions.

The effectiveness of digital interactive technologies must be considered in the design process not only for supporting visitor interaction, but also for enabling the CHPs tasks, such as tweaking, adapting and maintaining design. From the point of view of HCI and Interaction Design researchers and practitioners who focus on cultural heritage and, specifically, on how CHPs can be supported in the design of interactive exhibitions through either collaborations with external experts or through the use of DIY toolkits, we identified a number of issues to discuss further.

### **Supporting different design motivations**

The CHPs expressed a variety of reasons for including technology in the design of exhibitions; however, the shared sentiment is that technology use must have a strong underlying purpose: it may be to enhance the visitors’ understanding of a theme, object or concept, or to communicate an expert view on an aspect of the collection, or even simply to provide visitors with an attractive novelty that might bring them to the museum for the first time – a very important motivation for institutions working with limited resources. The choice of technology comes after these core concepts have been established.

William and Dorothy also expressed interest in using digital technologies for enhancing the traditional museum environment and encouraging engagement with museum objects and themes. This finding complements much of the design research undertaken by HCI and Interaction Design researchers in cultural heritage, who focus on subtly introducing technology in interactive exhibitions in support of the museum’s overall character [6, 9]. However, the curatorial and interpretation goals that motivate CHPs’ design choices should also be considered paramount when designing interactive exhibitions. In designing DIY toolkits, the phrasing used to illustrate examples should be empathetic toward these diverse design motivations: whether it is to highlight a story, concept, or object.

It is important to note that the CHPs’ motivations and approaches to designing interactive exhibitions were not only influenced by the type of institution they work for but also by their education and work background, as explicitly mentioned by Eleanor and Nadine. Furthermore, only one of the CHPs interviewed had formal training in exhibition

design. It would be important for practitioners collaborating with CHPs to learn of their influences from the onset of the project - not only in terms of their design motivations, but also to identify their understanding of how technology can support their design strategies. For those with experience in designing with digital technology, the ability to participate in the design of interactive exhibitions was invaluable.

### **Personalisation as a curatorial goal**

While other research has highlighted the desire expressed by visitors for personalised content [1, 3], the findings from our study inform us of the CHPs desire to use technology in exhibitions as a means to deliver personalisation in order to achieve specific curatorial goals. These include applying different engagement strategies for different types of visitors, encouraging repeat visits etc. CHPs are acutely aware that a unique narrative might not suit everybody, and see interactive technologies as a way to help them deliver personalised narratives to different groups. While research on personalisation in cultural heritage has been ongoing for the past two decades, further exploration is needed as to which forms and modes of personalisation should be part of the interactive exhibitions designs developed by CHPs.

As well as the ability to tell different stories, some CHPs also valued the ability to deliver different methods for interacting with an exhibition. The CHPs noted that not all visitors were going to be drawn to the same exhibition and the same method for interacting with an exhibition was not going to work for everybody. It would be important to support a multitude of interactive experiences so visitors can choose the experience that appeals to them.

It is an open question whether the forms of personalisation preferred by visitors coincide with those proposed by CHPs. Nevertheless, it would be important to demonstrate to CHPs interested in experimenting with digital technologies how these can be used to enhance a visitor’s personalised experience, especially since these technologies provide new avenues for delivering personalised content [1]. Technology experts designing in collaboration with CHPs should provide demonstrations for how interactive technologies could be used to reveal personalised experiences to visitors. Providing visual representations of projects that have utilised personalisation techniques may aid CHPs in understanding the possibilities technology can offer and so these visual representations should also be considered when designing DIY toolkits.

### **Supporting established and novel interactive strategies**

The interviewees responses describing their past use of digital technologies and their expectations for future design projects show that there is an established set of design strategies involving technology: a set of “common” or “accepted” applications for digital interactive exhibits is becoming part of the repertoire that CHPs refer to when designing interactive exhibitions. Examples include technology as a support to wayfinding for visitors, as providing a “layer” of additional content (for example,



when using augmented reality applications), as a means for communicating concepts or narratives around exhibits, etc.

However, CHPs often develop a design concept that does not fit into these established interaction frames: as noted through the interviews, the CHPs also have their own diverse ideas of what constitutes interactivity. Furthermore, many CHPs may also lack the technical knowledge that might help them realise their design concept. Clearly, CHPs have gained certain ingenuity when it comes to technical possibilities; however, some decisions regarding technology may require additional knowledge and expertise.

