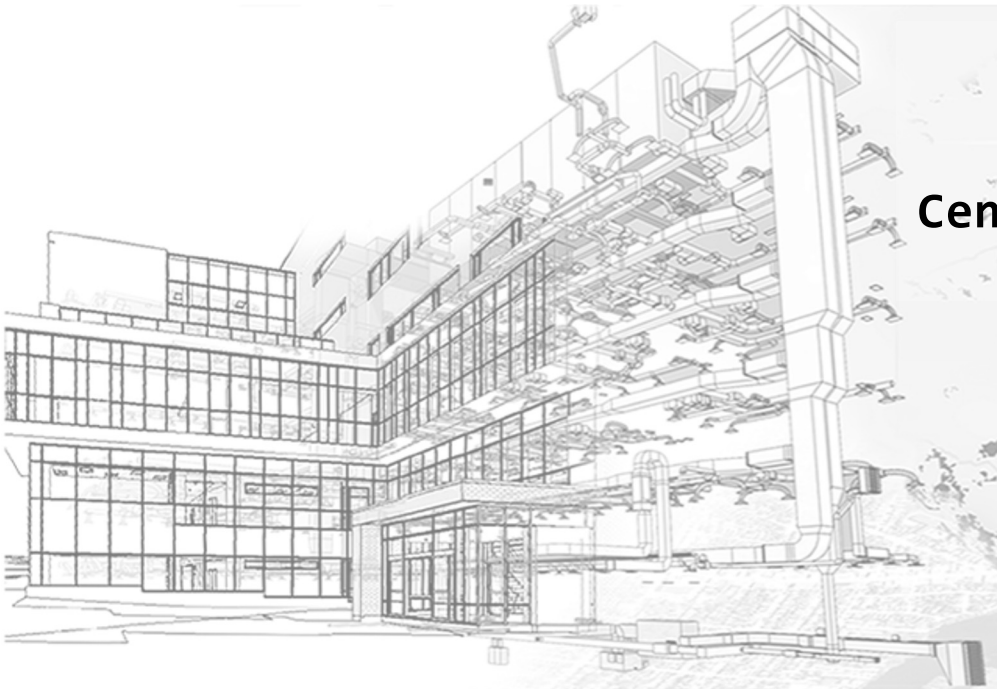

ACA 2024
Access & Algorithms Session
Future-Proofing:
Centring Care Now for Archives Tomorrow
June 13, 2024

Creating Today's Digital Twins for the Archives of Tomorrow!

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Administration

Funding, Objectives, Members

Joins 2 Research Projects

- CU04 Digital Twin Case Study - ***Archives 4.0: Artificial Intelligence for Trust in Records and Archives***, UBC, PI Luciana Duranti & Co-director Muhammad Abdul-Mageed, SSHRC Partnership Grant
  - Identify specific AI technologies that can address critical records and archives challenges;
  - Determine the benefits and risks of using AI technologies on records and archives;
  - Ensure that archival concepts and principles inform the development of responsible AI; and
  - Validate outcomes from Objective 3 through **case studies** and demonstrations

- Object of Study - ***Imagining Canada's Digital Twin*** Project, New Frontiers in Research Grant, Carleton University Immersive Media Studio (CIMS), Carleton University

Digital Twin Case Study Objectives

Goals

- Study the making of the CIMS Digital Twin
- Test the preservation of the CIMS Digital Twin
- Assess if AI can automate the preservation of Digital Twins & their related technologies
- Explore how the AI/ML + sensor/metre + Automation + code in the Digital Twin can be preserved
- Results to inform the making of Digital Twins w/preservation in mind

CS04 - Digital Twin CS Team

- **Tracey P. Lauriault**, I Trust AI Lead, Associate Professor, Critical Media and Big Data, School of Journalism and Communication, Carleton University (Tracey.Lauriault@Carleton.ca)
  - **Anna-Lena Theus**, PhD Candidate at Carleton University | Project GAA, (annatheus@cmail.carleton.ca)
- **Stephen Fai**, Professor cross appointment in the Department of Civil and Environmental Engineering, the Institute for Comparative Studies in Literature, Art, and Culture, and the Azrieli School of Architecture and Urbanism; Director of the Carleton Interactive Media Studio (CIMS) (sfai@cims.carleton.ca)
  - **Nicolas Arellano**, PhD Candidate at Carleton University | Research Team Lead at CIMS (narellano@cims.carleton.ca)
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- **Sherry Xie**, Renmin University of China - School of Information Resource Management (sherrylx@outlook.com)
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- **Göran Samuelsson**, Senior lecturer, Department: Department of Information Systems and Technology (IST) and Information Specialists for The Swedish Transport Administration (Goran.Samuelsson@miun.se goran.samuelsson@trafikverket.se)
- **Liam O'Brien**, Professor in Architectural Conservation and Sustainability Engineering, PI the SUSTAIN Project (Sensor-based Unified Simulation Techniques for Advanced In-Building Networks) project at Carleton University (liam.obrien@carleton.ca)
- **H. Burak Gunay**, Assistant Professor in Building Science, Department of Civil and Environmental Engineering (burak.gunay@carleton.ca)
- **Annantonia Martorano**, Dipartimento di Storia, Archeologia, Geografia, Arte e Spettacolo - SAGAS, University of Florence (UNIFI) (annantonia.martorano@unifi.it)
  - **Elena Gonnelli**, PhD student at the University of Florence., (gonnellielena@gmail.com; elena.gonnelli@unifi.it)

