

Preserve Your Cake and Eat It Too:
Issues in the Conservation and Preservation of Video Games

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Introduction

The past decade has seen an exponential rise in video game scholarship and preservation, as video games edge their way into cultural institutions, most notably libraries, university archives, and museum collections. Commercially released video games were never intended to be collected for their historical significance, but their cultural impact is undeniable. Institutions beginning to collect or acquire such complex works as video games are faced with new challenges from acquisition to exhibition to conservation. Conservation is particularly challenging because the choices a conservator or preservationist makes now will how or even if the video game is accessible to a future audience.

Collecting Video Games

There are also collections and museums devoted solely to video games and are taking different approaches to how they are handling them. These include The Computerspielmuseum in Berlin, the International Center for the History of Electronic Games (ICHEG) in Rochester, NY or The Museum of Art and Digital Entertainment (The MADE) in San Francisco. Each museum acquires, exhibits, and conserves video games and contributes to video game research in slightly different ways.

The Computerspielmuseum opened in 1997, and was the first museum dedicated video and computer games. Since 2011, it has maintained a permanent exhibition called “Computer Games: Evolution of a Medium” which recognizes the cultural, social and artistic heritage of digital interactive entertainment.¹ The museum partnered with other organizations in Europe from 2009-2012 for the Keeping Emulation Environments Portable (KEEP) Project, an initiative to investigate the legal and technical issues of emulation as a preservation strategy.² KEEP wrapped up in 2012 but the Computerspielmuseum remains active in research initiatives and advocates for video game preservation.

ICHEG takes similarly expansive approach to video game preservation by collecting games and their related hardware along with electronic game ephemera such as publications, packaging and advertising, and game related products. The center also promotes scholarly research by making the materials available to researchers and producing exhibitions from their collection.³

Although very similar to ICHEG’s goals, The MADE, which opened in 2011 in San Francisco, takes a more active initiative in event and community programming to raise awareness in video game preservation. In building its

¹ "About KEEP." KEEP Project. Accessed April 13, 2013. <http://www.keep-project.eu/ezpub2/index.php?/eng/About-KEEP>.

² Other consortium members include Joguín SAS, Koninklijke Bibliotheek, University of Portsmouth, Deutsche Nationalbibliothek, Cross Czech a.s., Tessella, and European Games Developer Association.

³ "About." International Center for the History of Electronic Games. Accessed February 16, 2013. <http://www.icheg.org/about>.

collection, The MADE is focusing on games that are ten or more years old, as they feel these games are most at-risk. The museum specifically preserves the code for games. In doing so, they not only document and preserve the original code but the revisions to games as well. This strategy allows the organization to document and reveal the design process and, as Alex Handy, one of the founders describes, “allow us to see when, why and where changes were made.”⁴ Through regular programming, including lectures, parties or community events, The MADE is active in outreach and education and promotes video games as an artistic medium.⁵

Whether they are active politically, socially, or academically, an important point to make regarding these organizations and their missions is how quickly they have grown and how active each one is. Video game preservation is a burgeoning field that, as a research endeavor, relies on the interest and enthusiasm of those advocating for it. As the projects and initiatives detailed below will demonstrate, research into the preservation of interactive works has been building over many years, with an increasing amount of attention being paid to implementing preservation strategies previously identified in other fields. Conservators and preservationists are beginning to merge the strategies of adjacent fields, notably digital preservation and new media art conservation. This merger is essential to video game conservation and preservation.

In November 2012, the Department of Architecture and Design (A&D) at the Museum of Modern Art (MoMA) announced the inclusion of fourteen video games to their collection.⁶ Immediately, the news groups, bloggers, and critics were asking the same questions they asked before: “Are video games art? Do they belong in an art museum? Are video games worth conserving?” But now with a new question: Are video games design?

Art and Design at MoMA

Design is about effective communication or lack thereof, and interaction revolves around various forms of communication. Interaction is “mutual or reciprocal action or influence.”⁷ While there are many works which are widely regarded as being interactive, it is important to note that digital media is not necessarily interactive nor is interactive art necessarily digital. However, as scholars Seth Giddings and Helen Kennedy state, “digital media interactivity becomes the central mode of engagement with screen information, images and

⁴ Alex Handy, phone conversation with author, January 17, 2013.

⁵ “What Are We?” The Museum of Art and Digital Entertainment. Accessed April 29, 2013. <http://www.themade.org/content/what-are-we>.

⁶ Paola Antonelli, “Video Games: 14 in the Collection, for Starters.” *Inside/Out* (blog), November 29, 2012. http://www.moma.org/explore/inside_out/2012/11/29/video-games-14-in-the-collection-for-starters/.

⁷ Merriam-Webster. Accessed April 10, 2013. <http://www.merriam-webster.com/dictionary/interaction>.

worlds.”⁸ This description brings up a good point: the difference between engagement and interaction.

There are some scholars who take a broad approach to defining how an audience interacts with a work of art, and one could claim that viewing a painting on a wall is interacting with it. Except the influence is not mutual. The terms engaging, or engagement, better describe *how* an audience would view any work of art, either dynamic or static. One can be engaged by a moving image in a theater and react to it, yet they do not influence the narrative or the end result. In contrast, the act of “playing” with digital media raises the level of engagement to become more intricate and multifarious.⁹ The player must read and decipher meanings as images and text move across the screen. Video game scholar Sean Fenty notes how “as an interactive medium, video games give over a great deal of control to players that other media retain.”¹⁰ To summarize, the viewer becomes engaged when they react to a work of art. The viewer becomes a “player” when they can react—or become engaged—and have the ability to influence or manipulate the work. Interaction is a step in the evolution of viewing. In the case of a video game, the player can manipulate the storyline and the outcome based on their reactions essentially making a video game an assortment of input and output exchanges. This is how the term interaction will be used throughout this paper.

With their exhibition, *Talk To Me: Design and Communication Between People and Objects*, which took place from July 24th to November 7th in 2011, the department began a conversation with the museum audience on human to object interaction and, accordingly, the relationship between humans and technology. The exhibition included materials such as “interfaces, information systems, visualization design, and communication devices”, with a focus on how these materials invoke an “emotional, sensual, or intellectual connection with their users.”¹¹ In determining what art objects, either material or immaterial, to acquire or present for this exhibition and others, the A&D department follows a set of criteria that aligns with the department’s mission as well as the broader mission of the museum.

In selecting works, A&D considers both form and function, or how and why the object exists. “Objects have to communicate values that go well beyond their formal—and functional—presence, starting from the designer’s idea and intention.”¹² *Form* is identified as the beauty of the piece through its construction

⁸ Seth Giddings, and Helen W. Kennedy. “Digital Games as New Media.” in *Understanding Digital Games* ed. Jason Rutter and Jo Bryce. pp 129-148. (New York: New York University, 2006) 137. doi: 10.4135/9781446211397

⁹ Ibid, 138.

¹⁰ Sean Fenty. “Why Old School Is ‘Cool’” In *Playing the Past: History and Nostalgia in Video Games*, by Zach Whalen and Laurie N. Taylor. (Nashville: Vanderbilt University Press, 2008) 25.

¹¹ “EXHIBITIONS: Talk To Me.” MoMA. Accessed April 30, 2013.

<http://www.moma.org/visit/calendar/exhibitions/1080>.

¹² Department of Architecture and Design. “Our Idea of Great Design.” *Talk to Me: Beyond the Galleries*, Blog. Accessed April 25, 2013. http://wp.moma.org/talk_to_me/about/our-idea-of-great-design/.

and appearance. The object's *function* is defined by the purpose of the object. These two principles go hand in hand, with some give or take on either end. The designer imposes a meaning on the object through form and function but the audience must also be able to impose their own meaning through personal perspectives and experiences. What is beautiful or functional for one person may not be so for another.

A&D also takes into account innovation, necessity, and process. Experimental design works with “new and promising forms, materials, or structures” to address old and new problems.¹³ *Innovation* is both the incorporation and application of these elements. *Necessity* questions whether or not the object is essential to its audience, which can also include objects that inspire innovation but are not necessarily vital in and of themselves. The *process* considers the lifecycle of the object, such as what material went into development or how it was distributed.¹⁴ The first two elaborate on the function of the piece, while the third provides background and along with the original context of the work.

Finally, the curators also identify the direct or indirect cultural impact of a piece. The *cultural impact* takes a broader view by looking beyond the piece to its environment and its use or acceptance by the intended audience.¹⁵ The ways in which the audience gauges the form and function of a piece affects its cultural impact. Good design builds upon accepted facts and notions on both the individual and social levels, so how the object affects or adapts those preconceptions and how the audience perceives these changes also determines cultural impact.

Returning to the earlier questions of whether or not video games are art or design and if they belong in an art museum, the answer is yes. Video games are a form of complex art that integrates and often inspires new technologies and forms of interaction and communication. They belong in a museum as much as any other object recognized for its cultural, artistic, or historical significance. The saturation of video games in contemporary culture is evidence of their significance and validates their place in cultural institutions, including art museums. Yet their existence as complex works with both physical and nonphysical components presents concerns for their conservation as art objects.

This research project addresses the methodological approach to preserving video games once they have been acquired, although assessment should occur prior to acquisition. It aims to determine what aspects of the process should be emphasized for preservation. While obtaining source code is argued as a priority for preservation, this project asserts how other factors, such as designer input, production materials, and documentation can be essential to the preservation of

¹³ Ibid.

¹⁴ Ibid.

¹⁵ Ibid.

the technological elements of video games in the museum setting. The case study for this project is the preservation of *Portal* by MoMA.

Portal: an Introduction

One of the fourteen games to be exhibited and preserved by MoMA is *Portal*, developed by Valve Corporation and released in 2007. The game concept was designed by a group of students at DigiPen Institute of Technology who were hired by Valve to bring the project to full fruition.¹⁶ The *Portal* development team at Valve has been working with MoMA's conservators to assist with this project. They are very open and willing to share their knowledge and provide the conservation department at MoMA with any materials needed to properly exhibit and preserve the game, making *Portal* an excellent choice for a case study. *Portal* is a single-player online puzzle game. The description from the Valve website:

Set in the mysterious Aperture Science Laboratories, players must solve physical puzzles and challenges by opening portals, maneuvering objects, and moving themselves through space in ways that used to be impossible.¹⁷

Players work their way through different levels (also referred to as rooms or test chambers), with each level building on the skills learned in the previous levels. Throughout the game, a computer named GLaDOS promises a reward of cake at the end of the testing, while writings and scratches on the wall warn the player "the cake is a lie." "The cake is a lie" became a catchphrase in the *Portal* gaming community and helped promote the game to wider audiences.

Video Games as Art and Design

Spacewar!, ostensibly the first computer or video game, was developed on the PDP-1 computer in 1961 and used to demonstrate the capabilities of the technology.¹⁸ It was highly praised for its innovative and creative use of programming. Today, video games are considered less revolutionary feats of technological advancement, and more disposable products of the entertainment industry. Media scholar, Henry Jenkins, notes how most games are developed with "the fun factor" in mind, which he also describes as "the quality of the emotional experience they offer players".¹⁹ There is a discernible parallel to early cinema

¹⁶ Jeep Barnett, interview with author,

¹⁷ "Games: Portal." Valve. 2013. 04 January 2013. <http://www.valvesoftware.com/games/portal.html>.

¹⁸ "Restoring the DEC PDP-1 Computer Exhibit: Spacewar!" Computer History Museum. Accessed April 13, 2013. <http://pdp-1.computerhistory.org/pdp-1/?f=theme>.

¹⁹ Jenkins, Henry. "Games, The New Lively Art." In Jeffrey Goldstein (ed.) *Handbook for Video Game Studies*. (Cambridge, MIT Press, 2005). Available at: <http://web.mit.edu/cms/People/henry3/GamesNewLively.html>

evident in the rise of video games. Games are often revered for being “cinematic” in their effects, or how well they depict real world actions.²⁰ Websites such as gametrailers.com or IGN Entertainment offer promotional trailers prior to a game’s release. One of the most obvious correlations is nostalgia: the way a cinephile remembers the first time a movie transformed them, a gamer often remembers the first game they played or the one which sparked their interest in the video gaming world. Fenty defines nostalgia as “the emotional by-product of change” and refers to classic video games as “nostalgic artifacts.”²¹ In cinema studies, most notably in film preservation, films are often described as physical artifacts,²² and more so now in the post-video and current digital era where materiality is becoming increasingly scarce.

Like early cinema, games are at risk of being lost due to neglect. Yet unlike early cinema, many games are also at risk of digital decay in addition to physical deterioration. In discussing Gilbert Seldes treatise on *The Seven Lively Arts* from 1924, Henry Jenkins draws this parallel to cinema as well:

Readers then were skeptical of Seldes’ claims about cinema in particular for many of the same reasons that contemporary critics dismiss games—they were suspicious of cinema’s commercial motivations and technological origins, concerned about Hollywood’s appeals to violence and eroticism, and insistent that cinema had not yet produced works of lasting value. Seldes, on the other hand, argued that cinema’s popularity demanded that we reassess its aesthetic qualities.²³

A researcher does not need to search for long to find news articles or op-ed columns concerning the violence in video games and how graphic and immersive imagery is negatively impacting children and society.²⁴ However not all games have a potentially negative impact. The field of education has been inspired to incorporate video games into the curriculum to create a richer, more engaging atmosphere and hopefully get kids interested in technology and mathematics.²⁵ The health sector continues to use video games for rehabilitation and physical

²⁰ Whalen, Zach, and Laurie N. Taylor. "Playing the Past: An Introduction." Introduction to *Playing the Past: History and Nostalgia in Video Games*. (Nashville: Vanderbilt University Press, 2008).

²¹ Fenty, "Why Old School Is 'Cool'" In *Playing the Past* (2008) 20.

²² Anthony Slide, *Nitrate Won't Wait: A History of Film Preservation in the United States*. (Jefferson, NC: McFarland &, 1992) 151. Quoting the Court of Appeals regarding a 1988 verdict by the U.S. Claims Court, which refers to nitrate negatives as ‘historical artifacts.’

²³ Jenkins, “Games, the New Lively Art.” 2005.

²⁴ Benedic tCarey, "Shooting in the Dark." The New York Times. February 12, 2013.
<http://www.nytimes.com/2013/02/12/science/studying-the-effects-of-playing-violent-video-games.html>.

²⁵ Toppo, Greg. "Video Game Invades Classroom, Scores Education Points." USA Today. March 04, 2013.
<http://www.usatoday.com/story/news/nation/2013/03/04/video-games-education-simcity/1963239/>.

therapy, plus now, they are even developing games specifically for this purpose.²⁶

The growing scholarship on game preservation is usually approached from a nostalgic perspective and there are many benefits to this approach. Researchers, archivists, and preservationists are often gamers themselves; most game study scholars entering the field today grew up with video games and are thus equipped with familiarity of a games' interactivity. The role of nostalgia is a testament to the cultural impact of games; it brings the past to the present and in view of fresh eyes. With regards to game preservation and with credit to nostalgia, many otherwise lost or inaccessible games are still available to gamers through emulations of the older technologies and underground resources.

Alex Handy of The MADE describes these methods as "underground quasi-legal" strategies in preservation. He and The MADE do not condone or participate in these strategies but he does stress that many games would be unavailable today without the efforts of the underground community.²⁷ The legality of these practices is questionable while the justification is fair: if no one else, then who? Legal rights are an important topic to address in video game preservation; however, they are not applicable to this paper and will be addressed only as they pertain to specific projects and strategies.

In order for museums, or many other cultural institutions, to treat video games as conservable heritage, nostalgia and appreciation of form must be combined with recognition of function and technology. A goal of A&D is to present the video games as feats of engineering, a form of interaction design and art.²⁸

Terminologies

As with the definition of interaction, video games as a form interactive art is still a broad classification. There are many types of interaction and understanding the different types helps curators and conservators identify the significance of the work. The existing taxonomy in the game development industry and gaming community informs how these interactions can be identified and what a museum can glean from them. For reference, a working glossary of terms used throughout this paper is available in Appendix A.

Genres

Most developers, players, and scholars divide games into genres, or into various categories and sub-categories, such as role-playing game (RPG), fighter, adventure, or puzzle and so on. Different categories have a distinct style of play

²⁶ Ashley Southall, "Specialists See Tools to Treat Pain in Video Games." The New York Times. April 21, 2013. <http://www.nytimes.com/2013/04/21/health/in-gaming-some-see-tools-to-treat-pain.html?hp>

²⁷ Alex Handy, email message to author, April 19, 2013.

²⁸ Antonelli, "Video Games: 14 in the Collection, for Starters." 2012.

that defines them and these categories are primarily market-driven, catering to the preferences of the players.²⁹ A genre category implies what skill sets the players may need to use and is more of a guide than taxonomy for what the player should expect. A good comparison is a fighting game vs. a role playing game as these often have different objectives. A fighting game is about beating an opponent, either the computer or another player while in an RPG, the player takes the persona of a character in order to act out a narrative. By acknowledging how the gaming community utilizes this vocabulary, curators and conservators can have a better understanding of how to determine the significance of a game.