Digital technologies open up diverse forms of interaction to what low-tech resources can offer. CHPs experienced in designing interactive exhibitions with technology may have their own practice for exploring different forms of interaction with digital technology; however, those with less experience will need to further explore the possibilities that digital technologies can afford. Accessing videos and exploring other interactive exhibitions, as mentioned by some CHPs, can act as resources for exploring novel interaction possibilities. Nonetheless, CHPs will also require further support to tweak the ideas provided in these resources to suit their design goals. Technology experts collaborating with CHPs should support them in understanding how their ideas could be realised using digital technologies. Furthermore, toolkits should also support CHPs in identifying how pre-composed ideas can be transformed to suit their own needs. This could be achieved through a small-scale prototype or simulation environment that demonstrates other possible forms of interactions with various kinds of technologies. Another solution, as raised by Martin, Paul, Ray and William, is encouraging CHPs to afford the time and mental space to actively experiment with digital technologies, such as touch screen and gesture-based technologies. This approach could be taken with those more experienced with technologies.

### **Merging the digital and the material**

The participants often referred to the importance of materiality in experiencing heritage. Eleanor, who felt that materiality was important for conveying a particular experience to visitors, particularly highlighted the importance of materiality, although her argument also dismissed digital technology as a meaningful means for engaging with materiality. Furthermore, the one professional who was involved in designing a completely digital exhibition commented on how the need to incorporate an analogue element emerged soon after the exhibition opened. The design concepts that the CHPs develop do include both material and digital elements. However, many examples of interactive exhibitions tended to separate the digital experience from the material one; this possibly influenced the CHPs' perception that the two should be separated. In order to support CHPs in the design of interactive exhibitions, it is important to emphasise that

digital technology can also support the material experience, as highlighted in HCI research [9, 14, 15].

Many CHPs had highlighted their desire to control as much of the design and content of the exhibition as possible. However, existing toolkits to aid exhibition design lack the ability to incorporate materiality into interaction. This is not only a limit of certain current technologies, but also a risk to avoid when developing the toolkit design – losing out on the engaging qualities of material artefacts in favour of digital content only. Furthermore, encompassing digital content only in both interactive exhibition design and the design of toolkits may also enhance the CHPs' perception that the digital component must be separated from the material. CHPs should be supported in considering and subsequently developing tangible elements when designing interactive exhibitions. In saying that, the creation of a DIY toolkit for integrating material and digital elements in interactive exhibitions also poses a major challenge: CHPs will need to visualise how such an exhibition would look and work. A solution could be the inclusion of a simulation environment that provides CHPs with examples of other exhibitions that integrate material and digital components.

In this paper we have presented the results from a qualitative study of CHPs involved -to various degrees- in the design of interactive exhibitions. The data collected provided useful insights on how CHPs are engaged in the design of interactive exhibitions, in terms of process, expectations and understandings of technology. With this work, we hope to contribute to the HCI community by presenting key aspects of the design practices of CHPs that are often overlooked in the existing literature and highlight key considerations for supporting their design motivations. We hope to complete further studies to formulate a detailed set of design requirements for the toolkit, complementing the design thinking of various CHPs.

### **ACKNOWLEDGMENTS**

This study was completed as part of the Material EncounterS with digital Cultural Heritage (meSch) project. The project (2013-2017) receives funding from the European Community's Seventh Framework Programme 'ICT for access to cultural resources' (ICT Call 9: FP7-ICT-2011-9) under the Grant Agreement 600851.

### **REFERENCES**

1. Ardissono, L., Kuflik, T., Petrelli, D. Personalization in Cultural Heritage: The Road Travelled and the one Ahead. *User modelling and User Adapted Interaction* 22, 1-2 (2012), 73-99.
2. Ardito, C., Costabile, M. F., Lanzilotti, R. and Simeone A. L. Combining multimedia resources for an engaging experience of cultural heritage. In *Proc. of the ACM workshop on Social, adaptive and personalized multimedia interaction and access (SAMPIA) 2010*, ACM Press (2010), 45 - 48.

