Designing the Future Landscape: Digital Architecture, Design & Engineering Assets

A report on the Architecture, Design and Engineering Summit organized by the Library of Congress, the National Gallery of Art and the Architect of the Capitol on November 16 & 17, 2017 at the Library of Congress.

#DigADE2017

Report author: Aliza Leventhal for The Library of Congress

March 12, 2018

This work is available for worldwide use and reuse under CC0 1.0 Universal.

Designing the Future Landscape: Digital Architecture, Design & Engineering Assets

ACKNOWLEDGEMENTS **2**

INTRODUCTION **3**
- GOALS 3
- STAKEHOLDERS 4
- BACKGROUND 5
  - Archival Community's Efforts 5
- PRODUCT, DATA, PROCESS 7

LEGACY DATA & DEVELOPING SUSTAINABLE DELIVERABLES **8**
- INTRODUCTION 8
- LEGACY DATA 8
  - Background: Emerging from the Wild West 8
  - Approaches and Initiatives 10
    - Approaches 10
    - The Landscape of Past and Current Initiatives 11
    - Software as Infrastructure 13
    - Emulation as a Possibility 14
  - Case Studies: Accessing Legacy Data 15
    - Narrative Support 15
    - Early exploration, the new research frontier 16
- DEVELOPING SUSTAINABLE DELIVERABLES 17
  - Background: A Shared Goal 17
  - Making the Business Case 18
    - Collecting Institutions 19
    - Designers/records Creators 20
    - Insufficient Surrogate Records 21
    - Long-term Reference 22
  - Standardization 23
    - Developing Standards 23
    - Resistance to Standards 26
    - Adopting Standards 27

CONCLUSION: MOVING FORWARD **29**
- EXPLORING THE "WHAT" AND THE "HOW" 30
- RAISED AWARENESS 31
- COLLECTIVE IMPACT 32

APPENDIXES **34**
- APPENDIX A: PROMPTS FOR SYMPOSIUM PANELS 34
- APPENDIX B: WORKSHOP QUESTIONS & RESPONSES 36
- APPENDIX C: WORKSHOP PARTICIPANTS 39
- APPENDIX D: SUMMIT PROGRAM COMMITTEE 41
- APPENDIX E: SYMPOSIUM PANELS – SESSION SPEAKERS 43

Acknowledgements

This report was written by Aliza Leventhal, the librarian and archivist for Sasaki, an interdisciplinary design firm. She is the co-founder and chair of the Society of American Archivist's Design Records Section's CAD/BIM Taskforce. She leads research and advocacy efforts with fellow archivists around digital design files and software. Focused on expanding visual and technical literacy for design and architectural archivists, her research aims to lower the barriers for archivists to engage with digital design records.

The author would like to thank the Library of Congress, the Architect of the Capitol's office, and the National Gallery of Art for hosting the November Summit. Additionally, thanks is due to all of the participants of the Symposium's Sessions and the Workshop. A special thanks to Kit Arrington and Kate Murray from the Library of Congress for their support of the Summit, as well as for their critical feedback during the writing of this report.

The Summit Organizing Committee would like to acknowledge and thank the members of the Program Committee (Appendix D) who generously provided their time and expertise, and who, through a series of telephone conferences, were instrumental in creating the content of the Summit.

Cover Image:

CAD representation of the Library of Congress Jefferson Building Dome from the records of the Architect of the Capitol.

Introduction

GOALS

The Library of Congress, in partnership with the Architect of the Capitol and the National Gallery of Art, organized the Designing the Future Landscape: Digital Architecture, Design and Engineering Assets[1] summit held over two days in November 2017 with about 180 participants attending the first day of the Symposium and 24 participants in the half day workshop that followed (Appendix C). The event provided the opportunity for a broad community of stakeholders connected with the architecture, design and engineering (ADE) professions, from creators to curators, to come together to explore the issues and obstacles around long-term preservation and access of these records and begin working towards sustainable solutions. Together on the stage and in the audience, participants included architects, building managers, archivists, engineers, librarians, record managers, government agencies, academics, collecting institutions, digital preservationists, and many other professions. The summit provided the necessary space for this diverse group to engage in thoughtful discussion around the past, present and future state of the changeable landscape of digital design records. The edifying one-day presentation-based Symposium and thought-provoking half-day informal workshop facilitated the exchange of important context and perspective of the various attending professions' initiatives, concerns and priorities related to these records.

The first day's four sessions were organized to build upon themselves providing the necessary base knowledge to appreciate the insights of the next session. Starting with a brief overview of the last 50 years of the complicated landscape of digital design software (Session 1), the rest of the day covered the culture and workflows of practitioners using those software (Session 2); how researchers, collecting institutions and practitioners are and will use the records produced by those software (Session 3); and what collaborative efforts are occurring around guidelines and standards to facilitate access and interoperability among software (Session 4). Through this progression the attendees were able to see the various layers that burden the efforts to preserve digital design files and software that go further than the data and products involved, while also exploring the process of record creation to better visualize opportunities for solutions and change.

Throughout the two days the critical issues that arose within the community of stakeholders were:

1. Identify and articulate the full landscape of digital design files
2. Determine what design records, and specifically data or information in those records, that the various stakeholders need in the immediate and long-term
3. Develop better communication and information sharing practices, which are critical to developing sustainable solutions to long-term preservation, access and use of digital design files

[1] Library of Congress. "Designing the Future Landscape: Digital Architecture, Design and Engineering Assets." 2017. Accessed March 2018. http://loc.gov/preservation/digital/meetings/ade/ade2017.html

STAKEHOLDERS

The stakeholders represented in the selected presenters and in the audience of the November Symposium ranged from the record production side, including designers and technologists, to the curation and preservation of those records in software, including collecting institutions, owner-operator agencies, archivists and digital preservationists. Each stakeholder recognized that there are significant issues and barriers to long-term access of digital design files, and articulated their specific concerns related to those challenges.

- **Designers/Records Creators** expressed frustrations that could be encountered sharing files during project collaborations, and disappointment in being unable to open files from older projects that their current software does not support. They recognized the shortcomings of saving PDF versions of their final plans, models and renderings as insufficient to provide insights and a foundation to build upon when they return to that project at a later time.

- **Researchers/Scholars** recognized the value of having access to the complete file directory or comprehensive access to the digital environment the design files were created within. Two presenters described how their privileged position in accessing historic records from within a firm was the ideal research environment, especially when comparing with archives that face barriers and limitations to providing similar digital access in their reading rooms.

- **Collecting Institutions** have a substantial challenge of providing technical support and subject expertise for design collections that have hybrid or entirely digital records. These collections vary in size, but will result eventually in Petabytes of data, and have significant software dependencies that are difficult to acquire and maintain if each institution were to take on this challenge independently.

- **Software Vendors**, although this group was less represented than others at the Symposium, play a critical role in determining which standards to support and will require their clients to articulate the preservation, interoperability and workflow requirements for their software to respond to. In the absence of an articulated business model, without users asking for long-term accessible files, or providing guidance about features and priorities, vendors do not have incentive to add those features.

- **Guidelines, and Standards Organizations** have made efforts on both national and international stages, and across industries; however their development has not included all stakeholders' perspectives or needs. There are reasons to be optimistic about the potential for standards to improve the future of design records, but it became abundantly clear that standards will need to include implementation guidelines and interoperability capabilities in addition to the desired output of a preservation format. There are successful examples of this type of collaboration across interest groups, such as the CAx Implementor's Forum within the aerospace and defense industries, which was discussed in some detail by Phil Rosche.[2] Additionally,

[2] Session 4, "A Template for Interoperability Testing," **Phil Rosche,** CAx Implementor Forum, ACCR,

there was an expressed need for a tiered approach to preservation, such as the Federal Agencies Digital Guidelines Initiative's (FADGI) scanning guidelines to ensure best practices are upheld regardless of an institution's available resources.[3]

It is important to note that there was a bias in the sessions and focus of the presenters towards architectural records. However, the issues raised for the records produced by the architecture profession resonate within engineering and other design professions including graphic design, landscape architecture, planning and urban design, and archeology.

Several presenters shed insight on the efforts undertaken thus far by their professional community to begin to address their most pressing concerns about these records that range from exploratory research,[4] to offering record creators workflow improvements,[5] to developing digital environments to access files in their original environment.[6] This Summit served as a call to action as the result of many years of work across several professional communities and will hopefully serve as a spring board for agencies and the newly formed collective community of stakeholders to begin to take actionable steps to ensure long-term access and preservation to existing and future records.

BACKGROUND

Archival Community's Efforts

There is a rich history of collecting architecture and design records in the United States, starting at the end of the 19th century when universities began formal architecture programs and the Library of Congress' Division of Graphic Art (now Prints and Photographs Division) was established, which included architecture and design related records in its scope. Since collecting began, the task of preserving design records has been challenging not only due to the fragile and chemically volatile nature of common support materials such as trace paper and reproductions such as blueprints; but also as a result of the experimental practices architects and designers have utilized to layer or merge materials, or in reproduction methods to provide new and interesting documents to communicate their design intent, and in the challenge of storing physical models. This predicament has continued as the design professions adopted Computer Aided Design (CAD) in its variety of forms and functions ranging from graphic rendering, technical drawing, animation, and three-dimension (3D) modeling. Since the 1960s computers have played a role, if mostly theoretical at first, in the architecture and design

---

https://www.youtube.com/user/LibraryOfCongress, and https://www.cax-if.org/

[3] FADGI's scanning guidelines has different levels built in to provide scalable solutions for institutions with varying levels of resources or capacity. Federal Agencies Digital Guidelines Initiative (FADGI). "Technical Guidelines for Digitizing Cultural Heritage Materials." September 2016. Accessed March 8, 2018. http://www.digitizationguidelines.gov/guidelines/digitize-technical.html.

[4] Session 3, "New Archives: Digital Forensics and Programmatic Methods in Digital Design History," **Andrew Witt**, Graduate School of Design, Harvard, and "Expanded Archives of Digital Culture," **Matthew Allen,** Harvard University, University of Toronto, https://www.youtube.com/user/LibraryOfCongress

[5] Session 2: Data Flowing Through Time & Digital Tapestry, https://www.youtube.com/user/LibraryOfCongress

[6] Session 3, "Emulation for Access," **Euan Cochrane**, Digital Preservation Manager, Yale University Library - Presentation

disciplines. As the first Session of the Symposium discussed in depth, the development of computers and design software within that context, especially from the 1980s and 1990s, provided a veritable digital playground for tech-savvy architects to push the structure and communication of their designs.[7]

In a parallel world, starting around the same time (late 1970s) architectural archivists under the name COPAR (Cooperative Preservation of Architectural Records)[8] began organizing regionally to proactively connect with architecture firms and raise their awareness of the value their records held to collecting institutions. Forty years later, these cooperatives are still being formed as the Library of Congress in partnership with the Architect of the Capitol and the National Gallery of Art hosted this Summit to reach beyond architectural archivists and bringing together stakeholders with shared concerns about preservation and access to digital design records. Since the establishment of the COPARs archivists have pursued a variety of methods to educate themselves and the creators of design and engineering records about the value of their records. The COPARs sought to engage, support and learn from active and retiring design practitioners through efforts such as developing regional directories of active design firms, to publishing best practices for firms to care for their project records, to establishing a formal community of architectural archivists within the Society of American Archivists. In the past five years, the Architectural Records Roundtable, now Design Records Section, has sponsored a CAD/BIM Taskforce whose work to research the issues around digital design software, contributed significant momentum to this in-person inclusive gathering of the full community of stakeholders concerned with various aspects of the lifecycle of the assets produced by architecture, design and engineering professionals.

