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Building Bridges Between the Virtual and Real: A Study of Augmented and Virtual Realities in the Museum Space and the Collaborations That Produce Them

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Building Bridges Between the Virtual and Real:
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by

Katharine Rose Allen

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ABSTRACT OF THE THESIS

Building Bridges Between the Virtual and Real:

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Katharine Rose Allen

Master of Arts in Moving Image Archive Studies

University of California, Los Angeles, 2016

Professor Ellen J. Pearlstein, Chair

Building Bridges Between the Virtual and Real utilizes interviews with content creators, technology developers, and museum personnel to detail the ways in which these parties have worked together to bring augmented reality (AR) and virtual reality (VR) experiences into the museum. With a brief summary of museological theory on the function of digital technologies in the museum and a survey of AR and VR experiences exhibited in museum space, this study is designed to facilitate and foster collaborative projects that further integrate AR and VR into the museum environment.

The thesis of Katharine Rose Allen is approved.

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Ellen J. Pearlstein, Committee Chair

University of California, Los Angeles

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Introduction

Imagine you could give schoolchildren the opportunity to stand before Abraham Lincoln and persuade him of the justice of the Emancipation Proclamation. Imagine you could give members of your museum public the opportunity to create a monumental public artwork inside the museum's walls with no threat of paint or sawdust, chalk or sparks limiting their activities. Imagine inviting a to-scale dinosaur into the museum and permitting visitors to stand beside it, their ears and eyes feet away from the muscles that ripple as it moves. Imagine giving visitors license to take over the museum. All of this and more can be accomplished with augmented and virtual reality technologies.

Augmented reality (AR) and virtual reality (VR) technologies and content are becoming more readily accessible on the commercial market every day. If the aspirations of their producers are met, AR and VR will soon influence how we work, how we communicate, how we learn, and how we play. These changes will reach the museum and in fact, they already have. Many museums have begun to experiment with augmented and virtual reality experiences, using them as didactic tools, artworks on display, and as part of novel programs designed to connect museums with their communities. These experiments have been presented as case studies at the annual conference, Museums and the Web, as well as in institutional blogs, and in the popular press. However, no study has brought together lessons and experiences expressed in these various sources to serve as a guide for those interested in utilizing AR and VR in the museum environment.

A full history and analysis of AR and VR in the museum space could fill the pages of a journal or compose one, if not more, book-length volumes. What I propose is merely the beginning. In order to study a wide but manageable dimension of this use, I will focus primarily

on the nature and achievements of those experiments which have utilized handheld or wearable technology in the museum sector in the last decade. Though touched upon, the content of the AR and VR experiences will remain peripheral, giving way, instead, to an analysis of the theories and motivations that drive various collaborators to involve themselves in the creation and exhibition of these experiences.

This will be a practical look at the working relationships that develop between the collaborative entities. Many different people and institutions both inside and outside of the museum, all with unique motivations and needs, take part in AR and VR projects. A study examining the relationships between them and the challenges, benefits, and consequences of participating in AR and VR-related collaborations will help the various parties to better understand and work with one another to create a product that benefits all. In this study, I will be looking at the relationship between three groups: museum personnel, content creators including the sub-groups independent artists and corporate content creators, and technology developers.

Definitions

Before moving on to the analysis that forms the body of this paper, I must first define its two subjects: “augmented reality” and “virtual reality.” “Augmented reality” and ”virtual reality”have been defined in a variety of ways by different sources. For the purposes of this paper, I have focused only onparticular types of AR and VR and whittled down my definitions of the terms to match.

My definitions of these termsare structured by two dimensions: level of immersion and mode of access. Let us begin with “augmented reality.” For the purposes of this paper, I will define augmented reality (AR) as an experience in which a virtual world is superimposed over the physical world in such a way as to allow both to be visible at the same time. Often, the virtual

world is designed to interact with the physical one in some meaningful way, such as by providing context or information on a piece of architecture or painting, or helping an individual perform a task through the addition of data or diagrams to their field of vision. This is not the only possible definition of augmented reality. Two decades ago in a paper entitled "Augmented Reality: A Class of Displays on the Reality-Virtuality Continuum," Paul Milgram et al. grappled with the incongruous ways in which the term was being used and attempted to both distinguish AR from like technologies and give it its proper place amongst them.[1] One of the results was the *Reality-Virtuality (RV) Continuum*.[2] On one end lay the "real environment" and on the other, the "virtual environment."[3] The space in between was the realm of "mixed reality," an umbrella term that covered both "augmented reality" and "augmented virtuality."[4] Milgram et al. divided augmented reality into two categories, those accessed by "see-through" display and those accessed by "monitor."[5] Depending on the way in which the augmented reality experience was accessed, it could either be immersive or non-immersive.[6] Though augmented reality may still be accessed by HMD (head-mounted display), one type of "see-through" display, more often, augmented reality experiences are designed to make use of the screen of a smartphone or other portable device, unencumbered by a full headset. This has been referred to as the "magic lens" approach to augmented reality display.[7] In these experiences the user is never fully immersed in

[1] Paul Milgram et al., "Augmented Reality: A Class of Displays on the Reality-Virtuality Continuum," *SPIE* 2351 (1994): 283.
[2] Milgram et al. 283.
[3] Ibid.
[4] Ibid.
[5] Milgram et al. 284.
[6] Milgram et al. 284-285, 290.
[7] The term "magic lens" here is taken from a case study wherein this technique was used to provide visitors with AR content: T. Miyashita et al., "An Augmented Reality Museum Guide," *Proceedings of the 7th IEEE/ACM International Symposium on Mixed and Augmented Reality*, ISMAR '08 (IEEE International Symposium on Mixed and Augmented Reality, Washington, DC, USA: IEEE Computer Society, 2008), 103–6, doi:10.1109/ISMAR.2008.4637334.

a virtual world. It should be understood that "augmented reality" is only one method that can be applied to "augment" physical space, and the assertion that a space has been "augmented" with digital technology does not necessarily mean that "augmented reality" is in use. Rather than melding the physical and digital worlds together, virtual reality (VR) transports the viewer, in terms of sight and sound, into a virtual space, resulting in full immersion.[8] In his 1991 book, *Virtual Reality*, Howard Rheingold wrote:

> Imagine a wraparound television with three-dimensional programs, including three-dimensional sound, and solid objects that you can pick up and manipulate, even feel with your fingers and hands. Imagine immersing yourself in an artificial world and actively exploring it, rather than peering in at it from a fixed perspective through a flat screen in a movie theater, on a television set, or on a computer display. Imagine that you are the creator as well as the consumer of your artificial experience, with the power to use a gesture or word to remold the world you see and hear and feel. That part is not fiction. The head-mounted displays (HMDs) and three-dimensional computer graphics, input/output devices, computer models that constitute a VR system make it possible, today, to immerse yourself in an artificial world and to reach in and reshape it.[9]

Rheingold's description of the capabilities of virtual reality contains not only an understanding of the VR experience as immersive but also the expectation that users can interact with and even alter the virtual space. My definition of VR does not require a VR experience to be interactive in this way. Yet, the level of an experience's interactivity serves as the defining factor when determining which VR category I place it in this paper: 360 degree environment or VR film.[10]

HMDs currently being developed specifically to support augmented and mixed reality experiences are the Microsoft Hololens and the Magic Leap. "About Us: Company," *Magic Leap*, accessed November 28, 2015, http://www.magicleap.com/#/company., "Microsoft HoloLens: Commercial," *Microsoft*, accessed November 28, 2015, https://www.microsoft.com/microsoft-hololens/en-us/commercial.

[8] The rest of the senses: touch, smell, and taste, are left out of most VR experiences.
The definition provided in this passage follows closely on the one given by Milgram et al., "The commonly held view of a VR environment is one in which the participant-observer is totally immersed in a completely synthetic world, which may or may not mimic the properties of a real-world environment, either existing or fictional, but which may also exceed the bounds of physical reality by creating a world in which the physical laws governing gravity, time and material properties no longer hold." Milgram et al. 283.

[9] Howard Rheingold, *Virtual Reality* (New York: Summit Books, 1991): 16.

[10] While the degree of an experience's interactivity will be addressed in this paper, for the most part, I will refrain from an in-depth discussion of the input devices used to enable it.

These categories will be defined and described in the second chapter. In this paper, I will focus primarily on HMD-based virtual reality though VR can also be accessed in a dome or CAVE.[11] The term "virtual reality," as it is defined here, should not be applied to every virtual environment, only those that offer immersion.

Though for the most part I will focus on virtual and augmented reality devices and experiences designed in the last decade, head-mounted displays have been in development for over fifty years with one of the most famous early examples being Ivan Sutherland's "The Sword of Damocles," created in the 1960s.[12] Even then, his work was inspired by an existing HMD being developed by an airplane company.[13] Later in the 20th century, AR and VR was invited into the museum in the form of artworks created by such artists as Char Davies, Scott Fisher, and Jeffrey Shaw.[14] My emphasis on the contemporary wave of AR and VR technologies and projects is motivated by my intention to create an overview of the current landscape of relations

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[11] During its Virtual Reality Weekend, the British Museum offered its commissioned VR experience on an iPad as a flat 360 experience in addition to placing the experience in a dome and on a Samsung Gear HMD. In the dictionary, *3D A-to-Z*, Richard W. Kroon defines a CAVE as "an immersive virtual reality environment where the viewers stand within a box 10' on each side and 9' high. Stereograms are projected onto three walls (rear projection) and the floor (down projection) while the viewer wears wireless active eyewear." Richard W. Kroon, "CAVE," *3D A-to-Z: An Encyclopedic Dictionary* (Jefferson North Carolina: McFarland & Company, Inc., Publishers, 2012).,
The British Museum, "Virtual Reality Weekend at the British Museum," press release, 2015, http://www.britishmuseum.org/about_us/news_and_press/press_releases/2015/virtual_reality_weekend.aspx.

[12] In a talk at the Proto Awards, Ivan Sutherland noted that, at the time of development, he did not refer to "The Sword of Damocles" as a virtual reality device and that it was given that label only later. *Ivan Sutherland at Proto Awards 2015*, video (Proto Awards: Convrge VR, 2015), https://www.youtube.com/watch?v=R2BfcKxpB8U., Paul James, "Watch the 'Godfather of VR' Ivan Sutherland Speak at the 2015 Proto Awards," *Road to VR*, September 23, 2015, http://www.roadtovr.com/watch-the-godfather-of-vr-ivan-sutherland-speak-at-the-2015-proto-award.

[13] *Ivan Sutherland at Proto Awards 2015*, video .

[14] Information on the works of these artists and more can be found at: "Home," *Char Davies: Immersence*, accessed May 25, 2016, http://www.immersence.com/., Raphael Chau, "Home," *Jeffrey Shaw Compendium*, accessed May 25, 2016, http://www.jeffreyshawcompendium.com/.,
"Virtual Brewery Adventure," *Scott S Fisher - Portfolio of Work*, accessed May 25, 2016, http://itofisher.com/sfisher/portfolio/files/virtual_brewery.html.
. A small list of artists including Char Davies, Margaret Dolinsky, Monika Fleischmann, Wolfgang Strauss, Brenda Laurel, Rachel Strickland, Michael Naimark, Fabricators, Jeffrey Shaw, Teresa Wennberg, and Lawrence Paul Yuxweluptun, are included along with a brief description of their work in the 1. "Virtual Reality: Artists," *Digi-Arts: UNESCO Knowledge Portal*, accessed May 25, 2016, http://digitalarts.lmc.gatech.edu/unesco/vr/home.html. Documentation of some of their projects can be found at the Archive of Digital Art: "Home," *ADA: Archive of Digital Art*, accessed May 25, 2016, https://www.digitalartarchive.at/nc/home.html.

between technology developers, museums, and content creators and a guide to working within this environment. Nevertheless, as this thesis unfolds, I will return to earlier theories, technologies, and projects for the purpose of contextualization.

AR and VR in the Commercial Marketplace

The total immersion that virtual reality provides, though intriguing, can ultimately limit its usability. According to one report written in 2015, augmented reality is estimated to become a $120 billion market by 2020 with virtual reality lagging behind at $30 billion because AR supports a variety of activities that VR does not.[15] According to Tim Merel, the author of the 2015 report and Managing Director of Digi-Capital, a technology consulting firm, virtual reality will mainly be used for entertainment and by "niche enterprise users."[16] In contrast, augmented reality will have applications similar to those of a smartphone or other mobile device and support activities such as web browsing and communication in addition to gaming.[17] A 2016 report from Goldman Sachs predicts a slightly different future for these technologies: "At this stage, we have greater conviction in the relative success of VR versus AR given VR's technological progress and momentum, and the early formation of an ecosystem of vendors and partners."[18] However, the writers of this second report suggest that uses of augmented reality will grow with the

[15] A report from Heather Bellini et al. at Goldman Sachs does not separate augmented reality and virtual reality but predicts that by 2025, their combined industries could have a combined revenue between $23 billion and $182 billion. Tim Merel, "Augmented and Virtual Reality to Hit $150 Billion, Disrupting Mobile by 2020," *Tech Crunch*, April 6, 2015, http://techcrunch.com/2015/04/06/augmented-and-virtual-reality-to-hit-150-billion-by-2020/#.0c4cf1:R0vA., Heather Bellini et al., "Virtual and Augmented Reality: Understanding the Race for the Next Computing Platform," excerpt, Profiles in Innovation (Goldman Sachs Group, Inc., January 13, 2016), 4, http://www.goldmansachs.com/our-thinking/pages/technology-driving-innovation-folder/virtual-and-augmented-reality/report.pdf.
[16] Merel, "Augmented and Virtual Reality to Hit $150 Billion, Disrupting Mobile by 2020."
[17] Merel, "Augmented and Virtual Reality to Hit $150 Billion, Disrupting Mobile by 2020."
[18] Bellini et al. 5.

technology.[19] Given the variation between the predictions of the companies, it is difficult to say what the relative impacts of AR and VR will be on the commercial market.

When it comes to development, at least, virtual reality is moving faster than augmented reality. Several major consumer-level virtual reality devices were released in late 2015 and early 2016.[20] The Samsung Gear VR was made available for pre-order at the price of $99 in November 2015 and shipped to consumers the same month.[21] The Oculus Rift, backed by Facebook, began shipping pre-ordered headsets in March 2016 with a price of $599 for the headsets and an additional $900 for a high-end computer to support it.[22] Additionally, the HTC Vive was opened for pre-order in February 2016 at $799 and Playstation VR is now available for pre-order at $499.99 bundled with necessary controllers or $399.99 alone and will be fully released in October 2016.[23] Augmented reality head sets are making slower commercial progress. Magic Leap and HoloLens, the two most anticipated HMDs, have yet to receive a commercial release date. Yet, as mentioned previously, augmented reality can be accessed without a headset using the "magic lens" approach. This does not allow for the multitasking that augmented reality will ultimately be capable of supporting but it does mean that the consuming public can grow comfortable with AR even as the technology remains in the early stages of development.

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[19] Bellini et al. 5.
[20] Quinten Plummer, "The Real Reason Why Samsung Gear VR Headset Sold Out on Amazon and Best Buy: Price," *Tech Times*, November 23, 2015, http://www.techtimes.com/articles/109384/20151123/the-real-reason-why-samsung-gear-vr-headset-sold-out-on-amazon-and-best-buy-price.htm.
[21] The Oculus Team, "Samsung Gear VR Now Available For Pre-Orders at $99," *Oculus Blog*, November 10, 2015, https://www.oculus.com/blog/samsung-gear-vr-now-available-for-pre-orders-at-99.
[22] The Oculus Team, "Oculus Rift Is Shipping," *Oculus Blog*, March 28, 2016, https://www.oculus.com/blog/oculus-rift-is-shipping.,The Oculus Team, "Oculus Rift Pre-Orders Now Open, First Shipments March 28," *Oculus Blog*, January 6, 2016, https://www.oculus.com/blog/oculus-rift-pre-orders-now-open-first-shipments-march-28.
[23] HTC, "HTC and Valve Bring Virtual Reality to Life With Unveiling of Vive Consumer Edition," press release, February 29, 2016, https://www.htc.com/us/about/newsroom/2016/htc-and-valave-bring-virtual-reality-to-life/., "PlayStation VR," *Playstation*, accessed March 30, 2016, https://www.playstation.com/en-us/explore/playstation-vr/.

Many more museums have experimented with augmented reality than virtual reality. Yet, VR has been at the center of many more projects in the past year than AR has. This may be influenced by the growing accessibility of VR technology and the support technology development companies such as Google and Samsung are providing those museums willing to try something new.[24] AR and VR may both eventually be widely adopted into the museum environment but, once there, they are likely to be used for different purposes.

Chapters

In chapter one, I review a few key aspects of modern museum theory using Gail Anderson's "Reinventing the Museum Tool" as a guide and supplementing it with readings from *The Digital Museum: A Think Guide* edited by Herminia Din and Phyllis Hecht, *Digital Technologies and the Museum Experience: Handheld Guides and Other Media* edited by Loïc Tallon and Kevin Walker, and articles written by scholar, Erkki Huhtamo on the historical evolution and implications of virtual museums..[25] From these sources, I draw five key terms ("experience," "engagement," "expansion," "personalization," and "gaming") that represent convergence points between the visitor-centric ambitions of the modern museum and the

[24] *Cardboard App*, version 1.0.5, iOS (Google, Inc., 2015)., Sophie Charara, "What the British Museum's First VR Exhibit Means for Future School Trips," *Wareable*, August 4, 2015, http://www.wareable.com/vr/british-museum-samsung-gear-vr-headset-party-667.

[25] Erkki Huhtamo, "Museums, Interactivity, and the Tasks of 'Exhibition Anthropology,'" *The International Handbooks of Museum Studies: Museum Media*, ed. Michelle Henning (John Wiley and Sons, Ltd., 2015), 259–77., Erkki Huhtamo, "On the Origins of the Virtual Museum," *Virtual Museums and Public Understanding of Science and* Culture (Nobel Symposium (NS 120), Stockholm, Sweden, 2002)., Erkki Huhtamo, "Virtual Museums of Photography- Problems and Promises," SEPIA Conference (Helsinki, Finland, 2003)., Gail Anderson, "A Framework: Reinventing the Museum," *Reinventing the Museum: The Evolving Conversation on the Paradigm Shift*, 2nd ed., ed. Gail Anderson (Lanham, MD: AltaMira Press, 2012): 3-4, originally published in *Mission Museum Statements: Building a Distinct Identity* (American Association of Museums Technical Information Service, 1998)., Herminia Din and Phyllis Hecht, eds., *The Digital Museum: A Think Guide* (Washington, DC: American Association of Museums, 2007)., Loïc Tallon and Kevin Walker, eds., *Digital Technologies and the Museum Experience: Handheld Guides and Other Media* (Lanham, MD: AltaMira Press, 2008).

capabilities of AR and VR technologies and content. This chapter serves to place the following chapters in context.

In the second chapter, I provide a brief guide to the AR and VR-related projects museums and their collaborators have undertaken in the past decade. I broadly divide the experiences by whether they are augmented reality or virtual reality and then subdivide them by their use and purpose. For augmented reality, I follow a loose classification system already designed by Shelley Mannion, the Digital Learning Programmes Manager at the British Museum and her colleagues there.[26] This system identifies four types of augmented reality experiences: "outdoor guides and explorers," "interpretive mediation," "new media art and sculpture," and "virtual exhibitions." This system only applies to augmented reality so I devised a separate scheme for VR which divides the experiences into two categories: 360 degree environments and VR films. I also use this chapter to identify and define the five types of collaborators that work together to make AR and VR present in the museum: museum personnel, content creators (independent artists and corporate content creators), technology developers, museum visitors, and non-profit and government sponsors.

In the third chapter, I focus on the motivations and needs of three of the collaborative groups: museum personnel, content creators (independent artists and corporate content creators), and technology developers. For this portion of my thesis, I conducted interviews with two museum personnel and two members of each content creator subgroup: independent artists and corporate content creators. Before the interviews, I developed a general set of questions to be customized for each individual and sent my study materials for IRB approval. A board

[26]"Biography: Shelley Mannion," *Museums and the Web*, 2010, http://www.museumsandtheweb.com/mw2010/bios/au_395013213.html., Mannion, "British Museum- Augmented Reality Beyond the Hype."

representative deemed the study Certified Exempt. All passages quoting or paraphrasing interviewee responses have been approved by the interviewees. Instead of personally conducting interviews with technology developers who proved hard to reach, I turned to press releases and quotations from popular press articles. In analyzing these interviews and alternative sources, I identified words and topics that repeated both within and across collaborator groups such as "context," "engage," "expand," and subjects such as monetization vs. open-sourcing and technological expertise. I then used these words, topics, and subjects to further analyze, compare, and contrast the needs and motivations of the various collaborative parties so as to uncover the points of commonality likely to strengthen AR and VR projects and the points of divergence that must be carefully navigated to avoid creating rifts among the groups.

In chapter four, I address the ways in which augmented and virtual reality experiences may be preserved. The interviews predominantly addressed in the second chapter also included discussions on current efforts to preserve AR and VR content, both by the content creators themselves and other interested groups. Along with the interviews which provide a sense of the current state of AR and VR preservation, I looked to a guide published in 2002 by the Arts and Humanities Data Service in London entitled, *Creating and Using Virtual Reality: A Guide for the Arts and Humanities* and studies on similar materials such as digital art and virtual games for guidance in composing a list of potential preservation techniques.[27] These studies included publications by the Time-Based Media and Digital Art Working Group at the Smithsonian, Matters in Media Art, a collaboration between New Art Trust, the Museum of Modern Art, the San Francisco Museum of Modern Art, and Tate, and Preserving Virtual Worlds, a Library of

[27] Kate Fernie and Julian D. Richards, eds., *Creating and Using Virtual Reality: A Guide to Good Practice, AHDS Guides to Good Practice* (London: Arts and Humanities Data Service, 2002), http://www.vads.ac.uk/guides/vr_guide/index.html.