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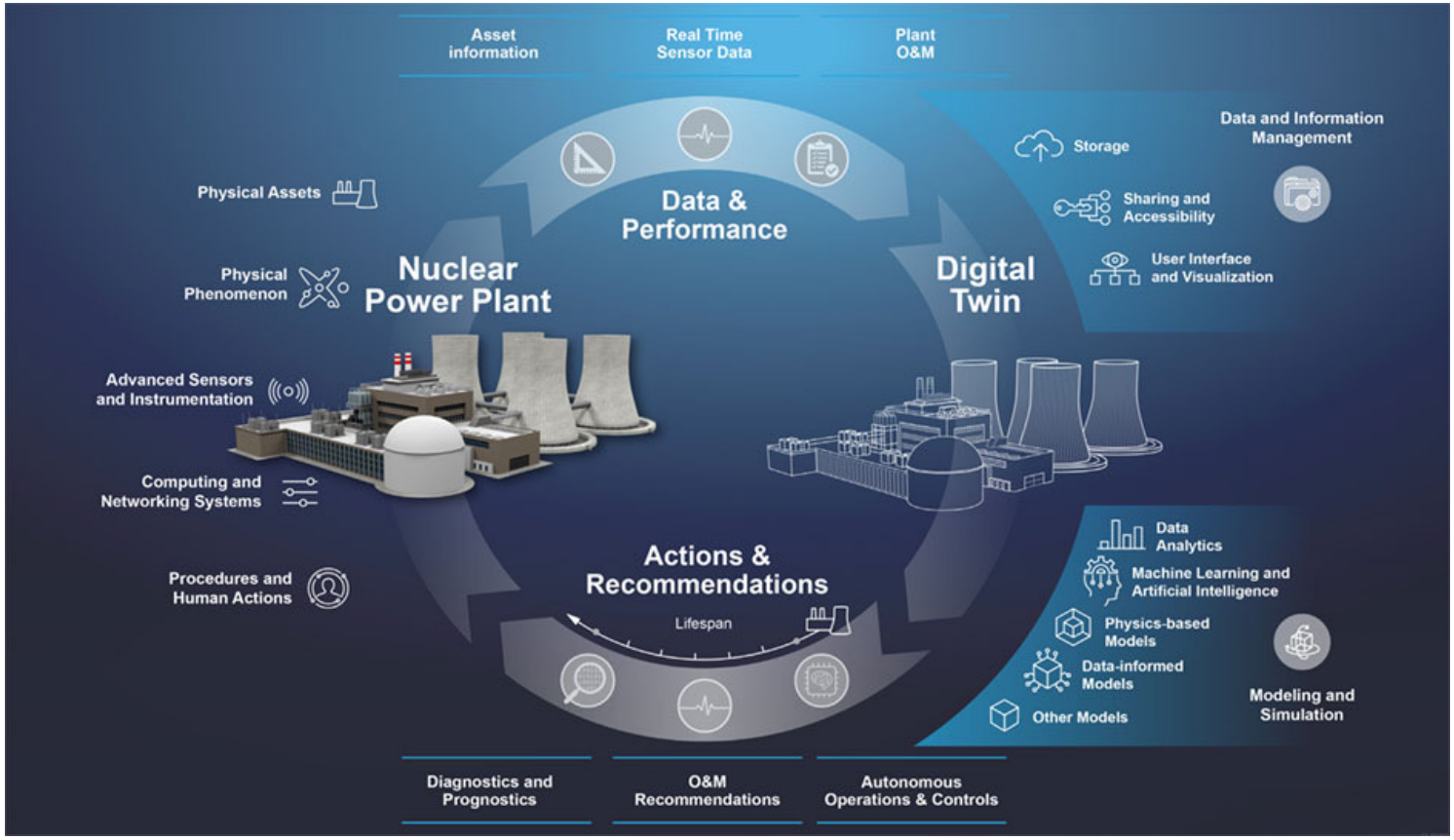
Definition

Digital Twin – AECOO & City View

Digital Twin



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Digital Twins – AECOO & City View

- technologically instrumented & networked w/ systems that are interlinked & integrated, where vast troves of data are generated by sensors & administrative processes used to manage & control physical assets and environments in real-time
- **A**rchitecture, **E**ngineering, **C**onstruction, **O**wner **O**perated (AECOO) sectors invest in digital twin and asset management systems to inform the design, construction, management & operation of physical assets
- Urban planners often invest in the creation of 3D mapping
- The focus is most often to quantify & manage & operate physical assets such as buildings, building environments, and other features of the built and sometimes the natural environment
- City use the 3D to plan and create scenarios