The above example is one of the most basic, yet it is still arbitrary. In their book, *Understanding Video Games*, scholars Simon Egenfeldt-Nielsen, Jonas Heide Smith and Susana Pajares Tosca from the University of Copenhagen define genre as “analytical constructs imposed on a group of objects in order to discuss the complexity of their individual differences in a meaningful way.”³⁰ The authors go on to recommend criteria for categorizing the content in games: rather than defining the game by strategies or themes, they propose defining a game by its goals and how the player achieves a goal. With this criteria, the games can be divided into four categories: adventure games, which involve problem solving and logic skills; action games involve battles and requires fast reflexes; strategy games, require a player to “analyze interdependent variables”; and process-oriented games, which involve exploration and where the journey is the goal.³¹

Genre lists are open to interpretation and have evolved over time. Most games are designed with any combination of the above themes in mind, which can determine how the player interacts with the game. It should also be noted that most games are hybrids and involve more than one of these themes or genres. It is not necessary to go into more detail or evaluate the genres here but in considering video game conservation, it is important to understand the genres create variations in human-computer interactions by defining the rules of interaction. The information above demonstrates examples to approaching genre, but this paper does not prefer one over the other. The information is intended to provide information to the curators and conservators and call attention to different possibilities in recognizing interactions between human and computer and how those interactions can affect significance. These interactions are made possible by how the game is built, or the technological structure.

²⁹ Thomas H. Apperley, "Genre and Game Studies: Toward a Critical Approach to Video Game Genres." *Simulation & Gaming* 37, no. 1 (March 01, 2006): 6-23. doi:10.1177/1046878105282278.

³⁰ Simon Egenfeldt-Nielsen, Jonas Heide Smith and Susana Pajares Tosca. *Understanding Video Games: The Essential Introduction*. (New York: Routledge, 2013) 46.

³¹ Ibid, 50.

Building a Game: Tools as art

There are two primary digital assets with regards to video games: the source code and the executable file. Creating an executable file from source code follows a basic series of steps. A programming language is used to create source code, the same way the letters of an alphabet create a sentence. An editor, which is a program similar to a word processor, is used to create and save the code as a source file. Next, the source file is processed through a compiler in order to translate the source code into an object file, or object code, which is a binary, machine-readable file.³² Programming languages can be either interpreted or compiled: an interpreted language is saved in the same form it was written in, meaning it has to be fully processed into machine instructions, line by line, every time it runs; a compiled language is translated into machine instructions upon being saved, which allows for a faster runtime.³³ Then a linker connects the object file to any needed external files and then creates the executable file. To begin the program, such as the game, the executable file is launched.³⁴

The process makes use of and generates a number of elements and steps which the artist or collector could potentially consider the artwork. In most cases, the final product is considered the artwork but the “art” can exist on other levels of the process as well. (Graph 1)

An *esolang* is an esoteric programming language or a programming language as an art form. Esolangs are computer-programming languages with no real executable intent or practical use.³⁵ A good example of an esolang is Piet, a computer language designed to look like a Piet Mondrian painting, with one design principle: “Program code will be in the form of abstract art.”³⁶ Each unit of instruction is in the form of a color block. In this case, the language, not the source code or executable file, is the artwork and the visual entity. (Figure 1)

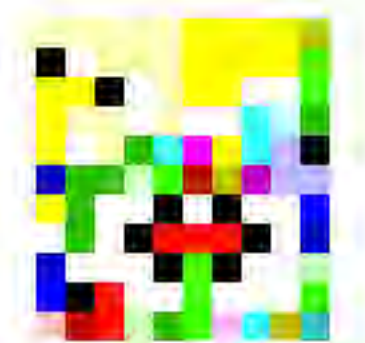


Figure 1. David Morgan-Mar, *Fibonacci Numbers* program, written in Piet.

In 2002, The Whitney commissioned artists to participate in CODEDOC by submitting a source code assignment, or a set of instructions written in the language of their choice, which would then be reviewed by other participating artists. Adjunct Curator of New Media Arts, Christiane Paul,

³² Michael Dawson, *Beginning C++ through Game Programming*. (Australia: Course Technology, 2011) 3.

³³ Vangaurd Software Corporation. "Compiled vs. Interpreted Languages." Compiled vs. Interpreted Languages. Accessed March 16, 2013. <http://www.vanguardsw.com/dphelp4/dph00296.htm>.

³⁴ Dawson, *Beginning C++ through Game Programming*.3.

³⁵ Saikat Basu, "10 Programming Languages You Probably Never Heard Of." MakeUseOf. June 30, 2012. Accessed April 29, 2013. <http://www.makeuseof.com/tag/10-programming-languages-heard/>.

³⁶ David Morgan-Mar, A.k.a. DangerMouse, "Piet." DM's Esoteric Programming Languages. Accessed April 29, 2013. <http://www.dangermouse.net/esoteric/piet.html>

recognized code as a more than a tool for creating art, but as works of art with distinct artistic signatures. According to the assignment, CODEDOC

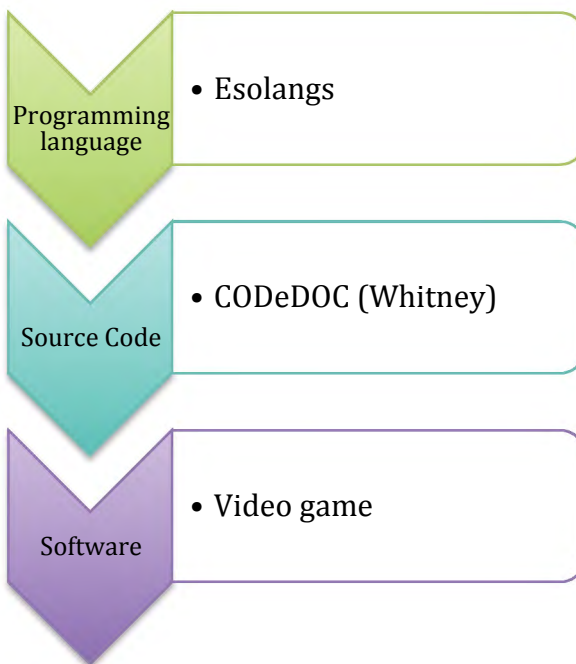
...takes a 'reverse' look at artists' projects by focusing on and comparing the back end of the code...The project explores both the artist's creative expression on the level of source code and the linguistic universe of code.³⁷

This understanding of the instructions as the artwork is comparable to Sol LeWitt's *Wall Drawings*, where the exhibitor is provided with a set of instructions or guidelines for a two-dimensional work to be installed on a wall. The guidelines are interpreted by the exhibitor, resulting in a different installation each time the work is presented.

Defining the "Object"

It is also important to consider that some terms have different definitions in different settings. Video game conservation in a museum setting is representative of an overlapping of disciplines: interaction design, variable media preservation, and digital asset management, to name a few. The conservator must be aware of

this overlap when describing video game preservation. Specific terminology discussed here concerns the conservation object and the digital object.



Art object, Conservation Object

Conservation is "examination, documentation, treatment, and preventive care, supported by research and education."³⁸ More often than not, the goal is to conserve the artwork in its original state, or as close as possible to the original state. With preservation, the conservator takes a more active role in the maintaining the longevity of a piece by treating the work to minimize the

Graph 1: Levels of art in the software

³⁷ Christiane Paul, "CODEDOC: Assignment." Whitney Artport Commissions. August 2002. Accessed April 28, 2013. <http://artport.whitney.org/commissions/codedoc/CODEDOC.html>

³⁸ International Council of Museums Committee for Conservation. "The Conservator-Restorer: A Definition of the Profession." Definition of Profession. Accessed February 18, 2013. <http://www.icom-cc.org/47/about-icom-cc/definition-of-profession/>.

effects of chemical or physical damage.³⁹ This paper looks at the video game as an object intended for both conservation and preservation. In the museum setting, “art works are commonly conceived as unique physical object”⁴⁰ to be conserved or preserved as needed, giving the video game, essentially a piece of software, a physical presence. The video game becomes what Salvador Viñas Muñoz, and later Pip Laurenson, refers to as the “conservation object.”⁴¹

Laurenson uses this terminology to denote the difference between “the state of an object” and “the identity of a work” in determining what is “original” in ephemeral art, noting how the identity is often less concerned with materiality.⁴² The state of an object recognizes physical presence while the identity is the concept or the essence of the work being conserved. While this terminology works really well for performance pieces or installation art, it still considers the “identity of the work” as a static object: something that won’t need to be managed over time. Museums are concerned with both the state and identity of the object, however in regards to digital art forms, art historians, curators and conservators recognize an ambiguity in the “state” of the art object and the “identity” becomes more complex than, for example, an instantiation of a Shakespearean play might be.⁴³ The “identity” of a video game incorporates nostalgia, aesthetic experience, technical structure, and, most importantly, interactivity. Defining the object and determining how and what to preserve has become increasingly challenging in the field of new media preservation.

In contrast, other organizations and colloquia are addressing ephemeral art—time-based and variable media—as dynamic works in need of regular care. Initiatives, such as Archiving the Avant-Garde and the Variable Media Network, adopted this perspective and inspired progress. This perspective ties in closely with the definition of the digital object.

Digital Object

A digital object is identified as the content files, metadata, which can inform us what software or hardware should be used, and the container binding all

³⁹ “About Conservation.” The Australian Institute for the Conservation of Cultural Material. Accessed February 18, 2013.

http://www.aiccm.org.au/index.php?option=com_content&view=article&id=6&Itemid=4

⁴⁰ Pip Laurenson. “Authenticity, Change and Loss in the Conservation of Time-Based Media Installations.” Home. October 1, 2006. Accessed February 18, 2013. <http://www.tate.org.uk/research/publications/tate-papers/authenticity-change-and-loss-conservation-time-based-media>.

⁴¹ Muñoz, Viñas Salvador. *Contemporary Theory of Conservation*. (Oxford: Elsevier Butterworth-Heinemann, 2005) 27.

⁴² Laurenson, “Authenticity, Change, and Loss,” 2006.

⁴³ Gina Cavallo Collins, “The Future of Video Art in the Digital Age.” In *Moving the Image: Visual Culture and the New Millennium*. Proceedings, Courtauld Institute of Art, London. Vol. 3. CHArt: Computers and the History of Art, 2000. Accessed April 13, 2013.

<http://www.chart.ac.uk/chart2000/papers/noframes/cavallo-collins.html>

of this information together.⁴⁴ It is intended to facilitate both access and preservation, and because of the fleeting nature of digital objects, they require management and intervention in order to remain accessible.

A video game is electronically produced and results in digital elements, most notably the source code and the object file, or executable file. There is also the software and hardware, both of which facilitate access to the digital elements and this essential information would be acknowledged in the metadata.

For a museum highlighting the interactive-ness and design of a video game, the two definitions of the object need to be combined. For this project, the “object,” or the artwork being conserved, is all of the components of the game. It is the physical and virtual space it occupies; it is the aesthetic experience as an art piece; it is the interactivity that makes it design. Since this paper recognizes the role of the video game as a complex work of art in the context of a museum, the terms *variable media* or *new media* will also be used in describing video games.

The game is not to be understood as a static conservation object, but rather as an object in need of regular management, invoking a level of curatorship on the part of the conservator. The conservator is by default, tasked with responsibility of making the game accessible in the future, a responsibility shared by the curator.

MDA: Mechanics, Dynamics, Aesthetics

A video game is where function meets form and inspires interaction on the part of the player. Therefore, a video game is essentially based on human and computer interactions, or a set of input and output functions. But interaction is not tangible; it does not exist solely in a physical or virtual space. If a future curator in the A&D department or another department at MoMA wants to exhibit the game or consider it in different contexts, they will need to understand how the game looked and what encouraged the player to interact with it. These needs can be understood through elements, which facilitate interaction and can be preserved.

Based on this project’s definition of the “object”, a game can be further divided into what the conservator must work with: technical components, interactive identity, and visual elements. One approach that takes all of the above into consideration is the MDA (Mechanics, Dynamics and Aesthetics) approach developed by Robin Hunicke, Marc Leblanc and Robert Zubek at Northwestern University.⁴⁵

MDA was intended to unite the disparities between game design and the scholarly study of games. It was developed as a formal approach to game research

⁴⁴ Ronald Jantz, and Michael Giarlo. "Digital Preservation: Architecture and Technology for Trusted Digital Repositories." *D-Lib Magazine* 11, no. 6 (2005). Accessed March 19, 2013. doi:10.1045/june2005-jantz

⁴⁵ Robin Hunicke, Marc LeBlanc, and Robert Zubek. *MDA: A Formal Approach to Game Design and Game Research*. Northwestern University. Northwestern.edu: Computer Science. 2004. Accessed March 13, 2013. <http://www.cs.northwestern.edu/~hunicke/MDA.pdf>

and analysis, and breaks the game down into its design components: the development of the game, how the interaction functions, and the visual results.

From the designer's perspective, the mechanics give rise to dynamic system behavior, which in turn leads to particular aesthetic experiences. From the player's perspective, aesthetics set the tone, which is born out in observable dynamics and eventually, operable mechanics.⁴⁶

Mechanical is defined as the technical components; dynamics is the run-time behavior of the mechanical components as well as player inputs and reactions. The creators identify aesthetics to be the emotional responses the game produces in people.⁴⁷ For the needs of conservation, as defined above with regards to the "object", this paper interprets aesthetics as the visual components, which either respond to or encourage player interaction.

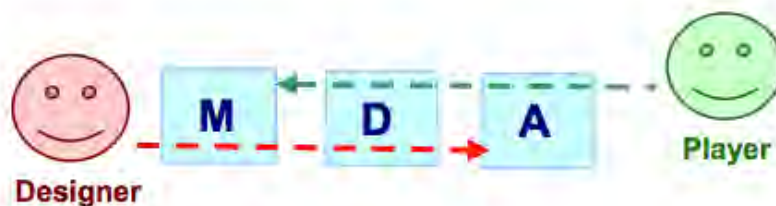


Figure 2. MDA Model, Robin Hunicke, Marc LeBlanc, and Robert Zubek

The MDA approach unites the contrasting definitions of the conservation object and digital object and it also recognizes overlapping strategies for preservation. Therefore, this was adopted as a framework where the dynamics is the core of the artwork, the intangible interactivity being preserved. The mechanics and aesthetics are the avenues of approach to preserving the dynamics. By looking at the mechanics and aesthetics we can begin to understand the risks and strategies relevant to both areas.

A reflection of this strategy can be found in the Performance Model developed in 2002 by the National Archives of Australia (NAA) for handling the preservation of digital records. The *source* is defined as the data or virtual information. The *process* operates the source, so the process is the technology used to render the data. This results in the *performance*, which is read by the *researcher*. The approach was developed in order to "[break] down the concept of a digital record into components that help explain their fundamental nature."⁴⁸

⁴⁶ Hunicke, LeBlanc, and Zubek. "MDA: A Formal Approach" 2004.

⁴⁷ Ibid.

⁴⁸ Helen Heslop, Simon Davis, and Andrew Wilson. *An Approach to the Preservation of Digital Records*. National Archives of Australia. (December 2002.) Accessed April 28, 2013. http://www.naa.gov.au/Images/An-approach-Green-Paper_tcm16-47161.pdf.

The Performance Model can be mapped almost directly to the MDA approach: the *source* is the digital file that interacts with the technology, both of which would be incorporated in the mechanics; where *process* meets *performance* is the interactive or dynamic element; and the *researcher* is interacting and reacting to the aesthetics, which would be the *performance* or *rendering on screen*.

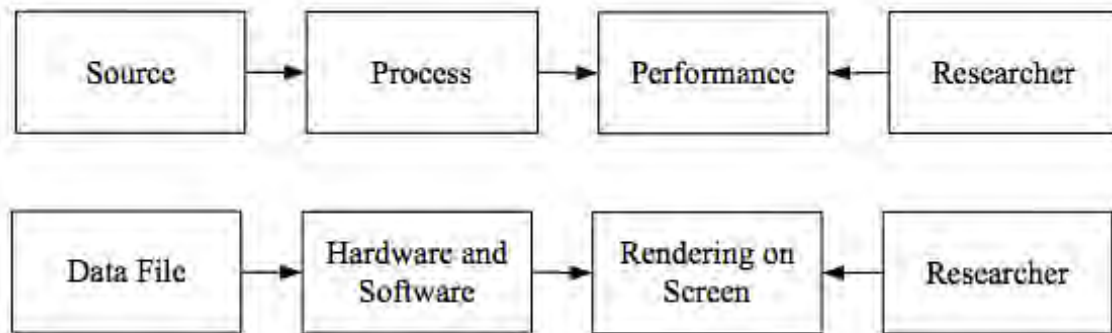


Figure 3. Performance Model, National Archives of Australia

The Performance Model could just as easily be adapted for discussing video game preservation. However, the MDA model was developed specifically for discussing video games and is therefore more applicable in the context of this research paper.

Taking into account the definitions of the conservation object and the digital object along with the MDA approach, this paper next identifies the risks associated with conservation and preservation of both. It will address the risks attributed to video game conservation and how they would be assessed for an individual game. The results of the assessment would generate a risk profile for the game and inform the conservators or curators how best to proceed in its preservation.

A takeaway from this paper is a guide tailored in the style of the prompts created by the Matters in Media Art consortium.⁴⁹ Matters in Media Art is an initiative between the New Art trust and partnering museums, which include MoMA, Tate, and the San Francisco Museum of Modern Art (SFMOMA). The project is set to end in 2015 and aims to develop shared practices for collecting and preserving time-based or complex media art works.⁵⁰ The prompts created by the consortium are insightful and provide excellent guidelines for how to approach conserving and exhibiting time-based art; however, none are specifically geared towards preserving video games, which encompass a myriad of formats. A working draft of the prompt is available in Appendix B.

