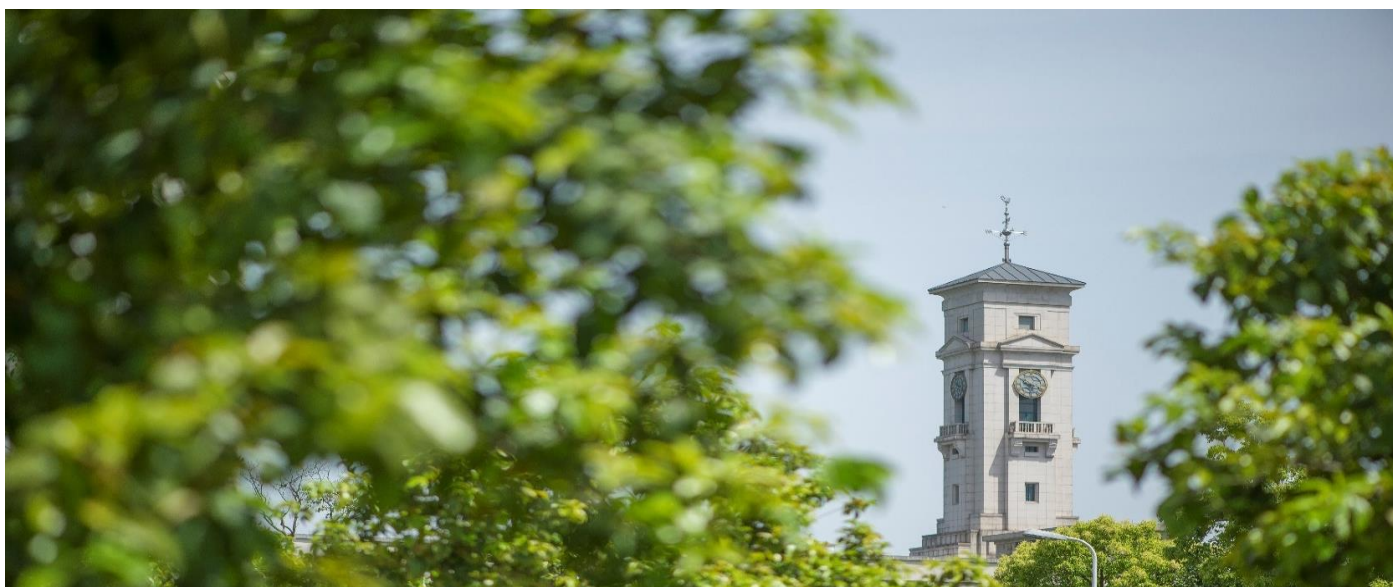


# China Museum's Digital Heritage Profile: An Evaluation of Digital Technology Adoption in Cultural Heritage Institutions

Andrew White and Eugene Ch'ng



**University of  
Nottingham**

UK | CHINA | MALAYSIA

Faculty of Humanities and Social Science, University of Nottingham  
Ningbo China, 199 Taikang East Road, Ningbo, 315100, Zhejiang, China.

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# **China Museum's Digital Heritage Profile: An Evaluation of Digital Technology Adoption in Cultural Heritage Institutions**

Authors: Andrew White and Eugene Ch'ng, The School of International Communications, University of Nottingham Ningbo China.

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## **Introduction**

Discussion about the academic use of digital technologies in cultural heritage institutions was contentious even from the earliest days of their introduction. Arguments that the digital provided the public with a qualitatively enhanced viewing experience were countered by more sceptical voices, which viewed it as remaining superfluous. This paper begins by revisiting that debate before focusing on the adoption of these technologies in so-called Western and Chinese cultural heritage institutions. This approach is not comparative. It was adopted as an acknowledgement that these technologies were integrated in displays in cultural heritage institutions in North America and Europe long before they were in mainland China. (It should be noted that this gap between Western and Chinese institutions is likely to be rapidly reduced in the next decade; indeed, we can foresee a future in which Chinese cultural heritage institutions are leading in augmented reality (AR) and virtual reality (VR) enhancement rather than following developments in other parts of the world.) The paper concludes with the discussion of a technology adoption survey that the authors undertook in a number of Chinese national museums and, within the context of the earlier debates, an assessment of the extent to which these qualitatively enhance the public's engagement with museum collections.