Beginning with the first session, a clear distinction was made about the issues surrounding ADE assets: we are fighting two battles.[9] The first is addressing the backlog of unpredictable digital files and obsolete software that have and are slowly making their way into private or institutional archives; and the second is developing a future world of platform independent file types and archival standards based record guidelines. These issues are part of a continuum of the evolution of design records, but both this past/present and present/future collections of records pose very different challenges to our collective community. The categorizations of past/present and present/future indicates that we are not yet at a place to confidently identify when the shift to less platform-dependent files will be, and as such, must accept this overlap.

As each stakeholder group has attempted their own comprehensive or stop-gap measure solutions to providing long-term access to these demanding records, it is clear that it is time to work as a collective rather than in isolated efforts within each professional group. Even within the short two day meeting this approach proved fertile as stakeholders shared the types of work and initiatives being undertaken that had not been known by the entire gathering, and offered potential opportunities for collaboration. These examples will be explored more in the concluding section of this report.

---

[7] Session 1, ADE Formats Primer

[8] Library of Congress. “Prints and Photographs Reading Room.” 2010. Accessed March 8, 2018. https://www.loc.gov/rr/print/adecenter/ade-about.htmls.

[9] Session 1, ADE Formats Primer, and Summary, **Tim Walsh**, Canadian Centre for Architecture

PRODUCT, DATA, PROCESS

"What are we preserving, and why?" was the prompting question Nancy Hadley, the archivist for the American Institute of Architects, heard within the subtext of each Session, to which she offered a high-level synopsis of Product, Data, and Process. This succinct synopsis facilitate more granular investigations of the issues within each category. This question can and was asked of each stakeholder, resulting in varying answers, but inherent in each will be elements of the Product, Data and Process involved in the creation and existence of digital design records.

Products are the outputs, the wide range of complex digital objects created by designers and engineers. Preservation of the products includes storage and access. Access to the files can require the original version of the software and the operating system it was used within in order to be accessed as their creators had previously done. Current work with emulation suggests that it might be possible to create such an environment, but this requires the acquisition of all of those dependent pieces, contextual understanding of how the software and Operating Systems (OS) were used and expertise to build and maintain the emulated environments. Such an environment is challenging to recreate, and requires parallel preservation efforts of the digital files, the software, and the OS and sometimes knowledge of how the creators used, or modified the software and hardware. Emulation could work despite all of its dependencies for complete success, but the products will still require initial mitigation; and, without proactive intervention of future file types the list of possible products (e.g. file types) will only continue to grow.

Data is at the root of the question "What are we preserving?" Data is the foundational element of all digital records, and the strength of the metadata aggregated across digital files and intentionally included by record creators is critical to the accessibility and interpretability of a project through its digital files. This category is specific but the content is broad reaching, as data pertains to all the pieces of information that influence or support a designer's work and the functionality of their wide selection of software. This category includes environmental or contextual data such as GIS and energy modeling data, and also refers to the robust data set developed within a Building Information Model (BIM) record. It is critical for designers and records creators to identify what data is important to their work, and indicate how much of the robust data developed are new or evolving attributes of the design process. This type of conversation with creators will help archivists better understand the developing practices within the design and engineering fields, and better prepare them to ask and categorize the records they accession into their collections.

The **Process** of designers and their work is the most complex element to capture in digital records. Barriers to capturing and collecting records that articulate the design process include technological limitations, lack of documentation by project teams, the use and integration of multiple software tools in contributing to a single document output, an institutions' collection policies, and communication between records creators and institutions receiving their donated materials. Technological limitations include how software varies in their automatic capture of data that would provide insights into identifying who did what work; and the inconsistent availability of versions of software used throughout a designer's career or firm's existence can inhibit access to a collection's materials. There are also potential contextual limitations, as the contextual business records such as the accounting and marketing records about project teams or project pursuits, are not always collected by archives, but could be valuable information depending on a researcher's focus. These challenges are exacerbated by communication

issues, which was a concern mentioned several times throughout the Symposium and Workshop. Communication was seen as an area to improve upon by institutions and designers alike, whether records are donated to an archive or kept within a firm. As archivists and facilities managers ask designers to explain and record the phases of a project (Schematic Design, Design Documents, Construction Documents, and Construction Administration) the nuances of the design process will be better captured. This need linked directly to the topic of creating and providing guidelines which will be discussed later in *Standardization* Section (pg. 20-25) of this report.

Legacy Data & Developing Sustainable Deliverables

INTRODUCTION

In approaching the issue of preserving and providing long-term access to digital design software with our framework of "Product, Data, and Process" the issues of the past/present and present/future records become more clearly divided. As done during the Workshop, this report will discuss the issues of the legacy data and the potential of the present/future records separately in this section. This separation provides the necessary space to discuss in greater details the issues and opportunities of each category of records.

The first section will focus on legacy data. Starting with an overview of the landscape of past and current efforts within the archival community to better understand and address the preservation concerns, and closing with case studies from practitioners and researchers using the past/present category of records.

The second section focuses on current efforts and future aspiration for the development of sustainable deliverables. All mentions of sustainability in this report is from the lens of digital preservation, which implies that several issues and concerns are addressed to reliably ensure long-term access and integrity of the digital information, and recognizes that there is a continuous maintenance component.[10] In addition to describing the possible business cases to be made for investing in more sustainable record production, this second section will explore the discussion around the use and development of standards for digital design software.

LEGACY DATA

Background: Emerging from the Wild West

The 1980s and 1990s were an especially experimental time for architects and designers who were testing the limits of design software at their disposal. This led to outputs without contextual documentation, which is unfortunate as that context is often critical not only to understanding design intent, but for an archivist or researcher to see the nuanced aspects of how a record was

[10] Library of Congress. "Sustainability Factors." Sustainability of Digital Formats. January 5, 2015. Accessed March 8, 2018. https://www.loc.gov/preservation/digital/Formats/sustain/sustain.shtml.

created. The contextualization of digital design within the broader evolution of technology was a recurring theme of the Symposium.

The third Session, Access Use Cases, shed light on the limitations and opportunities of early design software to support designers' visions beyond what the software was originally intended to do.[11] Both the first Session, an ADE Formats Primer, and the Access Use Cases Session argued that the digital design is but another tool to the designer, and as the functionality of the software developed and designers gained more mastery over them new possibilities were not only imagined but created. As exhibited by the development of Gehry Technologies, it was often the users pushing the limits of the technology and software vendors to develop better graphic and geometric functionality.[12] This process and progression can be studied through the files and data from the time of creation as was explored in the Canadian Centre for Architecture's three-part exhibit (2013-2016), *Archeology of the Digital.*[13] The first Session provided additional critical context discussing the evolution of design software's close connection to and inspiration from the automotive, aerospace, and animation professions. In this Session, Tim Walsh identified how the same software used for special effects in the original *Jurassic Park* was adopted by architects[14] to improve their rendering and design representations and models with animated fly-through.[15]

This anecdotal information has been more quantitatively captured in the software/technology surveys conducted by the American Institute of Architects (AIA).[16] These surveys, which began in 1987 and was most recently conducted in 2016, indicate that CAD was rapidly adopted by large and medium sized firms in the 1990s, and by the end of that decade these software were being utilized in projects beyond experimental exploration. Katie Pierce-Meyers and Walsh attribute the rapid adoption of computers and thereby design software to the wider availability of the 32-bit Operating System in the mid-1990s. Design software vendors, like so many software vendors during the 1990s, seized the opportunities provided by the available hardware of this time period to achieve more and more of the envisioned and desired potential benefits and functionality that had continued to grow since the early predictions. Such predictions were being made as early as 1976, as practicing architect Genevieve Greenwald-Katz articulated that architects would be motivated to use architect-computer interfaces if they could relieve the architect of repetitive remedial tasks, support time-intensive tasks, or process significant quantities of data, all which have been addressed by various digital design products.[17]

The broad adoption of computers and design software by the end of the 1990s does not mean that the software was, or is now, being consistently used across the profession, or even within a

[11] Session 3, Access Use Cases
[12] Session 3, Access Use Cases
[13] Canadian Center for Architecture. "Archaeology of the Digital: Complexity and Convention." Exhibition, Main galleries, 11 May 2016 to 16 October 2016. Accessed March 8, 2018. https://www.cca.qc.ca/en/events/38273/archaeology-of-the-digital-complexity-and-convention
[14] Asymptote. Virtual Trading Floor. Accessed March 8, 2018. http://www.floornature.com/asymptote-architecture-virtual-trading-floor-4818/
[15] Session 1, ADE Formats Primer
[16] For the most recent of these surveys, https://www.aia.org/resources/6151-firm-survey-report-the-business-of-architectu
[17] Greenwald-Katz, Genevieve. Computers in Architecture. York: Univ. of York, 1972. Pp. 315-320.

firm; but rather implies that the foundation for some digital workflows was being more formally developed as the design professions continued to value and strive for better collaborative project work experiences. As Mark Rylander, a sole practitioner, identified "the inherent issue" of incongruity between designers and the technology they use is that: "designers aren't as methodical as would be ideal to reconcile the processes computers require."[18] Greg Schleusner, of HOK, explained that the design process is inherently adverse to standardization, including the production process and technology used, which is consistently adjusted to support the unique needs of each project as it comes.[19] This leaves archivists and collecting institutions to prepare for the intricate puzzle of records not only unique to each designer or firm's collection, but often for every project within a single collection.

Approaches and Initiatives

APPROACHES

Throughout the Symposium and Workshop, there was very little discussion about retroactively applying standards to existing digital design records. Instead, it was commonly held that these legacy records should be accepted as the complicated sets they are and institutions should focus on supporting them in their original environments, or as close to that as possible. Walsh, having had significant experience working with the highly experimental records collected at the CCA, expressed gratitude for videos and recorded walkthroughs of the models that proved to be more dynamic and compelling representations than the static renderings or models made up to this time.[20] Such recordings provide important insight into how a designer used various software and offers an accurate representation of a file in its original environment, although slightly removed for the viewer. This is especially invaluable as providing original environment experience may not be replicable for all institutions depending upon their ability to replicate the technological and user knowledge dependencies required by that specific file (e.g. to know to select layers on and off, or how to change the viewing options).

The market for design software has continued to grow and change overtime, with market winners shifting as innovative software came on the market and changed the way designers created and communicated their designs. A few vendors have maintained their position as market dominators, but as Walsh explained in his presentation in the first Session, these market dominators have not simplified the landscape of design software as they support and use dozens of file formats.[21] The market developed in response to industry demands emphasizing design tool innovation and following a proprietary software business model. Software development resources did not include creating interoperability among software, or backwards compatibility within software.

For collecting institutions that want to reflect the development of design disciplines, or the architecture, engineering and construction (AEC) community in general, this evolution and market dominance is important and it is difficult to demonstrate without the original software,

[18] Session 2, Fireside Chat - Data Flow
[19] Session 2, "How We Create and Save," **Greg Schleusner**, HOK
[20] Session 1, ADE Formats Primer
[21] Session 1, ADE Formats Primer

sometimes original hardware, and understanding the workflows of that time period. Meyerson explained that the need to preserve information produced by the software and the inherent value and cultural memory benefits of understanding the development of software is a separate concern that cannot be forgotten or de-prioritized as the issues of long-term access and preservation of digital design are discussed.[22]

The conversations consistently returned to the questions: "What is important to keep" and "how do we make sure our future colleagues can use existing records and those made in the future?" Asked several times and by every stakeholder group present, it became clear that stakeholders looked to each other for impactful answers, begetting the question: which is the right stakeholder to make these decisions? While that question was not answered, consensus was reached that the "what" and "how" widely varied based on the stakeholders' priorities and capabilities; and that the appropriate solution would acknowledge this range.