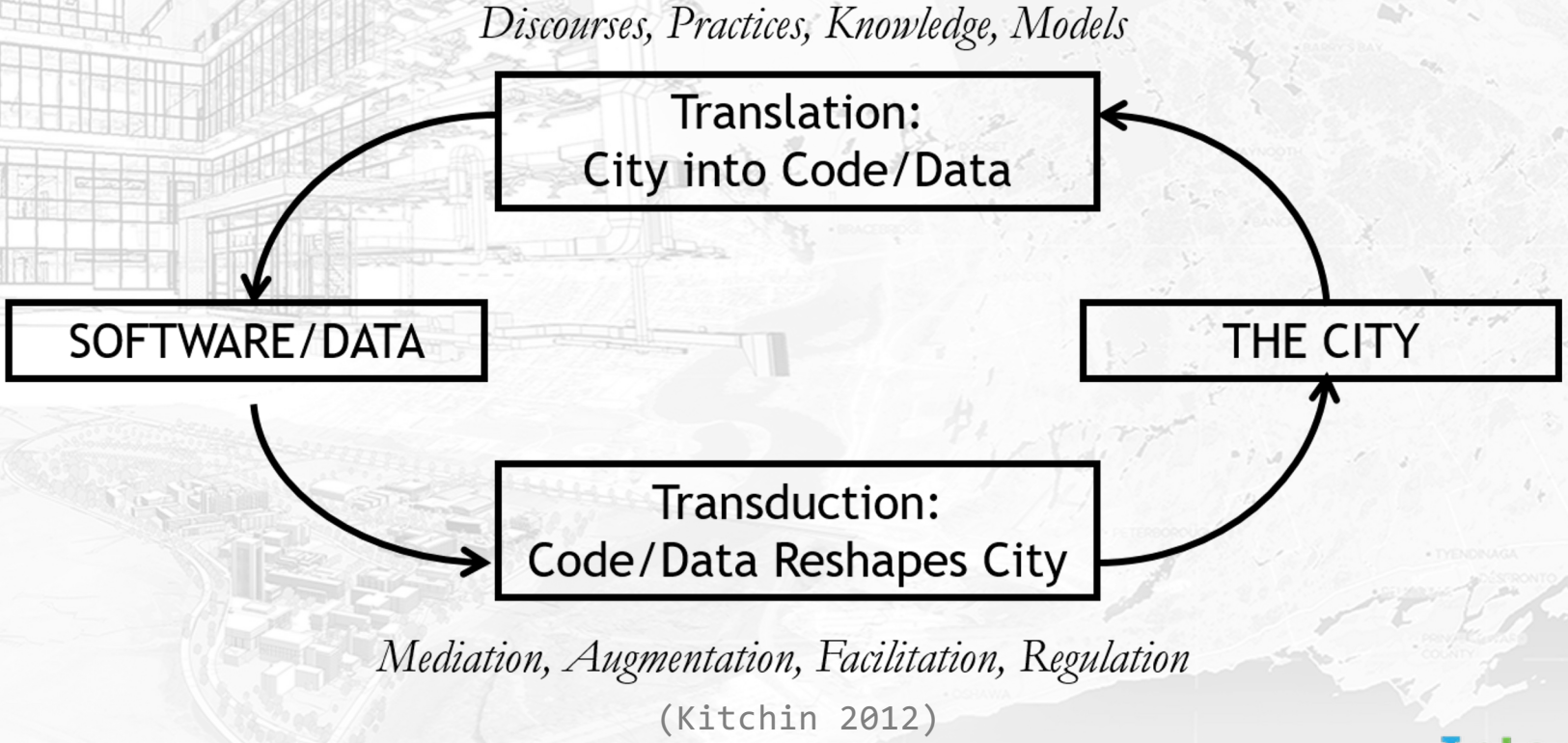
Case Study

ICDT – Why? – Rational - Theoretical Framework - Juridical Actors – Data Collection – Preliminary Observations – Next Steps

Imagining Canada's Digital Twin

ICDT proposes a national, inclusive, and multidisciplinary research consortium for the creation of a technical, cultural, and ethical framework for building Canada's digital twin. We see this initiative as a necessary next step in placing Canada at the vanguard of the digital economy. The scope for this initial phase of research will focus on a digital twin of the built environment concentrating on Canada's Architecture, Engineering, Construction, and Owner Operator (AECOO) industry.

Why a Digital Twin Case Study?



(Kitchin 2012)

Also, Data & Technology Governance

- "the exercise of decision making and authority for data-related matters.
- a system of decision rights and accountabilities for information-related processes, executed according to agreed-upon models which describe who can take what actions with what information, and when, under what circumstances, using what methods."
- **"about making sure that people are properly organized and do the right things to make their data understood, trusted, of high quality, and, ultimately, suitable and usable for the enterprise's purposes"** (Plotkin 2021)

4 Interrelated Theoretical Frameworks

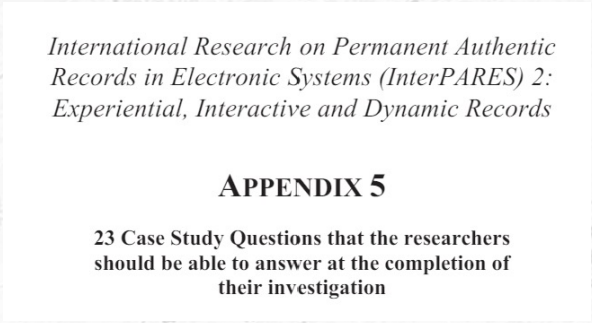
1. Critical Data Studies (Kitchin & Lauriault, 2018)
2. Digital diplomatics (InterPARES project)
3. Social and Technological Data Assemblage (Lauriault 2022)
4. Combination of technological Walkthrough (Light, Burgess & Duguay 2018) with Digital Record Forensics (Duranti 2009).