Congress-sponsored project that culminated in a published final report in 2010.[28] Ultimately, I identify five potential preservation methods for AR and VR experiences based on the findings of these studies: management, documentation, migration, emulation, and reinterpretation.

Conclusion

Within the theoretical and practical context of the museum as described in the first chapter, chapters two through four address the entire lifetime of augmented and virtual reality experiences in the museum from a concept and idea in the second chapter, to a defined and working project in the third, to a preserved artwork or asset in the fourth. Augmented and virtual reality have the potential to dramatically alter museum space in a way that has a positive impact on both the institution and its visitors. However, as the technologies develop and more museums try their hand at utilizing them, museum personnel and their collaborators must have a path to follow. This thesis will provide, if not a clear path, at least a set of branching trails to navigate amongst.

[28] "About: The Smithsonian's Time-Based Media and Digital Art Working Group," *Smithsonian*, accessed November 16, 2015, http://www.si.edu/tbma/about., Jerome P. McDonough et al., "Preserving Virtual Worlds Final Report" (Library of Congress, August 31, 2010), http://hdl.handle.net/2142/17097., "Matters in Media Art," *Tate*, accessed November 16, 2015, http://www.tate.org.uk/about/projects/matters-media-art.

Chapter 1

The Museological Perspective

Though this thesis will revolve around the use of augmented and virtual reality technologies in the museum, it would be remiss of me not to begin with a short explanation of current trends in museum theory and practice. Only by looking at AR and VR within this context will it be possible to understand the ways in which these technologies might support and enhance museum practices or, alternatively, threaten them.

In this chapter, I turn to the publications, *Reinventing the Museum: The Evolving Conversation on the Paradigm Shift* edited by Gail Anderson, *Digital Technologies and the Museum Experience: Handheld Guides and Other Media* edited by Loïc Tallon and Kevin Walker, and *The Digital Museum: A Think Guide* edited by Herminia Din and Phyllis Hecht for an explanation and summary of recent museum theory as it relates to the definition of museums and the integration of digital technology.[29] Erkki Huhtamo's work on the concept and practice of the "virtual museum" will be also be addressed in this chapter, serving as a reminder that museums are no strangers to the virtualization of their space.[30]

Gail Anderson's "Reinventing the Museum Tool"

[29] Gail Anderson, ed., *Reinventing the Museum: The Evolving Conversation on the Paradigm Shift*, 2nd ed. (Lanham, MD: AltaMira Press, 2012)., Herminia Din and Phyllis Hecht, eds., *The Digital Museum: A Think Guide* (Washington, DC: American Association of Museums, 2007)., Loïc Tallon and Kevin Walker, eds., *Digital Technologies and the Museum Experience: Handheld Guides and Other Media* (Lanham, MD: AltaMira Press, 2008).

[30] Erkki Huhtamo, "Museums, Interactivity, and the Tasks of 'Exhibition Anthropology,'" *The International Handbooks of Museum Studies: Museum Media*, ed. Michelle Henning (John Wiley and Sons, Ltd., 2015), 259–77., Erkki Huhtamo, "On the Origins of the Virtual Museum," *Virtual Museums and Public Understanding of Science and* Culture (Nobel Symposium (NS 120), Stockholm, Sweden, 2002)., Erkki Huhtamo, "Virtual Museums of Photography- Problems and Promises," SEPIA Conference (Helsinki, Finland, 2003).

In her introduction to *Reinventing the Museum: The Evolving Conversation on the Paradigm Shift*, Gail Anderson detailed the nature of the so-called "paradigm shift" in museum theory by way of the "Reinventing the Museum Tool", a chart that juxtaposes features of a "traditional museum" with those of a "reinvented museum."[31] The features on the "reinvented museum" side of the chart are suggestive of a visitor-centric, open, flexible, evolving, and community-minded institution whereas the features on the "traditional museum" side are indicative of a collection-centric, closed, rigid, stagnant, and authoritarian one. Anderson wrote:

> The centrality of the public, learning, and civic engagement embody some of the most significant shifts in institutional values for museums. Collections---historically viewed as the center of museum activities---have moved to a supporting role that advances the educational impact of the museum. The collection holdings are no longer viewed as the sole measure of value for a museum; rather, the relevant and effective role of the museum in service to its public has become the central measure of value.[32]

In her role as editor, Anderson included parts one and two of John Cotton Dana's, "The Gloom of the Museum"(1917), originally published as the second book in the *New Museum Series*, in *Reinventing the Museum*.[33] This work, written approximately 80 years prior to Anderson's "Reinventing the Museum Tool," also embraces a visitor-centric understanding of what a museum should be.[34] While Dana's text reflects the paternalism and authoritarianism of Anderson's "traditional museum," he did suggest that museum collections should be of "use" to their surrounding communities.[35] Thus, the idea of putting the public first is in no way

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[31] Gail Anderson, "A Framework: Reinventing the Museum," *Reinventing the Museum: The Evolving Conversation on the Paradigm Shift*, 2nd ed., ed. Gail Anderson (Lanham, MD: AltaMira Press, 2012): 3-4, originally published in *Mission Museum Statements: Building a Distinct Identity* (American Association of Museums Technical Information Service, 1998).
[32] Anderson 5.
[33] John Cotton Dana, "The Gloom of the Museum," *Reinventing the Museum: The Evolving Conversation on the Paradigm Shift*, 2nd ed., ed. Gail Anderson (Lanham, MD: AltaMira Press, 2012): 17, 25, originally published as the second book of the *New Museum Series* (Woodstock, Vermont: The ElmTree Press, 1917).
[34] Dana 30.
[35] Dana 17.

revolutionary. However, it is still important to keep in mind as it forms the foundation upon which many digital-technology-related endeavors are undertaken in museums.

In the following sections, I will look at the terms "experience," "engagement," "expansion," "personalization," and "gaming" as they are used time and again in the three publications *Reinventing the Museum*, *The Digital Museum*, and *Digital Technologies and the Museum Experience* in order to lay the groundwork for the connections I will draw in the following chapters between AR/VR technologies and the digitally-inquisitive museum theory present in these texts.

Experience

"Experience" is generally used in these texts as a broad term pertaining to a multi-sensory understanding of the museum environment that a visitor obtains from entering and interacting with it. In his article, "The Exploded Museum," Peter Samus rephrased the visitor-centric versus collection centric narrative with the passage, "The museum is the sum not of the objects it contains but rather of the experiences it triggers."[36] In their article, "Immersive Media: Creating Theatrical Storytelling Experiences," Michael Mouw and Daniel Spock connected experience to emotion:

> In this sense, museums are most effective when they take the experiential qualities one tends to associate with theater and fiction (as opposed to, say, the classroom): an experience of other people's dramas and dilemmas, those not necessarily rational but certainly universal aspects of the human experience.[37]

[36] Peter Samis, "The Exploded Museum," *Digital Technologies and the Museum Experience: Handheld Guides and Other Media*, ed. Loïc Tallon and Kevin Walker (Lanham, MD: AltaMira Press, 2008): 4.
[37] Michael Mouw and Daniel Spock, "Immersive Media: Creating Theatrical Storytelling Experiences," *The Digital Museum: A Think Guide*, ed. Herminia Din and Phyllis Hecht (Washington, DC: American Association of Museums, 2007): 47.

The term "experience" is also used frequently in discourse on virtual reality and augmented reality to refer to otherwise difficult to classify content that does not fit well within the categories of games or films.[38] Yet, as we shall see in the coming chapters, VR content and technology is often designed to elicit an emotional reaction such that it may be said to generate an "experience" as defined by Mouw and Spock for those who watch and/or interact with it.

AR and VR are not the only forms of digital technology that can be used to generate complex and rewarding experiences for museum visitors and communities. In the "Foreword" to *Digital Technologies and the Museum Experience*, James M. Bradburne wrote:

> Digital technologies and the Museum Experience explores the ways in which mobile devices and digital technology can be used to enhance and transform the visitor's experience of the museum, and looks at the technologies that can extend the museum's ability to invest the world with meaning beyond its own walls, by inviting visitors themselves to contribute to the museum's meaning-making activities.[39]

Not only does Bradburne's passage further the visitor-centric, experience-based museum theory described in the last two sections, it adds another component: visitor participation.

E**ngagement**

Visitor participation is one of several factors of "engagement." In its broadest sense, "engagement" may refer to the degree to which visitors interact on any level with a museum and its content. Ben Gammon and Alexandra Burch seemed to be using the term in this generalized way in the following passage from "Designing Mobile Digital Experiences": "While some studies indicate that digital technology can be a distraction, there is considerable counterevidence

[38] In his book, *Virtual Reality*, Howard Rheingold writes, "At the heart of VR is an *experience*- the experience of being in a virtual world or a remote location- and the problems inherent in creating artificial experiences are older than computers." Howard Rheingold, *Virtual Reality* (New York: Summit Books, 1991): 46.
[39] James M. Bradburne, Foreword, *Digital Technologies and the Museum Experience: Handheld Guides and Other Media*, ed. Loïc Tallon and Kevin Walker (Lanham, MD: AltaMira Press, 2008): ix.

that when it is properly designed, it can actually increase visitor's engagement with other exhibits."[40]

However, one of the most complex forms of engagement that digital technology, in general, and AR and VR, in particular, can offer museum visitors is the ability to participate in the curatorial and artistic practices of the museum. Bradburne referenced this form of engagement in the passage, "Communication tools such as the iPod and Web-enabled mobile phones, which let users augment gallery visits with off-site 'unauthorized' video and audio content, mean the museum spaces are being opened—willingly or not—to voices other than those of the curators."[41] Similarly, in "The Whole World in Their Hands: The Promise and Peril of Visitor-Provided Mobile Devices," Robin Dowden and Scott Sayre wrote:

> The foreseeable significance of this emerging hybrid, personalized, mobile, location-aware device on museum practice cannot be overstated. The hybrid mobile device will defy physical and institutional boundaries, redefine authoritarian sources and practices and forge new communities with or without the museum community's support.[42]

Though neither Bradburne or Dowden and Sayre specifically mentioned augmented reality apps, augmented reality applications allow for a similar redistribution of roles wherein visitors can become either curator or artist or both.

As museums begin to embrace mobile technologies' interactive potential, however, Erkki Huhtamo warns against interactivity without purpose. He wrote the following passage in response to his experience at a museum full of interactive exhibits:

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[40] Ben Gammon and Alexandra Burch, "Designing Mobile Digital Experiences," *Digital Technologies and the Museum Experience: Handheld Guides and Other Media*, ed. Loïc Tallon and Kevin Walker (Lanham, MD: AltaMira Press, 2008): 41.

[41] This is one case where the word "augment" does not refer exclusively to the use of "augmented reality." Bradburne x.

[42] Robin Dowden and Scott Sayre, "The Whole World in Their Hands: The Promise and Peril of Visitor-Provided Mobile Devices," *The Digital Museum: A Think Guide*, ed. Herminia Din and Phyllis Hecht (Washington, DC: American Association of Museums, 2007): 35.

> Any exhibit with something to click, pull, or rotate drew hands like a magnet, but normally the experience both started and ended there. It was as if there had been nothing at all to be gained beyond the momentary acts of punching and tapping, pushing and pulling. The user interface had become The Thing, instead of serving as a gateway to more cerebral pleasures and discoveries (as I believe it is supposed to do).[43]

Later in the same article he wrote, "It is becoming clear that an interactive relationship between a human, an artifact, and (often but not always) other humans does not guarantee the quality of the experience."[44] In another article, he asked, "How important is user interaction? Wouldn't it be good to try to do without it, at least sometimes? What would be the consequences of non-interactive virtual museum design?"[45] Thus, Huhtamo's work serves to moderate the celebration of digital technology's interactive potential as expressed in the previous works addressed in this section, reminding his readers that, though the realm of what is possible may be growing, museum personnel must remain attentive to the smaller territory that lies within it representing what should be done.

As we shall see, not all virtual and augmented reality experiences provide for the same amount of interactivity. For some of them, interaction is limited to the simple act of turning ones' head and looking around. In others, the method of interaction is more unique and complex. In the works *Osmose* and *Ephémère*, created by Char Davies in 1995 and 1998 respectively, the user navigates through the virtual worlds using a "breathing interface" that allows them to control

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[43] Erkki Huhtamo, "Museums, Interactivity, and the Tasks of 'Exhibition Anthropology,'" *The International Handbooks of Museum Studies: Museum Media*, ed. Michelle Henning (John Wiley and Sons, Ltd., 2015): 260.
[44] One specific concern Huhtamo expresses about interactivity has less to do with how it is facilitated in the museum than with how it is used outside of it. He argues that the interactivity visitors have come to expect in their lives outside of the museum, leads them to be confused in the museum setting which includes restrictions, particularly where touching is concerned. Huhtamo, "Museums, Interactivity, and the Tasks of 'Exhibition Anthropology,'" 261-263.
[45] Erkki Huhtamo, "On the Origins of the Virtual Museum," *Virtual Museums and Public Understanding of Science and Culture* (Nobel Symposium (NS 120), Stockholm, Sweden, 2002): 14.

their movement by breathing in and out.[46] As we shall see in the next chapter, sometimes user interaction helps to generate the content of the experience itself, particularly for augmented reality.

Expansion

Connected to a museum's interest in working for and with their community is the idea that museum educational initiatives and offerings should reach beyond the physical museum. Gail Anderson wrote, "Public engagement is on site, off site, and online and is defined and created where people decide to make it happen."[47] This idea also appears in John Cotton Dana's "The Gloom of the Museum:"

> Museums of the future will not only teach at home, they will travel abroad through their photographs, their textbooks, and their periodicals. Books, leaflets, and journals---which will assist and supplement the work of teachers and will accompany, explain, and amplify the exhibits which art museums will send out---will all help to make museum expenditures seem worthwhile.[48]

Of course, digital books, leaflets, and journals are now available online. Yet, what Dana may have been unable to predict nearly a hundred years ago is the variety and complexity of the content that can now be shared in an instant with people all over the world. With VR, it is even possible to visit a museum gallery without ever leaving home.[49]

As the word "expansion" implies, efforts by museum personnel to increase the reach of their institution's influence beyond the building that holds its physical assets and exhibits do not

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[46] Char Davies, "Virtual Space," *Space: In Science, Art and Society*, ed. François Penz, Gregory Radick, and Robert Howell (Cambridge University Press, 2004), 68-83, https://books.google.com/books?id=nzbuV_WWS5EC. Full text accessed at: www.immersence.com, May 17, 2016.
[47] Anderson 9.
[48] Dana 30.
[49] The ability to bring artwork and even galleries home from a museum does not originate with modern virtual reality experiences. In his article, "On the Origins of the Virtual Museum," Huhtamo describes several predecessors to the virtual-reality-based virtual gallery including virtual museum CD-ROMs from the 1990s and the work of artists Frederick Kiesler and László Moholy-Nagy. Huhtamo, "On the Origins of the Virtual Museum," 3, 10-11.

simply add to the list of activities museums already engage in, it changes the definition of the institution itself. In "The Exploded Museum," Peter Samis writes, "In a technological world, the museum visit no longer begins when a person enters the building, nor need it end when she or he leaves. The museum's physical space is but one site—albeit a privileged one—in the continuum of the visitor's imaginative universe."[50] The redefinition of the museum in terms of its space has functioned as the goal, inspiration, or, alternatively, bedrock for the generation of museum-related AR and VR content as we shall see in chapter three.

Personalization

With engagement, comes the demand for personalization. In their article, "Enhancing Visitor Interaction and Learning with Mobile Technologies," John H. Falk and Lynn D. Dierking presented a "Contextual Model of Learning" that identified three types of context that influence a visitor's "meaning making" in a museum.[51] The first among them is "personal."[52] Given the visitor-centric nature of modern museum theory and the understanding of museum visitors as diverse individuals reflected in Falk and Dierking's article, it is unsurprising that the ability of digital technology to support "personalization" is deemed an asset for museums.[53]

Personalization need not be completed by museum personnel but should at least be facilitated by them. Bradburne writes, "These days, the motivated visitor can arguably reconfigure a gallery visit to meet his or her own specific needs—with or without the museum's

[50] Samis 3.
[51] John H. Falk and Lynn D. Dierking, "Enhancing Visitor Interaction and Learning with Mobile Technologies," *Digital Technologies and the Museum Experience: Handheld Guides and Other Media*, ed. Loïc Tallon and Kevin Walker (Lanham, MD: AltaMira Press, 2008): 21.
[52] Ibid.
[53] Falk and Dierking 28., Loïc Tallon, "Introduction: Mobile, Digital, and Personal," *Digital Technologies and the Museum Experience: Handheld Guides and Other Media*, ed. Loïc Tallon and Kevin Walker (Lanham, MD: AltaMira Press, 2008): xviii.

help."[54] Thus, Bradburne argues that visitors do not require the assistance of museums to personalize their own experiences. Yet, Gammon, Burch, and Tallon, all stress the value of using digital technology for the purposes of personalization.[55] This suggests that there are people working in the museum field, these scholars included, who are eager to take an active role in the process of personalization even if it is unnecessary for some visitors. Moreover, by participating in this process, they are also able to direct it to support and grow the relationship between visitor and museum. In the following chapters, I will analyze the ways in which museums have dealt with AR and the opportunity it provides visitors and artists alike to personalize their museum experience and the museum space itself.

Gaming

Finally, gaming was mentioned in several of the articles referenced in this chapter. In Gammon and Burch's "Designing Mobile Digital Experiences," the authors wrote, "Digital technology also allows museum visitors to engage in gameplay and exploration of experiences that would be impossible to replicate in the real world because such experiences are too small, too large, too slow, to fast, or too expensive."[56] In speaking of engagement, Bradburne wrote, "The museum ideal is visitor engagement—but this means more than the self-sustained activity of a hamster on a treadmill; it is self-absorbed concentration in which users direct their own learning."[57] He likens this type of concentration to that generated by computer games. These scholars are not necessarily arguing that actual games be brought into the museum, but instead, are suggesting that museums aim to create the level of engagement for their visitors that games

[54] This passage directly follows the one on mobile technology and alternative voices included in the above section on engagement: "Communication tools such as the iPod and Web-enabled mobile phones, which let users augment gallery spaces are being opened—willingly or not—to voices other than those of the curators." Bradburne x.
[55] Gammon and Burch 37., Tallon xviii.
[56] Gammon and Burch 36.
[57] Bradburne xi.

offer their players. Virtual reality is well positioned to act in this way as it has strong ties to the gaming industry. In Bellini et al.'s Goldman Sachs report, the authors predicted that the videogame revenue for VR will be around $11.6 billion in 2025 with none of their other use cases such as live events, video entertainment, or retail reaching anywhere near those numbers.[58] Similarly, in his article, "Augmented and Virtual Reality to Hit $150 Billion, Disrupting Mobile by 2020," Tim Merel of Digi-Capitalist included a pie-chart in which VR games make up nearly half of the $30 billion industry he predicts VR will be in 2020.[59]

Conclusion

As AR and VR enter the museum, they are incorporated into an evolving ecosystem of museum theory, museum practice, public, and technology. The terms "experience," "engagement," "expansion," "personalization," and "gaming," all serve to represent the convergence points their entrance will form with the existing entities in that ecosystem. As such, these terms will be utilized in the coming chapters to address the ways in which AR and VR have been and might be used in the museum space and how they are perceived by the museum personnel, content creators, and technology developers that put them there.

[58] Heather Bellini et al., "Virtual and Augmented Reality: Understanding the Race for the Next Computing Platform," excerpt, Profiles in Innovation (Goldman Sachs Group, Inc., January 13, 2016): 16-18, http://www.goldmansachs.com/our-thinking/pages/technology-driving-innovation-folder/virtual-and-augmented-reality/report.pdf.
[59] Tim Merel, "Augmented and Virtual Reality to Hit $150 Billion, Disrupting Mobile by 2020," *Tech Crunch*, April 6, 2015, http://techcrunch.com/2015/04/06/augmented-and-virtual-reality-to-hit-150-billion-by-2020/#.0c4cf1:R0vA.

Chapter 2

Invasions and Revolutions: AR and VR in the Museum

Though wearable augmented reality (AR) HMDs are still in the development stage and wearable virtual reality (VR) devices are only beginning to enter the consumer market, AR and VR content has already begun to appear in the museum space. Accounts of these projects can be found in institutional blogs, papers and presentations from scholarly journals and conferences such as Museums and the Web, and on the digital pages of the popular press. Institutions such as the British Museum, the Los Angeles County Museum of Art, the Victoria and Albert Museum, the Museum of Modern Art in New York, and the Stedelijk Museum in Amsterdam have left behind traces of multiple augmented and/or virtual reality endeavors. Others such as the Museum of London and the Natural History Museum in London were early adopters of AR and VR and their projects, though scarce in recent years, served as inspiration for the other institutions named above.

The augmented and virtual reality experiences that museums have engaged with in the past have been designed for multiple purposes and used in a variety of ways to support or, in some cases, challenge the institution. They are often produced by collaborations between several of five parties: museum personnel, content creators, technology developers, visitors, and non-profit and government agencies. In this chapter, I will define the boundaries between the various functions of augmented and virtual reality experiences as well as the collaborations that make them possible.

