



PROJECT  
TRANSFORMATION  
DIGITAL ART

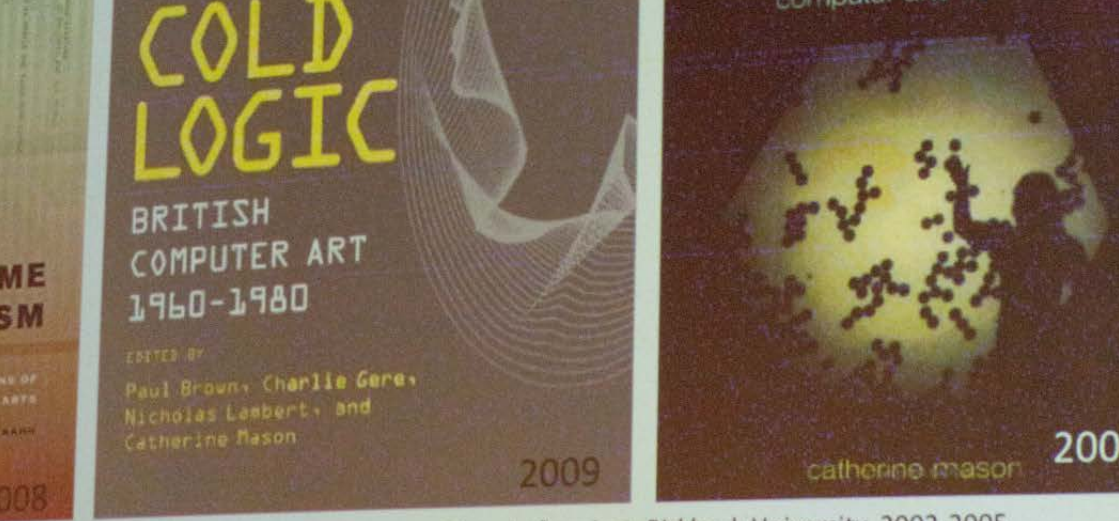
preservation of  
born-digital art

# PROJECT TRANSFORMATION DIGITAL ART to notsvareq the Istigib-mod

2014-2016

## Contents

<u>Project Transformation Digital Art 2014-2016</u>	
<u>Introduction</u>	7
> PAULIEN 'T HOEN AND GABY WIJERS	
<u>Preserving Three Works by Peter Struycken</u>	15
<i>DISP (1977), SHFT-34 (1982-2007), AND BLOCKS (1997-2016)</i>	
> GABY WIJERS	
<u>The Preservation of Digital Art Is a Major Challenge for Collection Managers</u>	31
<b>DOCUMENTATION IS THE FIRST AND MOST IMPORTANT STEP</b>	
> NINA VAN DOREN AND MARLEEN WAGENAAR	
<u>New Workflow for Digital Art</u>	47
> GABY WIJERS	
<u>What Further? Conclusions and Recommendations</u>	65
<b>CONSERVATION OF BORN-DIGITAL ART IS BESPOKE</b>	
> GABY WIJERS	
<u>Short biographies</u>	71
<u>Colophon</u>	73



CAHE[Computer Arts Context Histories] project, Birkbeck University, 2002-2005

al and computer-based arts, both in the United Kingdom and elsewhere, have been largely overlooked by contemporary art galleries and institutions involved in the history of art. This lack of understanding of not only this area of practice, but, more generally, art and technology in the United Kingdom and Britain. The post-war era was a time of technological optimism and even utopianism, which played a central role in enabling cultural understanding and acceptance of new forms of art. As technological optimism and utopianism has somewhat abated, the highly digital world we now live in owes much to such pioneers.



## Project Transformation Digital Art 2014-2016 Introduction

> PAULIEN 'T HOEN AND GABY WIJERS

Digital technology plays an important role in our daily lives. Computers have changed the world and artists, too, increasingly make digital work. They reflect on the media, write software, and explore the limits of technical feasibility. Even when computer technology was still in its infancy, artists were exploring the medium. Museums and archives are also increasingly confronted with works that have no physical carrier and exist only in digital form: 'born-digital art'. Displaying and preserving digital art brings with it new questions and challenges. Digital artworks rely on their technological environment, and this is constantly changing. Equipment grows obsolete and software develops. Artworks adapt or perish. Sustaining these works in museum collections requires different approaches than those traditionally taken for visual art and digital heritage.

Dutch museums have a small selection of digital artworks in their collections. One reason for this is that the world of digital art, with its own experts and channels and experimental attitude, operates externally to the institutional art world. Over time, the number of digital artworks will significantly increase and more are expected to be included in museum collections. The museum's experience in dealing with these works is limited. The handling, conservation, and presentation of these artworks is a relatively unknown territory. Meanwhile, collections must be proactive and require knowledge to take on this delicate contemporary heritage and maintain its future accessibility to the public. In 2012, Virtual Platform, DEN | Digitaal Erfgoed Nederland / Digital Heritage Netherlands, SBMK | Foundation for the Conservation of Contemporary Art, and NIMK | Netherlands Media Art Institute (now LIMA) conducted joint research on the collecting and preservation of digital art in Dutch museum collections.<sup>1</sup>

From the various conversations and discussions this research generated, it became clear that born-digital artworks require a different approach than has been customary. The existing registration process, conservation models, and documentation methods should be adapted or set up to ensure the management and conservation of these artworks. The study's recommendations were threefold: practical, strategic, and regarding policy.

<sup>1</sup> *Born-digital kunstwerken in Nederland, 2012*, published in the series *Virtueel Platform Research*. Participating museums: Van Abbemuseum, Eindhoven; De Appel, Amsterdam; Bonnefantenmuseum, Maastricht; Boijmans van Beuningen, Rotterdam; Groninger Museum, Groningen; RCE sector Kunstcollecties, Rijswijk; Kröller-Müller Museum, Otterlo; Netherlands Media Art Institute, Amsterdam (including LijnbaanCentrum, Rotterdam, Montevideo and Time Based Arts Amsterdam); Gemeentemuseum Helmond; Rijksakademie, Amsterdam; Stedelijk Museum, Amsterdam; Centraal Museum, Utrecht; Frans Hals Museum|De Hallen, Haarlem; V2, Rotterdam; \* Schunck, Heerlen.

## RECOMMENDATIONS IN BRIEF

### PRACTICAL

- Regular showing and installing of born-digital art provides insight into potential problems.
- Case study related solutions could lead to standardization.
- Make sample contracts for production, purchasing, maintenance, and preservation of born-digital artworks.
- Develop a standard checklist to support the current registration system.

### STRATEGIC

- Establishing a joint knowledge centre/platform in the field of born-digital art.
- Develop a documentation method for born-digital artworks as one possible conservation method or as a support for other conservation strategies.
- Establish joint (inter) national research projects with museums, organisations, and universities for preservation and documentation of born-digital artworks.

### REGARDING POLICY

- Increase awareness with funders, sponsors, and museums.
- Raise awareness of this problem to the wider public.

To implement the recommendations, in 2014, LIMA and SBMK together with participating museums initiated the *Transformation Digital Art* project. During the project, three works from five collections were examined and the questions and findings were shared and tested in four expert meetings. Other participants included museums and institutions with similar Struycken works or collections with similar digital works. Participants in the expert meetings came from: Stedelijk Museum Amsterdam, EYE Film Museum, DEN, Groninger Museum, Museum Boijmans Van Beuningen, Centraal Museum Utrecht, Van Abbemuseum, Gemeentemuseum Den Haag, Kröller-Müller Museum, Maastricht University, University of Amsterdam, and RCE (Rijksdienst voor het Cultureel Erfgoed/ Cultural Heritage Agency Ministry of Education, Culture and Science). The project was concluded in February 2016 with a two-day symposium.

## TRANSFORMATION DIGITAL ART PROJECT

The aim of the *Transformation Digital Art* project was to identify the possibilities and consequences of technical and aesthetic changes in manifestations of digital art, based on three case studies of Peter Struycken's work. Struycken is the only digital pioneer in the Netherlands whose work is well represented in museum collections. Central to Struycken's oeuvre is the use and variability of colour in its immaterial form. Since the sixties, his visual images have been informed by the use of computers that calculate relationships between colours. More recently, the use and lifespan of these type of artworks has repeatedly been put into question. The computer-controlled 'material light and colour' is indeed immaterial and many works were specifically designed for use in public space. The research focuses on all relevant issues concerning technical innovation and sustainability, accountability of emergency conservation measures, and aspects of copyright. Working with the SBMK, LIMA investigated the options available to best ensure accessibility to its offline digital work in the long term. These problems and the possible solutions can serve as an example for born-digital works in other collections.

### GENERAL QUESTIONS

- Can we develop parameters for migrating digital artworks to ever changing technologies?
- How can these parameters be managed?
- To what extent can/should the work and its staging be adapted in order to perpetuate the work?
- Who is responsible for the correct functioning of a digital artwork?
- How can a digital artwork be sustained, operated, and presented so that it remains accessible to the public in the long term?
- How can audiences get engaged in the issues and possible solutions?

## RESULTS

The intended outcomes of the project were threefold:

- The joint development of a methodology, with professionals from various museums, consisting of a set of 'models' for sustainably maintaining the availability of digital art, presented in both a public setting and a publication.
- The sustainable conservation of at least three digital works by Peter Struycken from various Dutch collections, which, in their current state, can be considered lost and no longer accessible to the public.
- A film aimed at the public to raise awareness about the work and its sustainable conservation.

These results have all been achieved. The articles in this digital publication are the result of research into documentation of born-digital works as a first step in the conservation and workflow associated with sustainable digital conservation.

The article on the case studies reports on the conservation of the three selected works *SHFT-34*, *DISP*, and *BLOCKS*, which respectively are from the collections of Kröller-Müller Museum, LIMA, and Gemeentemuseum Den Haag. And, last but not least, the film *Digital Art: Who Cares?*

The project's results were shared during the *Transformation Digital Art* symposium. It was well visited with 130 participants. The international audience consisted of museum employees, curators, conservators, scientists, artists, and students from different disciplines from all over Europe.

SBMK, LIMA, and the participating museums thank the Mondriaan Foundation and the Prince Bernhard Culture Fund for making this project possible.

**PAULIEN 'T HOEN**, coordinator SBMK

**GABY WIJERS**, director LIMA





## Preserving Three Works by Peter Struycken *DISP* (1977), *SHFT-34* (1982–2007), AND *BLOCKS* (1997–2016)

> GABY WIJERS

An important objective of the *Transformation Digital Art* project was the sustainable preservation of three digital works by Peter Struycken that are found in various Dutch collections and which are either lost or inaccessible to the public.

