ChoreoSave: A Digital Dance Preservation System Prototype

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ABSTRACT
This paper presents the design and implementation of a short-term digital dance preservation solution called ChoreoSave. The author created a prototype system that identifies what components comprise a dance work and how such components can be represented using EPrints software hosted on an Amazon EC2 instance. Suggestions for future development are discussed based on evaluation and challenges encountered in the course of research.

Keywords
Dance preservation, digital preservation, cloud computing, open source software, dance, performing arts

INTRODUCTION
Dance and digital media are both difficult to preserve over time due to their ephemeral natures. Several organizations such as the Dance Heritage Coalition (DHC) have initiated the digital preservation of dance since the early 2000s by digitizing collections and making finding aids available online. While large institutions such as the New York Public Library and Merce Cunningham Foundation have the funding and infrastructure to preserve certain choreographic works, the majority of dance companies and choreographers do not have access to a proper digital repository in which to store and preserve dance works. Instead, individuals in the dance field rely on social media services such as Youtube or Vimeo to share choreography and performance. Both formal and informal repositories have positive qualities that can be combined to form a more accessible yet standardized hybrid repository. This use of social media services indicates that dancers need such a preservation tool.

To meet these needs, the author has created a short-term preservation community-based digital repository prototype called ChoreoSave using open source software. Instead of saving multiple versions of performance footage, a customary form of archiving dance works, this design preserves the movement choreography and related elements such as music through documentary footage and contextual information. This approach challenges traditional notions of capturing movement through the use of information organization principles. By forming a standard submission template with customization options for users, the appraisal, selection, and ingestion processes will become the users’ responsibility, thereby streamlining the flow of content from creator to repository. The short-term characteristic coupled with a peer-based model facilitates a more immediate ingest process that permits the holding of content while it is evaluated by the choreographer and other members of the dance community. This paper will focus on the design and construction of the prototype as informed by the combined perspective of choreographer, archivist, and technologist.

BACKGROUND
The purpose of ChoreoSave is to provide a short-term preservation service for emerging choreographers who are not affiliated with an organization that possesses an archives/library system. It is inspired by the use of video sharing sites to distribute dance works and the loss of early works by prominent choreographers. The system design is informed by archival practices, digital preservation, social media, and past methods of preserving dance. However the final product is not intended to look like a traditional archives nor a social networking site. Rather, it is meant to be a digital curation tool for preserving dance choreography, not performance.

In order to formulate a different perspective of digital dance preservation, additional factors must be taken into consideration and a working definition of “digital dance preservation” must be established. For the purpose of this research, “digital dance preservation” refers to the use of digital technology to record important choreographic information for the recreation and reference of a dance work. As such, the primary goal of ChoreoSave is to preserve and store facets of performance that may or may not be in born-digital multimedia formats.

Within the confines of this paper, the “choreographer” specifically refers to an emerging and/or independent artist engaged in the process of making dance works irrespective of style or tradition. These choreographers could generally be defined as belonging to the Generation X and Millennial age groups and being generally comfortable with the use of digital technology. Students in undergraduate and graduate dance programs are a prime example of emerging
choreographers. The terms “dance work” should also be distinguished from “dance performance”. For the purpose of this research, “dance work” is the overall collection of components related to a piece of choreography regardless of whether it was completed or made public. “Dance performance” generally implies a single iteration of choreography that focuses on the execution of movement and related production elements.

**Figure 1. Diagram of a Dance Work**

**Existing Methods of Dance Preservation**
Dance has traditionally been preserved in two ways. The first method was through the transmission of dance techniques and pieces from teacher to student over multiple generations. The other method was through documentation of the dance movement through various media formats. Documentation options include dance notation, motion-capture, film and video, and “capsules.”

Dance notation systems generally consist of symbols written textually, each system taking a different approach to its interpretation of movement. Three established notation systems in Western dance are Benesh Movement Notation (BMN), Laban Movement Analysis (LMA), and Labanotation (DHC, 2006). These systems are not commonly taught outside of academic environments.

