

Men and Videogames

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All fields of the arts are replete with legendary masterpieces, from Leonardo Da Vinci's *Mona Lisa* to Ingmar Bergman's *Seventh Seal*, and from Beethoven's symphonies to Shakespeare's plays. While individuals who have never directly experienced these great works of art may live well without seeing them, the impacts they have on our culture and society are so great that to remove their influence from human memory would be a grave injustice for they would take with them the muses that have inspired countless artists who came after and had experienced or were enthralled by these works, or in turn those who were influenced by them secondhand. These works are considered great masterpieces and are valuable to many people, so steps have been taken to ensure their preservation for hundreds of years to come.

But is all that should be preserved in this world great art? Such a proclamation would require further questions such as what is to be considered great art, and who is to determine those qualities? Such questions are far too complex for simple answers for they bring with them many other questions regarding culture and society, and perhaps also about the very core of humanity. They also often fail to consider that even popular culture can have profound – and often positive – impacts on people both within and without the realm of the 'high arts,' ignoring the everyday and popular creations of a culture for the perceived master works that epitomize the declared qualities of a field.

Convincing people that popular culture should be preserved isn't easy to do. Popular culture, some critics argue, has no value as art nor is it a significant cultural form because it was not created by learned men – and women – who strived for the highest standards, to express themselves with the greatest perfection for the sake of beauty and the betterment of humanity as a whole. By comparison, they argue, popular culture is made by and for the masses, as entertainment and consumable product that cannot possibly cause audiences to become better people or teach them new things. Videogames¹ in particular are labeled as 'pure entertainment' at best and destructive, corruptive influences at the worst, and are frequently condemned for their sometimes violent and/or sexual content.

Yet games are a very important part of any culture – all cultures have games. Some games even have great cultural or spiritual value, such as the Mayan ball game, Pok-A-Tok, which was performed as a ceremony to help bring rain. And in western culture, Chess is held as one of the most important games: Chess is an intense mental game that involves high levels of strategic thinking; it is supposed to make you smarter. Chess has influenced great artists like Marcel Duchamp, and it has played prominently in stories and films such as Ingmar Bergman's *The Seventh Seal* where it is used as a metaphor for the struggle of life against death. No one can doubt the influence of games on human culture.

¹ I use here the term 'videogame' to apply to a wide range of games played on different interfaces, from computers and arcade machines to televisions and handheld devices. To some extent, I also tend to apply the term towards certain simulations and similar programs such as *Sim City*, which, while not having a set goal, possess many of the attributes common to videogames. Finally, the term 'videogame' is used here instead of its more common form 'video game' due to the greater specificity of the singular word.

As a form of new media, videogames also have tried to develop as an art form. And yet one of the easiest and somewhat uncritical counters to the question of whether or not videogames are art is to ask the art question of one of the most popular and yet most un-artlike of games: Is the latest *Madden* football game art?

The art argument is still ongoing, particularly because there is such a wide diversity of games – while *Madden 2007* may not be considered art, there are a good many other games, such as *Katamari Damacy* and *Shadow of the Colossus* that make a strong case for art. However, the art argument is not one that should be discussed in this paper as it is a long and complex one that is not likely to be answered any time soon.

And yet while Chess may not be art, it is still a masterpiece: it is one of the best and most popular games ever designed and has had a profound affect on Western culture and society. It does not matter whether or not Chess is art: Chess is a masterpiece of ‘fun’, or to be more precise, a masterpiece of games.²

Games then, can be culturally important and they can be masterpieces in what they do, and they have also had a profound influence on those who play them. The same can be applied to videogames: the people who grew up playing these games have been greatly influenced by them in the work they make as adults. Though games need not imitate the beauty of nature or teach us about what makes us human, the games we play still influence who we are, just as do works of art, and the significance of this cannot be underestimated. It also illustrates to us why we must preserve games.

The Importance of Preserving Videogames

Games should be preserved for several reasons: their value as entertainment and in influencing those who are entertained by these games, their historical significance to the games industry, and their design value for game developers and game theorists.

While we can clearly say that to lose all copies of the *Mona Lisa* would be a terrible loss to society, we can also say that if no one could play Chess ever again, this would also be a great loss. So, too, would be the loss of a great videogame such as *Super Mario 64* or *Pac-Man*. Games, far from being the idle entertainment of youth or a bane that steals our production hours, are an important means of relaxing and refreshing our minds. Everybody needs entertainment in his or her free time because entertainment helps us lighten up. Entertainment helps us break from the seriousness and monotony of life – it is what keeps us from going insane. Far from being a scourge of mankind, entertainment and joy are part of what helps us survive, and are a part of makes us human.

² I tend to not apply the term ‘fun’ when dealing critically with games because it is such a nebulous and ill-defined term that suggests all games should be about ‘fun’ and nothing else. This realm of thinking, of course, limits what game designers think we can and cannot do when making a game, that the only reason someone might want to play a game is because they want to have ‘fun’, not because they are compelled to play it for other reasons such as catharsis. Fortunately, Warren Spector agrees with this analysis in his article, “‘Fun’ is a Four-Letter Word” (*Escapist Magazine*. Issue 65, October 3, 2006; Pages 15-17; <<http://www.escapistmagazine.com/issue/65/15>>).

As we grow older, some of us may gain nostalgia for the pastimes of our youth. Today, there are many people who want to play again old videogames but cannot find them because they are out of print. If the game is rare, it is available used and only for considerable amounts of money. This cannot help the player who merely wants to experience the joy and release that games have to offer. It is therefore imperative that we preserve games, because when we lose games, we lose a part of the joy that games have given us throughout the ages.

Videogames also have historical value, particularly due to the nature of the medium as an emerging art form. Early videogames are an important part of game history because they chronicle how early videogames developed from earlier board game and sports paradigms. Games should thus be preserved for their historical significance because they are important to the history of the industry.

We can compare early videogames with early forms of film from before the time when film was considered art - nobody thought that nickelodeons or early film reels would be of any importance a hundred years later: they were developed primarily for short-term profits, and when their use-value had exhausted itself, they were destroyed to make room for new ones. And yet today there would be an uproar if we were to find out that the last copy of *Schindler's List*, or *The Godfather*, or *Seven Samurai* was lost forever. Who knows what was lost in early film because nobody thought to preserve it? What significant games are we in danger of losing today if no one preserves them?

Just because something does not seem to be that historically significant today does not mean that it will not be significant twenty or thirty years from now, particularly in a medium such as videogames which has so deeply penetrated our culture. Looking at the past thirty years of videogames, it is difficult to imagine where videogames will take us in another thirty years, but we can only suspect it will be nothing short of amazing.

To future game designers and theorists, early and contemporary videogames alike will offer important lessons to the creation of games and the analysis and understanding of the medium. The design challenges imposed during the creation process may be overcome in many different ways, and by analyzing preexisting games, we can better understand the process of game development and ultimately create better games. If a game is lost, it takes with it all the lessons we might learn from it: if we lose our history, we ultimately lose a valuable pool for designers and theorists alike.

It is also imperative that we preserve these games, which are so important to us as people, as historical and cultural material, and as examples for design and critical theory, because many of these games are stored on material that is at risk of loss or deterioration if it has not been lost already. Obsolescence prevents us from running most of the games created throughout the first two decades of the videogame industry on contemporary hardware. Games stored on floppy disks, the primary storage medium for computer software during the 1980s and early 1990s, are also at risk because floppy disks are susceptible to deterioration due to the flexible nature of the magnetic disk and the flimsiness of the

plastic shell in which the disk is stored, easily exposing them to the elements and leading them to fall prey to bit rot, which causes the magnetic properties of a disk to “fade” over time.³ The life expectancy of many of these disks is reaching the end of the projected 10 to 30 year limit.⁴ If we do not act to preserve these games, then an irreplaceable part of videogame history and human culture will be lost with them.

What to Preserve?

When we consider videogame preservation, we have to consider what should be preserved. Initially, the concept of videogame preservation seems simple: just obtain a physical copy of every game ever made – cartridges, disks, and CDs – stick them in an archive, and the job is finished. However, videogame preservation involves more than just the physical artifact, and in some cases, the physical artifact is inadequate.

Besides the games themselves, videogame preservation can include instruction manuals, packaging, advertising, promotional material, and gameplay recordings, among other things.⁵ However, due to the scope of this paper, I will only be focusing on the games themselves, the actual software that contains the game. The game software then is to be considered for the scope of this paper the equivalent of the text in literature – the game is the text.

When considering what games to preserve, we might – and should – ask the question: Are some games even worth preserving? Certainly good games should be preserved, but there are also many poorly designed games or games with offensive content. For instance, if we are so concerned with preserving *Pac-Man*, for posterity, should we even be concerned with preserving the likes of *Custer's Revenge*?⁶ Or should we preserve all videogames because each game, regardless of content or quality, is a part of the history of videogames, and that if some part of that history was poorly executed or offensive, then we should learn from these mistakes?

³ Software Preservation Society. “Bit Rot,” *Software Preservation Society*. March 7, 2006.

< http://www.softpres.org/glossary:bit_rot >

⁴ Estimates by the Office of Information Technologies at the University of Massachusetts in Amherst, place the life expectancy of magnetic disks at 10-30 years, grave numbers for early computers that are now reaching the thirty-year limit. Michael W. Gilbert. “Digital Media Life Expectancy and Care.” *University of Massachusetts Amherst Office of Information Technologies Newsletter*. Fall, 1998. Web archived: January 29, 2001. < http://web.archive.org/web/20010320134912/http://www.oit.umass.edu/publications/at_oit/Archive/fall98/media.html >

⁵ See Appendix 1 for a more comprehensive list of metadata.