This article describes the three selected case studies for the *Transformation Digital Art* project together with the conservation questions, research, and selected conservation strategy. The case studies are all typical of other digital works of art that can be found in museum collections. The *DISP* case study (LIMA Collection) focuses on the parameters for re-construction based on documentation. *SHFT-34* (collection Kröller-Müller Museum) primarily addresses questions about technique, *BLOCKS* (collection Gemeentemuseum) addresses questions on context.

The conservation of these three works is the subject of the documentary *Digital Art: Who Cares?* This film was realised by LIMA, SBMK, and ArtTube in collaboration with photographer and filmmaker Maarten Tromp and researcher Nina van Doren.

### PETER STRUYCKEN: COMPUTER ART PIONEER

In 1968, Peter Struycken began using the computer to make work for autonomous and commissioned projects. His work builds upon artistic traditions of colour and movement research, systematic uses of colour, and scientific research on perception. Through nature, philosophy, and painting, this tradition is continued and developed in the analogue and digital arts. Using specially developed computer programs, Struycken makes photographic works, drawings, paintings, films, videos, sculptures, and real-time computer-controlled works for television and light, ranging from the minute to the monumental.

Like Nam June Paik, Struycken is a pioneer of technological experiments whose outcomes are abstract image manipulations and he explores sound-image relationships. In 1967, Nam June Paik, in collaboration with others, made a video synthesizer. This made it possible to mix recorded images on video in any colour or shape. Steina and Woody Vasulka are also recognised pioneers in the domains of both video and electronic art. In the late sixties, they started researching creative procedures and media, both analogue and digitally. Their first



experiments attempted simultaneous audio and video signals. Another Dutch representative in this field was Livinus (van de Bundt). He was the first Dutch artist to create abstract images using video technology. He started studying graphic arts and was strongly influenced by surrealism. After experimenting with abstract photography and slide projections, in 1970, he concentrated on working with video, through which became interested in manipulating image and light and combining it with sound.

## CASE STUDY 1

### DISP, 1977, PETER STRUYCKEN

#### THE WORK

*DISP* is one of the first programs written by Peter Struycken and was developed between 1976 and 1977 at the Technical University (TU) in Delft. For his earliest computer-based work, Struycken wrote a series of programs. These programs, six in all (*WAVES*, *DISP*, *VLOEI*, *SQUARE*, *GRID-3*, *LINE-1*), are among the first examples of Dutch software-based art. The only remaining evidence of these programs is video documentation from 1980 showing the six programs under the title 'Computer Art'. The 29-minute and 45-second recording further consists of a voice-over by the artist and credits. This video, which was the starting point for the case study, is in the collections of LIMA and the Museum Boijmans Van Beuningen.

The voice-over gives a visual analysis of the various programs, describes how to start them, and their difficulties. Based on perception research, Peter Struycken speculates that what our senses register becomes experience according to a certain organisation or design.<sup>1</sup> He, therefore, analyses various properties of form and colour and determines the experience of their visual appearance. The aspects he focuses on are size, boundary, brightness, saturation, hue, material, space, texture, movement, and duration. The computer allows Struycken to calculate these and other factors with more ease, depth, and accuracy than with manual calculations.

In the seventies, when *DISP* was made, there was limited access to computers and much work went into creating a functioning program. Researchers from TU Delft's Graphics Group managed to connect a colour monitor to a computer (a PDP-11) and wrote the necessary software to enable the monitor to 'show' what the computer program generated. Struycken had access to this computer and colour monitor for one day a week. The PDP-11 is a 16-bit computer with an 8-bit video card (three bytes for red, three bytes for green, and two for blue) of 256 colours. The colour screen (aspect ratio 4:3) communicated to the computer using custom-made software and GPU (graphics processing unit). *DISP* is a program in which the artist explores the relationship between colours. *DISP* is the basis for the creation of other works: *VLOEI* (Flow), *GRID*, *GRID-3*, *SQUARE*, *GOLVEN* (Waves), and *LINE-1*.

<sup>1</sup> P. Struycken Een leefbare omgeving in ex. cat. *Structuur 67*, Haags Gemeentemuseum 1967.

The voice-over on the video recording provides contextual information that is useful for understanding what the program does.

*DISP* shows a new colour on the screen at intervals of two seconds. In essence, the intention is to determine the quality of the change: large or small, sudden or gradual. The difference between the colours is perhaps more important than the colours themselves.

### QUESTIONS

Is it possible to reconstruct this work based on the available documentation? If so, can this work be sustained, operated, and presented in the long term? Subsequently, can this work again be distributed?

### RESEARCH

The videotape was transferred to Umatic and then digitised to Betacam SP and Digital Betacam. The work has subsequently also been saved as an uncompressed .avi file and is available for display as an MPEG file. The source codes for this series of works no longer exist. The works could be reconstructed according to video recordings of the works and the pictures that Peter Struycken made at the time. The initial discussions and investigations relate to the 1:1 reconstruction of the work, which is a simple task according to Struycken. For this, Struycken wanted to make a new voice-over in English. Therefore, a new voice-over was translated and annotated. The original program generated the colours and images in real time in 256 colours. This colour palette was available and accessible through a colour chart; the operating speed can be determined from the video recording. Reprogramming and/or reconstruction based on the documentation of *DISP* is a possible conservation strategy. This approach is similar to reinterpretations of performance art or music scores. So long as the same essential score runs within the appropriate parameters, the work will remain recognisable and maintain its integrity. Although simple, the outcome is of little relevance. What was then a spectacular result, almost impossible to achieve in 1977, is now easily realised and provides little or no interesting visual image other than the video documentation.

Another aspect of reinterpretation concerns context. The artist's voice-over in the video recording is particularly interesting. This is very informative about Struycken's artistic practice and helps to better understand these early works. This form of reinterpretation emphasises the work's cultural value and historicity, allowing new audiences to rediscover and reassess the original works. This can be achieved through the production of a film or app. Developing a website or app for

this purpose was discussed with Peter Struycken and Floris van Manen, as were a number of 'exercise programs' and the options to provide the programs with some kind of 'toolkit' and accompanying explanations. In this way, the various programs can be examined and copied by the user.

### CHOSEN CONSERVATION STRATEGY

Forty years after the work's creation, it was decided to reinterpret or to reconstruct the work on the basis of both elements. An animation was made, highlighting the technical limitations of the time and to acquaint the contemporary viewer with Peter Struycken's early experiments with monitors, programming, and additive colour systems. The animation is available for research purposes.

## CASE STUDY 2

### SHFT-34, 1982-2007, PETER STRUYCKEN

#### THE WORK

In the early eighties, Peter Struycken wrote a program for a stand-alone image generator: *SHFT-34*. It generated computer images in real time, which were then shown using a large video projector. The work was donated to the Groninger Museum for permanent display in the coffee corner. Struycken is interested in the exploration of ever-different possibilities, not in their repetition. *SHFT-34* generates continuously changing images based on the interference of waves. The algorithm generates constantly changing waves, using almond shapes and loops, as moiré-like patterns. Struycken has also used the program for producing drawings and photographs. These works use the same title and an accompanying numerical suffix, e.g. *SHFT-19*, *SHFT-30*. Struycken used the title *SHFT-34* (1982–1983) for a series of forty photographs in which the computer stop was programmed to extract stills.

The intended permanent placement of *SHFT-34* as a standalone image generator at the Groninger Museum was not realised due to renovation and management changes. As a result, an essential part of the work was lost. The software (program) was found by accident ten years later. The technology eventually became outdated and Peter Struycken decided to remake the work in 2007. Floris van Manen translated the source code from its original Pascal programming language to 'Java'. For Struycken and Van Manen, this allowed for some changes to improve the work while remaining faithful to the original. Additions were: different view modes via a menu, a 'drag-and-drop' option allowing the viewer to navigate the colour space with a mouse, and printing options. The interactive features were introduced to help the viewer better understand the entire colour-space. Further added options were a screen-shot function and printing for non-commercial purposes. *SHFT-34* (2007) is an interactive software-based artwork on CD-ROM and SD card with an accompanying publication in an edition of 30. This version has been acquired by the Kröller-Müller Museum and included in this case study. The same version with another edition number is in the Rabo Art Collection. This version was shown, including printer, in the exhibition *Geestverwanten* (Kindred Spirits) (2013) at the Rabo Kunstzone in Utrecht.

#### QUESTIONS

This case study is primarily focused on questions about technology. Can this work be re-shown using current technology? What parameters apply to any eventual migration? Can these parameters apply to the subsequent migration? Can the owner, the artist, and the experts jointly define these parameters? What is the state of *SHFT-34* now, ten years later? Does the work still function, and how sustainable is the current version?

#### RESEARCH

In producing the 2007 version, Peter Struycken and Floris van Manen were already focused on long-term preservation. The program was migrated to Java and developed for three different operating systems (Linux, Windows, Mac) and delivered on two storage formats. The reason for using the new version CD-ROM and SD card has no special significance in this case. Until about 2005, CD-ROMs were used to distribute software, after this point, they were gradually replaced by SD cards (Secure Digital, solid state). Both carriers are prone to damage and aging and must be permanently preserved.

*SHFT-34*'s program content produces an image of unlimited size, which is computed dynamically; each section can be picked out. The program could be adapted for wide screen, just as Peter Struycken did for the work *VARA* in 1990. Struycken made this computer work for the hall of the *VARA* building in Hilversum with technical support from Van Manen. It is now in the collection of the Groninger Museum. To achieve a wide image, the configuration must be nearly twice as large because the program was originally developed in the shape of a square. *SHFT-34* (2007) proposes few specific hardware requirements. It is important to maintain the resolution ratio and aspect ratio. The speed and amount of colours are specified in the program's source code. The program runs on the computer but can be displayed on a colour monitor or projector. A problem that can occur with presentations is that current HD widescreen monitors automatically switch to full screen. The work is based on squares – an aesthetic principle that cannot be changed.

The program's source code is documented on paper – both Struycken's original program and the later translated version by F. van Manen – and is available from the artist, but it is available for research. It is Peter Struycken's intention to keep the work's source code unpublished until both he and Floris van Manen are deceased. This is to prevent theft or plagiarism.

The significant properties of the work were examined and described and, together with their metadata, added to the maintenance reports and the collection- information system. The functionality was described and a video recording was made. This documentation should be consulted for future access to *SHFT-34*. A digital backup is the first necessary step in maintaining *SHFT-34* for the long term. For this reason, the contents of the CD-ROM and SD card are compared, the information is read, a .ISO file is made from the CD-ROM and backed up to and stored on the SD card. ISO is a standard format that contains an exact copy of all data on the physical format.

The program itself is dependent on three main components:

- Hardware;
- Operating system;
- Java software.

Although the program works, expect future problems are:

- Java might no longer support its older versions
- Java may be a less relevant platform in the future.

If one of the three components no longer work or is no longer available or compatible with the program's requirements, *SHFT-34* will no longer function.

