ICHIM
Berlin 04

www.ichim.org

Digital Culture & Heritage
Patrimoine & Culture Numérique

Haus der Kulturen der Welt, BERLIN
Aug. 31st - Sept. 2nd, 2004
31 Âout - 2 septembre 2004

PRESERVING AUTHENTIC INTERACTIVE DIGITAL ARTWORKS: CASE STUDIES FROM THE INTERPARES PROJECT

John Roeder,

University of British Columbia School of Music and InterPARES* Vancouver, B.C., Canada

http://www.interpares.org

Abstract (EN)

Interactive digital artworks by nature are among the most difficult to preserve. The InterPARES project, a multinational interdisciplinary collaboration, is studying many specific cases to understand how to preserve them authentically. This essay first investigates the relation between the archival concept of authenticity, which involves the identity and integrity of the work, and performance authenticity, which is the main interest of most artists. It then examines two works for interactive performance, showing specifically how modeling and analysis can clarify what is needed to preserve their identity and integrity.

Keywords (EN): authenticity, preservation, interactivity, art, music, performance, InterPARES, archive, metadata.

Zusammenfassung (DE)

Interaktive digitale Kunstwerke gehören zu jenen, die am schwierigsten zu erhalten sind. Das InterPARES Projekt, eine multinationale interdisziplinäre Zusammenarbeit, untersucht viele spezifische Fälle um zu verstehen, wie man sie authentisch erhalten kann. Dieser Beitrag untersucht die Beziehung zwischen dem archivarischen Konzept von Authentizität, das die Identität und Integrität des Kunstwerks umfasst, und der Authentizität der Performance, bei der das Hauptinteresse der Künstler liegt. Anschließend wird anhand von zwei interaktiven Performances gezeigt, wie das Modellieren und die Analyse klären können, was man für die Erhaltung ihrer Identität und Integrität benötigt.

Schlüsselwörter: Authentizität, Erhaltung, Interaktivität, Kunst, Musik, Performance, InterPARES, Archiv, Metadaten.

Résumé (FR)

Les oeuvres d'art numériques interactives sont parmi les plus difficile à conserver. Le projet d'*InterPARES*, une collaboration interdisciplinaire et internationale, étudie de nombreux cas spécifiques pour comprendre comment les préserver authentiquement. Cet essai discute d'abord de la relation entre le concept archivistique de l'authenticité, qui implique l'identité et l'intégrité de l'oeuvre, et l'authenticité d'exécution, qui est l'intérêt principal des artistes. Il examine ensuite deux oeuvres interactives, pour montrer spécifiquement comment la modélisation et l'analyse peuvent clarifier ce qui est nécessaire pour la préservation de leur

identité et de leur intégrité.

Mots-clés : Authenticité, Préservation, Interactivité, Art, Musique, Performances, *InterPARES*, Archives, Métadonnées.

I. Introduction

1. The challenges of preserving digital artworks

Digital objects face special difficulties of preservation. As bit strings they cannot be easily distinguished by their contents. Perfect copies are readily made, obscuring original contexts. Digitally expressed ideas are easy to alter and repurpose, confusing authorship. The impermanence of electronic storage, aggravated by the continual obsolescence of hardware and software, challenges efforts to establish secure, controlled, persistent repositories. Without appropriate metadata that identifies each digital object and specifies its relation to its context, and without appropriate procedures for controlling access, one cannot ascertain whether it is *authentic*, that is, truly what it purports to be. This is why some approaches to preserving digital systems, such as emulation, are not sufficient (Bearman 1999).

A multinational research collaboration of archivists, artists, and scholars—the InterPARES project (www.interpares.org)–is studying the problem from the perspective of diplomatics, a branch of archival science rooted in practical needs to preserve business, government and religious documents. Focusing on *records*—documents that are created or received in the course of an activity and that, when properly retained, can stand for actions or facts—the first phase of InterPARES developed requirements for establishing and maintaining authenticity. (Hence its acronym, which stands for International research on Permanent Authentic Records in Electronic Systems.)

Although InterPARES 1 restricted its focus to e-records of government and business, it acknowledged the imperatives of preserving artistic heritage. Indeed such attention is timely. National institutions with mandates to preserve cultural heritage (for example, France's IRCAM, see Blanchette 2003), confronted with the increasing submissions of digital materials, have begun searching for appropriate preservation strategies, and artists themselves are beginning to research and implement solutions (Chadabe 2001, Rinehart 2002, Ballowe 2002).

All acknowledge that artistic digital objects pose special challenges for archiving (Besser 2001). Many artworks fall into three broad (and overlapping) classes for which the notion of "preservation" seems problematic. The realization of *interactive* works varies, based on input from the user or performer. *Dynamic* systems present displays whose contents are derived in the moment of access from constantly updated sources. *Experiential* systems (Lynch 2001) present not fixed, unchanging objects, but sensory displays that vary in time, such as music or moving images. The digital objects produced in connection with them are special to each

work, making it difficult to determine their identity, and thwarting archival arrangement and description. Moreover they do not directly present the artworks, but are software for controlling idiosyncratic equipment that presents (aspects of) the work. Works involving machine-human interactions also challenge systems of description and classification. Finally, artworks are complex entities constructed within technological, legal, and social contexts that regulate not only creation but also affect what may be selected and preserved. Some descriptive instruments (such as the Variable Media questionnaire; see www.variablemedia.net) for digital art have been developed; but since they are intended to facilitate remounting works, they do not treat all aspects of authenticity essential to long-term preservation. Moreover these instruments are oriented towards visual artworks, so do not address specific digital objects of music, dance, e-literature, and theatre.