## **What is the Point of the Augmented Experience in Cultural Heritage Institutions?**

As computing technology became more powerful and portable in the 1980s, academics and cultural heritage professionals began to adopt it for a variety of uses. One of the earliest forms of experimentation was in modern literature, where these technologies were deployed in hypertext novels to give people a more interactive reading experience (Barnet, 2015). The proliferation of static and moving imagery that the nascent world wide web triggered in the early 1990s provided a far greater scope for the development of interactive online experiences, including early forms of online three-dimensional (3D) imagery in

disciplines like archaeology (Jacobs & Holland, 1997). Contiguous with these attempts to provide viewers/watchers/listeners (hereafter ‘users’) with more interactive, and visually rich, experiences was the digitisation of academic textual collections. Some of these, in their provision of full-text searching, employed an interactive form of engagement that enabled researchers to find specific terms without the need to manually search every single page of a document (White, 2011, p. 318).

The benefits of employing digital technologies in cultural heritage institutions and to augment our engagement with academic material are often assumed rather than made explicit, all the more curious when one considers how underwhelming some applications can be. Studies of interactive reading for instance, have highlighted the banality of much of the engagement between reader and text (White, 2007). Indeed, the notion that giving readers a choice of paths to take through a novel rather than being directed by the author’s fixed narrative fails to appreciate the extent to which the pleasure of reading is, to paraphrase Umberto Eco (2006), dependent on a coherent narrative and a sense of direction from the author, and the reader’s desire to be educated by someone more knowledgeable than them on particular subjects (pp. 14–15). This is supported by studies that have identified readers’ unease when they are navigating online texts without a strong linear narrative (Chiong, Ree, Takeuchi & Erickson, 2012; Pope, 2013). A further consideration in relation to cultural heritage institutions is that constraints on time and resources mean that it will be virtually impossible to digitise everything in large institutions (Kuan, 2015, p. 43). Indeed, in 2006, the then Librarian and Archivist of Canada, Ian E. Wilson, estimated that, notwithstanding the existence of a long-term technological program, in the following 10 years, his institution would only have digitised 0.5 per cent of its total holdings (Wilson, 2006). It is a similar story with ambitious programs in the private sector, where, more than a decade after it started its project to scan every single book ever published, the Google Books program has not been able to satisfactorily overcome the obstacles to disseminating e-versions to the general public (Somers, 2017). Conversely, institutions that have eschewed what might be termed an industrial approach to digitisation have prospered. A prime example of this is the British Library’s use of *Turning the Pages* software to present beautifully illustrated books of historical and cultural significance online and on consoles displayed in the entrance of its building in London (British Library, 2018).

All this highlights the importance of technology being deployed to enhance rich content within collections, rather than curators fetishising advancements in technical forms of display to such an extent that the importance of that content is downplayed (Koukoulis & Koukoulis, 2016). According to White (2011, pp. 317–318), digitisation of cultural heritage content tends to be motivated primarily by three

factors. The first is the desire to disseminate the content, or digital versions thereof, to as wide an audience as possible. We would add that, in their endeavour to widen access, cultural heritage institutions increasingly view ever-more sophisticated digital media technologies as the means to achieve this objective. In a sense, digital media technologies are being used to facilitate ‘experiences’ for visitors to cultural heritage institutions rather than solely presenting content in a static form (Kocsis & Kenderdine, 2015; Kuan, 2015; Thomas, 2015). These experiences can be delivered online, as in the case of the sensation of ‘turning the page’ of some of the British Library’s special collections. The second factor is conservation. This might appear counterintuitive, as the very act of exposing collections to scanners and other means of visual recording can sometimes damage the originals. However, if this is managed so that the digital capture of the content of collections is not repeated too often, this is a useful means of ensuring that the handling of the original artefact or document is lessened when a copy or simulation is available. Although this argument usually relates to the capture of two-dimensional textual material, it is increasingly common for sophisticated simulation technologies (e.g. 3D) to be viewed as a means of ‘conserving’ elements of our built heritage that are vulnerable and at risk of not existing in their present state for much longer (Quintero & Eppich, 2016).

Third, digitisation can create new methodologies, or—at the very least—a different way of viewing source material (White, 2011, p. 318). In terms of AR and VR, this might entail the introduction of new ways of seeing, or ‘scopic regimes’ if you will (Kenderdine & Shaw, 2015, p. 199). The argument that new viewing technologies can change our philosophical perception of objects has been recycled at various times, for instance in centuries-old discussions on the influence of ‘Renaissance perspective’ and, more recently, the debates around stereoscopic photography in the middle of the 19th century (Plunkett, 2013). Today, visualisation technologies have become part of the process of research (Ch’ng, Gaffney & Chapman, 2013REe) using a variety of techniques from data capture to interactive visualisation (Ch’ng, Gaffney & Chapman, 2013). While there is sometimes a danger in confusing an essentially quantitative form of technological development with a qualitative shift in thinking and perception (Plunkett, 2013, p. 389), there are nonetheless some new technologies that afford forms of academic enquiry hitherto not possible.