⁴⁹ "Templates for Acquisitions." Tate. Accessed January 11, 2013.

<http://www.tate.org.uk/about/projects/matters-media-art/templates-acquisitions>.

⁵⁰ "Matters in Media Art: About." Tate. Accessed January 11, 2013.

<http://www.tate.org.uk/about/projects/matters-media-art>

Regarding a video game as an object of design, a work of art, implies a creator, an artist. Museums perform interviews with artists upon acquisition of a work in order to better understand how it was created and how it can be preserved. This is especially true for variable media works; insight into how a work was developed can be a useful guide to the conservator.⁵¹ The role of the artist, or artists, in the preservation and conservation of video games is especially important and will be addressed in this paper.

Identifying Significance and Assessing Risks

Understanding significance involves recognizing the perspectives of everyone involved, or the stakeholders. In this project and in the field of digital preservation, the stakeholders are identified as people or organizations that may have a vested interest in a work and/ or a responsibility to lifecycle of the materials.⁵² In a museum, the stakeholders would be identified as the curators, the conservators, the artists, and the museum audience. The roles and responsibilities of the curators and conservators would make decisions with the artist and audience in mind, while the opposite would not necessarily be true.

The curators in A&D do the research to acquire or exhibit any work based on the six assessment criteria described earlier—form, function, innovation, necessity, process, and cultural impact. For the curator, this information establishes the significance of on an object. In identifying the significance of a video game, questions to consider include what makes a game qualify for conservation or preservation? How does it fit in with the curatorial mission of the institution?

With regards to video games, the MoMA curators have established their curatorial mission, and consequently the significance, based on the criteria used by the department and an additional set of criteria for evaluating games: behavior, aesthetics, space, and time.⁵³ This is, in a broad statement, is interaction design. Although they may recognize the cultural impact of video games, curators may not be well versed in the technological elements. For the *First 14*, the curators worked with game scholars, historians, and critics as well as digital conservators and legal advisors to select the games for acquisition.⁵⁴

Chris Romero, a former student of arts conservation who conducted a thesis on the acquiring, displaying, and conserving video games at MoMA, also notes how the roles and responsibilities of the curator and conservator have become

⁵¹ Miwa Yokoyama, "Capturing the Artist Interview: Interview Methodologies and Resources for Documenting and Preserving Time-Based Media Art." Thesis, New York University, 2008.

⁵² Blue Ribbon Task Force. "About Us." Blue Ribbon Task Force on Sustainable Digital Preservation and Access. Accessed April 14, 2013. <http://brtf.sdsc.edu/about.html>.

⁵³ Antonelli, "Video Games: 14 in the Collection, for Starters." 2012.

⁵⁴ Ibid.

“blurred.”⁵⁵ Curators need the technological information from the conservators in order to make informed decisions and conservators need a firm grasp on what their options for conservation and preservation are, all of which is tied to the acquisition policies of the collecting department. Both parties are also responsible for making these materials available to future audiences: the curator is responsible for explaining the work and making the information accessible to the audience,⁵⁶ and the conservator is responsible for making the components accessible to the curators and researchers. However, accessibility involves not only providing the technical components in working order, but also information *about* the technical components. As demonstrated by A&D’s dependence on external knowledge for the video game acquisitions, curators normally do not have a background in handling complex or legacy technologies and depend on other resources for that technical information. Overall, conservators and technicians should strive to make information comprehensible and approachable for curators, and possibly outside researchers.

Since this paper is focused on conservation and preservation, the practical and ethical responsibilities of the conservator are examined more thoroughly.

Overview: Role of the Conservator

The preamble to the Code of Ethics as laid out by The American Institute for Conservation (AIC):

The primary goal of conservation professionals...is the preservation of cultural property. Cultural property consists of individual objects, structures, or aggregate collections. It is material, which has significance that may be artistic, historical, scientific, religious, or social, and it is an invaluable and irreplaceable legacy that must be preserved for future generations. In striving to achieve this goal, conservation professionals assume certain obligations to the cultural property, to its owners and custodians, to the conservation profession, and to society as a whole.⁵⁷

Note the phrase “...significance that *may* be artistic, historical, scientific, religious or historical...” Conservators, archivists, librarians, et al cannot be certain what researchers will find historically or aesthetically significant in the future. It is doubtful many amateur 16mm or Super 8mm filmmakers foresaw their works being used to provide insight into a particular cultural heritage, a heritage not

⁵⁵ Christopher L. Romero, "Long March Restart: The Acquisition, Display and Conservation of Video Gamers." Thesis, (New York University, 2012) 12.

⁵⁶ Ibid, 30.

⁵⁷ American Institute for Conservation of Historic and Artistic Works. *Code of Ethics and Guidelines for Practice*. About AIC. Revised 1994. Accessed February 12, 2013. <http://www.conservation-us.org/index.cfm?fuseaction=Page.ViewPage>

necessarily recognized as being so when it was filmed. Conservators must acknowledge all risks and allow for flexibility in future interpretations. In order to mitigate the risk of loss, conservators work closely with curators, researchers, scholars, and often the creators to determine the best approaches to conservation. According to International Council of Museums Committee for Conservation:

The conservator-restorer must be aware of the documentary nature of an object. Each object contains - singly or combined - historic, stylistic, iconographic, technological, intellectual, aesthetic and/or spiritual messages and data. Encountering these during research and work on the object, the conservator-restorer should be sensitive to them, be able to recognise [sic] their nature, and be guided by them in the performance of his task.⁵⁸

While this is intended for conservators handling physical objects, it is also applicable to the long-term management of games. The phrase in the AIC preamble, "...conservation professionals assume certain obligations to the cultural property..." indicates the conservators are responsible for understanding methodologies in preserving a work to the best of their ability. This involves staying aware of current practices in the conservation field. However, with regards to video games, conservators must also be aware of and be up to date on research and strategies in digital preservation. This implies the level of curatorship on the part of the conservator mentioned earlier.

Most people involved with video games, especially developers and players, assert that the interaction with the game is the most important. The style of interactivity defines the game and the loss of it or loss of knowledge of it would be the greatest risk. Assessing the risks of one game or a collection of games involves understanding their significance, essentially curating elements for preservation. In describing the thought process in selecting games for acquisition, Paola Antonelli, a Senior Curator in A&D states:

Our criteria, therefore, emphasize not only the visual quality and aesthetic experience of each game, but also the many other aspects—from the elegance of the code to the design of the player's behavior—that pertain to interaction design.⁵⁹

This, again, leads to defining what components make up interactivity and invokes questions such as what elements are essential to preserving interactivity and what can be sacrificed? "Ultimately, a computer game cannot be played without a

⁵⁸ International Council of Museums Committee for Conservation. "The Conservator-Restorer: A Definition of the Profession." Accessed February 18, 2013. <http://www.icom-cc.org/47/about-icom-cc/definition-of-profession/>.

⁵⁹ Antonelli, "First 14," 2012.

complex and interconnected set of programs and hardware.”⁶⁰ The most essential questions become whether or not the playability can or should be preserved, or if documentation of the game sufficient. In some cases, documentation is preservation when there are no other options available.

Since many elements or aspects are incorporated into defining a video game, it is important consider how others have approached the handling of complex works and digital materials. Recognizing significance in a work informs the conservator about what elements are key to preserving the work. The following projects demonstrate how different initiatives have recognized significance or identified and evaluated risks, such as authenticity or long-term sustainability. Several initiatives and organizations in the field of variable and new media preservation have occurred between different and occasionally overlapping consortia. Each one offers insights into the different elements of a video game and some of the risks inherent including hardware, software, and data obsolescence. While MoMA is one of the collaborating consortiums, many other collectors and handlers of ephemeral or variable media have been researching and experimenting technological strategies for conserving and preserving the art objects.

Romero’s thesis also discusses the merging of conservation strategies between the art world and the video game preservation realm, while touching on the influence of digital preservation options.⁶¹ With regards to video game preservation in an art museum, digital preservation strategies need to be considered more carefully and integrated into the processes. Research initiatives in variable media preservation and digital preservation have taken slightly different approaches in establishing significance and identifying risks, with an increasing amount of cross over as more artists work with digital materials. In *Rethinking Curating*, researchers Beryl Graham and Sarah Cook note that researchers of new media art must incorporate an interdisciplinary approach in addressing the “overlapping characteristics of new media art.”⁶² This recommendation reflects much of the research that has come before. The following section does not represent a review of the literature, but rather, it recognizes the relevant methodologies or conclusions in different concentrations applicable to video game conservation at MoMA.

⁶⁰ J., McDonough, R., Olendorf, KiM., rschenbaum, Kraus, K., Reside, D., Donahue, R., Phelps, A., Egert, C., Lowood, H., & Rojo, S. *Preserving Virtual Worlds Final Report*. PDF. Technical paper no. UleRA#2008-01111-00-00. Library of Congress, 2010. <http://hdl.handle.net/2142/17097>.

⁶¹ Romero, “Long March Restart,” (2012) 46.

⁶² Beryl Graham and Sarah Cook, *Rethinking Curating: Art after New Media*. (Cambridge: MIT Press, 2010) 283.

New Media Art Preservation

Matters in Media Art

MoMA's conservators work frequently with evaluation and workflow strategies as well as complex artworks, including time-based, digital, and multimedia pieces. Recognizing the speed at which technology evolves or falls into obsolescence, the Matters in Media Art, as described earlier, is an initiative between the members of the New Art Trust: MoMA, Tate, and the SFMoMA. The initiative began in 2005 and is ongoing. Over the course of the project, the group has developed a series of prompts for evaluating a complex work of art, divided by pre-acquisition, structure and condition reports, and accessioning and post-acquisition. The prompts also fall into two categories: theoretical and technical. The theoretical prompts help curators and conservators recognize the significance of a work, while the technical one helps the same stakeholders identify the important components of the work.

The prompt most relevant to video game conservation is the "Media Elements for Computer Based Artworks."⁶³ The prompt contains a section that identifies specific forms of human-computer interaction with media works, along with software components and other digital elements. It is thorough and covers a lot of ground. Although the prompt is not necessarily lacking in defining elements, there are additional elements to video games not covered in the prompt. Suggestions for additional considerations to add to the prompt are provided in Appendix B.

Variable Media Initiative

In researching strategies for new media preservation, MoMA joined a growing discipline, which began to form as technologies started to fail. The Variable Media Network (VMN) was organized in 2009 by the Guggenheim in New York in partnership with other institutions and organizations handling ephemeral or variable media artworks. The original network was established in 1999 around the same time as another initiative, Archiving the Avant-Garde. These were two of the earliest projects to recognize variable media as dynamic works in need of constant care. In 2009, these initiatives joined forces to develop Forging the Future, a consortium intended to combine their strategies in preserving variable media works. The current members of Forging the Future still work together and utilize the network as a space to explore ideas with one another.

The VMN identified eight *behaviors*, or medium independent attributes, of new media art. These are contained, installed, performed, interactive, reproduced,

⁶³ Tate. "Matters in Media Art." Home: About. Accessed January 11, 2013.
<http://www.tate.org.uk/about/projects/matters-media-art>.

interchangeable, encoded, and networked.⁶⁴ Several, or nearly all, of these attributes can be applied to a video game as a work of art.

A result from the original VMN initiative was the Variable Media Questionnaire (VMQ).⁶⁵ In his part within the VMN publication, *Permanence through Change*, Jon Ippolito describes the questionnaire as

... an instrument for determining how artists would like their work to be re-created in the future—if at all. In contrast to one-size-fits-all technical fixes, this instrument is meant to be applied case-by-case, one artwork at a time.⁶⁶

The Questionnaire provides a framework for analyzing a complex artwork by identifying the appropriate behaviors and developing guidelines for the preservationist to follow.⁶⁷ It is currently in its third generation as part of Forging the Future. The third generation “looks at works as ensembles of functional components, making it easier to compare different works created with similar parts.”⁶⁸ This means instead of applying behaviors to the work as a whole, the behaviors are applied to the different parts that make up the whole. For example, the encoded behavior would apply to the software of a game, while it would not apply to the game’s hardware. (Figure 4,)

⁶⁴ Variable Media Network. “Terms: Behaviors”. Accessed January 22, 2013. <http://www.variablemedia.net/e/index.html>.

⁶⁵ Variable Media Network. “Home Page.” Accessed January 22, 2013. <http://www.variablemedia.net/e/index.html>.

⁶⁶ Jon Ippolito, “Accommodating the Unpredictable: the Variable Media Questionnaire.” In *Permanence Through Change: The Variable Media Approach*. New York: Solomon R. Guggenheim Museum, 2003. Pp. 47-53. Available at http://variablemedia.net/e/preserving/html/var_pub_index.html

⁶⁷ “Tools: Variable Media Questionnaire.” Forging the Future: New Tools for Variable Media Preservation. Accessed February 02, 2013. <http://forging-the-future.net/>

⁶⁸ Forging the Future Alliance. “What’s New.” Variable Media Questionnaire. Accessed December 08, 2013. <http://variablemediaquestionnaire.net/>

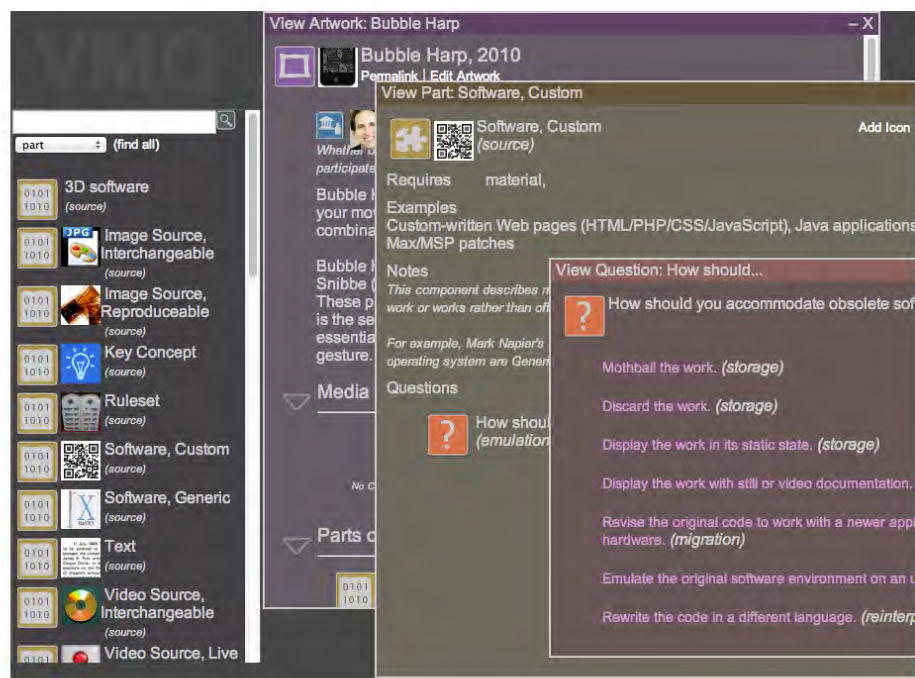


Figure 4. Variable Media Questionnaire, Variable Media Network and Forging the Future

Overall, the questionnaire determines the best strategy of preserving a work by focusing on the intent of the creator and identifying what aspects of a work are most important to preserve, what can be replaced, and what can be substituted. What is notable about the Questionnaire is how it acknowledges there is no single solution to preserving variable media. Every piece of work is different with different dependencies and distinctive elements. This same concept can be applied to video games. Every game is different in form and therefore the risks to each game and many of its relevant preservation strategies will be slightly different as well.

The third generation also encompasses more factors including environments and external references as well as input from stakeholders other than the artist—curators, assistants, viewers, and conservationists.⁶⁹ The VMQ is an excellent guide for approaching new media art preservation, but it is also an example of the assessment tool being as complex as the artwork being assessed.

The behaviors listed above are umbrella terms. In mapping the relevant questionnaire behaviors listed above to the identified elements in the MMA computer-based artworks prompt, it is obvious the prompt is more granular than the questionnaire. However, the granularity does not extend to all elements of a video game such as the elements that motivate player interaction or what the role of source code is in the artwork. The questionnaire addresses the latter example

⁶⁹ Variable Media Network. "Tools: Questionnaire". Accessed January 22, 2013. <http://www.variablemedia.net/e/index.html>.

through the *encoded* behavior. The MMA is also a prompt, a guide, and does not provide suggestions for how to manage the materials and risks it identifies.

DOCAM: the Documentation and Conservation of Media Arts Heritage

Another relevant initiative is the Documentation and Conservation of Media Arts Heritage (DOCAM) Research Alliance established by the Daniel Langois Foundation for Art in 2005 in collaboration with several other institutions. It was a five-year research project to develop methodologies and tools through case studies for the analysis of complex and variable media and to provide resources to help guide conservation decisions. By the end of the project, DOCAM released five tools or guides to assist conservators: a preservation guide, a cataloging guide, a documentation model, a glossary, and a technological timeline (Figure 5 and Figure 6).⁷⁰

The timeline identifies the significant technical components used in case studies of complex artworks such as storage media, display units, computer hardware, and computer software. It also provides a detailed description of how a component was developed and how it is or has been utilized during its lifecycle. While it is not a complete list, it does provide a good way of showing how components relate in context of one another. Each record provides a detailed history of the component and also links to the relevant case study.