Analysis of digital artworks using time-tested concepts of archival science offers hope for meeting these challenges. To preserve a digital artwork, one must understand the process that generated it and the function of its records within the process. It is important to understand how new digital tools have changed the practice of creative artists, how the various types of records created can be identified as belonging to their creator, and how records created in such environments fulfill their intended purposes. To preserve such artwork in authentic form, it is necessary not only to know how it should be described, the purposes for which it is kept by its creator, and which of its features will allow its authenticity to be determined, but also to ensure that the work is generated in such a way that it is possible to preserve it over time.

This paper reports on the progress so far of the InterPARES team's search for this knowledge. We are studying a wide variety of visual, performing, musical and literary creations, including works presented on stage, in museums, and over the Internet. To understand the full scope of preservation requirements we are conducting intensive case studies, interviewing creators, and modeling their activities, in order to identify all records, their technical dependencies, and their interrelations. We aim to suggest practical guidelines and policies to help creators, legislators and archivists ensure that digital artworks may be preserved authentically in perpetuity.

2. Research activities of InterPARES 2

A brief overview of the project will help contextualize its goals. The second phase of InterPARES is a five-year investigation that began in 2002. Its specific objective is to develop a theoretical understanding of the electronic records generated by interactive, dynamic, and experiential systems. While these categories clearly apply to digital artistic works, they are

also increasingly evident in scientific and government record-keeping systems. We hope, then, that what we learn about interactive works in the arts will help us recognize features, for instance, of citizens' online transactions with their governments, or of visualizations of scientific data, and will help solve the pressing problems of archiving them as well.

Accordingly the researchers of InterPARES stem from various backgrounds. They include theorists of diplomatics and archival science, who direct the project, as well as such obvious stakeholders as representatives of major national archives. There are also scholars from many other disciplines, including music, dance, literature, geography, archeology, and computer science. Government and industry, including software designers, multimedia and film production companies, are represented, as are experts in policy, metadata, and description. This diverse expertise is mobilized to maximize interactions between disciplinary specialists and preservation professionals.

I see at least five dimensions to the project:

1. *Theoretical studies*. In order to understand and accommodate creators' preservation needs in their own terms, we are reviewing the literature of participating disciplines, focusing on discussions about identity, authenticity, accuracy, and reliability. This review also feeds the construction of terminological instruments, such as a glossary, that we intend to facilitate communication among stakeholders.

2. Specific *case studies* of records creation in arts, science and government. We are striving to maximize the diversity of the cases while ensuring that each case still represents a significant class of similar record-creating activities. To date, 25 studies have been completed or begun. The methodology involves interviews and on-site observation, and researchers are responsible for answering a common set of questions. The information we glean is contextualized by more general surveys of records-creation practices we are conducting through web-based questionnaires targeted at specific communities, such as composers and digital photographers.

3. *Modeling*. Using formal modeling languages, we are representing the activities and entities in the case studies, in order to identify essential features and context.

4. Research in *policy* and *description*. Working groups are documenting standards and laws around the world that affect preservation of digital objects, such as privacy and copyright, and using literary warrants to determine appropriate metadata structures. The goal is to suggest ways that existing metadata schemes can be augmented to accommodate information necessary to preserve authenticity.

5. Refining and *testing* in new environments the results of InterPARES 1, which made specific recommendations to ensure authenticity of e-records in business and government. For example, since InterPARES 1 found that authentic preservation of e-records is possible only if creators meet certain benchmark requirements, we are focusing our initial efforts on analyzing records creation. We are also refining and testing a larger-scale model of preservation and appraisal proposed by InterPARES 1, with which we hope to reconcile the case-study models.

These different activities feed into each other in productive ways. In the remainder of this paper I will show how the combination of theoretical research, observation, and modeling help clarify problems of preservation in two representative cases of digital interactive art.

II. Conceptions of authenticity in the arts and archival science

One immediate problem in studying artists' preservation practice is that they seem to have different conceptions of key archival terms.

To an archivist, "authenticity" has a very specific meaning. It stems from that discipline's original concerns with business and government transactions that were recorded on durable media, following established protocols and forms, and set aside. In archival science, an *authentic record* is a record that is what it purports to be and is free from tampering or corruption (Duranti 1998). To assess the authenticity of a record, in other words, one must establish its *identity* and its *integrity* (MacNeil 2002). Essential to the identity of a record is the identification of the persons whose transactions it records. A record's identity is also determined by the action in which a record participates, the relationship of the record with other records in the same aggregation, and the presence of the elements of form that records of its type should have. A record's *integrity* is revealed by the fact that it is *effective*, that is, intact enough to convey the message it was meant to communicate. By identifying records, and by analyzing the social and legal contexts in which they arise, archivists arrange, preserve, and control access to them in ways that protect the identity and integrity of the records. Upon such preservation of authenticity depends our collective memory—our basis for future action.

In theories of art, "authenticity" has some, but not all of the connotations it has in archival science. In general the identity of an artwork does not derive from its form, because artworks lack standard forms. Yet it certainly involves a link between a work and its creator:

> Authenticity in all the arts involves a relation to a unique, historically positioned creative act…The authentic *Night Watch* is the one Rembrandt made on a definite occasion in 1642. An authentic *Capriccio no. 43* is one pulled directly from a plate on which Goya toiled in 1779. So too, an authentic copy of *Correspondences*, or an authentic performance of the *Tragic* Overture, is one that is intentionally (and usually also causally) linked to particular creative activity of Baudelaire and Brahms in 1845 and 1881, respectively. (Levinson 1990, 106)

Note that this aesthetician (following Goodman 1968) cites several different types of artworks. Generally, the more durable the work, the more closely notions of authenticity correspond to those of archival science; for example, durable objects are fixed in a medium, so the context of their creation can be documented, and their chain of custodianship can be determined and controlled.