3. Bohnert, F. and Zukerman, I. Non-intrusive Personalisation of the Museum Experience. In Proc. International Conference on User Modeling, Adaption and Personalization (UMAP) 2009, London: Springer (2009), 197 – 209.
4. Bossen, C., Dindler, C. and Iversen, O. S. Impediments to user gains: experiences from a critical participatory design project. In Proc. of PDC 2012, ACM Press (2012), 31 - 40.
5. Caulton, T. Hands-On Exhibitions: Managing Interactive Museums and Science Centres. Routledge, London, UK, 2006.
6. Ciolfi, L. and McLoughlin, M. Designing for Meaningful Visitor Engagement at a Living History Museum. In Proc. of NordiCHI 2012, Copenhagen, ACM Press (2012), 69 – 78.
7. Dindler, C., Iversen, O. S., Smith, R. and Veerasawmy, R. Participatory Design at the Museum - inquiring into children's everyday engagement in cultural heritage. In Proc. OZCHI 2010, ACM Press (2010), 72 – 79.
8. Falk, J. Identity and the Museum Visitor Experience. Left Coast Press Inc., CA, USA, 2009.
9. Ferris, K., Bannon, L., Ciolfi, L., Gallagher, P., Hall, T. and Lennon, M. Shaping Experiences in the Hunt museum: a design case study. In Proc. DIS 2004, ACM Press (2004), 205 - 214.
10. Fischer, G. and Giaccardi, E., Meta-Design: A Framework for the Future of End User Development, in Lieberman, H., Paternò, F., Wulf, V., eds., End User Development, Kluwer Academic Publishers, Dordrecht (2006), 427 - 457.
11. Flintham, M., Reeves, S., Brundell, P., Glover, T., Benford, S., Rowland, D., Koleva, B., Greenhalgh, C., Adams, M., Tandavanitj, N. and Row Farr, J. Flypad: Designing Trajectories in a Large-Scale Permanent Augmented Reality Installation. In Proc. of ECSCW 2011, London: Springer (2011), pp. 233-252
12. Heath, C., Luff, P., Vom Lehn, D. and Hindmarsh, J. Crafting participation: designing ecologies, configuring experience. Visual Communication 1, 1 (2002), 9-33.
13. Hindmarsh, J., Heath, C., vom Lehn, D. and Cleverly, J. Creating Assemblies in Public Environments: Social Interaction, Interactive Exhibits and CSCW. CSCW Journal 14, 1 (2005), 1 – 41.
14. Hornecker, E. Interactions around a contextually embedded system. In Proc. TEI 2010, ACM Press (2010), 169-176.
15. Hornecker, E. and Buur, J. Getting a Grip on Tangible Interaction: A Framework on Physical Space and Social Interaction. In Proc. CHI 2006, ACM Press (2006), 437-446.
16. Leslie, M. Applying Basic Design Principles to Technology in Museums. In Proc. of Rethinking Technology in Museums 2011, University of Limerick (2011).
17. McDermott, F., Clarke, L., Avram, G. and Hornecker, E. The Challenges and Opportunities Faced by Cultural Heritage Professionals in Designing Interactive Exhibits, In Proc. NODEM 2013 Beyond Control, Stockholm, Sweden.
18. Petrelli, D., Ciolfi, L., van Dijk, D., Hornecker, E., Not, E. and Schmidt, A. Integrating Material and Digital: A New Way for Cultural Heritage. ACM Interactions July + August 2013, ACM Press (2013) 58 – 63.
19. Reeves, S., Fraser, M., Schnädelbach, H., O'Malley, C. and Benford, S. Engaging Augmented Reality in Public Places. In Adjunct proceedings of CHI 2005, ACM Press (2005).
20. Schnädelbach, H., Koleva, B., Flintham, M., Fraser, M., Izadi, S., Chandler, P., Foster, M., Benford, S., Greenhalgh, C. and Rodden, T. The Augurscope: a mixed reality interface for outdoors. In Proc. CHI 2002, ACM Press (2002), 9 -16.
21. Simon, N. The Participatory Museum. Museum 2.0, USA, 2010.
22. Smithsonian Institution. The Making of Exhibitions: Purpose, Structure, Roles and Process. In Smithsonian Report 2002, Smithsonian Institution (2002), Washington, DC, USA.
23. Sparacino, F., Larson, K., MacNeil, R., Davenport, G., Pentland, A. Technologies and methods for interactive exhibit design: from wireless object and body tracking to wearable computers. In Proc. of ICHIM 1999, Washington, DC, Sept. 22-26.
24. Sprengart, B., Collins, A. and Kay, J. Curator: a design environment for curating tabletop museum experiences. In Proc. of the ACM Intl. Conference on Interactive Tabletops and Surfaces (ITS) 2009, ACM Press (2009), Article no. 5.
25. Sylaiou, S., Economou, M., Karoulis, A. and White, M. The evaluation of ARCO: a lesson in curatorial competence and intuition with new technology, Computers in Entertainment (CIE) - Theoretical and Practical Computer Applications in Entertainment 6, 2 (2008), Article no. 23.
26. Taxen, G. Introducing participatory design in museums. In Proc. of PDC 2004, ACM Press (2004), 204 - 213.
27. Wiberg, N. Dramaturgy in Interaction. In Proc. NODEM 2013 Beyond Control, Stockholm, Sweden.