Such a tool would be useful for MoMA as the museum's collection has various types of new and old media and is collecting more software. While the conservators may be familiar with the myriad of physical and digital formats, curators and researchers might not be. An access document for conservationists to provide as a reference could assist curators with acquisition decisions and agreements.

⁷⁰ Documentation and Conservation of Media Arts Heritage. "About." DOCAM. Accessed January 22, 2013. <http://www.docam.ca/>.

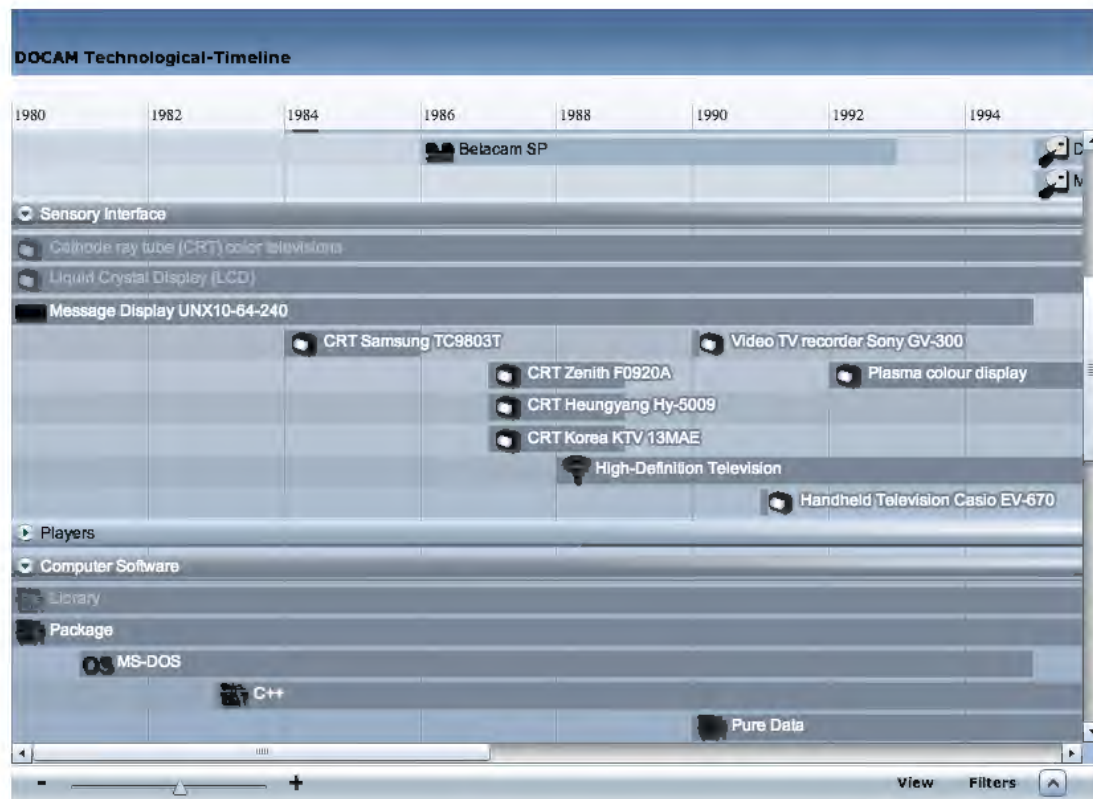


Figure 5: Screen shot of DOCAM Technological Timeline

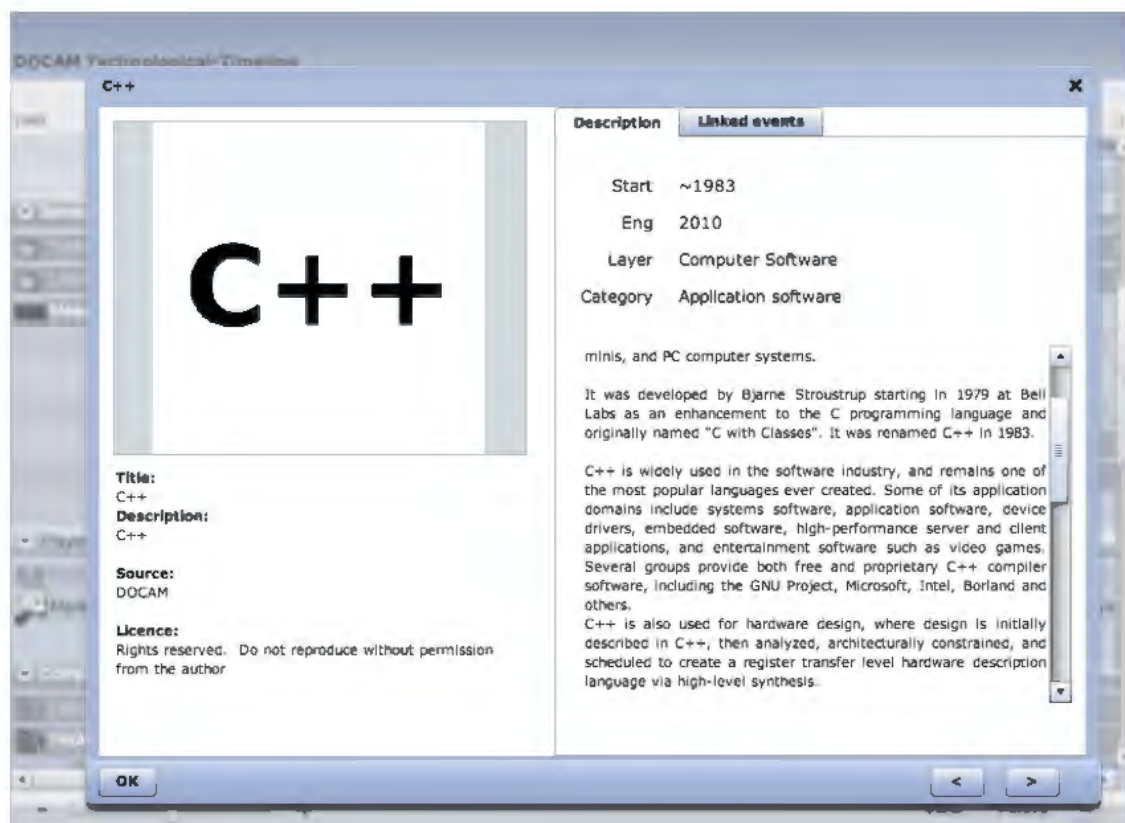


Figure 6: C++ entry from DOCAM's Technological Timeline

Inside Installations

Inside installations was a three-year initiative from 2004-2007 carried out by members of the International Network for the Conservation of Contemporary Art. This project focused on the preservation and presentation of installation art and, like DOCAM, worked with case studies for research and investigation.

At a workshop in 2006, the participants developed a general methodology for risk assessment:

- Establishing the anatomy of the installation
- Developing a 'Statement of Significance'
- Determining the relative value to the whole of the elements identified
- Developing scenarios and identifying the risks
- Exploring the possibility of recovering lost value
- Carrying out a qualitative or (semi)-quantitative assessment of risks⁷¹

Although the steps are intended for installation works with primarily physical components, the step-by-step guide can be applied generally to all complex works. The workshop participants recommended that curators and conservators work together to establish the significance by being in conversation with the artist. Similar to the Variable Media Questionnaire, the artist provides insight to the work. Again, this methodology can be applied in assessing the risks to video games. By identifying the individual elements in relation to the whole, their significance becomes apparent and the strategies for preserving each element become defined.

Rhizome Artbase

The Rhizome Artbase was established in 1999 as an online archive for digital art, including websites, games, code, and other software artworks. Upon acquisition, an original copy of the artwork is stored on Rhizome's server, a detailed description of the work and its necessary metadata is created, and broken URL's are fixed as needed. The work is then hosted by the website for public access.⁷² In considering how to describe New Media art, Ward Smith, archiving and database consultant to Rhizome, wrote in 2008 about the issues in describing and cataloging complex or new media, especially computer operating systems and other objects with elements beyond the physical that are inherently hard to describe. He also recognizes how artists resist being categorized into a genre of

⁷¹ International Network for the Conservation of Contemporary Art. *Preservation and Presentation of Installation Art*. Netherlands Institute for Cultural Heritage. Inside Installations. Accessed April 14, 2013. <http://www.inside-installations.org/home/index.php>

⁷² "About the Rhizome ArtBase." Rhizome. Accessed April 30, 2013. <http://rhizome.org/artbase/about/>.

art.⁷³ Thus, those working with artists and handling new media, curators and conservators included, are still adapting, and in some cases creating, terminology to accurately describe these works.

In defining digital preservation practices, Ben Fino-Radin, Digital Curator at Rhizome, identifies data obsolescence as the most “pervasive” of the risks to variable media works.⁷⁴ Obsolescence can occur on both the software and hardware levels of a digital work of art. Fino-Radin cites an instance of an online artwork created in 1999 that has been restored twice by the artist to date, both a result of more modern computer systems no longer able to support the older software. In the first instance, the artist recreated the artwork with a newer processing language. In the second instance, although the processing language and compiled file were still relevant, the hardware it was designed to run on—a computer with a 32-bit processor—was becoming obsolete. Online viewers owning computers with the faster, more powerful 64-bit processors were unable to view the artwork.⁷⁵ This case illustrates the need for long-term management practices of digital art objects rather than a single solution. It also calls into question the responsibilities of the stakeholders, namely the artist and the conservators. It is often the responsibility of the conservator to maintain the artwork, especially if the artist is no longer available.

This is not a complete list of initiatives in new media art preservation. Many of these projects can be mapped to one another such as in recognizing the functions of technical components or assessing the risks to their vulnerabilities. A review of the projects described above however, points out that the strategies for assessment and analysis are for works *intended* for a museum or gallery space. This presents issues for video games since they are aimed towards the commercial sector and the development of the art form often responds to public demand. Although we are viewing a video game as an interactive art piece, how does a museum preserve variable and interactive works that were never intended for a museum space? Video games are digital objects and some of the more recent work done in new media art conservation—MMA, Forging the Future, and Rhizome—begins to incorporate digital preservation strategies. To help understand how and why they are being incorporated, a review of relevant strategies and projects is given below.

⁷³ Ward Smith, “Research Issue: Challenges for the cataloging of New Media Art.” *Rhizome*. 2008. <http://media.rhizome.org/artbase/documents/Cataloging-New-Media-Art.pdf>

⁷⁴ Ben Fino-Radin, “Digital Preservation Practices and the Rhizome Artbase.” PDF. (2011) Accessed February 18, 2013. <http://media.rhizome.org/artbase/documents/Digital-Preservation-Practices-and-the-Rhizome-ArtBase.pdf>

⁷⁵ *ibid.*

Digital Preservation

The five initiatives described above provide examples of museum practices in recognizing significance and identifying risks in variable media. These practices tend to be applied on an as needed basis, one object at a time. Digital preservation on the other hand tends to address long-term management of a collection of digital objects.

OAIS Reference Model and FRBR

MoMA is in the process of implementing the Reference Model for an Open Archival Information Standard (OAIS). The OAIS Reference Model is an organization “of people and systems that has accepted the responsibility to preserve information and make it available for a Designated Community.”⁷⁶ The model was developed by the Consultative Committee for Space Data Systems was originally intended for managing the wide scope of data being collected by space agencies but has since been accepted into the wider archival community. OAIS operates as a framework for understanding the relationships between the functional components and identifying the minimum requirements of an archival system.⁷⁷ It does not, however, detail the steps or processes an organization should take for the long-term preservation of digital objects and its accompanying metadata. Most importantly, it stresses the intertwined relationship of long-term preservation and access for the designated community. (Figure 7)

Representation information on digital materials begets additional digital materials. The PVW Final Report notes how the model also acknowledges that the digital representation information might require representation information as well.⁷⁸ It also describes context information, which recognizes the relationship between the content data object and its representation information (the object, or artwork being conserved in this paper) to its environment.⁷⁹

⁷⁶ Consultative Committee for Space Data Systems (CCSDS). *Reference Model for an Open Archival Information System (OAIS) CCSDS 650.0-M-2*. Magenta Book. Issue 2. June 2012. Available at <http://public.ccsds.org/publications/archive/650x0m2.pdf>

⁷⁷ Brian F. Lavoie, *The Open Archival Information System Reference Model: Introductory Guide*. Office of Research, OCLC Online Computer Library Center, Inc., (January 2004) 3. Available at <http://www.dpconline.org/advice/dpc-reports>

⁷⁸ McDonough, et al. *Preserving Virtual Worlds: Final Report*, (2010) 99.

⁷⁹ CCSDS, *Reference Model*, (2002) p1-10.

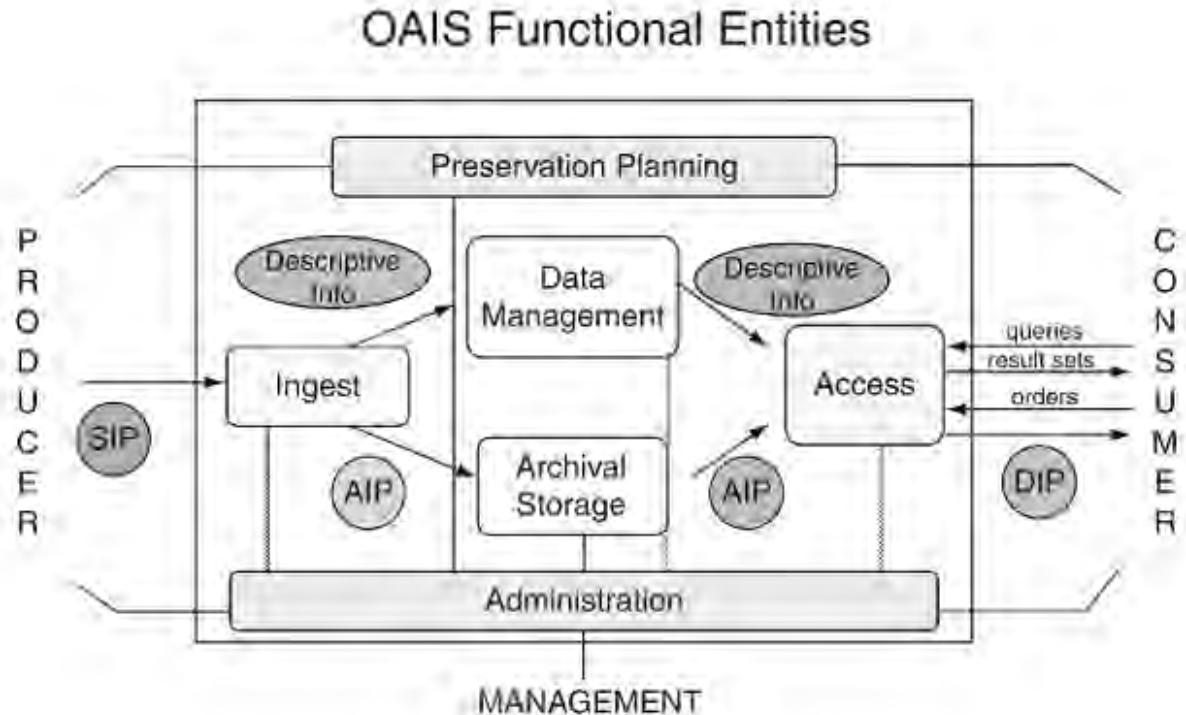


Figure 7. Reference Model for an Open Archival Information System

The PVW team also recommends the use of the Functional Requirements of Bibliographic Records (FRBR) model. FRBR is a model for bibliographic description based on classes of entities, which establish relationships between concept, realization, and versioning.⁸⁰ The model is divided into four parts or entities:

The entities [are] defined as *work* (a distinct intellectual or artistic creation) and *expression* (the intellectual or artistic realization of a *work*) reflects intellectual or artistic content. The entities defined as *manifestation* (the physical embodiment of an *expression* of a *work*) and *item* (a single exemplar of a *manifestation*), on the other hand, reflect physical form.⁸¹

⁸⁰ Jerome McDonough "Packaging Videogames for Long-Term Preservation: Integrating FRBR and the OAIS Reference Model." *Journal of the American Society for Information Science & Technology*. 62, 1, (Jan 2011) 176.

⁸¹ "Functional Requirements for Bibliographic Records." International Federation of Library Associations and Institutions (IFLA). Accessed April 29, 2013. <http://www.ifla.org/publications/functional-requirements-for-bibliographic-records>.

Jerome McDonough, the Principle Investigator on the Preserving Virtual Worlds Project, and the rest of the PVW team recommend applying the FRBR entity-relationship model to the information package. The claim that FRBR applied to OAIS

...provides both the precision in identification and description of resources and the set of relationships necessary to encapsulate information about computer games in a way that supports their long-term preservation.⁸²

Based on OAIS, the content being managed and its relevant metadata are identified through the information packages as described in the OAIS model: the Submission Information Package (SIP), Archival Information Package (AIP), and Dissemination Information Package (DIP), all of which are essentially different versions of the same information package.⁸³ The SIP is determined upon ingest and is not necessarily what is provided by the Producer. For example, additional metadata may have to be included in order to properly manage or provide access to the digital objects. The AIP is how the information package as it is managed by within the framework based on OAIS, and the DIP is the material provided from inquiries. As the PVW project team admits, the preservation of a video game is a matter of defining the complex web of relationships between the different forms of structural metadata.⁸⁴ All of this information is included in the SIP and an example of what might be included in the SIP will be provided for the case study, *Portal*.