For many less concrete works of art, however, these notions bear closer scrutiny. A musical work, for instance, can be said to consist of sound structures, that is, it is a display of real-time varying acoustical signals. A musical score, although it may be a record in the archival sense, is not the musical work in this strict sense. Rather, the score specifies how to produce the work, and by following its instructions, performers can instance the work multiple times. Musicians judge authenticity accordingly: "An ideally authentic performance is a performance that is faithful to what is determined in the musical notation according to the conventions appropriate to the interpretation of that notation" (Davies 1988, 54). "Faithfulness" in this context entails notions of *accuracy*: "an authentic performance is (at least) an accurate performance, [that is] a performance that reproduces all that is constitutive of the work's individuality" (Davies 2003, 60, 74). What constitutes the work varies considerably. Some works are so "thickly" specified that only playback of a recording properly instances them. Scores specify the works more "thinly", leaving many decisions up to the performers who will "interpret" the work live (Davies 2003). As others (Grier 1996, Chadabe 2001) have also noted, performance authenticity is not merely a matter of realizing notated instructions, but also following the (often unwritten) conventions associated with the making and interpretation of the notational system. In order to preserve a work so that it can be performed authentically one must also preserve these conventions by which the author intended the notation to be interpreted.

Lately, developments in the visual arts have stimulated art-theorists to revise traditional notions of authenticity. Buskirk (2003) points out that many "minimal" artworks are not durable objects that are carried from one venue to another; rather, they are refabricated for each show. The revised notion of "authentic" is even clearer in installation art, which presents

multi-sensorial experiences. "When preserving and representing media-based works of art, we should give up the notion of a single, authentic object and view these works as sets of instructions rather than precious originals" (Rinehart 2000, see also Hapgood 1990). The nature of all interactive new-media art, in other words, approaches that of music.

For interactive works to be remembered, then, they will have to be performed in the future. The effectiveness of an artwork's record, then, must be measured partly by whether they can produce an authentic performance.

III. Case studies

Keeping in mind the various attitudes and concepts of artists, then, InterPARES is studying the creation of music, theatre, installation art, photography, moving images, and dance. The remainder of this paper gives a detailed look at two cases that present some interesting similarities and contrasts. I will discuss how we identify the records associated with each work, and discuss the creators' ideas about preservation.

1. *Obsessed again…*

Obsessed again... for bassoon and interactive electronics, by the Canadian composer Keith Hamel, was premiered in 1992. InterPARES chose to study it partly because it is typical of a broad class of interactive works for performance. The behavior of the electronic (sound) display both responds to and influences the actions of the performer.

To characterize the identity of this work, we hierarchically decompose the process of its creation into component activities. Following the BPWIN modeling paradigm, each activity is conceived in relation to the *controls* that guide or regulate it, the *resources* (human and capital) that support it, the *inputs* that initiate it, and its *output* or products. Figure 1 arranges these as arrows feeding into the activity, labeled with general descriptions:

A commission, shown as an input on the left, initiated the composition.

The top arrows show several different controls upon it, emphasizing that its records were created within systems that constrained their form and content. For instance, an obvious constraint was the terms of the commission, specifying medium and duration. Each control merits detailed analysis (the state of technology, which obviously constrained the composer's ability to realize the commission, will be scrutinized more closely below). Together they anchor the identity of the work to a particular historical

set of circumstances; this reflects the view of authenticity that a record cannot be regarded as authentic unless it is properly contextualized.

The outputs of the activity, shown on the right of Figure 1, included three distinctive types of products: musical notation (score), computer code, and written instructions and graphical diagrams. The activity produced not only "final" products (that is, those that were effective in realizing the commission) but also byproducts that help define the work by negation, that is, by what it is not. To a future scholar seeking to understand this work in the context of the composer's life work, such products are important.

The lower arrows show the two resources for the activity, the composer and the performer.

**Fig. 1**: Highest level of the activity model (BPWIN) of composing *Obsessed again…*
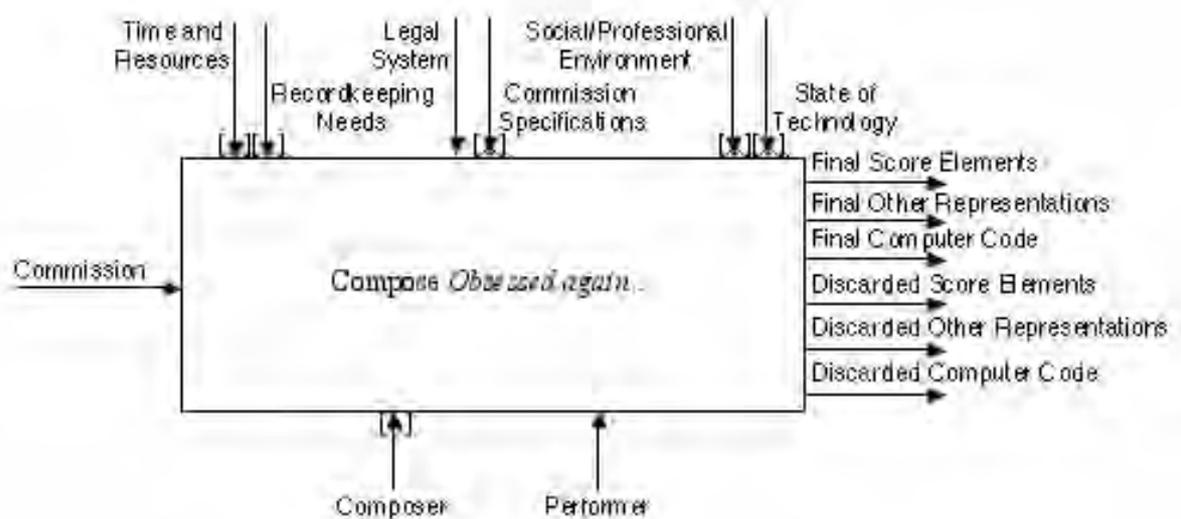
The role of the performer and the constraints of the legal environment (shown with unbracketed arrowheads on Figure 1) are clarified in Figure 2, which decomposes the composition activity of Figure 1 into a series of subactivities. Each of the central three subactivities represents a drafting stage in which the composer produced the instructions (computer code, musical notation, or other representation) for numerous possible musical passages. The performer acted as a testing agent, thus as a resource, for the composer's programming and notating activities. Copyright laws constrained the form of code and notation. In the final subactivity, the composer selected which of these passages would constitute the work, and so which instructions (outputs) would make reliable records.