THE LANDSCAPE OF PAST AND CURRENT INITIATIVES

As mentioned previously in the report, and often during the course of the Summit, there have been many efforts to address and explore the issues of digital design software and their outputs prior to the November, 2017 summit. This section will provide a brief overview of those efforts; which range from exploratory information gathering, to providing best practices, to exploring potential processing and preservation practices, these efforts have been ambitious and have each been significant in raising awareness and understanding of issues around digital design software for collecting institutions.

Within the collecting institution space, efforts like Kristine Fallon's 2003 work for the Art Institute of Chicago[23] and the two-part IMLS-funded "FACADE: Future-proofing Architectural Computer-Aided DEsign" projects hosted out of MIT[24] and Harvard University[25] (2010 and 2013 respectively) demonstrate the need for continuously revisiting and assessing the landscape of digital design software and file types as well as the challenges of offering recommendations for managing records. As a practicing architect, Fallon's report provided recommendations to cultural institutions managing digital design records as well as related born-digital and digitized records. Similarly, the first FACADE project explored the diverse landscape of digital design files, with a clear focus on Computer Aided Design (CAD) and Building Information Modeling (BIM), and offered recommendations to support curators to describe these files by developing an ontological model for capturing architectural drawings. The second phase of FACADE, entitled FACADE2, aimed to build upon its namesake to develop the Curator's Workbench, which was intended to help facilitate the description of digital design records. This technologically

[22] Session 4, "Software Preservation Network: The Access Breakdown and System Level Change," **Jessica Meyerson**, Software Preservation Network, Educopia Institute
[23] Art Institute of Chicago. "Project Update, October 2007." Digital Design Data. October 2007. Accessed March 8, 2018. http://www.artic.edu/collections/digital-design-data
[24] Massachusetts Institute of Technology. "Final Report for the MIT FACADE Project: October 2006 – August 2009." April 2009. Accessed March 8, 2018. https://www.architectuurarchiefvlaanderen.be/sites/default/files/projecten/bijlagen/bib_3896_facade_final.pdf
[25] Harvard Library Lab. "Façade 2." Accessed March 8, 2018. http://osc.hul.harvard.edu/liblab/projects/facade2

ambitious effort was not fully actualized, but the source code is open to support continued research.[26] In 2013 the United Kingdom's Digital Preservation Coalition released a seminal report providing "a comprehensive overview of the development of CAD technologies": "Preserving Computer-Aided Design (CAD)" by Alex Ball, referenced in more detail later in this report, which still serves as a guide in the technological challenges, and changes in practice needed.[27] These projects, as well as 10 others were explored by the Society of American Archivists' Design Record Sections' CAD/BIM Taskforce in 2013, which resulted in an annotated bibliography of 13 projects undertaken since 2000 that sought to give an overview of the landscape of digital architectural records and management at that time.[28]

Developing a rich corpus of knowledge over the last two decades has been insightful, but the complexity and continuously changing landscape of digital design records has hindered attempts to establish and implement recommendations within collecting institutional settings. The dynamic market of software and myriad of file types has been intimidating to any institution attempting to adopt or uphold these recommendations thus far. Institutions like the CCA that focus on the experimental records of early adopters and technologically avant-garde designers have been able to process their collections as unique instances that fit within a strong digital preservation workflow. However, even with the resources and expertise at the CCA, Walsh argued that there are challenges in using well established preservation standards such as STEP or IGES due to the scalability required to process the large number of records related to each project.[29] This is often a shared sentiment within collecting institutions who rarely have a large enough staff to provide enough time and expertise to process and support both the analog and digital design records donated.

Past and current archiving efforts by firms appears to be primarily limited to the common practice of maintaining their original digital project files for the statute of limitations for legal liability. Some progress is being made in this realm as collecting institutions, such as Yale University, have developed donor agreements with active firms to have them hire an archivist and process their project records in advance of the materials being transferred to Yale. This is an interesting model that allows the archivist to proactively engage and raise the awareness of current design practitioners of the anticipated concerns and issues their records will present to archives, and offers that valuable opportunity for knowledge transfer and sharing to happen between the donor and archivist as they review the materials to be donated. As more archivists are being hired in architecture and design firms, this will be an interesting area to continue to follow and an opportunity to leverage as flexible best practices develop.

---

[26] Berkman Center. "Back-end Rails application for the Curators Workbench." GitHub. 2015. Accessed March 8, 2018. https://github.com/berkmancenter/cwb_backend

[27] Ball, Alex. "Preserving Computer-Aided Design (CAD)" DPC Technology Watch Report 13-02. April 2013. Accessed March 8, 2018. https://www.dpconline.org/docs/technology-watch-reports/896-dpctw13-02-pdf/file

[28] Leventhal, Aliza and Zalduendo, Inés. "Draft Bibliography On Studies Dealing With Legal, Technical, And Curatorial Issues Related To Born-Digital Architectural Records CAD/BIM Taskforce. " CAD/BIM Taskforce Society of American Archivists. 2013. Accessed March 8, 2018. https://www2.archivists.org/sites/all/files/AR%20Taskforce_Born%20Digital%20StudiesBibliography_AL+IZ_FinalDraft_revised.pdf

[29] Pratt, Mike. "Introduction to ISO 10303 - the STEP Standard for Product Data Exchange." NIST. March 01, 2001. Accessed March 8, 2018. https://www.nist.gov/publications/introduction-iso-10303-step-standard-product-data-exchange-0

On a larger scale and looking to the horizon, DuraArK (Durable Architecture Knowledge) a European Union Community Research and Development Information Service funded initiative that began in 2013, has been developing methods and tools to support the long-term preservation of architectural knowledge, including data and 3D models.[30] This broad-scoped program has developed numerous management plans, a metadata schema, as well as infrastructure elements to support the project itself.[31] Though not fully exploring issues of access to legacy data, there is much good work occurring as this multifaceted project continues to evolve as it proactively tackles new platforms and file types, such as point cloud data from 3D scanning. This work must continue while sustainable deliverables for the future are being developed and adopted.

SOFTWARE AS INFRASTRUCTURE

While the Symposium often focused on the records produced, which pose their challenges, there was a clear understanding that the software must be kept at top-of-mind throughout discussions of solutions for preservation and access to the records. The most compelling argument for this was by Jessica Meyerson in the fourth Session, What is Happening Now?, where she broke down how software is infrastructure.[32] Meyerson, the cofounder and leader of the Software Preservation Network (SPN), provided succinct descriptions of software features that assert it is an infrastructure:

- Software is embedded with a reach and scope throughout our physical and virtual world.
- Software is a transparent invisible support for tasks of the simplest and most complex orders.
- Software use is a signifier of a learned membership of tacit and tactical skills.
- Software embodies standards, as systems and rules impact its use and functionality.
- Software continuous improvements are experienced through fixed and modular increments with changing dependencies.
- Software is visible when it breaks down or malfunctions.

These descriptions make up the compelling argument Meyerson offered explaining how software is a form of infrastructure. These separate but connected characteristics describe and support the concerns, challenges, and opportunities discussed throughout the Symposium and Workshop.

Researchers, practitioners, archivists and technologists recognized throughout the sessions that the evolution of software's functionality and priorities have influenced the design process and types of documents created. Because of the importance of preserving software both for

[30] DURAARK. "DURAARK: Durable Architectural Knowledge Home." Accessed March 8, 2018. http://duraark.edu/
[31] DURAARK. "DURAARK: Deliverables." Accessed March 8, 2018. http://duraark.eu/deliverables/
[32] Session 4, "Software Preservation Network: The Access Breakdown and System Level Change," **Jessica Meyerson**, Software Preservation Network, Educopia Institute

access to the records content as well as to accurately be able to explore the design process that created records, more than one speaker raised questions related to copyright and licensing of software that may be stored or transferred with records and potential related licensing restrictions, an issue that is being explored and addressed in the digital preservation community.[33] As the technological foundation of the design process, software pushes the AEC/ADE community in new directions and normalizes new methods of production and communication. Allen, referencing architect and early technology adopter/experimenter Greg Lynn, illustrated how the software can be visible within the design and how researchers can benefit from exploring this subtle but essential layer of the design process and records.[34] In juxtaposition to Walsh, Pierce-Meyer and Aliza Leventhal's assessment of the significance of documenting the evolution of adoptions of various software within the design professions, Allen's observation demonstrates how much more of the nuanced information a researcher can identify and use within digital design records.[35] For archives and scholars to successfully support and explore the new methods and forms of designing and expressing design intent it is imperative to recognize software as the foundation.

EMULATION AS A POSSIBILITY

Emulation as a Service (EaaS) is a possible method for achieving full access to the original experience previous generations of designers experienced in their work with design software. Euan Cochrane's development and use of emulation acknowledges the costs of expertise, time, and support technology; but it is clear from his brief demonstration during his presentation that the ability to provide original-environment experience to access complex digital design objects could offer something previously unimaginable to researchers and practitioners.[36] Cochrane, in collaboration with the Software Preservation Network, has been awarded two $1 million grants from the Alfred P. Sloan Foundation and the Andrew W. Mellon Foundation to continue to develop and explore this possible digital access solution.[37]

While emulation has not been accepted as the ultimate solution by the digital preservation community, it is absolutely deserving of continued exploration and it is incredibly helpful to the design records community to have digital design records from the past/present era included in Cochrane's pilot efforts. Using this project as a possible solution for access, curation and description support, institutions collecting design records can begin to imagine new reference and access models for researchers, where they would be able to access the digital collection in its entirety and also the files in their original program. Through emulated environments designers would be able to walk through their design files in their original programs, supporting the

---

[33] Association of Research Libraries. "The Copyright Permissions Culture in Software Preservation and Its Implications for the Cultural Record." February 2018. http://www.arl.org/storage/documents/2018.02.09_CopyrightPermissionsCulture.pdf

[34] Session 3, "Expanded Archives of Digital Culture," **Matthew Allen**, Harvard University, University of Toronto

[35] Session 1, ADE Formats Primer

[36] Session 3, "Emulation for Access," **Euan Cochrane**, Digital Preservation Manager, Yale University Library

[37] Cummings, Mike. "Project revives old software, preserves 'born-digital' data." Yale News. February 13, 2018. Accessed March 8, 2018. https://news.yale.edu/2018/02/13/project-revives-old-software-preserves-born-digital-data.

interview and recording model the CCA established during its exhibition preparation.[38] Depending on the success of Cochrane's program, there is a possibility for exploring a consortia-style model for sharing software resources and digital design software expertise, which were identified as major barriers for smaller or less resource-rich collecting institutions to invest in on their own.

Case Studies: Accessing Legacy Data

This section offers a few examples of the efforts undertaken by practitioners and researchers using legacy data records. Each Case Study demonstrates the richness of the records in their original environment and the frustration or risks involved in not having the files in their dynamic state and without the support of their dependent software.