Interviewed Juridical Actors

- Carleton Immersive Media Studio (CIMS)
  - Imagining Canada's Digital Twin (ICDT)
- Carleton University Facilities and Plant Management (CU FMP)
- Delta Controls
- Carleton University Building Performance Research Centre (CU BPRC)
- Carleton University Corporate Records and Archives (CU A)
- City of Ottawa
  - Building Code Services
  - Geospatial Analytics, Technology and Solutions (GATS)
  - City Archives

Data Collection

- Adapted the IP2 Case Study Questionnaire
- Conducted 13 Interviews
  - +/- 25 hours of recordings
  - Documentation
  - Photos/Screen captures
  - Videos, Audio
- Participated in 3 Tours
  - Carleton University Facilities, Plant & Control Rooms
  - Engineering Design Centre Building Labs
  - City Archives
- Round 2 of Preliminary Observations

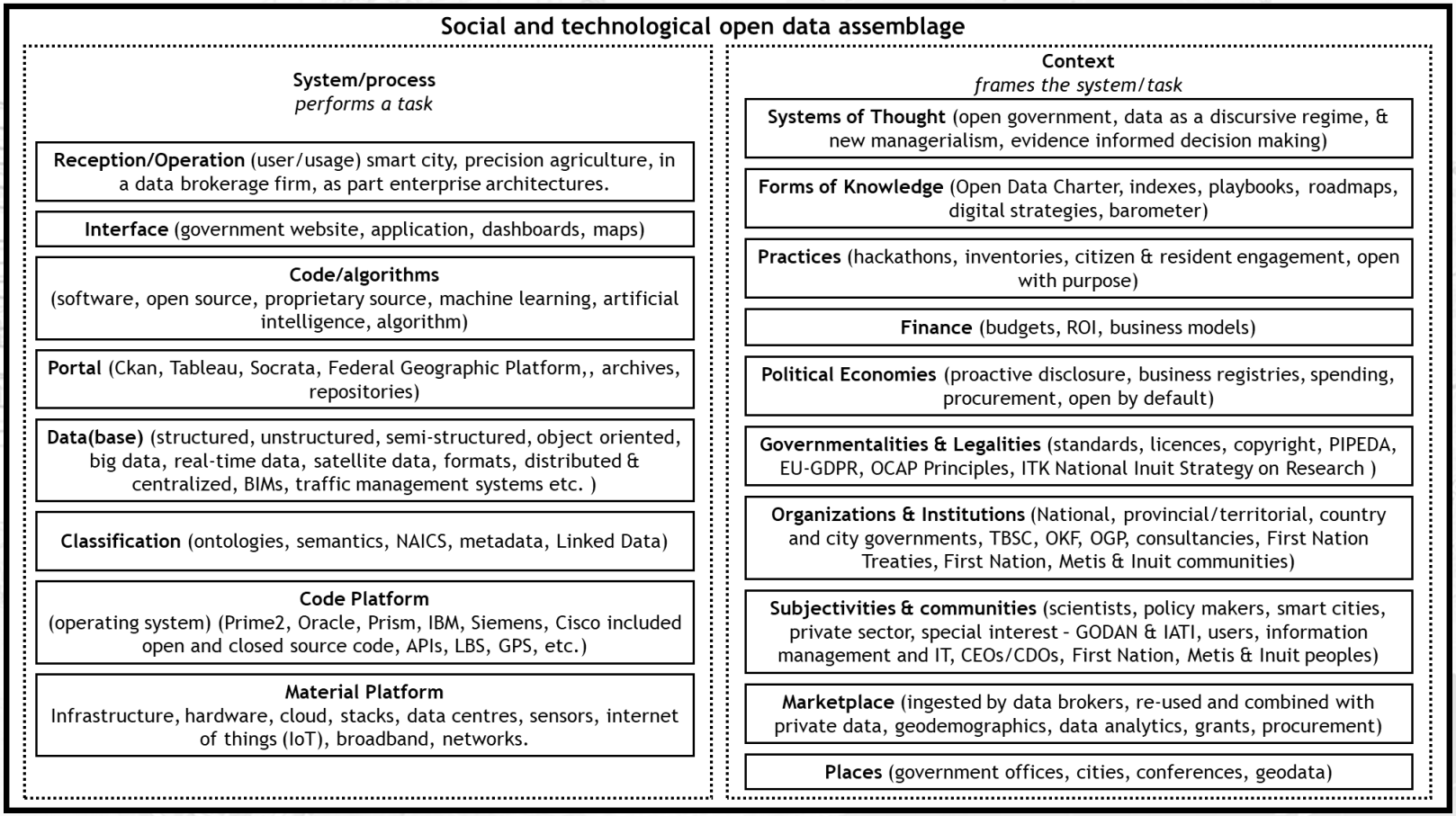


International Research on Permanent Authentic Records in Electronic Systems (InterPARES) 2: Experiential, Interactive and Dynamic Records