An additional rationale, for not just the digitisation of collections but the use of technological enhancement in all its forms, is the conscious desire to promote the ‘knowledge economy’ (Lin, 2015). In this sense, cultural heritage institutions become entangled in wider discourses about promoting particular forms of economic development, with the consequent danger that collections are being

subjected to technological enhancement to match governmental discourses about technological innovation and the creative economy rather than for the purely intrinsic value of so doing. We will explore this relationship between a discourse of modernisation and developments in AR and VR technologies in cultural heritage institutions in the next section.

### **The Development of AR and VR Technologies in Western Cultural Institutions**

While we appreciate that AR and VR technologies are in many respects qualitatively different from earlier technological enhancements in the cultural heritage sector, the principle of improving user experience is the same. For this reason, we will use the rationales explicated above for digitising cultural heritage content to frame our discussion of the adoption of AR and VR technologies in Western cultural heritage institutions.

As with digitisation more generally, the introduction of VR and AR into cultural heritage institutions is undoubtedly partly a means of attracting a more diverse audience into the institutions themselves as well as onto online platforms. For various reasons, including their increasing imbrication in discourses about the creative economy (which we will discuss later), the participatory culture that our exposure to sophisticated digital media technologies has afforded has also had an impact on the cultural heritage institution (Soler-Adillon, 2018); this dovetails with the modern social democratic state's wider project of 'inclusion'. In short, while developments in digital media technologies have provided cultural heritage institutions with the means of displaying interactive online platforms, the institution is as important as it ever was in providing a fixed site for interaction with the collections within it. Nonetheless, attracting people through its doors can only be done with the promise of an experience that reaches beyond what a 1980s cultural heritage institution would have offered. Developments in digital media technologies since the 1980s have raised visitors' expectations, with a general sense that, in some respects, cultural heritage institutions are competing for attention with their own online collections (Thomas, 2015, p. 127). In other words, can cultural heritage institutions offer a better onsite experience than potential visitors can enjoy online? Most institutions have realised that presenting themselves as an antidote to digital platforms is untenable. Hence, they have thought carefully about how they can bring these technologies into the institution without imperilling the intrinsic scholarly value of their collections. These technologies have encouraged a more personalised experience of mass media forms, in the sense that users can access content on platforms that are not tied to place and schedule in the way that watching television programs in the broadcast era were (Thomas, 2015). VR and AR can give users a similar personalised experience

in the cultural heritage institution. This is especially the case when handheld screens are utilised to provide individual ways of viewing collections in surgical detail or from different visual perspectives (Kenderdine & Shaw, 2015, pp. 205–206). A more kinesthetic experience can be offered, such that visitors' sense of touch and sensitivity to certain sounds is used to provide a more embodied experience (Kenderdine & Shaw, pp. 206–208). In extremis, a site, such as an old shopping street, can be digitally reconstructed to provide an immersive experience for visitors that is remarkably similar to being at the actual site (Ch'ng, Chapman & Gaffney, 2015).

It is sometimes argued that, in constructing virtual reproductions of original artefacts or environments, AR, VR and 3D technologies have a conservational function; in this sense, the image or idea is conserved rather than the original object (Quintero & Eppich, 2016). The use of digitisation in conservation is a complex task, exacerbated by the urgency to preserve the surface information of artefacts in full, to prevent further erosion or damage with the introduction of high-resolution 3D scanning devices. 3D digitisation is not a small task, as demonstrated by the gradual release of a mere 242 3D models online by the British Museum since 2014, in comparison to the collection of eight million objects in both its archives and exhibits. This is a testament to the difficulty of the act of digitisation alone, discounting the need to process, store, curate and share the digital facsimiles. Funded projects to digitally 'resurrect' heritage monuments that have been eroded by natural forces, tourism activities, rapid economic development and especially threats from terrorism through crowdsourcing means (Curious Travellers, 2018) does add further complexities to the issue.