NARRATIVE SUPPORT

Noemie Lafaurie-Debany, a principal at Balmori Associates, shared her office's attempt to address missing context and provide some insight into the design process by having the project team or principal in charge provide a project narrative as part of the project close-out process.[39] Lafaurie-Debany mentioned the value of such narrative context to the team and in their archival donations to Yale University's Architectural Archives that capture insights into the design process and influencing factors that led to the project's end result. This is a unique practice by Balmori Associates, motivated by their donor relationship with Yale, but is also not consistently implemented within the firm despite the observed benefits. HOK's Schleusner explains that this practice will most likely not be widely adopted throughout the design profession due to its well-earned reputation of "not caring about the continuation of knowledge/records" and therefore the industry has not invested or adopted technologies to enable and support such a continuum.[40]

Similarly, as Walsh mentioned in both the ADE Formats Primer and the Symposium's Summary, the knowledge held within the designer can be a treasure trove of critical information for providing access and appropriate representation of a dynamic digital object.[41] This is made abundantly clear by the outcomes of the CCA's three part exhibition, *Archaeology of the Digital*, which provided valuable opportunity for the collecting institution and preservation community to begin unpacking the Pandora's Box that is the ecosystem of digital design records. The leverage of the exhibit as a method for public engagement, as well as an intellectual exercise in grappling with the questions of "what is 'important'?" and "how do we show the 'important' elements?" allowed curators and archivists at the CCA to conduct numerous interviews with the exhibit contributors. [42] With a clear and formal ask, the recorded interviews open up the world of records in a way that only a career's worth of time and thought can. The harbinger files archivists are

[38] Canadian Center for Architecture. "Peter Eisenman, Frank Gehry, Chuck Hoberman, and Shoei Yoh in conversation with Greg Lynn." Digital Tools in Four Practices. February 2016. Accessed March 8, 2018. https://www.cca.qc.ca/en/issues/4/origins-of-the-digital/31697/digital-tools-in-four-practices
[39] Session 2, Data Flowing Through Time & the Digital Tapestry
[40] Session 2, Fireside Chat – Data Flow
[41] Session 1, ADE Formats Primer, and Summary
[42] Canadian Center for Architecture. February 2016.

sure to find in their collections will only be truly accessible with integrity if they are accompanied by explanations and guidance from the designers themselves.

EARLY EXPLORATION, THE NEW RESEARCH FRONTIER

How do designers encapsulate knowledge? How do designers communicate visually? How do designers express their perceptions during design? How do designers catalog the built form relatively realistically? These are but a few questions that Andrew Witt shared in his presentation of current and future research he has explored.[43] During the Access Use Cases Session, Witt, Matthew Allen, and Dennis Shelden, all academics within the architectural history and design disciplines, shared that these questions and many more are being explored using automation, scripting, artificial intelligence, shape grammar, digital culture, and digital archeology.[44] These three scholars shared different aspects of the design files they, their colleagues, and their students have leveraged or focused on so far. From documenting the user community's experience with the evolution of software updates for a specific software, to digital forensics that track the development of a model, to leveraging building models of courthouses to define typologies, the breadth and depth of possible research that digital design records data can support is nothing short of incredible. This short list demonstrates the types of research already being conducted using digital design records; reinforcing the importance for archives to provide access to digital design files in their original formats and in their original software versions when possible.

Unlike architects and designers of the built environment, Allen explained that "historians aren't always looking for the full buildings." Rather, what is "appropriate" or expected research is an expanding category, making static copies or surrogate records insufficient for the dynamic needs for most current and future scholarship involving digital design records. These changing needs also include the access level to the records. Allen discussed his privileged position when given unfettered access to the project files of Preston Scott Cohen Inc. for a research project, which he compared to the feeling one has while freely perusing through a tube or drawer of drawings within an archives' reading room. Walsh noted in his closing remarks that Allen's experience doing research directly with the files, without any archival intervention, is an important learning moment for archivists, who will need to continue to learn from researchers for the foreseeable future. Allen shared Greg Lynn's perspective that "software is sometimes visible in the architecture," meaning that a viewer who is proficient with the tools can glean additional information based on the geometries, illustrative or other functionality visible in the digital object.[45] This is the subject expertise of practitioners and scholars, and cannot be the expectation of archivists to reach this level of familiarity with every design software represented in their collection, though an awareness and general familiarity of the landscape of design software will help archivists provide appropriate description and access support to researchers. Allen demonstrated the lessons researchers can reveal including what are the important features and data within the files, how they interact with the files, and understanding the significance of what the larger working-file ecosystem is to conducting research. Archivists, even

[43] Session 3, Access Use Cases
[44] Session 3, Access Use Cases
[45] Session 3, "Expanded Archives of Digital Culture," **Matthew Allen**, Harvard University, University of Toronto, https://www.youtube.com/user/LibraryOfCongress

with subject expertise, will most likely not be familiar with the majority of the digital file types their future collections will contain, and thus the archival community must begin to develop partnerships with practitioners and scholars for ongoing awareness and familiarity with the various design software and file formats in use.

While the learning curve will be steep as archives adjust their definition and policies for access and use of digital materials, Cochrane from Yale University offered emulation as a potential solution for much of the technological challenges archives will need to overcome.[46] Cochrane's Emulation as a Service (EaaS) builds upon the foundation developed out of the University of Freiburg,[47] replicates the older operating systems, software, and even hardware if necessary (such as access dongles). As Cochrane demonstrated in his presentation, the EaaS environments can all be accessed through a single portal and each digital design file's original software and version are identified before a file is opened. This is critical to ensure the integrity of the file is not corrupted by missing infrastructure or fonts. Cochrane explained that his development of EaaS environments is only limited by the amount of operating system and copies of software available, both a heartening and worrisome observation as the availability (both in numbers of the software and affordability of acquiring the various software or licenses) may be a significant hurdle for collecting institutions.

The third Session's presentations indirectly asked archives to not only be thoughtful about providing appropriate access to digital design records, but also to re-evaluate the scope of their collecting practices and collection policies to accommodate (or not) the changing scope of current and future scholars. As Allen's research demonstrates, the context in which design software is evolving and being used is just as important as the records created. This begs the question to archives of how much should they be collecting and how the larger archival community can collaborate and develop stronger connections to prevent the expense of scope creep from overwhelming the budgets and staff time and skillset to support the existing and future collections. There are several options for how this collaborative community development could happen, from a formalized consortia-model of joint investment in infrastructure to a heightened awareness and mutual respect as institutions clarify their collecting practices with the recognition they fit into a symbiotic ecosystem. Regardless of what is eventually implemented, a shared understanding and supportive agreement is fundamental to any version of success.

DEVELOPING SUSTAINABLE DELIVERABLES

Background: A Shared Goal

As a primary goal of this Summit, it is not surprising that aspects of developing sustainable deliverables of digital design records were raised in all four sessions. The Symposium served as an initial opportunity to share the perspectives, expertise, and critical record needs of the various stakeholders. Two key concepts were repeated across sessions and amongst stakeholders: the need to establish and provide a comprehensive list of requirements and

[46] Session 3, "Emulation for Access," **Euan Cochrane**, Digital Preservation Manager, Yale University Library
[47] http://eaas.uni-freiburg.de/ and https://blogs.loc.gov/thesignal/2014/08/emulation-as-a-service-eaas-at-yale-university-library/

definition of a sustainable deliverable; and that the discussion around standards incorporates the multiple stakeholders to ensure the future records created can be made in the active design process, while also fulfilling the needs of the current and future stakeholders. It is important that these efforts occur around current workflows and records creation to ensure consistency in record production and collection.

The current environment that records are produced in was most starkly articulated by Nick Gicale, a Program Manager/Product Owner at the Government Services Administration, who expressed concerns about the uniformity of records provided by architecture and construction firms for the 10,000 annual projects the GSA oversees.[48] Gicale indicated that the standard deliverables outlined in the GSA's contracts for work done on federal government buildings are often compromised by practical necessity to accommodate the technology of design firms, or are not strictly enforced due to the small size of many of their projects. The common practice of not upholding the requirements of contract deliverables leaves any building owner-operator vulnerable to future issues around accessing original files, updating the files as changes are made to a building, or maintaining a BIM as a facilities manager to monitor the actively used building.

The future world was optimistically shared by Technologist and representative of the buildingSMART international standard, Jeff Ouellette, who asked the collective community to think broadly and approach issues of accessibility and preserving digital design records by looking at the global software landscape.[49] Through this lens he presented a comprehensive view of the data created in the design processes to illustrate the power of data when released from its platform dependencies. The work that Ouellette's standards group is developing is promising and offers an alternative future of design software that leverages a collaborative ecosystem relying on Application Programming Interfaces (APIs) to create connections and facilitate smoother data and file compatibility across platforms. This is an exciting possibility, if widely adopted, but in looking to the future we must also think about the current state and acknowledge the unknowns of the future for a collaborative software ecosystem.

Making the Business Case

The variety of stakeholders invested in having access to design files epitomizes categorically the obstacle to succinctly articulate the business case for preserving project records. Not only is there a wide variety of perspectives to consider, but there is also a continuously growing diversity of software vendors and project files produced. To create the matrix of perspectives, available records and supporting software is an intimidating task in itself. Though models like the LOTAR collaborative consortium[50] and related initiatives offered a tantalizing model to adopt, it became apparent that the multiple stakeholders and the unique, vs. reproduced, projects in the

[48] Session 2, Fireside Chat – Data Flow
[49] Session 4, "buildingSMART International and Industry Foundation Classes (IFC): THE solution to A/E/C/O data interoperability," **Jeff Ouellette**, Assoc. AIA, buildingSMART International - Implementation Support Group
[50] LOTAR International. "LOng Term Archiving and Retrieval – LOTAR." 2018. Accessed March 8, 2018. http://www.lotar-international.org/

architecture world were not comparable to the automotive, aerospace, and defense industry models (for more on this see Standardization Section below).

A comprehensive business case for each of the stakeholders of the past/present and present/future scenarios was not developed during the Symposium or Workshop, but the challenges were better articulated to provide use cases and issues that needed to be addressed in order to create a useful, comprehensive business case for saving and maintaining records, and their software, beyond the narrow scope of what is currently legally required.

COLLECTING INSTITUTIONS

In his 2013 report *Preserving Computer-Aided Design (CAD),* Alex Ball concluded the executive summary saying: "The wider preservation community should build a business case that underlines the importance of interoperability and preservation for CAD customers and vendors, and use it to campaign within both groups (and beyond) for better support for standard formats in CAD systems."[51] A comprehensive business case has yet to be fully articulated or realized, and this shortcoming was lamented during the Symposium and Workshop as each stakeholder articulated their need for a business case in order to ensure the authority and financial feasibility to dedicate resources and personnel to address the preservation and access of digital design files.

Due to the inherent delay in the acquisition of records into collecting institutions, it is difficult for this group to provide motivation to software vendors or record creators to establish more sustainable deliverables and clearer workflows. The altruistic missions of collecting institutions to provide a record of the development of design and engineering professions, and preserve the legacy of their donors could be better leveraged to articulate a shared business case. Donors care about their legacy being properly represented, and collecting institutions may require additional resources (support software) and information (how to use that software) in order to uphold this promise. Similarly, vendors are receiving residual benefits as their products are being included in the historical narrative of the professions that used them. This perspective creates a clear ask of the donors and vendors, which has not been formalized. Obtaining copies of the software as part of a donation has been one approach, though that presents legal issues around licensing, and often firms are not keeping the older versions of software used to make their early digital design records. Asking vendors for legacy copies of their software has been successful for a few institutions, but is not a consistent practice of institutions or vendors.

Archivists and collecting institutions are not interested in altering the design process or to be present in the active creation of digital design records; however, due to the complex nature of digital design records that have already been donated to institutions it is apparent that some proactive engagement is necessary to ensure the records will still exist by the time an individual or firm wants to donate their collection. We are currently situated within a dichotomous world of design records, the break between past/present and present/future records. The past/present represent the complex "wild west" world of digital design records and the present/future offers a glimpse at potential shifts in designer's workflows, software capabilities, and contract

[51] Ball, Alex. 2013.

deliverables that might make the digital design records created more manageable and accessible.