Scope

In an introductory chapter to *Museums in a Digital Age*, Ross Parry wrote, "the reality for anyone working in digital heritage is of an evidence and literature base that is complex,

diversified and distributed, with relevant content available through multiple channels, on varied media, within myriad locations, and different genres of writing."[60] He partially attributes this to "the diverse professional roles and identities of the people who engage with the subject, and not least what each of them choose to call it."[61] A study of virtual and augmented reality faces some of the same challenges. Like that of digital heritage, the study of AR and VR is further complicated by a lack of standard terminology.[62] Advances in and experiments with these technologies tend to be reported in popular and informal sources such as blogs and industry-specific reporting sites, making it difficult to pinpoint exactly how much use museums throughout the world have made of AR and VR and to discern any trends in this use. After all, if museums create or sponsor the creation of AR and VR experiences without publishing a scholarly paper, writing a blog post on a stable website, or building a marketing campaign strong and broad enough to draw in major news sources, their projects disappear from the web-searchable record. Thus, this analysis of prior augmented and virtual reality use in the museum must be read with the understanding that it is based upon a survey of only the most broadly published or otherwise visible projects. I found these projects primarily by searching the Museums and the Web database and Google Scholar. Additionally, I conducted wider internet searches using the Google search engine. My search terms generally incorporated the words "augmented" or "virtual", "reality", and "museums." Once I identified a relevant source, I then conducted more tailored searches based on the information supplied. Often this meant visiting the website of the museums, companies, and artists involved in AR and VR projects. This

[60] Ross Parry, "The Practice of Digital Heritage and the Heritage of Digital Practice," *Museums in a Digital Age*, ed. Ross Parry, Leicester Readers in Museum Studies (London: Routledge, 2010), 1–7.
[61] Parry 3.
[62] Parry 4.

method ensured that I gained an understanding of the most influential projects and the relationships that exist between them.

Museums could be using these technologies in a completely different way than detailed here, but it is those projects that are published on a page, whether virtual or physical, that will be addressed in this thesis. Thus, rather than serving as a comprehensive summary of past endeavors, this chapter should be read as a challenge to other institutions, large and small, with different experiences, to jump into the fray, to publish, and to create new ways of using augmented and virtual reality while minds are still open and the technology is still new.

With these parameters in mind, let us begin with a look at the use of augmented reality in the museum.

Augmented Reality

Though artists have been making augmented reality artworks for decades, we begin our narrative of augmented reality in the museum in the first decade of the 21st century.[63] Experiences in this time period began utilizing the mobile devices that revolutionized the portability and scope of augmented reality.[64] They are also the ones to which museum personnel such as Margriet Shavemaker et al. of the Stedelijk Museum and Shelley Mannion of the British Museum refer when contextualizing their own museum's augmented reality experiences.[65] Two

[63] In the 1975 work *Viewpoint* created by Jeffrey Shaw and Theo Botschuijver, an augmented reality experience was created using "a large projection screen and an optical viewing console with an automated pair of slide projectors." Thus, while technology such as iPhones and iPads make augmented reality easier to access, analog equipment can be used to similar effect. Raphael Chau, "Viewpoint," Jeffrey Shaw Compendium, accessed May 25, 2016, http://www.jeffreyshawcompendium.com/portfolio/viewpoint/.

[64] Marisa Gómez, author of the article, "Augmented Archives: The Museum in the City or the City as Museum," identifies 2006 as the year AR "hit the mass market." Marisa Gómez, "Augmented Archives: The Museum in the City or the City as Museum," *Interartive*, accessed October 12, 2015, http://interartive.org/2014/09/augmented-archives/, originally published in *VV.AA. Innovaciones Artísticas y Nuevos Medios: Conservación, Redes y Tecnociencia* (Barcelona: Universitat de Barcelona, 2013), ISBN: 978-84-695-9407-0.

[65] M. Shavemaker et al., "Augmented Reality and the Museum Experience." *MW 2011: Museums and the Web 2011*, Philadelphia, Pennsylvania, 2011, http://museumsandtheweb.com/mw2011/papers/augmented_reality_and_the_museum_eperience., Shelley Mannion,

of these experiences are Hugo Barroso's installation *Pret-a-Porte*, exhibited at the National Centre for the Arts in Mexico City in 2005 and the experience *Mirror, Mirror* commissioned by the Victoria and Albert Museum in 2009.[66] Both provided visitors with the opportunity to see themselves wearing objects from or inspired by the museum's collection.[67] Two other examples are a Layar-based [an augmented-reality browser] AR tour of Sydney, Australia developed for the Powerhouse Museum by the company Mob-Labs in 2009 and a joint project between the DNP (Dai Nippon Printing Co., Ltd.) and the Louvre in 2008 which used augmented reality as a "guidance system" for an exhibition. [68]

One year before the Powerhouse Museum's AR tour was developed, Apple announced the release of its first iPhone.[69] The invention of the smartphone has had a deep impact on the development of both AR and VR.[70] Two of the most widely available VR devices, the Samsung Gear VR and the open-source Google Cardboard, make use of smartphones as central

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"British Museum-Augmented Reality: Beyond the Hype," *Ideas (blog), Museum-iD*, accessed September 26, 2015, http://museum-id.com/idea-detail.asp?id=336.

[66] Mannion, "British Museum-Augmented Reality: Beyond the Hype," *Ideas (blog).*

[67] Ibid.

[68] Layar is an augmented reality browser packaged in a smartphone application. For information on DNP see: "Home," *DNP: Dai Nippon Printing Col., Ltd.,* accessed February 4, 2016, http://www.dnp.co.jp/eng/. "Layar: Augmented Reality Browsing of Powerhouse Museum Around Sydney," *Powerhouse Museum*, accessed March 31, 2016, http://www.powerhousemuseum.com/layar/., Shelley Mannion, "British Museum-Augmented Reality: Beyond the Hype.," T. Miyashita et al., "An Augmented Reality Museum Guide," *Proceedings of the 7th IEEE/ACM International Symposium on Mixed and Augmented Reality*, ISMAR '08 (IEEE International Symposium on Mixed and Augmented Reality, Washington, DC, USA: IEEE Computer Society, 2008): 103–6, doi:10.1109/ISMAR.2008.4637334.

[69] The press release for Apple's first iPhone is dated January 9, 2007. Apple, "Apple Reinvents the Phone with iPhone," press release, January 9, 2007, http://www.apple.com/pr/library/2007/01/09Apple-Reinvents-the-Phone-with-iPhone.html.

[70] Though the smartphone has facilitated the proliferation of augmented reality experiences, the birth of AR occurred much earlier than the birth of the smartphone. In their article, "Pure Land: Futures for Embodied Museography," Kenderdine et al. locate the origin of augmented reality to Ivan Sutherland's work in the 1960s. Sarah Kenderdine, Leith K. Y. Chan, and Jeffrey Shaw, "*Pure Land*: Futures for Embodied Museography," *Journal of Computing and Cultural Heritage* 7, no. 2 (June 2014): 8:5, doi:10.1145/2614567.

components in their designs.[71] Similarly, augmented reality experiences are usually developed to be viewed on iPhone, iPad, or other smartphone screens and make use of the devices' cameras.

Three years after the release of the iPhone and five years after Barroso's installation, 2010 became a year of popularity for AR. Two examples of projects undertaken in this year are the Museum of London's *Streetmuseum* and the Netherlands Architecture Institute Museum's *UAR* (*Urban Augmented Reality*).[72] Both projects comprised smartphone and tablet applications that used GPS to place digital representations of historical images from the museums' collections around the city.[73] Another example is the Stedelijk Museum's *ARtours* which, while inspired by *Streetmuseum* and *UAR*, was composed of several projects that utilized AR both within and outside of the museum space, in some cases as a way to display existing artwork in new locations and, in others, as a canvas for new works.[74] *WE AR in MOMA*, an augmented reality "intervention" at the Museum of Modern Art in New York, also took place in this year and will be described and analyzed along with other works planned by the artists' collective, Manifest.AR later in this chapter.[75]

An AR Taxonomy

[71] Among other VR head-mounted displays, the Samsung Gear at $99 and the open-source Google Cardboard are the most affordable. Cade Metz, "The Inside Story of Google's Bizarre Plunge Into VR," *WIRED*, June 1, 2015, http://www.wired.com/2015/06/inside-story-googles-unlikely-leap-cardboard-vr/., The Oculus Team, "Samsung Gear VR Now Available For Pre-Orders at $99," *Oculus Blog*, November 10, 2015, https://www.oculus.com/blog/samsung-gear-vr-now-available-for-pre-orders-at-99.
[72] Gómez, "Augmented Archives: The Museum in the City or the City as Museum., Shavemaker et al., "Augmented Reality and the Museum Experience," *MW2011: Museums and the Web 2011*, Philadelphia, Pennsylvania, 2011, http://museumsandtheweb.com/mw2011/papers/augmented_reality_and_the_museum_experience., "Streetmuseum," *Museum of London*, accessed February 4, 2016, http://www.museumoflondon.org.uk/Resources/app/you-are-here-app/home.html.
[73] Ibid.
[74] M Shavemaker et al., "Augmented Reality and the Museum Experience."
[75] John C. Freeman, "ManifestAR: An Augmented Reality Manifesto," *John Craig Freeman*, January 24, 2012, https://johncraigfreeman.wordpress.com/manifestar-an-augmented-reality-manifesto/.

When exploring the history and scope of augmented reality in the museum, it is useful to begin with an established set of categories like the ones identified in the article, "British Museum-Augmented Reality: Beyond the Hype," written by Shelley Mannion, the Digital Learning Programmes Manager at the British Museum.[76] In this article, Mannion described the history of augmented reality at the British Museum and identified 2011 as the year in which the museum began experimenting with this technology in earnest.[77] In preparation for the museum's early AR projects, Mannion wrote that her team developed four categories to encompass the augmented reality projects that had been conducted by other institutions and artists.[78] These categories are: "outdoor guides and explorers," "interpretive mediation," "new media art and sculpture," and "virtual exhibitions."[79] Of the projects from 2010 and earlier listed above, she places *Around Sydney* and *Streetmuseum* in the first category, *Mirror, Mirror* in the second, and *We AR in MOMA* in the third and fourth.[80] These categories will be defined and analyzed in the following passages. However, it is important first to understand that the categories Mannion and her team identified were always flawed artificial constructions. Mannion acknowledged that the classification system is not perfect.[81] She wrote, "the more projects we did the less clear these categories became."[82]

[76]"Biography: Shelley Mannion," *Museums and the Web*, 2010, http://www.museumsandtheweb.com/mw2010/bios/au_395013213.html., Mannion, "British Museum- Augmented Reality Beyond the Hype."
[77] This effort was undertaken by the museum's "digital learning team." Mannion, "British Museum- Augmented Reality Beyond the Hype."
[78] Ibid.
[79] Ibid.
[80] *Around Sydney* seems to refer to the Powerhouse Museum's project mentioned above, though the project page on the Powerhouse Museum's website does not bear this name. "Layar: Augmented Reality Browsing of Powerhouse Museum Around Sydney," *Powerhouse Museum*.
[81] Mannion, "British Museum- Augmented Reality Beyond the Hype."
[82] Ibid.

Yet, Mannion and her colleagues at the British Museum were not the only ones to make distinctions between different types of augmented reality use. In their article, "Augmented Reality and the Museum Experience," Margriet Shavemaker (Manager of Education, Interpretation and Publications at the Stedelijk Museum) et al. single out what Mannion would have called "outdoor guides and explorers" as the inspiration for *ARtours*.[83] At the time when *UAR* was being planned, the appeal of AR for Shavemaker et al. lay in its ability to expand the museum beyond its physical walls and place it in "dialogue" with the surrounding urban environment. Shavemaker et al. wrote:

> Utilizing AR on smartphones seemed particularly interesting, as the Stedelijk Museum, for years homeless due to a renovation of its original premises and the construction of a new wing, has been drifting from one location to another in the city of Amsterdam. The new dialogues this generated with the urban realm, the people in the street and various Amsterdam cultural institutions proved to be very powerful and inspiring- and essential to continue.[84]

Just as Mannion's category designation "outdoor guides and explorers," implies, the projects that Mannion and Shavemaker et al. were referring to are meant to be used outside of the museum and use GPS to place digitized-versions of a museum's historic or artistic collection in relevant areas of the city i.e. a historical photograph may appear in the spot in which it was taken, temporarily replacing, on the smartphone's screen, the contemporary scene with one from the past.[85] The Museum of London's webpage devoted to *Streetmuseum* reads, "Hold your camera

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[83] Shavemaker et al., "Augmented Reality and the Museum Experience.," "A Short Biography," *Margriet Shavemaker*, accessed April 2, 2016, http://www.margrietschavemaker.nl/biography/.

[84] The San Francisco Museum of Art also experimented with AR during a period of physical transformation. At the San Francisco Museum of Modern Art this took the form of *SF MOMA AR Expansion*, an augmented reality artwork created by two members of the group Manifest.AR, John Craig Freeman and Will Pappenheimer, that foreshadowed the physical expansion that was just beginning. Will Pappenheimer, "SFMOMA AR Expansion," *Willpap Projects*, accessed February 4, 2016, http://www.willpap-projects.com/SFMOMA_AR/SFMOMA_AR.html., Shavemaker et al., "Augmented Reality and the Museum Experience."

[85] The artists Janet Cardiff and George Bures Miller have created several augmented reality works that, like these applications, utilize smartphones and other mobile technologies to place content around cities and other locations. In 2014, they created *The City of Forking Paths* which utilized an iPod touch as a display device for a tour complete with audio and visual content around locations in Sydney, Australia. A description of the experience reads, "Against

up to the present day street scene and see the same London location appear on your screen, offering you a window through time."[86] Augmented reality experiences in this category often share other features including an assumption that many people own smartphones capable of relaying the experience and that they are willing to download an application. Perhaps one of the greatest assumptions, however, is that residents of the museums' communities have an interest in relating to their museums and their cities in this way.

The next of Mannion's categories is "interpretive mediation," by which she seemed to mean the use of augmented reality to permit museum patrons to interact with museum objects, not in new spaces as the "outdoor guides and explorers" do, but in new ways.[87] The examples that she gave, *Mirror, Mirror* and *Pret-a-Porte*, both superimposed digital images over the bodies of museum goers, so that, in the case of *Mirror, Mirror*, their likenesses appeared on a screen wearing masks inspired by the Victoria and Albert Museum's collection.[88] Another project that fits within this category is *Ultimate Dinosaurs* at the Royal Ontario Museum.[89] *Ultimate Dinosaurs* also used the screen of a smartphone or tablet to alter the way in which visitors perceived the collection. Designed for a dinosaur-fossil exhibition, the project's

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the backdrop of the real time city, Cardiff and Miller have positioned scenarios onto the corresponding virtual video topography, incidents, performances and musical experiences for us to discover along the way as we reflect upon the history worn into the streets." They call these experiences video walks. They have been making them using different display devices since 1999 when they used the screen of a small video camera for the display. Unlike *Streetmuseum* and *UAR*, there is often a strong audio component to these works and they have a pre-determined duration and path. Unlike most of the augmented reality experiences described in this paper, the digital content fills the screen of the display device rather than sharing it with live images of the non-virtual world. 1. "The City of Forking Paths | 2014," *Janet Cardiff and George Bures Miller*, accessed May 25, 2016, http://www.cardiffmiller.com/artworks/walks/forking_paths.html., "In Real Time | 1999," *Janet Cardiff and George Bures Miller*, accessed May 25, 2016, http://www.cardiffmiller.com/artworks/walks/realtime.html., Mannion, "British Museum- Augmented Reality Beyond the Hype.," Shavemaker et al., "Augmented Reality and the Museum Experience."

[86] "Streetmuseum," *Museum of London*.

[87] Mannion, "British Museum- Augmented Reality Beyond the Hype."

[88] Mannion, "British Museum- Augmented Reality Beyond the Hype."

[89] Randy Rieland, "Augmented Reality Livens up Museums," *Smithsonian*, August 14, 2014, http://www.smithsonianmag.com/innovation/augmented-reality-livens-up-museums-22323417/.

smartphone application worked with markers placed at stations around the gallery to "flesh out dinosaur skins," and "bring our great Southern dinosaurs to life."[90] It also worked around Ontario to advertise the exhibit and a marker near the museum provided visitors with the opportunity to take a photo with a revived beast.[91] Experiences in the "interpretive mediation" category tend to be marker rather than GPS-based and, unlike the "outdoor guides and explorers," are designed for use within the museum galleries.[92]

Mannion did little to differentiate between her last two categories: "new media art and sculpture" and "virtual exhibitions." Mannion wrote, "Innovation in the third and fourth categories of new media art and exhibitions has come from artists, who continue to push the boundaries of AR with guerilla interventions in museum galleries."[93] By "guerilla interventions," she was referring to the placement of digital artworks in the museum space without the consent of the curator or any other museum personnel. Like those experiences in the first category, "outdoor guides and explorers," "new media art and sculpture" and "virtual exhibition" projects often utilize visitors' own technology. However, unlike those in the first category, these projects frequently take place within the gallery and gain meaning through their presence in this space. Artists, Mannion wrote, "were the first to recognize AR's potential to challenge the curatorial hegemony over galleries."[94] If the artwork were not in the gallery, this "challenge" would never occur. In these passages, she was referring to the work of one group of artists: Manifest.AR.[95]

Manifest.AR and the Public

[90] "Augmented Reality," *Royal Ontario Museum*, accessed April 5, 2016, https://www.rom.on.ca/en/exhibitions-galleries/exhibitions/past-exhibitions/ultimate-dinos/augmented-reality.
[91] Ibid.
[92] Mannion, "British Museum- Augmented Reality Beyond the Hype."
[93] Mannion, "British Museum- Augmented Reality Beyond the Hype."
[94] Ibid.
[95] Ibid.

Manifest.AR was a group or "collective" of artists that utilized augmented reality as a medium and an exhibition space for their work.[96] They first came together for an event called *We AR in MOMA* in 2010 at the New York City-based museum and, subsequently, wrote a manifesto in early 2011.[97] John Craig Freeman, one of the founders of Manifest.AR, has referred to *We AR in MoMA* as "the groundbreaking uninvited augmented reality intervention."[98] The group's manifesto suggests an aggressive stance towards what Mannion called "curatorial hegemony." One of its tenets reads, "With AR we install, revise, permeate, simulate, expose, decorate, crack, infest and unmask public institutions, identities and objects previously held by elite purveyors of public and artistic policy in the so-called physical world."[99] It becomes apparent, after a brief glimpse at the work of Manifest.AR and its members, that one of their main assault points was the museum gallery. They performed this assault by assuming the role of curator as well as artist. Freeman wrote, "It is now the artist, not the curator, who decides which artworks can be placed where."[100] In this passage, he eliminated the role of the curator completely. Yet, this may also be seen as self-curatorship. Tamiko Thiel, another of Manifest.AR's former members, suggested an alternative role for curator: source of inspiration. Speaking of Manifest.AR's self-curated "interventions" at the Venice Biennial in 2011, she said, "We wanted to intervene at the heart of the system and in the Biennial Giardini, in the closed curatorial space and we were interested, also, in addressing the curator's questions and her theme..."[101] Yet, in the same interview, Thiel, like Freeman, presented Manifest.AR's project as an assault on the power of the curator when

[96] "About Manifest.AR," *Manifest.AR*, accessed November 24, 2015, https://manifestarblog.wordpress.com/about/.
[97] John C. Freeman, "ManifestAR: An Augmented Reality Manifesto," *John Craig Freeman*, January 24, 2012, https://johncraigfreeman.wordpress.com/manifestar-an-augmented-reality-manifesto/.
[98] Freeman, "ManifestAR: An Augmented Reality Manifesto."
[99] Ibid.
[100] Freeman, "ManifestAR: An Augmented Reality Manifesto."
[101] Tamiko Thiel, interviewed by Lanfranco Aceti, video, 2011, https://vimeo.com/25855771.

she said, "no curatorial space is safe from us anymore."[102] With the word "anymore," Thiel indicated that something had changed for artists. This change, she asserted, was made possible by the development of AR technology.[103] She called AR "freeing" with the result that artists are now limited only by the power of the cell phone signal.[104] While Thiel focused on the freedom AR can give to artists, it can also be used liberate and empower museums and their visitors.

AR, as designed by Manifest.AR, has the power to turn visitors and people on the street into curators. For their intervention, *#AROCCUPYWALLSTREET*, Manifest.AR utilized the idea of a flash mob to inspire protestors to assemble on Wall Street and view or even become a part of an augmented reality exhibition.[105] Some protestors were given hats with markers on them that, when viewed in AR, covered their faces in masks. In this way, they became both a platform for the artwork, acting almost as a mobile gallery wall, and a curatorial force as they manipulated the relationship of their masks with Wall Street, other AR protestors, and AR artworks by walking around. The spatial relationships between the AR content were likely constructed in an accidental and unintentional way dictated by the flow of the crowd. Nevertheless, it was the protestors who had the power to determine the placement of the art. Another example of Manifest.AR's empowerment of the public is its work with FACT (Foundation for Art and Creative Technology) and ARtSENSE (a "research project that explores the potential of Adaptive Augmented Reality for enhancing the museum and gallery visiting experience through the combined use of visual, audio and physiological sensors.")[106] Perhaps one of the most

[102] Thiel, interviewed by Lanfranco Aceti, 2011.
[103] Ibid.
[104] Ibid.
[105] "Opening Info," *AR Occupy Wall Street*, accessed December 10, 2015, https://aroccupywallstreet.wordpress.com/opening-info/.
[106] Roger McKinley and Areti Damala, "ARtSENSE and Manifest.AR: Revisiting Museums in the Public Realm through Emerging Art Practices," *MW 2013: Museums and the Web* 2013, Portland, Oregon, 2013,

difficult to imagine but also most suggestive projects Manifest.AR artists developed for FACT's exhibit *Turning FACT Inside Out* utilized "diminished reality" which breaks down rather than supplements physical reality as seen through the screen of a mobile device.[107] The project, created by Mark Skwarek and Animesh Anand, manifested itself in an app called "Diminished City" that allowed visitors to curate the urban landscape around FACT, not through addition, but instead, through destruction or elimination of buildings and other structures.[108]

Lest it seem that Manifest.AR democratized the role of curator, while jealously guarding the designation of "artist," the collective also designed artworks to amass and display the creative input of the public. A few of the applications designed for *Turning FACT Inside Out*, allowed members of the public to create and display their own works of art. For example, *FACT Sky Museum* by Will Pappenheimer and Zackary Brady asked visitors to design "sky written drawings and messages" and place their work in the sky for other augmented reality users to see.[109] For an exhibition at the Corcoran Gallery of Art in Washington D.C., artists Sander Veenhof and Mark Skwarek of Manifest.AR designed a project called *Infiltr.AR* which used Google Maps to place digital artifacts in the shape of balloons on an augmented reality layer visible inside the Oval Office and Pentagon.[110] They then invited the public to write Twitter messages using "#ovalofficechat or #pentagonchat" at which point their tweets would become visible on those balloons and thus, to anyone in the Oval Office or the Pentagon viewing the

http://mw2013.museumsandtheweb.com/paper/artsense-and-manifest-ar-revisiting-museums-in-the-public-realm-through-emerging-art-practices/.