⁶ *Custer's Revenge* was a pornographic game for the Atari 2600 where the objective is to navigate a naked General George Armstrong Custer through an ambush-filled landscape to rape a naked Indian woman tied to a cactus. The game has become nothing less than infamous and is frequently used as an example of the depravities which videogames have stooped to. *Custer's Revenge* went down in infamy as No. 9 on Seanbaby's 20 Worst Games of All Time, published in slightly different format in *EGM*. However, the game is still perhaps the worst game of all time in terms of both horrible game design *and* offensive content. (Seanbaby. “EGM's Crapstravaganza: The 20 Worst Games of All Time.” *Seanbaby.com* < <http://www.seanbaby.com/nes/egm.htm>>).

Ultimately, libraries and archives will have to answer this question when they get to that point. However, the relative ease of videogame preservation seems to suggest that we can preserve everything simply because it's so easy to do – once all the legal issues are resolved, of course. The final decision will ultimately affect how digital material is preserved in the future due to choices resulting from questions of quality, content, and perhaps censorship. Such decisions will reflect on how we approach games from a critical and curatorial standpoint, just as similar decisions have done so in the traditional museum gallery.

What Is Involved In Preservation – The Unpreservability of the Physical Artifact in Digital Media

Once we have established that videogames should be preserved, we must consider the methods of how they should be preserved. After examining the unique characteristics of digital media, we find that traditional notions of the preservation of the artifact do not apply or are simply inadequate towards the preservation of digital media. What is the digital artifact, and what does its preservation entail?

In new media, the digital artifact is more than the material it is preserved on. At its most basic level, the digital artifact consists of the software code in the form of 1's and 0's and on a second level, the physical medium on which that code is stored. Yet there is no standardization of how that code is translated and stored, meaning there are thousands of file formats and hundreds types of storage media, the majority of which are proprietary. Thus, in order to run the software – that is, the digital artifact, one must have the proper interface to read the physical storage medium to read the file.

To further compound matters, the digital artifact must also require a computer program to access it, a veritable Rosetta Stone that translates the 1's and 0's into something readable by the computer which in turn can present the artifact in such a way that people can understand it. This program in turn requires an operating system to run the software and further, special hardware is also required to run the operating system, software, and digital artifact. Preserving the digital artifact without the proper hardware and software to run it is akin to preserving the entirety of the Egyptian language without a single method of translating it into modern languages.

Thus, the preservation of the digital artifact requires more than simply preserving the physical artifact on which the digital artifact is stored: it also requires the computer program to run the digital artifact as well as the operating system and compatible hardware. Preservation of the digital artifact is thus considerably more complex than preserving a physical artifact such as a painting, which does not require special technology for access.

Yet even if an archive was to preserve the physical substrate on which the digital artifact is stored along with the required software and hardware to run it, it is still impossible to preserve an original physical copy of the digital artifact due to the nature of the storage

medium and new media in general: despite the promises and advertising of new media, many forms of media storage will not physically last for more than a hundred years.⁷

Magnetic floppy disks are especially vulnerable due to the flimsiness of the magnetic disk and the plastic case that stores it. While we have many books and magazines that were printed over thirty years ago, magnetic storage media is predicted to only last between ten and thirty years due to bit rot and exposure to the elements – this after the age of the floppy disk, which lasted from the early 1980s into the early 1990s. This means a floppy disk from 1985 is already over twenty years old and has a high chance of having already undergone bit rot or of being completely unreadable altogether. Further, the rewritability of magnetic disks means the original contents of the disk may be irreparably altered by only a single use, making the original software extremely volatile. Overall, it is simply impossible to ensure the long-term preservation of a floppy disk: the digital artifact must be transferred to another medium.

Yet even software that has been stored on more stable material, such as solid-state silicon cartridges, is under threat, this time from technological obsolescence. Computing technology undergoes rapid improvements in speed, performance, and storage technology, leading to new hardware and software that can take advantage of these improvements. As technology develops, old software and hardware formats are used less frequently and eventually are no longer produced – the technology has become obsolete. This older technology is no longer usable by the latest hardware and software, so in order to use it, one must obtain the original compatible hardware and software that is still properly functioning, a task that can become rather difficult the older and more obscure the technology becomes.

Floppy disks used to be a standard format for storing software and computer programs. Today, many computer manufacturers no longer manufacture computers with floppy drives, and make them only available through special request. And yet, in the case of optical media, this trend of obsolescence seems to be stabilizing as the latest form of optical media continues to be backwards compatible with older formats such that the latest Blu-Ray disc drive will be able to read CDs and DVDs. However, optical media will likely be replaced in the future by a new storage format that offers considerable advantages over optical disc media, much as the optical disc offered substantial benefits over older magnetic disks.

In addition, the proper software – and at times, hardware – is required to run and interface with the digital artifact. Just as hardware advances over time, so too does the software that runs on it. As new operating systems are released to take advantage of more powerful hardware, so too are new software programs released to take advantage of the more powerful hardware and operating systems as well as more advanced media formats

⁷ Even though companies advertise that optical discs will last many decades, we should remember that optical discs have been around for little more than fifteen years, only a small percentage of the projected lifespan. Today we are discovering that some discs have become unreadable due to exposure to light or heat or from being placed in a high-speed disc drive, which caused the data tracks to misalign, rendering the disc unreadable. Brady Essman. “Re: Data preservation.” (personal communication, January 19, 2007).

developed solely for the new software. This often leads to incompatibility issues with older file formats, even though they may contain the same file extensions – a Microsoft Word 95 document may thus have to undergo considerable modification in order to run on Microsoft Word 2007, rendering much of the original formatting unreadable.

The software programs themselves may also become obsolete. One such case is WordStar, the most popular word processing application of the mid-1980s.⁸ Yet today's most popular word processing applications, such as Microsoft Word, are almost incapable of reading any of the millions of the WordStar files created during this period, even after the data has been migrated to a modern hard drive.⁹ This is because later word processing programs did not adopt the file format used by WordStar, and thus they are unable to translate the file's text, let alone what formatting was used: to a modern word processor – and to the program's user – WordStar files may as well have been written in Egyptian hieroglyphs – the program simply cannot translate it into a format that a person can understand.

The 1996 US Commission on Preservation and Access, or Task Force 1996 first outlined these problems of software and hardware requirements as well as hardware, software, and file format obsolescence.¹⁰ Task Force 1996 was established to address issues of information preservation in the digital age, particularly after the disastrous results of government programs to store information on media that today is no longer readable or that has become degraded,¹¹ as well as the inability of government organizations to archive even such material as the first ever e-mail correspondence.¹² Digital preservation was by that time a known and serious problem, and Task Force 1996 succeeded in identifying several main factors required for data preservation, including data refreshing, migration, and emulation.

Data refreshing involves “periodically copying a file from one physical storage medium to another to avoid the physical decay or obsolescence of that medium.”¹³ This allows digital media to be preserved in its original format, ensuring that it will survive the

⁸ “Wordstar.” *Wikipedia*. January 16, 2007. < <http://en.wikipedia.org/wiki/Wordstar> >.

⁹ Howard Besser. “Longevity of Electronic Art.” February, 2001. < <http://www.gseis.ucla.edu/%7EHoward/Papers/elect-art-longevity.html> >.

¹⁰ Task Force on Archiving of Digital Information (1996). *Preserving Digital Information*, Commission on Preservation and Access and Research Libraries Group < <http://www.rlg.org/ArchTF/tfadi.index.htm> >.

¹¹ For instance, several large bodies of data such as a considerable portion of the Viking mission (Howard Besser. “Digital Longevity.” 1999. < <http://www.gseis.ucla.edu/~howard/Papers/sfs-longevity.html> >) and satellite photos of the Amazon have been lost forever due to failure to preserve them (Task Force on Archiving of Digital Information (1996). *Preserving Digital Information*, Commission on Preservation and Access and Research Libraries Group, Page 3. < <http://www.rlg.org/ArchTF/tfadi.index.htm> >). In addition, the BBC also failed to preserve the electronic Domesday Book census performed in 1986, which could only be read by a special micro computer. (Julian Jackson. “Digital Longevity: the lifespan of digital files.” *Digital Preservation Coalition*. 2002. < <http://www.dpconline.org/graphics/events/digitallongevity.html> >.)

¹² Task Force on Archiving of Digital Information (1996). *Preserving Digital Information*, Commission on Preservation and Access and Research Libraries Group, Page 3. < <http://www.rlg.org/ArchTF/tfadi.index.htm> >

¹³ Howard Besser. “Longevity of Electronic Art.” February, 2001. < <http://www.gseis.ucla.edu/%7EHoward/Papers/elect-art-longevity.html> >.

lifespan of the physical storage medium it was originally contained in. However, while data refreshing solves the problem of hardware obsolescence and decay, it does not solve the problem of software obsolescence. For this reason, Task Force 1996 recommended migration and emulation.

Data migration involves periodically moving files from one file encoding format to another that is useable in a more modern computing environment.”¹⁴ This will allow modern programs to read and display older files in a format that is understandable by the user. However, data migration can result in the loss of original file formatting techniques that are not completely translated by the newer program, such as spacing and italics in a word processing program. Though the core content of the file may have been accurately translated, it may lose information critical to the interpretation of the file.

This problem of data loss can be solved through emulation. Emulation involves the creation of software that “mimics every type of application that has ever been written for every type of file format, and make them run on whatever the current computing environment is.”¹⁵ This means the file format need not be migrated but can simply be refreshed and included with a copy of the emulation program.

When videogames are re-released on newer systems, emulation is often the method of choice because it requires only the creation of an emulator and does not require modification of the original program. However, developers may choose to rebuild the game from scratch in order to improve on limitations of the original games.¹⁶ Such a choice was made in Capcom’s *Mega Man Anniversary Collection*, which included ports of all the original eight Mega Man games as well as two previously unreleased arcade titles. Significant changes included correction of game slowdown, adding additional button functions to make scrolling through subweapons simpler, and eliminating software glitches inherent in the original games.¹⁷ Whether a developer decides to rebuild or emulate an older game depends on the perceived problems inherent in the original title.

Data migration and emulation also bring up the question of the authenticity of the digital work. As a game is copied, emulated, and migrated from one format to another or completely rebuilt, changes may occur in the game, rendering it either subtly or quite different from the original format. Though the nature of the authenticity of the work of art in the digital age has been questioned, particularly when the original physical copy no longer exists,¹⁸ curators, librarians, archivists, and new media theorists continue to address these issues to come closer to a solution.

