"Archaeology of the Digital and Born-Digital Archives at CCA"

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Hello. My name is Tim Walsh. I am the Digital Archivist at the Canadian Centre for Architecture – or CCA – in Montreal. I'm going to talk for a bit about CCA's experiences with archiving, exhibiting, publishing, and researching born-digital architectural records, and some general thoughts on what it means to preserve these files over the long term as part of a research collection.

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Perhaps it makes sense to start with a brief introduction to CCA. What is CCA? CCA is a Research Institution, where exhibitions, publications (both print and electronic), a bookstore, a public program and the Collection all equally are part of the investigation on architecture being a public concern.

CCA's activities and collection are not intended to capture our build environment, but rather to explore the architectural discourse, experiments, with an international and theoretical perspective. In figures, CCA has:

- 2 main exhibitions, 3 octagonal exhibitions, and 3 hall case presentations per year
- About 50 lectures, seminars, and public conversations per year
- Collection: ca 190 archives, 100.000 prints and drawings, 60.000 photographs (prints/albums/etc), ca 240.000 monographs and ca 5000 series of periodicals

- Approximately 80 full-time employees

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The past few decades have seen profound changes in the way that we design, build, and study architecture. Inevitably, research and collecting institutions must respond and change in kind. The question is: how?

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At CCA, part of this process of reflecting and adapting to changing modes of production has happened through the Archaeology of the Digital project. I'm going to spend the next few minutes contextualizing this project, and explain what it has meant for the CCA across departments and activities.

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Archaeology of the Digital is a long-term, multifaceted program curated by Greg Lynn and initiated by the CCA in 2012. The project is comprised of in-depth research into digital architecture and a historical reading of the trajectory of digital architecture through twenty-five key projects, from early experiments in the 1980s through to work in the 2000s. These projects were developed by some of the protagonists central to the debate on architecture and digital technology, and each has influenced recent architecture history in a particular way. The research has resulted in a new acquisition strategy for born-digital material and the formation of a digital archive. Since 2013 CCA has presented two exhibitions, both of which then travelled to the Yale School of Architecture. The third exhibition will open shortly on 10 May 2016. The CCA has also produced a print publication, with another forthcoming in 2016, and is continuing work on a series of digital publications on each of the projects,

incorporating screenshots, videos, and original born-digital files from the archives alongside transcripts of interviews between Greg Lynn and the participating architects.

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Here you see a list of all 25 projects selected by Greg Lynn and CCA for inclusion the Archaeology of the Digital project. The list includes buildings both built and unbuilt, as well as design projects of an entirely different nature, such as Chuck Hoberman's expanding geodesic domes and Karl Chu's Catastrophe Machine, an analog elastic drafting machine device designed to demonstrate topological principles and generate and study non-linear geometry. What unites the projects is their use of computation and digital technologies in ways that changed the practice of architecture in a historical moment of experimentation and play. Because the projects occurred over a span of more than twenty years, they also offer the ability to see how developments in technology affected architectural design and vice versa, an idea that is explored through the thematics and subject matter of the three Archaeology of the Digital exhibits.

Due to its complexity and the need for broad, collective expertise, Archaeology of the Digital has required the collaboration of a number of departments at the CCA: Collection, Programs, Publications, Research and Information Technology. Furthermore, this research project has fostered the development of new knowledge and experience in the field of digital archives. CCA approaches the difficulties with born-digital archives from a curatorial point of view, meaning we want to overcome the issues related to the digital and we are working to find technical solutions, but the focus and reason for this work is to understand the projects in their context and in their complexities.

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The first Archaeology of the Digital exhibition opened in May 2013 and investigated four seminal projects that are notable for their experimentation and use of digital tools: the Lewis Residence by Frank Gehry (1985-1995), Peter Eisenman's unrealized Biozentrum (1987), Chuck Hoberman's Expanding Sphere (1992) and Shoei Yoh's roof structures for Odawara (1991) and Galaxy Toyama (1992) Gymnasiums.

The first show consisted of records and artefacts in numerous formats: CAD files in digital and printed paper form, physical models, textual records, and some computing hardware contemporary to the projects being investigated. As the pictures demonstrate, for a show on digital practice, Archaeology of the Digital is a heavily analogue show, reflecting the early stage of the technologies utilized and the hybrid processes of the architects – for example, Frank Gehry's practice of form-finding with physical models, and then recreating these designs in a digital space.