“Digital Longevity” and Sustainability

In the *Handbook for Digital Projects*, Howard Besser provides a chapter focusing on digital longevity, or long-term access to digital materials. The *Handbook* was put together in 2000, and around this time, the major topic of discussion in digital preservation was digital conversion with only a growing interest in managing the digital objects or born-digital materials. In this chapter, Besser identifies five areas of concern that pose risks to access and accurate rendering of digital works: the viewing problem, the scrambling problem, the inter-relation problem, the custodial problem, and the translation problem⁸⁵, all of which are relevant to video game preservation. Especially relevant is the viewing problem (intrinsically tied to the inter-relation problem) which recognizes that file formats, operating systems, applications, and hardware are interoperable, thus an old file may not open in a new application or a new computer may not be capable

⁸² McDonough, “Packaging Video Games,” (2011) 176.

⁸³ Lavoie, OAIS: *Introductory Guide*, 11.

⁸⁴ McDonough, et al. *Preserving Virtual Worlds: Final Report*, (2010) 100.

⁸⁵ Howard Besser, “Digital Longevity” in *Handbook for Digital Projects*. Maxine K Sitts, ed. (Northeast Document Conservation Center Andover, Massachusetts, 2000).

of running an older application. The translation problem also poses concerns for video games. For example, a file may be migrated to a more stable format and accessible on new hardware, but “the viewing environment also affects the nature of the work,”⁸⁶ This means the new file in the new environment may hold the same information, but look completely different. In some instances, this may change the value of the information. These issues are addressed by other research projects in digital preservation.

In considering how the digital objects will be stored and managed long-term, the conservators should keep in mind the various sustainability factors affecting digital preservation. According to the Library of Congress, these factors include: the degree of adoption by the development and user community; disclosure on information of the digital format; transparency, or readability of the file; self-documentation of digital objects, or metadata; amount of encryption or copyright protections on the file or media; external dependencies on hardware and software; and the impact of patents on commercial software.⁸⁷ These factors come into play as the technical components for preservation are identified, along with video and textual documentation elements.

JISC and the Blue Ribbon Task Force

The Joint Information Systems Committee, now simply known as JISC, takes a broader look at risk assessment. “Risk identification and analysis should be ongoing throughout the project but particularly at project start-up and stage boundaries.”⁸⁸ A wider view involves looking at every possible factor that could influence the management of digital assets. The JISC Info kit identifies five relevant, overarching factors: the project plan, stakeholders, resources, the organizational environment, and the external environment.

The stakeholders have already been identified as anyone with a vested interest in the long-term management of the digital objects. Regarding the project plan, the info kit states the greatest areas of risk will be with unfamiliar technologies, the involvement of multiple departments or third parties, or other areas of uncertainty. In understanding where risk can be found, an institution can evaluate their practices to find the areas of greatest concern and determine their vulnerabilities. For example, an area of risk might be the “availability of key decision makers at critical points.” A vulnerability for this would be that two departments share the role of managing a step-by-step process and the project cannot move forward until both departments agree on the next step. A solution to

⁸⁶ Ibid.

⁸⁷ Library of Congress. "Sustainability of Digital Formats Planning for Library of Congress Collections." Sustainability Factors. March 20, 2013. <http://www.digitalpreservation.gov/formats/sustain/sustain.shtml>.

⁸⁸ JISC. "1 Identifying Risk." *Jisc InfoNet*. Joint Information Systems Committee, August 30, 2004. Accessed March 11, 2013. <http://www.jiscinfonet.ac.uk/infokits/risk-management/identifying-risk/>

this vulnerability might be splitting up the responsibilities of the role based on the skills set of the department.

With funding from the National Science Foundation and the Andrew W. Mellon Foundation, JISC partnered with the Library of Congress, the Council on Library and Information Resources and the National Archives and Records Administration to form the Blue Ribbon Task Force on sustainable Digital Preservation and Access (BRTF) in 2008.⁸⁹

BRTF was a project to study the costs of sustainability in long-term management of digital materials by identifying the materials as commodities or goods. The results of the project showed how even when preservation concerns are similar, the costs can vary widely across institutions. MoMA is a well-established institution with many resources. However, the costs of preservation are still a concern albeit not as extreme as they might be at a smaller institution. The inherent risks to long-term sustainability were identified as long time horizons, diffused stakeholders, misaligned incentives, and a lack of clarity regarding the roles of stakeholders. Financial concerns are important but something the BRTF did not fully address was time and time is money. Managing digital materials is a time commitment, especially if the stakeholder has other responsibilities outside of their role and the media conservators at MoMA work with all of the departments that acquire complex media. Conserving one video game at a time will require a lot of commitment on the part of the conservator, especially in documentation. Taking advantage of previously created documentation can help moderate the time commitment.

JISC, Digital Preservation Coalition, and the British Library 2008 Conference

The British Library, the Digital Preservation Coalition (DPC), and JISC held a conference on significant properties in 2008.⁹⁰ Like JISC, the other two organizations regularly conduct research and provide informational resources on digital preservation. Specifically the conference discussed how organizations and institutions recognize the significant properties of digital objects for long-term management. At the conference, many of the speakers advocated for intervention during the lifecycle of objects, not only to maintain accessibility but also to habitually review the significance to ensure the information stays relevant to the organizations mission or goals.

The JISC-Funded InSPECT project team, in attendance at the conference, discussed their methodology for evaluation:

1. Define the intellectual components of a record that must be maintained.

⁸⁹ Blue Ribbon Task Force. "About Us." Blue Ribbon Task Force on Sustainable Digital Preservation and Access. Accessed April 14, 2013. <http://brtf.sdsc.edu/about.html>.

⁹⁰ Helen Hockx-Yu, and Gareth Knight. "What to Preserve? Significant Properties of Digital Objects?" *The International Journal of Digital Curation* 1, v. 3. (April 2008) 142.

2. Identify the technical properties of each component that are required to recreate it.
3. Classify the function performed by each property and assess its relative value.
4. Measure each property through the use of a pre-defined assessment method.⁹¹

This parallels well with the previously described projects, most of which take these steps into consideration. In fact, this process can be mapped almost directly to the methodology developed by the Inside Installations team described earlier.

Additional presentations focused on the significant properties of vector images, moving images, and software, all of which were based on the Performance Model established by the NAA. The speaker discussing significant properties of vector images points out “the definition of certain properties considered to be significant is often based on the assessment criteria of the assignee.”⁹²

On the subject of identifying significance in moving images, the speaker considers how a “moving image resource [the source in the Performance Model] may be understood at different levels of granularity”⁹³ in order to present the visual, including color, frame rate, frame size, or bit depth, depending on how the work is viewed.

With regards to recognizing significant properties of software and the Performance Model, software is usually recognized as the means of access to the data, rather than as a target for preservation. This discussion made a case for software preservation, with special attention to the role of proprietary or “in-house” software. There are many example of software being developed to perform a single function for a short period of time. The speaker on this topic provides scientific research as an example: software developed to perform one function, such as collect data, for a short period of time.⁹⁴ In such a case, the software becomes just as necessary for preservation because it defines the context of the data. In the realm of scientific research, experimentation and the process of data collection must be re-producible, which means those intending to collect the same information must have access to the software utilized or complete documentation of the software in order to complete the task. Although video games allow for more flexibility, the same principles apply. In a situation where a compiler might be a proprietary piece of software, information about it and how it output a working file, or a file that did not work could be relevant to the file’s preservation.

⁹¹ Ibid, 143.

⁹² Ibid, 144.

⁹³ Ibid, 145.

⁹⁴ Ibid, 146.

Video Game Preservation Initiatives

The institutions described at the beginning of this paper were organized to preserve and present video games to audiences. Of the three, the Computerspielemuseum is most actively engaged in partnering with other institutions to conduct research into video game preservation. Effectively, this is how most of the research takes place: institutions partnering with one another, often receiving grants or another form of funding in order to conduct research.

On a smaller scale, projects are occasionally taken up by an individual or a class, producing a detailed report on a single game at the end. For a class on handling complex media, the Moving Image Archiving and Preservation (MIAP) program at New York University is currently finishing work on another game for MoMA: *EVE Online*, a massive multiplayer online role-playing game (MMORPG) released by CCP in 2003. Since *EVE Online* is such a drastically different game from *Portal*, its conservation has been dealt with differently. The game exists on various servers and no physical artifacts are produced, and the class did not work with any technological elements, but instead provided a final report to the conservators regarding the preservation of *EVE Online*.

EFGAMP

Soon after KEEP concluded, the Computerspielemuseum joined forces with a number of other European groups to form the European Federation of Game Archives, Museums, and Preservation Projects (EFGAMP), which would build off the research revealed during the KEEP Project. During the Quo Vadis conference in Berlin, from April 23rd-25th of this year, EFGAMP gave an official announcement of their establishment as a non-profit organization under German law.⁹⁵ Andreas Lange, the Director of the Computerspielemuseum, identifies this project as a “political” endeavor to promote and aid in coordinating collaborative activities as well as the circulation of knowledge and legal issues concerning interactive media.⁹⁶ The consortium also aims to facilitate preservation and public access to interactive entertainments and information media.

Preserving Virtual Worlds

The Preserving Virtual Worlds (PVW) project was established as part of the Preserving Creative America, an initiative of the National Digital Information Infrastructure and Preservation Program at the Library of Congress. It was a two-year collaboration between libraries and researchers on the preservation of digital games and interactive fiction.⁹⁷ The project team released their final report in

⁹⁵ "The Birth of EFGAMP." Germany's Leading Game Developers Event – Berlin / April 23 – 27. April 23, 2013. Accessed April 29, 2013. <http://www.deutsche-gamestage.de/2013/birth-efgamp>.

⁹⁶ Andreas Lange, email with author, April 22, 2013.

⁹⁷ McDonough, et al. *Preserving Virtual Worlds: Final Report*, (2010) 5.

2010. The project covered plenty of ground, including working with games from different eras of videogame history as case studies and detailing areas of concern and vulnerabilities. The team also tackled issues with access, copyright, and documentation. Although the group emphasized the research was aimed to help libraries, archives and museums, it was predominantly interested in preserving games for scholarly research, which is higher priority for libraries and archives than for museums.⁹⁸

PVW addresses a broad landscape in preserving and archiving video games, with a strong focus on the digital humanities and digital preservation strategies, and not as much on variable media preservation practices. The group quite comprehensively identified the general risks to all video games as such: hardware and software obsolescence; scarcity of media; third-party dependencies (developed by collectors or hobbyists); complex code (including compilers and information on compiling processes); authenticity; intellectual property rights; significant properties, such as interactive and artistic elements; and context.⁹⁹ All of these are pertinent to libraries and archives taking games and most of these are recognized as risks in both media arts conservation and digital preservation. Both spheres are susceptible to hardware and software obsolescence, along with issues in maintaining both authenticity, and context. The term, *boundaries*, references the interconnectedness and dependencies of the game between its software and hardware, similar to the inter-relational problem defined by Besser in 2000.

One of the recommendations from PVW was to begin developing packaging and ingest standards for games based on the OAIS and FRBR. Another recommendation is to involve the gaming community in preservation. As described earlier, the gaming community is already responsible for the continued existence of many games. However, the legality of the employed methods might affect ingest of certain materials into a digital repository. Other recommendations include addressing copyright issues and supporting more collaborative partnerships.¹⁰⁰

The same institutions are currently working on Preserving Virtual Worlds 2, building on the research uncovered in this first project. This stage involves identifying significant properties in games, along with research into documentation and preservation options with migration and virtualization.¹⁰¹

The approaches taken by PVW and PVW2 differ from MoMA in that they focus on video game preservation within libraries and archives, establishments with different missions and concerns. MoMA concentrates on unique pieces of variable or time-based media as individual works of art, while PVW and its

⁹⁸ McDonough, et al. *Preserving Virtual Worlds: Final Report*, (2010) .

⁹⁹ Ibid, 14.

¹⁰⁰ Ibid, 7-8.

¹⁰¹ Megan Senseney, "Home." Preserving Virtual Worlds 2. Accessed March 05, 2013.
<http://pvw.illinois.edu/pvw2/>.

institutions focus on commercial games and address video game preservation in a broader scope.

The PVW consortium predominately operates in the context of a university and the biggest challenges libraries and archives face involve issues in copyright and ownership. MoMA on the other hand has cleared their rights issues with the game developers. The legal agreement sets in stone how the museum can exhibit and preserve the games in perpetuity. Although the agreements for each game vary, copyright issues are not a concern for MoMA once the agreement is final. Intellectual property rights are a huge concern for libraries and archives because it often limits what the institution can do to conserve a game. Duplication and or any altering of the game in order to run it in modern technology violates copyright laws. PVW and the newly formed EFGAMP in Europe have and continue to devote much of their resources to copyright research and change. Since the differences in how a library or archive handles copyright varies so greatly from a museum, their missions are not aligned well enough. Full partnerships between these institutions would certainly not be a futile effort, but they would most likely deter the mission of one or more institutions.

However, there are growing seeds of crossover in efforts from both sides. In December of 2012, an update to PVW2 was posted on the Still Water blog run by the New Media program in the University of Maine. Jon Ippolito, formerly of the Guggenheim and a principle organizer of VMQ, is co-founder of Still Water, and the program is part of the Forging the Future Consortium. According to the post, the PVW2 team is exploring the use of the VMQ and other tools developed by Forging the Future for preservation and documentation strategies.¹⁰² Although MoMA is not officially involved with either of these consortia, this would potentially pool more resources and motivate the share additional notes in areas where their interests overlap. Another factor supporting this theory of crossover is MoMA's implementation of the OAIS Reference Model as previously researched by PVW for video games.

A preservation project at the University of Texas, independent of any consortium support, took on the preservation of a single video game, the way MoMA approaches the games one at a time. Yet, the University of Texas Video Game Archive has a mission very different from MoMA's. The group was employing digital forensics to access a game stored on a 5 1/4" floppy

Ultima II Preservation Project

The Ultima II preservation project was a class project on preserving *Ultima II: Revenge of the Enchantress*, an RPG published in 1982 and created by game developer, Richard Garriott. The project took place in the school of information at

¹⁰² Jon Ippolito, "Preserving Virtual Worlds Asks Whether Crowdsourcing Can save Vintage Videogames." *Still Water Blog* (web log), December 23, 2012. <http://www.blog.still-water.net/2012/12/preserving-virtual-worlds-asks-whether-crowdsourcing-can-save-vintage-videogames/>.

the University of Texas at Austin. It focused on both the technological knowledge of the archival community and intellectual property issues for a commercially released game.¹⁰³ The team performed digital forensics in order to access the game materials off of 5.25" floppy disks but they were hindered by technological incompatibilities and copyright protection on the disks. Through some careful research, the team was able to break the copyright protection and access the information on the disks. Ironically however, breaking the copyright prevented them from preserving an authentic version of the commercially released game because they were unable to preserve the copyright protection.¹⁰⁴ A lesson to learn from their experience is that although they did everything correctly and to the best of their ability to preserve the game, not all of the elements can always be captured.

The students also conducted a study to assess the significant properties of the game. In order to measure fun, the study also questioned how significant properties affected the authenticity of the work. The team invited other students to come in and play the game and then interviewed them about their experiences. The key variable in their study was the different prior gaming experience between the players—some were lifelong gamers while others were casual gamers. Despite this, nearly all the participants found the hardware to be the most significant part of the game play. The results showed that the “authenticity” of the original game play was derived from being able to play on the original hardware.¹⁰⁵

This is a very different approach compared to MoMA’s but certainly not a less valid one. As mentioned before, MoMA reached out to scholars, game developers, and historians to determine significance, but they did not reach out to the general public. For defining significance in future games, MoMA may be interested in adopting this strategy, as this will again, provide information on what elements, likely physical, should be preserved.

The Artist and Conducting the Artist Interview

Recognizing whom the artist is and understanding their intent with regards to video game development takes on layers of complexities not necessarily understood in the realm of art conservation, or at least not evident. The Archives Department at MoMA has been conducting oral histories regularly with museum affiliates since 1990, primarily to preserve institutional memory. In 2011-12, MoMA received funding to focus on and record more artist interviews. These were conducted with MoMA curators as well as art historians from outside the

¹⁰³ Anna Chen, Mark Cooper, and Halley Grogan. “Ultima II: Project Documentation.” The University of Texas at Austin. Spring, 2011. Available at https://pacer.ischool.utexas.edu/bitstream/2081/23267/1/FINAL_Ultima%20II%20Project%20Documentation.pdfhttps://pacer.ischool.utexas.edu/bitstream/2081/23267/1/FINAL_Ultima%20II%20Project%20Documentation.pdf

¹⁰⁴ Ibid.

¹⁰⁵ Ibid

institution and the interviews are recorded in the presence of the artwork being discussed.¹⁰⁶ An artist interview with game developers poses some interesting problems.