**Fig. 2**: Decomposition of the activity of composing *Obsessed again…*
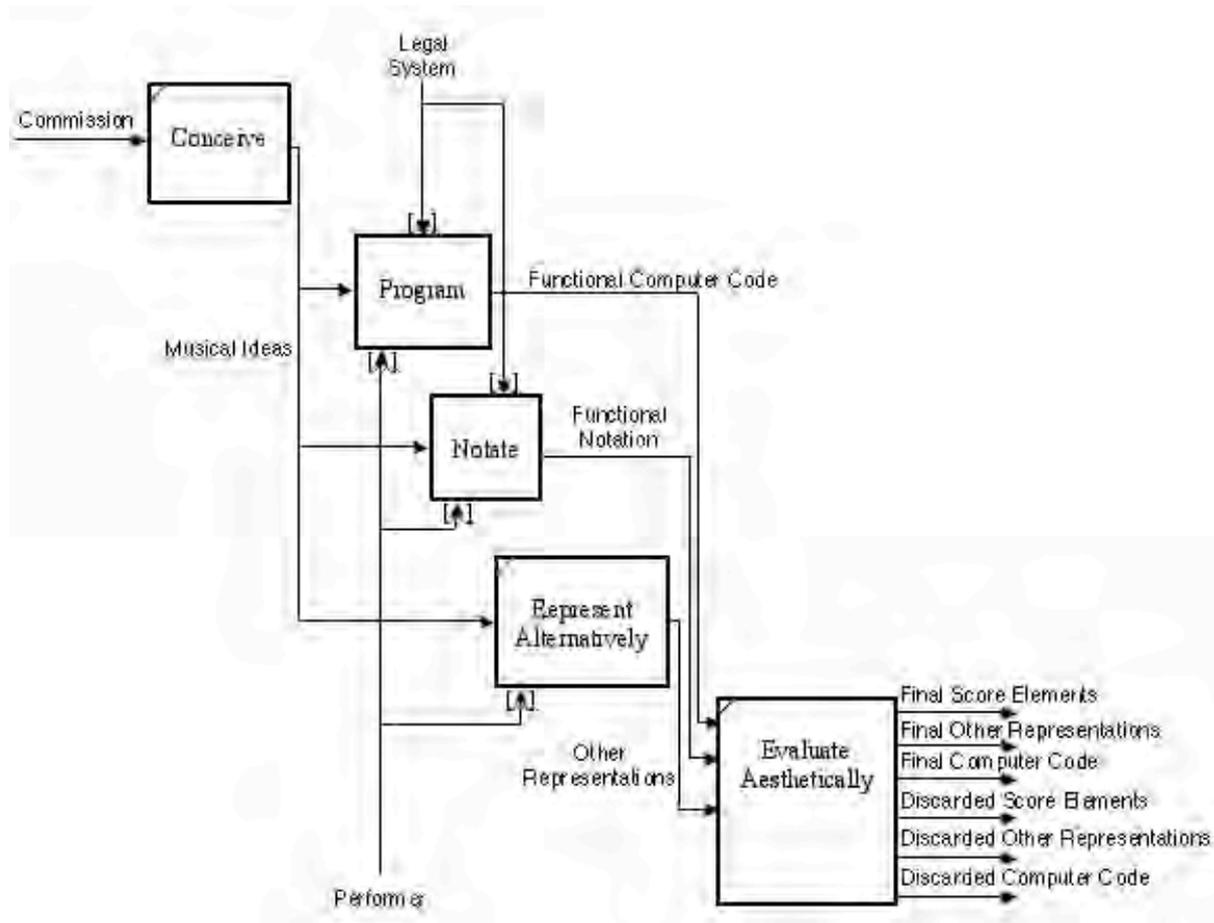
On the basis of this activity model, we identify and characterize the entities involved in the activity. These are sketched in Figure 3. Round-headed arrows denote the entities' interrelationships. Specifically, the diagram shows that the entity "*Obsessed again…*" comprised one notation entity, multiple computer-code entities, and one alternative representation that directed use of the computer code. Listed within each entity-box are all the descriptors necessary to characterize it. They include identifying some typical identifying metadata, such as author's name, title, and date of creation, but also many others. For example, each computer code entity is tagged with the identification for the alternative representation that directs its use. These cross-references make dependencies explicit and so bind the distinct entities logically into an archival aggregate.