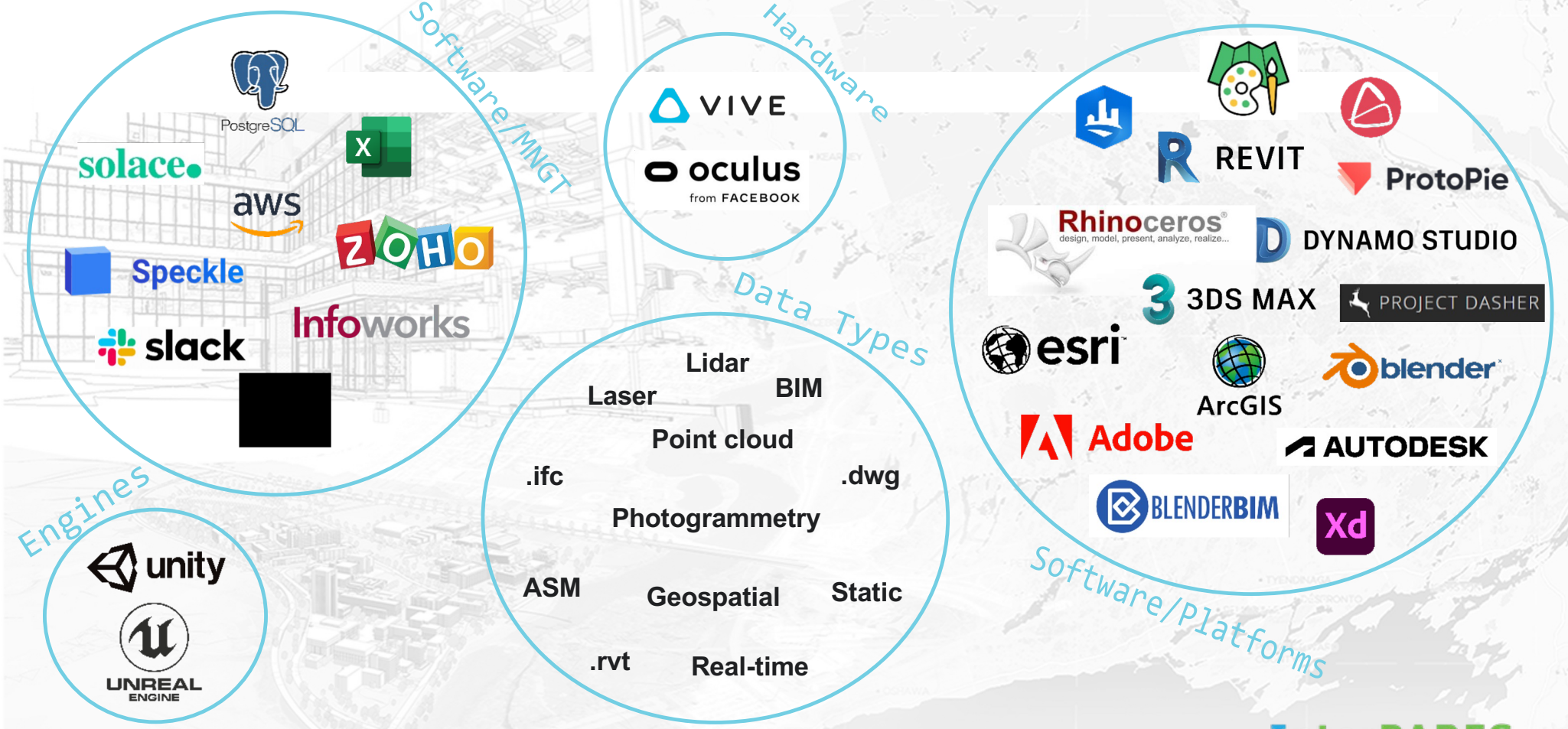
APPENDIX 5

23 Case Study Questions that the researchers should be able to answer at the completion of their investigation

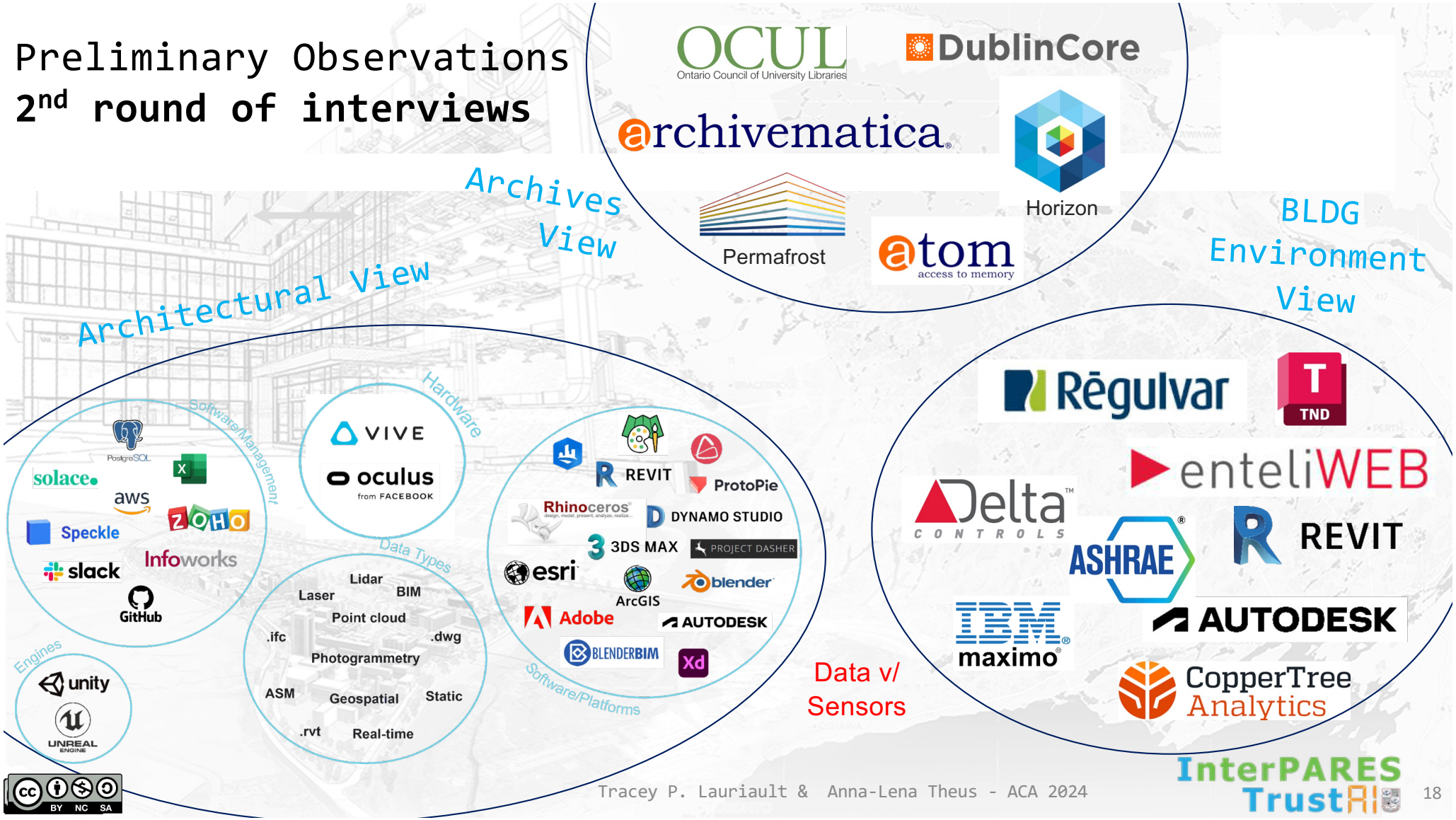