For many major producers of video games, a number of people will be involved on the project such as computer programmers, story developers, graphic artists, etc. Who is the artist in this case? Conceivably, this could either be the person with the original idea for the game, the programmer who constructed the code, or the artist who incorporated the visual elements that encouraged interaction within the game.

While selecting a single artist would simplify many steps, involving those who made different contributions to the project would be more inclusive and provide the conservators and curators with a better understanding of the project's development. For complex works, MoMA requests artists to complete a form that describes the significance they place on their work, which suggests how the work can be preserved in the long term. PVW recommends collecting source code, technological documentation, production materials, designer stories and records of interaction with the user community from the developers.¹⁰⁷ For much of this type of documentation, explanation or context is needed.

For video games, the developers primary concern is to build a good game, fix the bugs as they arise and moving onto the next project. How the game is dealt with in the long-term is less a concern for them unless they are already aware that they need to re-visit the game in the future. Some materials may end up in archival collections post-acquisition, but these materials are not always easily available or decipherable.¹⁰⁸ For an institution collecting the works as art objects, scholarly research is a secondary concern.

Technologist as the Artist

Many of the new media art preservation initiatives above, including the Variable Media Network and Inside Installations discussed the importance of feedback and insight from the artist. In developing the questionnaire, the authors quickly realized that each individual art piece have to be treated differently and that solutions could not be media-specific since most variable and time-based media formats would likely fall to obsolescence as new ones arose.¹⁰⁹ Such a format would probably have become obsolete within a year. Instead the team developed a set of modular behaviors for the artist to address in describing the

¹⁰⁶ "Oral History." MoMA. Accessed April 04, 2013.

<http://www.moma.org/learn/resources/archives/oralhistory>.

¹⁰⁷ McDonough, et al. "Preserving Virtual Worlds" 2010.

¹⁰⁸ Megan A. Winget, & Caitlin Murray. (2008). "Collecting and Preserving Videogames and Their Related Materials: A Review of Current Practice, Game-Related Archives and Research Projects." [Long Paper] Annual Meeting of the American Society for Information Science & Technology (ASIS&T). Columbus, OH (October 24 – 29, 2008).

¹⁰⁹ Ippolito, "Accommodating the Unpredictable," (2003) 48.

work. Building upon this format, the next generation of the questionnaire brought in viewpoints from additional stakeholders including the curator, conservator, an artist's assistant, among others.¹¹⁰ This method generates conversation between the stakeholders and allows topics to arise organically, including information that may have been otherwise overlooked.

Inside Installations keeps the focus on the artist. In their research on artist's interviews, currently available online, the authors note how Oral History strategies have evolved over time and are being implemented into artist interviews.¹¹¹ Since there is the possibility of interviews having to be conducted via phone call or video conferencing, conservators at MoMA and at other museums acquiring and conserving video games should research oral history interviewing strategies.

MMA does not provide a guidelines for conducting an artist interview, however the prompts developed by the consortia operate as guidelines for understanding the work ahead of time. Research, preparation, and a thorough knowledge of the piece being discussed are essential to conducting an artist interview.¹¹² By addressing all of the relevant points, the prompts provide an thorough way for the curators and conservators to prepare themselves for the interview. Again, MoMA conservators are experienced at conducting interviews, however, they must also remain up to date on new technologies and also be able to transfer that knowledge to the curators prior to the interview.

There are some who might consider source code and programming not to be an art form, it does a disservice to the creators who put so much into these games or artworks, especially the developers who see the game from its design conception to an executable and launched game. But there are certain things to take into consideration including how many people were involved in development and at what stages. In many cases, such as with Valve and *Portal*, there is more than one person designing a game, and each person brings their own unique contributions to a project. For example, programmers create the algorithms and designers create the artistic elements, both of which are essential to game play. This brings up another important point that curators and conservators need to be aware of: not only is every game different, but so are the design practices, workflow and storage systems of every independent and studio game developer.¹¹³ Each developer will have their own internal structure for managing digital materials, if they do at all. Game scholar Megan Winget suggests identifying

¹¹⁰ Ibid, 52.

¹¹¹ Netherlands Institute for Cultural Heritage. "Preservation and Presentation of Installation Art." Inside Installations. Accessed March 09, 2013. http://www.inside-installations.org/research/detail.php?r_id=659.

¹¹² Yokoyama, "Capturing the Artist Interview," 28.

¹¹³ Megan. Winget, (2009). "Archiving the Videogame Industry: Collecting Primary Materials of New Media Artifacts." [Poster] Proceedings of the 9th ACM/IEEE-CS Joint Conference on Digital Libraries(JCDL). Austin, TX (June 15 – 19, 2009) p. 459.

common practices in the game development industry and using this information to guide collection development and long-term management practices.

Like the initiatives in researching conservation strategies for new media art, Winget also proposes addressing the creative process in collecting video games by recognizing programmers, developers, and producers as artists creating an artifact. She considers that many initiatives are focused on the end product, and uses this as an argument for the necessity in understanding the creative process.¹¹⁴ While being involved in the creation process would create an incredible advantage, any level of contact with the creators is the important element in the relationship and a more realistic one for the conservators. Documentation is one of the best ways to understand artistic intent. A problem arises when artistic intent does not match the significance imposed on the work. Winget also brings up the point of allowing a work to “age” as a painting or sculpture might, if the artist would have agreed with this philosophy.

Player as the Artist

When discussing the context information element of OAIS, PVW recognizes that “the ‘why’ of [video games] creation is not necessarily something established by the game designers, but is constructed on an on-going basis by the games’ users.”¹¹⁵ This implies the user or player as an artist in, for example, a process-oriented game as described by Egenfeldt-Nielsen, Heide Smith, and Pajares Tosca.

In the recent Smithsonian exhibition, *The Art of Games*, which is currently touring the country, the video game players were the curators, or the ones who established significance in the works. Although the Smithsonian did not acquire these games, this example calls into question the definition of the artist of a video game.

The exhibition consists of eighty games displayed in a chronological manner in order to represent the history and development of games, recognizing them as an artistic form. In selecting the eighty games to be included, guest curator Chris Melissinos presented a multiple-choice list to the public. Video games for different categories were then voted on and the results tallied. According to Melissinos, while the artist can create a work, a game, and share it with the world, but to some scholars, it is the audience, the players, who give it meaning.¹¹⁶ *The Art of Games* illustrates the debate about who the artist is, and in some cases who the curator is, with respect to video games and gaming. As with other topics discussed in this paper, this approach inherently leans towards nostalgia.

When considering the player as the artist, another approach is to discern the significance of the game by *how* the audience interacts with the game based on

¹¹⁴ Winget and Murray, “Collecting and Preserving Videogames and Their Related Materials, (2008).

¹¹⁵ McDonough, et al. “Preserving Virtual Worlds” (2010) 101.

¹¹⁶ Chris Melissinos, in conversation with the author, February 15, 2013.

the human-computer relationship, the dynamics, of the game—dynamics made possible by the programmer or developer.

Therefore, considering the members of an audience as the artists is applicable but players should almost never be considered the only artistic stakeholder, especially in regards to video games. They are moving through a virtual space, but for the most part, they are *reacting* to the aesthetics and mechanics, not creating them. An exception to this might be an RPF where the player drives the narrative and interacts with other avatars with real-life counterparts. A case can certainly be made for this, but the possibilities of interaction are still rooted in the technological elements of the game.

The Artist Interview at MoMA

Although this is already practiced at MoMA, a curator and conservator should be present at an interview since they will have different questions and concerns: one may have more aesthetic and the other technical. Best practice recommends the interview generate a video and/ or audio recording of the interview, preferably in different formats. Having a record allows the interviewer or interviewers to remain focused on gleaning information from the artist rather than taking copious amounts of notes.

In her MIAP thesis in 2008 on conducting museum interviews with artists, Miwa Yokoyama describes the process of an interview conducted on a Nam Jun Paik piece with the artist's representative at MoMA. She notes that both video and audio were used to document the interview, except that after the interview, they discovered the video had failed to capture. Luckily, they still had the audio to work from.¹¹⁷ Based on her thesis, it does not appear anyone was aware that the camera was not recording the interview. Redundancy mitigates the risk of technological failure at vital moments, and therefore there should be two forms of recording at the very least for interviews.

If they do not already, when conducting the interview, the curators and the conservators at MoMA should take a similar approach as the Variable Media Questionnaire by documenting not only what the artist deems important about different behaviors, but what all of the stakeholders deem important as well, including the conservators or artist's assistant. These insights could raise awareness for future interpretations about the work. Yokoyama also stresses the importance of the work being present while the interview is taking place.

It is also important to bring in an outside perspective for the artist interview, which MoMA has done previously. The same will go for video games, MoMA intends to bring in another game designer. This will be someone familiar with both MoMA's curatorial mission and the game being conserved enough to provide insight or translate programming lingo if needed.

¹¹⁷ Yokoyama, "Capturing the Artist Interview" (2008) 28.

One strategy to consider for conducting an interview with the artist or artists is through video conferencing for computer or online games. Applications such as Skype and Google chat allow users to share screens. This would allow either the interviewer or interviewee to present the work in its medium. For example the artist can guide their way through the game, with an explanation of the interaction, or the curator or conservator could have previously recorded screen captures with specific questions on certain interactions. There can be several downsides to this strategy such as dealing with lag time over the internet, or losing the subtle but key hints projected through body language, if the interviewer is skilled at this.

Strategies for Conservation and Preservation

For most museums, the curatorial mission is to conserve the authenticity of a work by preserving the original elements and technological strategies are being explored to determine the feasibility of maintaining authenticity. Most, if not all, digital preservationists disagree with this strategy.

Traditionally, preserving things meant keeping them unchanged; however, our digital environment has fundamentally changed our concept of preservation requirements. If we hold on to digital information without modifications, accessing the information will become increasingly more difficult, if not impossible.¹¹⁸

Since preserving a work in its original state is not always a possibility, the work must be reenacted or recreated in order to be accessible. Citing an example from earlier, the piece collected by Rhizome was recreated by the artist in a new programming language in order for it to render in a contemporary environment. In this case, the work had to be recreated by the artist a second time when the first solution became obsolete. A good portion of new media artists and video game developers are still alive and even if they are unable to fix a work, they can provide valuable information for its preservation. This type of information relies on documentation in order to understand the “look and feel” of a piece.

From the previously discussed methodologies of evaluation, it is evident that establishing the significance of a video game and how it fits with the curatorial mission of the museum is the first step in launching a preservation plan. The next steps are to identify and document the aesthetic elements and technical components that contribute to the significance of the game. Then define the risks inherent to the components. This information relies on the agreement established between the developers and the collecting institution, specifically what the developers will be providing the institution. In defining the areas at risk, it may help to list out specific vulnerabilities to each area of risk.

¹¹⁸ Su-Shing Chen, “The Paradox of Preservation”, *Computer*, (March, 2001), pp. 3.

Although it should be considered throughout the process, documentation should take precedence in the early stages of conservation. The collecting institution should then take the opportunity to analyze what is being received and what forms of documentation will best preserve the significance of the work but also invite future interpretations of the works. Documentation will also acknowledge and may bring to light additional technical components for preservation and additional information potentially relevant to the game's preservation. Following documentation strategies will be a review of technical strategies for preserving the mechanics with an example of some of the strategies at work.

Documentation: Aesthetics

Using MDA as an approach, the documentation can be broken down into the aesthetics and the mechanics. To reiterate: aesthetics is how the game is supposed to look while mechanics defines how the game is supposed to work. From a museum's perspective, all of these elements are equally important because they are, essentially, the whole game. This section addresses how an institution can document the aesthetic and mechanical elements of a game and then provides an overview on preservation strategies for the technical components.

For the aesthetics, documentation *is* preservation. Documenting the aesthetics demonstrates how the game is characterized: Why is the game significant and how has this been determined? What unique elements relate to the statement of significance? Should the genres or themes of the game be addressed? Many of the answers to these questions are concerned with aesthetics.

The documentation can consist of still images, and demonstration videos of noteworthy puzzles within a game or other important human computer interactions. While this paper often discusses visual interaction within a game, audio is also a substantial element to inciting action from the player. Some game developers incorporate unique music and there are conferences and concerts devoted solely to video game music.¹¹⁹ If the audio is deemed significant, conservators should create audio files or clips. Creating descriptions of what is in the documentation also provides additional support if access to images or video is unavailable. These descriptions should exist outside of the media files, preferably a PDF-A document, in the event the visual and audio media files are no longer accessible.

Again, as the OAIS model takes into account, representation information of digital information begets more digital information. By creating documentation, the conservators have effectively created more media to be preserved: video, still images, audio clips, and text documents. While text documents are usually small and do not take up much room, high quality image, audio, and most especially video files require more storage space and additional software for playback and

¹¹⁹ Two of note are The Annual Music and Gaming Festival (MAGFest) in January and The Game Sound Conference around October.

access. The conservators should determine what quality of media files they want to produce. For video, it is easy to make access files such as with H.264 compression with a Quicktime container as an access copy by recording a screen capture of game play.¹²⁰ As of now, the technology to create preservation standard files (10-bit uncompressed) does not exist for screen captures, but there are programs which claim to record in high quality HD formats with uncompressed audio, such as Camstudio or Camtasia.¹²¹ The capability of this software has yet to be explored for this research project. If recording screen captures and taking still images from the computer, it would also help to make note of the screen resolution at time of capture. Noting the resolution could help future conservators know if the image was originally a poor quality or if the file is deteriorating.

Documentation: Mechanics

The mechanics are the technological components that make interaction possible: the source code, the executable file, and hardware. If the developers provide anything mechanical, it will most likely be the executable file. The institution may provide none or all of these components, which again, raises questions of authenticity and how an institution determines what the “original” work is. In documenting the mechanical aspects of a game, an important step is taking in the source code if it is provided. The source code is the original computer instructions in a human readable form; while both the executable file and the source code can be defined as the original work, the source code provides more robust information as to how the file functions.¹²² Another way of looking at this, is that the source code and the executable file are both the original work, but different versions of the work. This relationship could potentially be reflected in the FRBR model.

Conservators could also go beyond collecting the source code as is. Programmers often utilize a commenting feature in the code for personal notes, to communicate information between a team of programmers, or for various other reasons. The majority of programming languages offer a function for commenting, which can be scattered throughout the code. When a game can consist of tens of thousands of lines of code being developed by a team of programmers, comments help the developers recognize how the features work or provide information on how and why it was developed in case a flaw, or bug, needs to be fixed or edited.

For preservation purposes, identifying these comments provides insight on how the programmers created the game and what sections of the code create or influence interaction. But the comments are mixed in with the code and not easily discernable. Pulling these comments out would help create more user-friendly documentation.

¹²⁰ Demo videos for the presentation of this thesis were created with this format and wrapper.

¹²¹ "Video Screen Capture Best Practices." DE Oracle Main. Accessed May 03, 2013.
<http://deoracle.org/tech-skills-software/video/video-screen-capture-best-practices.html>.

¹²² McDonough, et al. "Preserving Virtual Worlds," 2010.

A tool discovered during this research project is Docco, an open source parser tool currently available through Github. Docco separates the comments sections from the rest of the code and presents the comments adjacent to the relevant code in an HTML document.¹²³ Many compilers and interpreters have a parser integrated into their software in order to assist in their outputs, but these aren't always useful or accessible for documentation efforts.

Other projects have been inspired by Docco such as Groc, which essentially does the same thing as Docco, by aligning the comments side by side with the script but also generates a searchable table of contents and is capable of handling hierarchies within the code. Groc also posits "readable command line output is just as important at readable documentation" for developers and presumably, conservators.¹²⁴ Taking this concept into account, conservators may desire the use of a tool such as Docco or Groc, or consider means of creating a tool to parse the code.

An inquiry was conducted outside of this paper as to how one might use a language script to parse comments from code. While the parsing instruction is fairly straightforward, the way in which the comments exist outside of the code complicates the exercise. There are different forms or styles the results can take and the conservators need to have some idea of what they want to get out of it.¹²⁵

It is important to mention here that this step is only worthwhile if there *are* comments within the code and if these comments have already been determined to be useful. As mentioned in the recommendations for the artist interview, MoMA should bring in an outside game developer to review the game and the code if it is available, along with providing feedback for the artist interview.

This paper touts the source code as being an original form of artwork, and it is. But without context, such as information on the software and hardware environment or information on the compiler used to process the code, the act of preserving the code begs the question—why? As discussed with regards to PVW, the *Ultima II* Preservation Project and NZTronix, which will be described at the end of this section, intellectual property issues can too easily bar the opportunity for research and preservation activity to take place. Most companies or developers would never release their code if they continue to believe it gives them an advantage on the consumer market. Also, as the reader is certainly aware, technology moves at a rapid pace. Acquiring the code with flexible rights that allow for preservation puts MoMA in a prime position—once the technology starts to become available—to conduct research on uses for preserved source code while other institutions are still searching for copyright loopholes just to access it. In a "what if" scenario: What if, in the future, an emulator is able to read an old source

¹²³ Jeremy Ashkennas, "Docco." Docco. Last updated March 14, 2013. Accessed March 17, 2013. <http://jashkenas.github.com/docco/>.

¹²⁴ Ian MacLeod. "Groc". groc. Last updated April 13, 2013. Accessed April 15, 2013. <http://nevir.github.io/groc/cli.html>

¹²⁵ Kathryn Gronsbell, in conversation with the author, May 3, 2013.

code directly, whether or not it has been updated, then compile or interpret it and execute it as an accessible file with no additional software components? This is pure speculation on the author's part—especially since this may already be in development. Either way, since the conservation department has the source code, they should make an effort to preserve it.