Fig. 3: Entity model for *Obsessed again…*
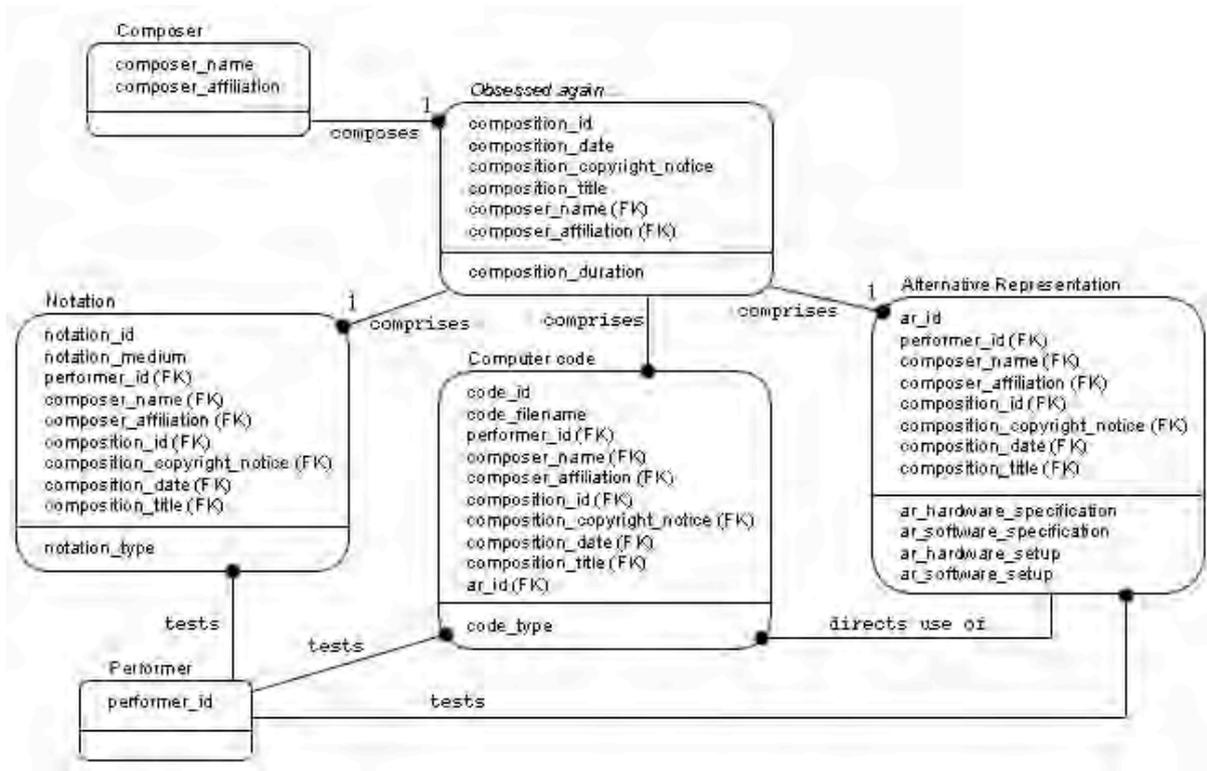
We are modeling all of our case studies similarly. The models identify all associated records, the actions in which they participate, and their interrelationships, all of which is necessary for their authenticity (in the archival sense) to be determined.

It is not clear from this analysis, however, whether preserving these entities will preserve the integrity of the work, that is, its ability to be performed authentically. We must therefore analyze the technical aspects of the system more closely. In performance, the entities of Figure 3 directed the operation of an arrangement of commercial musical, audio, and computing instruments specified by the ar_hardware_specification and ar_hardware_setup metadata. Figure 4 represents that arrangement schematically.

Fig. 4: The system that first produced a performance of *Obsessed again…*
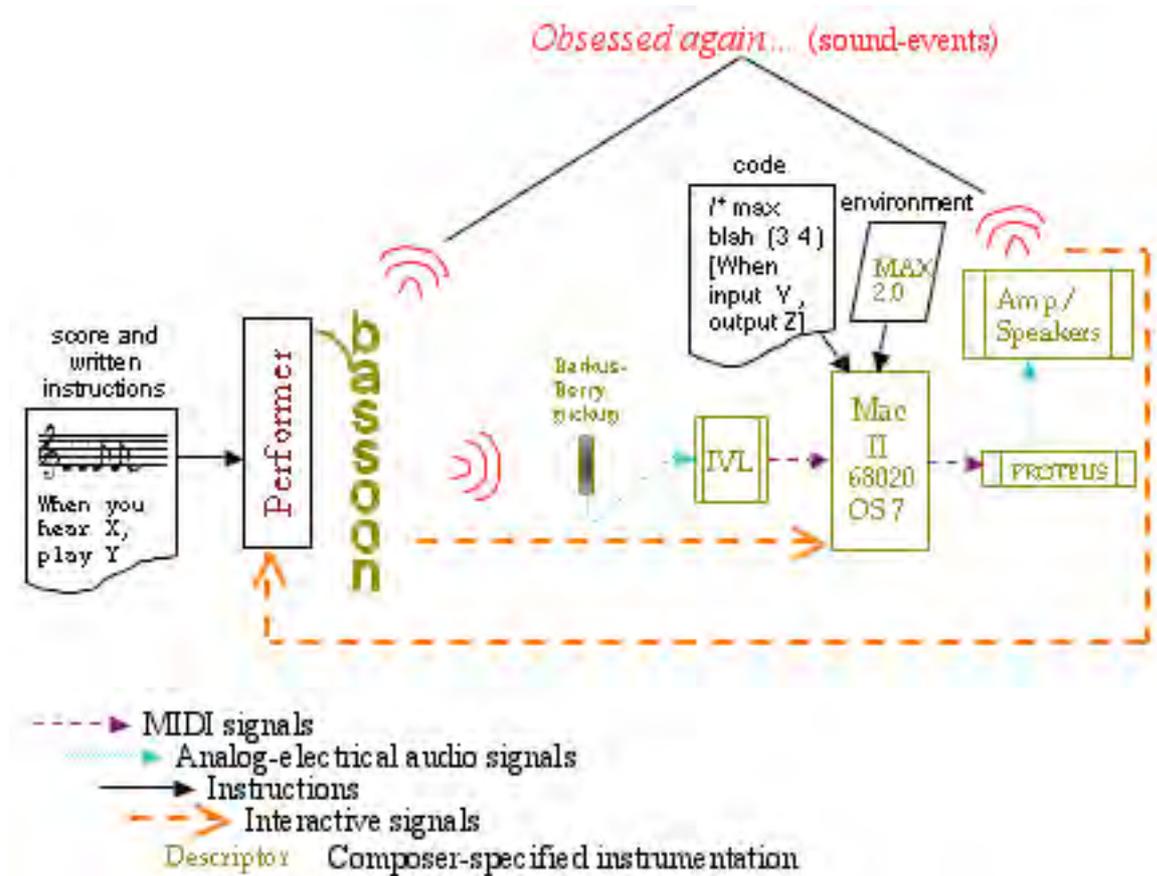
To prepare for a performance the technical components were assembled and connected as specified by written instructions. A Barkus-Berry pickup, attached to the bassoon, was routed to an IVL Pitchrider, which converted the analog signal to a bit stream structured as MIDI code. Its output connected to the serial port of a Macintosh II computer, into which was loaded (from a double-sided 3.5 inch diskette) composer-provided code that could control a real-time music performance software environment, Max version 2, under System 7. The MIDI bit stream produced according to the code was routed to a Proteus synthesizer, whose output was converted to sound by audio playback equipment.