Wiel Seuskens and Paul-Jansen Klomp conducted various tests on behalf of LIMA to understand how current systems are still compatible with *SHFT-34* (2007), and which of the three elements constitutes the greatest challenge both now and in the future. By testing the program on different systems, aesthetic differences were also observed, such as the dynamic movement, speed, colour, etc. The following have been tested:

- PC Mac (OSX Yosemite 10.10.2 / 2,5 GHz Intel Core i5 / Java 8)
- PC (i7 / Windows7 / Geforce GTX460 / Java 8,31)
- Linux (Ubuntu / 2007)
- PC (Windows XP / Java 6)

From this study, it can be concluded that the most critical aspect of the Java programming environment is conservation. Using different operating systems spreads the risk. The open-source Linux version currently offers the best prospects for future access to the program. Linux is Unix-like and mostly POSIX compliant computer operating system and open source in its development and distribution. Windows and Mac are both commercial and closed systems.

### CHOSEN CONSERVATION STRATEGY

Emulation was chosen for *SHFT-34* because it requires the least degree of intervention. The operating systems and software are stored at LIMA. The preserved .ISO or disk image can be loaded onto the directory of a virtual machine, which is set to emulate the desired system. For presentation in the next three to five years, an MSI Cubi mini-pc with the following characteristics has been selected: Small, SSD, solid state drive, fast running without sound, VESA mounts on the back of the monitor, and HDMI via Mini DisplayPort, VGA, and DVI video port.

### CASE STUDY 3

#### BLOCKS, 1997-2016, PETER STRUYCKEN

##### THE WORK

In 1976, Peter Struycken wrote the *BLOCKS* program, where the position, size, colour, and shape of hovering blocks infinitely change in relation to one another. He used this program for a sculpture on Takenhofplein in Nijmegen and seven smaller sculptures. He uses the same title and adds an accompanying numerical suffix such as *BLOCKS 3*, *BLOCKS 4*. In 1997–1998, Struycken in collaboration with D. Dekkers was commissioned by the Gemeentemuseum Den Haag to create a site specific, architecture related version of *BLOCKS* for its first-floor space. The work was funded by the museum, the friends of the museum, and Struycken himself. In real time, the computer program generates dynamic three-dimensional shapes that shift and move within the projection screen, mounted inside an alcove on the museum's first floor. The computer and projector are concealed behind the screen and projected through a mirror construction. The colour of the produced forms or 'blocks' adapt to the grey-blue tiles of the museum walls, its screen size, aspect ratio, and number of colours.

At midday, the sunlight falls through a window onto this part of the wall. The architect H. P. Berlage designed the building in this way so that the wall's surface could be used for special works. However, the window was covered for *BLOCKS* because the work was lit differently: as if there was nothing to see. This was possible under Hans Locher's directorship, but the work was eventually removed. The work was on permanent display until around 2010, when it was dismantled during the museum's renovation, the alcove was boarded up, and the work no longer existed. The original mirror structure is still intact, and the computer and the program were returned to the artist.

##### QUESTIONS

Can this work be installed again? If so, to what extent do the original conditions and surroundings determine the work's staging? Who is responsible for its sustained and proper functioning? What is the role of the artist when making adaptations of the work?

##### RESEARCH

The Gemeentemuseum prefers a flexible placing for the work. On 20 May 2015, however, the artist stated the following: "a site-specific work cannot be presented or displayed elsewhere without losing its significance. This is the essential difference between bound and

unbound artworks. When this happens, the work lapses into being a document. Over the years, artists have created a number of works specifically for different parts of the Haagse Museum. If the museum correctly documents and preserves the work it might, in due course, be re-shown. Whether a work is taken away or mounted depends on the director or curator. When my work is re-installed on the landing it can be shown on a made-to-size LED screen. Procuring the LED display and new computer can wait until the decision is made to install the work again. The software will need to be prepared for this eventuality. For this, D. Dekkers is the designated person." Since this is definitive, the work can be documented and migrated so that, in the future, the existing site can be rebuilt and the work installed as intended. Meanwhile, Struycken decided *BLOCKS, 2015* should be considered a joint work between Dekkers and himself. Thereby, Dekkers holds the copyright on the software and hardware and Struycken retains his rights over the dynamic image and the display. The nature of the work dictates that these rights cannot be operated separately from one another. While investigating the work's preservation in 2015, the Gemeentemuseum announced that the work would cease being on permanent display. The artist abides by this decision.

##### CHOSEN CONSERVATION STRATEGY

In this case, migration is the preferred strategy. The technical performance of the software in a new environment and the use of current new projection techniques allow for the effective displaying of the work in its original location. The necessary LED screens, projectors, and rear projections were researched and presented for approval. The significant features of the work were examined and described and then, together with their metadata, added to the maintenance reports and the collection-information system. The functionality was described and video documentation was made. This documentation can be consulted for future access to *BLOCKS, 2015*.

D. Dekkers has adjusted the software and hardware and, following recommendations, safeguarded its use for the future. The work will only be shown on the original site for which the work was designed and manufactured. *BLOCKS, 2015* is delivered as a file compatible with an Intel NUC computer running the Windows 7 operating system. The source code was delivered on the same computer and on a USB stick. Access to and use of the source code is only allowed for the restoration (porting) of the software for use in the above architectural context. There is an icon for *BLOCKS, 2015* available on the desktop – this

program is also automatically started when the computer is turned on. The image signal is exported using HDMI with a resolution of 1920x1080 (HD standard). The multi-sampling technique used gives a sharp image on larger surfaces. This has been tested on the 1998 version, which had an even lower resolution. The 1920x1080 resolution corresponds to a ratio of 16:9, almost twice as wide as high. Determining whether the image can be used without modification depends on future picture ratios. It can be downsized with an acceptable vertical bias that has been reduced to fit the precise ratio of the window. If, for example, a completely different image technology makes it impossible to adjust the ratio of the optical image, it must be reset in the software. There is a video recording added to both the external drive and the computer for testing whether the program is working properly (even after any eventual porting) or, for example, for quickly testing a screen. The test sequence lasts 5 minutes and consists of images that are created when the main program runs its 'demo movie' variables as described in that part of the program code.

A digital backup and long-term storage in LIMA's digital repository (equivalent to *SHFT-34*) has been agreed to preserve *BLOCKS* for the long term, but has not yet been realised. The sustainable storage of the computer has not been realised at the time of writing. From the discussions and recommendations for this work, new quality control procedures that require a work's digital installation every three years to check its performance have been applied to the workflow of the LIMA digital repository for computer-based work.

#### FURTHER READING

Dekkers, Daniel, *MODULES, een digitaal atelier*, in C. Blotkamp (ed.), P. Struycken, Rotterdam (NAi Uitgevers), 2007, pp. 43-53.

Jobse, Jonneke, *Kleur dat wonder*, in C. Blotkamp (ed.), P. Struycken, Rotterdam (NAi Publishers), 2007.

Jobse, Jonneke, *Peter Struycken over zijn voorgangers: de geometrisch-abstracten uit de jaren 1945-1960*, Jong Holland 4, 1988, pp.17-20

Struycken, Peter, *Kleur, ruimte en verandering. Colour, space and change*, Heerlen, (Sikkens) 1987.



## The Preservation of Digital Art Is a Major Challenge for Collection Managers

### DOCUMENTATION IS THE FIRST AND MOST IMPORTANT STEP

> NINA VAN DOREN AND MARLEEN WAGENAAR

The discovery of 28 unlabelled floppy discs containing works by Warhol in the Andy Warhol Museum in Pittsburg exemplifies the challenges faced by modern and contemporary art collections when managing digital art. The three major problems are: obsolete software and hardware, unreadable files, and the lack of expertise among museum professionals. Digital artworks are highly susceptible to decay and, without proper care, will cease to function in the short term. Documentation is the first and one of the most important steps in the maintenance of software-based art. It can be an assurance of future performance and establishes parameters within which a work functions and is exhibited. This article underlines the importance of documentation and gives guidelines and advice for the handling of digital artwork.

In 2014, Andy Warhol enjoyed another 'fifteen minutes of fame' when a stack of unlabelled floppy disks<sup>1</sup> containing 28 of the artist's digital works was discovered. In 1985, during a demonstration for the Commodore Amiga 1000, Warhol demonstrated the use of graphics on this now disused computer. The artist died soon afterwards and the digital material was lost.

In 2011, Cory Arcangel (1978, Brooklyn), digital artist and self-proclaimed Warhol enthusiast began researching these works. Alongside these disks, he discovered forty floppy disks, software and hardware all well kept in the collection of the Andy Warhol Museum in Pittsburg. No one knew, however, what the unlabelled floppies contained. Given the vulnerability of 25-year old storage, accessing them was not without risks. It was feared the process of viewing and archiving the documents could irreparably damage the data. Arcangel and Carnegie Mellon University's Computer Club collaborated on using reverse engineering to retrieve the files.<sup>2</sup> The floppies contained many works including digital drawings of the famous Campbell's soup cans and edited images of celebrities such as Debby Harry and of Botticelli's Venus. Those familiar with Warhol's work will instantly recognise these subjects and not be surprised that the artist used a computer for his art. The

<sup>1</sup> **ILLUSTRATION 1**  
Commodore Amiga computer, photo editing software, and floppy discs owned by Andy Warhol. The artworks Warhol made using these devices were only discovered in 2014. CREDITS: Andy Warhol Museum, Pittsburg, Pennsylvania

<sup>2</sup> **Reverse Engineering** includes investigating software and reconstructing the original software used to create the file. The unreadable Warhol files could only be read again by first reconstructing the program (*GraphiCraft*) with which they were made.



computer is indeed a medium that is perfectly capable of endlessly reproducing without loss of quality. The digital work by Warhol confirms his fascination with copying and the latest reproduction techniques to develop his favourite themes. As this example illustrates, three recognisable problems arise in the preservation of digital art.

### THREE PROBLEMS

Firstly, is the obsolescence (in disuse) of software and hardware; the file carriers can no longer be read. Even though Warhol neatly stored documents, this doesn't ensure that the file carriers are compatible for the future. Due to technology's fast development, this also applies to modern file carriers such as CD-ROM, flash drive, and hard drives. Secondly, digital files extracted from the carrier format are still unreadable. Outdated media require retro-computing and reverse engineering by computer specialists to reconstruct software and render files readable again. It is especially delicate work to limit any irreparable data loss. Such a process can take months. This brings us to the third point: museum professionals generally lack the expertise and equipment to preserve these fragile artworks.

### DOCUMENTATION AS A BASIS FOR CONSERVATION

The reality, however, is that these artworks are very sensitive because both hardware and software will eventually become obsolete and, therefore, no longer function. Only a small number of restorers worldwide have the adequate training in information technology and yet a growing number of collection managers are entrusted with the preservation of such digital artwork. They are expected to monitor the condition of these works, to develop conservation protocols, and to act appropriately when necessary. These works fall into oblivion leading to gaps in an artist's oeuvre, or even entire periods of art history. The Warhol example is also hopeful. It shows that, even decades later, there are solutions for recovering obsolete digital artworks. Technical problems may be complex but not insurmountable. The challenge is to address this kind of situation, and time-consuming and costly work in the future. Museum professionals are experts in analysing and documenting works, which is essential for the preservation of digital art. Documentation is the first and one of the most important steps in maintaining software-based art because it facilitates preservation procedures.