During the half day, small group Workshop it became clear that without an explicit mandate and dedicated funding by the collecting institutions, the ability to invest in the technological support and maintain collections of digital design records would be impossible. Without this charge the archivists and preservationists in the room acknowledged they would be unable to dedicate the necessary time to develop the necessary skills and prioritize the purchase of technical dependencies of their digital design collections. Based solely on the challenges some institutions have already had attempting to acquire all the older versions of software their collections currently need indicated to the Workshop participants that it would be difficult for every institution to independently acquire all the software and hardware they would require even if the mandate and resources were made available. Acknowledging this barrier, the discussion shifted to an alternative business case for a consortia-model for resource sharing that would only be achievable if best practices for processing, preserving, and providing access to digital design files can be identified. As mentioned in the Introduction's Stakeholders Section (pg. 2-3), this may be achievable following similar models as the CAx Implementor's Forum[52] and FADGI.[53]

DESIGNERS/RECORDS CREATORS

There are legal and financial motivators outlined in each project's contract for firms to hold onto their project records, especially the contract deliverables, which are used most often by Records Managers to protect the firm from legal liability. First introduced during the ADE Formats Primer by Leventhal, [54] the motivation of contractual requirements was confirmed by the practitioner panelists of the second Session on Data Flowing Through Time and Tapestry, where Schleusner acknowledged that without a hefty enough financial motivator even the contractual obligation can sometimes not be enough to produce standards-compliant deliverables.[55] This moderately successful motivator is still not sufficient to providing consistent archiving of project records practices in any comprehensive way. The potential legal and financial risks associated with lost access to project records is a compelling argument, but this pecuniary business case does not account for the more contextual and less legally significant documents preserved by collecting institutions (e.g. early sketches and developing physical or digital models). Additionally, the client must have an appreciation for what the enhanced records will contain, and understand that this additional information in a project's records will probably increase the overall fee required for a project.

Regardless of the mixed results of contractual obligations, this is a practice that should continue to be explored by firms, clients, and collecting institutions alike. If each stakeholder is able to clearly articulate their record needs and establish an agreement for compliance, the heightened awareness of sustainable deliverables by the design software users can influence the functionality software vendors support. This is a long view for affecting the necessary change

[52] CAx Implementor Forum. "CAx Implementor Forum." Accessed March 8, 2018. https://www.cax-if.org/
[53] FADGI, 2016.
[54] Session 1, **Aliza Leventhal**, Sasaki / SAA CAD-BIM Task Force
[55] Session 2, Fireside Chat – Data Flow

in the production of design records; as Ouellette explained (and is further discussed in the following section about Standardization), designers complying with standards must not be an additional step to their workflow, they need their existing tools to support the standards their asked to comply with.[56]

INSUFFICIENT SURROGATE RECORDS

The design professions' perspective, as articulated by sole-practitioner Rylander, sees the final built structure as more valuable than any 2D representative document."[57] This perspective implies that there is no existing or acceptable surrogate record to the physical built structure. This viewpoint has been a major obstacle to the advocacy efforts of archivists and collecting institutions that recognize the value of the design documents, analog and digital, to shine light on the design intent and evolution. Lafaurie-Debany shared how this perspective is changing as the strength of the original dynamic digital design records can be critically useful to project teams in the future, and are significantly more useful than a PDF or static copy of a project's plans or design components.[58]

Lafaurie-Debany provided an argument for keeping original records and illustrated the challenges of doing so through the example of Balmori Associates relying on PDFs as a cost savings effort to avoid the expense of maintaining multiple versions of software and to reduce server storage needs.[59] However, the project teams that relied on PDFs of their project's final documents found them insufficient to fulfill their future reference needs. Rylander offered additional reasoning from the practitioner's perspective to keep more robust records beyond what is necessary in the event of litigation inquiries, as an effort to preserve a design's potential, which is most clearly articulated during the Design Documents phase. Rylander explained that the design intent can be diminished due to value engineering as the project moves into construction and experiences financial pressure.

Documenting the design intent, or the evolution and practice of a designer or firm, is often a goal of institutions collecting design records; even though each has their own collection policies, many include far more contextual records than the as-built drawing sets. When a designer is interested in their personal or firm's legacy, their interests become closer aligned to those of collecting institutions, and as demonstrated by the donor relationship between Balmori Associates and Yale University's Architecture Archives, a compelling business case can develop through the donor agreement.[60] As a result, Balmori has incorporated an end-of-project narrative reflection and review of project records to make sure they are complying with the guidelines and requirements outlined in their firm's donor agreement with Yale University's Architecture Archives. There is much to be learned and shared with firms and collecting institutions about legacy preservation from the Yale-Balmori model that could influence a change in practices or workflows. Ultimately, critical factors that produce an actual cost-savings business case will likely be needed in order for change to be mandated. The Standardization

[56] Session 4, What is Happening Now?
[57] Session 2, Fireside Chat – Data Flow
[58] Session 2, Fireside Chat – Data Flow
[59] Session 2, Data Flowing Through Time & the Digital Tapestry
[60] Session 2, Fireside Chat – Data Flow

Section below discusses the development and adoption of standards, and what potential progress is being envisioned to accomplish what Ball challenged us to do.

LONG-TERM REFERENCE

Architect of the Capitol, Stephen Ayers offered an argument for the inherent value of creating records with the intention of their long-term access.[61] Using the recent restoration of the Capitol's dome, Ayers explained the most important reference resource for the project team was the 1855 original watercolor drawings and details from Thomas Eustace Walter, the fourth Architect of the Capitol. These records were critical for the contractors to properly identify, disassemble and reassemble elements of the dome. They recognized the value of these original records, and with that mindset selected BIM360 as the software to document their restoration project, believing it offered the best offer for creating comprehensive reference records for future restoration and repair efforts.

Ayers recognized that the current state of the BIM360 records may not be accessible 50 or 75 years into the future, but explained that by taking the time to provide additional detail within these digital files there is a better chance to reduce the risk and increase savings by reducing time and confusion in future projects when records are properly created for reliable access to information. This effort was presented with an overarching motivation to "pay it forward" to the future Architects of the Capitol, who will need these records for generations to come. Ayers' position can be compared to that of owner/operators and facilities managers. The residual benefits of producing records to support future building maintenance or renovations are the foundational value of Knowledge Management and Records Management.

By incorporating a standard or a technology that is intended to extend the access of design files demarcates a shift in the designer's focus, as they are required to document for future reference in addition to following their organic workflow. This is a shift that may be difficult to appreciate at first, but could have residual implications as designers are asked to think about the longevity of their files rather than simply producing their design. Archivists are increasingly conscious of determining an appropriate level of proactive engagement and outreach to ensure records are saved while also maintaining the designer's process. Schleusner explained that HOK's archiving effort, a global file system that backs up their entire network drive every 15 minutes, captures the work done at the firm and not about how the work was done.[62] This is an important distinction between priorities of an internal firm archive and that of a collecting institutional archive; where the latter is to provide access to records for a broad range of inquiry, including the workflow of a designer or firm, the former serves as a reference resource for future work. Gicale shared that the GSA has a similar approach to attempt to collect "everything" and worry about accessing the files later.[63] This may be a reasonable solution for a large firm like HOK and a federal government agency, but it is important to appreciate the feasibility to support such an initiative, which Lafaurie-Debany commented would not be possible for a smaller firm like Balmori Associates.

[61] Opening Remarks, **Stephen Ayers**, Architect of the Capitol
[62] Session 2, "How We Create and Save," **Greg Schleusner**, HOK
[63] Session 2, Fireside Chat – Data Flow

Standardization

DEVELOPING STANDARDS

At almost three decades into active use of design software, collecting institutions, facilities managers, as well as practitioners are able to appreciate the inconsistency of the design workflows and use of the ever evolving list of available software. This Symposium's four sessions and summary provided a glimpse into the pain points that stakeholders are experiencing as a result of this variety, and illuminated some efforts to standardize and provide order to project records. Standards are being developed on municipal, state, national and international levels, as well as within some firms. Although discussions throughout the Symposium and Workshop can be applied to the broader range of engineering and design professions, there was a heavy bias towards the efforts and implications related to the digital files within the architecture discipline.

Standards often resolve specific issues for specific communities. To offer and learn from a comparison of initiatives addressing shared software and file output issues but from different communities, the fourth Session's presenters[64] represented a range of standards organizations including the European-based international efforts buildingSMART OpenBIM standard;[65] the US National BIM Standard;[66] PDES Inc.[67] initiatives such as the STandard for the Exchange of Product model data,[68] the Long Term Archiving and Retrieval (LoTAR)[69] ISO standard for the aerospace and defense community and the CAx Implementor's Forum;[70] and the broader scoped Software Preservation Network.[71] Each of these organizations, efforts and standards have experienced different levels of success. Possibilities for additional opportunities of communication and collaboration were raised throughout both the Symposium's presentations and the Workshop.

Representing two important Building Information Modeling (BIM) standards and guidelines, Jeff Ouellette and Roger Grant discussed how some standards have been developing around platform-independent file types and established interoperability, particularly through the adoption of the open IFC file format (ISO 16739:2013).[72] The fundamental shift that Ouellette and Grant presented was the separation of the data from the proprietary platforms they were originally created in, and the mapping of that data to an open standard to ensure long-term

---

[64] Session 4, What is Happening Now?
[65] buildingSMART. "Technical Vision." Accessed March 8, 2018. https://www.buildingsmart.org/standards/technical-vision/
[66] National Institute of Building Sciences. "Welcome to NBIMS-US V3." National BIM Standard-United States (NBIMS-US). Accessed March 8, 2018. https://www.nationalbimstandard.org/
[67] PDES, Inc. "Who Are We." 2017. Accessed March 8, 2018. https://pdesinc.org/
[68] LK Soft. "About STEP (ISO 10303) Standard." 2014. Accessed March 8, 2018. http://www.ida-step.net/support/resources/about-step
[69] LOTAR International. "LOTAR 3D CAD with PMI Workgroup." 2018. Accessed March 8, 2018. http://www.lotar-international.org/lotar-workgroups/lotar-3d-cad-with-pmi.html
[70] CAx Implementor Forum.
[71] Software Preservation Network (SPN). "About SPN." Accessed March 8 2018. http://www.softwarepreservationnetwork.org/
[72] Session 4, "buildingSMART International and Industry Foundation Classes (IFC): THE solution to A/E/C/O data interoperability," **Jeff Ouellette**, Assoc. AIA, buildingSMART International - Implementation Support Group; and "Documenting Building Information Requirements," **Roger Grant**, Program Director, National Institute of Building Sciences

access to important data about the project, data that has a business importance for construction and maintenance through time, and which also offers both academic and industrial research potential. This last category of data focused on research captures the design process, which is more difficult to prioritize to practitioners who are focused on supporting the practical applications of construction and maintenance of their structures.

Ouellette, the chair of buildingSMART International's Implementation Support Group and the senior architect product specialist at Vectorworks, Inc., declared at the beginning of his presentation that "standards are the solution" for long-term access to digital design records. He explained the benefits of an effort that is focused on removing the proprietary layers of the design file to ensure the integrity of the file's design-data, which would give design files independence from the proprietary and version-incompatible software. Ouellette reported that the IFC standard has been adopted with clear timelines by several nations within the European Union, and that several others have developed their own local and national standards that can be rolled up into OpenBIM. The holistic approach of buildingSMART that Ouellette outlined includes the engagement of software vendors and training practitioners proposing that through increased vendor support of the standard's file type, and including functionality to apply the necessary metadata into a file without adding additional steps to the workflow, the burden on designers would be significantly reduced. This is an ambitious undertaking that Ouellette predicted was about a decade away from the adoption by American designers and vendors becoming a reality.