Motion-capture technology has been successfully adapted for multimedia dance by choreographers such as Merce Cunningham’s *Hand-drawn spaces* and BIPED as a means of extending choreographic possibilities (Birringer, 2002). Yet the effectiveness of this technology as a documentation and preservation tool is not optimal due to the high cost and specialized equipment.

Film and video also have the ability to capture “incidental” elements such as costumes, lighting, and an individual dancer’s unique inherent qualities (Armelagos & Sirridge, 1978). Nonetheless, the quality of footage, selection of proper storage media, and other factors can interfere with the capturing of the precise elements of choreography unfiltered by interpretation the way a notated dance score can. As the cost of camera technology drops, digital video has increased in popularity across many fields. Along with the popular use of digital videos, video sharing websites such as Youtube (http://www.youtube.com) and Vimeo (http://www.vimeo.com) have become increasingly utilized to view and share dance resources.

Most recently, the “capsule” for the Merce Cunningham Dance Company is a holistic example of dance preservation. The dance capsule was developed specifically for the purpose of preserving the choreography of Merce Cunningham (1919-2009), former dancer for the Martha Graham Dance Company and modern dance pioneer. It consists of the following components:

“…performance videos, sound recordings, lighting plots, décor images, costume design, production notes from rehearsal and performance, and interviews with dancers and artistic staff (Cunningham Dance Foundation, 2009, p. 2).”

The capsule not only captures reference content but also includes contextual and secondary elements that contribute to the choreography. A digital equivalent to the Cunningham dance capsule is the Siobhan Davies Dances Archives also known as Siobhan Davies Replay. Siobhan Davies Replay is the result of Sarah Whatley’s doctoral studies and is considered to be “the UK’s first digital dance archive (http://www.coventry.ac.uk/cu/d/162/a/468, n.d.).” It was released in January 2007 and is completely dedicated to Siobhan Davies’ choreography. The most useful and unique aspect of the archives is the extensive metadata. Each dance work has a list of metadata associated with it that includes Title, Date, Choreographer, Music, Design, Garments, Lighting, Dance Artists, Musician, Summary, and Analysis. Visitors can also view related media that includes movies, images, audio, text, object, and profile. Each media object also has its own metadata profile as well as access permissions based on the copyright status of the object.

**Dance and Technology**
Since the advent of modern dance, an increasing number of archives, libraries, and other institutions have maintained these dance documents in both physical and digital forms.
However, these methods are unable to resolve the fact that dance choreography is a temporal-spatial form of expression that rarely has identical iterations. Each time a dance piece is performed or staged, it is fundamentally different from previous iterations due to elements of style being lost or the work becomes modified (Armelagos & Sirridge, 1978). To be truly effective, documentation needs to be usable by dance practitioners for both practical and scholarly purposes while maintaining revision control.

The primary problem in dance preservation examined in this paper is the lack of repositories for the average dance practitioner to deposit their choreography and contextual information. Few sources mentioned formal archival practices or potential of open source digital repositories in the literature reviewed despite the extensive work of the Dance Heritage Coalition and its network of archives and libraries. As stated by Wang (2005) there are a limited number of repositories with narrow access to materials. Even with digitization, materials are not necessarily available to the public and only a few choreographers are selected to provide materials for preservation without any clear acceptance criteria. The concert dance community also has the increasing problem of diminishing funds and unclear relationship with society-at-large (Wang, 2005). As a result it seems that a number of dance organizations either view technology solutions as very expensive or are unclear as to how to effectively use technology. It is therefore essential to combine archival principles and choreographer needs into an effective cyberinfrastructure.

RESEARCH QUESTIONS AND METHODOLOGY

The complex nature of dance preservation requires examination of several fields of inquiry. This multi-part research utilized predominantly qualitative methods with supplementary content analysis. In this phase of the research, established dance and academic institutions were surveyed to learn about existing practices for dance preservation, digital collections, and institutional repositories. Additional website analyses of academic institutions and video sharing websites were conducted to provide additional insight to the sustainability of the ChoreoSave system.