The show was accompanied by a print publication consisting of two separate volumes: an oral history built through a series of conversations between Greg Lynn, the four architects, and seven key collaborators of the featured projects; and a compilation of 270 documents selected from the project materials. The archives of Chuck Hoberman and Shoei Yoh joined the CCA collection, alongside that of Peter Eisenman.

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Archaeology of the Digital: Media and Machines, which marked the second phase of the research project, opened in May 2014. This second exhibition continued the first show's investigation of computation as a design medium, while shifting focus slight to explore the

practices made possible by experimentation and advancing technology such as interactive media and algorithmic design algorithms. This shift can be seen in the design of the exhibition itself – although Media and Machines contains a number of large and complex physical pieces, the show also features many more screens than the first show. Still, digital materials are shown not on modern high-definition displays but in forms that convey an archaeological approach to the projects.

Archaeology of the Digital: Media and Machines featured Asymptote's New York Stock Exchange Virtual Trading Floor and Operation Center, Karl Chu's Catastrophe Machine and X Phylum, the Objectile Panels by Bernard Cache, Hyposurface by dECOi Architects, Muscle NSA by ONL [Oosterhuis_Lénárd], and NOX's H2Oexpo. The breadth of creative scope among these projects extends from the design of buildings to the design of interactive media, interactive robotic mechanisms, drafting machines based on the Catastrophe theory, generative algorithms, and the writing of disciplinary and cultural theories. As a whole, they show the field's deeper engagement with digital technologies as time progressed.

Due to the nature of the projects and material, Media and Machines required CCA to actually reconstruct some of the built products of the featured projects. Benard Cache's digitally designed wall panels, the HypoSurface wall, and the Catastrophe Machine, among others, had to be first modified or entirely reconstructed in order to then be displayed and interrogated.

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Archaeology of the Digital: Complexity and Convention, the third show in the series, opens

shortly, on May 10 of this year. Like the first two shows, it will travel to Yale after closing at

CCA.

This third installment features 15 projects, by:

- Testa & Weiser
- Foreign Office Architects
- UNStudio
- Neil Denari
- Preston Scott Cohen
- Office dA
- COOP HIMMELB(L)AU
- RUR Architecture
- Cloud 9
- Morphosis
- KOL/MAC
- Peter Kulka with Ulrich Koenigs
- OCEAN North
- New-Territories/R&Sie(n)
- Zaha Hadid

These projects demonstrate various applications of technologies such as sophisticated CAD

software, high-fidelity visualizations and 3D printing in the design process.

Whereas the curatorial method of the first two exhibitions emphasized individual projects based on their distinct and clearly defined digital approaches, in the third exhibition the approach is more synthetic. Instead of singular practices, aspects of multiple projects are presented together. Through the lens of the curatorial themes High Fidelity 3D, Structure/Cladding, Data, Photorealism, and Topography/Topology, archival material is dissected and reassembled to provide a reading of innovative design strategies from the recent past that have now become convention.

The show will also feature the e-publications of all of the Archaeology of the Digital projects from across all of the shows in addition to the project's second print publication, creating a bridge between all three exhibitions.

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The Archaeology of the Digital project has fostered research in a number of areas. In order to understand, contextualize, and examine the projects, it has been necessary to conduct research with the project creators. The architects of the twenty-five projects and many of their collaborators have been interviewed to create oral histories that are a rich source of insight into design thinking and relevant context. The oral histories have helped to establish context and provide insight into the projects from a curatorial perspective, while simultaneously helping us understand in practical terms what digital materials in the archives are and how to interact with the files. The oral histories are being published in e-pubs and will ultimately be made available online for research. These oral histories have also been supplemented by "archival walkthroughs" conducted via Skype, where CCA curatorial and collection staff share our screen and walk through the files with the architects, to better

understand how their working practice is reflected in the organization and makeup of the files.