However, a stronger case can be made by advancing the proposition that AR, VR and associated technologies enable innovation in learning methods. This in part centres on the earlier argument about these technologies facilitating new ways of seeing, or scopic regimes (Kenderdine & Shaw, 2015, p. 199). Kenderdine & Shaw (2015, p. 199) argue that scopic regimes are preferable to 'vision', as they are culturally specific ways of viewing, preferable to the simplistic, hegemonic universalism that 'vision' embodies. The beauty of AR and VR is that they can reveal these culturally specific ways of seeing (e.g. the demonstration of the 'reading' of a handscroll) (Kenderdine & Shaw, 2015, p. 199). There is also the sense that the way we construct knowledge has a somatic as well as cognitive element (Kenderdine & Shaw, 2015, pp. 206–208), and that technologies that create embodied experiences in the cultural heritage institution are making a profound pedagogical intervention. Others have argued that AR is useful for 'scaffolding' learning within the museum (Yoon et al., 2018) and that there is some survey evidence from school children that AR is a valuable learning tool (Chen & Wang, 2017). While it is right to be

sceptical about some of the claims made for the benefits of technologically enhanced interactive or AR learning environments, the very fact that these can encourage greater engagement with intellectual content is something to be welcomed.

Finally, to what extent can the introduction of AR and VR technologies into cultural heritage institutions be understood as part of wider national strategies on the information society and creative economy? In answering this question, one needs to first appreciate the extent to which cultural heritage institutions are already imbricated in discourses of modernity generally and in discussions of the creative economy specifically. Even in a nation like the UK, where entrance to many national galleries, museums and libraries is free, cultural heritage institutions are marketed as valuable contributors to the cultural/creative economy (Kendall, 2015). As in the rest of the creative economy, visitors are viewed as consumers who can be parted from their cash in the numerous cafes, restaurants and souvenir shops that proliferate in cultural heritage institutions. Attracting those consumers is dependent on providing a positive experience, which means that VR and AR technologies have an economic role as well as the more obviously educative one outlined above. This is why much of the academic literature on AR and VR focuses on its role in the tourist industry, in which the pleasure that these technologies can give those visiting sites of historical interest within the city is, in principle, what they are doing within cultural heritage institutions too (Han, tom Dieck & Jung, 2018; Yung & Khoo-Lattimore, 2017). That the cultural heritage institution is an integral part of the way cities market themselves, and consequently attract tourists, demonstrates the key role of AR and VR technologies in these spaces (World Cities Culture Forum, 2015).

We will now consider the development of these technologies in Chinese cultural heritage institutions by examining the extent to which the four rationales outlined above can be applied to the present situation in mainland China. Our examination will be informed by the results of a survey on the adoption of various display technologies that we carried out with a number of Chinese cultural heritage institutions in 2017.

### **Technological Enhancement in the Chinese Museum**

While the adoption of AR and VR is not at the same level in mainland China as it is in Western cultural heritage institutions, the Chinese government's future direction is clear. In the recently released Cultural Technology Innovation Planning (13th Five-Year Plan, Ministry of Culture, 2017), the first goal stated in relation to the marrying of technology with culture is the need to:



fully facilitate the integration of scientific technology into the cultural sectors. This includes information networks, intelligent manufacturing, virtual reality, big data, cloud computing, internet of things, 3D printing and to have a broad application of other advanced and innovative technologies. The capability to innovate new technologies for the cultural sector should be greatly improved.

This was elaborated further in more concrete terms as to:

encourage all related institutions to provide the opening of a catalogue of digital resources to collect a complete shared list of digital cultural resources.

investigate the data resources of libraries, cultural centres, galleries, art troupes, and etc. to understand the archives and enhance the storage condition of basic data. To improve the research and development of the collection, cleaning, analysis, sharing and visualisation of big data in the cultural sectors.

Based on the storage construction of the metadata of digital cultural resources, all data should be collected, organised and connected ... to encourage libraries, museums, cultural centres and galleries to collect and share user data ... to develop and utilise the data of cultural resources with the power of the whole society (crowd sourcing), and finally select and integrate the high-quality social data and cultural resources.

To map the use of these technologies in the sector, one author carried out a survey of various cultural heritage institutions in China in 2017. The survey was conducted as part of the 2016 and 2017 Museums Masterclass, coordinated by the University of Nottingham in collaboration with museums such as V&A, National Portrait Gallery and New York Metropolitan Museum of Art, among others. The data presented below are interpreted together with personal discussions with delegates, who included managers and directors of China's museums. Following the survey, we evaluated 22 national museums across 16 cities, enumerating the adoption of the types of technologies that Western museums tended to use. While we do not yet have data relating to Western museums, figures on the types of digital exhibits presently installed within China's priority museums, which received the larger portion of the Ministry of Culture's funding, provide us with an overview of where, in terms of technology adoption, China is positioned. This will provide a clearer platform from which to gauge how far they have come in meeting the previous 12th Five-Year Plan, and the ambitious objectives of the 13th Five-Year Plan.