Social, Data & Technological Assemblage



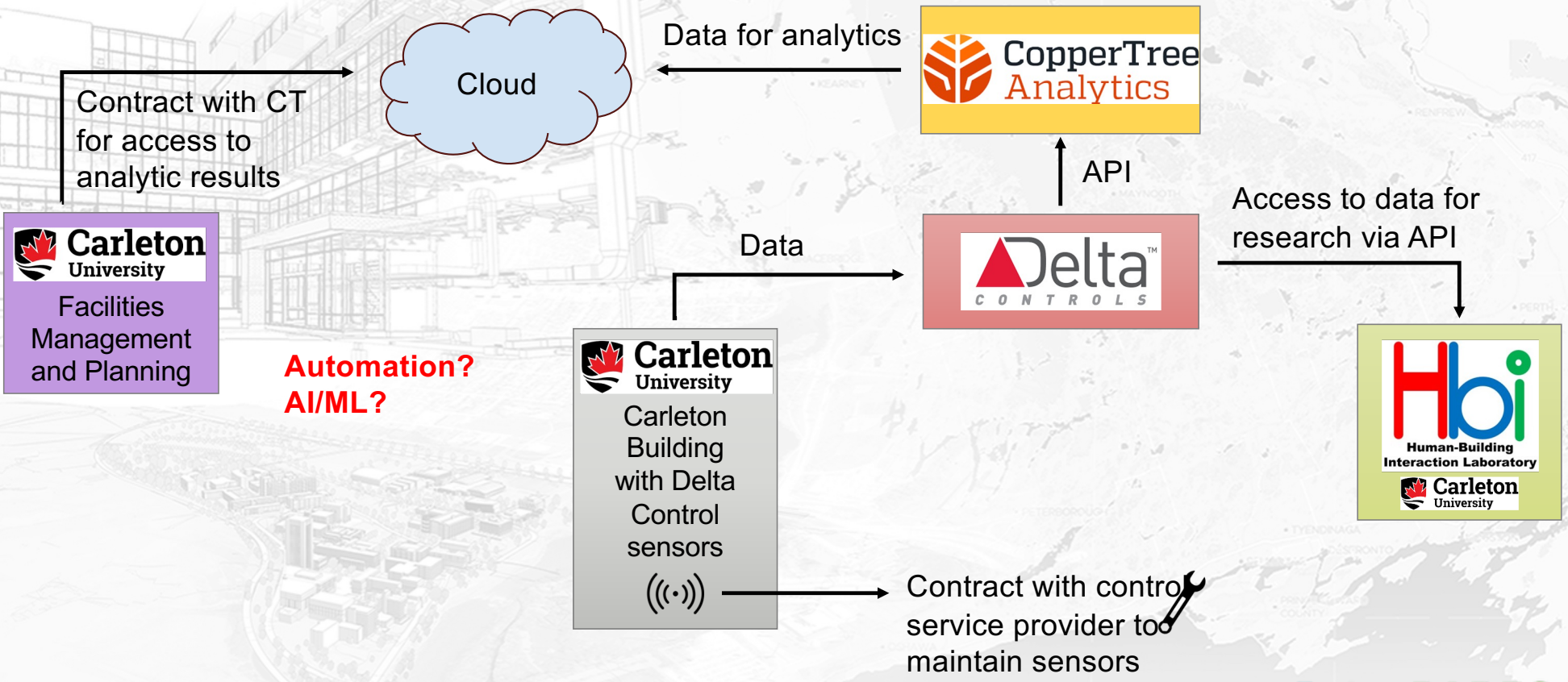
Preliminary Observations – 1st round of interviews



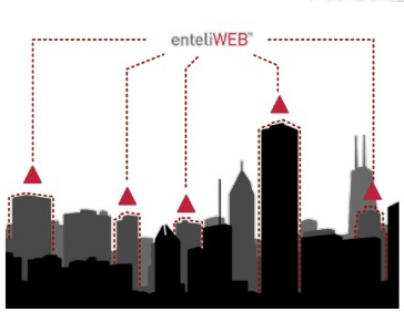
Preliminary Observations
2nd round of interviews