Once the setup was complete, the composition could be performed interactively as intended. The interactivity of the composition was bidirectional; it is represented on Figure 4 by large dashed orange arrows, each linking an audio source to the agent that responded to it (that is, upon which the sound "acted"). The bassoonist played according the instructions provided by the score. The code loaded into the Max environment caused the computer to poll constantly the serial port, which brought in MIDI signals representing the bassoonist's pitches and timing. When the input matched certain preprogrammed conditions, the code caused the

computer to send MIDI signals to the synthesizer, producing sound. The notated score also instructed the bassoonist to respond to certain cues from the synthesized audio.

Accordingly many kinds of interactions took place. For instance, when the bassoonist played a series of pitches oscillating in register, the computer played a percussive sound coincident with one of the lowest pitches of each oscillation. (Listen to the first 24 seconds of Multimedia Appendix 1.) In another passage (0:25-0:45), the electronics matched several pitches played in sequence by the bassoonist and sustained them in a pulsing wash of sound; the pitches were exactly specified on the score, but the timing was left open, allowing the performer to choose the most expressive presentation. In a third passage (0:45-1:05), the bassoon repeated a rising figure of two pitches, varying freely the time between them; in each iteration a different electronic figure started with the lowest pitch and stopped with the highest. In a fourth (starting at 1:06), the electronics echoed the bassoonist's freely timed gestures, while also initiating two steady beats with which the bassoonist was instructed eventually to synchronize.

Implicit in this interactivity was a crucial act of translation between two very different symbolic systems for notating musical information—the common music notation of the bassoonist's score and the binary MIDI information processed by the Max patches. This translation had to be made accurately by the central instruments in Figure 4 in order for the computer to respond as the composer intended. But the accuracy of the translation was only *implicit* in the design. It was nowhere specified. And it depended on the timing and power spectrum of the bassoonist's playing, the location of the pickup, and the sensitivity of the Pitchrider. Indeed the composer has confirmed the influence of these factors on the materials and form of the work. By experimenting with the equipment and the bassoonist, he determined the most viable cues and incorporated them into the works. He also designed a flexible sectional form for the work, so that in case a particular cue failed to trigger a response, the performer could go back and repeat the cueing material.

Therefore the particular choices of performing means—the electronic devices—determined to a great extent the identity of the work, in the sense of constraining its content. That is, the analysis of Figure 4 makes explicit the constraints of the "State of technology" arrow in Figure 1. It suggests that the implicit pitch-to-MIDI translation algorithm, and the associated constraints of pitch and timing resolutions, should be preserved to enable an authentic performance. That is why I described this work in the past tense—to emphasize its dependency on a particular historical condition, namely one in which all this instrumentation functionally existed.

Such a preservation strategy is impractical. Already the original equipment is defunct, and for at least one of them (the Pitchrider) no emulation has been constructed. Accordingly it would seem that, even if all the outputs of the composition process are preserved authentically, the work is not preserved.

However, our interviews with the composer revealed that he believes it is possible to realize the same musical ideas of Figure 2 in performance with different technology. Specifically he intends to replicate the behavior of the entire right side of Figure 4 with other machines and software. This suggests some important points about preserving interactive artworks. The outputs of the original process of creation (Figure 3) do not uniquely determine the work, because they *over-specify its means of performance.* An authentic performance can be produced in other ways. (In the ontological terms reviewed above, the specific electronic instrumentation is *not* "constitutive of the work's individuality.") This does not invalidate the archival notion of authenticity, rather it suggests the need to specify the entities and interactions with hardware- and software- independent descriptions. If such performance specifications are created with all the elements we have identified to ensure their authenticity, then the composer can hope that not only the digital objects but the work itself can be preserved authentically.

2. *Waking Dream*

This multimedia theatrical work for two dancers and interactive audiovisual electronics was premiered in Belgium in 2001. It originated in a collaboration of an electrical engineer, a video artist, and a choreographer/performance artist. The engineer provided a narrative sketch of the piece, designed custom hardware and software, and controlled technical aspects of each performance. The video artist created sound and moving-image files for assembly by the choreographer, who also danced each performance.

The work represented the state between sleeping and waking. It was performed in a dark theatre, with a rear-projection screen on stage. By its light the dancers were sometimes visible on stage, but during parts of the performance they and the audience were lit only by infrared. Prerecorded video images were projected alternately with live moving images fed from two infrared cameras, one fixed and one on a helmet that a dancer wore, sometimes interrupted by a projector shutter that the dancer controlled remotely. Multimedia Appendix 2 presents a video montage of the main events specified by the narrative sketch, which can be found at hct.ece.ubc.ca/research/wakingdream/wakingDream.pdf.

Recall that one important feature essential to preserving a record is the identity of its author. In this work, uncertainty about authorship could have an effect on later productions of the piece. The engineer considers the work to be a theatrical performance that retains its identity when staged by other personnel. The choreographer views her own execution of her choreography as essential to the work's identity, which would preclude performances without her.