### DOCUMENTATION OF ARTWORKS

A document is data recorded on a data carrier. Documentation is the collecting, organising, and storing of data. The documentation of artworks tells how the artwork generates its meaning and what it should look like. It is essential for determining the work's condition and the consequent preservation or treatment plan. The primary purpose of documentation is conserving and restoring cultural heritage. It can take many forms, and like traditional art documentation, documenting modern and contemporary artworks includes a description and photographic material of the work. This involves recording both the physical characteristics and the artwork's significance. Condition reports and the restoration history document the artwork's latest state. Recording the exhibition history, place/s displayed, and environmental factors are the artwork's biography and unlock its life. In documenting installations or structures without solid or physical form, instructions for re-installation are important and necessary. As contemporary art develops, so must the ways it is documented. These kinds of documentation techniques may suffice for traditional artworks, but other types of art, such as software-based artworks, can require different or more extensive forms of documentation.

### DOCUMENTING DIGITAL ARTWORKS

Digital art has a different character than traditional art. Its functioning – how it 'exists' – often depends on sensitive technology, which is often ephemeral and obsolete. The software (operating systems, programming, and application software) and hardware (floppies, CD Roms, video cards, monitors, etc.) are consumer level and not designed to last forever. Maintaining the work's function means adapting the artwork. Such changes intrinsically belong to this type of art. The traditional concepts of 'authenticity' and 'the original' have a different emphasis in digital art. Original technological components can be of secondary importance to its functioning as a whole. Digital artworks can have different exhibiting forms, such as when an artwork constantly generates new information.

For example, José Carlos Martinat Mendoza's *Brutalism: Stereo Reality Environment 3*, 2007<sup>3</sup> – a sculpture with a built-in computer that searches the internet for sources related to the words 'Brutalismo / Brutalism'. The work changes and evolves because the results obtained from Google's search engine adapt to geographical location or past searches. The language also changed

<sup>3</sup> ILLUSTRATION 2  
Jose Carlos Martinat  
Mendoza, *Brutalism:  
Stereo Reality  
Environment 3*, 2007.  
Fibreboard, three  
printers, paper, tracking  
system, central  
processing unit, cables,  
web search program.  
COLLECTION Tate  
Modern, London

because the initial search terms were in Portuguese and Spanish (the work was shown mostly in South America). In preparing the work for showing at Tate, English terms were added at the request of the artist. Other examples are works of art based on twitter feeds, such as Cory Arcangel's [Working On My Novel](#)<sup>4</sup> 2011-2014.

In contrast to traditional art forms, digital art raises questions about what data continues to be of possible importance for its presentation and sustainable preservation. Therefore, the conservation process begins once the work is purchased, often long before degradation is detected or the work no longer appears to function. An artwork's intake is the moment to obtain as much information from the artist (or other producers involved). Digital artists often have detailed documentation of the creative process and its subsequent amendments; at least for as long as the work is in private ownership. It is also good to be prepared for the future and find out the artist's position on conservation. Who is allowed to 'update' the work in the future? Does the work contain significant components that cannot be replaced?

These are important questions to establish in advance.

[The Artist Interview](#) is a useful handbook on conducting artist interviews in relation to the management and conservation of contemporary artworks.

#### DOCUMENTATION AS A BASIS FOR CONSERVATION

A good impression of the artwork and any previously affected (preservative) action is needed to determine which conservation strategy is the best. What are the possibilities and parameters for prolonging an artwork's life without losing the work's integrity? There are four, recently revised, very detailed global conservation strategies for digital art.

- STORAGE  
maintaining the original hardware and software, the most basic of all four.
- MIGRATION  
'updating' the work to a new standard.
- EMULATION  
copying the original technical environment to a new computer.
- REINTERPRETATION  
reactivating the work based on documentation.

<sup>4</sup> [ILLUSTRATION 3](#)  
Cory Arcangel, *Working On My Novel*, [Twittered @workingonmynovel](#), 2011-2014.  
[website Novel](#)

The best conservation strategy depends on the work and may change over time. It is, therefore, important to know when and how the work was created and with what idea. For example, rare digital works from before 1980 are often unsuitable for emulation. Computers of that time were cumbersome calculators with very limited graphic capabilities. Peter Struycken made a series of works in the 1970s on a PDP-11 computer that was controlled by punched tapes. Today, rather than emulating these obsolete system environments, it is more practical to translate the algorithm into something that modern computers can read and execute. For work made after 1980, emulation is often a godsend, so long as the original work's system requirements are known. Although reinterpretation apparently has the most direct relation to documentation, the other three conservation strategies heavily depend on proper documentation. To support the four conservation strategies, documentation should comprehensively include all facets of the work.

#### SIGNIFICANT PROPERTIES OF DIGITAL ART

The process of documenting is, in fact, an attempt to capture all of the components that determine the work, also called the 'significant properties'. Significant features of digital art can be divided into five categories.

- CONTENT  
What the information contains and conveys, such as text, graphics, and programming codes. This information does not necessarily need to be readable by a human; it can also exist only for the operation of the artwork's technical components.
- APPEARANCE  
How content, such as shape, colour, and layout, is displayed on playback devices.
- STRUCTURE  
The organisation of the content elements and how they relate to each other.
- BEHAVIOUR  
How do the components function?
- CONTEXT  
Background information on the content of the other four categories that makes transparent the what, how, and why of the artwork.

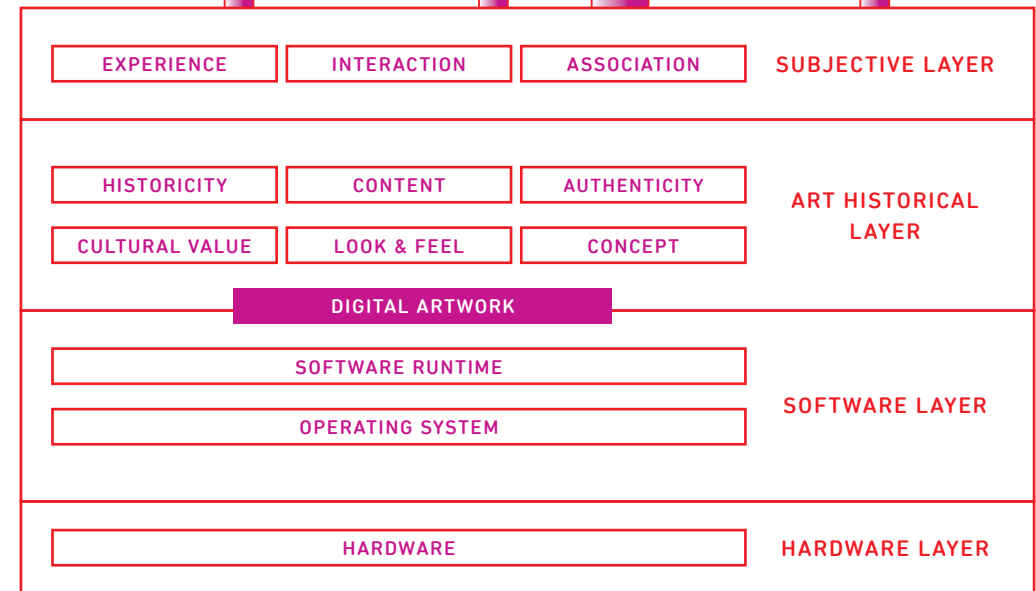
Alongside hard facts, the latter point's 'soft' knowledge on what is needed for conservation of modern and contemporary art is important. The artist's intent usually plays a big role in the work and thus in decisions regarding its preservation. Collecting and organising

information on the work's significant properties together with the current state of the work, the work's (art-historical) significance, and the context in which it was made, provides a clear picture of the digital artwork.

#### DOCUMENTING IN LAYERS

Digital art, like traditional artforms, has an physical form, but it also has a digital core on which the information is stored to further define the outer form. Although the work's core is technical, aesthetic and conceptual qualities of the work are usually as important. It is therefore essential to understand how the 'look & feel' of the work relates to its technical core. When the artwork is not installed, it is often no more than a storage medium that sometimes requires hardware, as with the previously described digital works by Warhol. One cannot see what the work really is, nor what it should look like and how it functions. It is only when the work is operating that the entire external form becomes perceptible. Unlike traditional art forms, digital art is difficult to 'capture'. It is unreadable for the average conservator and therefore its condition is unclear. Once the work enters a collection, it is, therefore, all the more important to document its digital core and external physical features and determine whether it still functions properly. This documentation is an essential reference for future professionals entrusted with the work's preservation, therefore, it is always important to consider what information is needed in the future. How can the relationship between the digital and technical core and the aesthetic appearance be documented? The information needed to get a clear picture of this is located at various layers. The chart on the right<sup>5</sup> visualises the layers of documentation needed for digital artworks. Each layer must be examined separately and contains valuable information or 'significant properties' that define the work's authenticity. Therefore, the relationship between these significant properties needs to be clear: What exactly is the work of art? What is essential to preserve?

The top two layers require semantic metadata – data about the data and its meaning. A description of how a work functions (look & feel) can be based on a visual analysis and can be recorded using photography, video, and text in the form of descriptions and interviews.



<sup>5</sup> ILLUSTRATION 4  
Diagram visualising the stratification of digital artworks.

In general, the documentation of upper layer components is increasingly important in contemporary art. Through the development of art forms, such as performance, installations, and digital art, the second layer's components are closely related to a traditional analysis of art in which the artist's concept, context, historicity, and the work's cultural value are taken into account. The bottom two layers of the diagram include the hardware and software.

This is where the work's technical core is located and is where digital art and its documentation differ from other art forms. The computer/s on which a work functions belong/s to this layer, but also the carrier of the work, such as the hard disk CD-ROM or flash drive, and monitor type and peripheral devices, such as mouse, keyboard, etc. Hardware specifications are generally well documented by the developers and can be researched and added to the art documentation. However, this is not necessary when the hardware is of minor importance to the artwork and the change of the hardware does not interfere with the work's meaning and appearance. The relationship between the technical core and aesthetic appearance is key.

## STEP-BY-STEP DOCUMENTATION PLAN

According to the [diagram](#)<sup>5</sup>, a software-based artwork can be documented in various ways.

The following four steps provide practical guidance. What data needs to be collected, organised, and stored, and what type of document is appropriate?