¹⁴ Ibid.

¹⁵ Ibid.

¹⁶ “[Capcom of America has] the source code and assets for pretty much everything Capcom’s ever done.

As for how we bring stuff back, it depends on the platforms and the games. In many cases we do create new emulators on new platforms for old platforms (console and arcade boards). In some cases, porting of the code is more efficient/appropriate for the application.”

Christian Svensson. “Videogame Preservation, Response #4.” December 7, 2006. *Capcom BBS – Ask Capcom*. < <http://www.capcom.com/BBS/showthread.php?t=10070> >.

¹⁷ Jeremy Dunham. “Mega Man Anniversary Collection Review.” *IGN*. June 17, 2004. < <http://cube.ign.com/articles/524/524441p1.html> >.

Some organizations, such as the Software Preservation Society, or SPS,¹⁹ have directly addressed this issue by developing software that can help determine the authenticity of an original floppy disk before it is preserved.²⁰ By verifying a disk's authenticity the SPS can then securely refresh a copy of the original, authentic version of the disk so that it will be available in a format that is in less danger of software degradation.

As we become more familiar with the complex nature of digital media and the digital artifact, we will eventually arrive at answers to these questions that may make the preservation of digital artifacts such as videogames easier and more standardized. However, these decisions will also shape our interpretation of the digital artifact for years to come.

Current Methods Taken For Videogame Preservation

The question of videogame preservation is not a new one. Since the explosion of interest in data preservation resulting from the Task Force 1996 report, and certainly before, librarians, archivists, and new media theorists have performed considerable research on the topic of electronic preservation. Thus, considerable work has already been done in considering how best to preserve electronic information, and among them, videogames. Some of the most important work has been done in legalizing the preservation of electronic information by libraries and archives.

The trouble with data refreshing, and to some extent migration and emulation, is that it violates existing copyright laws. Copyright law under the Digital Millennium Copyright Act of 1998 prohibits “backing up” or “copying” – forms of data refreshing – and most electronic user agreements state that the user does not own the software but merely the rights to use it: not to copy, back up, or refresh it. This means that libraries and archives could face legal proceedings if they attempt to archive and preserve digital artifacts that were in danger of becoming irreparably damaged or lost due to the volatility of their storage medium. Despite the noble intentions of the archive, companies and organizations interested in protecting the rights to their work might see such action as a violation of their rights and a threat to their business, meaning that libraries and archives could be sued for attempting to preserve digital media. Though these fears have solid ground based in protection against digital piracy, which has run particularly rampant and is a considerable threat to some businesses, these same restrictions that were meant to protect could easily lead to the failure to preserve or to make creative use of the work.

¹⁸ Howard Besser. “Longevity of Electronic Art.” February, 2001. <
<http://www.gseis.ucla.edu/%7EHoward/Papers/elect-art-longevity.html> >.

¹⁹ The Software Preservation Society was formerly known as the Classic Amiga Software Preservation Society (CAPS) (<http://www.softpres.org/>).

²⁰ “The Importance of Data Authenticity.” *Software Preservation Society*. March 7, 2006. <
http://www.softpres.org/article:importance_of_data_authenticity >. “How could my disk have become modified or copied?” *Software Preservation Society*. March 7, 2006. <
http://www.softpres.org/faq:imaging_disks:disk_modification >.

“Technology means you can now do amazing things easily; but you [can’t] easily do them legally.”²¹

And in the meantime, irreplaceable digital information rotted away.

This all changed in 2003 when Brewster Kahle, head of the Internet Archive,²² and with help from Stanford University Libraries, successfully lobbied and defended his proposal for the Librarian of Congress to pass exemptions from the prohibition against the circumvention of access-control technology for the purpose of archiving computer programs and videogames by the Internet Archive. This exemption was renewed in November of 2006 after Kahle again defended his exemption and demonstrated the work that he and his team had done.²³ This now allows the Internet Archive and other libraries and archives to legally circumvent copyright protection of “computer programs and videogames distributed in formats that have become obsolete and that require original media or hardware as a condition of access” for the purposes of the “preservation or archival reproduction.”²⁴ The Internet Archive agreed to only make this software publicly available if the copyright holder expressed permission to allow its distribution or if the copyright expired: else, the data is “locked away in [a] vault for safekeeping.”²⁵

The Internet Archive is now leading the spearhead to preserve videogames and computer programs stored in obsolete formats, in particular floppy disks, through their Classic Software Preservation Project (CLASP) division. CLASP is also preserving extensive metadata including basic information, box, and disk scans so that future historians can better understand these games.²⁶ The Internet Archive has teamed up with The Software Preservation Society (SPS),²⁷ an organization that preserves videogames and computer programs stored on floppy disk formats, and Tucows, which provides over 40,000 software titles on a “freeware” or “shareware” basis.²⁸ The conjunction of these two

²¹ Lawrence Lessig. *Free Culture*. The Penguin Press: New York, 2004. Pg. 105. < <http://www.free-culture.cc/freeculture.pdf> >.

²² Henry Lowood. “Playing History with Games.” June 14, 2004. Pages 10-11. < <http://aic.stanford.edu/sg/emg/library/pdf/lowood/Lowood-EMG2004.pdf> >.

²³ Brewster Kahle. “Comments of the Internet Archive Before the Library of Congress Copyright Office Washington, DC.” Docket No. RM 2005-11. February 1, 2006. < <http://www.copyright.gov/1201/2006/reply/12kahle.pdf> >.

²⁴ “Computer programs and video games distributed in formats that have become obsolete and that require the original media or hardware as a condition of access, when circumvention is accomplished for the purpose of preservation or archival reproduction of published digital works by a library or archive. A format shall be considered obsolete if the machine or system necessary to render perceptible a work stored in that format is no longer manufactured or is no longer reasonably available in the commercial marketplace.” “Rulemaking on Exemptions from Prohibition on Circumvention of Technological Measures that Control Access to Copyrighted Works.” *U.S. Copyright Office*. 17 U.S.C. § 1201(a)(1)) exemption 2. November 27, 2006. < <http://www.copyright.gov/1201/> >.

²⁵ “Welcome to CLASP.” *Internet Archive*. < <http://www.archive.org/details/clasp> >.

²⁶ Metadata is additional descriptive information related to the object being digitally preserved, such as descriptions of the work, instructions for its use, and in the case of time-based media, video of it in action. This means that the preservation of a digital artifact includes more than just the digital artifact itself but associated metadata. A list of metadata associated with videogames is included in Appendix 1.

²⁷ The Software Preservation Society has recently extended its preservation efforts towards software for such obsolete computer systems as the Commodore 64 and Atari ST.

²⁸ “About Tucows.” *Tucows.com*. < <http://www.tucows.com/about> >.

organizations with CLASP means that not only will the Internet Archive be able to preserve thousands of software titles stored on obsolete computer hardware and which are still under copyright, but they will also be able to store thousands more pieces of software that are already free and open source as well as older versions of these programs.²⁹

In addition, the Software Preservation Society has developed software to determine the authenticity of a computer program stored on a floppy diskette.³⁰ This software reads a disk at a low level and can detect the signature traces on the disk that let SPS technicians know if a disk reader has altered it at any time.³¹ Migrating an altered disk is not effective data preservation because it does not contain the original, unaltered form of the program, and is therefore worthless for preservation purposes.

This need to ensure authenticity derives not only from classic museum and archive interests in the authenticity and originality of the artifact, but also from the fact that digital information is very malleable and thus can undergo intentional or unintentional changes as well as data corruption. For instance, software may be corrupted over time as its storage medium degrades, and other software programs may overwrite the storage medium to save such information as user settings, save files, and high score tables. The software developed by the SPS thus ensures the authenticity of the data preserved, making it even more valuable considering the fact that over 60% of all software stored on floppy diskettes has been altered or degraded over time.³²

Other organizations are also interested in videogame software preservation and are actively working towards that goal. These organizations include the Digital Game Archive (DiGA),³³ the Computerspiele Museum in Berlin,³⁴ the Computer History Museum Center in Mountain View, California,³⁵ the Stephen M. Cabrinety Collection at Stanford University,³⁶ and the PlayStation Museum.³⁷ Other organizations such as

²⁹ Software preservationists have to also be concerned with earlier builds of a videogame or software program, rather than simply the latest version. This is because newer versions may contain differences that minutely or significantly affect the interpretation or operation of the piece or may have different compatibility with interfacing software.

³⁰ "CTA (SPS Disk Image Analyzer)." *Software Preservation Society*. March 7, 2006. < <http://www.softpres.org/glossary:cta> >.

³¹ "The Importance of Data Authenticity." *Software Preservation Society*. March 7, 2006. < http://www.softpres.org/article:importance_of_data_authenticity >. This software is also required because what is read through the floppy disk controller is not what is actually stored on the floppy disk. "Jitter." *Software Preservation Society*. March 7, 2006. < <http://www.softpres.org/glossary:jitter> >.

³² "The Importance of Data Authenticity." *Software Preservation Society*. March 7, 2006. < http://www.softpres.org/article:importance_of_data_authenticity >.

³³ Digital Game Archive < <http://www.digitalgamearchive.org/home.php> >.

³⁴ Computerspiele Museum < <http://www.computerspielemuseum.de/> >.

³⁵ Computer History Museum < <http://www.computerhistory.org/> >.

³⁶ Stephen M. Cabrinety Videogame Collection < <http://www-sul.stanford.edu/depts/hasrg/histsci/index.htm> >.