To preserve a work it is also necessary to establish what it is, and that the instructions for it have not been tampered with. In this case, one of the authors considers the work to comprise not only the performances but also the narrative description and a web site (hct.ece.ubc.ca/research/wakingdream/). The files exist on various participants' hard disks, which makes it more difficult to establish which of them are essential, to preserve their contextual associations, and to assure their unbroken custodianship.

Lastly, as with *Obsessed again…*, much of *Waking Dream*'s content depended on the specific technical properties of the equipment and software. The snowy, interrupted quality of the moving infrared images was an unintended consequence of the state of video technology when the work was created, but the authors found it so appropriate that they now consider that quality integral to the work. The helmet that the dancer wore was cumbersome, again due to technological constraints, but its restrictions of her motions also became integral to the work. The dancer's interactions with the technology—for instance, the kind of images she could generate in real time through feedback—and with the audience (at the end, the dancer moved invisibly through the audience, touching them lightly) were similarly constrained by technical factors.

Our activity model of the creation of *Waking Dream*, one level of which is shown in Figure 5, makes explicit these issues of authorship, custodianship, and technological dependencies. It shows that the products of this creation process include not only files and technical gadgets, but also a web site and program notes. Each product is tied to a performance activity supported by specific performers, created for a specific performance venue, and supported by specific technology. Unlike in the process of composing *Obsessed again…*, each performance results from feeding the elements of a previous performance back into the activity of developing it. In considering how to identify this work, then, these many descriptors need to be included in the metadata.

Fig. 5: Activity model for the creation of *Waking Dream*
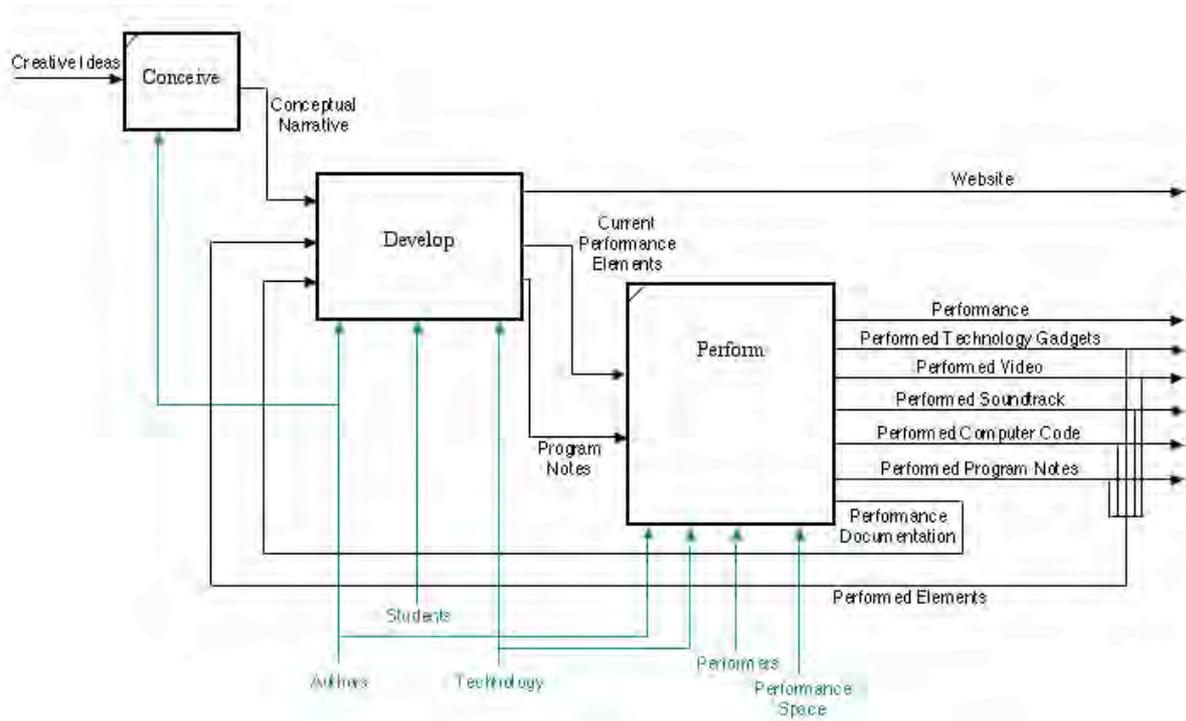
The interdependencies of the interacting entities of the work also need to be expressed by the metadata. Thus in Figure 6, which displays part of the entity diagram for Waking Dream, each audiovisual element is tagged with metadata that specify the computer code that controls it, which in turn is tied to specific technical gadget, performers, and technical directors that participate in a performance. Until the authors decide exactly what constitutes an authentic performance of the work, however, the specifications for the interactivities remain undetermined.