At the same time as the exhibitions and publications, there have also been other complementary research activities happening at CCA. The 2013 Toolkit seminar, for instance, aimed to develop a critical reading of a spectrum of digital thinking, featuring presentations by Greg Lynn, Peter Testa, Hani Rashid, Bernard Tschumi, Antoine Picon, and others. A CCA-hosted Experts Meeting brought together practicing architects, scholars, and archivists to discuss the issues of archiving computer-aided design from a variety of perspectives. The years since Archaeology of the Digital began have also seen an increase in visiting scholars at CCA whose practice and/or research interests tie them to the digital, and whose presence and lines of research continue to push thinking about this period and what it means to interact with the archives.

Simultaneously, the research conducted for the exhibitions and publications, reading these projects through the lens of Archaeology of the Digital and in relation to each other, is revealing aspects of the projects that were not presented in publications at the time. This new research is being offered to the public through the print and electronic publications, which hopefully will in turn foster more research and interest in the architectural community at large.

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Perhaps the best way to examine the projects more deeply, and with an eye towards their handling as archives, is by examining a few in greater detail.

Archaeology of the Digital examined 25 significant digital design projects, and this has resulted in the donation of 25 archives to the CCA collection. Nearly all of the archives consist of both born-digital and analogue materials. They range in size from small project archives consisting of a few paper drawings and a handful of digital files to full fonds consisting of tens or hundreds of cubic feet of paper records and several hundred gigabytes of digital records. The material spans from the 1980s to the 2010s, but the bulk of the records were created between the early 1990s and mid 2000s. As a whole, the born-digital component of the Archaeology of the Digital archives comprises roughly 5 terabytes of data, made up of several hundred thousand individual files that arrived at CCA via network transfer services such as Dropbox and WeTranser on a wide range of original and new digital storage media.

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We're going to look at three archives in particular, with an eye toward demonstrating the range of born-digital archives in the Archaeology of the Digital project, and different types of challenges they present.

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The Testa & Weiser records were one of the first Archaeology of the Digital archives to be processed. It consists of over 400 GB of born-digital records, 56 paper drawings, and eight 3D-printed physical models produced by 3D Systems and displayed widely in the mid-2000s.

The archive documents four unbuilt projects by the firm, including Carbon Tower, a 40-storey building made almost entirely of carbon fibre that was developed in parallel with scripting software designed at the Emergent Design Group at MIT under the direction of Peter Testa and Devyn Weiser.

The archive contains a wide range of digital file formats. In addition to original design and 3D printing files, the archive also contains correspondence, images of the models on display in museums and galleries, presentation materials, written materials such as articles, and software scripts.

The majority of the actual design and rendering work occurred in Rhino and Maya, respectively, with the use of home-developed Maya Embedded Language scripts. Designs were exported as STL files to be 3D printed as models, several years before this would become fairly standard practice for firms.

The material was well organized by the firm prior to arriving at CCA, which greatly aided in making the material available to researchers quickly. There were, nonetheless, some obstacles and lessons learned. Perhaps the biggest lesson is that the difficulties in describing and preserving these digital archives may often result from their sheer scale: when confronted with thousands of files in very large and complex multi-level folder structures, it can be difficult to understand all of the connections between files and conduct detailed file-level preservation work. Processing of the Testa & Weiser records also underscored the need to revise our descriptive vocabularies to better describe born-digital records and their function within the design process, especially when – as in this example – they exist alongside more traditional analog counterparts.

The Testa & Weiser records are also a great example of how the archive, finding aid, and e-publication complement each other. Here you see a screenshot from the recently published iBook, which situates files such as this screen capture of a Rhino wireframe a conversation between Greg Lynn and the architects. The reader has an accessible way to learn about the project and the architects' take on the digital, and if interested can then explore further in the archive on their own in our Study Room in Montreal.

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The records of KOL/MAC's Ost/Kuttner Apartment illustrate a very different type of born-digital archive. Sulan Kolatan and Bill MacDonald's design for this widely recognized New York apartment eschews clean lines for curves made of composite resins and carbon fibers, which flow from one space to another. The architects scanned traditional furniture and décor such as couches and pillows, then played with their shape and scale in 3D modeling software. In a way, the resulting design is both the result of and testament to 3D technology.

The KOL/MAC records at CCA include approximately 9,000 digital files that arrived on eleven floppy, Zip, and Jaz disks (only one of which had degraded to the point of being totally unrecoverable), 42 paper drawings, and 2 Hi-8 tapes, which have been digitized and are now being preserved digitally.