³⁷ PlayStation Museum < <http://www.playstationmuseum.com/> >

MobyGames,³⁸ GameFAQs,³⁹ and The Hall of Light⁴⁰ are also actively recording and in some cases preserving metadata on videogames such as box and manual scans, game credits, and game reviews. Many of these organizations are linked through the International Game Developers Association's (IGDA) Special Interest Group (SIG) project on Game Preservation.⁴¹

In addition to work already being performed by libraries and archives, game developers are also interested in game preservation, primarily because they are interested in ensuring their data is secure so they can continue to develop and profit from it. Game developers are also interested in backing up their development materials as well as the finished games because development materials can be useful for future design projects.⁴² This work is done internally and archived within the game development studio due to its valuable nature.

Videogame preservation is also being indirectly performed through the re-release of old software. Companies such as Atari, Capcom, Konami, Midway, Namco, Nintendo, Sega, Square-Enix, and Taito have all released classic game compilations or standalone software in the past, giving their past libraries a new life as they actively 'mine the past' for today's profits through the growing nostalgia towards classic gaming.

Recently, developers have also been re-releasing games in "virtual consoles" and online arcades. The most popular forms of videogame reincarnation have been Xbox Live Arcade, which emulates a large number of classic arcade titles as well as ports of recent PlayStation 1 titles,⁴³ and Nintendo's Virtual Console, which emulates a wide range of titles from systems developed by Nintendo, Sega, and Hudson Soft.⁴⁴ Customers purchase games from an online server once and have unlimited access thereafter. While Nintendo and Microsoft's online game services use a pay-once-per-game system, other

³⁸ MobyGames < <http://www.mobygames.com/> >. Contains metadata information on many videogames, including their credits.

³⁹ GameFAQs < <http://www.gamefaqs.com/> >. Contains user-submitted content about games; game reviews; walkthroughs, and faqs.

⁴⁰ Hall of Light < <http://hol.abime.net/> >. Fan-run Amiga game database.

⁴¹ Game Preservation SIG < http://www.igda.org/wiki/index.php/Game_Preservation_SIG/ >.

⁴² One such case was when Koji Igarashi's team consulted the previous 3D *Castlevania* installments as well as the cancelled Sega Dreamcast *Castlevania: Resurrection* while producing *Castlevania: Lament of Innocence*.

⁴³ Xbox Live Arcade currently emulates several arcade games from the 1980s, including *Scramble*, *Contra*, and *Joust*. *Castlevania: Symphony of the Night*, a PlayStation 1 title, has also been given a definite release date. Xbox Live Arcade also allows developers to create original titles, but Microsoft has imposed limitations on the number of titles that can be released each year to 52, or one per week, as a quality control method.

⁴⁴ Currently, the Nintendo Virtual Console supports emulation for the Nintendo, Super Nintendo, Nintendo 64, Sega Genesis, and NEC and Hudson Soft's TurboGrafx-16. Games are released regularly at affordable prices, particularly in comparison with the cost and availability of many of these titles on the second-hand market. It is also certainly not out of the question that the Virtual Console's library could expand to include systems such as the Sega Master System, Sega CD, Sega Saturn, TurboGrafx-CD, and early arcade games, or that developers might be allowed to create original titles for platforms supported by the Virtual Console. This would help counter some prejudices against obsolescence and extend the lifespan of these systems well beyond their shelf lives.

online services, such as GameTap,⁴⁵ have opted for a monthly payment plan to allow access to a larger number of titles.

In all of these networked videogame distribution systems, the right to access media is stored in the user's account, so data backup is not required. Network distribution thus provides a cheaper alternative or supplement to traditional methods of re-releasing games as standalones or in classic compilations as a way to mine the nostalgia of current gamers, though these compilations only help ensure software preservation of the most popular titles.⁴⁶

Further, because there are no manufacturing costs, distributors of networked media are not required to maintain a back stock of content or to remove media from their service due to low projected sales. Where in the past, manufacturers would create new product only if they felt demand was high enough to pay for the cost of manufacture, with network distribution, digital media has infinite supply, meaning a product could be kept available for purchase indefinitely rather than being subject to the forces of the market.⁴⁷

Videogames and videogame metadata are also collected by videogame fans. Fan websites often contain extensive information about a game or series, including reviews, and screenshots, as well as photographs of packaging, advertising, merchandizing, and development material.⁴⁸ Some of this information may be unique to the website, but in many cases, fan sites serve mainly as repositories for vast amounts of data related to a game or series as well as providing a community for fans to interact.⁴⁹

Beyond the scope of videogame fan sites are materials accumulated by videogame collectors. Underground videogame collectors are not interested in supposedly 'rare' games like *Panzer Dragoon Saga* (Sega Saturn), *Dracula X* (PCE), and *Metal Slug AES*. Sooner or later, these games appear on eBay or other online auction sites. While they are

⁴⁵ GameTap, a subsidiary of Turner Network Systems, currently has a library of over 800 titles from systems as far back as the Atari 2600, Commodore 64, and Intellivision and as recent as the Sega Dreamcast and current PC titles. GameTap also releases original games, such as the episodic *Sam & Max* series, and contains television programs such as *Space Ghost Coast to Coast*.

⁴⁶ Major game developers such as Atari, Capcom, Konami, Lucasarts, Midway, Namco, Nintendo, Sega, Square-Enix, and Taito have frequently released classic game compilations or standalone titles. In addition, developers may also rebuild or enhance older titles to update them for current audiences and help provide incentive to repurchase an older game. However, other companies may be less willing to re-release games due to licensing issues and the cost involved in relation to projected sales.

⁴⁷ Such distribution will, of course, lead to a new range of questions regarding length of copyright and the fate of this material once its copyright runs out. Whether or not the U.S. Copyright Office addresses this issue now or when it becomes a future issue remains to be seen. However, it is certainly quite possible online distributors could continue distributing public domain material and that this could add to the popularity of the distributor by providing 'free advertising' for copyrighted content and personal experience with the distributor's system.

⁴⁸ For example, the Metroid Database (MDb, <http://mdb.classicgaming.gamespy.com/>), contains a vast collection of information on the Metroid series, including a development map for Super Metroid, which was purchased from an online auction by the MDb's webmaster, TJ Rappel.

⁴⁹ Fan sites may be devoted to a single series, such as *Castlevania* (<http://castlevania.classicgaming.gamespy.com/>) or to a large collection of games, such as Hardcore Gaming 101 (<http://hg101.classicgaming.gamespy.com/>).

not exactly common games, their resale value is high enough to warrant peaked interest from normal collectors. What hardcore underground videogame collectors search for – and go to great financial and sometimes legal lengths to acquire – are truly rare, one-of-a-kind pieces of software and hardware such as betas, development kits, and unreleased or canceled software.⁵⁰ Software and hardware that had very limited print runs are also in high demand, and often traded only for other rare items,⁵¹ but the most valuable are videogames that have only one copy in existence and were never reprinted or dumped into digital format. Though created by developers, this material is often no longer owned by their originators.

Some top echelon collectors will only trade one-of-a-kind games with the express intent that no one will ever leak them to the public and decrease their value – such items remain forever locked away within private collections.⁵² Other collectors purchase prototypes and other rarities “in order to release them to the community” for the benefit and enjoyment of all rather than to hold on to the item to give it a “legendary” status and make it more “historically valuable” or to have the satisfaction of knowing they are the only ones who will ever experience such a game.⁵³ Still others may wish to release their games to the community or archive them for future posterity, yet are unable to publicly do so due to the intensive legal proceedings they are often threatened with. In such an expensive, high-stakes, and secretive community, only insiders who have built trust within the group may share the information and artifacts they have acquired, always with an equal exchange of like for like.⁵⁴

One final category of videogame preservation lies in videogame piracy. Hundreds of thousands of volumes of videogame software have already been dumped into digital format as ROMs and are circulating through different, often obscure, channels on the Internet. Dozens of emulation programs have been built to run this software, often with special tools that allow for the recording of gameplay footage, the capturing of screenshots and audio, and saving game states. The sheer volume of material yet the small file sizes of early games seems to indicate that the entirety of non-optical disc-based computer and videogames created within the first twenty or so years of the industry might fit in compressed format on a single dual-layer DVD. Many emulation programs also include tools for cataloguing ROM dumps and identifying minor variations of a single game. A rather substantial community has also evolved around emulation and ROMs, where independent developers modify or hack existing games, often to create original works.

Despite what creative and cataloguing benefits videogame piracy might provide, the fact remains that videogame piracy is illegal, and often does not further the ends of preservation. Piracy gives many people free access to copyrighted content that they would otherwise have to pay for. While some dumped ROMs may be perfectly legal and

⁵⁰ John Szczepaniak. “Obscurity Below the Radar.” *The Escapist*. Issue 23, December 13, 2005. (Pages 3-10). < <http://www.escapistmagazine.com/issue/23/3> >

⁵¹ *Ibid*, 5.

⁵² *Ibid*, 5-6.

⁵³ *Ibid* 6-7.

⁵⁴ *Ibid*, 8-9.

others are backups of rare or obscure games that are not easy to obtain or had extremely limited print runs, and thus the distributor is no longer profiting off them, a large quantity of pirated software is currently available on the market through firsthand distributors rather than secondhand stores. Many of these copies are transferred to individuals who have chosen to pirate the game rather than to purchase a legal copy of it. In this regard, videogame piracy ‘robs the owner of his profit’ by preventing the sale of a good the distributor is still making money from.⁵⁵

Further, some software that is dumped is not necessarily in an original format that has been verified as authentic and that may be examined in more detail for preservation purposes, as demonstrated by the Software Preservation Society. Thus, dumping inauthentic or altered copies of a game is not true preservation.⁵⁶ Further, if a game has been dumped already, there is a good chance that the original version of that game still exists somewhere which can be obtained again and refreshed accurately and legally. Thus a ROM may only become useful when the original software is impossible to find or if it was purposefully altered or hacked to create a new work.

This wide array of preservation methods – some legal, some questionable, and some purely illegal – is the current state of the videogame preservation field.

Problems with Current Preservation Methods

While considerable effort has already been made to ensure the preservation of early videogame software, particularly those that are in the direst need of preservation, there is still considerable work that needs to be done, as is demonstrated below.