[107] "Manifest.AR: 'Turning FACT Inside Out,'" *Manifest.AR*, June 13, 2013, https://manifestarblog.wordpress.com/turning-fact-inside-out/.

[108] Ibid.

[109] "Manifest.AR: 'Turning FACT Inside Out,'" *Manifest.AR*.

[110] "Manifest: AR @ Corcoran," *Manifest.AR*, September 14, 2013, https://manifestarblog.wordpress.com/manifestar-corcoran/.

augmented reality "layer" Manifest.AR had created. [111] Though tweeting in this context may not have turned participants into "artists," it did give them the power to change the content of the work.

If Mannion's use of Manifest.AR as an example says anything about how she perceived her third and fourth categories, "new media art and sculpture" and "virtual exhibitions," it reveals her belief in the power of AR to redistribute and redefine two common roles in the museum world: "artist" and "curator."

Virtual Reality

Virtual reality, like augmented reality, has received several invitations into the museum in the past several years. A search of alternative-reality experiences and programs in museums suggests that augmented reality has been used more in, by, and for museums in the past. Yet, it was virtual reality that dominated in the museum in 2015 and this trend seems to be continuing into the current year. Already in early 2016, the Eye Museum in the Netherlands became one of ten hosts for the Kaleidoscope VR film festival and the New Museum held a virtual-reality related symposium called Versions.[112]

Categorizing VR in the Museum

Like augmented reality, virtual reality experiences can be divided into categories. As Mannion's categories ("outdoor guides and explorers," "interpretive mediation," "new media art

[111] Note: In order to make this artwork visible in someplace other than the White House or Pentagon, Manifest.AR placed a "live google map" feed in the Corcoran gallery that was attuned to the particular "layar" they had designed. This use of the word "layar" is used on the Manifest.AR blog site and is a reference to the augmented reality browser called Layar used to create a virtual, geographically informed platform for the placement of augmented reality. "Manifest: AR @ Corcoran," *Manifest.AR* .

[112] *The 2016 Kaleidoscope World Tour*, video, Kaleidoscope, 2016, https://www.youtube.com/watch?v=RfkOpo4ZrP8., "Kaleidoscope World Tour VR Film Festival 2016," *Eye Film Museum*, accessed April 5, 2016, https://www.eyefilm.nl/en/film/kaleidoscope-world-tour-vr-film-festival-2016., "Welcome: Versions," *Versions 2016*, accessed April 19, 2016, http://versions.killscreen.com/.

and sculpture," and "virtual exhibitions") were only designed for AR, they will not be used for guidance in this section. Instead, I separate virtual reality experiences into two categories based on the interactivity they offer to museum visitors. These two categories are VR films and 360 degree environments. VR films are narrative and, though users are able to look around at a 360 degree environment, they are led through it. Experiences like the ones in this category are said to be "on-the-rails."[113] Chris Milk and Gabo Arora's *Clouds Over Sidra* is a VR film about the real-life of Sidra, a young Syrian refuge, narrated in her own voice.[114] 360 degree environments, on the other hand, are those virtual reality experiences wherein users determine where they look and, in the more sophisticated experiences, where to move. In other words, it is up to users to navigate and uncover the hidden treasures of these environments. Char Davies' two virtual reality experiences, *Osmose* and *Ephémère*, would fit into this category. Davies describes them in this way, "I want to emphasize that they are spaces, or rather places, for perceptual play. They do not contain a predetermined linear narrative. In these works, each participant's experience is unique, unrepeatable, and dependent on one's own behavior, on one's whim or will."[115] The VR experience created for the British Museums' Virtual Reality Weekend can also be placed in this category as it features a digitally reconstructed roundhouse that visitors explore.[116] The content of either of these categories can be composed of any mixture of 360 degree video footage and computer generated graphics. A third category, VR games, may be added. They, like 360 degree

[113] Kent Bye, "Ikrima Elhassen on the INSURGENT Movie VR Experience + Developing the Alembic Cache Playback + Stereo 360 Movie Export Plugins for UE4," *Voices of VR Podcast- Designing for Virtual Reality*, March 28, 2015, http://voicesofvr.com/111-ikrima-elhassen-on-the-insurgent-movie-vr-experience-developing-the-alembic-cache-playback-stereo-360-movie-export-plugins-for-ue4/.
[114] Gabo Arora and Chris Milk, *Clouds Over Sidra*, *Vrse* IOS Application, version 2.2.1,Vrse.works.
[115] Char Davies, "Virtual Space," *Space: In Science, Art and Society*, ed. François Penz, Gregory Radick, and Robert Howell (Cambridge University Press, 2004): 87, https://books.google.com/books?id=nzbuV_WWS5EC. Full text accessed at: www.immersence.com, May 17, 2016.
[116]The British Museum, "Virtual Reality Weekend at the British Museum," press release, 2015, http://www.britishmuseum.org/about_us/news_and_press/press_releases/2015/virtual_reality_weekend.aspx.

environments, require substantial user input. However, even though the VR industry has strong ties to the gaming industry, there is little evidence of VR games in the museum.

Also like AR, VR has, at times, been introduced into the museum by artists. Nonny de la Peña, VR journalist and "Godmother of Virtual Reality" utilizes the medium to inspire empathy.[117] The subjects de la Peña chooses for her virtual reality films have ranged from urban hunger in Los Angeles and violence in Syria to domestic violence.[118] Her work has been welcomed into the Victoria and Albert Museum and the Los Angeles County Museum of Art.[119] As mentioned in the last section, the Victoria and Albert Museum had previously worked with AR for the experience, *Mirror, Mirror*.[120] Nonny de la Peña is one of the current artists participating in the Art and Technology Lab at LACMA, though it is unclear if her work has been displayed as of yet within LACMA's walls.[121]

The work of other virtual reality artists and filmmakers such as Max Rheiner and Chris Milk were included in an exhibition called *Sensory Stories* sponsored by Future of Storytelling, a "summit and community platform" designed to "explore how stories are changing in the digital age."[122] It was held at the Museum of the Moving Image in New York in 2015. Max Rheiner's VR experience, *Birdly*, was created with the Zurich University of the Arts and, according to the

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[117] Nonny de la Peña is quoted in the following article as calling virtual reality an "empathy generator." Joseph Volpe, "The Godmother of Virtual Reality: Nonny de La Peña," *Engadget*, January 24, 2015, http://www.engadget.com/2015/01/24/the-godmother-of-virtual-reality-nonny-de-la-pena/.
[118] For more information on these projects visit: "Kiya," "Project Syria," "Hunger," *Emblematic Group*, accessed Feb. 15, 2016, www.emblematicgroup.com., Victoria and Albert Museum, "Project Syria," *What's On (blog)*, accessed September 26, 2015, http://www.vam.ac.uk/whatson/event/3462/project-syria-4930/.
[119] Victoria and Albert Museum, "Project Syria."
[120] Mannion, "British Museum- Augmented Reality Beyond the Hype."
[121] Amy McCabe Heibel, "Eight Artists Receive Art + Technology Lab Grants," *Unframed (blog), LACMA*, June 10, 2015, https://unframed.lacma.org/2015/06/10/eight-artists-receive-art-technology-lab-grants.
[122] Museum of the Moving Image, "Future of Storytelling and Museum of the Moving Image Announce Immersive Media Exhibition 'Sensory Stories,'" press release, April 2, 2015, http://www.movingimage.us/files/pages/about/sensory_stories_press_release_20150402.pdf.

press release for the exhibition, "makes your longtime dream come true: it allows you to fly."[123] Judging by the description of the experience, *Birdly* would fit in the category of 360 degree environments as described above. The VR film, *Clouds over Sidra*, was also included in the exhibition at the Museum of the Moving Image.[124] It is composed of 360 degree video footage and was produced by Chris Milk and Gabo Arora under Milk's company, VRSE.works.[125] Despite the amount of films included in *Sensory Stories* that were created by commercial production companies, their creators were still referred to as "artists" and the event as an "exhibition" rather than filmmakers and a film festival in the event's promotional materials.[126] Later in this chapter, I will discuss the way in which the separation between "independent artists" and "corporate content creators" hinders rather than assists an understanding of the collaborative groups involved in VR production.

All of the VR experiences mentioned above were placed within the museum gallery but were composed of content and hardware designed to make the museum visitor believe, however momentarily, that they were somewhere else. There are also some virtual reality experiences with content that places their viewers inside museum galleries though they are physically at home or in a classroom and they almost always belong in the 360 degree environment category. One example is the Google Cardboard application designed to be used with the affordable HMD of the same name.[127] Among other things, the application allows users to look around museum galleries from the perspective of an immobile visitor, an experience made possible by 360 degree images of the galleries. Locations explored in this app include the American Museum of Natural

[123] Museum of the Moving Image, "Future of Storytelling and Museum of the Moving Image."
[124] Ibid.
[125] Ibid.
[126] Ibid.
[127] *Cardboard App*, version 1.0.5, iOS, Google, Inc., 2015.

History in New York City and the Frontiers of Flight Museum in Dallas, Texas.[128] In Erkki Huhtamo's "On the Origins of the Virtual Museum" he discussed the historical precedents to todays "virtual museums." One particular area upon which he focused was "CD-ROM-based virtual museums" from the early 1990s such as Apple's "Virtual Museum."[129] Though these were composed of "3-D simulations," they were non-immersive and designed to be viewed on a computer screen.[130] Huhtamo stated, "For many users such CD-ROMs were supplements rather than substitutes for the physical museum."[131] VR experiences of this nature can be created by museums and may feature real-world galleries but neither are necessary. For example, Luis Tejeda created an experience called *Mona Lisa Room* which seems to make reference to an existing gallery.[132] Its description reads, "Tour one of the rooms of the world's most visited museum."[133] This was not built to be used inside a museum, nor, it seems, was it commissioned or otherwise supported by one. Instead, it was designed to replicate and, even, improve upon the in-gallery experience: "Whether or not you've visited before, you've never experienced it like this."[134] In other experiences, generic galleries serve merely as a setting in which to view artwork otherwise dispersed or un-exhibited. This is true for *Museum of Stolen Art* by New York University graduate student, Ziv Schneider.[135] This experience comes in the form of an Oculus application and it allows visitors/users to view destroyed or stolen art in a generic digitally-

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[128] Ibid. AMNH, "Museum Joins With Google to Launch Virtual Reality Visits," *American Museum of Natural History*, May 28, 2015, http://www.amnh.org/explore/news-blogs/news-posts/museum-joins-with-google-to-launch-virtual-reality-visits., Carla Meadows, "The Frontiers of Flight Museum Shares Artifacts Online with the Google Cultural Institute," press release, *Frontiers of Flight Museum*, accessed April 18, 2016, http://www.flightmuseum.com/wp-content/uploads/2012/07/2015_FOFM_GoogleCulturalInst_FINAL.pdf.
[129] Huhtamo, "On the Origins of the Virtual Museum," 2.
[130] Huhtamo, "On the Origins of the Virtual Museum," 2.
[131] Huhtamo, "On the Origins of the Virtual Museum," 2.
[132] Luis Tejeda, "Mona Lisa Room," *Oculus Share*, April 16, 2015, https://share.oculus.com/app/mona-lisa-room.
[133] Tejeda, "Mona Lisa Room."
[134] Tejeda, "Mona Lisa Room."
[135] Miles Klee, "Taking a Virtual-Reality Tour of the Museum of Stolen Art," *The Daily Dot*, March 3, 2105, sec. Tech, http://www.dailydot.com/technology/museum-of-stolen-art-virtual-reality-tour/.

rendered gallery. In a similar way to augmented reality, virtual reality opens up a space for alternative curation but, whereas augmented reality can make any space a gallery, virtual reality allows its artist to create any space.

There are times when museums harness the power of virtual reality for the purpose of what Mannion called "interpretive mediation." For the Amsterdam-based Van Gogh Museum's event, Museum Night 2015, museum personnel included a virtual reality experience as one element of the overall programming.[136] An advertisement for the event reads: "A painting on the wall dull? Google Cultural Institute and Veejays.com transformed the paintings which Munch and Van Gogh did of their bedrooms into Virtual Reality. This evening, you literally walk through the masterpieces. And you thought a painting was dull!" The advertisement speaks to what is assumed to be a disinterested museum-going public and suggests that virtual reality is the key to changing their perception of art. One aspect to this event that should be noted, however, is that virtual reality is one of many tools, digital and non-digital, designed to mediate the Munch and Van Gogh artwork for visitors. This is an important reminder that virtual reality (and augmented reality) should not be seen as a replacement for other types of programming but instead, as a supplement to what is already there.[137] Video of the event, uploaded by Veejays.com, reveals that the museum used Google Cardboards to access the experience.[138] Another Van Gogh-inspired virtual reality experience called *The Night Café* was created by

[136] Van Gogh Museum, "Museum Night 2015 - Van Gogh Museum," *Van Gogh Museum*, accessed February 19, 2016, http://www.vangoghmuseum.nl/en/whats-on/museum-night-2015.
[137] In Peter Samis' paper, "New Technologies as Part of a Comprehensive Interpretive Plan," he made a similar argument about digital technology in general. He wrote, for the moment, "a hybrid palette of complementary resources—both analog and digital—seems to offer the best chance of giving our visitors a cognitive scaffolding that hones their confidence and builds their capacity to experience even the most unfamiliar and challenging art." Samis, "New Technologies as Part of a Comprehensive Interpretive Plan," 31.
[138] "Veejays Com | Art | Virtual Bedrooms, Van Gogh in Virtual Reality," Veejays.com, 2015, https://www.youtube.com/watch?v=IR50dLUwIO4.

Borrowed Light Studios.[139] Unlike the experience described above, *The Night Café* was not commissioned by a museum and is only viewable on more costly virtual reality equipment such as the second Oculus Rift development kit and the less expensive, Samsung Gear VR.[140] Its full name is "The Night Café: An Immersive Tribute to Vincent Van Gogh" and Borrowed Light Studios advertises it as a way to "explore the world of Vincent van Gogh first-hand."[141] Both experiences use popular existing material, Van Gogh's paintings, to create something new that is designed, not to replace the original material but, instead, offer another vantage point for those who otherwise might have difficulty connecting to the art.[142]

A Break Down of Collaborators

Regardless of the category in which an experience may be placed, many—if not all— of the projects above, share one characteristic: collaboration; not only collaboration between departments in a museum but also collaboration between museum personnel, content creators, technology developers, the public, and sponsoring agencies.

Content Creators and Museums

Two of the most frequent collaborators are museums and content creators (independent artists and corporate content creators). Their collaborations begin at the level of idea exchange. When discussing the inspiration for their museums' AR-related undertakings, Schavemaker et al. of the Stedelijk Museum and Mannion of the British Museum referred to projects undertaken by other museums, revealing the importance of idea sharing across institutions. However, many of

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[139] "The Night Cafe," *Borrowed Light Studios*, 2015, http://www.borrowedlightvr.com/the-night-cafe/.
[140] Ibid.
[141] Ibid.
[142] The advertisement for "The Night Café" reads, "While creating the environments of these paintings in 3D space We've [sic] had to expand on areas that can't be seen; rooms behind doors, objects hidden from view, people turned away from the viewer. It's been an interesting process in using reference material from Van Gogh and other impressionist painters but also imagining what might have been there, just off the edges of the canvas." "The Night Cafe," *Borrowed Light Studios*, 2015, http://www.borrowedlightvr.com/the-night-cafe/.

the projects Mannion described were not created by museums but by artists. She wrote, "Inspired by the work of Manifest AR[sic], The British Museum's digital learning team decided to create its own 'guerrilla' exhibition."[143] This exhibition was in turn a collaboration between the museum, Adrian Hon (author and game designer), and the participants of a workshop led by Hon.[144] Like several of Manifest.AR's projects, this exhibition used AR as an alternative curation space. In addition to independent artists, museums often work with corporate content creators. For instance, the Stedelijk's *ARtours* project is a collaboration between the museum and a design bureau called Fabrique.[145]

It is difficult, however, to separate the two sub-categories of content creators when it comes to VR. This is because several VR artists like Nonny de la Peña have formed their own production companies. De la Peña is the founder of Immersive Journalism and co-founder of the Emblematic Group.[146] Chris Milk, in turn, co-founded VRSE.works.[147] In the end, it is perhaps best to collapse the two sub-categories, independent artist and corporate content creator, entirely when it comes to VR.

Technology Developers

Technology companies, the third type of collaborator, may function as contractor or sponsor. Perhaps the greatest example of a collaboration between technology developers and a museum in terms of the sheer volume of participants is the Art and Technology Program at the Los Angeles County Museum of Art (LACMA). The original program ran from the late 1960s to

[143] Mannion, "British Museum- Augmented Reality Beyond the Hype."
[144] Ibid.
[145] Shavemaker et al., "Augmented Reality and the Museum Experience."
[146] Nonny is referred to most often as a journalist but she fits into the independent artist group in this context as her work was treated as a piece of art on exhibit at the museums listed above rather than as digital material commissioned from a contractor. Nonny de la Peña, TED., Victoria and Albert Museum, "Project Syria," *What's On* (blog).
[147] "About," *Vrse*, accessed April 19, 2016, http://vrse.com/

the early 1970s.[148] It was designed to develop and support collaborations between artists and corporate leaders in the technology industry.[149] The program's primary goal, according to Maurice Tuchman, its curator and conceptualizer, was to support "the process of interchange between artist and company" and not necessarily the creation of works of art for exhibition.[150] Designed as a temporary program, Art and Technology ended in 1971.[151] However, in 2013, the program was reborn in altered form as the Art and Technology Lab.[152] Artists selected each year for inclusion in the Lab receive a grant from the museum and work with the Lab's "advisors."[153] In 2015, the museum's set of advisors included "Hyundai Motor Company, Accenture, NVIDIA, DAQRI, SpaceX, Google, Gensler, and independent artists and academics," according to a blog post by Amy McCabe Heibel, Vice President of Technology, Web, and Digital Media at LACMA.[154]

When it comes to VR projects, technology companies are almost necessarily drawn into the development process early on. After all, they supply the technology that makes virtual reality viewable. Samsung, the developer of Samsung Gear VR, has spent time and capital supporting the humanities as the sponsor of the British Museum's Samsung Digital Discovery Centre.[155]The website for the Centre reads, "Free activities and workshops using the latest Samsung digital equipment, enabling children to bring the world's history and cultures to life through advanced

[148] Maurice Tuchman, Introduction, "A Report on the Art and Technology Program of the Los Angeles County Museum of Art 1967-1971." (Los Angeles County Museum of Art, 1971): 9.
[149] Tuchman 9.
[150] Though the main goal of the program may not have been exhibition, it resulted in two exhibitions, one at the 1970 World Expo and the other at the museum itself. Tuchman 12, 26.
[151] Tuchman 11.
[152] Amy Heibel, "LACMA Launches Art + Technology Lab," *Unframed (blog), LACMA*, December 10, 2013, https://unframed.lacma.org/2013/12/10/lacma-launches-art-technology-lab.
[153]Heibel 2015.
[154] Ibid.
[155] "Samsung Digital Discovery Centre," *The British Museum*, accessed February 20, 2016, http://www.britishmuseum.org/learning/samsung_centre.aspx.

technology."[156] There is no specific mention here of the Samsung Gear VR, though it was used in the British Museum's recent Virtual Reality Weekend, an event designed by Lizzie Edwards and Juno Rae from the Samsung Digital Discovery Centre.[157]

The Public

As seen in the work of Manifest.AR, augmented reality technology can allow museum visitors to take on new roles such as curator and artist. Thus, visitors and community members are the fourth type collaborator. In an interview with the author, John Craig Freeman said, "I, as an artist, I'm really committed to this idea that my primary collaborators are actually the subject of the work itself."[158] The work he completed for the Art and Technology Lab, *EEG AR: Things We Have Lost*, is composed of a network of "virtual objects, people and scenes" placed at GPS points around Los Angeles, visible only through the use of an AR application.[159] The AR content consists of avatars of the people Freeman and his students interviewed on the streets of L.A. and digital representations of objects the interviewees said they had lost.[160] There was also a component set up within the Lab itself wherein visitors wore EEG-reader-equipped head-mounted displays.[161] Based on their EEG readings, the visitors saw different lost objects. Thus, the content of *EEG AR* was not entirely determined by Freeman, but was informed by those he interviewed and the neural patterns of the Lab visitors wearing HMDs.

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[156] "Samsung Digital Discovery Centre," *The British Museum*.
[157] Sophie Charara, "What the British Museum's First VR Exhibit Means for Future School Trips."
[158]John Craig Freeman, Skype interview with author, January 13, 2016, follow-up email April 11, 2016, May 8, 2016.
[159] Quotation from email correspondence confirming included passages on April 11, 2016. Freeman, interview.
[160] Freeman , interview, confirmed April 11, 2016., "John Craig Freeman, *EEG AR: Things We Have Lost*," *LACMA*, accessed April 19, 2016, http://www.lacma.org/eeg-ar-things-we-have-lost.
[161] Brian Mullins and John Craig Freeman, "Art, Technology, and Collaboration," interview, *Unframed* (blog), *LACMA*, July 8, 2015, http://unframed.lacma.org/2015/07/08/art-technology-and-collaboration.