Our investigation asked six questions related to participants' roles and seniority in the museums, entry payment, types of digital technologies used, future plans for the adoption of digital technology for exhibits, current in-house human resources for digital contents, and cultural heritage content most suited to VR.

## Questions:

- 1) Do users have to pay to enter your museum?
- 2) Do your museum exhibits use any of the digital technologies below?
- 3) If your museum has plans to adopt the digital technologies (below) for exhibits, when will you likely adopt them? (After 6 months, in 1–2 years, 2–5 years, 5–10 years)
- 4) Does your museum have in-house human resource and skills to create digital contents for the technologies below?
- 5) What cultural heritage contents will you be using VR for in your museum?

## Categories of Digital Technologies Mentioned in the Questions:

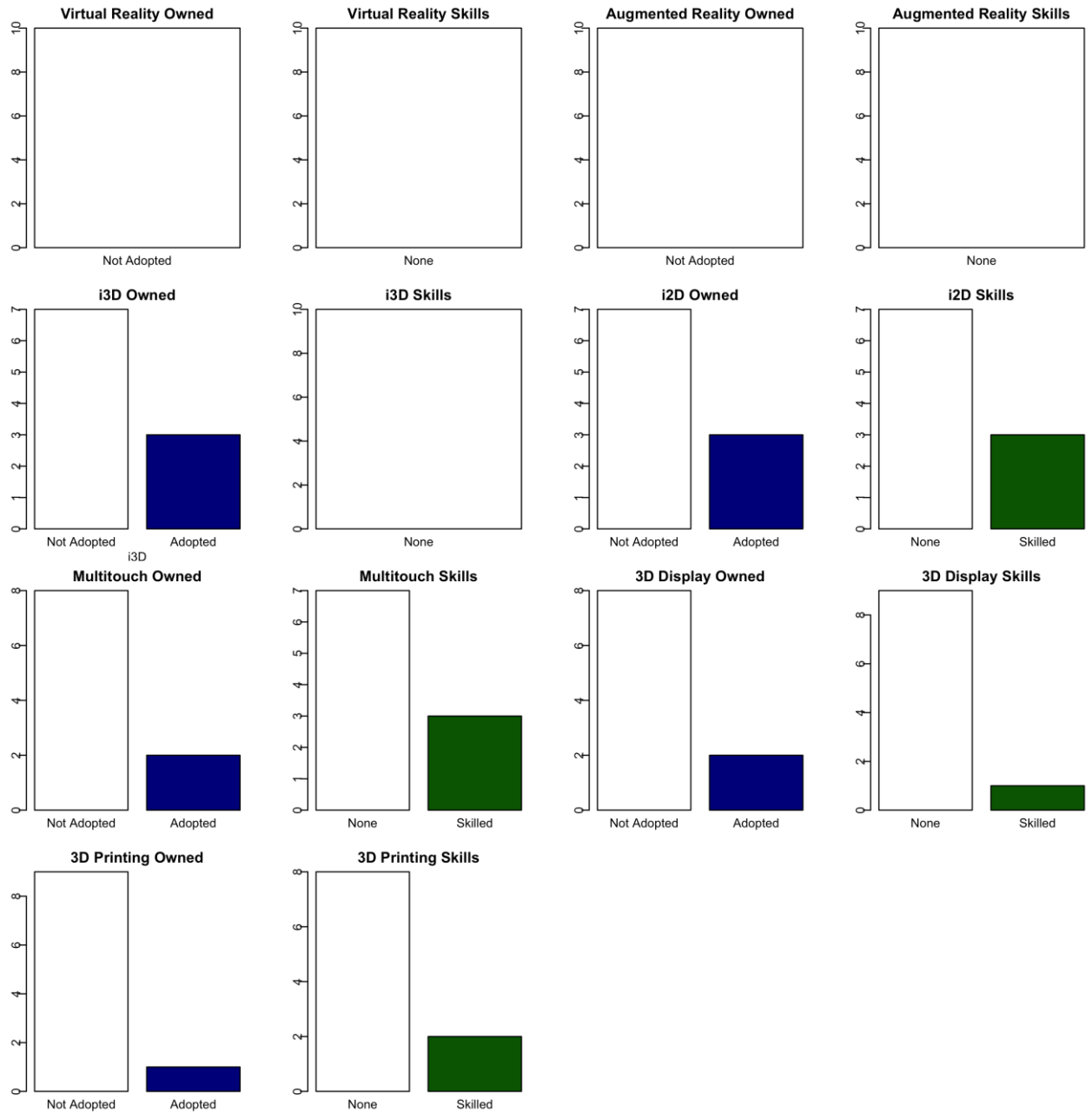
- VR
- AR
- interactive 3D (non-immersive 3D environments)
- interactive 2D (basic touchscreen)
- multitouch screens (touchscreens supporting gestures)
- 3D projection displays (stereo 3D displays)
- 4D displays (theatres with physical effects)
- 3D printing.