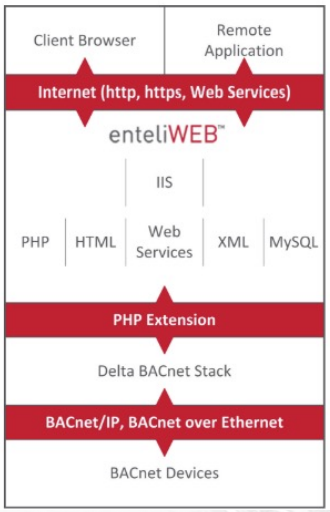


Preliminary Observations
2nd round of interviews

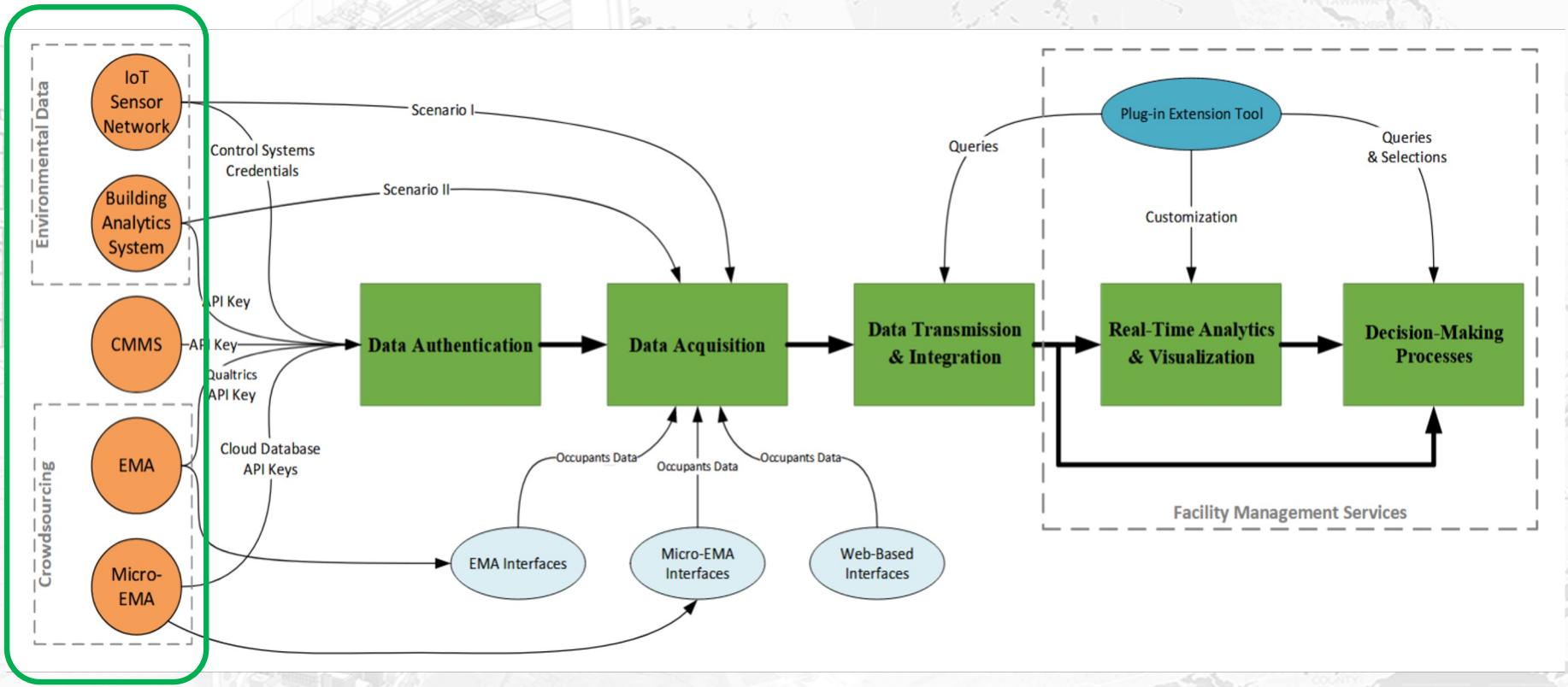


Preliminary Observations
2nd round of interviews





Preliminary Observations
2nd round of interviews



Pedram Nojedehi, 2023 - Proposed Framework for Digital Twin development

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Preliminary Observations
2nd round of interviews

Types	Archives	FMP	CIMS	Research	City
Sensors	?	✓	✓	✓	-
Buildings	?	✓	✓	✓	?
Data (NRL, Sensors, Building)	?	?	✓	✓	?
BIMs	✓	✓	✓	-	✓
Seals / Certification	✓	✓	-	-	✓
Contracts	✓	✓	-	✓	✓
Permits	✓	✓	-	-	✓
Agreements / MOUs	✓	✓	✓	✓	?
Policies, Directives	✓	-	-	-	?
Blueprints	✓	✓	✓	-	
Standards	✓	✓	✓	✓	?
Software	✓	✓	✓	✓	?
Cloud	?	?	?	✓	?
Storage / Backup	✓	✓	✓	✓	?

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What do we know?

Types of digital twins

Each type of digital twin requires a greater degree of maturity and digital transformation, offering increased value to your business.

Level 1: Descriptive twin

The descriptive twin is a visual replica with live, editable design and construction data, including 3D models and BIM.

Level 2: Informative twin

The informative twin uses increased integration with sensors and operations data for insights at any given time.

Level 3: Predictive twin

The predictive twin captures real-time data, contextual data, and analytics to identify potential issues.