Another AR project that expanded the role of visitor was *ARtours* at the Stedelijk Museum. One sub-project of *ARtours* asked students to create and subsequently display digital art using augmented reality. A second *ARtours* sub-project turned festival-goers at the 'A Campingflight to Lowlands Paradise' festival into curators by lending them digital images of artwork from the museum's collection to place around the fairground.[162] Similarly, The Tate Britain's *Pocket Art Gallery* app allows its users to place digital images of artwork from the museum's collection in their environments: "A J.M.W. Turner landscape could complement your local park or a dramatic Pre-Raphaelite painting could brighten up your work place."[163] LACMA's "guerilla-exhibition" mentioned above also invited participants to become both artist and curator.[164]

The potential for the museum public to take part in the creation and curation of content has not yet been as well-explored in virtual reality as it has in augmented reality. The virtual reality viewer does have some freedom i.e. where to place their gaze but is rarely, if ever, allowed any greater creative control of the virtual world. This can change. The viewer can become artist using applications such as *Tilt Brush* by Google. The advertisement for *Tilt Brush* reads, "Tilt Brush lets you paint in 3D space with virtual reality. Your room is your canvas. Your palette is your imagination. The possibilities are endless."[165] *Tilt Brush* and other applications

[162] Shavemaker et al., "Augmented Reality and the Museum Experience."
[163] This quote is taken from the first of the sources mentioned below and speaks directly to the community the app is intended to reach. This application is the result of a multi-point collaboration between museums, a design consultancy firm called All of Us, the British government (funding the project by way of the Heritage Lottery Fund), and, finally, the users turned to curators. "Pocket Art Gallery," *The Great British Art Debate*, accessed February 7, 2016, http://www2.tate.org.uk/greatbritishartdebate/pocketartgallery/., Tate Britain, "New Pocket Art Gallery App Extends the Legacy of the Great British Art Debate Project," press release, (October 29, 2012), http://www.tate.org.uk/about/press-office/press-releases/new-pocket-art-gallery-app-extends-legacy-great-british-art-debate.
[164] Mannion, "British Museum- Augmented Reality Beyond the Hype."
[165] Google, "Tilt Brush," *Tilt Brush*, accessed February 21, 2016, http://www.tiltbrush.com/.

like it could easily be brought into the museum and utilized to interest visitors in becoming creators.

Yet, the greatest way in which virtual reality might alter the relationship between museums and their visitors is, like augmented reality, empowering them as curators. Virtual reality could serve as a tool for initiatives such as the Google Cultural Institute, which supplies high-resolution images to visitors so that they might curate their own galleries, to place these galleries in VR.[166] These need not be solitary spaces, either, as virtual reality developers are constantly working to make VR social.[167] The Google Cultural Institute already allows users to share their custom-made galleries but virtual reality would allow the creator to walk through them with their friends. This is important as Ben Gammon and Alexandra Burch reminded us in their article "Designing Mobile Digital Experience" that digital technologies should be used to "facilitate" and enhance social interaction and not interfere with it.[168] User-generated galleries in VR might not feel as radical as AR-based user-generated galleries as they lack the powerful juxtaposition inherent in the latter but it may help to ease museums and their visitors into the idea of user-curated content in the museum space.

Government Departments and Non-Profit Organizations

A fifth type of collaborator is the government department or non-profit organization, both of which tend to act as sponsors. Government sponsors are rare, as of yet, but a few examples

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[166] "Home," *Google Cultural Institute*, accessed October 5, 2015, https://www.google.com/culturalinstitute/home.
[167] *AltspaceVR*, accessed May 25, 2016, http://altvr.com/., Bernard Marr, "Facebook, Virtual Reality (VR) And The Future Of Social Networks," *Forbes*, March 17, 2016, http://www.forbes.com/sites/bernardmarr/2016/03/17/facebook-virtual-reality-vr-and-the-future-of-social-networks/., Owen Hughes, "Facebook Shows Off Virtual Reality Social Media with Cyber Selfies Making a Star Turn," *International Business Times UK*, April 14, 2016, http://www.ibtimes.co.uk/facebook-shows-off-virtual-reality-social-media-cyber-selfies-making-star-turn-1554842.
[168] Ben Gammon and Alexandra Burch, "Designing Mobile Digital Experiences," *Digital Technologies and the Museum Experience: Handheld Guides and Other Media*, ed. Loïc Tallon and Kevin Walker (Lanham, MD: AltaMira Press, 2008): 36, 41, 47.

can be found in Europe and the United States government has acted as sponsor to at least one AR-related program. The Stedelijk Museum's *ARtours*, for example, was funded by the Dutch Ministry of Culture.[169] Similarly, the ARtSense project wherein artists of Manifest.AR created augmented reality experiences for FACT was partially funded by the European Union. [170] John Craig Freeman, formerly of Manifest.AR will soon take part in a program called American Arts Incubator, a collaboration between the U.S. Department of State's Bureau of Educational and Cultural Affairs and the arts organization, Zero 1.[171]

With the exception of Chris Milk and Gabo Arora's *Clouds over Sidra* commissioned by the United Nations, the civilian application of virtual reality does not seem of as much interest to world governments as augmented reality.[172] Perhaps as the technology grows, government bodies will begin exploring virtual reality just as the European Union and the Dutch Ministry of Culture supported the AR-endeavors above.

As for non-profit organizations, it was a not-for-profit foundation based in Switzerland called World Economic Forum that funded Nonny de la Peña's VR film *Project Syria*.[173] Other

[169] Shavemaker et al., "Augmented Reality and the Museum Experience."
[170] McKinley and Damala, "ARtSENSE and Manifest.AR: Revisiting Museums in the Public Realm through Emerging Art Practices.," Nenad Stojanovic, "Augmented Reality Supported Adaptive and Personalized Experience in a Museum Based on Processing Real-Time Sensor Events," Record Number 97475, *CORDIS*, (September 9, 2014), http://cordis.europa.eu/project/rcn/97475_en.html.
[171] Zero 1 is an arts organization that develops and supports partnerships between "art, science, and technology." According to further email correspondence between Freeman and the author on April 11, 2016 addressing the above passage, the collaboration also included "the U.S. Consulate General, Wuhan and K11 Art Foundation China." Freeman, interview. "About," *ZERO1 American Arts Incubator*, October 5, 2014, http://americanartsincubator.org/about.
[172] Gabo Arora is an employee of the United Nations and is given co- creator status of *Clouds over Sidra* alongside Chris Milk. Thus, in this case, the UN acted in a role exceeding that of sponsor. "The United Nations – Clouds Over Sidra," *Vrse.works*, accessed April 19, 2016, http://vrse.works/creators/chris-milk/work/the-united-nations-clouds-over-sidra/.
[173] "Our Mission," *World Economic Forum*, accessed February 22, 2016, http://www.weforum.org/about/world-economic-forum., Victoria and Albert Museum, "Project Syria."

non-profits such as PETA (People for the Ethical Treatment of Animals) have commissioned virtual reality experiences, though these do not seem have been invited into museums.[174]

These sponsors are important as they provide museums with the capital, monetary and cultural, to freely experiment, a necessary component to AR and VR collaborations as we shall see in the next chapter. However, the government-based sponsors also represent a potential threat expressed by John Craig Freeman and Will Pappenheimer in their interviews with the author that AR's democratizing potential will end when those in established positions of power begin to control it.[175]

Conclusion

In this chapter, I have highlighted several use-cases of augmented and virtual reality by or in museums. For augmented reality, I divided these cases according to Shelley Mannion's four types of augmented reality use: "outdoor guides and explorers," "interpretive mediation," "new media art and sculpture," and "virtual exhibitions." For virtual reality, I instead distinguished between virtual reality films and 360 degree environments. These categories, like Mannion's types, differ in level and nature of user interaction with the virtual world. Unlike Mannion's types, however, they cannot be distinguished by the space in which they are meant to be used, inside or outside of the museum, as experiences in these categories can usually be used in either.

[174] Erin Carson, "VR Doing Good: How a Non-Profit Wrecked an Oil Tanker in Vancouver Without Spilling a Drop," *TechRepublic*, March 17, 2015, http://www.techrepublic.com/article/vr-doing-good-how-a-non-profit-wrecked-an-oil-tanker-in-vancouver-without-spilling-a-drop/., Jonathan Nafarrete, "Amnesty Virtual Reality Headsets Bring War-Torn Syria to the Public," *Projects (blog), VRScout*, May 22, 2015, http://vrscout.com/projects/amnesty-virtual-reality-headsets-syria/., "PETA's Innovative Virtual Reality Experience Turns You Into a Chicken," *PETA*, September 2, 2014, http://www.peta.org/blog/petas-innovative-virtual-reality-experience-turns-chicken/.

[175] Freeman, interview., Will Pappenheimer, phone interview author, January 20, 2016, follow-up email April 20, 2016.

I have also noted the five types of collaborators involved in AR and VR projects: museum personnel, content creators, technology companies, the public (visitors to the museum or users of the technology), and non-profit or government agencies. In the next chapter, we will investigate the ways in which the various motivations and needs of these collaborative groups interact in challenging and, alternatively, fortuitous ways.

Chapter 3

Building Worlds:

The Collaborations That Bring Augmented and Virtual Reality to the Museum

In this chapter, I will explore the motivations, needs, and perspectives of the various parties that collaborate to bring augmented and virtual realities into the museum space. By museum space, I refer both to the physical space occupied by the museum building and the dialogic space amongst the museum community as its members seek to update the museum experience for the 21st century visitor.[176] In the last chapter, I defined and introduced five different collaborative parties: museum personnel, content creators, technology developers, members of the public, and governmental or non-profit sponsors. This chapter will focus on three: museum personnel, content creators (independent and corporate), and technology developers. Interviews with members of the first two parties are used in the coming chapter to provide insight into some of the viewpoints that museum personnel, independent artists, and corporate content creators bring to the collaborations. However, it was more difficult to contact members of the third group and thus, their viewpoints are represented by promotional quotations that were packaged in such sources as press releases. While these quotations are no doubt heavily tailored, pre-prepared, and broad, they reveal the ways in which technology companies want their activities to be perceived. This does not overtly expose any of the companies' less public motivations to partner with museums. Yet, the very existence of the press releases reveals that one motivation likely has to do with the ability to market their contributions.

[176] Texts such as *Reinventing the Museum*, edited by Gail Anderson, reveal the changes that museum theory has undergone in the last century while others, like *The Digital Museum*, focus on the changes that have occurred in the last few decades. Gail Anderson, ed., *Reinventing the Museum: The Evolving Conversation on the Paradigm Shift*, 2nd ed. (Lanham, MD: AltaMira Press, 2012)., Herminia Din and Phyllis Hecht, eds., *The Digital Museum: A Think Guide* (Washington, DC: American Association of Museums, 2007).

Each type of collaborator is primarily represented in this thesis by two individuals. Though this does not result in a particularly vast data pool, it does provide a glimpse into the commonalities of thought and divergences of opinion and motivation that are likely to arise during the collaborations that make AR and VR in the museum possible.

An analysis of the interviews conducted with members of the first two groups and the press releases and other sources from the last group, reveal several common needs and motivations not only among members of the groups but also across them. Words such as "context," "engage," and "expand" were echoed on all sides. In some cases, this might be explained by the fact that some of the interviewees have, in fact, worked together in the past. These terms also appear often in museum-theory texts such as Gail Anderson's *Reinventing the Museum* and *Digital Technologies and the Museum Experience*, edited by Loïc Tallon and Kevin Walker, suggesting that some of those interviewed are aware of shifting museum theory. This is almost definitely true when it comes to the museum personnel interviewed. However, what the presence of these terms in both the interviews and the museum literature suggests is that augmented and virtual reality are capable of supporting the type of relationships that many museums are now trying to build with their communities.[177]

As mentioned above, the three types of collaborator I will focus on in this chapter are museum personnel, content creator, and technology developer. For the museum perspective, I turned to interviews with Christiane Paul, Adjunct Curator of New Media Arts, Whitney Museum of American Art, and Associate Dean and Associate Professor of Media Studies at The

[177] Gail Anderson's definition of the "new museum," mentioned both in the previous chapter and the introduction, includes the desire to become a "community participant" and open up a "two-way communication" between members of that community and the institution. Anderson 3-4.

New School, and Joel Ferree, Program Director of LACMA's Art and Technology Lab.[178] Christiane Paul has curated festivals and exhibitions that included the work of Will Pappenheimer and is a vocal participant in discussions relating to the preservation of new media art.[179] As the Art and Technology Lab Program Director at LACMA, Joel Ferree has experience working with artists that use virtual reality and artists that use augmented reality. His position also makes him the facilitator to collaborations between artists and technology developers.

The category of content creator can be divided into two sub-categories: independent artists and corporate content creators.[180] As mentioned in the previous chapter, it is difficult to draw a clear line between these two groups, especially when it comes to VR, as some artists such as the virtual reality journalist Nonny de la Peña have their own production companies.[181] However, in the context of this thesis, the groups can be viewed as distinct based on how their work is treated in the museum, as artwork or as supplement or marketing tool for a larger exhibition. As will be explored later in the chapter, placing the power of definition in the

[178] Christiane Paul, phone interview with author, February 17, 2016, follow-up email April 26, 2016., Joel Ferree, phone interview with author, January 20, 2016, follow-up email April 29, 2016.
[179] John Craig Freeman, Skype interview with author, January 13, 2016, follow-up email April 11, 2016, May 8, 2016., Will Pappenheimer, Skype interview with author, January 20, 2016, follow-up email April 20, 2016 . Smithsonian's Time Based Media and Digital Art Working Group and the Smithsonian Office of Policy and Analysis, "The Smithsonian Interview Project: Questions on Technical Standards in the Care of Time-Based and Digital Art: Ten Insights from Artists and Experts in the Field," July 2014, http://www.si.edu/content/tbma/documents/SI_TBMA_10_Insights.pdf.
[180] The category of content creator may divided in another way. Speaking of the creation of new media art in general, artist Jeffrey Shaw wrote, "There are only a few new-media artists with the all-round capability to conceptualize, design, and build such typically complex works. More usually, they require a working relationship between artists and technicians with various skills such as programming and electromechanical engineering." While it could be argued that this passage, like this thesis, is making a distinction between two collaborative parties: technology developers and content creators, I would, instead, locate the distinction being made in the passage between various subgroups of content creator. Jeffrey Shaw, Sarah Kenderdine, Roderick Coover, Thomas Bartscherer, and Roderick Coover, "Re-Place: The Embodiment of Virtual Space," *Switching Codes: Thinking Through Digital Technology in the Humanities and the Arts* (Chicago: The University of Chicago Press, 2011): 231, accessed at: www.jeffreyshawcompendium.com, May 17, 2016.
[181] "About," *Vrse*, accessed April 19, 2016, http://vrse.com/. , "About Us," *Emblematic Group*, accessed February 22, 2016, http://www.emblematicgroup.com/about-us/.

museum's hands can be dangerous and detrimental to artists. Yet, it does provide a useful toehold in exploring the roles of various collaborators in an augmented reality or virtual reality project. By creating two categories of content creator, corporate content creator and independent artists, I intend to highlight the importance of labels: Can augmented and virtual reality experiences be art? If so, when? What parameters need to met? Where does the artist and the museum stand in this debate? Though these questions will be partially addressed in the following pages, a study dedicated entirely to their analysis would serve as a valuable guide in artist-museum relations in the age of digital art.

To represent the corporate content creators sub-category, I turned to Steve Colmer, Creative Director of Soluis Heritage, and Dr. Douglas Gann, a preservation archaeologist with Archaeology Southwest.[182] The British Museum commissioned Soluis Heritage to create the Bronze Age Roundhouse virtual reality experience the museum showcased during the event, Virtual Reality Weekend.[183] Soluis Heritage, a division of the digital production company, The Soluis Group, designs many forms of digital content, or what Steve Colmer refers to as "digital interpretation," for their clients.[184] The company's offerings include but are not limited to virtual and augmented reality experiences.[185] Like Soluis Heritage, Archaeology Southwest uses digital tools to develop 3D models of standing heritage sites and recreations of those that have been destroyed.[186] Douglas Gann uses virtual reality to create navigable digital 3-dimensional

[182] Steve Colmer, email interview with author, responded February 19, 2016, follow-up email May 1, 2016., Douglas Gann, email interview with author, responded January 25, 2016, follow-up email May 1, 2016.
[183] The British Museum, "Virtual Reality Weekend at the British Museum," press release, 2015, http://www.britishmuseum.org/about_us/news_and_press/press_releases/2015/virtual_reality_weekend.aspx.
[184] Colmer, interview., "Heritage," *The Soluis Group*, accessed March 16, 2016, http://www.soluis.com/heritage/.
[185] Ibid.
[186] This is only one method Archaeology Southwest uses to support archaeological conservation and education. Artist Jeffrey Shaw worked on a similar project, resulting in two experiences, one VR and one AR, called *Pure Land: Inside the Mogoa Grottoes* and *Pure Land: Augmented Reality Edition*, respectively. In the article, "Pure Land: Futures for Embodied Museography," written by Jeffrey Shaw, Sarah Kenderdine and Leith K.Y. Chan, the authors present the creation and dissemination of these experiences as a way to protect the at-risk heritage site.

recreations of archeological sites.[187] He defines virtual reality in the following way: "I'm going to call projects that serve 3D rendered content as virtual, and restrict the use of the phrase VR to true interactive worlds."[188] In the past, he has created virtual reality experiences for CAVEs but is now beginning to work with head-mounted displays such as the Google Cardboard, Samsung Gear VR, and HTC Vive and "building applications for desktop virtual reality."[189]

To represent the second sub-category of content creators, artists, I contacted John Craig Freeman, Professor of New Media at Emerson College and Will Pappenheimer, new media artist.[190] Both are former members of the Manifest.AR group described in Chapter 1 and have had multiple experiences placing their augmented reality art in the museum space and doing so with varied degrees of cooperation and acceptance by the museums. They have often worked in complex collaborative networks, partnering with museums, fellow artists, visitors, and sometimes technology companies in the scope of one project.

Samsung will be used as the primary representative of technology developers in this chapter. Its involvement in such efforts as the British Museum's Virtual Reality Weekend by way of the Samsung Digital Discovery Centre at the museum is publicized on the company's press release page.[191] Other companies like DAQRI, with which John Craig Freeman worked on his Art and Technology Lab project, do not actively promote their roles in these collaborations,

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Ibid., "Home," "Who We Are: Our Mission and Goals," *Archaeology Southwest*, accessed March 16, 2016, http://www.archaeologysouthwest.org/. Gann, interview. Sarah Kenderdine, Leith K. Y. Chan, and Jeffrey Shaw, "*Pure Land*: Futures for Embodied Museography," *Journal of Computing and Cultural Heritage* 7, no. 2 (June 2014): 8:1–8:15, doi:10.1145/2614567.

[187] *Chaco's Legacy* is one of Gann's projects using virtual reality gaming software. "Chaco's Legacy," *Archaeology Southwest*, accessed March 16, 2016, http://www.archaeologysouthwest.org/what-we-do/information/exhibits/chacos-legacy/.

[188] Gann, interview.

[189] Gann, interview, updated with information from follow-up passage confirmation email with Gann, May 1, 2016.

[190] Freeman, interview., Pappenheimer, interview.

[191] Samsung, "Virtual Reality Weekend at the British Museum," press release, August 8, 2015, http://www.samsung.com/uk/citizenship/press-releases/british-museum-virtual-reality.html.

though an interview with Freeman and Brian Mullins, CEO and Founder of DAQRI is available on LACMA's blog.[192] The difference between the high visibility of Samsung's involvement and the relative opacity of DAQRI's suggests that each company had slightly different motivations to participate in their projects.

Motivations

Up until this point in the thesis, I have yet to thoroughly address the reasons why content creators and technology developer choose to work with AR and VR and why they would do so in partnership with museums. I proposed a broad explanation for museums' interest in this type of technology and content in chapter one but, in this chapter, I endeavor to go into more detail and depth.

Content Creators and Museums

For artists, the main incentive to create in AR is that it allows them to say what they need to say, explore what they want to explore.[193] When asked why he chooses to use AR now rather than VR, Freeman said:

> If you ask any of the group from Manifest.AR, augmented reality was convenient, and a form that spoke to the time and it continues to do so but really, the concepts are what came first in all of our minds. The thing about augmented reality, it raised these whole new questions about how art is disseminated and who gets to say so. So that gesture of going to the museum and deciding, there's something, a little ah, you know, little Wild West about saying okay, now, I don't need the approval of curators, critics, and directors, and so forth. As an artist, I can choose to put art anywhere I want. It doesn't have to be sanctioned by taste-makers.

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[192] Freeman, interview. Brian Mullins and John Craig Freeman, "Art, Technology, and Collaboration," interview, *Unframed (blog), LACMA*, July 8, 2015, http://unframed.lacma.org/2015/07/08/art-technology-and-collaboration.
[193] For Char Davies, virtual reality was a medium with which he could interrogate and challenge the way in which people related to their bodies and their environments: "The medium's paradoxical qualities may effectively be used to redirect attention from our usual distractions and assumptions to the sensations of our own condition as briefly embodied sentient beings immersed in the flow of life through space and time." Char Davies, "Virtual Space," *Space: In Science, Art and Society*, ed. François Penz, Gregory Radick, and Robert Howell (Cambridge University Press, 2004): 71, https://books.google.com/books?id=nzbuV_WWS5EC. Full text accessed at: www.immersence.com, May 17, 2016.