While OpenBIM is intended to produce project records for long term access and interoperability between systems through time, as explored by Grant, the US National BIM Standard is focused on lowering the cost of construction. This standard was developed by the congressionally-established National Institute of Building Sciences, with the fundamental understanding that organized information is more valuable and that the digital design files should be able to leverage that organized information to produce more efficient buildings. More efficient buildings were defined as having lower cost of construction, use less materials, are more sustainable in their use of materials and systems (i.e. Heating Ventilation and Air Conditioning (HVAC)), and are completed with improved workflow processes. Grant argued that these efficient buildings provide strong motivation for the implementation of buildingSMART Standards offering a unifying goal that impacts stakeholders throughout the building's lifecycle from the architects, contractors, and building material suppliers to the facilities managers and inhabitants. However, buildingSMART Standards rely on practitioners to input better data and leveraging the properties and objects within the model, thus adding rather than reducing from the designer's existing workload. This is a significant barrier to implementation, unless such data governance is required by an overarching government agency, such as in Grant's example of Great Britain's comprehensive government building agency, Digital Built Britain.[73]

With platform independence and connection to standards, such as the open and neutral data format, IFC (Industry Foundation Classes),[74] and the information exchange specification

[73] University of Cambridge. "Centre for Digital Built Britain." 2018. Accessed March 8, 2018. https://www.cdbb.cam.ac.uk/

[74] buildingSMART. "IFC Overview summary." 2018. Accessed March 8, 2018. http://www.buildingsmart-tech.org/specifications/ifc-overview

metadata format, COBie (Construction Operations Building information exchange),[75] Grant concludes that designers will be able to make smarter design decisions based on collective data. Even though these initiatives aim to address the acknowledged issues, and are being developed to remove barriers to application, we are still seeing resistance to standards throughout design community. Greg Schleusner succinctly explained that architects can, will, and do comply with standards when they are contractual required to do so; however, compliance can be difficult as the standards only provide the desired end result rather than offering the full path for architects to follow throughout the model's development.[76]

The incomplete nature of the way standards have been written is a serious concern for ensuring proper implementation, a concern Phil Rosche, representing the software standards and interoperability community within the aerospace and defense industries, emphasized.[77] Rosche explained how the collaborative CAx Implementor Forum developed as a direct result of software vendors adopting standards without emphasizing the critical interoperability aspect of those standards. Implementor oversight proved to be a symbiotic development that ensured that standards are incorporated and carried out by the software vendors effectively, and the software vendors are able to receive quicker feedback to improve the next versions of their products. The impetus for this initiative was industry demand to address real business and production hurdles resulting from interoperability issues. Ouellette echoed the importance of establishing clear communication and review of standards that are integrated into software, and encouraged software vendors to focus on meeting the requirements of the standards rather than perfecting the Application Performance Interface (API) between specific software.

In contrast to the architecture and design business model of unique creations the transport, aerospace, defense and manufacturing sectors business model compelled standards collaborations as illustrated by the mid-1990's release of the STEP (ISO 10303) standard.

"The ultimate goal is to cover the entire life cycle, from conceptual design to final disposal, for all kinds of products. However, the most tangible use of STEP today is the ability to exchange design data as solid models and assemblies of solid models. STEP led the way with three dimensional data exchange by organizing an implementation forum for the CAD vendors so that they could continually improve the quality of the solid model data exchanges. The history of this success is relatively interesting because it show that the initial reluctance of vendors to implement user-defined standards can be overcome with enough perseverance."[78]

Rosche provided valuable insight into the success of the aerospace and defense industries to motivate and enforce adoption of STEP, as these industries have a smaller field of players (including firms and software products) and a long-term business need for maintaining consistent

[75] Tardiff, Michael. "Construction Operations Building information exchange (COBie)." National Institute of Building Sciences. Accessed March 8, 2018. https://www.nibs.org/?page=bsa_cobie
[76] Session 2, Fireside Chat – Data Flow
[77] Session 4, "A Template for Interoperability Testing," **Phil Rosche**, CAx Implementor Forum, ACCR
[78] STEP Tools, Inc. "STEP Application Protocols." 2018. Accessed March 8, 2018. https://www.steptools.com/stds/step/step_2.html

design files for decades of production of their products.[79] Conversely, architecture, engineering and design professions have an incredibly large and diverse community of players ranging from sole practitioners to global firms, and can use over a dozen software within a single firm. The significance and impact of these industries became increasingly apparent during the Symposium and Workshop, and it was during the latter that it became clear that despite the similarities of programs with AutoCAD (architecture software) and CATIA (engineering software used by the aerospace industry), the environmental context these software are used within is more of a barrier to developing comparably strong and universally adopted standards such as ISO 10303.

RESISTANCE TO STANDARDS

While there are multiple elements to consider as potential motivators, practitioners, standards advocates, vendors, archivists, and technologists all agreed that the insistence of their collaborators or clients, or any external entity with a contractual agreement, is currently necessary to push the standards-resistant design community to adopt available standards. Client requirements, collaboration across firms or multiple offices within a single firm are all potential motivators for some standardization to be adopted, but as the presenters explained these are all case-by-case scenarios.[80]

Lafaurie-Debany and Schleusner explained that even with the best of intentions, pressure around a deadline for a project team might result in the lapse in maintaining a standard when there is no immediate ramification or consequence for this delinquency.[81] As mentioned in the Business Case section (pg. 16), Schleusner shared that when there is a contractual and fiduciary motivation for the incorporation of standards they can and will be upheld. The other contractual motivator is between Prime and Sub contractors, who must align their workflows, software versions and file types to ensure a smooth collaborative project. Similar alignment may also happen when a larger firm shares a project across multiple offices. It is clear that without an explicit consequence for incompliance, such as a significant time or financial cost, there is little motivation to incorporate standards into a project.

Similarly to STEP's successful development with high level support, Ouellette, pointed to the engagement of European and Asian markets and governments promoting and requiring firms to adhere to standards has been critical to their successful adoption in specific countries.[82] Without this pressure Ouellette argued that designers will see the use of standards as a burden and additional work to accomplish their contract deliverables. Schleusner explained that the perceived and actual burden and expense for project teams to implement standards is passed on to the clients requiring compliance, who may adjust their expectations or needs if the cost for implementing standards outweighs the potential benefits of the sustainable deliverables. As

[79] Session 2, Data Flowing Through Time & the Digital Tapestry, and Session 4, "A Template for Interoperability Testing," **Phil Rosche**, CAx Implementor Forum, ACCR
[80] Session 2, Fireside Chat – Data Flow
[81] Session 2, Fireside Chat – Data Flow
[82] Session 4, "buildingSMART International and Industry Foundation Classes (IFC): THE solution to A/E/C/O data interoperability," **Jeff Ouellette,** Assoc. AIA, buildingSMART International - Implementation Support Group

most built works experience a round of cost-saving value engineering cuts, it is understandable how the producing standards-compliant contract deliverables may slip in priority for clients during the phases of design and construction.

Despite the inconsistency of value associated with standards-compliant deliverables, both Gicale and Schleusner pointed out that standards can be critical to supporting collaboration across multi-firm or multi-office (within the same firm) projects.[83] In this scenario standards prove useful for setting the requirements that support the sophisticated coordination required for this type of project. Such situations demonstrates the benefit standards can provide as a shared foundation that ensures consistent outputs and working files amongst many designers. However, even with this recognition there is still work to be done to expand the applicability and value of standards in the eyes of designers; as Schleusner, Lafaurie-Debany, and Rylander all reiterated that each project has unique parameters that cannot be easily adapted to the requirements of available standards.[84]

ADOPTING STANDARDS

This section offers an assessment of key factors mentioned throughout the Symposium as potential sources of motivation for designers to adopt or invest in the development of standards. Despite the clearly appreciated value of well-organized records, including the cost and time savings they can provide firms in their daily work, there is a fundamental issue of competing business demands of the present and the future for designers, regardless of their firm size. Designers are constantly responding to deadlines, an environment that does not lend itself to a long-view of records organizationally or in their accessibility, therefore the resistance to adding to the workflow, even when it helps the immediate health of the project, can be significant. The design professionals in the second and third Sessions explained that their future wants or needs are often in competition with their current needs, which inherently impedes a designer's ability to truly internalize the value of long-term access to their records.[85] Each stakeholder shared their perspective, and as they pointed to different elements of the record creating and keeping process, it became clear that a lack of awareness of what resources and record types are available is a barrier for incorporating standards into workflows.

As mentioned earlier in this report, the changing landscape of digital design software has been long and winding. The first Session outlined the evolution of design software has vacillated between dozens to hundreds of software over the almost 60 years of design software development.[86] The explosion of available software has fostered a culture of experimentation and project files that could be considered digital bricolage when the combination of software used to produce a single file is taken into account. With such a diversity of options it becomes obvious how a standard that separates the file's data from the proprietary software, such as buildingSMART, can be a valuable resource for future access and long-term preservation. Additionally, while there are many smaller, customized tools in development, there is also consolidation in the field amongst the largest design software companies.

[83] Session 2, Fireside Chat – Data Flow
[84] Session 2, Fireside Chat – Data Flow
[85] Session 2, Data Flowing Through Time & the Digital Tapestry, and Session 3, Access Use Cases
[86] Session 1, ADE Formats Primer

This ever burgeoning and evolving market of software was discussed as a significant barrier to normalizing the workflows and outputs of designers. Walsh and Rosche both recognized that the consistently changing landscape of digital resources was a critical difference between the AEC/ADE community and the aerospace and automotive community that was able to develop and adopt LoTAR. As mentioned briefly above, Rosche explained that the relatively small group of major players in the aerospace and automotive markets not only supports but demands a consolidated set of software.[87] The demand for limited software reflects this community's heightened value on the design assets as they place on their physical production; which is an important differentiation to the architecture and design community. Rylander expressed that architects often place a higher valuation on the built structure than the design and construction documents.[88] There are clear reasons for this, as most buildings are not mass-produced in the same way as airplanes and automobiles are, and as a result the market and internal industry forces present in the aerospace/automotive industry cannot be easily replicated within the AEC/ADE industries. Nonetheless, the LoTAR model of collaboration and standards implementation offers valuable lessons.

To overcome the dispersed and discordant power across the thousands of firms within the AEC/ADE community Schleusner proposed going higher up the "food chain" of consumers and vendors to find a comparatively smaller group of stakeholders with more consolidated power and political capital.[89] Ouellette supported this proposition, explaining that by supporting the buildingSMART standard within Vectorworks' software allows his company to most efficiently connect to other software, rather than having to develop unique APIs for each software they wanted to explicitly support a connection with.[90] As demonstrated by the success of the aerospace and defense communities, it is imperative not only for the tools to support the implementation of standards, but the standards must also provide clear guidelines for implementation that remove ambiguity and potential for variation in the outputs produced in intended compliance with those standards. The Introduction (pg. 2) and the Collecting Institution's Business Case Section (pg. 16-17) indicated that the establishment of standards must also have levels of achievement built in to support scalable solutions for designers to comply with based on availability of resources (e.g. a sole practitioner vs. international firm).

Jessica Meyerson's argument that software is an infrastructure that much of our world relies heavily upon becomes critical in looking for solutions.[91] Meyerson points to the software as the key to identifying a long-term preservation and access plan. Similar to the adoption of design software in the industry, standards will not be adopted unless they can support and address both the designer's need to feel unbridled during the design process, and the fast-pace of design projects that prioritize efficiency and end product above all else. Designers at the Symposium implied that unless standards can be flexible enough to support the broadest range of design

[87] Session 4, "A Template for Interoperability Testing," **Phil Rosche**, CAx Implementor Forum, ACCR
[88] Session 2, Fireside Chat – Data Flow
[89] Session 2, Fireside Chat – Data Flow
[90] Session 4, "buildingSMART International and Industry Foundation Classes (IFC): THE solution to A/E/C/O data interoperability," **Jeff Ouellette**, Assoc. AIA, buildingSMART International - Implementation Support Group
[91] Session 4, "Software Preservation Network: The Access Breakdown and System Level Change," **Jessica Meyerson**, Software Preservation Network, Educopia Institute

experimentation and can also be applied without adding or interrupting the design workload or workflow, they will not be able to fully embrace and incorporate standards into their practice. While this might seem like an insurmountable obstacle, the almost ubiquitous adoption of design software into AEC/ADE practice across the United States and world demonstrates that disruptive technology can become the norm.