## Findings

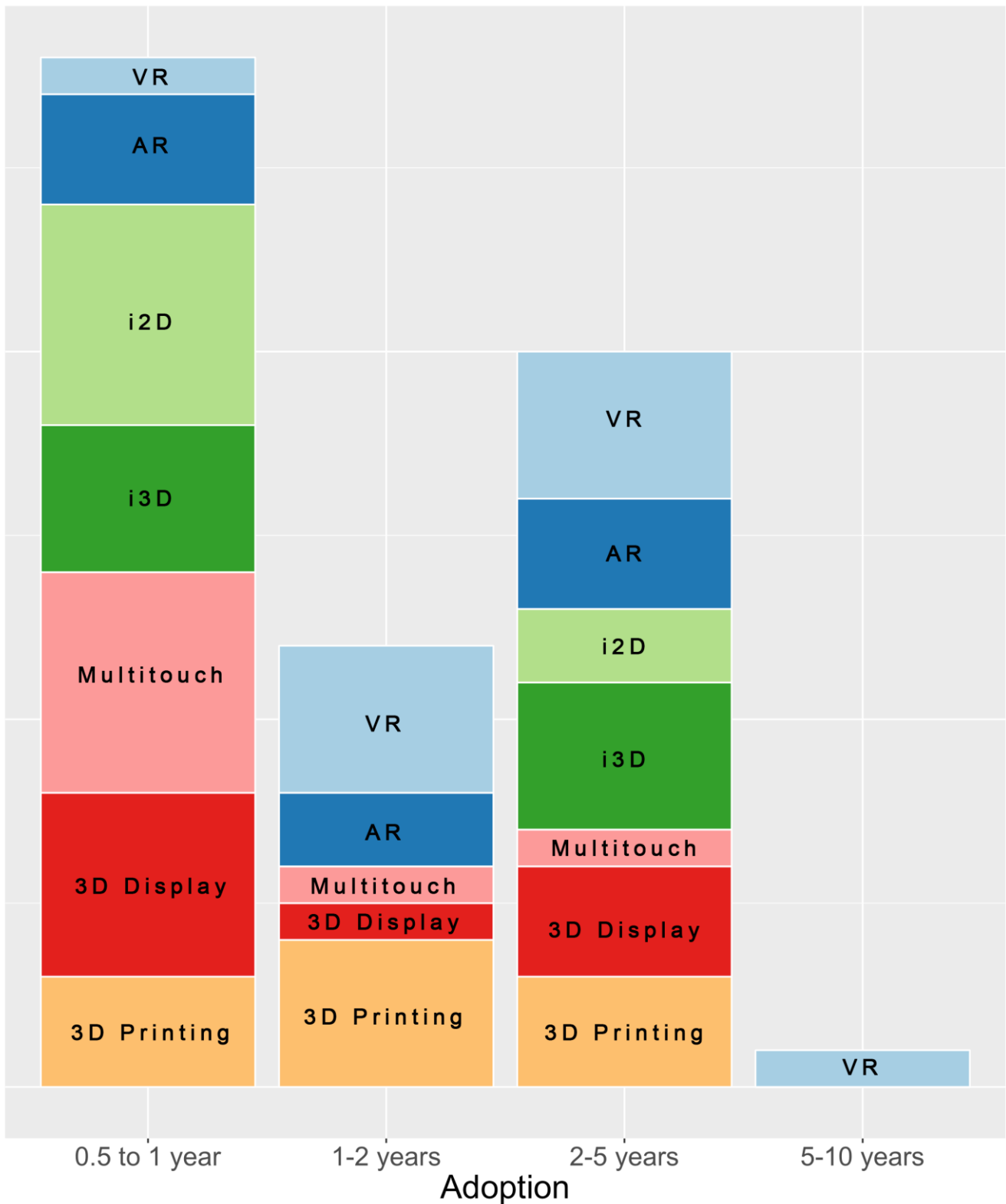
We obtained only 10 samples from the 45 museum delegates attending our masterclass. This is a low response rate, which we believe may be due to those in the lesser managerial roles not having access to such information. Further, participants may have been unwilling to divulge strategic information without permission from higher authorities. Our sample represents senior roles from museums and galleries with a participant as an owner, two roles as directors, a director of public relations, two deputy chairs, an international collaboration and outreach activity representative, and two anonymous respondents.