This research was designed to address the following questions:

**RQ1:** What are key characteristics of current practices in dance preservation and related fields that can inform the creation of a short-term preservation repository for dance choreography?

**RQ2:** What are the process and challenges in using open source repository software and cloud computing services to implement a short-term preservation repository for dance choreography? Does the process require extensive technological expertise and support?

To answer RQ1, a combination of questionnaires and website analyses were conducted to identify current trends in dance preservation, digital repository initiatives, and online video social media to confirm or dispute findings from the literature review. In doing so, the author was able to identify common patterns, existing challenges, missing components for each area of inquiry, thereby answering RQ1.

These findings were then incorporated into the system design for the ChoreoSave prototype in the following ways in order to address RQ2:

1. The metadata elements and standards that should describe the various components of a dance work.
2. The type of repository software and server infrastructure that should be used to minimize cost and technical support.
3. The kind of user interface that is simple and intuitive for a user familiar with online social media tools.

Preliminary Data Gathering and Analysis

The first stage of data collection took place from July 7, 2010 to October 29, 2010. The data collection was subdivided into three components: an e-mail questionnaire surveying existing dance preservation practices (Survey A), an e-mail questionnaire and website analysis of university digital initiatives (Survey and Study B), and a website analysis of video sharing websites (Study C). For Surveys A and B, respondents were allowed to choose which questions they would answer. In some cases, the questions asked were not applicable or public information available for that institution.

**Survey A**

Purpose sampling was used to select subjects for the Survey A group. The principal qualification criteria were that the subject be an established dance organization with known dance preservation activities and have an archivist or other type of information professional on staff. Organizations were selected from the member list of the Dance Heritage Coalition website and dance companies of influential American choreographers. A total of 13 organizations were contacted of which 7 responded. The respondents consisted of 3 dance companies, 2 libraries, 1 dance festival, and 1 other type of organization. Despite efforts to identify a more regionally diverse sample all the participating organizations were based on the East Coast geographical region of the United States.

A 10-question survey was sent to each organization asking them about their dance preservation practices including the types of media they accepted for dance preservation, criteria for accepting media, their use of digital media, and the minimum education required of their dance archivists/curators/etc. Questions were kept open-ended so that any unique insights into dance preservation could be captured. No question was mandatory and participants were permitted to answer as many or as few questions as they wished to.
Organizations were contacted by e-mail on July 7, 2010 and given the survey questions as an in-text message. Five organizations responded by e-mail and one organization answered the survey by phone call. One organization provided two separate summary responses by e-mail instead of directly answering the survey questions. Some organizations required additional contact for clarification of survey questions. Other organizations did not respond despite multiple follow-up attempts. The last response was collected on July 26, 2010.

The first question of Survey A asked dance organizations to list the types of items that are accepted in archiving and preserving dance choreography. There were 7 respondents who returned a total of 23 responses. As seen in Table 1, the most frequently listed items were “Films/Videos”, “Photographs”, and “Printed Materials.” The percentage of total responses did not directly correspond to the percentage of total respondents for a given item but the ratio between the percentages was still proportionate.

Table 1. Items Used to Preserve Dance Works

<table>
<thead>
<tr>
<th>Item</th>
<th>Frequency</th>
<th>Percentage of Total Responses</th>
<th>Percentage of Total Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-faceted Approach</td>
<td>1</td>
<td>4%</td>
<td>14%</td>
</tr>
<tr>
<td>Music Scores and Media</td>
<td>1</td>
<td>4%</td>
<td>14%</td>
</tr>
<tr>
<td>Dance Scores</td>
<td>2</td>
<td>9%</td>
<td>29%</td>
</tr>
<tr>
<td>Lighting Cues and Designs</td>
<td>2</td>
<td>9%</td>
<td>29%</td>
</tr>
<tr>
<td>Production Information</td>
<td>2</td>
<td>9%</td>
<td>29%</td>
</tr>
<tr>
<td>Costume Sketches and Fabric</td>
<td>3</td>
<td>13%</td>
<td>43%</td>
</tr>
<tr>
<td>Films/Videos</td>
<td>4</td>
<td>17%</td>
<td>57%</td>
</tr>
<tr>
<td>Photographs</td>
<td>4</td>
<td>17%</td>
<td>57%</td>
</tr>
<tr>
<td>Printed Materials</td>
<td>4</td>
<td>17%</td>
<td>57%</td>
</tr>
</tbody>
</table>