One of the "concepts" that Freeman likes to engage with is the evolution of the museum and particularly, "how institutions need to change…in terms of…in the future…is it going to be the case that museums will continue to remain inside institutional walls or do they, necessarily have to kind of expand out into the communities?" Will Pappenheimer spoke about the projects Manifest.AR did for ARtSense as "extending the museum outside into the town, into the place that it's in." In speaking about where he envisions augmented reality and virtual reality being most useful to museums, inside or outside of their buildings, LACMA's Joel Ferree noted the opportunity they both provide to "expand upon what a museum is." He reminisced on the allure John Craig Freeman's project held for the general public when the Los Angeles County Museum of Art hosted an event on the streets of Downtown Los Angeles to share his work and the way in which interest in the augmented reality project developed into interest in the museum and its Art and Technology Lab. Artists like Freeman and Pappenheimer are working at the very time when museum scholars are asking questions about the position of a museum relative to its community. In her introductory chapter for, *Reinventing the Museum*, Gail Anderson wrote that one of the key beliefs underlying the articles included in the text is that, "Public engagement is on site, off site and online, and is defined and created where people decide to make it happen."[194] Even as far back as 1917, John Cotton Dana wrote, "Museums of the future will not only teach at home, they will travel abroad through their photographs, their textbooks, and their periodicals."[195] And now, AR and VR experiences. At this moment, the interests of artist and museum are

[194] Anderson 9.
[195] John Cotton Dana, "The Gloom of the Museum," *Reinventing the Museum: The Evolving Conversation on the Paradigm Shift*, 2nd ed., ed. Gail Anderson (Lanham, MD: AltaMira Press, 2012): 30, originally published as the second book of the *New Museum Series* (Woodstock, Vermont: The ElmTree Press, 1917).

intertwined, providing solid ground for future augmented reality artist and museum collaborations.

VR artists are drawn to their medium for much the same reason as augmented reality artists are drawn to theirs: it fits their expressive needs. In a recent TED talk, Nonny de la Peña reflected on virtual reality's potential to stimulate a visceral "whole body experience" and, thus, a closer sense of empathy, in a way that she had been unable to accomplish in any other medium.[196] This, too, would support the way in which museums are now urged to relate to their public. In their article, "Immersive Media: Creating Theatrical Storytelling Experiences," Michael Mouw and Daniel Spock suggest that museums should stimulate visitors' emotions in order to engage them:

> museums are most effective when they tap the experiential qualities one tends to associate with theater and fiction (as opposed to, say, the classroom): an experience of other people's dramas and dilemmas, those not necessarily rational but certainly universal aspects of the human experience.[197]

Much of Nonny de la Peña's VR films do just this, giving viewers the experience of someone waiting in a line at a Los Angeles food bank or witnessing police violence against an illegal immigrant.[198]

Yet, even as they stand on common ground, artists do not necessarily perceive the ground they share with museums as particularly even. Freeman asserted that augmented reality and other forms of new media art are "ghettoized by the larger art world." As evidence, he pointed to the fact that, for much of the projects he conducted with museums, he had worked, not with the curatorial department, but instead, with that of education. In the case of his work with FACT and

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[196] Nonny de la Peña, TED (TED Women Conference, 2015), http://www.emblematicgroup.com/#/reality/.
[197] Michael Mouw and Daniel Spock, "Immersive Media: Creating Theatrical Storytelling Experiences," *The Digital Museum: A Think Guide*, ed. Herminia Din and Phyllis Hecht (Washington, DC: American Association of Museums, 2007): 47.
[198] "Hunger," "Use of Force," *Emblematic Group*, accessed Feb. 15, 2016, www.emblematicgroup.com.

ARtSENSE, he said, "the exhibition was really done kind of in the lobby area…They never allowed us in the exhibition space proper." Will Pappenheimer made the same observation, though he phrased it as a compliment to education departments. He said, "I've come out of this thinking that education departments are really some of the more forward-looking…prospects for doing this type of work." In his article "What is a Museum?" from 1942, Theodore Low also suggested that education departments are the innovative centers of museums.[199] He wrote, "As a group, they [educational staff] have the public at heart and are willing to accept new ideas and to fight to make the museum a more valuable institution."[200] Ferree, Program Director of the Art and Technology Lab at LACMA, works within the Technology, Web, and Digital Media Department and he spoke of the Lab as a flexible and failure tolerant space: "We're more interested in the process, than the results, and showing that process." This suggests that there may be advantages to being, to borrow Freeman's phrase, "ghettoized."

Yet, interestingly enough, corporate content creators and their work are not necessarily relegated to the education department. In his interview with the author, Steve Colmer said that Soluis Heritage often deals with people from both departments: curatorial and education, each of which provide their own insights and input into the project. The curators, he said, supply "the historic knowledge on the look and feel of the spaces, on their construction and materials used" and the educators focus more on the "user experience." The relationship between the corporate content creator and the museum and the one between the artist and museum is, in some ways very different. Even though artists, like corporate content creators, may have their work

[199] Theodore Low, "What is a Museum?" *Reinventing the Museum: The Evolving Conversation on the Paradigm Shift*, 2nd ed., ed. Gail Anderson (Lanham, MD: AltaMira Press, 2012): 38, originally commissioned by the American Association of Museums in 1942 and published in *The Museum as a Social Instrument* (New York: Metropolitan Museum of Art, 1942).
[200] Ibid.

commissioned, the curatorial department exercises a different amount of control depending on the type of collaborator they are working with and what exactly they expect out of the joint effort. Whereas curatorial control extends to the content of AR and VR experiences commissioned from companies, curators cannot even determine where artists place augmented reality work in the gallery, much less the nature of its content, even when the work is commissioned. Pappenheimer described his experience as an invited artist at the Institute of Contemporary Art's (ICA) Boston Cyberarts Festival in 2011: "they [the ICA] told us, in a way, where we could kind of work in terms of the museum which was kind of a funny thing because we didn't have to…we could put our objects anywhere…"[201] Thus, augmented reality artwork threatens curatorial authority and some artists wield AR this way quite intentionally. One of the lines in Manifest.AR's Manifesto reads, "With AR we install, revise, permeate, simulate, expose, decorate, crack, infest, and unmask public institutions, identities and objects previously held by elite purveyors of public and artistic policy in the so-called physical real."[202] In his interview with the author, Freeman said, "it challenges the institutions, the museums, to think differently about their role, as we, as artists are thinking differently about our role."[203] Threatening, indeed. Yet, it is not a malicious challenge; it is meant to trigger change, not to destroy. Will Pappenheimer said it was an "honor" to have his work exhibited in some of the museums he has collaborated with. Freeman and Pappenheimer's careers prove that the friction augmented reality

[201] "Manifest.AR @ ICA," *Boston Cyberarts*, 2011, http://bostoncyberarts.org/festival/events/?eventid=619., Pappenheimer, interview.
[202] John C. Freeman, "ManifestAR: An Augmented Reality Manifesto," *John Craig Freeman*, January 24, 2012, https://johncraigfreeman.wordpress.com/manifestar-an-augmented-reality-manifesto/.
[203] In his article, "On the Origins of the Virtual Museum," Erkki Huhtamo analyzed the work of artists from the early 20th century who worked with the museum space in much the same way. He wrote, "For radical art, practices exposing the ideological camouflage of the exhibition space and re-configuring its elements were a main challenge." Erkki Huhtamo, "On the Origins of the Virtual Museum," *Virtual Museums and Public Understanding of Science and Culture* (Stockholm, Sweden, 2002): 5.

creates in a museum space does not have to result in antagonism on either side. Referring to the passage quoted above, John Craig Freeman said some museums "have accepted that challenge." He holds up LACMA as one of these museums because "they're embracing, not only the idea that this work is something that should be collected and preserved, but also that the institution itself needs to be thinking differently about the role it plays within society…"[204] Gail Anderson's "Reinventing the Museum Tool" proves that many working in museum theory, at least, are doing just that.[205] For both Freeman and Pappenheimer, museums as institutions serve as a rich environments in which to insert their work because of the power relations and subtexts that operate in this space. Pappenheimer is also interested in museums as collections. The artist said, "it's wonderful to create a dialogue with a collection." When used in such a way, augmented reality experiences might be said to function within Shelley Mannion's "interpretive mediation" category. For artists like Pappenheimer, a museum's collection can function as inspiration, canvas, content, or counterpoint to their own work. Pappenheimer and Tamiko Thiel used digital scans of a Liverpool museum's plant collection as content for their work, *Biomer Skelters*.[206] Just as artists may ask how a museum's collection might help them to create augmented reality artwork, museums might ask how augmented reality experiences can promote their collections. In an interview with the author, Steve Colmer of Soluis Heritage said, "AR is a great way to complement existing museum artefacts, allowing the visitor to interact with an object which

[204] Freeman, interview.
[205] Anderson 3-4.
[206] In his article, "Virtual Museums of Photography-Problems and Premises," Huhtamo warned against treating digital reproductions such as photographs of physical items in the museum's collection as replacements for the original based on Walter Benjamin's theory of the unique "aura" of the original. "'Biomer Skelters,'" *Manifest.AR*, May 14, 2013, https://manifestarblog.wordpress.com/biomer-skelters/. Erkki Huhtamo, "Virtual Museums of Photography- Problems and Promises," SEPIA Conference (Helsinki, Finland, 2003): 11-14., Pappenheimer, interview.

usually sits locked away in a glass cabinet." Christiane Paul of the Whitney Museum of American Art even suggested that augmented reality might "be used in the future to create the next level of the exhibitions label or audio tour."[207] According to Colmer, virtual reality can serve a similar function but instead of focusing on the object itself, VR's strength is creating a context in which the object can be better understood. In an article for *Wareable*, Lizzie Edwards of the Samsung Discovery Center at the British Museum suggested that the experience of being in the "original context" is powerful, especially for children, and that it can change, not simply how visitors view one object, but an entire exhibition.[208] Speaking of the same Bronze Age virtual reality experience at the British Museum, Andy Griffiths, Head of Samsung UK, is quoted in a Samsung press release as having said, "This will be a completely new way to interact with the British Museum's Collection."[209] There is one word that has been repeated throughout these passages: "interact." "Interactivity" is a key term in Ben Gammon and Alexandra Burch's essay, "Designing Mobile Digital Experiences" and it supports the visitor-centric mission of Gail Anderson's "reinvented museum" as it provides a way to "engage" the museum's visitors.[210] At the same time, artists benefit from the continued existence of the collection, the focus of the "traditional museum."[211]

[207] Quoted passage clarified and extended by Paul in follow-up email, April 26, 2016.
[208] In his article, "Virtual Museums of Photography- Problems and Premises," Erkki Huhtamo noted the inability of digitized images of objects maintain the original objects "aura" but suggests that virtual museums may be used to bring the collection into a space (the Web) where it may be better contextualized through the addition of more informational resources. Ultimately, he wrote, "If successfully realized, it [the virtual museum] can certainly create interest towards the "originals",[sic] raising the desire to view Daguerreotypes as Daguerreotypes, not as incomplete reproductions." Sophie Charara, "What the British Museum's First VR Exhibit Means for Future School Trips," *Wareable*, August 4, 2015, http://www.wareable.com/vr/british-museum-samsung-gear-vr-headset-party-667. Huhtamo, "Virtual Museums of Photography- Problems and Premises," 17.
[209] Samsung, "Virtual Reality Weekend at the British Museum."
[210] Anderson 3-4.
[211] Ibid.

Despite the similarity between the way in which artists' and other collaborative parties' understand AR, there is danger in failing to recognize that, rather than being identical, their interests in augmented reality are nearly mirror images of one another. Without this understanding, there is a great chance that artists' work will not be treated as art in the museum space. Speaking of Christiane Paul, Pappenheimer said, "she will work with you in…developing the idea and holding its integrity and making sure that, you know, that I was listed as an artist project, not…a technology add-on." In this passage, Pappenheimer makes the distinction between defining AR content as art and AR content as supplement and makes it clear that he wishes to be seen as an "artist" and thus, his work as art or an "artist project." In previous sections of this thesis, I supported the blurring of the line between corporate content creator and artist but it is here the line must be thickly drawn in order to fight the "ghettoization" of augmented reality within the museum.

Technology Developers

So far, I have addressed the incentives AR and VR present to artists and museums. The third type of collaborator, technology developer, is also incentivized to work with AR and VR, especially when it involves collaborating with the other two. The participation of technology companies in collaborations with artists and museums can be explained in at least two ways: press and innovation. For Samsung, at least, part of the appeal of teaming up with the British Museum is the way in which the work frames public perception of their company. There is at least one press release on Samsung's website about Virtual Reality Weekend and several more about the Samsung Discovery Centre that the company sponsors at the museum.[212] The staff time

[212] Samsung UK, "Samsung and the British Museum Win Arts & Business Award," press release, May 22, 2014, http://fb.uk.samsung.com/news/local/samsung-and-the-british-museum-win-arts-and-business-award.

that must have been devoted to publicizing the company's contribution suggests that publicity was, if nothing else, a perk. The company seems, indeed, to have garnered a positive reputation from their work with the British Museum as their collaboration has won the parties an Arts & Business Award.[213] In Samsung's press release announcing the win, a quote from Andy Griffiths, Managing Director of Samsung UK and Ireland, reads:

> Samsung is thrilled that the partnership with the British Museum has been such a success and we're delighted it's been recognized by the industry and A&B Awards. We want to inspire young people to unlock their learning potential through the use of technology and The British Museum has been at the forefront of innovating digital learning and we are excited to see where the future will take us.[214]

By complimenting the British Museum on being at "the forefront of innovating digital learning" while accepting an award for collaborating with that institution, Griffiths seems to be subtly crediting Samsung for the museum's status as innovator. Even if Griffiths did not explicitly say it, Neil MacGregor, Director of the British Museum, did: "The Museum's long-standing partnership with Samsung has enabled us to be at the forefront of digital education, with a programme that gets better year on year."[215] I do not mean to say that Samsung is not at the "forefront," nor even that their status as such is in question or in need of defense, but merely that press releases about the company's altruism are valuable spaces for the company's self-promotion. In placing its technology in the hands of museum personnel, Samsung is also using the institution's physical space to advertise specific products including their virtual reality device, Samsung Gear VR. The British Museum's Virtual Reality Weekend, organized by the Samsung-sponsored Discovery Centre, introduced the Samsung Gear VR head-mounted display

[213] Samsung UK, "Samsung and the British Museum Win Arts & Business Award," press release.
[214] Ibid.
[215] Ibid.

to visitors only months before its release on the commercial market.[216] A quote from Griffiths reads, "I hope people see the start of the potential for how VR can illustrate a subject much more dramatically and really give you the feeling that you're there."[217] In this sentence contained in an article about Samsung's collaboration with the British Museum, Griffiths bridges the gap between virtual reality as educational tool and virtual reality as consumer device by generalizing its power.

Another motivation for technology companies to collaborate with artists, according to Freeman and his experience with DAQRI in the Art and Technology Lab, is the creation of a better product. Freeman suggested that technology companies involved in collaborative efforts with artists can draw financial reward from their efforts by using the unique insights of artists to improve their technology. He pointed out artist-in-residence programs held by technology companies such Google that are established on the notion that an artist's mind is a valuable commodity in the design of technology. Similar collaborations form the bedrock of LACMA's Art and Technology Lab. Joel Ferree said that there is a "marketing benefit that they [the technology companies] do get from being involved with the lab but the advisors from the companies are really engaged in the artists' projects…" and, ultimately, "we really haven't had to deal a lot with…them benefitting…from us." Ferree's and Freeman's perceptions of the motivation of their technology company partners seems to be slightly different, even when talking about the same collaborations. This shows that members of the same collaboration do not

[216] Colmer said, "Obviously because of the sponsorship of the centre, the technologies used was Samsung based." In a follow-up email with the author on May 1, 2016,, Colmer clarified "technologies" to mean, in this context, "delivery platform or mechanism."
[217] Samsung, "Virtual Reality Weekend at the British Museum." For information on Google's Residency Program see: "Art Explorations: Artists in Residency with 89Plus," *Google Cultural Institute*, accessed April 19, 2016, https://www.google.com/culturalinstitute/thelab/index.html.

all have the same relationships with their partners. Even within a collaborative project, there are complex power dynamics and the parties all interact in slightly different ways with one another. Unlike Samsung, DAQRI did not write a press release. This suggests that DAQRI was not interested in the Lab for its marketing potential. Yet, according to Freeman, his desire to use an EEG reader-equipped HMD for his project, *EEG AR*, led DAQRI to install a reader in one of their augmented-reality head-mounted displays and that this ultimately led the company to pursue research into including the readers in their HMDs on a more regular basis. If the company is able to include EEG readers in all or even some of its headsets and this gives it a market edge, all of the revenue earned by the product can be attributed to its participation in the Art and Technology Lab.

Conflicting Motivations and Interests

The motivations and interests of the various collaborating parties do not always support one another. For example, the commercial interests of the technology developers may take some power away from the artists. Although Freeman acknowledged that he participated in a "fruitful collaboration" with DAQRI, he expressed the belief that there is a fundamental difference between how the company wanted to treat the product of their collaboration, i.e. the headset and software, versus how he would have liked it to be used. Freeman said that if he owned the rights to the technology and software created during his work with the Art and Technology Lab, he would make them open-source and he believes that museums would have done the same. Instead, according to Freeman, the rights are owned by DAQRI who treats them like "intellectual property," keeping the products and the information secure and controlled, rather than releasing them for general use by the public, an action, of course, that is important if the company wishes to monetize them. Freeman pointed out that this arrangement prevents him from maintaining and

preserving the artwork he created with DAQRI's assistance. Thus, collaborations between technology companies and less-commercially-driven parties have innate challenges based on the simple fact that they each need something different to survive and thrive.

This discussion of open-source versus intellectual property can be broadened to reflect a similar concern over open versus closed virtual space. Once again, artists are on the open side of the debate but both Freeman and Pappenheimer fear that as augmented reality technologies evolve, their ability to exhibit freely in the virtual space will be limited. In his interview with the author, Freeman said:

> I've been in this long enough to know that there are…windows of opportunity for artists to intervene with these new technologies before the space becomes colonized and corporatized and so,…we all expect…this to go the same way as virtual reality where augmented reality space will be polluted with crass corporate advertising.

Freeman believes that, eventually, the currently free space of the virtual world will become highly controlled.[218] Pappenheimer has the same concerns:

> there probably will come a time, you see, where [sic] virtual space will be cordoned off or owned or something, right? 'Cause why are you going to want thousands… of different type [sic] people interfering, you know, in certain spaces, I mean, here comes the brave new world at us.[219]

The "brave new world" of augmented reality may yet be in the future but the release of expensive virtual reality HMDs on the consumer markets suggests that the "brave new world" of virtual reality may be, if not already here as Freeman suggests, fast approaching.

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[218] Freeman, interview. On the other hand, in Char Davies' article, "Virtual Space," he challenged the idea that virtual space has ever been free. He wrote, "It is important to understand that virtual space is not neutral. The origins of the technology associated with it lie deep within the military and western-scientific-industrial-patriarchal complex." Before Char Davies worked with virtual reality, he was a painter. Char Davies, "Virtual Space," *Space: In Science, Art and Society*, ed. François Penz, Gregory Radick, and Robert Howell (Cambridge University Press, 2004), 72-73, https://books.google.com/books?id=nzbuV_WWS5EC. Full text accessed at: www.immersence.com, May 17, 2016.,

[219] Pappenheimer, interview.

Besides competing economic outlooks, another challenge that AR and VR collaborations face is communication. When asked about the challenges he has seen arise during his work as Program Director of the Art and Technology Lab, Ferree replied that every project is entirely unique. However, he indicated that communication can be one challenge:

> sometimes,…I think you're trying to make sure that the artist and the technologist are communicating and that they're not talking over one another, um, and that they understand each other. And so sometimes you want to try and,…you don't want to like muddy the waters by getting involved…, but you do want to make sure that there's clarification. And, you know, that each party understands where the other is coming from and…what they're looking to do.

While acknowledging the potential difficulty of achieving communication and understanding among artists and technology collaborators, Ferree said, "you just have to be persistent." As communication is hard to maintain reliably even among a small group of people working in a single location much less across the country and between different fields, it is no surprise that this is a challenge that these collaborations face. Yet, the Art and Technology Lab and the role that Ferree plays presents a useful solution with one party of a three-party collaboration serving as a mediator between the other two.

Needs

With communication comes an understanding of each party's motivations and needs. While the motivations of the collaborating parties have been analyzed in the above passages, the rest of the chapter is dedicated to analyzing their needs.

Content Creators

Content creators generally need resources. The Art and Technology Lab at LACMA was designed, at least in part, to provide artists with these resources. Joel Ferree said:

> with the lab, I think something that we're trying to do is, you know, we're not looking for an exhibition, we're not looking for the artists to create just another artwork. It's really a chance for them to take a year to talk with our... technology advisors as well as our

> curators and really sort of expand upon their process, their artistic process, and what new tools could they use…could they incorporate into their practice.

Some of the resources these advisors can offer are: "expertise," "experience," and "networks."[220] As mentioned above, even a museum's existing collection can serve as a resource to artists. Corporate content creators also need resources from the museums that hire them. Of particular importance for Douglas Gann of Archaeology Southwest, are "source materials that are free and clear of any complications or legal restraints."[221] As museums and archives digitize their collections to place them on the internet and on websites like the Google Cultural Institute, opportunities begin to grow for artists to reuse this material just as Pappenheimer used the plant collection for *Biomer Skelters*. Artists in the virtual reality community seem to be just as interested in repurposing museum collections as AR artists. One episode of the virtual reality podcast, *Voices of VR*, which usually consists of interviews with virtual reality content creators and technology developers was devoted, instead, to an interview with Isabel Meyer from the Smithsonian Institution regarding the digitization of the Smithsonian's collection, drawing a clear connection between VR and digitization.[222]

Another specific resource that artists need is press coverage and marketing. Pappenheimer said:

> it's something to…remark on that that these kind of projects really need a kind of support…a PR side to them in order to work…and to work well. And as soon as that's there, everybody pays attention to it, right?...But if it's not there… an AR project can go completely unnoticed.

[220] Ferree, interview.
[221] Gann, interview.
[222] Kent Bye, "Isabel Meyer on Digitizing Smithsonian Collections and Making Them Available For Educational Use," Voices of VR Podcast- Designing For Virtual Reality, July 26, 2014.

AR is literally invisible to anyone who does not know to look for it. If the museum is not supplying the technology to view it and, instead, expects visitors to use their own smartphones, there may be no trace of its existence in the galleries. AR has almost no physical presence. Marketing is not as essential to the success of virtual reality in the museum space. Virtual reality journalist, Nonny de la Peña has noted that there was no marketing for her VR film, *Project Syria*, when she brought it to the Victoria and Albert Museum.[223] Yet, the physical presence of the supporting technology and gear peaked visitors' curiosity because of its incongruity with the objects in the gallery where it was set up.[224] Thus, museums interested in introducing augmented reality to their visitors must develop a strong marketing campaign in order to make the experience visible. While virtual reality experiences would undoubtedly benefit from effective marketing, the equipment that they require to function ensures that there are visual indicators of their presence in the museum gallery.

