

I Trust AI

Digital Twins: Preserving the Parts and not the Whole

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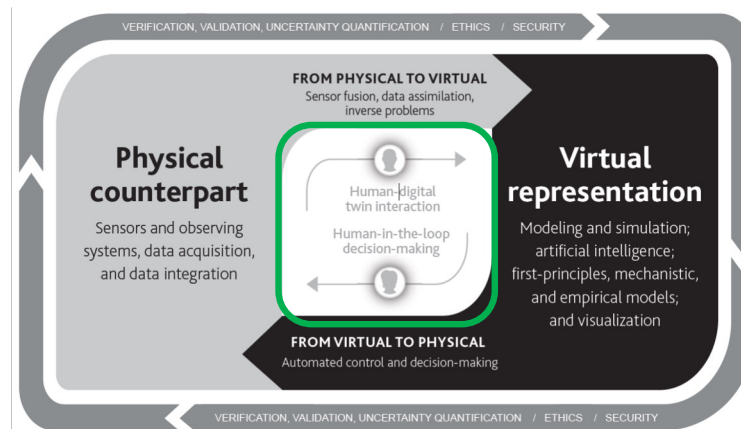
Anna-Lena Theus

GRA



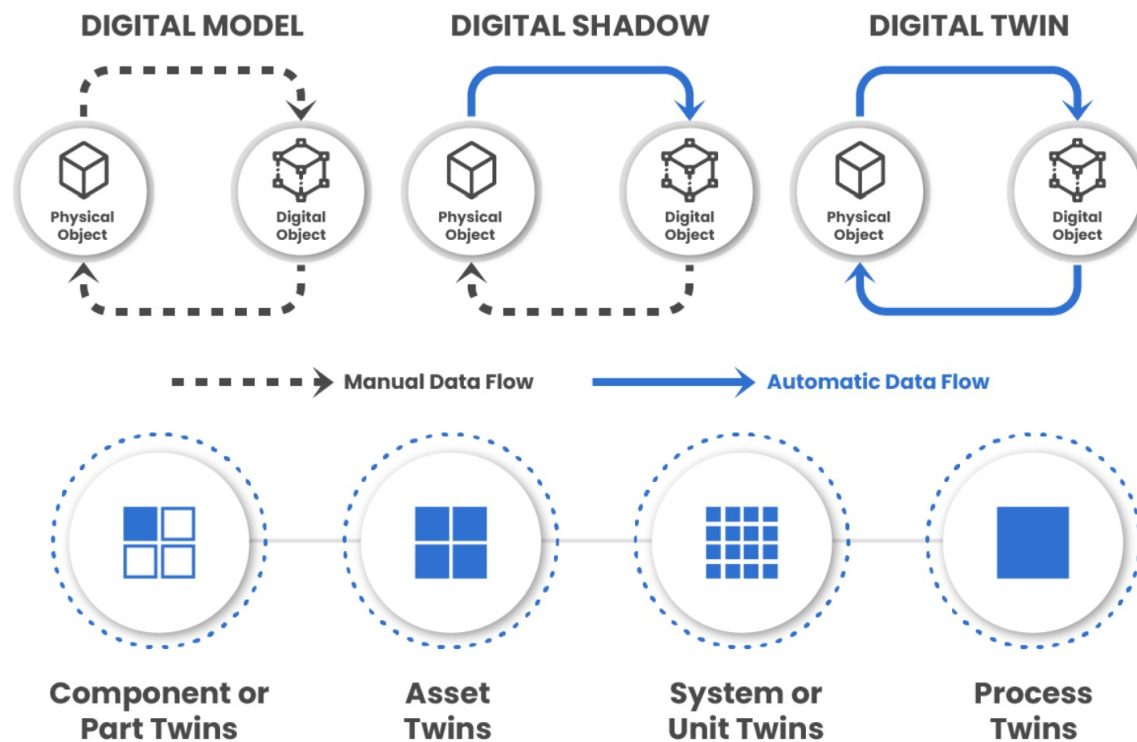
Digital Twin Definition

“a set of virtual information constructs that mimics the structure, context, and behavior of a natural, engineered, or social system (or system-of-systems), is dynamically updated with data from its physical twin, has a predictive capability, and informs decisions that realize value. **The bidirectional interaction between the virtual and the physical is central to the digital twin**”. (NAP 2024)