Fig. 6: Some of the entities of *Waking Dream*
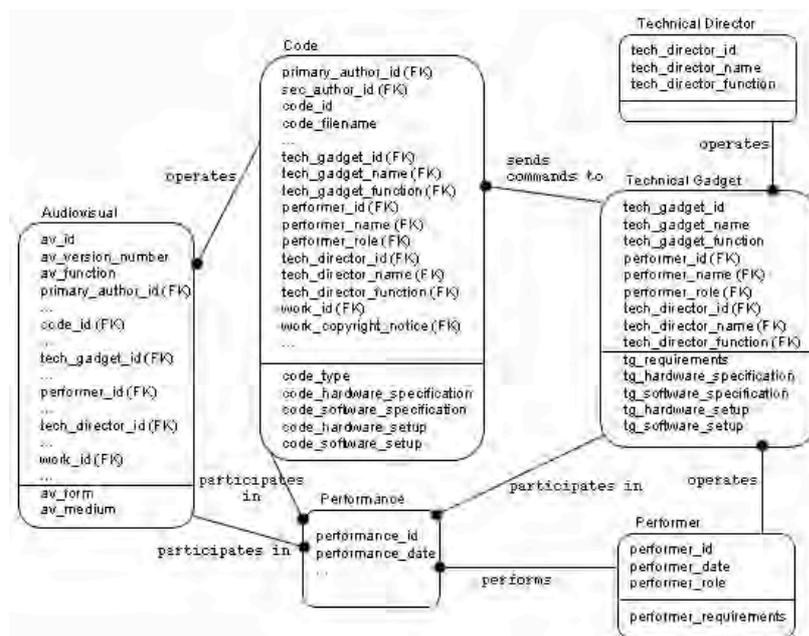
Although the two cases presented here have many similarities, there are some interesting contrasts. In both cases the authors' attempts to perform the work again have necessitated rewriting code and updating equipment. Yet they consider the new performances to be of the same work. This clearly shows that they conceive of their works as having an identity somewhat independent of technological context. In the case of *Obsessed again…* the creator has not made this identity clear, leaving it implicit in the interactions of hardware and software that cannot be preserved. *Waking Dream*, in contrast, does have a technologically independent conceptual narrative, but its authors disagree on whether that sufficiently specifies the actions of the performers, and so it may not be adequate for identifying the work. In both cases the challenge is to define the entities of the work in a performer- and technology-independent manner, but one that still preserves the context of creation and the link to the creators.

IV. Summary

Although InterPARES 2 has just begun its investigations, and although these case studies will need some refinement, a few insights into the preservation of interactive digital art are already evident from the review of aesthetic theory, the case studies, and modeling presented here.

Artworks, especially those that involve digital technologies that facilitate interaction, are becoming like music always has been. The work is an experience that the artist must specify with instructions. Preserving the works means preserving the ability to perform (display) them.

Since interactive works involve devices and instructions for controlling them during performance, modeling the entities and activities of creation helps identify all the interdependencies of authors, performers, and technology in the instructions for performance.

When works are created around particular performers, authorship needs to be clarified. Some of the content essential to the identity of these works may derive originally from unanticipated properties of the devices. In *Obsessed again…* it was the delicate calibration of device sensitivities, and the crudeness of the translation of sound to MIDI signal that determined content and form. In *Waking Dream* it was the weight, resolution, and inconsistent signal quality of the helmet video camera. It is necessary to analyze the technological components of the work in order to understand the constraints on these interactions.

However, once the work is conceived, artists may not require these essential properties to be displayed by the original devices.

Through attempted migration such properties can be discovered. In effect, by making inauthentic performances one can discover how to provide instructions that can be preserved authentically and that can produce authentic performances.

Creators, while they are still living, are the best arbiters of the authenticity of performances. So it behooves creators to describe works in technologically independent (and authentically preservable) ways that will allow authentic performance in the future.

We invite readers to visit our website and contribute advice and comments.

References

Ballowe, J. (2002). Report on Related Digital Preservation/Archiving Projects. Last updated 11 August 2002. Consulted 17 June 2004.

Bearman, D. (1999). Realities and Chimeras in the Preservation of Electronic Records. *D-Lib Magazine*, 5/4. Last updated April 1999. Consulted 17 June 2004.

Besser, H. (2001). Longevity of Electronic Art. Last updated February 2001. Consulted 17 June 2004.

Blanchette, J.-F., et. al. (2003). Preserving Interactive Digital Music: A Report on the MUSTICA Research Initiative. Proceedings of the Third International Conference on Web Delivering of Music (WEDELMUSIC 2003), 15-17 September 2003, Leeds, UK. IEEE Computer Society Press.

Buskirk, M. (2003). The Contingent Object of Contemporary Art. Cambridge: MIT Press.

Chadabe, J. (2001). Preserving Performances of Electronic Music. *Journal of New Music Research* 30/4, 303-305.

Davies, S. (1988). Transcription, Authenticity, Performance. *British Journal of Aesthetics* 18, 216-227.

Davies, S. (2003). Ontologies of Musical Works. In *Themes in the Philosophy of Music*. New York: Oxford University Press, 31-46.

Duranti, L. (1998). Diplomatics: New Uses for an Old Science. Lanham, Maryland: Scarecrow Press.

Goodman, N. (1968). The Languages of Art. Indianapolis and New York: Bobbs-Merrill.

Grier, J. (1996). The Critical Editing of Music: History, Method, and Practice. Cambridge: Cambridge University Press.

Hapgood, S. (1990). Remaking Art History. *Art in America* 78/8, 114-117.

Levinson, G. (1990). Autographic and Allographic Art Revisited. In *Music, Art, and Metaphysics: Essays in Philosophical Aesthetics*. Ithaca: Cornell University Press, 89-106.

Lynch, C.A. (2001). When Documents Deceive: Trust and Provenance as New Factors for Information Retrieval in a Tangled Web. *Journal of the American Society for Information Science* 52(1), 12-17.

MacNeil, H. (2002). Providing Grounds for Trust II: The Findings of the Authenticity Task Force of InterPARES. *Archivaria* 54, 24-58.

Rinehart, R. (2002). The Straw that Broke the Museum's Back? Collecting and Preserving Digital Media Art Works for the Next Century. *Switch* 14. Last updated 14 June 2000. Consulted 17 June 2004.

Rinehart, R. (2002). Preserving the Rhizome ArtBase. Last updated September 2002. Consulted 17 June 2004.

Multimedia Appendices

1. Four excerpts from a sound recording of *Obsessed again…*, by Keith Hamel. Bassoonist: Jesse Read. Reproduced by permission of the composer and performer.

2. Montage of excerpts from *Waking Dream*, by Sidney Fels, Baerbel Neubauer, and Sachiyo Takahashi. Assembled from a video recording of its performance at the Telus Theatre, Vancouver, British Columbia, Nov. 8, 2003. Reproduced by permission of the artists.