### STEP 1 DOCUMENTING THE PHYSICAL COMPONENTS (MATERIALITY/ AUTHENTICITY)

This includes documenting the physical object itself (when it exists) and the physical parts that belong to it. It includes file carriers, such as CD-ROM, USB stick, hard disk, etc., but also furniture, monitor, computer, playback equipment, mouse, keyboard, joystick, and other hardware. Any booklet packages or documents signed by the artist and accompanying any artwork should also be documented. Photographic documentation in combination with a short description of brand, model, and specifications is often sufficient. The image of Warhol's equipment is an example of this, although a more comprehensive (photographic) documentation is preferred for accurately capturing important information.

### STEP 2 DOCUMENT THE WORK FUNCTIONING/IN ITS ORIGINAL CONTEXT (LOOK & FEEL)

It is important to document the work when it is installed because this is usually the only time when the work properly exists. Some documentation of the physical components gives little information about what the work really is and how it functions. The time of installation is therefore the time to better understand the work, to determine questions or uncertainties, and to ask the artist for additional information. If possible, capturing the work in its original condition and system environment is preferred, or a version approved by the artist. This is not possible for some works, such as when an artwork is incorporated into a collection many years after it was originally made. It is not relevant for some work to be in its original form, such as an alternating arrangement and/or a configuration of the work. In these cases, it is important to collect information on past, current, and future exhibitions or presentations. When the original system environment is obsolete, attempts should be made to find an alternative. A good example is the software-based artwork *Person to Person*, 1988, by Stansfield and Hooykaas. This interactive work was originally made on an iMac computer in 1998 running operating system OS 9<sup>6</sup>. Although this work can be displayed on other computers in the future, the



<sup>6</sup> ILLUSTRATION 5  
Stansfield en Hooykaas,  
*Person to Person*, 1998,  
interactive CD-ROM  
artwork on original  
hardware.  
COLLECTIE LIMA  
PHOTO Alex Michaan.

documentation here gives an image of an 'original environment' that is historically consistent with the time in which the work was created. When the work is installed, in the majority of cases a video recording is the most practical way of capturing the look and feel of the work. In a video recording, hardware and setup can be recorded and someone can be filmed interacting with the work. Video screen capture (for example using Quicktime) is a simple way to directly record on-screen activity. Note: this is not possible for software-based work on now-obsolete computers. Also note the specifications for each showing. Consider categories such as technical specifications (playing time, is it looped, synchronised, voltage, etc.) and the exhibition space (dimensions, partition walls, position of hardware, screen size, wall colour, carpets, audio levels, etc.). Evaluate the arrangement: was it successful, were adjustments needed, how did the public receive it?

### STEP 3 DOCUMENT THE TECHNICAL SPECIFICATIONS AND GENERATE METADATA AND CHECKSUMS (HARD FACTS)

In many cases the artist or developer can already provide much information on technical specifications. It is, therefore, important to already collect this type of information at the work's purchase. When a collection manager is unsure of what is important to know, then external ICT-expertise can be applied. Consider the following for technical specifications:

- Textual information about the required runtime environment  
Here, a series of accordant operating systems can be mentioned, for example, when the work is compatible with Mac and PC
- Required software (such as QuickTime, Java, etc.)
- CPU type (e.g. PowerPC G3 to G4 for Mac)
- Architecture of original environment (32 bit, 64 bit, etc.)
- RAM specifications
- Resolution
- Colour levels
- Original software (used to make the work)
- Recommendations for a particular conservation strategy.
- Source codes

Generate metadata by means of:

- Mediainfo and Videospeccs (when the artwork contains video/audio files). Mediainfo and Videospeccs are programs from which a digital file's technical specifications can be easily extracted. Note that these programs are not always compatible with other file types or audio and video. Always carefully check the details the artist provides are correct; for example, files can be delivered in a format other than what was communicated.
- MD5 & SHA256 checksums for every digital file.  
A checksum is an encryption algorithm that generates a series of numbers and letters for each file; it can be seen as a unique fingerprint of the current situation. Creating and comparing checksums (in the future) tells you whether the file has changed. Degradation can be determined in a simple manner without having to view every physical file.

### STEP 4 ART-HISTORICAL DOCUMENTATION

Art-historical documentation records the artists' intention, information about the context the work was created in, and the work's significance. Gathering this type of information is done using art-historical research (descriptive) and can be supplemented by an artist interview (audio, video or written). This part of the documentation is similar to traditional forms of documenting artworks.

#### REGISTERING DOCUMENTS

Once made, what happens to the documentation and how should it be stored? Many institutions use database software such as Adlib (current: Axiell ALM) for registering artwork. Database systems are indispensable, especially in large institutions, because they have all the necessary information (metadata) and documentation about the artwork. It may well be that imports from a software-based artwork in a database system such as Adlib are missing certain fields or may have become irrelevant. It is, therefore, advisable to regularly examine the register/database system that the institute uses. Can video recordings be linked to the system? Is there more than one version of the work? Is there enough server space for this kind of information? Adlib software is flexible, so adjustments are always possible. Technical metadata such as CPU type, RAM specifications, but also necessary peripherals, such as type of monitor and mouse, can be added as additional fields are added to the database system. The specific additions to a database make clear on what factors software-based artworks depend. Imported metadata about hardware (computer systems, display systems, interfaces, etc.) and metadata about software (operating systems, media players, internet browsers, etc.) make it possible for registrars and researchers to refer to data in searches. Combined with the date a work was produced, researchers can then search for a certain technological time period, a specific type of operating system or hardware. When several versions and migrations of a work are also maintained in the system, it is clear how a digital artwork will evolve in the future.

#### DIGITAL ART GETS A PERMANENT PLACE

Documenting, registering, and preserving digital art presents major challenges for collection managers, especially when there is not enough specific knowledge. Every challenge is an opportunity to be propagated by curators, registrars or trustees. By entering into partnerships and being closely involved with IT experts, we can ensure that digital art gets a (permanent) place in the museum. A careful documentation process provides the necessary knowledge about the artwork.

A growing understanding of the relationship between all (at first sight) possible complex technical components and the final aesthetic display form, makes it possible to continue innovatively displaying digital artworks in the future.

#### FURTHER READING:

- Beerkens, Lydia (et al.), [The Artist Interview for Conservation and Presentation of Contemporary Art. Guidelines and Practice](#), Jap Sam Books, 2012
- Casad, Madeleine Imogene, [Imminent Risks for New Media Art](#), Cornell University, 6 June 2013
- Dekker, Annet, [Born-Digital Kunstwerken in Nederland](#), Amsterdam, Virtueel Platform, 2012
- Depocas, Alain et al.(eds.), [The Variable Media Approach: permanence through change](#), New York, Guggenheim Museum Publications, 2003
- Graham, Beryl (ed.), [New Collecting: Exhibiting and Audience After New Media Art](#), Farnham, England, Ashgate Publishing Ltd., 2014, pp. 73-96
- Laurenson, Pip, [Old Media, New Media? Significant Difference and the Conservation of Software-Based Art](#)
- Laurenson, Pip, [Authenticity, Change and Loss in the Conservation of Time-Based Media Installations](#), Tate Papers, no.6, Autumn 2006.
- Lurk, Tabea, [Checklist for recording and documentation of digital artworks](#), RESEARCHGATE, 30 March 2014
- Noordegraaf, J, Saba, C.G. , Le Maître, B., Hediger, V. (eds.), [Preserving and Exhibiting Media Art](#), Amsterdam, Amsterdam University Press, 2007
- Rinehart, Richard and Jon Ippolito, [Re-collection: Art, New Media and Social Memory](#), London, MIT Press, 2014
- Serexhe, Bernhard (ed.), [Digital art conservation: preservation of Digital Art: Theory and Practice](#), Karlsruhe (AMBRA) 2013
- [THE INVISIBLE PHOTOGRAPH](#), Hillman Photography Initiative (production), 22 April 2014



## PART THREE - PANEL DISCUSSION

How to get and stay a professional in Digital Art Conservation?  
Panel discussion with young international professionals  
about their training and state of the art conservation of  
digital artworks.

MODERATED by **Maarten van Bommel**, professor of conservation  
science, University of Amsterdam | UvA

- **Patricia Falcao**, conservator, Tate London;
- **Ellen Jansen**, conservator and tutor conservation contemporary art,  
University of Amsterdam | UvA;
- **Arnaud Obermann**, conservator, Staatsgalerie Stuttgart, before ZKM  
center for Art and Media, Karlsruhe;
- **Alex Michaan**, independent conservator, France.



## New Workflow for Digital Art

> GABY WIJERS

Constant innovations in technology both increases an artist's expressive possibilities and creates challenges for interaction with the audience. Digital artists articulate their interpretations and criticisms of technological progress while expressing themselves through the same medium. Digital art often explores and stretches the boundaries of technical possibility. In this way, digital art not only promotes new technology, it also tests its boundaries and indicates what improvements are still required. But how do you keep recording the context, perception, and the aesthetics and handwriting of the artist? The instruments may continually renew, but does this mean the notion of the artwork changes, too? What measures should be taken by those working to preserve digital art for the future?

Digital technology is highly susceptible to ageing. Analogue, digitised, and born-digital formats, carriers, hardware and software, and display devices all share the constant need for translation into new technologies. To preserve artworks for ever-new technologies, it remains necessary to explore the boundaries of conservation opportunities and to investigate whether existing methodologies can be adapted to the new requirements set by new types of work. In 2014, LIMA and SBMK combined their years of intensive cooperation in the field of video and media art conservation to develop the *Transformation Digital Art* project. Developing a new workflow is an important part of this study on the conservation and future presentation of born-digital artworks.

### WHY A NEW WORKFLOW?

Various partnerships have conducted much national and international case study-based research and developed models for documentation and conservation strategies. Internationally, these include TATE, Smithsonian Institution, University of Bern, Solomon R. Guggenheim Museum, INCCA, and Packed. Domestic parties include RCE, SBMK, and LIMA. Guidelines are constantly being discussed and updated. In 2010, the first studies were conducted in the field of emulation and virtualisation as a conservation strategy for artworks. For migration and storage, a workflow and digital repository is needed. Research for *Transformation Digital Art* emphasises born-digital artworks that depend on the work of digital components: the tool or the media is not only the agent, it also provides meaning. For example, a work made in



the nineties assumes a certain processor speed and screen type, whereas a 2015 computer has a higher processor speed and more pixels. The screen's aspect ratio can also differ. This affects the artwork's aesthetic and content. In addition, born-digital, stand-alone, or networked artworks can be presented either online or offline. Digital objects and digital art are considered complex when: a) no single description is available on how to present or reproduce the work, and/or b) if the object is dynamic and includes programs or components that support interaction.<sup>1</sup> Above all, the work does not consist of a single object but from different components.