Despite the relatively small volume of records in the archive, the digital files of the Ost/Kuttner Apartment are a case study in the effects of software obsolescence, and have required a great deal of work to make accessible for CCA staff and the public. To see why, we'll look at the process required to access files on just one of the Zip disks received by CCA.

The first step with any original media at CCA – especially for already obsolete media such as Zip disks – is to make a forensic disk image of the media. This is essentially a 1:1 copy of the data exactly as it resides on its physical media – including any empty space, corrupted sectors, or partially deleted data – in software form. Typically, we can export files directly from these disk images, while retaining the images as a preservation copy of the data as it arrived at CCA.

In this case, we knew from the questionnaire, interviews, and context clues on the media themselves that KOL/MAC had been working on Macs. Given the project dated from 1995–1997; the architects were not working on OS X but a classic version of the Mac operating system such as OS 7 or 8. This is important information – because modern computers, including new Macs, are no longer capable of reading the HFS file system used by Macs prior to the introduction of OS X in 1999, we had to use specialized software called HFS Explorer to gain access to the files on the Zip disk.

Once we successfully exported the files to a new folder, we had another problem – we didn't know what to do with the .sea files we got as a result. These are Mac-specific proprietary Stuffit archive packages – a format like a zip file that has not been in use or supported by typical software for years. Early attempts to unpack these files on our forensic capture workstation – including the use of older command-line utilities like macutils, pictured here – all failed.

Finally, switching a modern Mac and using the command line version of "The Unarchiver" software, we were finally able to get access to the files contained within these .sea packages. All of our problems were solved.

…or so we thought. On closer investigation, because of the way that older Macs handled file types, many of the files contained within the SEA packages had no file extensions, meaning we were able to see filenames and metadata (dates, size), but weren't sure what we were looking at or what software to use to actually view the contents of the files.

At this point, we had to turn to more tools, such as Siegfried by Australia's own Richard Lehane, to compare the code of the files against file format registry databases and generate reports that would allow us to understand what we were looking at.

Ultimately, we were able to determine that most of the files without extensions were ClarisWorks Word processor files, which allowed us to finally track down modern software capable of reading this format, so that we could access and conduct research on their contents. As a side note, even with these advanced tools for identifying digital files, a certain amount of knowledge and skepticism is still required – for instance, the four "Microsoft Excel Backup" files listed in the aggregate report here are likely actually backups of Microstation DGN drawings, potentially misidentified due to their shared use of the BAK file extension.

The upside in this case is that the actual CAD design formats – once we were able to unpack them from the disk images, and then the SEA packages – were fairly standard Microstation DGN files that are easily viewable by a range of modern software.

The biggest lesson to be learned from this example is that the size of the archive does not necessarily correlate to the size of the challenge in investigating, researching, and exploring its records. CCA's interest in the early and experimental can greatly increase the amount of work involved in recovering content from obsolete media and combatting file format obsolescence. This underscores the need for knowledge of obsolete computing hardware, software, and file systems; and also the need to have clear file format policies and preservation plans for this type of material: given the amount of work involved in making this material accessible in 2016, we can safely say that unless we take action on these files now to prolong their longevity, such as migrating them to new file formats – there will be no way a researcher in 10 or 20 years will be able to interact with files in the archive.

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A third example, the records of the Hypo Alpe-Adria Center by Morphosis, show a related but slightly different challenge inherent in acquiring and archiving born-digital architectural records. The Center, which includes a five-story bank headquarters and branch, event space, commercial and office space, gardens, and a kindergarten, sits on the rural-urban edge of Klagenfurt, Austria, a fact that is reflected in the building's typology and typography.

The Morphosis records consist of 12GB of digital files – about 16,000 files in all. Unlike most of the Archaeology of the Digital archives, this one contains no physical material, although some models have been accepted on loan for the show. The digital files arrived at CCA on a single USB thumb drive, after the data was transferred off of a number of CD-ROMs by the firm. Like the KOL/MAC records, much of the Morphosis material was generated on older Macs, and so has a number of files with no extensions appended to the end of the filename.

This archive has not yet been processed, but will be an interesting case because of the firm's "Black Box" archiving procedure – because files were backed up to CD-R incrementally over the course of the project, there appears to be a lot of duplication throughout the archive, but even this duplication is reflective of the working practice of the firm. A Skype share-screen walkthrough of the files with Morphosis architects and CCA collection, curatorial, and publication staff proved very helpful in getting an understanding of what these "Black Boxes" were and the structure of the content in each folder.