Source code files can be saved as .csv (Comma-separated values) files, which can store information in plain text and is easily accessible, human readable, and is normally a small file size.¹²⁶ A copy of the .csv file should be saved as a master copy, with no edits or annotations. Derivative access copies can also be made available. In parsing out information from the code, it was originally suggested that comments are separated from the source code and displayed to sit adjacent to the original code. This suggestion can still stand for *Portal* since it was described as possessing quite a bit of commentary and communication between the developers.¹²⁷ However, as was discussed earlier, every game is unique and therefore its preservation plan will be as well. If the department is interested in pursuing this, the recommendation here is for a conservationist, and curator if possible, to begin working with a programmer in order to identify components of the art work within the code and determine options for different forms of code. The power and potential for the future of the code lies in understanding the options available now.

Documenting the hardware requirements of a game is also a necessary step, especially since many games run on multiple platforms. A game is often released to offer as many access options as possible for commercial purposes, because if more people are able to access the game, then more income is generated for the developers. Making note of the platform the game was originally intended for or first released on is important, but documenting all of the platforms the game was made available on provides more information as to how the game functions or how a player could potentially interact with it and also provides more exhibition options for the future.

Technical strategies for preservation

From documentation and an understanding of the specifics of what the institution is acquiring, the options for preservation begin to emerge. The Variable Media Network identified four primary strategies for preserving complex media: storage, migration, emulation, and reinterpretation. Other projects expand on these strategies but these are the most often researched and referenced.

Something to take into account before going any further is to determine how granular the significant properties have been identified. As demonstrated much earlier in this paper, the art object can exist on various levels: the programming language itself, the source code level, and the executable file. The

¹²⁶ "13.1. Csv — CSV File Reading and Writing." Python.org. Accessed May 04, 2013.

<http://docs.python.org/2/library/csv.html>.

¹²⁷ Jeep Barnett, email with author, 2013

presentations of JISC et al. at the 2008 conference also recognized levels of granularity. Determining the significance of a game and the components, which are employed to create the significance, instructs the conservators and curators about how granular the preservation process should be. Is the programming language a unique or not widely used language? If so, this should be considered and documentation about the language should be acquired as part of the Submission Information Package. Is the source code included as part of the SIP and is it identified as an authentic element of the video game as an artwork? If so, the source code should be given as much attention as the executable software being acquired.

Storage

Storage is a concern for both the hardware and software. When it comes to conserving the hardware, this decision is really reliant on whether or not the hardware is essential to the design of the game. As mentioned, many were originally released on different platforms, meaning the initial experience was different for everyone and the reviews of the game reflect this. This is a decision to be made per game.

According to VMN, storage is the most ineffective of the four and consists of taking in the physical and digital material, but not necessarily taking the proper steps to maintain it.¹²⁸ This is not useful for preserving less resilient works such as electronic artworks or digital objects. Storage in its original sense as defined by the VMN is not applicable to video games, but it does have a role in the long-term management of the work.

Storing hardware and software is a consideration many collecting institutions already pursue. Hardware provides information on the most authentic tactile experience of game play, while software provides the interactive element of a game. Conservators need to consider where a file will be placed and how it will be accessed tomorrow, five years in the future, or beyond.

Migration

Migration involves moving digital content from one format to another. The Digital Preservation Coalition (DPC) defines migration as “a means of overcoming technological obsolescence by transferring digital resources from one hardware/software generation to the next” where preserving the content is more important than preserving the original technology.¹²⁹ In a shorter definition, migration is the process of changing the digital object into “more stable or more widely adopted representations.”¹³⁰ This can occur on the binary code level—

¹²⁸ "Strategies." Variable Media Network. Accessed January 22, 2013.
<http://www.variablemedia.net/e/index.html>.

¹²⁹ "Introduction- Definitions and Concepts." Digital Preservation Coalition. Accessed April 06, 2013.
<http://www.dpconline.org/advice/preservationhandbook/introduction/definitions-and-concepts>.

¹³⁰ Christoph Becker, Andreas Rauber, Mark Guttenbrunner, Hannes Kulovits, and Hans Hofman.
"Systematic Planning for Digital Preservation: Evaluating Potential Strategies and Building Preservation

the executable file—or on the source code level. The PVW final report refers to these as binary migration and source code migration.

A binary migration occurs at the machine-readable level and is only effective when the target machine is backwards compatible to its predecessor or legacy format.¹³¹ In other words, the file is converted to work on a newer computer but only if the newer computer is still capable of reading the *type of file*. For example, the applications designed to run on the older, slower computers aren't compatible with the newer, faster and more efficient processors that are being installed in computers. This can result in the Viewing problem as defined by Besser earlier in this paper as well as a lack of sustainability in format adoption and external dependencies. Migrating files involves regularly updating them by converting them into contemporary formats.

A source code migration is a straightforward conversion of the computer instructions from one programming language to another, i.e. converting a paragraph of information from English into French, though, of course, computer languages are very different from spoken languages. Two terms are used on the source code level: *porting* and *translating*. The words essentially mean the same thing however the context of their use differs.

Porting is used early in the lifecycle of a game and usually in the context of distribution, for example a multi-platform release of a game is accomplished by porting. A multiplatform release occurs when a game is being released on a new platform or device by the publisher for commercial purposes. *Portal* was developed by valve for the PC and Xbox and then it was ported by another company, Electronic Arts, to be made available on the PS3. Translating is used more often with regards to preservation activities: for example, the preservationist would translate the code from an obsolete programming language to a newer or more widely used one.

In the context of preservation, porting would be used when referring to a recently created code. The origins of the code would be known or clearly documented. With regards to translating, the code's origins would be somewhat murky and require more time and research efforts on the part of the preservationist during the migration process.

PVW considers migration an easy and standard preservation strategy. It may be perfectly acceptable for institutions not concerned by the authenticity of the work undergoing preservation; however in the case of a museum, where authenticity is a factor, the decision to migrate must be considered much more carefully. One reason might be that the creator and curator agree the pure source code is not the artwork but the look and feel of the game is. For example, if the game is designed to move at a slow pace, transcoding to a more controllable format could achieve this quality rather than emulating the code on a faster

Plans." *International Journal on Digital Libraries* 10, no. 4 (December 19, 2009): 133-57. Accessed February 24, 2013. doi:DOI 10.1007/s00799-009-0057-1.

¹³¹ McDonough, et al. "Preserving Virtual Worlds" (2010) 78.

processor.

Emulation

Emulation takes the opposite approach of migration by seeking to recreate the original viewing environment rather than altering the file and emulation is the more researched and advocated strategy. Emulation “refers to the capability of a device or software to replicate the behavior of a different device or software.”¹³²

With emulation, the digital object is preserved as is, while the digital environment it operates in is rendered on newer hardware or software. This is the preferred method because the object is preserved in the purest form possible, which is a more ideal situation for source code. If the source code is placed in an emulated environment with the proper compiler, theoretically, it should generate an executable file.

Emulation developments and strategies are often community driven and made available online to other nostalgic gamers.¹³³ Since emulators are software, they also need a long-term management system in place if they are to be accessed in the future. There are resources available to assist programmers and others in building emulators, however, there are also drawbacks to running older files through emulators on newer hardware. In discussing the problem of Translation, Besser describes an instance where the emulated environment significantly changed the “look and feel” of an older computer game because the computer’s processing power was drastically faster than one it was built on.¹³⁴

Migration and emulation are not necessarily entirely independent of one another. The results of a migration still have to be reviewed in a virtual environment. Migrated files and emulated environments rely on the processing power of the machine they are running on.¹³⁵ One may need to emulate the environment of the target operating system in order to run a migrated file not otherwise accessible on any contemporary device. For example, a game file may have been migrated to a target operating system, but this doesn’t mean the file will be accessible in the next version of that operating system.

Reinterpretation, Reenactment, Recreation,

Reinterpretation of variable media art involves altering the work or modifying the meaning of the work every time it is recreated. A variation of reinterpretation is referred to as reenactment. This is dependent upon documentation and involves reconstructing the environment or the experience of

¹³² Mark Guttenbrunner, and Andreas Rauber. “Evaluating Emulation and Migration: Birds of a Feather?” in *The Outreach of Digital Libraries: A Globalized Resource Network - 14th International Conference on Asia-Pacific Digital Libraries, ICADL 2012, Taipei, Taiwan, November 12-15, 2012*. Hsin-Hsi Chen, Gobinda Chowdhury Eds. Proceedings. (Lecture Notes in Computer Science 7634 Springer 2012) pp 158-167.

¹³³ Alex Handy, phone conversation with author, January 17, 2013.

¹³⁴ Besser, “Digital Longevity” 2000.

¹³⁵ Guttenbrunner and Rauber, “Evaluating Emulation and Migration,” 2012.

gameplay. Reinterpretation is a concern for future exhibitions and since conservators are preserving works for future exhibitions and access, this concerns them as well.

Following these steps we end up with the information package and options for managing the digital objects. Along with the digital objects, it should contain all of the necessary representation information and contextual information as well as the relationships between these elements. An outline of this section is provided as part two of the guide in Appendix B.

NZTronix

The NZTronix team at Victoria University of Wellington in New Zealand began an effort to preserve locally written software, which primarily consisted of local video games. One of the original objectives of the team was to emulate and then port a software title from the Sega SC3000 microcomputer to a mobile device. Note the order of the workflow: emulate *then* port. Due to legal and technical limitations, emulation was no longer an option, so the team decided to do a source code migration.¹³⁶

The team translated a locally written game called *99 bottles* from Basic to Java with a code translator that was written in Java. Code translators are not a new concept and have been utilized by the computer science field, but this was one of the few times the technology was applied to the humanities and the visuals were especially relevant to the success of the project.¹³⁷ The team was successful and able to create a playable game for a Nokia phone.

However the team also acknowledged that source code translation is not a solution in and of itself but is part of a long-term strategy in software preservation. Melanie Swalwell, the project lead, also made note of how the concept of authenticity and an original is “problematic.”¹³⁸ This is a notable example because they were still able to make an older game available on a new device. It demonstrates a time intensive process and the importance in understanding how a piece of software was developed and originally operated in order to preserve it.

Preserving Portal

As mentioned, Portal is an online puzzle game released in 2007 by Valve. To elaborate further on the game, the player is in control of a portal gun which, as the name suggests, creates portals through which the player teleports to otherwise

¹³⁶ Melanie Swalwell, “Towards the Preservation of Local Computer Game Software: Challenges, strategies, reflections”, *Convergence: The International Journal of Research into New Media Technologies*, (special issue on cultural memory and digital preservation, ed. Will Straw and Jessica Santone), vol. 15, no. 3, (August 2009) 264.

¹³⁷ Ibid, 272.

¹³⁸ Ibid, 271-272.

inaccessible spaces, such as around obstacles or across wide gaps. The player is also required to maneuver cubes onto large buttons in order to open doorways and move ahead to the next level. At first these are seemingly a simple concepts, but the process forces the player to recognize unique ways of traveling through the three-dimensional space and consider the consequences of angle and momentum. Neither the first person shooter concept nor buttons and doors concept is unique to gaming. But the combination of the two in such a way that results in such unique spatial relations is what sets *Portal* apart from other games. The game received raving reviews upon its release; one of the worst criticisms being it was too short.¹³⁹ Kate Carmody, on behalf of the Architecture and Design Department at MoMA, describes its significance and reasons for inclusion in the collection:

Taking unique advantage of the virtual space in which the game occurs, the character can move in unexpected ways, the spatial freedom is reminiscent of the optical tricks drawn by M.C. Escher... Because of the way game is designed, the character has a distinctive way of moving through space, and the detail that the central character is a woman is also highly unusual in the gaming world. This, along with the fact that there is no violence except towards walls, is extremely unusual in first person shooter games.¹⁴⁰

Based on the description of the game from Valve and the reasons for its inclusion into MoMA's collection, one of the most significant elements of the game is how the player moves through portals. According to one of the designers, there are a significant amount of calculations involved with what the player sees when looking through a portal. In some levels of the game, the player creates an entrance (a blue oval) on a flat wall in order to move from their current location to a room with an exit (an orange oval). Later in the game, the player acquires an additional gun and is able to create both the entrance and the exit. When the player looks through the portal, they see either a different room or the same room from a different point of view.

A bit of trickery is applied through the code in order to accomplish this. When the player is looking into a portal, they are not actually looking through it but rather into another room constructed to *appear* as what the player should see. However when they move through the portal, they end up where they intend to be and not this additional room. These are the types of relationships within the code that need to be preserved. (Figure 8 and Figure 9)

¹³⁹ Adams, Dan. "Portal Review: The Cake May Be a Lie, but the Fun Isn't." IGN. October 9, 2007. Accessed February 16, 2013. <http://www.ign.com/articles/2007/10/09/portal-review?page=2>.

¹⁴⁰ Kate Carmody, email message to author, February 4, 2013.



Figure 8. Portal screen shot



Figure 9. Portal screen shot

Portal is accessed through Steam, Valve's digital distribution platform. Steam provides access to games created by Valve and independent developers, and most games can be accessed via computer or PlayStation 3 consoles, but not all. *Portal* is available for PC and Mac operating systems—and very recently, Linux—Playstation 3, and mobile devices, both iOS and Android. It was programmed using C++ programming language with additional assets in Perl and Python languages.¹⁴¹ One of the benefits to having an online gaming platform is that Valve and other game developers can provide direct updates to software and games. Issues arise for conservation such as whether or not a game on Steam can be preserved without the platform, or what alternative digital assets, such as appropriate emulators, should be obtained for preservation.

¹⁴¹ Jeep Barnett, email message to author, January 17, 2013.

Portal and C++

As mentioned, Valve is willing to provide the departments at MoMA, including the conservation department, with any resources they can provide and luckily for MoMA and *Portal*, this includes the game's source code. C++ is a well known and widely used programming language, so obsolescence is less of a risk compared to many older games.

C++ is predominantly an object-oriented programming language (OOP). It is also a compiled, multi-paradigm programming language, which means it can translate to machine readable code before executing and it can operate the OOP paradigm along with the three other styles of programming as needed: imperative, functional, and logic. From the website of Bjarne Stroustrup, the creator of C++:

...object-oriented programming is a style of programming... In the context of C++... it means programming using class hierarchies and virtual functions to allow manipulation of objects of a variety of types through well-defined interfaces and to allow a program to be extended incrementally through derivation.¹⁴²

In an attempt to clarify, files and software created from OOP are comprised of a collection of objects in a virtual space interacting with one another. When OOP is utilized in C++ it allows for a high degree of flexibility when maneuvering objects, although instructions must be written explicitly. The programming language is often used for video games because it has low overhead and high performance, which means the real time rendering from player input to display output is efficient. This also means the turnaround time in processing source code into machine readable code is quick and runs smoothly.¹⁴³

Notably, OOP allows for class hierarchies and inheritance. This is a code architecture that acts as a template for objects,¹⁴⁴ and establishes the relationships between base classes and derived classes. A class definition describes the form an object will take and the behaviors of the object; this means objects can also be referred to as *instances* or *instantiations* of a class.¹⁴⁵ Hierarchies help to manage complex relationships between objects and their instructions, as well as how objects interact with other objects. When an object receives its instructions, or a *message*, to perform an action from either its class definition or another object, the actions are referred to as *methods*.¹⁴⁶ Thus, a method is invoked when a message is

¹⁴² Bjarne Stroustrup, "Bjarne Stroustrup's FAQ." Stroustrup: FAQ. Modified October 3, 2012. Accessed March 16, 2013. http://www.stroustrup.com/bs_faq.html.

¹⁴³ Jeep Barnett, email with author, March 8, 2013.

¹⁴⁴ Greg Voss, *Object-oriented Programming: An Introduction*. (Berkeley: Osborne McGraw-Hill, 1991) 21.

¹⁴⁵ Roger Sessions, *Class Construction in C and C++: Object-oriented Programming Fundamentals*. (Englewood Cliffs, NJ: Prentice Hall, 1992) 52.

¹⁴⁶ Voss, *Object-oriented Programming: An Introduction*, 25.

received.¹⁴⁷ Finally, classes and class hierarchies allow for inheritance to be built in: a base class will describe the form and behaviors of a wide group of objects and a derived class inherits the functions of its base class.¹⁴⁸ Another way to look at this is moving from broad to specific: both a “cup of hot coffee” and a “cup of hot chocolate” have the base class definition “hot drinks”, but a “cup of hot coffee” will have a derived class of “highly caffeinated.”

Although the terminology regarding C++, OOP and classes can become confusing, the arrangement allows for more organization within the code and increased human readability overall. For video games and other types of complex software, C++ is used because it’s fast, flexible, and well supported.¹⁴⁹ Suffice it to say, C++ will more than likely be around for a long while. On a side note, Valve’s Steam platform is also written in C++. This does not necessarily imply improved integration of games but it does demonstrate the prevalence of the programming language.

Documentation

Documentation of the aesthetics and examples of the interactivity should be approached first. In order to understand the full breadth of interaction in *Portal*, it is recommended the full game be recorded for conservation in order to demonstrate the style of activity the player is engaged in throughout. MoMA can either take advantage of existing documentation or to create new documentation that highlights specific areas.