Inherent to digital works is the variable character, the idea of impermanence; many digital artworks have a variety of forms and versions: they are presented on different platforms (PC, tablet, mobile phone), they have several manifestations (online, offline, installation), they are not made to last forever, they are interactive, they must be generated live or utilising multiple dynamic networks connected to each other. Digital art is performative, it is experienced through media, screens and/or browsers, networks, and documentation. The emphasis in conservation is not only on the material object, but also on the work's intrinsic qualities, which deliver a certain experience to the visitor. Digital artworks form a separate group in museum collections, which usually require an object-based approach. Incidentally, the non-object-based approach is nothing new; it is also used for other contemporary art forms such as conceptual art, performances, and installations with perishable materials.

### PRESERVATION STRATEGIES

Changing browsers, tools, operating systems, and computers all contribute to the challenge of preserving digital art. The transience and immateriality of these works informs a series of actions and techniques that ensure their future display. The goal of preservation is to ensure artworks can be exhibited in the future, and if not permanently, then within the artwork's defining parameters, often specified by the artists.

There are methods for keeping this heritage available for future generations:

- TRADITIONAL CONSERVATION, STORAGE  
Maintaining the original hardware and software on which the work was created.

- EMULATION  
Running older software in a modern environment to keep files accessible – often done through a virtual machine running the original software and requires an emulation or virtualisation tool.
- MIGRATION, CONVERSION  
Converting file formats for access on modern devices.
- RECONSTRUCTION OR REINTERPRETATION (BASED ON DOCUMENTS)  
Whether or not to faithfully re-create the work.

The first three strategies have been thoroughly studied in previous (international) projects such as: *Digital Art Conservation* (ZKM), *DOCAM* (Daniel Langlois Foundation), *Obsolete Equipment* (PACKED and NIMk), *the Variable Media Network* (Solomon R. Guggenheim Museum) and the ongoing *Pericles* project (Tate). There is relatively little research on the last strategy.

Documenting the works is the first step. This is done on the basis of its features. The important features are identified based on work/core appearance, artistic concept, and cultural value and are documented to capture authenticity, intention, and performativity. This concerns content, assets and appearance, context and versions, formal and structural elements, and also details about programming languages, operating systems, and software elements.<sup>2</sup> Defining and assessing these properties in both physical and (future) virtual machines is the main challenge of this process. Only by defining the significant properties is it possible to determine the best conservation strategy. Identifying the work's key features and determining what measures are appropriate for their preservation is done in close consultation with the artist. For this, an artist interview is generally conducted.

<sup>1</sup> See the definition of 'Active' in *Advanced Digital Preservation*, David Garietti, Springer 2011

<sup>2</sup> There are various models for this purpose in use. See also [article about documentation](#).

Four aspects determine the documentation phase and conservation strategy:

- The information readout.
- The storage of the information and its physical carrier.
- The preservation of the stored digital information and carriers.
- The options available to present the stored work in the future.

The *Transformation Digital Art* project developed a workflow that describes ways to document work, make readout information, sustainably store and access work, and other activities aimed at preserving software-based work.

#### WHY LIMA DEVELOPS THE WORKFLOW?

LIMA is the international platform for sustainable access to media art in the Netherlands. In addition to its research and preservation activities, LIMA, as a media art distributor, is associated with production and presentation practices. LIMA offers digitisation services and advice to museums, artists, and private collectors and has a cross-institutional, domain-specific, digital repository for digital art, where media artworks from 25 Dutch collections are preserved for the future.

LIMA aims to translate media art according to the current time and technology and to support, promote, and encourage new presentation forms and meanings.

To do this, LIMA works with various museums and institutions. LIMA has extensive experience with born-digital art. LIMA's distribution collection includes about 175 software-based artworks. Montevideo/TBA/NIMk produced about 25 software-based works, which are partly in the distribution collection and partly in the archive. Within the 25 collections using LIMA's digital repository, there are about thirty software-based works. Systemic backlogs mean many institutes have little time and budget for the preservation of born-digital artworks. At heritage institutions and umbrella organisations, the inclusion of born-digital heritage and the shift to digital preservation methods for born-digital material is taking place too slowly. Budget cuts, privatisation, and other business changes, means updates are delayed – especially in this area.<sup>3</sup>

During the *Transformation Digital Art* project, a common methodology for sustainable conservation of software-based working was developed. It was about time: more digital artworks are now produced than ever, and rapidly changing technology is

permanent. There is an increasing need for visibility, accessibility, re/presentation, research, and re-use of digital art that is only possible through registration, documentation, and sustainable conservation. LIMA monitors the rapidly changing technical state of affairs in the outside world (technology watch) and shares this knowledge within a network for digital heritage and the conservation of contemporary art.

#### CASE STUDIES

The artworks by Peter Struycken selected for the *Transformation Digital Art* project (see case studies) were from different institutions and delivered to LIMA for sustainable storage on several different 'carriers'. The study focused primarily on the optical carrier CD-ROM, SD memory cards, and a variety of file formats.

It is not self-evident whether these types of carriers will remain accessible in the long term. Hereby, a combination of the following factors play a role:

- THE TRANSIENCE OF THE PHYSICAL STORAGE MEDIUM  
The signal quality reduces over time and at a given time will (partly) disappear
- THE AVAILABILITY OF HARDWARE TO READ FROM THE CARRIERS  
Modern PCs no longer support CD-ROM or SD cards
- THE AVAILABILITY OF HARDWARE AND SOFTWARE ENVIRONMENTS THAT CAN READ THE CONTENT  
Old carriers and old files usually require old hardware, software, and operating systems.

At the start of the project, LIMA had basic maintenance procedures for computer-based artworks, such as testing equipment, producing backups, documenting software, storage, and checking. LIMA also had an operational repository for digital video art. During this project, workflow and procedures for recording, monitoring, and the permanent storage for software-based works were defined, tested, and implemented. The case studies also functioned as test cases. The results were then successfully tested with different types of works from the repository including:

- Charles Sandison, *Currency*, 2004.  
computer program for WindowsXP
- Rafael Lozano Hemmer, *Reporters with Borders* (Shadowbox 6).  
This uses an Apple MacBook Pro running Windows XP SP2 operating system. The source is programmed in Delphi.

<sup>3</sup> Digitaal erfgoed is kwetsbaar erfgoed (Digital heritage is fragile heritage), March 2015

- Dominic Harris, *Bald Eagle*.  
Interactive computer-based work compiled in c+z+ for Linux. Movements are recorded using a camera, the source is available.
- Dominic Harris, *Jungled*.  
Interactive computer work in Python, source code and executables for windows, extensive documentation. Accessible through large touchscreen.
- Rafael Rozendaal, *Fill This Up*, 2016  
web page with JavaScript that runs on a modern browser.
- Rafael Rozendaal, *Abstract Browsing 15 01 22*.  
A Chrome browser extension that can only be installed via the Chrome Web Store.
- Kirsten Geisler, *Dream of Beauty 2.2 Touch Me*.  
Interactive work with (not functioning) touchscreen.  
Re-presented
- Stansfield and Hooykaas, *Person to Person*, 1998.  
CD-ROM emulation.

The workflow is re-formulated according to the *Open Archival Information System*. In addition, it is assumed that the act of sustainable digital storage is not a single gesture but a continuous process of monitoring and adaptation to technological change.

#### OAIS MODEL

OAIS<sup>4</sup> (*Open Archival Information System*) is the international reference model for setting up workflow and procedures for digital preservation. OAIS 'unites ideas, concepts, and experiences from the (limited) practice of digital preservation into a reference model.'

The model assumes that sustainable conservation and management of digital objects does not only consist of technically solid data storage. The data must also be checked regularly. It must be demonstrated that the data is authentic and the objects remain undamaged during the storage process (fixity information). The origin and processing of the data must be recorded and verified (provenance information). The digital objects should be easy to find and there must be plenty of content-based and technical information (metadata, representation information, context information) available on these objects. The data must be extracted and accessed correctly, in the appropriate form, and by the appropriate authority or person. One should therefore be aware

of whether the data can still to be used with the rapidly changing technical state of affairs of the outside world (technology watch). Before the data is rendered unusable, action must be taken by converting it to a different file format (transformation). The storage system must be maintained. Finally, the system itself must be durable and reliable.<sup>5</sup>

#### THE NEW WORKFLOW

The workflow is divided into a number of parts:

- (PRE)INGEST  
reception and preparation of digital objects for inclusion in the digital-depot.
- ARCHIVAL STORAGE  
storage of digital objects.
- DATA MANAGEMENT  
storing metadata for the benefit of searching, viewing, and handling functions.
- ADMINISTRATION  
management of the e-depot.
- ACCESS  
access to digital objects.

<sup>4</sup> The article 'Het OAIS-model, een leidraad voor duurzame toegankelijkheid' (The OAIS Model, A Guide to Sustainable Accessibility) by Barbara Sierman In *Handboek Informatiewetenschap*, December 2012, Part IV (2012) gives a good introductory overview to the OAIS model.

<sup>5</sup> <http://www.crl.edu/archiving-preservation/digital-archives/metrics-assessing-and-certifying/iso16363,22-november-2014>.

# WORKFLOW SOFTWARE-BASED ART - LIMA - JUNE 2016

## Pre Ingest

Determining Delivery specifications by:  
Museum / Institute / Collection / Author / Provider



- How is the artwork delivered?
- Technical specifications
- Description of parameters
  
- Who is authorised (in the future) to re-program/ migrate / update the artwork?
- Does the creator provide the source code?
- Can the creator describe the terms of the parameters?
- Is a video recording of the working program available that the artist can approve?
  
- Gather of all available documentation
- Formulate any questions concerning preservation and presentation of the work

for support see document 'Delivery Specifications'

## Pre Ingest

Consultation with the supplier / creator / collection



What can / must the institution do with the item concerning: disclosure, copying, promotion, conservation, research?



The works are delivered by the museum / collection or artist on any medium or as a file.



The supplied digital object to LIMA is validated for quality assurance. The file is opened in order to see if it has the expected properties. Optionally, additional equipment is checked to see if the work functions without error.

This inspection deals with technical and content-based matters: for example, the lack of documentation parts. Software-based art can take many forms and elements: standalone, networked, online / offline, interactive, platform dependent, part of installation, hardware dependent, software dependent, etc. Installation instructions, source codes, and descriptions of parameters are also examined during this stage .

- Is the supplied artwork technically of the highest possible quality?
- Is the work complete?
- Is the media / content current?

For obsolete formats the same procedure applies but first an additional operation / action must be carried out to deploy the right display equipment and to embed any possible additional knowledge.