The archive contains files in many design formats, include roughly 1200 Microstation DGN files, 700 AutoCAD DWGs, and 358 FormZ files. It's these latter files – the FormZ – that I want to focus on for a moment. This file is a total model of the Alpe-Adria Center, initially created in FormZ 4. When we first tried interacting with the material in the archive, none of the FormZ files would open in the free reader we had installed on our CAD workstations. This turned out to be because new releases of the FormZ software are not capable of reading files saved in previous versions. This meant that in order access files identified as potentially interesting for the exhibition and publication, we had to ask for the help of an outside architect to migrate the files from FormZ 4 to FormZ 6.7, and then again into FormZ 8, which could be read by the free reader currently made available by FormZ's developer, AutoDesSys. This worked well for a handful of files in one case, but doesn't scale as a solution for access and preservation when we're talking about large quantities of files.

CCA has since acquired formZ 6.73 and 8 Pro as donations from AutoDesSys, which has enabled us to access many – if not still all – of the FormZ files in our collection internally. The vendor also indicated that they might be able to provide even older versions of the software,

except that they have difficulty generating valid licenses for the hardware USB keys that must be plugged into the computer for the software to operate.

This example raises a number of questions for preservation and access of CAD and 3D modeling files:

- If our ability to open, view, and manipulate files is dependent on access to specific versions of software, what happens when that software no longer runs on our current ecosystem of software and hardware? This applies equally to software that is now old or obsolete and to the current software that we're using today. Unless we work out the technological and legal/licensing issues attendant to running old software for the foreseeable future, it is only a matter of time before we have serious issues of access.
- Fortunately, backwards-compatibility issues like this example seem limited to a few software platforms currently (in our experience: FormZ and Softimage have been the biggest obstacles). But eventually Autodesk may stop supporting older software such as Alias; and much further down the road, potentially even software that today still enjoy a wide user base. What then?
- For formats such as complex 3D models that cannot be saved into vendor-neutral file formats without losing some degree of data, what do we do? Is a certain loss of, for example, parametric information accessible? Even for parametrically-designed projects?

In short, the point I'm trying to make is that maintaining access to design files and their content means maintaining access to the software that can faithfully render them. Given the

range of software systems and formats in the Archaeology of the Digital archives, this is no small feat.

CCA's solution to this problem has been to compile four CAD workstations loaded with a wide range of software that we have received as donations, and occasionally purchased, from software vendors. These stations are used by staff and the public alike to view, manipulate, and transform files so that they can be used for research. On these stations we're currently able to access somewhere in the neighborhood of 80 to 90 percent of the digital design files in the Archaeology of the Digital archives – not a bad number considering that some of the projects are nearly 30 years old at this point.

Moving forward, it would be wise for collecting and research institutions to address the technological and legal issues associated with continuing to provide access to this software even as operating systems, hardware, and markets change. There is a good deal of research and advocacy going into the question of software preservation at present, including by some of the organizations listed above. Although many issues still need to be resolved, a coordinated effort by collecting and research organizations will go a long way toward solving problems that are much for difficult to address as individual organizations.

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I'd like to conclude my talk today with a few conclusions and thoughts for what all of this means for collecting institutions and practicing architects thinking about their own archives, as well as a few thoughts on future steps for archiving born-digital and CCA.

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For collecting institutions like CCA and the Architecture Museum here at the University of South Australia, a variety of staff expertise is needed to successfully engage with born-digital materials: for CCA, the perspectives and skills of architects, curators, editors, archivists, conservators, and cataloguers have all proven invaluable in investigating the Archaeology of the Digital projects and making them accessible. Particularly when working with older, more experimental content, knowledge of architectural history and practice, the software systems used, and legacy computing environments are also all critical to success in archiving.

The project has also clearly demonstrated the importance of collecting born-digital archives early. Gone are the days of collecting only after a firm closes its doors or an architect passes away – for born-digital material to be understood and made accessible, documentation and communication with the architects is crucial. This implies a shorter collecting window than museums, archives, and libraries have traditionally enjoyed.