While above I stated that many developers have been re-releasing their old libraries of games for contemporary audiences, re-released software is not always 100% accurate to the original version, meaning that now not only must the original version of that software still be preserved, but the re-released title will have to be preserved as well, particularly in cases where there are significant differences with the original.

For instance, in Capcom’s *Mega Man Anniversary Collection*, all ten games were completely rebuilt from scratch to run on PlayStation 2, Gamecube, and Xbox hardware rather than being simply emulated. This decision was made because the original hardware had problems with slowdown and some games had software limitations or glitches that could be fixed.⁵⁷ While some of these changes arguably improved the game playing experience, in other cases, the changes were very significant. In the collection’s

⁵⁵ A more in-depth overview of the four different kinds of file transfer is given in (Lawrence Lessig, *Free Culture*. The Penguin Press: New York, 2004. Pg. 105. < <http://www.free-culture.cc/freeculture.pdf> >).

⁵⁶ Software Preservation Society. “The Importance of Data Authenticity.” *Software Preservation Society*. March 7, 2006. < http://www.softpres.org/article:importance_of_data_authenticity >.

⁵⁷ A full list of these changes is available in (The Dover Tornado. “MegaMan Anniversary Collection Changes Guide. *GameFAQs*. July 22, 2004. < http://db.gamefaqs.com/console/gamecube/file/mega_man_anniversary_collection_changes.txt >).

version of *Mega Man VII*, for instance, the end credits no longer feature the animation of Mega Man walking away from the fiery ruins of Dr. Wiley's Skull Fortress that appeared in the ending of the original Super Nintendo version. This significant and dramatic animation was apparently not included in the *Mega Man Anniversary Collection* because the conversion team was unable to effectively duplicate the Mode-7 graphical effect used in the original version.⁵⁸

While some changes may not completely alter the interpretation of the game, such that it appears completely different from the original, sometimes they can. This can even occur in cases of emulation, which attempts to mimic the performance of the original application as accurately as possible. However, there are some characteristics that can be completely missed, as it is simply impossible to completely emulate every single characteristic of the original program.⁵⁹ While in many cases, the differences are not very noticeable, and in fact, can improve with later versions of the emulator, in other cases they can result in what is a completely different game.

For instance, when early computer programmer Jaron Lanier was shown an emulator running one of his earliest computer games, *Moon Dust*, he contended it was not the same game he had designed all those years ago because the pacing was wrong.⁶⁰ New pacing had changed the rules of the game significantly enough that an important formal quality of the original game was lost in translation.

For an interactive media such as videogames, the equipment on which a game is displayed or the controls with which it is interacted with can also change the play experience. In terms of display, one Nintendo Entertainment System game, *The Legend of Zelda*, was ported to two different consoles: to the Gameboy Advance as part of the Nintendo Classic series, and to the Nintendo Virtual Console on the Nintendo Wii. In the first instance, the graphics were stretched horizontally in order to fit on the wider and shorter screen of the Gameboy Advance; in the second instance, the graphics will only stretch when the game is played on a widescreen television and the player chooses to change the settings to stretch the screen. This is a notable difference that can alter the player's experience.

However, *The Legend of Zelda* and many older games, when played on high-definition television, will also have pixellation issues that were not apparent on older CRT televisions, due to the lack of scan lines on HDTVs.⁶¹ While some emulators allow for the addition of scanlines, most official virtual console and arcade emulation programs

⁵⁸ "Mega Man Anniversary Collection." *Wikipedia*. February 4, 2007. < http://en.wikipedia.org/wiki/Mega_Man_Anniversary_Collection >.

⁵⁹ This can also be true in emulation environments because the creators of these environments choose which aspects of the environment to emulate, and they cannot possibly emulate every single aspect. Besser, Howard. "Digital Longevity." 1999. < <http://www.gseis.ucla.edu/~howard/Papers/sfs-longevity.html> >.

⁶⁰ Besser, Howard. "Digital Longevity." 1999. < <http://www.gseis.ucla.edu/~howard/Papers/sfs-longevity.html> >; Besser, Howard. "Longevity of Electronic Art." February, 2001. < <http://www.gseis.ucla.edu/%7EHoward/Papers/elect-art-longevity.html> >.

⁶¹ Scan lines are single rows of pixels CRT monitors and televisions refresh one row at a time. Due to the distance between each scan line, older games displayed on these televisions will appear less pixellated than

currently do not provide the option.⁶² Though this problem may be more serious for some forms of electronic art that are meant to be viewed on particular displays set at particular resolutions,⁶³ it may not be as important to videogames, where the play experience may in many cases be improved through better display technology.

Another concern with emulation and data migration deals with the use of videogame controllers and other interface devices. Sometimes, a controller can make or break a game system. From the somewhat clunky first-generation joysticks of the Atari 2600 to the sleek and elegant design of the PlayStation 2 Dual Shock Controller, videogames offer a wide range of ergonomics, with arcade games in particular offering some of the most unique designs, often constructed around custom-built cabinets. The special feel many players experience with a particular model of controller has led many hardware developers to create custom controllers that replicate the designs of classic controllers or arcade sticks, or to adapt original controllers to new hardware.

When some games are ported to new consoles, the control schemes can be so vastly different that the game simply does not feel the same. Take for example the recent release of *Metal Slug Anthology* for the Nintendo Wii. This collection of games, which has previously found its way from the arcades and Neo Geo to the PlayStation and Xbox, has a wide variety of control schemes making use of Nintendo's innovative controller, the Wii remote. While *Metal Slug Anthology* allows players to use a Gamecube controller, the other control schemes involve any combination of the Wii remote and nunchuck adapter, often twisting the Wii remote at odd angles to create interesting gameplay mechanics. To fans of traditional control schemes using arcade sticks or standard two-handed controllers with digital movement, these controls may feel awkward, making the game all but unplayable – or at least a completely different experience.

Other games, such as *Guitar Hero* and *Taiko Drum Master*, use custom controllers to offer tactile experiences of playing with a guitar-shaped controller or a drum that cannot be replicated using a standard two-handed controller. As game controller designs continue to evolve, they will bring with them new experiences for playing, experiences that must be taken into account by videogame preservationists as well as developers planning to re-release or port titles to new systems that use different controllers because even minor changes to the control scheme can affect how a player experiences a game.

Videogame preservationists in particular will also have to consider how different display technology, play environments, and control ergonomics affect the game playing experience, and these experiences will have to at the least be preserved secondhand through recordings of gameplay and player accounts, but also through the preservation

they will on HDTVs or other monitors without scanlines.

⁶² However, some games, such as the upcoming *Castlevania: Symphony of the Night* port to Xbox Live Arcade, feature 'enhanced' graphics options and the ability to manually resize the image, that allow the user to decide how they wish to view the game. Sam Kennedy. "Previews: Castlevania: SOTN." *IUP.com*. January 8, 2007. < <http://www.1up.com/do/previewPage?cId=3156284> >.

⁶³ Howard Besser discusses need to preserve CRT monitors for particular electronic art works in (Howard Besser. "Longevity of Electronic Art." February, 2001. < <http://www.gseis.ucla.edu/%7EHoward/Papers/elect-art-longevity.html> >).

and reproduction of the physical artifacts. Will the experience of playing a game be radically different using different display and controller hardware or will it be akin to “viewing *Birth of a Nation* in a palatial theater with live music” rather than on a videotape at home?⁶⁴ Our answers to these questions will affect how we preserve videogame and electronic hardware and so should be carefully considered.

Perhaps most frustrating to consumers is the inability or unwillingness of developers to re-release some of their older games or games that underwent limited print runs. The scarcity of these games leads to dramatic price inflations on the secondhand market, which does not benefit players who must sometimes pay much more than the original retail price of the item, nor does it benefit the developer, who makes no money off secondhand sales. To benefit both themselves and their audiences, developers should take more efforts to make their products more reasonably available, particularly in a networked distribution environment where manufacturing costs are no longer an issue. In addition, re-releasing older titles in digital format over a network will help ensure their availability many years into the future.

Videogame developers at times also demonstrate the inadequacy of their own internal preservation methods. While videogame developers are obviously concerned with ensuring the security of their design materials and beta software as well as the master copies of each game, the security of this information often depends on the health of the developer – if the developer becomes bankrupt, development materials and source code have a greater chance of becoming lost, destroyed, or falling into the hands of an individual or organization that does not have the preservation and distribution of those materials in mind. A popular story of such an event comes from the final days of Atari where a filing cabinet containing the masters to all the original Atari games was sold at a company garage sale: the masters were finally recovered, but only after considerable prodding from the buyer.⁶⁵ However, similar instances to this still occur through company bankruptcy and liquidation, so current methods of the game development community continue to demonstrate the inadequacy of protecting and preserving their most important assets internally.

Furthermore, even healthy developers are not always prepared for disaster or misfortune. A case in point is the damage to Konami’s Kobe Building as a result of the tragic January 1995 earthquake, which resulted in the irreplaceable loss of original design material. For this reason, there is no high-resolution artwork available today for even such early high-profile games as *Castlevania*.⁶⁶ If developers wish to store valuable materials such as these for later use, stronger methods should be taken to help ensure their preservation.

⁶⁴ Henry Lowood. “Playing History with Games.” June 14, 2004. Pages 10-11. < <http://aic.stanford.edu/sg/emg/library/pdf/lowood/Lowood-EMG2004.pdf> >. Henry Lowood also discusses how the lack of original artifacts for a basketball game can change our interpretation of the game.

⁶⁵ Chris Crawford. *Chris Crawford on Game Design*. Boston: New Riders Publishing, 2003. (Pages 441-442).

⁶⁶ “Corporate History.” *About Konami*. 2006. < <http://www.konami.co.jp/en/corporate/data/index.html> >. Mark Bozon also reports that, “Much of the older *Castlevania* games lack current-day high-res art, as the majority of the original content was lost in a major earthquake during the late 90’s in Kobe, Japan.” Mark Bozon. “Castlevania: The Retrospective.” *IGN*. January 18, 2007. < <http://wii.ign.com/articles/756/756624p2.html> >.