**NO** **YES**



## Ingest

Inventory and identification of the work  
Importing in the Collection Information System (C.I.S)

# Ingest

Inventory and identification of the work  
Importing in the Collection Information System (C.I.S)



## BASIC METADATA ARTWORK

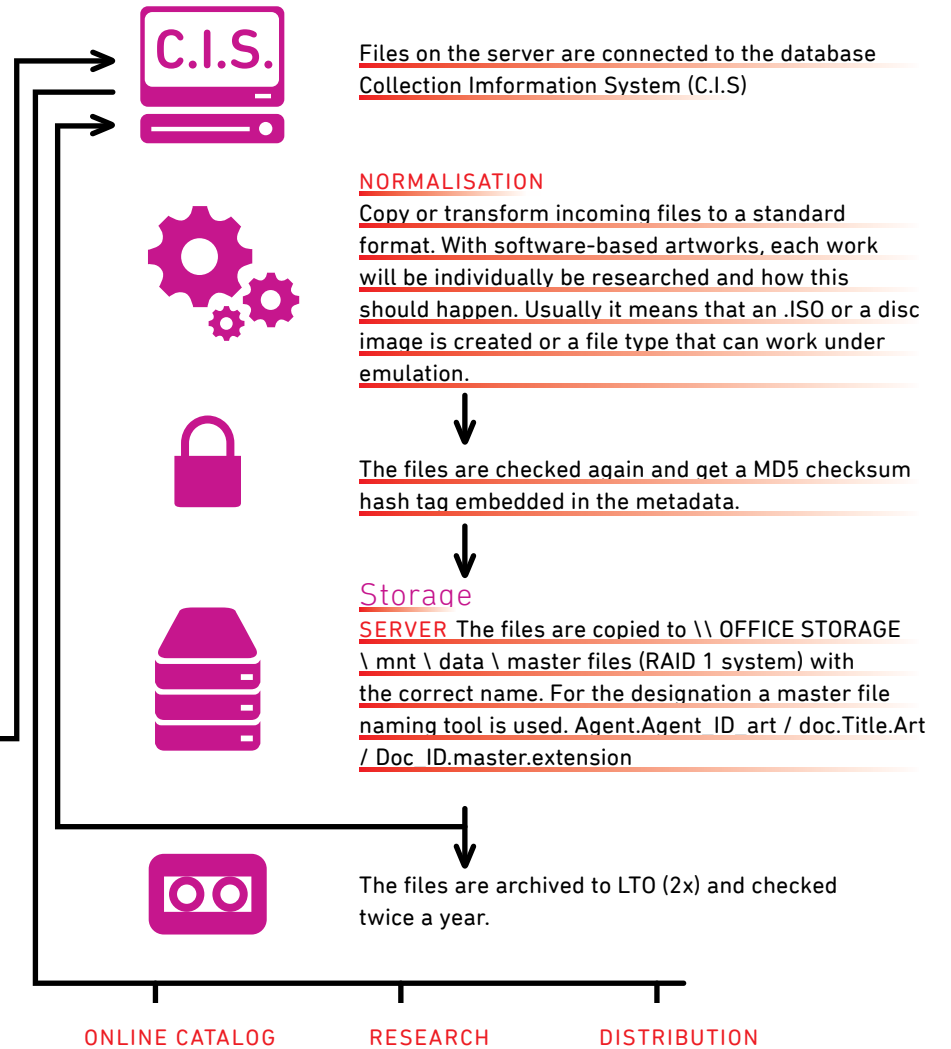
- A unique number
- Artist (s)
- Title
- Year
- Type (interactive / standalone)
- Operating System
- Executable File (s)
- Specifications Hardware and Peripherals
- Colour / Sound YES / NO
- Edition, version / Generation / Collection
- Files complete YES / NO
- Information complete YES / NO
- Conceptual information presentation and rights

## SUPPLEMENT METADATA

- Source
- Semantic description parameters
- Programming Language / Markup Language
- Frame dimensions in pixels (1920x180 / 720x567)
- Aspect Ratio
- Processor speed
- System requirements for graphics card
- Specifications peripherals
- Hardware Specifications
- Specifications executable files
- Installation Instructions
- Risk analysis

- Capture date of entry, actions
- Date creation and operations
- Ingest documentation
- Status (master / standardized copy)
- Which tools are used at Ingest

The above metadata is a summary of the fields to be completed, descriptions and characterizations of the work will also be entered into the C.I.S



Files on the server are connected to the database  
Collection Information System (C.I.S)

**NORMALISATION**  
Copy or transform incoming files to a standard format. With software-based artworks, each work will be individually be researched and how this should happen. Usually it means that an .ISO or a disc image is created or a file type that can work under emulation.

The files are checked again and get a MD5 checksum hash tag embedded in the metadata.

**Storage**  
**SERVER** The files are copied to \\ OFFICE STORAGE \mnt \ data \ master files (RAID 1 system) with the correct name. For the designation a master file naming tool is used. Agent.Agent ID art / doc.Title.Art / Doc ID.master.extension

The files are archived to LTO (2x) and checked twice a year.

For each work, the best rendition is chosen in consultation with the collection/artist. When the collection wants to use their files, they are digitally delivered using .zip or BagIt formats. The BagIt format contains a checksum and tag directory that can be validated for authenticity.

## PRESERVATION PLANNING

Preservation planning is an extension of the workflow. In the past, best practice was a seven-to-ten-year migration cycle. Every seven to ten years, data was migrated to a new and current best-storage medium. Due to media artworks that are now entering the digital workflow, the cycle is shorter. Since the material is digital, it can be written 'automatically' to next generation carriers for storage. For the functioning of a computer-based artwork, it is advised to install and/or to present it every five years (every three years is even better), so that its functions can be understood, tested, and updated if required. Since 2013, incoming born-digital artworks are copied directly to LTO in the proprietary codec, without standardisation, after quality control and adding metadata. This is an international agreement.

Transformation plans are available for the works included in LIMA's digital repository workflow. The annual budget also takes into account transformation activities and replacement of equipment.

How the artwork and its technology change over time depends as much on the display practices of different exhibitions as on the aging of hardware and software. The new workflow and OAIS focuses on the software's sustainability.

## FURTHER READING

- Rosenthal, David S.H. , *Format obsolescence: assessing the threat and the defenses*, Library Hi Tech, Vol. 28 Iss: 2, pp.195 – 210, 2010.
- <http://blog.dshr.org/2007/04/format-obsolescence-scenarios.html>.

## COLLECTION INFORMATION SYSTEM (C.I.S)

See metadata. The information collection system contains all descriptions from which information can be retrieved. For their own (distribution) collection, keywords and content descriptions are also added. In all cases a display file is created on request, and retroactive video recordings and stills are made by default.

## NORMALISATION

Copying or transforming incoming files to a standard format is called normalisation. Digitising means the work is transferred to a uniform and durable format. For born digital material, this only happens with obsolete formats (e.g. CD-ROM). The original files are saved and stored in the proprietary codec. For CD, CD-ROM, and other non-linear work, an ISO file is made. ISO is a term for the ISO 9660-file format that represents an exact copy or 'image'. In addition to the existing files on the media, this exact copy includes such things as boot code, structures, and attributes. An ISO can be copied onto a compact disc (CD) or DVD via special burning software. If a virtual CD-ROM drive is installed, a computer can see the ISO file, just like a CD or DVD in a physical player. This is exacting work with rigorous and comprehensive standards. According to David Rosenthal<sup>6</sup>, the danger of obsolescent file formats is, in most cases, not as great as previously believed. The advice is to wait as long as possible before transformation into other formats. It is also important to not wait too long: in order to make the conversion possible, there must still be a system on which the relevant software runs. Expertise within the fields of digital video and media art has agreed not to apply a transformation file.<sup>7</sup> The ageing of formats especially applies to early-period digital objects, when the market was still very diverse. New technologies are always appearing in contexts that have yet to stabilise. A recent example is the many different and evolving formats for apps on smartphones and tablets.

## SECURITY

The files are checked again prior to being stored and get an MD5 checksum hashtag embedded in the metadata. The files are linked to the information collection system in which the metadata is stored and copied, with the correct name, to \\OFFICE STORAGE\mnt\data\masterfiles. The files are then archived on LTO 6 (2x) with raid5 protection. Each LTO tape is immediately checked after writing (any file on the tape gets an MD5 hash tag (a checksum)). The data is indexed on the tapes using (custom) software based on TAR (Tape Archive), a file format and program designed to find and

extract files on tape. This enables files to be found and extracted. Documentation is thereby necessary because a tape cannot be read like an HDD. The (double set) LTOs are inspected twice a year and automatically migrated to the next generation within three to five years. LIMA does not use a tape robot. The tapes are loaded into the reader manually, as is the program, to monitor and automatically implement the MD5 hash tags. If there are differences between current and previously recorded MD5 files, the specific file will be compared with the backup and overwritten when the back-up MD5 files is correct. This procedure has not yet been necessary. The entire procedure and index file is documented in a database.

## STORAGE/SERVER

Since 2010, all master files are stored onsite, on 5th generation LTO tapes, with the second copy as an off-site backup (at the Stedelijk Museum Amsterdam). Distribution copies, stills, and documents are stored locally on the server. The HDDs are stored on site with an off-site backup at XS4ALL. As of 1-1-2016, about three hundred TB has been stored. In the selection of storage media, such as LTO tapes and Blu-ray optical discs, the international media art community and AV community were consulted.<sup>8</sup>

Every two years, a new generation of LTO appears and it is necessary to regularly migrate to the latest generation of LTO and invest in new readers/writers. The used reader/writer is backwardly compatible and LTO generation three, four, five can read and write generation four and five. It will not be possible to read or write with versions six to ten. So long as it's possible to read five generations, migration within the next five years is not needed, unless the script itself fails for some reason. The data on the respective tapes is not compressed or encrypted. Since the LTO tapes are hardly consulted, off-shelf storage is possible. In/output control and consultation checks are done manually. This can be performed by a tape-robot but this incurs a plurality of the costs (equipment and energy). This is not (yet) necessary for such a relatively small amount of work. Display/distribution copies are available on the server, usually in a lower resolution. The LTO tapes are kept in a safe on location, together with other tape formats, at 18°C and with a relative humidity (RV) between 35% and 55%. Temperature and humidity is monitored regularly. The off-site, backup LTO tapes are stored at the Stedelijk Museum Amsterdam. The HDDs are placed in a locked server room with an air conditioning system to prevent overheating, with additional backup at XS4ALL.

<sup>6</sup> David SH Rosenthal, 2010, *Format obsolescence: assessing the threat and the defenses*, Library Hi Tech, Vol.28 Iss: 2, pp.195 - 210. See also <http://blog.dshr.org/2007/04/format-obsolescence-scenarios.html>

<sup>7</sup> *Video Art Community of Practice – Standards*, Pip Laurenson, Anna Henry, 8 December 2014 PRESTO4U.