Various items comprising a choreographic work as listed by respondents

*(n = 7, total number of responses = 23)*

Participants were then asked to list any specific items that were required for preserving a work or characteristics of essential works. They were also asked to list any items, characteristics, or conditions of items that were ideal when preserving choreographic works.

The most common method for sharing collections through online digital technologies was the use of an online finding aid. However, not all respondents shared their collections online through any methods at all.

**Survey and Study B**

The group for Survey B was also selected through purposive sampling similarly to Survey A. A total of 15 digital library programs were invited to participate in the survey. 14 digital library programs were selected from a population of university libraries suggested by two experts in the field. Twelve of the digital programs contacted were members of the Digital Library Federation (DLF). One program not affiliated with the DLF was selected independently of the experts due to its association with a prominent DLF member university. Research institutions and academic libraries were selected largely due to the fact that advancements in repository developments generally take place within these environments.

A 9-question survey was e-mailed to each institution library asking them about the cyberinfrastructure for their digital library initiatives as well as any involvement with dance related projects. Six questions were in open-ended format and asked for factual information regarding the library’s digital programs. The three remaining questions were supplementary in nature and asked about future plans for the library. No question was mandatory and participants were permitted to answer as many or as few questions as they wished.

Organizations were contacted by e-mail on July 7, 2010 and given the survey questions as an in-text message. Four institutions responded by e-mail and 1 institution answered the survey by personal interview. The last response was collected on October 29, 2010. To supplement this data, the websites of four digital library programs who had not responded were analyzed to answer the survey questions. The websites were selected based on how much content was presented about a program.
Respondents in Survey B indicated that common digital archiving and repository software infrastructure consisted of ContentDM, Dspace, and Fedora. In-house and open source software solutions were commonly used, especially together. The definition of in-house software included custom configurations of existing software.

Frequently mentioned metadata standards listed included METS and Dublin Core. Institutions tended to use various combinations of metadata standards. Some respondents listed over 5 different metadata standards, including ones developed at the institution (Figure 2). When the data was combined with the metadata standards data from the analysis of the 4 websites, the use of METS increased as did MARC. The number of institutions using a mix of standards also increased (Figure 3).

Sources of financial support for maintaining digital initiatives were generally divided between institutional and grant-based/other funding. Social media was a common feature of university digital initiatives as was contribution of content from the general university community.

Study C

Study C analyzed a stratified sample of video sharing websites. The author identified ten categories of video sharing websites and selected one from each category. Each website was selected to represent a variety of content focuses and sizes. Data for ten characteristics of each website was collected on September 9, 2010. Half of the characteristics were descriptive and included the name of the website, its URL, its traffic ranking, its parent company, and the day data was collected. The primary characteristics included the sustainability model for the website, the types of metadata allowed for a single video entry, and the number of hits returned on a keyword search for “dance”. Only the primary characteristics of the websites were analyzed.

The findings for Study C focused on 6 characteristics: website focus, sources of revenue/financial stability, common uploading policies, number of hits for keyword search on “dance”, common metadata options, and common video formats. It was immediately apparent that websites where material is not necessarily user-generated, is submitted by users for viewing or consists of commercial content. Most revenue and financial support for video sharing websites came from advertising, sometimes in partnership with investors. Partnerships were almost as much as common an arrangement as investors. Paid subscriptions, however, did not seem to be a common method of sustainability.