Museums

Just as content creators need resources from museums, museums need guidance from creators. Steve Colmer said, "Generally, clients have a basic idea of what they would like, but are unsure what is achievable," and "People are very interested in the technology but can be unsure of how it can be used to create an engaging experience. Our experience and background helps guide them on ideas." According to Colmer and Pappenheimer, museums generally lack the expertise and experience to deal with certain kinds of new technology such as virtual and augmented reality. This has provided an open space of authority that artists such as Pappenheimer and other content creators are willing to fill. In his interview with the author, Will

[223] Nonny de la Peña, TED (TED Women Conference, 2015).
[224] Ibid.

Pappenheimer said, "Working with them [museums] has been really nothing but a pleasure because…they are…very open to how to do this…because they don't know how it's done and what to expect and so on and so, they've been very supportive." One specific thing that Pappenheimer suggested museums could learn from artists is audience engagement: "a museum could very easily, um, commission artists, there are artists working in these media, they know how to engage an audience so they could… certainly create AR for very informational reasons."[225] This might seem to erase the distinction between the work of corporate content creators and artists in so far as they are defined by whether or not their work is considered "art" or purely an educational tool. However, Pappenheimer does suggest that museums might "look at some kinds of projects in terms of information and then some…. kinds of projects that would really be inspired by artists who've thought about how this media works…and how it can be jammed…or produce different results other than just transferring information, if you will." He does not make it clear if the second type of project would be referred to as art, but he is distinguishing between purely "information"-carrying content and the material made by artists on commission for educational projects.

With the proper resources, instead of contracting out augmented and virtual reality content creation, museums could make their own. Archaeology Southwest has created a

[225] In a follow-up email with the author on April 20, 2016,, Pappenheimer wrote this passage in response to the quote above, "what artists might have to offer is also different methods and approaches to conveying information, [sic] that might engage the audience in different ways other than the familiar informational didactics tour of the museum."
This is not the first time artists have been credited for innovative museum practice. In his article, "On the Origins of the Virtual Museum," Erkki Huhtamo draws a connection between what he calls "artist-designers" from the early 20th century working on exhibition design as an artistic medium and what would eventually become virtual museums. He writes, "Aware of the need for radical changes in the concept and the roles of art, a radical re-thinking of the relationship between exhibition spaces, exhibits and spectators/visitors was needed." One of the goals of the artists in designing these exhibits the activation of the participant or visitor. These artists often experimented, like those working with augmented reality now, with "new media," which, at that time, included recorded sound and film. Follow-up email with Pappenheimer, April 20, 2016., Huhtamo, "On the Origins of the Virtual Museum," 3, 5-7.

Chronological Virtual Reality (CVR) tool to assist museums and institutions interested in creating their own VR content. According to Gann:

> The CVR is a modular content system for building virtual reality exhibits. Experiences within the CVR are intended to be shared through stand-alone touch screen exhibits, websites, game systems such as x-box and playstations, phones, head-mounted virtual displays and full-fledged VR cave environments.

The software itself is the result of a collaboration between two programmers and Douglas Gann.[226] As the software is owned by Archaeology Southwest, the company remains in the collaborative loop even as CVR might otherwise threaten the company's virtual reality contract work with museums if made publicly available.

Besides resources and guidance, collaborators in virtual and augmented-reality projects require the freedom to fail. Joel Ferree suggests that one of the aspects of LACMA's original Art and Technology Program that inspired Amy Heibel in her design of the current Art and Technology Lab was that "it was tolerant of failure." Artists are not the only ones that need the freedom to fail; museums need this as well and, once again, the Lab answers this demand. Ferree said, "the lab is this sort of safe space where you can mess around with these experimental tools and you know, see what happens…and you're not…implementing it at a fully institutional level, you're keeping it in this lab space."[227] Critical as Freeman is of the "ghettoization" of augmented reality and other forms of new media art, he acknowledges that museums have a lot to lose if something goes wrong. Referring to the Art and Technology Lab and its tolerance of failure, Freeman said, "And big institutional curatorial exhibition practices can't afford to do that. If they're going to put money and resources into an exhibition, it damn well better. This is why

[226] Gann, interview.

[227] The Art and Technology Lab is not alone in offering a safe and open resource-laden space for artists interested in working with new technologies. The New Museum in New York has just started a new art and technology incubator called NEW INC. "ABOUT NEW INC," *NEW INC*, accessed April 19, 2016, http://www.newinc.org/about/.

new media art frightens them, it might not even start up in the morning." Indeed, there are multiple points at which an augmented reality or virtual reality experience might fail. One point of potential failure is the technology. Speaking of *Hans RichtAR*, an experience he created with Will Pappenheimer for LACMA, Freeman described how outside temperatures caused the exhibition's iPads inside the museum to overheat. Freeman stressed the importance of flexibility on the part of the museum staff in their exhibition practices and the presence of a technical support staff familiar with, in Freeman's case, augmented reality technology.

Even when the technology is working at its peak, the potential for a failure more devastating that a rundown iPad battery looms above virtual reality experiences and it comes in the form of what some call "sim sickness."[228] This unfortunate side effect to watching virtual reality experiences can result in extreme dizziness and, generally, discomfort and it is something that all technology developers and content creators must consider. When the Natural History Museum in London held an event showcasing a virtual reality experience called *Great Barrier Reef Dive*, they even included a health warning in the event announcement. It included the passage:

> The Gear VR should not be used by children under the age of 13. If you are pregnant, elderly, have pre-existing binocular vision abnormalities or psychiatric disorders, or suffer from a heart condition or other serious medical condition, please consult a doctor before using the Gear VR. Do not use the Gear VR if you are under the influence of any drugs or alcohol. Immediately discontinue use of the Gear VR if you experience any discomfort.[229]

Not only could reports of such a negative reaction damage the success of the museum's virtual reality programming, the warnings that museums may ethically be required to display may

[228] Ferree, interview.
[229] "Events Calendar - David Attenborough's Great Barrier Reef Dive," *Natural History Museum*, 2016, http://www.nhm.ac.uk/visit/whats-on/programs/nhm/david_attenborough's_great_barrier_reef_dive.html.

discourage people from even trying the experience in the first place. Visitors might find it daunting to put on a headset that carries the same warnings as medications and roller coasters. Yet, as technology developers and content creators seek the cause for this condition and adjust their product to neutralize it, sim sickness should become less of a problem.[230] For now, though, Ferree admits, "it's just something that you have to worry about. I mean, it's still… a very new technology and…it's still imperfect." Even augmented reality comes with some health concerns. Though it is less likely to make its viewer sick, it can prove distracting. While discussing the future of VR and the potentially dangerous way in which HMDs might distract their wearers, Pappenheimer said, "we even saw this with…AR, where we would walk out into the street ourselves in search of a good view and there were cars coming." These may be some of the most troubling concerns regarding the use of AR and VR by museums but they are also the ones that are the likeliest to get addressed as everyone from powerful technology developers to independent artists are looking for solutions. It is in everybody's best interests to find them.

Conclusion

The interviews and press releases analyzed in this chapter suggest several clear motivations and needs that museums, content creators, and technology developers bring with them into the collaborative projects that generate augmented and virtual reality content. Artists are motivated to work in AR and VR because of the way it allows them to relate to public space and to their audience. As museum theory drives museums to develop closer and more complex

[230] "AMD LiquidVR™ Technology for Developers," *AMD*, accessed April 20, 2016, http://developer.amd.com/tools-and-sdks/graphics-development/liquidvr/., "Oculus Best Practices: Simulator Sickness," *Oculus Developers*, accessed April 20, 2016, https://developer.oculus.com/documentation/intro-vr/latest/concepts/bp_app_simulator_sickness/., "VR vs. Simulator Sickness," *VRFocus*, accessed April 20, 2016, https://www.vrfocus.com/2014/03/vr-vs-simulation-sickness/.

relationships with their visitors, museum personnel might turn to AR and VR for the exact same reason. Technology developers who rely on the successful sale of their augmented and virtual reality devices find that entering into collaborations with artists and museums provides them with valuable insights and cultural capital.

Even as these parties have different motivations, their needs are predominantly shared. Museum personnel, artists, and technology developers all need resources from one another whether it be experience, knowledge, funds, technology, or marketing. Recognizing the needs of their partners, each party in a collaborative project can help to ensure that the relationships among them remain healthy, strong, and reciprocal, increasing the chance that they will continue into the future, spreading AR and VR as they go.

Chapter 4

Options for Preserving Alternative Realities

The previous chapters have focused primarily on augmented and virtual realities in production or on display. This chapter will look at what happens next. After an augmented reality or virtual reality experience is over, when museum personnel move on to focus on other artwork, events, and media, what happens to these experiences and what should happen? The simple answer: they should be preserved. But then the question is how? By whom? What will this "preserved" artifact look like? Ben Howell Davis, in the abstract to his conference paper "Cultural Memory," made this assertion in 1999:

> To maintain models of this nature ["virtual worlds" and "augmented reality"] over time is exceedingly problematic because not only must the data, the formats, and the storage media and display system be preserved, but also the modes of user interaction must somehow be inventoried.[231]

He follows up this list of physical and digital components of virtual and augmented reality "modes" with this poignant statement, "The implication that these time machines may not survive their own complexity is equally of concern."[232] Up until 1999, there had been little study of the preservation needs of virtual reality experiences Since then, only one document has been published that addresses these needs. This is, "Creating and Using Virtual Reality: A Guide for the Arts and Humanities," published in 2002 by the Arts and Humanities Data Service in London.[233] Additionally, several studies have been conducted on the preservation needs of time-

[231] Ben Howell Davis, "Cultural Memory," Virtual Worlds and Simulations Conference (The Society for Computer Simulation International, 1999), http://www.mit.edu/~bhdavis/CultMemory.html.
[232] Davis referred to "virtual worlds" and "augmented reality" as "content-clocks" and "time machines." Ibid.
[233] The definition of virtual reality expressed in this document is broader than the one followed in this thesis in that it includes desktop non-immersive virtual reality and even declares that to be the most popular form of VR at the time. Yet, it still provides valuable insight into the preservation of three-dimensional computer graphics.
Though the guide includes instructions on how to submit virtual reality experiences for inclusion in the Service's collection, it is unclear as to whether any works of the kind were ever submitted much less entered into the collection as the catalog holding that information is no longer available online. Kate Fernie and Julian D. Richards,

based media art which have similar preservation needs and considerations to virtual reality as described by Davis in the passage above. Conservators of virtual reality experiences may turn to these studies for guidance until further studies tailored to VR have been published.

These studies and working groups give their subjects many different names including variable media, time-based media, and digital art. Yet, they all refer to artwork that utilizes technological apparatuses such as computers or television sets, film, video, computer code, or computer software and often includes an element of interactivity. Examples of these studies include, Matters in Media Art, a "collaborative project between the New Art Trust (NAT) and its partner museums (The Museum of Modern Art, the San Francisco Museum of Modern Art SFMOMA, and the Tate), Smithsonian's Time-Based Media Art and Digital Art Working Group, Independent Media Arts Preservation (IMAP), and Inside Installations, a project by European institutions "to investigate the care and administration of installations work[sic] of art."[234] Thus, while the study of time-based media artwork is fairly new, it is also very active and has generated some common results and conclusions.[235] These include an acknowledgement of the diversity of the material and the need to tailor conservation and preservation efforts to each artwork, the importance of extensive documentation, and a desire, by museums, for the artist to actively assist and guide the preservation of their own work.[236]

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eds., *Creating and Using Virtual Reality: A Guide to Good Practice*, AHDS Guides to Good Practice (London: Arts and Humanities Data Service, 2002): 1.2, 6.5, http://www.vads.ac.uk/guides/vr_guide/index.html.

[234] "About IMAP," *Independent Media Arts Preservation*, accessed December 5, 2015, http://www.imappreserve.org/about/index.html., "Inside Installations," *Netherlands Media Art Institute*, accessed December 6, 2015, http://nimk.nl/eng/inside-installations., "Matters in Media Art," *Tate*, accessed November 16, 2015, http://www.tate.org.uk/about/projects/matters-media-art., "Media in Transition," *Tate*, accessed December 5, 2015, http://www.tate.org.uk/whats-on/tate-modern/conference/media-transition.

[235] The Smithsonian's Time Based Media and Digital Art Working Group and the Smithsonian Office of Policy and Analysis 14.

[236] Pip Laurenson, "Authenticity, Change and Loss in the Conservation of Time-Based Media Installations," *Tate Papers*, January 31, 2012: 6, 10-11, http://www.tate.org.uk/download/file/fid/7401., Pip Laurenson, "The Management of Display Equipment in Time-Based Media Installations," *Tate Papers*, January 31, 2012: 4-5,

In this thesis, I will refer to the artwork addressed in these studies as "time-based media and digital art," following the example of the Smithsonian's working group of the same name.[237] The working group defines their subject in this way, "Time-Based Media and Digital Art is artwork with a specific duration including film, video, digital, audio, computer-based, web-based, performance and installation art."[238] Though augmented and virtual reality may sometimes fit within this definition, they are rarely mentioned in these studies. Nevertheless, these research efforts can help to guide the way in which these here-to-fore neglected works are preserved.

Studies on the preservation of computer and video games are also valuable resources when preserving AR and VR experiences. One example of such as study is Preserving Virtual Worlds to whose final report I will refer often in this chapter. Preserving Virtual Worlds is a project supported by the Library of Congress and conducted by scholars from a variety of universities including Stanford University and the Rochester Institute of Technology.[239] It focuses on the preservation needs of "video games and interactive fiction" and aims "to develop basic standards for metadata and content representation of these digital artifacts for long-term archival storage."[240] Though virtual reality experiences, as I define them in this paper, could be included in the category, "video games and interactive fiction," Preserving Virtual Worlds deals predominately with two-dimensional virtual worlds such as *Second Life*.[241] Thus, this project

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http://www.tate.org.uk/download/file/fid/7344., The Smithsonian's Time Based Media and Digital Art Working Group and the Smithsonian Office of Policy and Analysis 4, 11, 13.

[237] The Smithsonian's Time Based Media and Digital Art Working Group and the Smithsonian Office of Policy and Analysis 2.

[238] Ibid.

[239] Jerome McDonough et al., "Preserving Virtual Worlds Final Report" (University of Illinois at Urbana-Champaign, University of Maryland, Rochester Institute of Technology, Stanford University, August 31, 2010): 5, http://hdl.handle.net/2142/17097.

[240] McDonough et al. 5.

[241] McDonough et al. 5.

should not be taken as a complete authority on the preservation of virtual reality experiences but may be blended with conclusions derived from time-based media and digital art preservation studies as well as those from the 2002 guide from the Arts and Humanities Data Service to form the blueprints of a new study devoted entirely to virtual reality and/or augmented reality.

The first and greatest lesson that can be learned from these studies is that, as Christiane Paul said in her interview with the author, "there is no silver bullet;" all artworks, even those of the same medium, need to be assessed separately in order to determine their preservation needs and the form the preservation should take. This is true even among the work of one artist. Though John Craig Freeman does believe "augmented reality should be preserved," he distinguishes between event-centric augmented reality artwork meant to be experienced within a certain span of time and other works that he wants to last beyond the moment.[242] Pip Laurenson, in her article, "Authenticity, Change, and Loss," introduces the idea of "work-defining characteristics" when speaking of time-based media installations.[243] For these artworks, "work-defining characteristics" might include "plans and specifications demarcating the parameters of possible changes, display equipment, acoustic and aural properties, light levels, the way that the public encounters the work and the means by which the time-based media element is played back."[244] The preservation section of the guide, "Creating and Using Virtual Worlds," creates a similar hierarchy of characteristics, referring to what Laurenson called "work-defining characteristics" as the ones with "*substantial importance*." As only some of the characteristics of an artwork are "work-defining" or of "substantial importance," they do not all have to be carried

[242] Freeman, interview.
[243] Laurenson, "Authenticity, Change, and Loss," 7.
[244] Laurenson, "Authenticity, Change, and Loss," 7.

through the preservation process.[245] Display equipment, which in the case of augmented and virtual reality consists of head-mounted displays, smartphones, tablets, computers, and various input devices, is perhaps the weakest or must vulnerable characteristic and thus, is one of the most often addressed characteristics in these studies.[246]

Determining the "work-defining characteristics" of the work in question, whether it be a virtual or augmented reality experience or another digital artwork, ultimately helps to guide the choice of which preservation method to use.[247] In her interview with the author, Christiane Paul described four potential "approaches" to preserving digital art, including VR: storage, migration, emulation, and reinterpretation.[248] With the exception of reinterpretation, the 2002 guide, "Creating and Using Virtual Reality," proposed the use of the same list of methods for VR preservation.[249] This chapter will look at several of these options with the addition of documentation as a preservation method in and of itself.

Maintenance

The solution that sounds simplest but, in fact, is least practical in the long run is collecting and maintaining technological devices to serve as back up to the originals used in the artwork. This is one of three solutions to technological obsolescence that Laurenson gives in her article, "The Management of Display Equipment." [250] In my interview with John Craig Freeman,

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[245] Ibid.
[246] For a description of various input techniques and devices see: Tony Parisi, *Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile*, Kindle Edition (Sebastopol, CA: O'Reilly Media, Inc., 2016): 17%, location 592. Laurenson, "The Management of Display Equipment," 6., McDonough et al. 5, 14.
[247] Ibid.
[248] In a follow-up email with the author confirming the accuracy of the passages drawn from her interview, Paul added the additional approach "storage." While I had originally listed documentation as one of her suggested approaches, she wrote, "In addition, documentation plays an important role in all of these approaches." Paul, interview, follow-up email April 26, 2016..
[249] Fernie and Richards 6.
[250] Laurenson, "The Management of Display Equipment," 6.

he described one of his virtual reality works from the 1990s that he recently prepared for display. Knowing that it would be inaccessible without the proper hardware and software, he had long since purchased and stored a computer with the system software of the time necessary to display the experience.[251] This is how he prepared for both software and hardware obsolescence. Yet, the hoarding of equipment is ultimately a unsound long-term preservation strategy as the legacy equipment will ultimately become unavailable on the open market even as the experts who know how to repair it disappear.[252] In the guide, "Creating and Using Virtual Reality," the authors refer to this as a "very high-risk strategy."[253] Thus, reliance on this preservation strategy would be unwise. Relying on the ability to replace, repair, and maintain equipment, is particularly difficult for VR, AR, and other forms of digital media art that use custom-made equipment or equipment that never made it out of the development stages. As noted in chapter three, John Craig Freeman worked with DAQRI to create an EEG-reading helmet.[254] If the company does not in fact push forward and include this technology more generally in their commercial helmets, it is likely that the helmet designed for EEG AR may be the only one of its kind. There will nothing to replace it with should it fail.

A similar idea presents itself when it comes to augmented reality art. This is the notion that augmented reality art simply remains where it is placed. In my interview with Christiane Paul, she said, "Another thing to point out here is that as long as a certain software exists and a project is not removed,…AR projects remain accessible in public space."[255] She continued by telling me of an experience she had in discovering augmented reality artwork "still hanging there

[251] Freeman, interview.
[252] McDonough et al. 14, 61.
[253] Fernie and Richards 6.2.4.
[254] John Craig Freeman, Skype interview with author, January 13, 2016, follow-up email April 11, 2016, May 8, 2016.
[255] Quoted passage modified by Paul in follow-up confirmation email, April 26, 2016.

in space," in the GPS-based virtual layer in which it had been installed, long after the event for which it had been placed there was over. Similarly, in his interview with the author, Freeman described a future utopian/dystopian world he imagines in which historical virtual content is mined from "some future version of the cloud."[256] Both Freeman and Paul understand that this is not a preservation solution, that there are limits to what can "hang there." Yet, because experiences like Paul's are likely to continue occurring at a greater regularity as augmented reality becomes more popular and more people start using it, there is the dangerous potential that people, including archivists, may begin thinking that the artwork is somehow self-maintaining.

Indeed, augmented reality is extremely fragile because of all the invisible connections that make it function.[257] Some of these connections are analog such as those between collaborators. John Craig Freeman noted that the collaborations that make augmented reality experiences possible can result in the incorporation of highly controlled intellectual property into the artwork that, without the support of the company, cannot be maintained. Others are digital. In his interview with the author, Will Pappenheimer explained the complexity of the connections involved in running augmented reality content on a hosted application:

> if Layar [an augmented reality browser] went out of business, you wouldn't be able to see how the content…manifests. So, in terms of preserving some of these projects, what I've thought about is to make a complete copy of the server, right? I can save the application,… Layar,…that goes onto my iPhone and I can save different versions of it, which I do. I will keep that, ok? But if Layar prevents…There are sort of three components to it. There's the application that you have on your phone, there is your database which is my database, if you will, and all the information and content and so on. Then there's Layar…as… the service provider so that … when you log onto Layar…on the…application, it communicates with Layar, the company's servers, right, and asks

[256] Quotation from follow-up email between author and artist on April 11, 2016confirming this passage.
[257] In Christiane Paul's Smithsonian Interview, she discussed a web-based artwork she recently preserved in which many of the included links were corrupt and her decision to make one preservation version of the artwork with the broken links and one with functioning ones. Christiane Paul, interviewed by Crystal Sanchez and Claire Eckert, transcript, Smithsonian Institution Time-Based and Digital Art Working Group: Interview Project, 5, April 25, 2013, http://www.si.edu/content/tbma/documents/transcripts/ChristianePaul_130425.pdf.

> what permission do I have and then Layar says, yes, you have permission. (obviously there's a step that…could stop you)…and then it asks, okay, let me communicate with the database because there's an endpoint connection from Layar to the endpoint, uh, database, um, and then that gives all the information to the phone about what is in that location or what is to be recognized. So, if Layar goes out, there's no longer, if you will, a reflector.