However, due to the legal issues surrounding any form of intellectual property, particularly design materials in an industry whose products and profits revolve around IP, ensuring the preservation of any material, particularly development materials, is difficult at best. Measures for protecting and preserving development material, like the original software itself, will most likely have to come from within the respective development studios rather than from an outside source. Therefore, developers should become better informed in preservation methods if they wish to protect material that is important to their continuing process of learning and refining the art of game design as well as their financial success.

Finally, some videogame collectors may also not be adequately protecting the software they have acquired through time, treasure, and effort. Because many of the artifacts in the possession of serious collectors are one-of-a-kind and are particularly valuable to videogame history, it is imperative they be preserved to ensure they outlast the life expectancy of the original artifact. While many collectors may be concerned with the use-value of the artifacts they have collected, others may not be interested in preserving their functionality or have not taken measures to do so.

Much as important works of art have been destroyed over the ages or disappeared into private hands, some to become lost or never seen again, so too will we have to accept that a significant proportion of videogame history has also been lost or may never find its way to the hands of preservationists. As videogame preservationists, we should be concerned with minimizing this percentage as much as possible and ensure that the extent of what we already have will last for a long time to come.

Solutions to Existing Problems

As videogames progress ever farther from the field of 'just entertainment' to a genuine artistic medium, we must continue to realize the importance of preservation. Ultimately, the best method of ensuring videogame preservation will come from an open dialogue between the various factions involved in videogame preservation: certainly preservationists, librarians, and archivists, but also the developers themselves, operators of metadata collections, videogame collectors, and players. Open dialogue will allow each of the factions to better understand the objectives and desires of other groups, leading to the development of a working relationship that will best allow the creation of a system that will benefit and support the interests of all involved.

Developers need to open up discussion with archivists in order to better determine the range and extent of existing material that needs to be preserved and how that material will benefit developers, researchers, and players. Such dialogue will also help developers understand the importance of preserving their material so that it will be available to them in future projects and that their products will remain available for many years to come so that players and historians will have reasonable access to them.

Reasonable access here does not mean free and open access, but rather the relatively easy availability of the authorization to access archived materials based on the rights and privileges of the developers and copyright holders without having to run through obscure secondary channels at costs well above the suggested retail price. Players will be able to access material available for consumer use as well as public domain material, paying a proper access fee when necessary. In addition, systems will be available that let non-commercial researchers know how they may contact copyright holders for the right to access restricted material.

Developers and archivists also need to open up dialogue with collectors who are interested in sharing their material with a wider audience. Serious collectors continue to remain anonymous due to the very fact that they own certain videogame artifacts can – and often does – place them into lawsuits. Some of these concerns may be well founded, as in the case of employee theft, but in other cases these concerns may be unnecessary or extreme. But videogame collecting, just like videogame developing, is not something that will go away, so both parties will have to find a way of coexisting.

Of course, archivists cannot, and should not, force all developers or collectors to follow a single objective under the flag of preservation. Such enforcement would be nothing short of fascism and would be equated with forcing a private citizen to release a complete list of his or her personal possessions for public access while simultaneously decreeing how those possessions should be used. The objective of preservation should never be to do such a thing but rather to open up dialogue with collectors who are interested in collecting, sharing, and preserving their videogame artifacts.

Developers and collectors should also be educated in preservation methods should they be concerned with preserving the materials they have. There are many developers and collectors who are interested in preserving the use-function of their software and other possessions, but who are unaware of how to more securely do so. As a result, digital and physical artifacts that are valuable to these individuals and organizations are at risk of being lost, damaged, corrupted, or destroyed because stronger methods were not taken to preserve them. Should these individuals wish to access this material in the future or to donate them to an archive, they may therefore be unable to do so.

Individuals and organizations interested in preserving electronic material for future use should thus be informed of methods currently used by archives and librarians for ensuring digital longevity. They should be aware of methods in data refreshing, data migration, and emulation, as well as how to best perform these actions. Some recommended data backup techniques are included in Appendix Three of this paper.

Another aspect of preservation should include the construction of a catalogue that will enable librarians and archivists to see what has already been produced by the industry, making the collection and archival of such material easier. In addition, researchers and historians would benefit from such a catalogue by locating software and information necessary to their research. The contents of such a catalogue would include not only an extensive and exhaustive list of videogame hardware, but also software created to run in

these environments. Additional metadata should also be included with each entry, including images of the storage medium, packing material, instruction manuals, and advertising, as well as historical backgrounds of the software. Obviously, material should be collected, preserved, and compiled concurrent with the catalogue process, and should proceed under the knowledge that while an exhaustive listing with metadata is impossible, partial information is preferable to nothing.

The meta-directory should also include lists of beta and unreleased games. This does not mean that archives and libraries should obtain all such material and information, but merely that the existence of these titles is recorded somewhere in the meta-database. While every title can obviously not be included in the list, due not only to the loss of any record of its existence but also to the fact that much of this software might be considered 'trade secrets' by the developer, it should still be in the best interests of preservation to at least catalogue some of the more widely known and publicly acknowledge beta and unreleased titles.

Also difficult to compile would be a collection of independent, artistic, and homebrew games, as well as modifications of existing games. These are titles that would have seen limited production runs, have never reached publication, involve possible copyright infringements, or have creators who may never want the work to see the light of day, as it were, making the cataloguing of all such titles (particularly homebrew games) impossible. However, while the catalogue of such games would by nature be incomplete, what examples we are able to obtain would be valuable in understanding the nature of the industry as well as the independent and homebrew development scene it has inspired.

Such catalogues have already been partially constructed through existing libraries and archives, as well as fan sites, metadata organizations such as GameFAQs and MobyGames, internal developer records, and collector's lists, both public and private. Finally, the emulation scene has also created extensive software lists, including lists of hacks and variations of published games. Yet while much of the work has already been done, many of these listings are in disparate locations or include information specific to a particular interest group, meaning all the information has yet to be compiled into a single catalogue. Further, the information in one database may conflict with information recorded in another, as is often the case with release dates listed on GameFAQs and MobyGames, while some databases are of course highly interested in protecting their credit for the hard work they have already put into their catalogues.

The compilation of many existing catalogues into one meta-directory as well as its continued growth will of necessity require some level of cooperation between game developers, libraries, archives, collectors, the homebrew scene, and the emulation scene, as these factions have already contributed much of our knowledge of what has been produced by the games industry and can continue to add to our current knowledge.

Most importantly, the videogame industry needs to establish or adopt a videogame preservation organization that is interested in ensuring the longevity of videogames for many decades to come and that can also educate and help developers, individuals, and

organizations that are interested in preserving videogames and game-related material for future use. Such an organization would best come through further development of the Videogame Preservation Special Interest Group within the IGDA, making it the organization recognized and respected by videogame developers, allowing it to better pursue – and succeed – in the preservation of videogames and game-related material for posterity.

Videogame preservation is important to the games industry through its history and the lessons it has to teach us. While an extensive preservation program will be complex and require considerable resources to accomplish, such a task is not beyond the scope of the videogames industry and the videogame community at large and would certainly be remembered throughout the ages as a grand achievement.

Appendix 1: Further Research in Metadata Preservation

The preservation of videogames is more than just preserving the digital artifact – the game itself. We can learn more about a videogame through associated artifacts such as instruction manuals, advertising, and reviews than we could from just examining the game itself. Other games may require extensive metadata in order that we might fully understand them. The following is a list of metadata that preservationists should be interested in archiving.

Recordings of Game Play

Videogames are a plastic, interactive medium. Therefore, a complete understanding of a videogame requires that we play them and interact with them. However, many games require a certain level of skill and time in order to complete the game, time and skill that may be limited to the average videogame researcher. Gameplay videos are a useful way of learning more about a game without requiring extensive skill; they also are an artifact of gameplay in action. Videogame speedruns in particular are also unique cultural artifacts because they record gameplaying virtuosity.

Instruction Booklets

Instruction booklets often provide crucial or important information about a game such as how to play it and the game's back story. Many instruction booklets also include development artwork important in understanding the artistic design of a game.

Advertising

Videogame advertising includes video and audio commercials as well as print ads, store displays, and recordings and documentation of publicity events. Videogame advertising can be important to researchers who are studying the cultural milieu in which a game existed, and also to historians of advertising. Some players are also interested in viewing ads for their favorite games.

Videogame Soundtracks

Many game developers and music companies have produced videogame music and remix albums to go along with the release of a game. Though videogame soundtracks have not achieved the level of commercial success found in Japan, they are still an important part of videogame culture. As recordings of a game's audio, often, but not exclusively its music, videogame soundtracks provide a unique way of experiencing a game and can be important artifacts in and of themselves. Some Internet communities, such as Slightly

Dark (<http://www.slightlydark.com/>) and GMR Online (<http://www.gmronline.com/>) specialize in the collection and documentation of rare and obscure videogame music, providing a fascinating insight into the history of the videogame music industry. The cooperation of these communities will be important to archivists interested in preserving videogame soundtracks.

Merchandizing

Some archives may want to include recordings or physical artifacts of various videogame merchandise such as action figures, clothing, and promotional material. This material would provide an artifactual milieu or devotional and fetish recording of the commercial culture surrounding videogames. Some material, in particular officially endorsed products and promotional material, will also provide a context for the videogame artifacts themselves and campaigns associated with game releases.

Documentation and Commentary on Videogames

It will also be important for archives to build a collection of documentary material and commentary on videogames. This information will include game reviews, strategy guides, magazine and newspaper articles, as well as scholarly papers about videogames. Such a collection would provide invaluable information on how players and reviewers determine a game's quality, how critics analyze games, and recordings of historical events and opinions related to videogames.

Development Materials

In some cases, videogame archives may come across original development materials through donation; game developers may also publish some of their development art in art booklets and promotional items. Preservation of development materials is important to the videogame archive as development materials are physical and digital artifacts involved in the game creation process and can shed invaluable light on the nature of game development and the history of a particular game.