To get a sense of how many dance videos were present on video sharing websites, a keyword search for “dance” was run on each website. The median values for keyword search results for “dance” ranged from 1000 to 78,000 hits. The most extreme value was over 5,000,000 hits on Youtube and the lowest values were no hits. Veoh and Youku had the next highest number of hits after Youtube. The most common descriptive element options for video postings were Title, Description, and Tags. An Author/Creator element was implicitly always present because the user who uploads the video was always present as the creator even if they were not. This was likely due to the use of user accounts and names to keep track of content contributors.

SYSTEM PROTOTYPE DESIGN

Following data collection, the author investigated a solution for RQ2 through the design and implementation of the system prototype. Preparations for the prototype were started in July 2010 and continued until October 2010. Influences included the Siobhan Davies Replay website and the data collected from the first stage of research. The primary goals of the ChoreoSave prototype were to configure open source software for use in a cloud-computing environment, identify key descriptive metadata elements, and customize a generic user interface.
section describes both the motivation and cyberinfrastructure behind the ChoreoSave prototype. Other issues such as sustainability, troubleshooting, and evaluation are also discussed. The format of this section is loosely based on the article Setting up an institutional e-print archive by Pinfield, Gardner, and MacColl (2002).

The target user group of the prototype program is dancers who use digital and social media websites on a frequent basis. It is expected that these users have primarily born-digital materials or must convert their documents into at least basic forms of digital media. ChoreoSave is not intended for long-term preservation of primarily physical items in any condition. It is also not meant to be a scholarly source for social science research at this time. Instead, ChoreoSave is a short-term solution that can be modified as needed until a permanent solution has been developed.

The term “prototype” is used in reference to the concept of Systems Development Life Cycle, most specifically the “prototyping” process. This system used a rapid prototyping approach where the prototype will eventually be discarded rather than become a final product. In this case, however, the goal was to identify the process and challenges that one might occur while constructing a dance preservation system. For the purposes of this research the user feedback phase was not fully explored since the scope would widen too much.

Cloud Computing and Open Source Software
The root of the system design is based on the Merce Cunningham “capsule.” A typical capsule will include performance footage, notes, lighting designs and more information (Cunningham Dance Foundation, 2009). However, according to an e-mail from the Merce Cunningham Company archivist David Vaughan, these capsules are not accessible by the public either physically or virtually. Once the capsules have been transferred to the New York Public Library system as part of the Living Legacy Plan, such access policies may or may not be modified. Taking into account the strengths and limitations of the capsule, some basic requirements for the ChoreoSave system are that the system contain sufficient contextual information for reproducing a work, be viewable online, allow a creator to modify or add to their collection, and store audio-visual materials in an archival format. These requirements will determine the server, repository, and interface technology.

The majority of existent dance archives are created, maintained, and curated by a public or private organization that may or may not have information professionals on staff. A number of dance archives are for internal use and the general public rarely participates in the actual processing of materials for any dance archives. This arrangement is disadvantageous to dance archives since activities such as digitization, selection, and curation of materials are expensive and labor-intensive. Even when there is a digital system in place, the information management software is not always open source and hosting is likely to be a dedicated solution.

The unique aspects of ChoreoSave are the use of cloud computing, open source software, a custom metadata set that is based both in dance and information science knowledge for general purpose and sharing of dance works, and a user-moderator system that gives users more control and responsibility over their repository submissions. A convenient feature of ChoreoSave is that it can be bundled into an Amazon Machine Image (AMI) image for installation on elastic cloud computing instances by other parties in an open source manner.

Prototype Infrastructure
The base components for this system are the server and repository technology. This design makes the assumption that there is no organizational funding for the sustainability of ChoreoSave. To accommodate this restriction, cloud-computing and open-source software options popular within academic and non-profit communities were explored. For the server component, various virtual private servers and other hosting options were explored. Amazon Web Services was selected in the end for its flexible pricing options and lack of commitment requirements. There were also repository software options such as Greenstone, DSpace, and Fedora, the latter of which are both maintained by Duraspace. EPrints was another fairly popular product with advertised short set up time and customization options. Ultimately, EPrints was selected based on the ease of use demonstrated by the test repository at http://demoprints3.EPrints.org/. As it turned out, EPrints also had pre-existent AMIs for use with Amazon Web Services. Using a pre-existent AMI reduced the amount of preparatory work required for installing EPrints.