<sup>8</sup> Playoutrapport



Paper flyer handed out by Rhizome founder Mark Tribe at DEAR





## What Further? Conclusions and Recommendations

### CONSERVATION OF BORN-DIGITAL ART IS BESPOKE

> GABY WIJERS

Born-digital artworks require a different approach to conservation than has been customary. Existing registration, conservation models, and documentation methods have been examined and a new workflow developed to better ensure the management and conservation of these artworks. Standardisation and mass conservation are often problematic for the preservation of digital artworks, unlike other digital objects in the archive sector. This is partly due to the importance of preserving the authenticity and partly due to the often unusable formats. Artists often use new technologies and explore their technical features. It is in the first stage of a new technology that the risks of ageing and obsolescence are large. Experimental works are particularly vulnerable. Normalisation to a standard file format is not preferred. This can change the artwork by affecting its aesthetics and perception, and thus its intent and value. Therefore, a different approach is needed than the digital mass conservation used by archival institutions. Digital art is custom-made and requires bespoke approaches to its conservation and presentation. In order to experience the artwork, an artist's prescriptive method for the work's presentation is essential. Media art has an artistic relationship with its mode of display. Material and presentation requirements, such as installation instructions, spatial requirements, and any other components, together constitute the artwork. These requirements affect the work's metadata, conservation, and access. Moreover, there is a wide variety of born-digital artworks.

### CONSERVATION OF BORN-DIGITAL ART WITHIN AN INTERNATIONAL COMMUNITY

Although international, the community for the preservation of media and digital art is relatively small. The effort needed to establish international standards is aimed at this community. Budget, equipment, and conservation plans are determined on their own terms and in consultation with the community. There are major challenges that are specific to funding the media art community, but there are opportunities for cooperation with other sectors. Sharing information and experience within and outside the media art community is important for the development of the emerging community both in terms of practice and the sustainable preservation of digital artworks. Within this field, knowledge is required to determine which digital objects, sizes, metadata, and documentation are needed. The technology-watch and

ensuring access for future presentation requires specific knowledge of formats, rights, customer usage, and more. In collaboration with SBMK and DEN, LIMA has, over the years, evolved into a knowledge centre and a digital repository for media art and digital art. A domain-specific information centre where, in addition to nurturing forms of sustainable conservation, knowledge is acquired and shared. The LIMA workflow uses the internationally recognised OAIS as its reference structure.

#### FURTHER RESEARCH

LIMA, Foundation for the Conservation of Contemporary Art (SBMK), and the National Coalition for Digital Preservation (NCCD) actively collaborate at a national level in knowledge-sharing and research projects. The University of Amsterdam and LIMA have jointly submitted a NWO application for 'archiving interactive media art' and a PhD on the preservation of computer-based art. In addition, a sustainability-lab was initiated. However, it is not feasible to think all born-digital artworks can be stored long-term and can be used in the future without additional measures. LIMA participates in the international community of practice for software-based art. Logically, further research has been addressed internationally.

##### — EMULATION

Emulation provides many and perhaps the best opportunities for the future presentation of digital artworks. The possibilities of emulation as a service and the inclusion of this service in the workflow offer good opportunities. Research in collaboration with Rhizome, University of Freiburg, and Tate shall greatly increase opportunities for strengthening this knowledge. Emulation should ideally be authorised by the artist. Understanding what are the work's most critical features is probably the most complex challenge. Conceptually, this speculates on the following: 'when is emulation no longer possible?' 'Does documentation take the place of the artwork?' and 'what form should this documentation take?'. The next step in the workflow should be implementing emulation as a service.

##### — REINSTALLATION/REINTERPRETATION

Thinking further ahead, beyond the technology, it is advisable to develop a script for reinstallation over time that asks: 'to what extent we can mediate the core of the work's concept through reinterpretation?' Reinstallation and reinterpretation require artists and collection managers to consider the work as conceptual and performative and to recognise that digital artworks are re-made and this execution may be far from the original manifestations or reproductions of the work. Reinterpretation tells us a lot about the

work itself and gives room for creativity. It keeps the work alive in an entirely different way. By asking questions such as 'how is a work mediated?' and 'how is it executed?' leads to the core of the digital artwork. Reinterpretation ensures ongoing attention to the latest presentation modes and the artwork's tradition. This principle is traditionally used in other disciplines, such as music, dance, and theatre, but is recent to contemporary art. This traditional form of delivery becomes an experimental mode of presentation for contemporary art. Since this is a way in which artworks retain visibility, the method can also be seen as a conservation strategy. LIMA and SBMK want to explore museum collections in the Netherlands and show how this method can work for the visual arts.

In practical terms, broadening our understanding of born-digital art should be done through interaction, vocabulary, and the artists. This also requires a next step in the research.

##### — INTERACTION NETWORK

The characteristic variability of many digital artworks and the (online) relationships and interactivity that they bring (interaction with visitors, a community of developers, by clicking on the links in a website) are technically difficult to 'capture'.

##### — DISPLAY PRACTICE

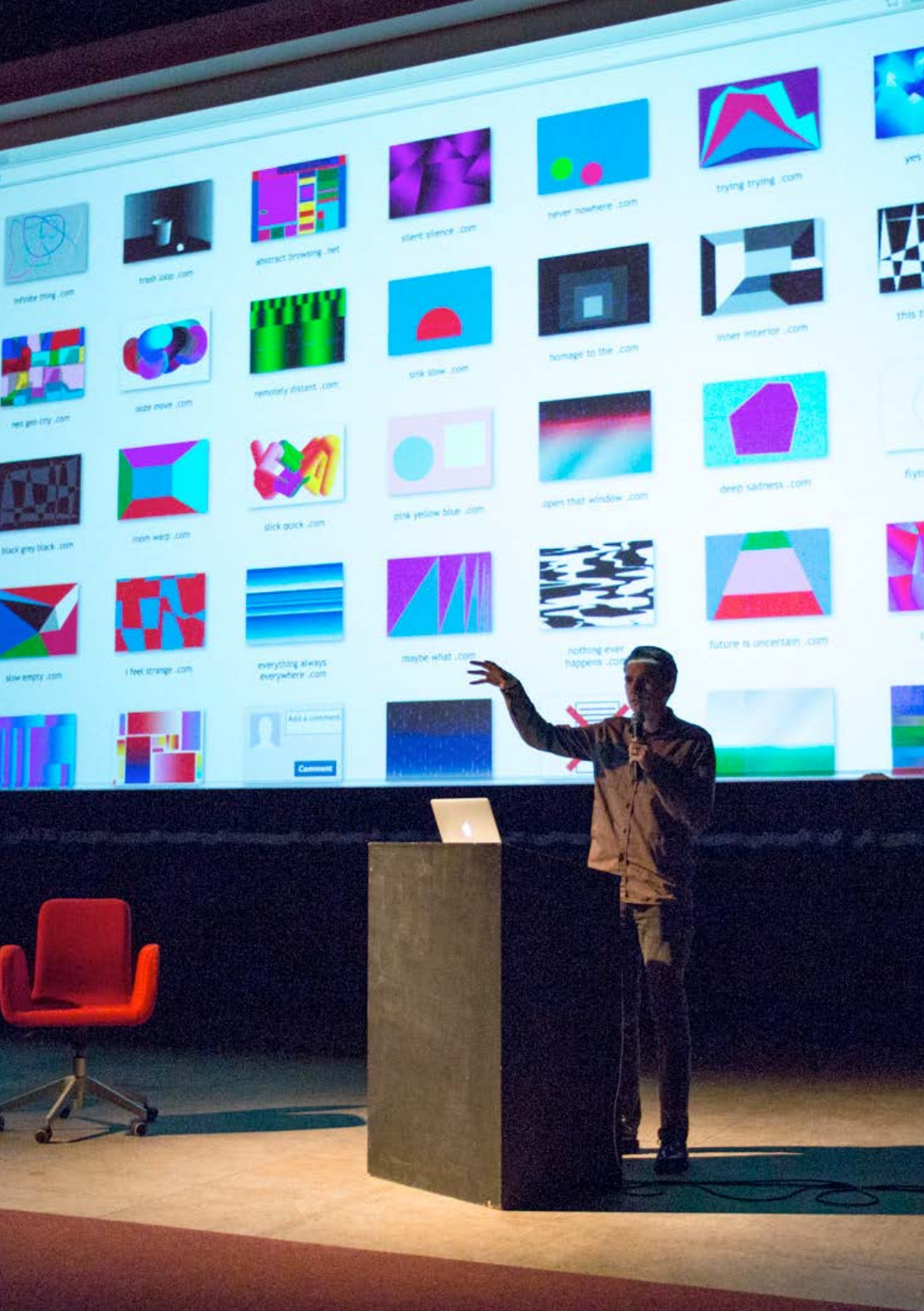
Display practice in relation to long-term storage was neglected in this study. Further joint (international) research would increase knowledge about this and provide a common frame of reference.

##### — VOCABULARY

The vocabulary for digital art is diffuse. It is a relatively young 'genre' that is in development. Different terms are used interchangeably, such as 'digital art', 'software-based art', 'computer-based art', 'net art', and 'born-digital art'. A growing common vocabulary is expected, as is a common frame of reference.

##### — ARTISTS

Conservation starts at the source, in the original assembly or production process of the digital object. Many digital media artworks were not and continue not to be purchased by museums or other collections. Thus, the artist is specifically important in the archiving process. Awareness, education, and providing practical solutions are essential.





## Short biographies

### PAULIEN 'T HOEN

Paulien 't Hoen studied Art History and Art Management at the University of Utrecht. Since 2004, she has been coordinator of the SBMK (Foundation for the Conservation of Contemporary Art). For twenty years, SBMK has dedicated itself to the maintenance, conservation, and preservation of contemporary art. Its aim is to develop sound practices that can benefit all concerned with the arts. SBMK initiates projects, enables their realisation, and sees to the distribution of information among colleagues in the profession.

### NINA VAN DOREN

Nina van Doren studied Art History and Media Theory at the University of Amsterdam. She is working as a researcher for LIMA and specialises in the conservation and documentation of born-digital art.

### MARLEEN WAGENAAR

Marleen Wagenaar studied Art History and Conservation of Modern and Contemporary Art at the University of Amsterdam. She is cofounder of RestauLab and works as conservator of modern and contemporary art.

### GABY WIJERS

Gaby Wijers studied Librarianship, Documentation, and Informatics. Since the mid-nineties, she worked for NIMk and specialised in documentation and preservation of media art. She initiated and participated in various national and international projects dealing with the documentation and preservation of media art and digital-born art. She is LIMA's founder and director. LIMA preserves, distributes, and researches media art and born-digital art.

## Colophon

Project *Transformation Digital Art* is made possible by Mondriaan Fonds, Prins Bernhard Cultuurfonds, Kröller-Müller Museum, Gemeentemuseum Den Haag, LIMA and SBMK.

### PROJECT ORGANISATON

LIMA en SBMK

### TEXT

Nina van Doren, Paulien 't Hoen, Marleen Wagenaar and Gaby Wijers

### EDITORIAL ADVICE

Paulien 't Hoen

### TRANSLATION

Jason Coburn

### PHOTOGRAPHY

Kees Fopma

### GRAPHIC DESIGN

Ariëne Boelens office

September 2016