Game Credits

Due to the nature of the videogame industry as a competitive and at times secret business where publishers and developers are more immediately recognizable than a game's director, the credits of those involved in developing a videogame are often poorly recorded, if at all. To make matters worse, many early games had no credits or had credits listed under pseudonyms to prevent other developers from hiring out important team members. As a result, we do not have accurate listings of the credits for many videogames.

In addition, videogame release dates often vary between metadata websites: for instance, one game may be listed as having a particular release date on GameFAQs, but the same listing on MobyGames has a different date.

In order to correct these inconsistencies and to provide exact information on developer credits and release dates, archives will have to contact the developers themselves. Furthermore, this project of giving developers the credits they deserve should also be something done internally within the International Game Developer Association, perhaps as an online credits database built and maintained by game developers, as the IGDA has a vested interest in doing so.

Historical Information About Games and Game Developers

One crucial piece of metadata is an historical reference of the history of game developers and the games they created. This information will allow historians to better understand the context in which videogames were developed as well as how certain games were developed. A good deal of this information has already been recorded in books, magazine articles, and online archives, so a videogame archive should track down copies of these documents to add to their library. Some of this information can be included or referenced in a videogame catalogue as metadata.

Game Saves

Videogame archives should include collections of game save files, which act as recordings of game states. A game save archive is necessary not only for allowing researchers to quickly access different sections of a game as digital ‘bookmarks,’ without having to play through a game from the beginning, but they will also allow for documentation of player virtuoso, such as the completion of a particular game using limited resources and/or under a certain amount of time.

Accounts of Gameplay Experience

Videogame historians should also be interested in recording accounts of game play, such as video of players in action and textual accounts of gameplay experience. This information will allow future historians to better understand how players experienced videogames in different eras as well as providing working documentation of the experiential nature of videogames.

Game Controllers and Peripheral Devices

Aside from official controllers developed by videogame console manufacturers, many third parties also develop new and at times unique controller interfaces for videogame consoles. While some controllers are better designed than others, the more popular and unique peripherals are particularly important to videogame preservation by demonstrating the different ways in which players can interface with a videogame console, from joysticks and two-handed controllers to light guns and arcade sticks. While some peripherals may be only of interest to collectors and historians, a videogame archive would not be complete without a collection of videogame controllers, particularly in cases where a specialized controller is required for playing a game, such as with *Guitar Hero* and *Donkey Konga*.

Cheat Devices

One aspect of videogame culture is the use of cheat devices to access hidden aspects of a game. Cheat devices modify a game's physics and rules, not only making games easier by allowing players to become invincible or have infinite resources, but they also can allow players to access hidden portions of a game or play against the rules for interesting effects. Like game controllers and peripherals, cheat devices allow for unique ways of playing a game and should be preserved for this reason.

Documentation of Videogame Culture

It is also important that we record video, audio, and textual accounts of the different aspects of videogame culture. Such documentation will help future historians understand the nature of past and contemporary videogame culture and its impact on society.

Emulators

While emulators are useful to preservation in general as they can run obsolete software in a contemporary computing environment, archivists should also be interested in preserving the emulators themselves. The reason for this is that many emulators, particularly those programmed by devoted individuals and small independent communities, offer unique ways of interacting with videogames that are simply not possible through the original hardware or through official emulators. These interactions involve such features as save states, which allow users to save a particular moment in a game, allowing them to return to it at any given time; direct recording of gameplay as well as game audio and gameplay stills; speedup and slowdown of emulation; the optional activation and deactivation of video and audio channels; and the customization of controller input devices, among other features. Another subcategory of emulation is hacks and game editing tools that allow players to modify existing games.

Unfortunately, many of these emulators are developed on legally questionable grounds, despite what creative and interactive possibilities these emulators allow. It is still important that we preserve these emulators, and navigate the legal minefield to best determine how to do so, in order that we might preserve these possibilities for a time when their existence becomes legal, rather than remaining in the gray or black area of digital media.

Preservation of Massively Multiplayer Online Games (MMOGs)

MMOGs provide a unique challenge to archivists and historians alike due to their fundamentally different nature: a MMOG is far more than its simply programming as its functioning is firmly cemented to player interaction. As players interact with an MMOG and with each other over a network, a unique community emerges and evolves, often aided by direct involvement from the game's publisher. The events that occur in an MMOG cannot be duplicated – they are ethereal and often connected to single or uncontrollable events resulting from the interactions of large numbers of players. So while the programming of an MMOG might be easily preserved, its unique gameplay, tied directly to its history, cannot be duplicated.

Archivists interested in preserving MMOGs will therefore have to also record a history of the program as well as stills and video footage of the game in action and accounts of player experiences. While the events themselves cannot be preserved, a recording of these events will provide an historical approach to the nature of MMOGs that is more closely related to the recording of performance art – or any historical event – than to artifact preservation.

Appendix 2: What Materials are at the Most Risk

This appendix helps provide a listing of videogame materials that are at the greatest risk of being lost forever. These listings are based primarily on the vulnerability of the storage medium as well as the scarcity of the software. Archives and libraries should consider focusing on preserving games within these categories as well as in identifying other possible categories of games that are at risk of being lost.

“University Games”/Early Non-commercial Videogames

Time is already running out for the preservation of the earliest computer games, programmed on university mainframes. Their preservation will require considerable cooperation from videogame historians and the developers of these early games, some of which have already left this world.

Today it is very uncommon to find original functioning hardware due to their lifespan – original mainframe computer equipment from the 40s, 50s, 60s, and 70s is often available only in computer museums and few are still functional, let alone running university game software. Often most of the relics that remain from this period are anecdotes made by people who have played these games or information gleaned from games that were inspired by them (for instance, we may learn more about *Panther PLATO* by studying its direct descendant, *Battlezone*). Sometimes, original programming code has survived and in rare cases, the original games or some version of them have been completely rebuilt to run on emulators. In many cases, however, little more than a name remains.

The Stanford University Library and other archives have taken some measures to help preserve information on these early games. What we need now is a complete survey of university games to place the study and preservation of them into perspective.

8” Floppy Disks, 5.25” Floppy Disks, 3.5” Floppy Disks, and Magnetic Tape

Due to the instability of early magnetic storage medium, software stored on these devices is at the greatest risk of being lost forever due to magnetic decay. While we have already lost a good portion of early university games, today there is at a far greater hope of preserving a greater percentage of software stored on magnetic disks and tape. However, such action must be taken quickly before the media becomes completely unreadable.

Thankfully, steps are currently being taken to help legally preserve this software without violating copyright law. Recent exemptions to the Digital Millennium Copyright Act have allowed libraries and archives to preserve data stored on these disks, provided they do not make copyrighted data publicly available. The Internet Archive, Software Preservation Society, and Stanford University Library are major institutions currently taking measures to ensure the valuable information contained in these artifacts is

preserved on more stable media, but there are still many that still need to be archived. Preservation of software from this era will require considerable cooperation from developers.

Arcade Games

Many arcade games are at risk due to low production rates, as well as hardware failure resulting from use and age. There are several institutions dedicated to the collection and restoration of arcade systems, but arcade games will ultimately only last as long as their hardware, making it imperative that these games be archived in a more stable format.

Independent Games

Independent games are not officially published and may only be available through the original machine the game was developed on. Some independent games are preserved due to their popularity: they are freely transmitted over networks and websites, giving them greater replicability. Others are presented in the form of electronic art, leaving their preservation in the hands of art museums. Many independent games also have limited distribution, sometimes due to lack of technology or disinterest in dissemination. Games developed on the TI-86 calculator, for instance, need to be connected to other TI-86 calculators or a computer through upload cables, which requires special hardware. Though it is impossible to preserve all independent games due to their volatile nature, archivists should be concerned with preserving what they can to provide a snapshot of the nature of independent games.

Rare and One-of-a-kind Games

Some videogames received extremely limited print runs or were never published at all. As a result, these games, some of which are stored on magnetic disk, are difficult to locate. Archivists should concentrate on preserving these games due to their rarity – by preserving these titles, these games have a greater chance of survival than they would as singular or limited print units. Due to their rarity, it is difficult to track down many of these games, and archivists may have to turn to the original developers and collectors to locate them.

Beta Software and Development Materials

Beta software and development materials should be preserved due to their scarcity and often one-of-a-kind nature. However, most beta software and development materials are within the possession of their respective developers and intellectual property holders, so their longevity will ultimately rest on the methods taken by those individuals and organizations to ensure their preservation. Archives should by no means impose

preservation methods in these cases, though they may discuss issues of preservation and archival with interested parties.

Battery Backup Games

Some videogames used battery backup devices to store save files. While immediate problems surrounding battery backup concern the loss of save files due to battery failure, and thus do not result in a threat to preservation of the game itself, battery backup games should be preserved or restored in the long term due to the eventual rupture of batteries used for storage and subsequent acidic corrosion. Though data refreshing will ensure the game survives in an alternative storage medium, batteries may also be removed or replaced as a restoration method.

Licensed Games

The nature of licensed games is in a somewhat unknown state, but could result in long-term preservation issues due to the fact that the re-release or continued release of these titles must constitute a licensing agreement between the developer, the license holder, and the publisher. Some groups connected with the licensed games may not be interested in preserving these titles; others may be unable to complete a licensing agreement that would allow the game to be re-released. More information on these titles will be required.

Appendix 3: Steps Game Developers Can Take to Help Ensure The Preservation of Their Own Data

Despite the initial optimism regarding computer technology and its promises for the future, in particular the indefinite life of a digitized object, we have learned today the depressing fact that the digital artifact has an extremely limited lifespan, perhaps somewhere between that of newspapers and pulp novels. Digital media does not last forever, and in fact has a very short life span, with magnetic media life expectancy from between 10 and 30 years. The current lifespan of optical media is unknown and is likely to be much shorter than the optimistic 100 years suggested by optical disc manufacturers. In addition, the lifespan of digital media may be cut short by obsolescence and hardware failure as well as the traditional killers of information, accident, disaster, purposeful destruction, and neglect.