System Implementation
The author decided to use a cloud computing solution in order to create a system that did not require an in-house server. Several options were explored including standard dedicated hosting services, but in the end, the author selected Amazon Web Services (AWS) for its scalability. AWS is a set of cloud-based technologies for web hosting, storage, databases, and other needs. The technical and financial setup allows a user to scale their technology use and fees depending on the size of their projects. Amazon also provides auxiliary services such as web traffic analysis. The advantage of using AWS was its flexible server model that allowed users to modify the resources they used based on changing needs. Most traditional virtual or dedicated servers ask for an immediate commitment whereas AWS lets a user experiment as needed.

The primary AWS service used for ChoreoSave was the EC2 (Elastic Compute Cloud). EC2 enables a user to create a virtual Linux or Windows based hosting server for setting up websites and software. To start using EC2 one must launch an instance, which requires creating or selecting an AMI to run on that instance. While creating and uploading
a custom AMI may seem straightforward, Amazon did not provide any standardized documentation. There were three different AMIs of EPrints available in AWS as part of the Community AMIs at the time of writing, of which only one seemed to be fully functional.

The author used the sole functional EPrints AMI and configured instance to use an Elastic IP. The Elastic IP address is similar to a static IP address in that it can support a consistent connection. However, it is also easily released and reallocated to other instances. In this case, the author used the Elastic IP to redirect the instance to the domain www.choreosave.org.

The installation and base configuration occurred through a command-line interface as seen in figure 5 in a Debian GNU/Linux environment. The process included the set up of the MySQL database associated with the EPrints archives for each repository setup.

Metadata
The metadata fields for ChoreoSave were influenced by three sources: the standard fields for the EPrints Performance type, the Siobhan Davies Replay archives, and the video archive of the California Institute of the Arts School of Dance. Well-known metadata standards such as Dublin Core or MODS were not taken into consideration because there were guaranteed overlaps in the ChoreoSave description fields with existing metadata standards fields.

The most basic metadata elements corresponded to the key components of a piece of choreography: a choreographer, a title (including ‘Untitled’), a set of performers, a musical or sound accompaniment (including silence), and a movement vocabulary. This vocabulary is ideally annotated in a set of choreographer’s notes and mentioned in some sort of description of the work. Describing a dance work that has been or will be performed brings into consideration additional details such as costumes, lighting, sets, sound, stage crew, performance venue, performance date, etc. Filming or taping the piece adds more metadata to be
considered. Finally, a choreographer may choose to post evidence of their work via YouTube or a personal website, creating a public iteration or imprint.

**Intellectual Property, Access, and Sustainability**

One key issue in making creative material available for the public online is that of protecting creators’ rights. The basic repository policies are linked to from the homepage. They are based on OpenDOAR policies (Directory of Open Access Repositories) that are required to be on a list of repositories maintained by the University of Nottingham in the United Kingdom. Although the focus is on academic open access repositories, the policy template is still useful. The primary components are Metadata, Data, Content, Submission, and Preservation. For each policy, there are a set of checkboxes and fields that must be filled out. Each base level option is mandatory but customization is optional. For ChoreoSave, the following policies were selected and defined.

The majority of policy options were selected to accommodate required access restrictions for the system testing period. One questionable item was the Preservation Policy in which the selected options did not clearly define a file preservation policy. Other options were not appropriate for the system and certain selections were worded more specifically to the academic community rather than general purpose. The most important policy options were numbers 6 and 7 in the Submission Policy section as it reinforces the need to respect copyright and intellectual property. All these policies can be customized further independent of the OpenDOAR policies by editing the corresponding XML page.