In the face of this inevitable disconnection, Pappenheimer suggests creating a description of the project and preserving the individual digital files so that the experience "could be reinstated on another platform."

Documentation

Documentation can serve as a guide to other preservation methods or be the sole step in the process. In the guide, "Creating and Using Virtual Reality," the authors argued, "No digital archivist can successfully preserve data that are not fully documented; with any strategy there is potential for information to be lost."[258] Christiane Paul and Will Pappenheimer both mentioned documentation in their interviews. Paul argued that, when it comes to augmented reality, documentation in the form of screenshots and video serves to "preserve" the otherwise easily lost context. When Pappenheimer, who had previously worked with Christiane Paul, spoke of documentation, he, too, celebrated its potential to preserve context:

> I have a lot of, uh, images and video and so on and, actually, to some of these projects, for me, the kind of the documentary video and documentary imagery is, in a sense, very close to the artwork, if not…part of the artwork itself because…it's a capture of the moment of the software, um, and hardware… in place at that time, taking in an image, okay? And who knows if that place will ever be the same.

He referred to the power of documentation to capture context with the words "moment" and "place" and the phrase "place at that time." However, he reflected that he has come into contact with some curators who did not seem to see documentation as anything significant and who

[258] Fernie and Richards 6.2.1.

claimed, instead, that it was "sideline." While all of the studies mentioned above deal with documentation to some extent, they often frame it as the gathering of information to guide further preservation attempts and not as a preservation plan in and of itself.

In addition to screenshots, the authors of "Creating and Using Virtual Worlds," suggest capturing information regarding the file types: "specification, version number and date of the format used" as well as details on the "plug-ins or viewers which can be used to view the application."[259] They even include a chart on the proper way in which to document virtual reality worlds in Dublin Core.[260]

The Archive of Digital Art has already begun to document a variety of virtual reality and augmented reality experiences created by such artists as Char Davies, Rebecca Allen, Tamiko Thiel (of Manifest.AR) and Jeffrey Shaw.[261] Though the entries for the various works included in the archive's catalog are inconsistent when it comes to the amount of metadata provided, some entries contain information on the technologies used, the way in which the work was installed in the gallery, a list of exhibitions, literature about the work itself, and pictures and videos. In addition to entries for individual works, the catalog includes entries for exhibitions, pieces of literature and scholarship, and artists. This type of documentation might prove invaluable to a museum collecting these works and might also serve as a model for the museum's own documentation practices for digital media art.

Migration

[259] This particular passage comes from the section on archiving "panoramas and bubble worlds." Fernie and Richards 6.3.1.
[260] Fernie and Richards 7.2.2.
[261] "Home," *ADA: Archive of Digital Art*, accessed May 25, 2016, https://www.digitalartarchive.at/nc/home.html.

In the glossary for Capturing Unstable Media, a research project undertaken by the V2, Institute for Unstable Media in the Netherlands, "migration" is defined as "to copy digital information from outdated media (storage media and software formats) to new, fresh, current media and formats."[262] The glossary entry goes on to stress the importance of standards, noting that "they are designed to be independent of any one application and thus require far fewer migrations in a given time period than quickly changing proprietary formats…" The entry also identifies the weakness of migration as a preservation strategy: "the 'look and feel' is endangered by this technique." The authors of the 2002 guide, "Creating and Using Virtual Reality," note the same weakness and add another: non-standard file formats may make migration impossible.[263]

Before getting too deep into the subject of file formats, it is necessary to note the reason they are important at all and the ways in which their fitness for archiving and long-term storage are determined. In the document disseminated by the AHDS, the authors asserted, "If researchers wish to preserve virtual reality for the future, the best strategy is to adopt standard formats."[264] They detailed two types of standard, "international or open" and "industry", both of which, they asserted, are likely to allow for future migration of data, with preference given to the first of the two types. By open, they meant a file format whose details and definitions are published and which are "implemented consistently by different software manufacturers." In contrast, "proprietary formats," formats that are often not provided to the public with full documentation and created and used by individual software companies, are less desirable for archival purposes

[262] "Capturing Unstable Media - Glossary," File, *V2_Institute for the Unstable Media*, January 19, 2004, http://v2.nl/files/2003/publishing/articles/glossary.pdf.
[263] Fernie and Richards 6.2.5.
[264] Though, ideally, according to the same document, the process of preparing an experience for preservation should begin at the time of its development. Fernie and Richards 6.2.5, 6.3.

as they depend on the continued health and interest of the software company that designs and utilizes them.[265]

Writing in 2002, the authors of the Arts and Humanities Data Service guide named the formats VRML 97 and X3D as standards fit for deposit with the Arts and Humanities Data Service.[266] Both of these formats have entries in Britain's National Archives' registry of file formats, Pronom, but neither appear on the Library of Congress' website, *Sustainability of Digital Formats: Planning for Library of Congress Collections*.[267] They are both under the care of Web3D, a "nonprofit organization that develops and maintains the X3D, VRML, and H-Anim international standards."[268] Thus, these file formats, X3D (extensible 3D) graphics and VRML, are standards used, admittedly, by a highly specialized community and they have been submitted by Web3D to the ISO, the International Standards Organization.[269] A brief exploration of the Web 3D consortium's website reveals that current work is being undertaken to use these standard formats in the creation of augmented and virtual reality experiences, though the consortium's definition of virtual reality is not as limited in scope as the one utilized in this paper.[270] Documentation of these standards can be found on the Web 3D consortium's website.

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[265] Fernie and Richards 6.2.2.
[266] Fernie and Richards 6.3-6.5
[267] "Sustainability of Digital Formats: Planning for Library of Congress Collections," *Library of Congress: Digital Preservation*, July 24, 2013, http://www.digitalpreservation.gov/formats/.,
The National Archives, "Virtual Reality Modeling Language 2.0," *The National Archives: The Technical Registry PRONOM*, June 11, 2012,
http://www.nationalarchives.gov.uk/PRONOM/Format/proFormatSearch.aspx?status=detailReport&id=662., The National Archives, "X3D 3.3," *The National Archives: The Technical Registry PRONOM*, August 28, 2013, http://www.nationalarchives.gov.uk/PRONOM/Format/proFormatSearch.aspx?status=detailReport&id=1370.
[268] "X3D Standards for Version V3.3," *Web 3D Consortium*, accessed May 25, 2016, http://www.web3d.org/standards/version/V3.3.
[269] "X3D Standards for Version V3.3," "Standards Adoption Process," *Web 3D Consortium*. http://www.web3d.org/standards/adoption-process
[270] "Mixed Augmented Reality (MAR)," "Videos," *Web 3D Consortium*, accessed May 25, 2016, http://www.web3d.org.

Though VRML and X3D are desirable formats from an archival standpoint, they do not represent the entire spectrum of file formats an archive or museum is likely to see when accessioning virtual and augmented reality works. The files that contain documentation of the work also must be maintained.[271] The authors of the guide, "Creating and Using Virtual Reality" also suggested maintaining, and migrating, "original data files" and "screen-shots."[272] Later in the guide, they identified the types of data that should be accessioned and maintained for different types of virtual worlds including "archaeological reconstructions," "panoramas and bubble worlds," and those constructed in Java3D.[273] Their recommendations often included the submission of various stages and elements of the virtual world including models, "original source files" for "archaeological reconstructions" and, for worlds constructed using Java3d, "a report which illustrates the world and describes how it was used."[274]

Though augmented reality art would no doubt benefit from similar treatment when it comes to the migration of documentation files, there are a few other file types to consider for the artwork itself. In an email to the author, artist John Craig Freeman, provided some insight into the types of data files a museum might expect from his augmented reality art. He wrote, "I keep the master asset files on my computer and backup drives in multiple formats including .ma, .obj and .fbx." According to Autodesk's Knowledge Network, .ma, .obj, and .fbx are all file formats that can be exported from their software, Maya, though .ma files are the only ones of the three that "preserve[s] all the information contained within your scene."[275] Maya ASCII files (.ma

[271] Fernie and Richards 6.2.5.
[272] Ibid.
[273] Fernie and Richards 6.3.1-3.
[274] Ibid.
[275] Autodesk. Help, "Supported Data Export Files," *Autodesk Knowledge Network*, May 11, 2016, https://knowledge.autodesk.com/support/maya/learn-explore/caas/CloudHelp/cloudhelp/2016/ENU/Maya/files/GUID-864BD203-C437-4481-8BFC-3A6C1D2C824C-htm.html.

files) are "the native ASCII file format used by Maya" and documentation for this format can be found on the Autodesk website.[276] According to a glossary published with Autodesk Maya 2011, .fbx "is a free platform-independent 3D authoring and interchange format that provides access to 3D content from most 3D vendors and platforms."[277] Delivery to the Layar application requires Freeman, and other content creators, to put the content in the proprietary file format, .l3D. Thus, Freeman appears to keep his artwork in a mixture of proprietary and non-proprietary file formats and it is one of these proprietary formats, .ma, that contains the most complete set of information. This may lead to some complications when it comes to preservation and would have to be addressed if his works were accessioned into a museums collection.

Emulation

Another preservation solution for time-based media and digital art is emulation. Recognizing the flaws in the hoarding strategy, some experts participating in the Smithsonian Interview Project suggested the use of "emulation" as an alternative to "trying to keep an obsolete technology alive."[278] An art-specific definition of "emulation" may be found in the Glossaurus created by DOCAM (Documentation And Conservation of the Media Arts Heritage) and it reads: "To emulate a work is to devise a way of imitating the original look of the piece by different means. The term can be applied generally to any refabrication of an artwork's components…"[279] More generally, "emulate" is defined in the Merriam-Webster dictionary as

[276] "Glossary: .ma File Format," *Autodesk Maya 2011 User Guide*, accessed May 25, 2016, http://download.autodesk.com/us/maya/2011help/index.html?url=./files/Glossary_M_ma_file_format.htm,topicNumber=d0e203834.
[277] "Glossary: .ma File Format," *Autodesk Maya 2011 User Guide*.
[278] The Smithsonian's Time Based Media and Digital Art Working Group and the Smithsonian Office of Policy and Analysis 11.
[279] Note: In the context of this paper, emulation may be digital or may be the physical substitution of objects. "Emulation," *Glossaurus* (DOCAM: Documentation and Conservation of the Media Arts Heritage), accessed December 6, 2015, http://www.docam.ca/en/see-the-glossaurus.html.

"to strive to equal or excel" or "to equal or approach equality with."[280] Emulation, however is not perfect and, in the end, strives for more than it actually achieves. According to the final report of Preserving Virtual Worlds, "Playing through an emulator varies from the original experience because the emulator is designed to execute on hardware that is radically different from the original platform and corresponding system architecture" and, often, "visual and aural aspects of the work can be strongly affected by running under emulation."[281] Despite the inexactitude of the match between emulation and the original artwork (or game), emulation can still prove valuable. In a paper from the Inside Installations project in the Netherlands, Gaby Wijers writes, " The results demonstrated that emulation is a viable option for presenting the works in the future, firstly for the short-to mid-term preservation, as current technological equipment will also become obsolete, and secondly for the long term, at least to compare functionality."[282] The writers of the guide, "Creating and Using Virtual Reality" went further: "For virtual reality applications that are dependent on specific hardware and software, emulation may be the only option."[283]

Emulation could be used for the preservation of virtual reality in much the same way as time-based media and digital art. In the case of VR, the obsolescing technology is primarily the HMD. As virtual reality has grown in the past several years, many different head-mounted displays have been designed. What is encouraging about virtual reality is that VR experiences

[280] "Emulate," *Merriam-Webster Dictionary*, accessed December 7, 2015, http://www.merriam-webster.com/dictionary/emulate.
[281] Jerome McDonough et al. 6, 61.
[282] Gaby Wijers, "To Emulate or Not: Conservation Case Studies From the Netherlands," in *Inside Installations. Theory and Practice in the Care of Complex Artworks*, ed. Tatje Scholte and Glenn Wharton (Amsterdam: Amsterdam University Press, 2011), 81, http://nimk.nl/_files/Files/page81-90.pdf.
[283] Fernie and Richards 6.2.5.

are often made available on multiple platforms.[284] Thus, it can be assumed that, for many experiences, the brand and nature of the HMD platform is not a work-defining characteristic. Similarly, other characteristics that impact the visual qualities of the experience such as resolution are altered to match the abilities of each HMD. What is important to emulate, however, is the experience's interactive elements and certain other characteristics such as the image's latency which is necessary to a comfortable experience.[285]

Reinterpretation

Perhaps the most radical preservation strategy is reinterpretation. In my interview with Christiane Paul, she suggested that a work should be reinterpreted rather than migrated when the intent or heart of the experience is obscured by graphics that are overly dated and limited by the technology available when the work was completed. She asserted,

> right now, AR is just in its beginning stages, so many of the models and a lot of the work still looks fairly crude. Ten years from now, it might look awkward if it was preserved as is. Given where the technology might be in ten years,…one would have to ask, well, shouldn't this be reinterpreted?...Shouldn't the project be recreated and perhaps pushed to a different level conceptually because now the technology has arrived? And that decision can only be made looking at each individual project.[286]

In other words, augmented reality experiences with work-defining characteristics that do not include a specific set of graphics, can be liberated from the restrictions of the technology on which they were created.

Responsibility

[284] The multi-platform release of VR experiences can also be a problem as it leads to the question of which one should be preserved. The same dilemma was addressed in "Preserving Virtual Worlds Final Report." McDonough et al. 14.
[285] "AMD LiquidVR™ Technology for Developers," *AMD*., "Oculus Best Practices: Simulator Sickness," *Oculus Developers*.
[286] Passaged altered for clarity by Paul in follow-up confirmation email, April 26, 2016.

Before preservation strategies can even be considered, someone needs to take responsibility for preserving the artwork. For now, it is in the hands of the content creators. When asked about preservation, Douglas Gann of Archaeology Southwest said, "For now I see it as the author's responsibility to preserve both the virtual work and a dedicated copy of the operating system that the exhibit runs upon." This is unsurprising and desirable in so far as preservation should begin prior to project completion. In the guide, "Creating and Using Virtual Reality," the authors wrote, "Perhaps the best way of preserving virtual reality for the future is to consider archiving material from the start of a project and not just at its completion."[287] John Craig Freeman preserves his own artwork, yet, he believes that museums should eventually be the ones to take up this task as an artist cannot live forever.[288] Freeman said, "If I die tomorrow, then my accounts would go fallow and the service provider would probably close the account and delete all of the database that the files reside on. So, in my mind, as an artist, I can only do so much with the resources I have." He does not believe that all of his works need to be preserved for the long-term, only those that continue to have meaning beyond a certain event such as his project, *Border Memorial: Frontera de los Muertos*, which marks the locations where migrants have died trying to cross the border from Mexico.[289] When I asked Pappenheimer about preservation he, like Freeman, primarily talked about the actions he took to preserve his own artwork. Yet, he mentioned that in his collaborations with the Whitney Museum and Christiane Paul, he was able to have his artwork placed on the museum's servers and even entered into the

[287] Fernie and Richards 6.1.1.
[288] Freeman, interview.
[289] Freeman, interview., "Border Memorial: Frontera de Los Muertos," *John Craig Freeman*, accessed April 5, 2016, https://johncraigfreeman.wordpress.com/border-memorial-frontera-de-los-muertos/.

museum's permanent collection. Though he noted that this was a rare case, it does show that some progress is being made.

Once we move past the stage where the artist is the sole conservator of his/her work and museums begin to take on that role, there continues to be a question of how and to what degree the artist should remain involved. According to the analysis and summary of the Time-Based Media and Digital Art Working Group's interview project, many of the interviewees saw artists as very important to the preservation process.[290] In my interview with Christiane Paul, she said:

> The artist always plays a very important role in the preservation process. Typically, collecting art institutions that have to preserve the work by mission, would gather a lot of information when the work enters the collection and also do interviews with the artist about future preservation strategies.[291]

Pip Laurenson from the Matters in Media Art project also placed a high degree of value and authority on the artist's "instructions" regarding the "identity" of their artwork.[292] This is a case where documentation is referred to as a means to inform other preservation strategies.

Conclusion

In this chapter, I explore the fact that, in terms of preservation, virtual reality and augmented reality are not really that different from anything that has been seen before. During our interview, Christiane Paul reminded me that the "no silver bullet" policy of preservation "is not specific to digital art but" stretches even further back than the studies of time-based media and digital art to paintings and other more traditional forms of art.[293] Museum professionals'

[290] The Smithsonian's Time Based Media and Digital Art Working Group and the Smithsonian Office of Policy and Analysis, "The Smithsonian Interview Project: Questions on Technical Standards in the Care of Time-Based and Digital Art: Ten Insights from Artists and Experts in the Field," July 2014, http://www.si.edu/content/tbma/documents/SI_TBMA_10_Insights.pdf.
[291] Passaged altered for clarity by Paul in follow-up confirmation email, April 26, 2016.
[292] Pip Laurenson, "Authenticity, Change and Loss in the Conservation of Time-Based Media Installations," *Tate Papers*, January 31, 2012, http://www.tate.org.uk/download/file/fid/7401.
[293] Second quoted passage added by Paul in follow-up passage confirmation email, April 26, 2017.

experience preserving these older media can guide them insight into caring for AR and VR artworks but only if they take the time to draw the connections. Using studies on the preservation of other forms of art as a guide, conservators of AR and VR may choose to maintain obsolescing technology and software, document the experience's function, purpose and design, or choose instead to emulate or re-interpret it, based on the experience's "work-defining characteristics**."**

Conclusion

In the last three chapters, I have analyzed the ways in which augmented reality and virtual reality experiences have entered the museum as invited guests and invaders, works of art and educational tools. Their ability to be created and placed in spaces of alternative reality tethered to the physical world but ungoverned by its traditional power structures, can make AR and VR appear threatening. Yet, it is exactly their ability to create and fill these spaces that makes them valuable to the "new museum" described by Gail Anderson. Gail Anderson's "new museum" is "audience focused," a "community participant," a "knowledge facilitator," and supports "multiple viewpoints" over one "voice of authority."[294] As discussed in the chapters above, augmented reality and virtual reality can be used to support all of these characteristics and more.

AR and VR are brought into museums by the collaborative efforts of several groups named here as museum personnel, content creators (independent and corporate), technology developers, visitors (users), and non-profit and government agencies. Each has a unique role in these collaborations and as interviews with museum staff, Christiane Paul and Joel Ferree, independent artists, John Craig Freeman and Will Pappenheimer, and corporate content creators, Douglas Gann and Steve Colmer, suggest, each group has its own unique motivations and needs. In the broadest sense, each group offers the others some resource that they need, whether it be knowledge, technology, funding, a marketing team, or a reputation. Perhaps the greatest challenge to contend with in these collaborations is ensuring that all of these group members agree on the nature of their creation, whether it is an artwork, a corporate asset, or a

[294] Anderson 3-4.

technologically-advanced exhibition label. Failing to achieve an agreement on this level, could not only damage the success of the current project but any plans to collaborate in the future.

Facing the obsolescence of both their hardware and software, AR and VR projects might easily live no longer than the exhibition or event for which they were created. Though there have few studies specifically on the preservation of virtual or augmented reality projects and none have been conducted in the last decade, a study from 2002 along with more recent studies on time-based media, digital art, and games, suggest five main options for preservation: hardware and software management, documentation, migration, emulation, and reinterpretation. Each project should be considered unique and its "work-defining characteristics" assessed in order to discern the appropriate preservation strategy.[295]

In the end, virtual reality and augmented reality are, in many respects, not that unique. Both Freeman and Pappenheimer used other media and technologies before turning to augmented reality.[296] Of his choice to pursue augmented reality, Freeman said, "If you ask any of the group from Manifest.AR, augmented reality was convenient, and a form that spoke to the time and it continues to do so but really, the concepts are what came first in all of our minds." Pappenheimer likened augmented reality to earlier art forms like collage. Neither does virtual or augmented reality, according to Christiane Paul, demand any new curatorial protocol, "specific

[295] Pip Laurenson, "Authenticity, Change and Loss in the Conservation of Time-Based Media Installations," *Tate Papers*, January 31, 2012, 7, http://www.tate.org.uk/download/file/fid/7401.
[296] Before Char Davies worked with virtual reality, he was a painter. Char Davies, "Virtual Space," *Space: In Science, Art and Society*, ed. François Penz, Gregory Radick, and Robert Howell (Cambridge University Press, 2004), 69–104, https://books.google.com/books?id=nzbuV_WWS5EC. Full text accessed at: www.immersence.com, May 17, 2016., John Craig Freeman, Skype interview with author, January 13, 2016, follow-up email April 11, 2016., Will Pappenheimer, phone interview with author, January 20, 2016, follow-up email April 20, 2016.

technical demands aside."[297] When asked how she explains the AR and VR artwork to her colleagues, she replied:

> of course you have to explain the technological specifics and how they work, and what makes the work interesting within them but I also always try to steer away from technical formalities and argue on the basis of artistic merits alone. Whether a work is good art is not at all dependent on its medium. And that's the last thing I would ever want to suggest because I believe that it would just undermine everything I would want to achieve as a curator if I propose augmented or virtual reality because it's hip and new.[298]

Even if AR and VR are simply treated as new types of media, they, like other forms of new media and time-based art, depend on technologies that befuddle museums ill-equipped in terms of knowledge and experience to deal with them. Independent of specific medium, museums need guidance and artists need resources. Technology companies like Samsung sponsor and support projects that include but are not limited to virtual and augmented reality and, in exchange, receive creative insight from artists and positive press for their efforts. Though augmented and virtual realities should be celebrated for what makes them different, the use of these technologies will only be effective if their similarities to other media and technologies are acknowledged.

[297] Quoted passage added by Paul in follow-up passage confirmation email with author, April 26, 2017.
[298] Passage modified for clarity by Paul in follow-up email April 26, 2016.

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