We generated a graph comparing the number of digital exhibits adopted by museums and galleries to the in-house human resource and skills needed to develop that type of exhibit. Figure 1 presents the side-by-side comparisons. The first two graphs—‘VR owned’ versus ‘VR skilled’—show that the museums and

galleries on which the interviews focused have neither adopted VR nor have in-house human resources and skills to develop VR. In the graphs comparing 'i3D adopted' versus 'i3D skilled', we can see that the museums and galleries have adopted interactive 3D installations but do not have in-house teams with skills. This suggests that cultural institutions in China tend to subcontract digital works to third-party digital media companies. This is logical, as it is cheaper to subcontract technical development than it is to form an in-house digital team. Personal conversations and our onsite survey of 22 museums confirmed this. The graphs illustrate that overall, museums and galleries tended to adopt more interactive 2D and 3D, with in-house human resource and skills for interactive 2D and multitouch development.



**Figure 1. Side-by-side comparisons (e.g. ‘VR adopted’ v. ‘VR skilled’) of the number of digital exhibits adopted by museums and galleries and in-house human resource and skills needed to develop that type of exhibit.**



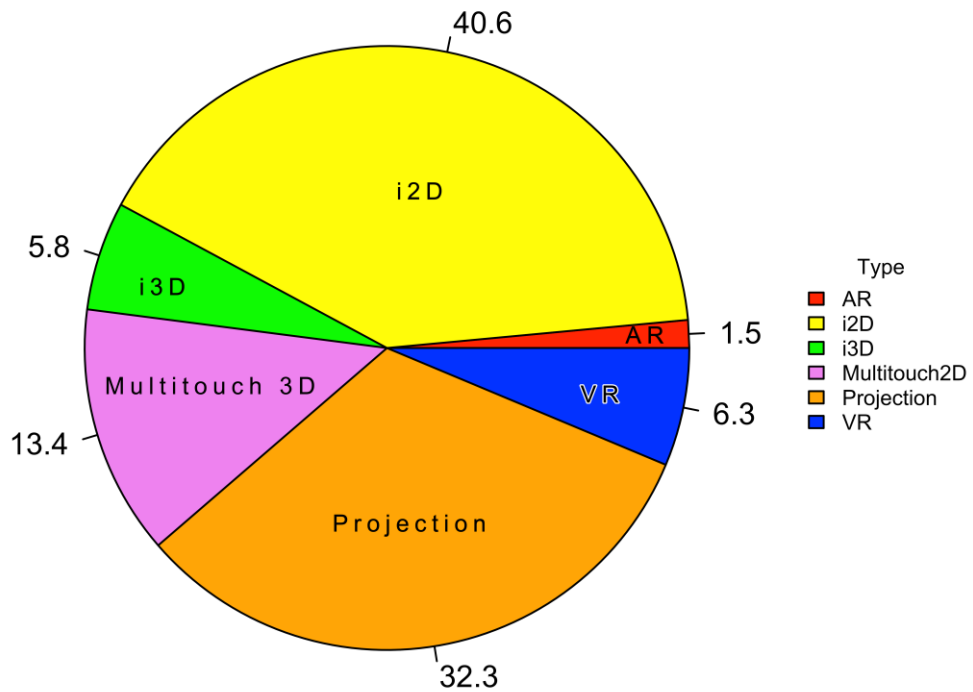
**Figure 2. Reported timescale for types of digital technology to be adopted (6 months–1 year, 1–2 years, 2–5 years, 5–10 years).**

Figure 2 is a layered bar plot of types of technology adoption reported by the participants. The graph is indicative of an early adoption of between six months and one year for all types of digital technologies. It is not surprising that most respondents reported a low planned adoption rate for VR and AR, pushing the adoption of such technologies further into the future because of concerns about the lack of requisite skills and expertise. More museums aimed for technologies familiar to them—interactive 2D/3D, multitouch and 3D displays. 3D printing hardware is well known in China, with many local start-ups designing and manufacturing such machines for sale or as services.

Figure 3 is a pie chart containing the breakdown of the percentage of digital system types within 22 top-level national museums over 16 Chinese cities. We explored and used 36 digital exhibits and categorised them accordingly.