The ChoreoSave prototype is currently hosted in a manner that makes it difficult for an administrator to properly control factors such as hardware maintenance and environmental conditions. AWS provides most remote server hosting options but does not allow one to actually physically access the server hosting an instance nor personally upgrade the server as desired. There is some technical support available for a fee but it does not include the option of having personnel custom maintain the instance server. In an ideal situation, the entire infrastructure would be hosted redundantly at multiple academic institutions using virtual servers. However, even free software does not guarantee free services, so institutions would have to be willing to donate resources to this system. The highest cost-saving measure would be the ability of an individual or organization to use a pre-packaged and pre–tested AMI for their purposes.

**RESULTS AND DISCUSSION**

The two primary objectives to this research are how to identify the different facets of choreography that must be preserved in order to archive a choreographic work and how to implement a system that enables such preservation through peer production. The main types of information gathered from the findings were how metadata elements as used by other organizations, common cyberinfrastructure components, typical media formats and standards, models of financial sustainability, and necessary background expertise to archive choreographic works.

The second of this two-stage research process focused on synthesizing information gathered from the preliminary data collection to create and implement a digital dance preservation prototype. Four specific parameters were imposed on the design as a reflection of the current state of funding in dance and developments in digital technology. In order to satisfy research question 2, the ChoreoSave prototype needed to fulfill the following requirements:

1. Successful identification of an open source repository software solution to run the prototype system.
2. Effective use of cloud computing services to host the prototype system.
3. Minimal time and knowledge requirement for setting up, configuring, and maintaining the prototype system.
4. Simple technology so that any problems encountered during the running of the prototype system can be fixed with basic software repair techniques.

In order to meet the first two requirements, the author used EPrints repository software and Amazon Web Services to implement and host the ChoreoSave prototype system. The third requirement was partially satisfied since no programming expertise is required for the program’s installation and maintenance other than knowledge of XML, HTML, and the Linux command line interface. The time span for setup and configuration also only took 2 months of part-time effort. However, the lack of comprehensive documentation for setting up EPrints on an Amazon EC2 instance caused some significant delays in the prototype system setup process. Troubleshooting the prototype required significant research into web server error messages and solutions. The primary issue was the tendency for the web server software to suddenly terminate its services. Regularly restarting the server provided a temporary solution for the testing period, but was not realistic for a final implementation of the system.

Nonetheless, the existence of ChoreoSave demonstrates that a basic prototype can be built under the parameters specified in Q2 with potential for actual use with the possibility for ChoreoSave to become a peer-production based system.

**Troubleshooting and Challenges**

The author conducted two evaluations of the ChoreoSave system. The first evaluation was that of basic quality assurance and troubleshooting. The author used standard tools such as the Apache2 and MySQL error logs to identify
any server problems and solutions. As it turned out, there were known issues between EPrints v.3.1.3, MySQL, and Apache2 leading to segmentation faults that appeared in the official EPrints technology support e-mail forum at http://www.eprints.org/tech.php. The author updated MySQL to the latest version of 5. Xx, but this did not resolve the problem. At the time of testing, ChoreoSave was experiencing web server crashes due to “child pid segmentation faults (11)”. The author monitored the website and restarted the Apache2 server as needed during these periods. The second form of evaluation took place in the form of a limited user testing of ChoreoSave. Due to the coinciding of testing with the fall concert and Nutcracker ballet season, there was a low response of 3 users out of a call for 50 dancers across college dance programs and young professionals. As such, the results were not significant.

FUTURE RESEARCH
Areas of improvement that could be addressed in future stages of program development would include modifications to the user interface, a clearer indication of how users can upload multimedia to the repository, and a revised version of the metadata fields. Overall, the results for all three research questions implies that the ChoreoSave prototype has a degree of uniqueness in that no large dance organization in the US runs such a system, there was no publicly or easily accessible documentation for creating such a system, and a custom set of metadata elements had to be created for the system. However, the areas of improvement can only be verified through the use of focus groups and structured user testing.