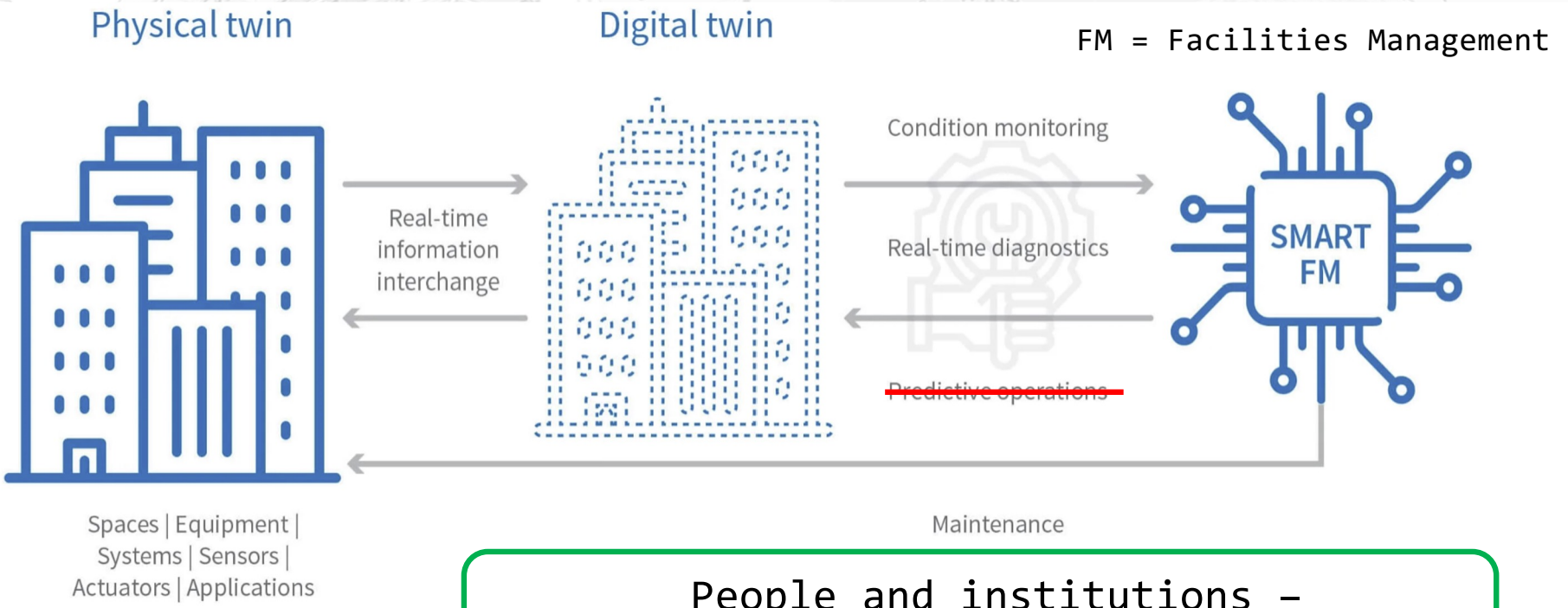
Level 4: Comprehensive twin

The comprehensive twin leverages advanced modeling and simulation for potential future scenarios as well as prescriptive analytics and recommendations.

Level 5: Autonomous twin

The autonomous twin has the ability to learn and make decisions through artificial intelligence, while using advanced algorithms for simulation and 3D visualization.

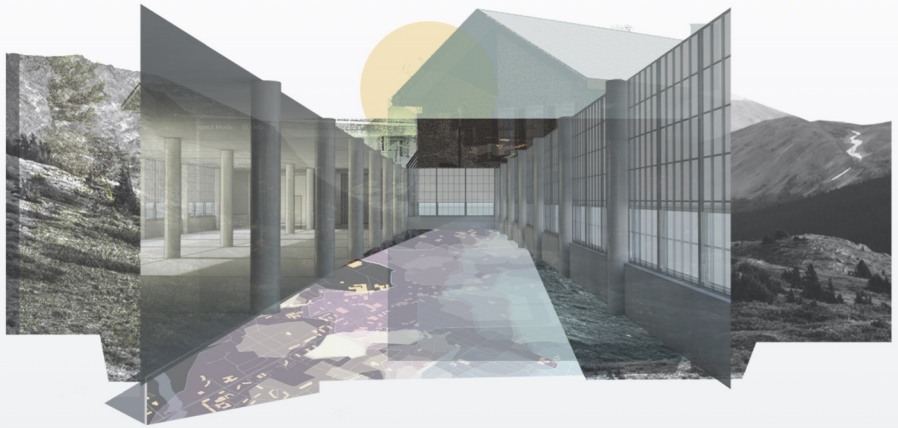
Is it a FM Digital Twin?



People and institutions –
Juridical actors

Next Steps

- **Analysis/Validation**
  - Respondents
  - Archivists
- **Identify records for Preservation at Carleton University**
- **Publish & Share Results**



Thank you

Q & A

ACA 2024 Abstract

Creating Today's Digital Twins for the Archives of Tomorrow!

Digital twin are large complex social and technical systems, that, in addition to being created and used in the architecture, engineering, construction and owner operated (AECOO) sectors to construct, operate and manage physical assets, digital twins are also used as immersive media in virtual reality environments accessible with virtual reality peripherals. City officials also use digital twins to pre-empt, predict, and prevent the potential harms caused by natural calamities such as floods related to climate change, to model scenarios for urban planning, and as place to conduct public consultations. Further, they augment knowledge about infrastructure, they are a spatial data infrastructure, and they are records. As fledgling systems, it will be argued, that now is the opportune time to influence creators to construct these in such a way that these can be preserved. This presentation will therefore discuss a SSHRC funded I Trust AI case study of the Carleton Immersive Media Studio (CIMS) digital twin of the Carleton University Campus. Research results derived from semi-structured interviews and technological walkthrough will be discussed, along with some observations about the context how digital twin creators and users envision their systems, concluding with some recommendations for digital twin creators and users.