CU04 Digital Twin
CU03 Smart Grid

I Trust AI Plenary
National Library and Archives, Abu Dhabi
Research Plenary Meeting, Day 2

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Urban Digital Twin

• An ecosystem of multi-dimensional and interoperable subsystems of
  • things in the real world, natural & human made
  • a digital replica of those things
  • a system that communicates between the digital and the real-world things, and
  • the people and institutions that govern, contribute to, use and share it

• Primarily w/in architecture, engineering, construction, and operations (AECO)
Urban Digital Twin

Carleton Immersive Media Studio
ESRI
Controlling a playable character as a real-time simulation between development scenarios and the real experience. Photo Credit: Natalie.
• Sustain Digital Campus project conducted experimentation in 4 test buildings at Carleton U.
• 8 BIM buildings at Carleton U.
• DT ecosystem of technologies & data allows Architecture, Engineering, Construction, and Operations (AECO) professionals analyze real-time data and visualize the modeling and analysis results into their actual designs, improving the overall process and to manage these assets.

Imagining Canada’s Digital Twin
CU04 – Digital Twin Objectives

• A case study to understand how a digital twin is used and created so that it can be preserved
• Test the preservation of the Carleton University Digital Twin created as part of the digital campus work at the Carleton Immersive Media Studio (CIMS) and the Sustain Project
• By doing so, is it possible to use AI to automate the preservation of digital twins and related technologies
• How can DT AI/ML + IoT be preserved
CS04 – Digital Twin

1. Provides critical records and archival challenges in terms of the use and creation of complex records – BIM, ASM, Digital Twins, VR and AI

2. Involves and ecosystem of data, real-time systems, AI/ML, IoT, building information systems (BIM), asset management systems (AMS), LIDAR, VR, simulations and techniques, technologies, and data of importance to fields in architecture, urbanism, planning, construction and engineering.

3. Archival concepts of authenticity, reliability, and accuracy, and others will be identified as research progresses.
<table>
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<tr>
<th>Digital Twin Team</th>
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<td><strong>Communication &amp; Media Studies</strong></td>
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<td><strong>School of Information Resource Management</strong></td>
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<td><strong>Corporate Records and Archives</strong></td>
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<td><strong>Department of Computer Science, Electrical and Space Engineering</strong></td>
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<td><strong>Dept. of Information Systems and Technology (IST) and Information Specialists</strong></td>
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<td><strong>Professor in Architectural Conservation and Sustainability Engineering</strong></td>
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<td><strong>Department of Civil and Environmental Engineering</strong></td>
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<td><strong>Dipartimento di Storia, Archeologia, Geografia, Arte e Spettacolo - SAGAS</strong></td>
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Smart Grid Case Study

InterPARES Trust
CS03 - Smart Grid Data Communication and Analytics

• Smart grids monitor energy consumption and manage production and distribution using a variety of AI/ML & algorithms to predict consumption to manage the grid at power generation but also at the individual household w/ billing and consumption information.

• A common central element in most smart city strategies, smart grids must address archival and record keeping concerns in order to support the accountability of decision-makers and transparency to clients/consumers.
CS03 - Smart Grid Case Study

- The Sensor Systems and The Internet of Things Lab at Carleton University conducts research with the Ontario Smart Grid that uses AI/ML in its IoT System.
- Inform how archival concepts and principles can influence the development of responsible AI; and will enable outcomes to be validated.
  - A source of information for other studies in connection with explainable AI, creation, use, retention, and preservation.
  - Important implications for utilities worldwide, for instance for The Ontario Smart Grid System.
CS03 – Smart Grid Objectives

1. To provide critical insights into the accountability of a major utility

2. Findings will clarify the degree to which AI/ML implementations of this scope and complexity are “explainable” to decision-makers and consumers

3. Good practices identified can be communicated to other jurisdictions and utilities considering similar ML-based enhancements

4. Analyze the juridical, provenancial, and procedural contexts of ML-based improvements
# Smart Grid Team

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<th>Department</th>
<th>Institution</th>
<th>Position</th>
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<tr>
<td>Communication &amp; Media Studies</td>
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<td>Engineering</td>
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<td>I Trust AI</td>
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<td>Retired archivist, considerable archival and program management experience</td>
<td>Jim Suderman</td>
<td>Canada</td>
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<td>in the public sector</td>
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<td>Sanja Seljan</td>
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<td>MacOdrum Library</td>
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<td>Professor and Director</td>
<td>Michel Barbeau</td>
<td>Canada</td>
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Case Study Methodology

InterPARES Trust
Walkthrough Method

Engage directly w/ a technological system to examine its technological mechanism & embedded cultural references

1. Environment of expected use
   • Vision, operating model, modes of governance

2. Walkthrough technique
   • Systematically & forensically step through the stages of use

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<td>Provenancial</td>
<td>Vision</td>
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<td>Documentary</td>
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Sample of CIMS DT Data & Technology
Semi Structured Interviews

- Adapted IP2 Case Study Questionnaire
- Consulted with Day 1 Plenary Attendees in Abu Dhabi, 21/02/2023
- Will circulate and seek input for the next couple of weeks
- Modify it
- Consult with Carleton Archivists
- Plan to schedule Interviews in April
6. Failure to conduct the research in accordance with the principles of the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans 2nd edition and the Carleton University Policies and Procedures for the Ethical Conduct of Research may result in the suspension or termination of the research project. Upon reasonable request, it is the policy of CUREB, for cleared protocols, to release the name of the PI, the title of the project, and the date of clearance and any renewal(s). Please email the Research Compliance Coordinators at ethics@carleton.ca if you have any questions.

CLEARED BY:  

Date: February 17, 2023
Data Capture

- Audio video recording of systems and how they operate
- Interview recordings and transcripts
- Document collection
- Inventory:
  - Data
  - AI/ML
  - Software
  - Hardware

- Test the preservation of the Digital Twin and the Smart Grid in the Carleton University Archives
Case Study Outcomes

InterPARES Trust
I Trust AI Case Studies

• Methodological approach to the study of large complex social and technical systems that include AI/ML

• Identify how records for decision making are created in these dynamic & interactive systems

• Test the preservation of these systems and their records, possibly

• Preservation Guidelines for Digital Twin and Smart Grid
  • creators
  • software & hardware developers
  • governments
Projects

InterPARES Trust AI, UBC Canada
• Funded by the Social Sciences and Humanities Research Council of Canada, https://interparestrustai.org/trust, @itrustai

Imagining Canada’s Digital Twin,
• Carleton Immersive Media Studio (CIMS), Carleton University, Canada
• funded by the New Frontiers in Research Fund (NFRF), https://canadasdigitaltwin.ca

Sustain Designing for People
• Carleton University, Canada
• funded by NSERC, https://sustain.sce.carleton.ca/

Sensor Systems and Internet of Things Lab,
• Department of Systems and Computer Engineering, Carleton University, Canada
• Funded by CISCO and others https://carleton.ca/internetofthings/people/dr-mohamed-ibnkahla/
Image Source CS04 & CS03

CS03 & CS04 Images come from:

• Cover Slide - CIMS  
  http://cims.carleton.ca/#/projects/imagining_canada's_digital_twin

• Zied Bouida, Sensor Systems and The Internet of Things Lab presentation at the WG1 Meeting on October 25, 2021

• Nicolas Arellano, Carleton Immersive Media Studio (CIMS) and the presentation at the WG1 Meeting on October 25, 2021

• Contact:
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