The project also encourages us to think of access to archives in a multi-faceted way. Although CCA is currently developing its tools and procedures for sophisticated access to digital files on-site in our Study Room in Montreal, we are also able to provide access to selections of the archives to a wider audience through print and electronic publications, web features, and exhibitions. These curatorial forms of access can also enrich and supplement the archives by bringing in research conducted by CCA, interviews with the architects, and other added value description and contextualization that goes beyond what we can provide in a traditional finding aid.

Of course, collecting institutions must also develop their capacity to responsibly steward these materials through the building of digital preservation infrastructures, policies, and

workflows. This means establishing monitored and redundant storage, file format migration plans for at-risk formats, and a regular habit of verifying that holdings are complete and unchanged. It also means developing strategies for ensuring the accessibility of the content of our archives over time. By engaging immediately with early, experimental, and thus often difficult material, and building CCA's digital preservation and digital archiving capabilities in turn, CCA has developed its capacity to collect other late 20th century and 21st century archives. Already, we have seen that contemporary acquisitions nearly always have a born-digital component, a trend that is only going to increase with time. Being prepared to handle this type of material enables us to make selections based on our interest in projects and architects, rather than by the limitations of what we are capable of working with.

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For the architects in the room, there are also some things you can do to ensure the archivability of your work. Perhaps the most important action that you can take is instituting good records management and documentation practices. Establishing consistent file naming and structuring practices will make your files more accessible to you and – if your records become part of the collection of collecting institution – easier for researchers to search, sort, and understand. Clear data retention policies and agreements, using tools like the American Institute of Architects' contractual documents for BIM projects, can do much to clarify roles, responsibilities, and practices, to ensure that your data remains accessible for as long as is necessary. As with many other pursuits, taking the time to properly document your processes is also crucial. This can include retaining information about who worked on projects, control of intellectual property rights, linked files and file dependencies, passwords, the software and operating systems being used at the firm, which software is used at various stages of the design methodology, and other such details. Being able to go back and refer to this

documentation in 10, 15, or 20 years can save a great deal of guesswork and digital archaeology.

Of course, routinely generating this type of documentation requires an investment in the present and can be difficult in an environment where every project has hard and fast deadlines. But thinking of and treating your archives as assets can be very beneficial, both for your internal practice and any interested researchers down the road.

And of course, I would be remiss not to say: always have your important digital assets backed up in several different places. The secret to keeping digital objects around is removing single points of failure: if hard disks by a certain manufacturer start failing early and often, or there is a building fire, or a cloud storage provider gets hacked, you want to be sure that not every copy of your files is affected. A simple mantra to remember is: lots of copies keeps stuff safe.

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So what does the future bring, at CCA and generally for collecting and research institutions?

It will be crucial to foster ongoing research into born-digital architectural archives, both to continue finding ways to provide meaningful access and insight in an interconnected world and to learn from the experiences of scholars working with digital material so that we can improve our access tools.

It will also be crucial to anticipate and developments in design practice. BIM is a reality that is changing the architectural profession. Given its recent adoption, it will likely be some time yet before Revit files and the like make their way to institutions like CCA, but we need to be ready

when they do. Similarly, we will need to respond to the changing product and sales models of the CAD vendor world. The shift to subscription-based cloud services for software already underway by companies like Autodesk, Adobe, and Microsoft will have significant affects on consumer markets and collecting institutions. In practical terms, this is a return to the days of thin clients connected to powerful mainframes, except now the mainframes are in giant data centers owned and operated by a small handful of large corporations. The move from lifetime licenses to monthly or annual subscriptions and instant, online verification of active accounts will be especially interesting in relation to software preservation efforts, and will likely mean that these questions can only be resolved cooperatively with the companies producing and maintaining CAD and BIM software.

Finally, at the heart of the matter, we as collecting institutions must continue building collections that document and provide insight into the effects of digital technology on the profession and vice versa, and to expand our capabilities to work with this material. Whether we are seeking to understand changing design practice or retain designs for building maintenance and renovation, we must adapt our practices to match the times. We will become adept at working with this new form of records only through practice, which is why the Archaeology of the Digital project and the pilot project here at the University of South Australia are so crucial.

This workshop seems to me an ideal place to start or continue many of these conversations, so I look forward to any questions or comments you might have. Thank you.