Although architects, designers, and engineers can appreciate the benefits of interoperable files, they are not likely to be the loudest advocates for incorporating any kind of standards into their workflow; which is a challenge standards communities need to address in order to leverage the historic power the software users have to drive the general direction and specific functionality of their digital tools over the past two decades. The client base of these fields is too broad to establish a uniform contractual requirement in the United States; even if professional organizations such as the AIA, or government agencies like the GSA provided guidelines this would be a challenge[92]. Finding the right motivation and argument may take time, but will hopefully become easier as the collaborative cross-discipline engagement continues after this Summit.

Conclusion: Moving Forward

"[I]t is pleasing to the senses to pull soft lead across clean vellum, to hear the squeak of a felt tip, to smell the dust of a pencil sharpener ... It is jarring and distasteful to realize that someday soon, almost all of this may be replaced by the chatter of teletypes, the hum of electric equipment, and the blue penumbra of great blinking tubes. Unfortunately, this is the price architects must pay for technological progress"[93]

Through four sessions and a half-day Workshop new questions arose, points of clarification were made, priorities were expressed, challenges were articulated, and an improved collective understanding was developed. This Symposium asked architects, building managers, archivists, engineers, librarians, record managers, government agencies, academics, collecting institutions, digital preservationists, and many other professions invested in the future of digital design records to come together with a common goal: identify the challenges and opportunities, the issues and obstacles around long-term preservation and access of digital design records and begin working towards sustainable solutions. With this goal in mind the archival, technology, design practitioner, and standards communities have learned from one another and have actionable next steps which include continuing to share information and building a community of practice.

As design software has been disruptive technology for the AEC/ADE industries, so it has been for the archives and the future of scholarship of design, architecture, construction and engineering. Despite software's growing ubiquitous presence within AEC/ADE firms over the last 30 years, only a few collecting institutions have intentionally accessioned digital design records into their collections, and only in the past decade or so at that. While there is a natural delay between record creation and donating a collection to the archive, the uneven presence of digital design

[92] Session 2, Fireside Chat – Data Flow
[93] Milne, M., "From Pencil Points to Computer Graphics." Progressive Architecture. 1970. pp. 168-176

records within firms and collecting institutions indicates a more significant problem that archivists have spent the past decade, and more aggressively since 2012, attempting to address. A major reason for this delay is the unclear nature of how digital design records will be used by future scholars. The Symposium brought a few scholars who have already begun to demonstrate the wide range of scholarship that digital design records can support, providing the user's perspective that will guide the priorities and practices of collecting institutions whose missions include documenting the evolution of designers and their related disciplines.

EXPLORING THE "WHAT" AND THE "HOW"

Similar to the development of a business case, without explicitly defining what the desired outcome is and providing a prioritized list of parameters, there is very little chance for successfully achieving a realistic goal. Following the successful efforts of the automotive, aerospace, and defense communities, our defined community of AEC/ADE stakeholders should be able to express what is necessary for the varying scale of use. This returns us to the question that archivists have debated for decades: "What is important to keep?"

Archives have been able to follow their institution's collection mission to inform their decisions about records of lasting value for future reference. The shift in types of records has caused a crisis of confidence for archivists that had been confident appraisers of design collections, and who have become reticent in making selections of what digital design records should be kept. Archivists have looked to the record creators to help articulate what documents are of permanent significance, and more than ever this profession and the institutions they work within is looking to the other stakeholders to weigh in. At the Symposium and Workshop each stakeholder group expressed their struggle to answer this question and shared their priorities and methods for gathering the records unique to their needs. Archivists and collecting institutions have developed collection policies and appraisal guidelines to help their accessioning process and set expectations for their researchers.[94] Facilities managers or owner/operators have a similar list of requirements that are often clearly articulated in their contracts with designers. Designers seem to tacitly know what records are significant to themselves and to continuing their work, but most likely have not established clear policies or guidelines to archive them that are consistently followed. Researchers have not traditionally been able to articulate in advance of an archival collection's existence what is important to them, but as Witt and Allen demonstrated, researchers are already leapfrogging over the archives in order to gain direct access to the records they want to use.[95]

Working within the tension and anxiety associated with the uncertainty of each stakeholder's attempt to answer the question of "what should be [consistently] kept?," archivists can prevent complete decision paralysis by focusing on building upon existing best practices, such as the appraisal grid published in Waverly Lowell and Tawny Ryan Nelb's seminal 2006 publication

---

[94] Lowell, Waverly B., Tawny Ryan Nelb. Architectural Records: Managing Design And Construction Records. Chicago, IL: Society of American Archivists, 2006.

[95] Session 2, "New Archives: Digital Forensics and Programmatic Methods in Digital Design History," **Andrew Witt,** Graduate School of Design, Harvard, and "Expanded Archives of Digital Culture," **Matthew Allen**, Harvard University, University of Toronto

Architectural Records: Managing Design and Construction Records and digital preservation workflows. Lowell and Nelb's archival appraisal grid, is an excellent reference tool for design record collecting, and is currently being updated by Aliza Leventhal and the CAD/BIM Taskforce to map frequently used digital file types to their analog counterparts. Becoming more proactive collectors, institutions seeking to continue to support future design, engineering and architectural history scholarship will need to begin conversations and raise awareness of the individuals and firms they hope to collect from identify what records and file types they will desire. By starting that conversation sooner than later, archives will be better positioned and capable of preparing the infrastructure required to process digital records, as well as better understand the scale of collections they are pursuing. The robust program Tim Walsh and his team of digital processing archivists have developed at the CCA demonstrates that design archives can and should look to the digital preservation community to establish a foundational program for processing digital design records.

The need for a digital preservation program for processing digital design records was reiterated numerous times during the Workshop as a clearly missing piece to the puzzle up to this point. It was recognized that archivists focused on design archives have not reached out to the digital preservation community yet, because they are still attempting to define and refine the parameters of their issues and needs from digital design records. Part of this defining process is information gathering from active scholars using digital design records, which provides valuable insight and affirmation for archivists and collecting institutions to begin to prepare to accept collections with digital design records. With that information, and a clearer articulation of needs from the various other stakeholders present at the Symposium and Workshop, the design records community is getting closer to articulating their needs and interests, which will allow better opportunities for collaboration and engagement with digital preservation.

RAISED AWARENESS

Collective engagement was reinforced throughout the Symposium's sessions as archivists, architects, and software vendors, each identified information gaps or necessary pressures necessary for standards to be implemented and for general improved communication between invested parties. These included: suggesting the American Institute of Architects (AIA) should produce a primer for clients to learn about the variety of standards and levels of service, such as the levels of detail within a BIM deliverable that architects could provide;[96] noting the missing presence of archivists and digital preservationists involved in the development of the standards being developed by organizations such as buildingSMART and the National BIM Standard; recognizing that even within the archival profession that the community focused on design records had not fully engaged and utilized the expertise of digital preservation.

These examples and conversations exemplify the beneficial outcomes of this Summit that brought a broad range of stakeholders into the same space to explore the solutions to a shared problem. Without identifying where progress has been made and where gaps persist (or are developing) it will be nearly impossible to address the issue of preserving and providing access to digital design records holistically, especially with recognition to the diverging groups of

[96] Session 2, Fireside Chat – Data Flow

past/present and present/future records that will require different approaches to achieve an overarching goal of long-term preservation and access to all digital design records collected.[97] Given the timeline Ouellette indicated, in conjunction with the established correlation of evolving design software with the trends of the larger technological and computer science worlds, there will be great opportunities for all of the stakeholders present at the Symposium to leverage future technology to support and potentially incorporate useful standards into the workflows of practitioners.[98]

COLLECTIVE IMPACT

Collective Impact is a model for understanding system level change. System level change means working outside the conventions of your community of practice and developing a shared or common information space and opportunities for collaboration. This includes connecting with communities with larger scopes, such as the digital preservation community and the SPN, which are addressing functionality and access issues that the design records community can learn and benefit from. Broadly applicable issues, such as the breakdown of access of software, acknowledges that the issues facing collecting institutions, firms, and researchers are bigger than their special interests, and that the issues of long-term preservation and access of digital design records are at the system level.

These wide-ranging issues can be more effectively addressed through the cross-discipline conversations facilitated by the Symposium and Workshop, through which a new awareness of technological capabilities and communication obstacles and opportunities between the various professional communities were identified both before and during record transfer. During the Workshop participants discussed in detail some of the missed opportunities in current communication practices that could address many of the concerns raised by archivists, facilities managers, and owner/operator communities.

The IMLS grant-funded Building for Tomorrow Forum, gathering in April 2018 in St. Paul, Minnesota, will be a continuation of this type of productive cross-discipline engagement.[99] This meeting intends to "provide a venue for the diverse group of stakeholders to think collaboratively about the issues in preserving architectural design data, to find alignments across communities, and to identify the needs required to develop an infrastructure to support archiving of digital design information that will be usable by a variety of types and sizes of architectural museums and archives."[100] Through such meetings a shared agenda can be developed that account for the varying priorities of stakeholders, and with better lines of communication established as a result of this shared agenda we can anticipate better coordination of existing and future efforts

---

[97] Summary, **Tim Walsh**, Canadian Centre for Architecture
[98] Session 4, "buildingSMART International and Industry Foundation Classes (IFC): THE solution to A/E/C/O data interoperability," **Jeff Ouellette**, Assoc. AIA, buildingSMART International - Implementation Support Group
[99] Whiteside, Ann. Building for Tomorrow: Collaborative Development of Sustainable Infrastructure for Architectural and Design Documentation. Harvard University Graduate School of Design. 2018. Accessed March 8, 2018. https://projects.iq.harvard.edu/buildingtomorrow
[100] Whiteside, Ann. 2018.

around standardization, documenting workflows and information needs, and establishing expectations of the relationships between stakeholders.

The Symposium and Workshop illustrated how momentum has been building over the past decade in every stakeholder's community. This uncoordinated simultaneous prioritization of addressing the issues of long-term access to design records indicates we have reached fertile ground to develop comprehensive solutions. This does not mean we are necessarily on the eve of defining a universal solution, but we can now begin testing and exploring potential solutions outside our silos and consistently collaborate cross disciplines.

Appendixes

APPENDIX A: Prompts for Symposium Panels

Session 1: **ADE Formats Primer**

Described in the broadest of terms this will be a one hour introduction that covers the history and issues of ADE digital content. Though we know that the audience will include sophisticated users, there is much for all to learn, particularly in the communities of archivists who have never opened a design software to folks who are frequent users yet haven't stepped away to ponder the implications of the structure of their tools

Session 2: **Data Flowing Through Time and Digital Tapestry**
(Case Studies illustrating workflow / systems / choices for data management, access and preservation)

Technical: software now and in the future

- What are the challenges of design software on your firm's workflow and design process?
- What are the compelling needs of future design software for your design process and workflow?

Workflow: daily operation and firm standards

- How do you transfer, share, or access files or data during a project internally and externally?
- What role do external guidelines/standards/vendor neutral file formats have in your workflow?
- Do you document the phases of a project, and who is responsible for capturing data?

Legacy/Archive: thoughts about and decision on long-term access

- Does your firm have a policy for archiving your project records?
- Can you think of a time when your firm experienced a situation where you were unable to find or access legacy data? What was the impact? What did you learn? What would you do differently?

Session 3: **Access Use Cases**
(Case studies of accessing legacy data/files for business and research needs.)