IGN offers walkthroughs of each test chamber, which may be of interest for documentation efforts.¹⁵⁰ There are also player videos available on YouTube and other video hosting sites, which provide screen recordings of game play.

A more lengthy and involved process would be for MoMA to generate their own documentation. Video documentation can be accomplished by recording a screen capture while someone plays through the game on a computer. A variety of screen record programs, both proprietary and open source, are available for all operating systems. For example, Screen Record Utility is available on Mac OSX and generates an H.264 compressed video. While this is not an archival quality video, it is important to remember this is not the “object” being conserved, but a demonstration of someone playing the game.

If recording the full game is not an option, another course of action would be to record portions of the game: identify examples of significance, such as movement through portals, and record these levels or actions. The most

¹⁴⁷ Sessions, *Class Construction in C and C++*, 53.

¹⁴⁸ Bjarne Stroustrup, "Bjarne Stroustrup's C Glossary." Modified October 3, 2012. Accessed March 16, 2013. <http://www.stroustrup.com/glossary.html>.

¹⁴⁹ Michael Dawson, *Beginning C++ through Game Programming*. (Australia: Course Technology, 2011) 1-3.

¹⁵⁰ "Walkthrough." IGN. Modified August 2012. Accessed March 17, 2013. <http://www.ign.com/wikis/portal/Walkthrough>.

informative levels would likely be the first level where the player is taught how to move through the space, a number of significant middle levels, which demonstrate advanced challenges, and the final showdown with GLaDOS.

Documenting the mechanical elements of the game is essential to the preservation of the game. Such documentation of *Portal* would include the source code and an annotated version of source code, similar to the strategies described above. The comments or annotations would assist in understanding how interactivity is implemented.

Portal and Preservation

The first step is to identify the mechanic components, as well as the significant dynamic elements and aesthetic aspect of *Portal*. The mechanical elements in *Portal* include the source code and executable file. In addition to the source code the conservators should also acquire an executable file of the game. The dynamic elements were described above: how the player teleports from one area to another and how objects interact in the space. The aesthetic aspects involve how the player is influenced by the visuals in order to create a portal, such as where the flat walls are, or in order to interact with a cube, such as place it on a button to open a door.

Possessing the source code, especially one written in C++, is incredibly advantageous because it opens more avenues for preservation, notably emulation, and migration. The conservators should first review the code and make note of comments in the code.¹⁵¹ It would be useful to have an annotated version from the developer which points out the significant portions such as the base classes for multiple objects. Conservators should consider this as essential to the technical preservation of the game and not just as documentation or support material. There are resources and tools available to generate documentation from code. For example, Docco is a tool which process source code and parses out the comments from the code into an HTML executable file. However, Docco also requires additional dependencies in order to run.¹⁵²

Emulation and Migration

Emulation as an option is available since MoMA possesses the code and can create the executable file as needed. MoMA would then need an application in order to run the code. As mentioned, Valve runs *Portal* through their platform Steam, also written in C++ so, ideally, an emulator should be written in C++ or in a language easily interoperable with C++, such as C# or Objective-C. Since C++ is not going anywhere, emulation is not yet necessary for preservation needs,

¹⁵¹ Comments in C++ source code are identified with and preceded by `“//”`

¹⁵² Jeremy Ashkennas. "Docco." Docco. Last updated March 14, 2013. Accessed March 17, 2013. <http://jashkenas.github.com/docco/>.

however, for future exhibition needs, this would be useful. If possible, MoMA should also take in a sample of the executable file. While source code would be sufficient, an executable file will provide additional information on how the game is constructed.

With the source code, migration is also an available option. Again, obsolescence is not an issue so such considerations will only be useful in the far future. However, should the game need to be migrated, the source code should be migrated into a language with the flexibility of C++. It should have OOP functionality and the ability to maintain the relationships between the separate objects within the game. Many contemporary or newer programming languages have this function.

Hardware

Portal was originally released as part of *The Orange Box* package that also included *Half Life 2* and *Team Fortress 2*, two other games developed by Valve. Valve developed *The Orange Box* for the Microsoft Windows and Xbox 360.

Valve outsourced the games to Electronic Arts who ported them to Sony's PlayStation 3.¹⁵³ When Steam was developed for Mac OS, *Portal* was subsequently released for Mac as well.¹⁵⁴ This is evidence that the game was not intended for a single hardware system, and instead intended to be as widely available as possible.

Since the game was initially released for Xbox 360 and PC simultaneously, the original experience of playing the game differs for everyone: some experienced *Portal* on their computers and others on an HD screen. Also of note, in 2007 *Portal* was awarded Best Puzzle Game for both the PC and Xbox 360 platforms. Choosing the appropriate hardware depends on the needs of the museum because the hardware is not relevant to the significance MoMA has placed on the game: the technical engineering, not the tactile experience. Rather than preserving physical hardware, MoMA should consider instead documenting the technical specifications of the various platforms Steam and *Portal* are available on. This can provide information for future emulation needs.

Recommendations

Based on assessment strategies the following section provides a summary or conclusions and a list of recommendations for preserving *Portal* as well as general preservation actions for video games. The list is intended for media conservators at MoMA, although other collecting institutions may find the suggestions useful.

¹⁵³ Jeff Gerstmann, "The Orange Box Review." *Gamespot*. October 10, 2007. Accessed March 17, 2013. <http://www.gamespot.com/the-orange-box/reviews/the-orange-box-review-6180730/?page=3>.

¹⁵⁴ Sean Hollister, "Steam for Mac Opens a Portal to May 12, Steps through." *Engadget*. April 29, 2010. Accessed March 17, 2013. <http://www.engadget.com/2010/04/29/steam-for-mac-opens-a-portal-to-may-12-steps-through/>.

There is some argument against approaching the video game as an object, which this paper is certainly guilty of. One of the biggest challenges facing a museum with regards to digital preservation, especially born digital materials, is “preserving informational content that may be completely disembodied from any physical artifact.”¹⁵⁵

Museums acquiring video games may need to rethink their perspective on the “traditional” concept of object-based conservation. The conservation object comes from the notion of authenticity and provenance, proof that a work is genuine. The proposed risk of video game forgery has yet to be calculated, but it is unlikely a high one.

While the majority of interest is in preserving old video games, efforts should also concentrate on preserving new games. Video game development is at a point where an increasing number of people have access to developmental tools. Colleges and universities are creating game development departments in response to a growing field. Putting a video game in an art museum, one not specifically designed for video games, legitimizes the video game to an audience not otherwise interested in them as art objects.

Museums and cultural heritage institutions should aim to get game creators involved wherever they can and begin the conservation process prior to the formal acquisition. Realistically, however, this option often does not involve the conservator’s input. Helping curators understand their options for future exhibitions based on what is being acquired may assist both conservators and curators in determining what to request in future acquisitions.

Become familiar with Programming Languages

The conservators should begin familiarizing themselves with notable programming languages, with special attention to significance and differences between languages. Since, as stated, C++ is often used for developing video games, this would be a good place to start.

Collect annotated source code

Portal is one of the few games MoMA is receiving the source code. This particular recommendation advocates for the preservation of source code in the museum setting because it is the most original form of the game, or the most original artwork. Having the code provides more options in the future. Conservators can also take advantage of this by creating an annotated version of the source code by using a parsing tool such as Docco or Groc, working with the original programmers or an outside programmer to review the script and determine significant areas in the code.

¹⁵⁵ Besser, Digital Longevity, 2000.

Document the Aesthetics

The aesthetics are half of the game, which stimulates interaction in the game, so documenting the visual elements is a preservation activity. Documentation includes still images and/or videos of important interactions within the game. In collecting this documentation conservators could approach this in two ways: by reaching out to the gaming community where many images, videos and tutorials already exist or the conservators could create their own

Artist interview: Walkthroughs

The format of artist interviews can vary based on the above. The interviews can take the form of computer screen recordings of game play that is accompanied by an audio interview or narration while a full walkthrough of a game is taking place. If there are time constraints the conservators, curators, and programmers, each can identify specific areas of the game of significance prior to the interview and isolate those sections for the interview.

Conservators and artists along with an outside programmer should do a review of the source code together if the option is available. The outside reviewer should also be available for the interview to guide questions, or translate programming lingo if needed.

Document the Hardware

The different types of hardware for portal should be documented with descriptions on how the game was operated on each device.

In a similar vein, the conservators may also want to consider developing a type of access document that provides an overview of information about certain pieces of game hardware, such as the type created by DOCAM. The Maryland Institute for Technology also developed an online access system for hardware formats along with use and context.¹⁵⁶ This could then be linked to from the documentation of the different games rather than including a full description of the hardware every time a game is entered into the system.

MoMA documents their exhibition history and conservators will often make note of any issues, which arose including hardware and software. This information could also be included with the last recommendation by making note of any bugs or idiosyncrasies of a particular piece of hardware.

Conclusions

Video games are complicated and they can be difficult to describe. In defining and analyzing all of the factors and pieces that are involved to build a game, it becomes evident that every game must be approached as a unique piece with a distinct preservation plan. To determine the significance, conservators and

¹⁵⁶ Matthew Kirschenbaum, "Introduction." Maryland Institute for Technology in the Humanities: MITH's Vintage Computers. Accessed April 30, 2013. <http://mith.umd.edu/vintage-computers/>.

curators, the museum stakeholders, should work together and in conversation with a point person on the game developers end. Prior to contacting the developer, the museum would have a clear idea of why they are interested in a particular game: what they find significant about the work based on their curatorial mission, how the game fits into the department's collection and the overall collection of the institution. This is basically what the A&D department did when they began the process of acquiring the games.¹⁵⁷ However, the museum had worked with people outside of the institution to determine significance by analyzing the games based on the museum's criteria: form and function of the game, its cultural impact, and so on. This point person on the development end should be knowledgeable about the acquired game, enough to continue developing a statement of significance with the museum.

While the primary goal of this research paper is to demonstrate how MoMA should consider preserving *Portal*, the overall aim is to recognize an interdisciplinary approach to preserving video games. This involved identifying concurrent and adjacent strategies for preservation used in fields working with similar elements. As demonstrated, the boundaries between digital preservation practices and variable media conservation are blurring, as are the responsibilities for the stakeholders, especially those charged with managing the materials. Yet although their responsibilities are merging, they have different concerns and needs regarding the video games. Both the curator and conservator should be in contact with the developer. With the influx of digital materials being collected by museums, conservators are taking on more responsibilities of the art works and fine-tuning their roles within the institution. If the conservator is in charge of managing access to the digital repository, then they are also responsible for how the information is dispersed. Due to this, the conservator may want to establish a reference file or access document providing information to terminology and taxonomies used by the conservation department and the video game realm.

Making video games accessible in the future is the purpose of conserving and preserving video games. Allowing room for them to be open to interpretation presents more challenges in determining significant properties and characteristics.

¹⁵⁷ Paul Galloway and Kate Carmody, Interview with author, January 24, 2013.

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Appendix I: Glossary

Binary Code: executable code, machine-readable code; code read by a computer to generate an executable file

Binary Migration: (vs. Source Migration) migration of machine-readable code

C++: widely used general- purpose programming language; a compiled, multi-paradigm language, most notably object-oriented and uses procedural functions, or statements that are invoked to create an action

Compiler (Compiled): mechanism that translates source code, human-readable code, into binary, or machine-readable, code; has elements of both High and Low Level languages. a programming language is said to be compiled or precompiled if this step occurs automatically when a source code file is saved before it runs through an interpreter.

Conservation Object: object or artwork intended for examination, documentation, treatment, and preservation

Digital Object: the content files, metadata, which can inform us what software or hardware should be used, and the container binding all of this information together

Emulation: capability of a device or software to replicate the behavior of a different device or software

Esolang: *Esoteric Programming Language*, - a programming language designed to test the boundaries of computer programming language design, through experimentation, as a proof of concept, or as a joke. Normally, the language is not intended for writing software and there is no practical use for the language. Examples: Piet, Brainfuck, Shakespeare, Whitespace.

Executable code: *binary code, machine-readable code:* Software in a form that can be run in the computer. It typically refers to machine language, which is the set of native instructions the computer carries out in hardware. may also refer to programs written in interpreted languages that require additional software to actually execute. Some interpreted languages remain in their source code form,

Executable File: .exe; : machine readable instructions for a computers Central Processing Unit

Interpreter: a computer program that executes, i.e. performs, instructions written in a programming language. An interpreter generally uses one of the following strategies for program execution:

- execute the source code directly
- translate source code into some efficient intermediate representation and immediately execute this
- explicitly execute stored precompiled code made by a compiler which is part of the interpreter system

A programming language is an interpreted language if it has to be converted into machine code each time the program is executed, which tends to make them run slower (Vs. A compiled language)

Linker (Linked): a computer program that takes one or more object files generated by a compiler and combines them into a single executable program. (Wikipedia)

MDA: Mechanics, Dynamics Aesthetics- an approach to researching and defining the human to computer relationship through video games. Developed by Robin Hunicke, Matt LeBlance and Robert Zubek and Northwestern University.

Machine-readable code: *binary code, executable code*; code read by a computer to generate an executable file

Migration: the process of moving code from one target platform to a newer or better target platform that is capable of running the software application.

Object file: a non-executable file that has not yet been compiled or linked to code libraries which would allow it to become an executable file

Object-oriented Programming (OOP): a style of programming where a concept is represented by an object. Programming using class hierarchies and virtual functions to allow manipulation of objects of a variety of types through virtual spaces and in relation to one another. Derivatives of functions allow a program to be extended incrementally.

Porting: a type of migration for video games, done at the source code level, not the executable file; usually occurs upon release of the game and less often for preservation practices; (generally used in reference to software: applications, video games, etc.

Programming Language: an artificial language designed to communicate instructions to a machine, particularly a computer. Programming languages can be used to create programs that control the behavior of a machine and/or to express algorithms precisely

Reinterpretation: *re-enactment, re-creation*, involves altering a work or modifying the meaning of a work each time it is reinstalled or recreated

Significant properties: The characteristics of digital objects that must be preserved over time in order to ensure the continued accessibility, usability, and meaning of the objects, and their capacity to be accepted as evidence of what they purport to record.

Source Code: collection of instructions to a computer written in a programming language, human readable code

Source Migration: *porting (vs. Binary Migration)* from PVW. conversion of the computer instructions from one programming language to another

Sprite Object: graphic representation of an object in programming. it can have behaviors and effects instructions applied to it, which are basically instructions for how the object should act and what reactions it causes

Transcoding: a form of migration; conversion from one format to another with similar qualities to the original (generally used for video files)

Translating: a form of migration, specifically source migration; moving from one programming language to another; usually takes place in a preservation setting, while porting usually takes place upon distribution

Appendix II: Video Game Evaluation Guide (Working)

It is recommended that this be used as an addendum Matters in Media Art's prompt Media Elements for Computer Based Artworks.

This prompt is divided into two parts: Part One, steps 1-6, gives a description of the game and recognizes areas of risk and vulnerabilities to the game. Part Two steps 7- outline the documentation process and identify potential strategies for preservation for the game. Elements generated from part two become part of the submission information package along with the material provided by the developer.

Part 1. Risk Profile

1. Provide a brief history of the video game including how it was developed if known.
2. Statement of significance. Identify the significance of the game and style of game play.
 - Does it cross genres?
 - How does the significance of the game fit the curatorial mission of the department and the museum?
 - Who contributed to establishing the significance?
3. Identify the technical components and aesthetic elements of the software.
 - How do they reflect the significance of the game?
 - Define the Input/output relationship: How do the components and elements facilitate interaction?
 - How do the mechanics of the game incite action from the player?
 - What actions does the player take in order to invoke activity from the game?
 - How might the most crucial components or elements be documented?
 - Hardware: does the controller, if there is one, use a complex system for interacting with the game?
4. Who are the stakeholders and what are their responsibilities?

5. Define areas of risk to the components. Areas may include:

- Roles and responsibilities of stakeholders
- Resources available for preservation
- Technological dependencies of the game
- Adequate storage space
- Reasons for access
- Transference of data

6. identify potential vulnerabilities to the areas of risk and how they might be mitigated.

Ex.

- Vulnerability: stakeholders, in separate departments of the museum such as the curator or conservator, share the responsibility of moving a preservation project along step-by-step—the project cannot move forward without authorization from both parties.
- Possible Solution: Have the preservation process outlined and determine which stakeholder is in charge of which steps in the process. They would be allowed to make those decisions individually.

Part 2: Documentation and Preservation

Documentation: Aesthetics

7. Create or collect Video, Image, and Audio files of significant properties in the game.

- How will these files be used?
 - Exhibition
 - Research
 - Internal Access
 - Support material
- At what level of quality will the files be created?
 - High Quality (i.e. exhibition)
 - Mid-level
 - Low or Access

8. Create descriptions of the media files generated during the process of documenting the aesthetics.

- Series of images?
- Full recording or Audio clips?
- Video of screen? Voice over narration?

Documentation: Mechanics

9. Identify technological elements to be acquired

- Executable File?
 - Format
 - Accompanying Assets
- Source code?
 - Language
 - Comments
 - Annotated
 - .csv files
 - information of software required to run source code (i.e. compilers)
- Hardware?
 - Hardware platforms
 - Controllers

10. Identify preservation strategies based on the above information