For this reason, game developers – as well as any individual interested in preserving his or her electronic data – should be aware of steps they can take to help ensure their data will be safe for many years to come.

Data Backup Hardware

There are multiple hardware formats available on the market for data backup, making it difficult to choose which is best. The current commercial-grade storage media formats in the order of most to least reliable are optical media, hard drives, magnetic tape, and flash drives.

Optical Media

Optical media of all write-once formats is by far the most stable due to its solid-state, non-rewriteable format.⁶⁷ Archived discs should be stored in a safe location, well away from any direct sunlight, which can easily destroy the discs by fading the foil backing if the discs are exposed for too long, rendering the disc unreadable. Backup discs should also be rarely handled due to the lack of scratch-resistance found on current optical media⁶⁸ – the more a disc is handled or used, the higher the likelihood it could undergo wear. It is also recommended to use lower-speed drives to read the discs, due to the tendency for the foil of early discs to warp under high speeds, rendering the contents unreadable.

In terms of optical disc quality, companies and institutions with extensive financial resources should consider gold series optical media by MAM-A, which currently offers

⁶⁷ Rewritable discs are not recommended for long-term storage due to the volatile nature of the ink used as well as the rewritability of the discs themselves.

⁶⁸ CDs and DVDs have low levels of scratch-resistance. However, the new Blu-Ray format claims higher levels of scratch-resistance, which is critical to this format due to the smaller wavelengths used to read the discs, which require smaller data tracks that are closer together.

the best quality for data storage. MAM-A gold series discs are, however, prohibitively expensive for most preservationists due to the high cost of the discs,⁶⁹ so most may want to opt for a cheaper solution.

Fortunately, developers can make use of Name-brand discs such as Sony and Memorex are suggested due to the higher quality production of the discs when compared to off-brands and store brands. Currently, DVDs offer the best storage capacity per dollar than any other optical format, with CDs coming in second and Blu-Ray in a distant third.⁷⁰ However, due to the greater storage capacity and better scratch-resistance provided by Blu-Ray, larger companies that can afford the cost of burners and writeable Blu-Ray discs may opt for the investment due to the large file size of high-fidelity content such as music, video, and graphics. Other developers will have to currently make do with DVDs as the standard until the price of the high-definition format drops and becomes more standard.

Hard Drives

Hard drives remain the second standard for data storage due to their high storage capacity and relative stability. Hard drive rewritability and larger storage capacity are benefits over optical media, but they are rated lower than optical formats due to their rewriteability and susceptibility to magnetic damage or physical failure. External hard drives offer greater portability than internal drives, though internal drives are more stable because they are not moved. In addition, the stability of hard drives decreases rapidly when higher-capacity drives are used due to the number of platters within the drive and the width between each platter, making them more susceptible to failure. The instability of hard drive sizes above 160GB increases dramatically so anything below that size is more highly recommended, though larger size 500GB and 750GB drives by Seagate still have a long lifespan.⁷¹

In terms of hard drive brands, Seagate and Samsung currently lead the market in terms of quality. Seagate hard drives are the most stable on the market due to the high quality of manufacture as well as the slower spin speeds.⁷² While this means Seagate drives are possibly less-suitable to gaming, which often requires higher-speed hard drives for better performance, they are well-suited to data storage.

For more complex backup systems, RAID arrays consisting of two or more mirrored hard drives may be installed within a single machine. Data will be saved simultaneously to

⁶⁹ As of this paper, MAM-A gold series discs are approximately \$2 per disc in bulk.

⁷⁰ Currently, writeable Blu-Ray discs run approximately \$12-\$14, roughly the price writeable DVDs were in 2001. Blu-Ray discs and burners should have dropped to a more affordable price range by around 2010.

⁷¹ “[Both the] 500[GB] and 750[GB Seagate drives] are pretty stable for their size.. [we] have a few in the shop and neither sizes have died yet.” (Brady Essman. “Re: - data preservation.” (personal communication addressed to Devin Monnens, January 19, 2007).

⁷² Brady Essman is a data recovery specialist at Digital Medix, which has performed data recovery services for the government. Seagate is recommended over Samsung due to the greater stability of the drives, while it is easier to recover data from a damaged Samsung hard drive. Seagate also currently offers a five-year warranty for their internal drives.

both hard drives, meaning if one drive should fail, there is another one readily available which contains all the data of the other drive.

Magnetic Tape

Magnetic tape is third on the list due to its high volatility. Magnetic tapes are subject to head skew and tape degradation,⁷³ particularly from magnetic interference, but also from bit rot. Further, the vast number of formats for magnetic tape means there is no standardization, so developers who use magnetic tape will have to ensure they maintain the hardware required to read the tapes.

Flash Drives

Flash drives are the most unstable of all current consumer-grade storage media due to their susceptibility to static and the difficulty of data recovery. Though flash drives are the equivalent of the next-generation floppy disks due to their large storage capacity, rewritability, and transportability, due to their susceptibility to failure, flash drives are best used for transferring copies of relatively large amounts of data between systems and should not be considered for permanent storage.

Recovery of Failed Storage Media

All storage media, without exception, is subject to failure if improperly preserved. In addition, all storage media is at risk of varying levels of degradation and hard drives are subject to mechanical failure. If you have important data that has become inaccessible, the best way of recovering the data may be to take it to a data recovery facility. Bear in mind that data recovery is extremely expensive and can easily run more than \$1000 per unit. The best way of ensuring data security is redundancy and periodic refreshing.

Redundancy

Redundancy is a critical part of preservation. Redundancy means the production of multiple copies of an item as well as their geographical disbursement. This protects the information against accidental destruction such as through fire or flood by providing one or more backup copies in geographically separate locations. Should one archive or one copy undergo misfortune, there will be another copy available that can be retrieved and refreshed.

Refreshing

⁷³ Interview

Data refreshing involves copying data onto a new storage medium, such as from floppy disk to CD. This will allow the digital artifact to survive beyond the original storage medium or that of the copy because the data is continually copied from one format to another before the storage medium fails or deteriorates. This effectively increases the lifespan of the digital artifact by preventing it from relying on a single instance of a material substrate.

Migration

Data migration involves translating a file from one file format to another, allowing the file to be read by different programs. The disadvantage of data migration is that it can often result in data loss due to the change of formatting techniques: for instance, a word document might lose font styles and line spacing when migrated to a different file format, and these formatting changes might drastically change how the document is interpreted if the original formats were valuable to the document.

Emulation

Emulation is the creation of a program that mimics the operation of hardware and software within a different computing environment. Emulation allows older files to be read and programs to be run while retaining much of the nature of the original computing environment.

Data Preservation Strategies

To ensure greater data security, use a combination of optical media and hard drives, with data redundancy across both formats in the form of either multiple copies of the optical discs and/or multiple hard drives. Copies are best kept in geographically disparate locations to protect against accident or disaster. For instance, flooding or fire can easily destroy an entire facility's contents, making it more secure to place your data in separate locations.

Data should be placed on a refresh schedule, ensuring greater security in case the original storage medium fails. However, this will result in greater redundancy over time. For hard drives, refreshing should be performed before the drive becomes too old to guard against drive failure. Optical media has a longer lifespan, so should not need to be refreshed as often.

Developers may also want to refresh their data to new storage formats as they become available or affordable. New storage formats are currently appearing once every five to eight years, with each format promising greater storage and higher fidelity, meaning less material for more storage. As new storage formats are produced, archivists should

refresh their data to these new formats as they become standardized due to the higher storage capacity and possible future standardization of each format.

Developers should consider regularly updating their data from projects in development. One team member, or a group of employees in the case of larger companies, could be assigned this task. If data is regularly backed up, then should system hardware fail, there is a recent copy available, preventing the loss of too much valuable time. Employees in charge of data backup should also pay attention to the age and condition of hard drives in company machines. They may also recommend the installation of RAID drives within each machine.

Destruction of Sensitive Data

Sometimes a developer might want to destroy a hard drive or other media containing sensitive information. This may be failed media. In any event, never attempt to completely destroy your storage media unless you are absolutely certain you no longer need it. Because data can sometimes be recovered from failed media depending on the money and resources pooled into it, complete obliteration is usually the best option, though in the case of hard drives, this involves completely melting it. Magnetic storage media such as hard drives and magnetic tape can undergo low-level formatting, though this will leave a residue that can be detected by recovery facilities.

Simpler and cruder techniques may be employed. Storage media may be physically smashed or shattered into pieces such that there becomes a point where any reasonable individual or organization attempting to recover data from this media is likely to spend more than the data is worth to recover it.

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Classic Software Preservation Project (CLASP)
<http://www.archive.org/details/clasp>

Computer History Museum Center
Mountain View, California, USA
<http://www.computerhistory.org/>

Computerspiele Museum
Berlin, Germany
<http://www.computerspielemuseum.de/>

DiGA – Digital Game Archive
<http://www.digitalgamearchive.org/home.php>

International Game Developers Association (IGDA): Game Preservation SIG
http://www.igda.org/wiki/index.php/Game_Preservation_SIG

Internet Archive
<http://www.archive.org/details/clasp>

The Killer List of Videogames (KLOV)
<http://www.klov.com/>

PlayStation Museum
<http://www.playstationmuseum.org/>

Software Preservation Society
<http://www.softpres.org/>

Stephen M. Cabrinety Videogame Collection in the History of Microcomputing
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Metadata and Databases

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Slightly Dark
<http://www.slightlydark.com/>

Useful Information on Data Backup (Suggested Readings)

Conservation Online
Stanford University
<http://palimpsest.stanford.edu/>
Contains resources for conservation professionals.

Information Longevity
<http://besser.tsoa.nyu.edu/howard/longevity/>
Compilation of information archival and longevity by Howard Besser, Ph.D., Berkeley.

Time & Bits Conference
February 8-10, 1998
<http://web.archive.org/web/20010209041800/http://www.longnow.org/10klibrary/TimeBitsDisc/index.html> (Archived)
Early conference on information longevity and electronic data preservation funded by the Getty Center.