- What is the focus of your research case study?
- What challenges did you experience accessing records?
- What were the most successful and most disappointing aspects of your case study?

Session 4**: What is Happening Now?**
(Case studies of current initiatives on standards; guidelines; software tools, etc.)

How does the work that you are representing help contribute towards solutions for accessing legacy, contemporary, or future records created by design software?

APPENDIX B: Workshop Questions & Responses

Designing the Future Landscape: Digital Architecture, Design and Engineering Assets

Workshop

November 17, 2017 9:00am-1:00pm, Library of Congress

Proposed concept: Defining the Archive Data Set for ADE Assets

Participants will sketch out a high level definition of what comprises an archival data set for ADE assets, focusing on answering the practical question "what data is important and why?" This broad characterization would be a valuable touchstone for the community to expand in later discussions post workshop.

Opening Query for Full Group asking for certain participants to offer their experiences:
If you have specific deliverables that you request or require, what are they, and why do you request them?

Facilitated remarks from Allison Olsen (UPenn), Ron Faunteroy (AOC), Ryan Donaldson (Durst Organization)

Small Group Discussions (questions & Easel Board Summary of Discussions follow):

Moderator: Jaime Mears

Tim Walsh; Phil Rosche; Jeff Klee; Mari Nakahara; Ann Whiteside

Moderator: Grace Thomas

Jessica Meyerson; Tawny Ryan Nelb; Ron Faunteroy; Roger Grant; Allison Olsen; Stacie Byas; Kurt Helfrich

Moderator: Leslie Matthaie

Jeff Ouellette; Katie Pierce Meyer; Ryan Donaldson; Nancy McGovern; Kristine Fallon; Michele Willens; Euan Cochrane

Roaming facilitators: Kate Murray; Kit Arrington; Aliza Leventhal

Workshop Small Group Discussion Prompts and Summarized Comments

1) **If technology wasn't an issue, what information would you want to access in the files through time? (15 mins)**

Scholarly Interest
- Content
- Technology
    - Can we provide partitioned access?

Identify Stages of a Project

- Stakeholders interests @ different points

Create a tool / List / Comparison of stakeholder interests

Collaboration of Archivist & Architects

- Possible to identify standards
- Possible to identify Milestones*
- Marking files during creation is important

2) **What limitations does technology impose to access? What technology solutions would you like to see? (15 mins)**

Challenge: Heterogeneous files/content vs. Boeing regular migration of anything with $ value/association.

Is it possible to concentrate technical expertise in certain institutions? Is a Clearing House a solution?

- Challenge of in-house capability
- Still need in-house expertise

Migration - scheduled

Filenaming challenges

Hydra (now Samvera)/Fedora: Some things can be normalized, but not all

* NDSA Levels of Preservation *

Saving through time vs. final project end

Architectural firm creates an AIP (*OAIS*) and submits it to _____ (*unnamed collecting body / institution / its own repository…)*

- Creating collected bodies of work

Archivists offer simplified output to ADE creators

- Lower threshold of output for collectibility
- Ex: Archeology has data deposit opportunities for sharing/research

"Curation Closers" at end of a project

3) **What are your driving external factors? What is holding you back? What defines your environment? (30 mins)**
    - **Business needs / Legal requirements / Financial limitations / Regulation requirements / other…**

Capture Narrative

ADE files: layers of data

Institutional Culture

- Tools to advocate TO Creators
- Challenge finding answers to questions
- Benefit of it being easier

Broad Standards that institutions could follow

Archive Expertise Devalued (need to change)

- Teach **VALUE** of downstream access

Different Institutional Mandates

- Library of Congress: "Forever" - reticent collecting
- CCA - more flexibility
- Geography & Map: GIS model - mandate
- Harvard: Library & Facilities
    - How? And Resources?

Aerospace / Engineering:

- Legal Requirements
- Business Requirements
- Known Downstream Use
- Customer Demand
- Can build in cost of Archival / Archiving

4) **WRAP UP**

Reach out to MANY design communities

Demonstrate value of collective effort across communities / stakeholders

Define Technical Deliverables: apply/store data to that object, but first need to know the data exists.

APPENDIX C: Workshop Participants

Designing the Future Landscape: Digital Architecture, Design and Engineering Assets

Workshop

November 17, 2017 9:00am-1:00pm

Proposed concept: Defining the Archive Data Set for ADE Assets

Kit Arrington	Library of Congress, Prints & Photographs Division, Digital Library Specialist
Stacie Byas	Architect of the Capitol, Curator Division, Records Management and Archives Branch, Chief
Euan Cochrane	Digital Preservation Manager, Yale University Library
Ryan Donaldson	Durst Organization, Senior Manager of Heritage and Information Services
Kristine K. Fallon	Kristine Fallon Associates, Inc., FAIA,
Ron Faunteroy	AOC, CAD System Manager, Planning and Project Development Division, Technical Support Branch
Kurt Helfrich	National Gallery of Art, Gallery Archives, Archivist
Jeff Klee	Colonial Williamsburg, Architectural Historian
Aliza Leventhal *	Sasaki; SAA Architectural Roundtable & CAD/BIM Task Force * Summit Report Author
Leslie Matthaei	Architect of the Capitol, Curator Division – Photography Branch, Archivist
Nancy McGovern	MIT, Director Digital Preservation
Jaime Mears	Library of Congress, National Digital Initiatives, Innovation Specialist
Jessica Meyerson	Educopia Institute, Research Program Officer; Software Preservation Network
Kate Murray	Library of Congress, Digital Collections Management & Services, Digital Projects Coordinator

Mari Nakahara	Library of Congress, Prints & Photographs Division, ADE Curator
Tawny Ryan Nelb	Nelb Archival Consulting
Allison Olsen	University of Pennsylvania, Digital Archivist, Office of the University Architect, Facilities & Real Estate Services
Jeffrey W. Ouellette	Vectorworks, Inc.; Assoc. The American Institute of Architects; IES; Chair, buildingSMART International Implementation Support Group
Katie Pierce Meyer	University of Texas at Austin, Humanities Librarian for Architecture & Planning, Architecture & Planning Library
Phil Rosche	CAx Implementor Forum;ACCR LLC. / PDES, Inc.
Grace Thomas	Library of Congress, Digital Content Management, Digital Collections Specialist
Tim Walsh	Canadian Centre for Architecture, Digital Archivist; SAA Architectural Records Section & CAD/BIM Task Force
Ann Whiteside	Harvard University, Loeb Library, Librarian, Assistant Dean for Information Services
Michele Willens	National Gallery of Art, Gallery Archives, Deputy Chief and Senior Archivist

APPENDIX D: Summit Program Committee

Designing the Future Landscape: Digital Architecture, Design and Engineering Assets

Symposium & Workshop: November 16-17, 2017

Program Committee:

Alex Ball	University of Bath, Research Data Librarian
Dylan Evans	Royal Institute of British Architects, Head of Systems and Services
Kristine K. Fallon	Kristine Fallon Associates, Inc., FAIA
Alexander Gorlin	Alexander Gorlin Architects, FAIA
Nancy Hadley	The American Institute of Architects, Archivist
Jeff Holmlund	Long Term Archiving Retrieval (LOTAR) Coordinator Americas, Lockheed Martin
Lamonte John	General Services Administration, Office of Project Delivery, Architect-Program Manager
William Kilbride	Digital Preservation Coalition, Executive Director
Aliza Leventhal	Sasaki; SAA Architectural Roundtable & CAD/BIM Task Force
Katie Pierce Meyer	The University of Texas at Austin, Architecture & Planning Library, Humanities Librarian for Architecture & Planning
Mari Nakahara	Library of Congress, Prints & Photographs Division, ADE Curator
Tawny Ryan Nelb	Nelb Archival Consulting
Suzanne Noruschat	Yale University, Manuscripts & Archives, Architectural Records Archivist
Jeffrey W. Ouellette	Vectorworks, Inc.; Assoc. The American Institute of Architects; IES; Chair, buildingSMART International Implementation Support Group

Dean Smith	General Services Administration, Office of Project Delivery, Deputy Ass't Commissioner
Tim Walsh	Canadian Centre for Architecture, Digital Archivist; SAA Architectural Records Section & CAD/BIM Task Force
Ann Whiteside	Harvard University, Loeb Library, Librarian, Assistant Dean for Information Services

Conference Organizing Committee:

Library of Congress

Kit Arrington	Library of Congress, Prints & Photographs Division, Digital Library Specialist
Jaime Mears	Library of Congress, National Digital Initiatives, Innovation Specialist
Kate Murray	Library of Congress, Digital Collections Management & Services, Digital Projects Coordinator
Grace Thomas	Library of Congress, Digital Content Management, Digital Collections Specialist

Architect of the Capitol

Stacie Byas	Architect of the Capitol, Curator Division, Records Management and Archives Branch, Chief
Leslie Matthaei	Architect of the Capitol, Curator Division – Photography Branch, Archivist

National Gallery of Art

Kurt Helfrich	National Gallery of Art, Gallery Archives, Archivist
Michele Willens	National Gallery of Art, Gallery Archives, Deputy Chief and Senior Archivist

APPENDIX E: Symposium Panels – Session Speakers

Designing the Future Landscape: Digital Architecture, Design and Engineering Assets

Symposium

November 16, 2017 8:30am-5:00pm, Library of Congress

http://loc.gov/preservation/digital/meetings/ade/ade2017.html

Opening Remarks

Mark Sweeney, Acting Deputy Librarian of Congress
Stephen Ayers, Architect of the Capitol

Session 1: ADE Formats Primer

"1960s-1980s," **Tim Walsh**, Canadian Centre for Architecture
"1990s-2000s," **Katie Pierce Meyer**, Architecture & Planning Library, UT Austin
"2010s," **Aliza Leventhal**, Sasaki / SAA CAD-BIM Task Force

Session 2, Part 1: Data Flowing Through Time & the Digital Tapestry

Moderator: **Kristine Fallon**, Kristine Fallon & Assoc., FAIA

"How We Create and Save," **Greg Schleusner**, HOK
Rick Zuray, Boeing (presented by **Phil Rosche**, ACCR LLC)

Session 2, Part 2: Fireside Chat – Data Flow

Moderator: **Ann Whiteside**, Librarian/Assistant Dean for Information Services, Loeb Library, Harvard Graduate School of Design

Nick Gicale, General Services Administration
Noémie Lafaurie-Debany, Balmori Associates
Mark Rylander, Mark Rylander Architect

Session 3: Access Use Cases

Moderator: **Kurt Helfrich**, Archivist, National Gallery of Art

- "New Archives: Digital Forensics and Programmatic Methods in Digital Design History," **Andrew Witt**, Graduate School of Design, Harvard
- "Emulation for Access," **Euan Cochrane**, Digital Preservation Manager, Yale University Library
- "Expanded Archives of Digital Culture," **Matthew Allen**, Harvard University, University of Toronto
- "Digital Architecture, Design & Engineering Assets," **Dennis Shelden**, AIA PhD, Director, Digital Building Laboratory, Georgia Tech

Session 4: What is Happening Now?

Moderator: Kit Arrington, Digital Library Specialist, Library of Congress

- "A Template for Interoperability Testing," **Phil Rosche**, CAx Implementor Forum, ACCR LLC
- "Software Preservation Network: The Access Breakdown and System Level Change," **Jessica Meyerson**, Software Preservation Network, Educopia Institute
- "buildingSMART International and Industry Foundation Classes (IFC): THE solution to A/E/C/O data interoperability, **Jeff Ouellette,** Assoc. AIA, buildingSMART International – Implementation Support Group
- "Documenting Building Information System Requirements," **Roger Grant,** Program Director, National Institute of Building Sciences

Summary: Tim Walsh, Canadian Centre for Architecture