The graph shows that contemporary interactive 2D systems (at 40.6% in our sample) are the most common systems adopted. These are ‘multimedia systems’ (i.e. i2D, from the 1990s). Projection systems with storytelling stands at 32.3%—the second largest group of exhibits. This is followed by multitouch 2D at 13.4%—a technology emerging from 2010— VR (6.3%), i3D (5.8%) and AR (1.5%). The graph demonstrated a small but emerging adoption of more advanced interactive systems, indicating that museums in China are transitioning into a new era. China’s 12th Five-Year Plan for making museums ‘Smart Museums’ has prompted the introduction of newer types of digital exhibits.

### Digital System Types



**Figure 3. A pie chart of the breakdown of the percentages of digital system types. Our sample, collected from 22 museums, comprised 36 digital systems.**

It is still unclear how VR and AR will contribute to China’s cultural heritage conservation. Chinese museums have only very recently adopted VR and AR for museum exhibits, at 6.3% and 1.5% respectively. Conservation is presently a traditional practice, apart from museums with the financial resources for subcontracting works for creating mobile, interactive 3D and VR/AR applications. Our understanding is that museums do not have digital teams for conservation; high-resolution photography works are subcontracted to companies. Prominent digitisation works, such as those at Dunhuang—which focus on conservation—result from collaboration with Western institutions.

Similarly, the effects of the adoption of VR and AR leading to new methodologies for learning about collections in cultural heritage institutions are yet to be proven. According to our understanding of the culture of technological adoption, and the general willingness of society to explore, accept and use new technology, a quick succession of applications will follow. We have already witnessed initial VR and

AR devices installed in the museums we visited, some of which, while not having quality computer graphics, were adequate to induce a sense of presence and believability within the environments. Our recent ‘in-the-wild’ observation of first-time users of VR and AR demonstrates how far such technologies have advanced. ‘In-the-wild’ studies bring research out from controlled environments such as laboratories into public spaces where technologies can be tested by any users, and in a number of ways unspecified by experimenters. Such studies have become very popular and are extremely useful for testing technology acceptance and observing users with new devices. In the study, we presented the reconstruction of an ancient maritime port in Ningbo to over 200 participants at the 2017 China (Ningbo) Cultural Industries Fair. The participants had no prior experience with VR. We discovered not only the ease of learning of such devices, but the ability of current VR and AR systems to induce the phenomenological approach to the experience of ‘being there’. Participants were unwilling to ‘leave’ the environment due to the reality of our simulation. There was an instance in which an elderly spectator reprimanded us for breaking cultural artefacts of national importance, even though they were virtual copies. VR and AR have indeed progressed from the 1990s, when they were crude virtual environments with geometrical objects, bad user interfaces and heavy headsets. Now, VR is as real as reality. Although relatively rare in Chinese museums, such experiences are perhaps the next step in the learning and teaching of cultural heritage through embodied experience. The introduction to the *Special Issue on VR for Culture and Heritage: The Experience of Cultural Heritage with Virtual Reality* discusses the need for museums to contextualise artefacts and provide spaces for personal and social interaction with the artefacts, and in relation to VR, ‘provide, through various media and narratives, an experience of the past’ (Ch’ng, Cai & Thwaites, 2018).

## **Conclusion**

A projection of how VR and AR will contribute to conservation and the creation of new methodologies for learning cultural heritage in China is difficult. However, the impact of digital technologies in the wider context of the social web is providing China’s cultural heritage institutions with new opportunities. A new program for cultivating a love of cultural heritage by the *CCTV Variety* show gathers nine museums, their directors and various celebrities to promote China’s cultural heritage. Each series has been viewed at least five million times on China’s Youku, a YouTube equivalent, with the most viewed at 17.58 million, shared through one of China’s largest social media platforms, WeChat. Its YouTube playlist indicated an average of 100,000 views internationally. The show is a success, as it has kindled the love of young people for China’s cultural heritage, with many expressing desires to work for



museums in the future. While the future projections on the contributions of specific digital technologies to cultural institutions is difficult, we can already see the wider impact of digital technologies for China's creative economy. In this sense, cultural heritage institutions are increasingly viewed as part of China's projection of soft power as well as one of the main drivers of the 'cultural industry [which] will become a pillar industry of national economy at the end of the "13th Five Year"' [Plan]. The Plan states that many cultural heritage institutions should increase their autonomy, which would involve becoming less financially dependent on the public sector (S. C. of China, 2017). In this sense, the development of VR, AR and 3D technologies in cultural heritage institutions in China will, in their enticing of more visitors whose admission fees and expenditure in onsite cafes and souvenir shops, generate increased income and contribute to greater financial sustainability. This will have an impact on pedagogy too, as a public habituated to the use of digital technologies will be receptive to the use of those same technologies for social and educational purposes within cultural heritage institutions in China.

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