Limitations and Future Development
The primary limitation of this research was the scope. To fully explore the research area would have required more personnel to develop the prototype and conduct a usability study over a sustained period of time. Conversely, narrowing the problem scope would have made the prototype too isolated from existent solutions and real world issues.

In order to accurately collect user feedback, a series of on-site focus groups and interviews with dance organizations and academic institutions would be most effective for gauging the effectiveness of ChoreoSave. An ideal scenario would be to locate a cross-national group of individuals representing a wider range of regional dance cultures. One complication in conducting the pilot surveys seemed to be an issue of timing. The fall season seems to be a traditional period for producing first concerts of the season followed by holiday performances. Some form of professional exposure as a result of testing would probably also provide an incentive for choreographers to participate.

Gathering such data would enable the evolution of the ChoreoSave prototype in terms of technological and service-oriented developments. One possibility would be to follow the DHC model and offer itself as a portal to the collections of both individuals and organizations. Another option would be to turn ChoreoSave into a beta release advertisement-funded free online social media service for the general public. Improvements and modifications would take place over time based on user feedback. With the lines of the concert and commercial dance worlds blurring, ChoreoSave can be a multi-purpose software solution with all the aforementioned characteristics in order to provide maximum benefit to several user groups.

Given these options, the most logical choice as a solo researcher would be to collaborate with the dance department of an academic institution with a digital repository service. This arrangement would enable the author to focus on user input to develop a beta version of ChoreoSave, whether through the institution’s cyberinfrastructure or an independent one. Students in college choreography classes are particularly ideal for feedback as they are emerging artists with limited resources who have incentive to build a portfolio for their career.

If a group of individuals were to develop ChoreoSave together, though, the social media option would become more feasible since the author would not be responsible for all aspects of the system. Placing ChoreoSave in a non-academic setting would also release the project from any institutional review board (IRB) requirements.

CONCLUSION
Digital dance preservation may not have a common definition in the United States nor be a standardized process but it is certainly being investigated by dance and information professionals within and outside the United States. The crux of the situation is likely the lack of a standardized approach agreed upon by both dance information professionals and the general dance community. A more specific definition of what it means to preserve dance using digital technology would aid the creation of such a standardized approach.

Likewise, repository software and cloud computing services may not be fully adaptable for digital dance preservation but are still able to provide a temporary technology solution. During the course of this study it was apparent that a digital repository for choreographic works needed as many features as there were facets of the work. Institutional repository software is increasingly able to accommodate many kinds of intellectual property but most lack the interactive multimedia interface of video sharing websites. This interface is important because a visual representation of dance is ultimately of the greatest importance to dance practitioners. It would be inefficient and impractical, however, for each organization to create its own customized system and certainly beyond the means of most individuals. Having a technologically complicated system would also be problematic since hiring a technology expert to provide constant maintenance for a program would be a significant expense. A general information technology specialist for an institution may not even be able
to handle this task since a high level of technical expertise is needed for doing basic tasks such as setting up a cloud-computing host particularly for specialized software. Nonetheless, a digital dance preservation system could be rooted in institutional repository and content management software as a website hosted in the cloud. It would require a very strong financial and technological sustainability plan that includes the collaboration of major organizations to bear the weight of major costs so that the public could use the system for free.

The most important issue in establishing standards and means for digital dance preservation is the lack of communication between choreographers, archivists, and non-professional users who will look up choreography. Information professionals, particularly archivists, are familiar with the difficulties of trying to recall minute details of collections without sufficient metadata. Likewise, users expect to find things using even remotely related search terms. However, choreographers have to understand the importance of providing detailed metadata. The lax requirements for metadata are what make a video sharing website such as YouTube unreliable as an archival option. If a single choreographic entry can be considered a “collection,” the less descriptive metadata and supporting media there are, the more difficult it is to understand the work as a whole.

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REFERENCES


Coventry University. (2010). Dr Sarah Whatley – Head of Performing Arts – Coventry University. Retrieved from http://www.coventry.ac.uk/cu/d/162/a/468