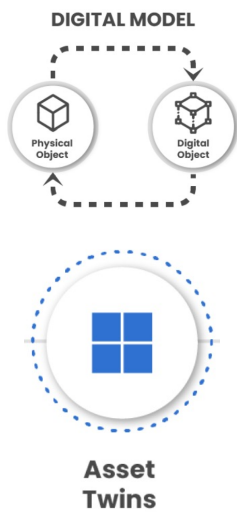
Digital Twins Explained (data view)

vidyatec.com



Butsuden hall Eiheiji Temple

Digital Model



Digital

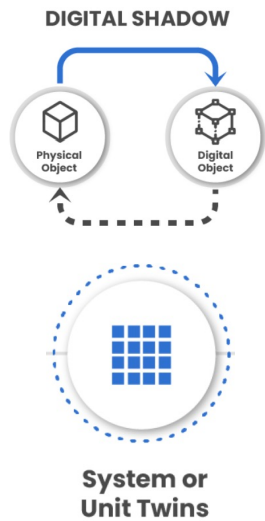
Physical



Image Source: Shimizu Corporation in the Asahi Shimbun 2024

Carleton University Campus

Digital Shadow



Physical



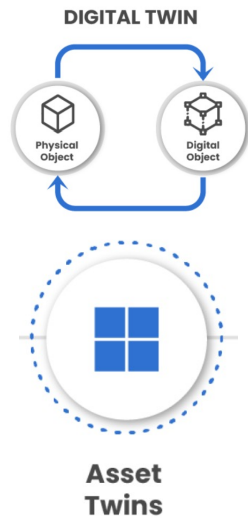
Digital

Interaction



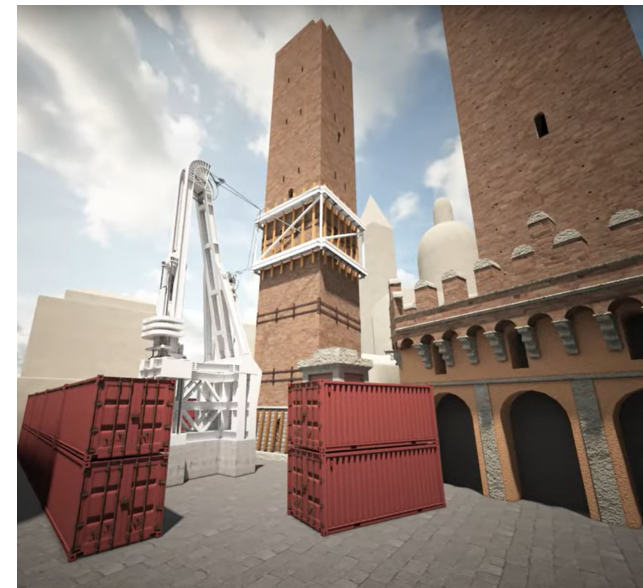
Bologna Garisenda

Digital Twin



Physical

100 +/- Sensors



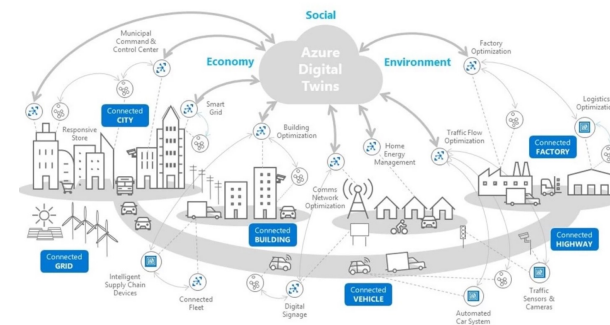
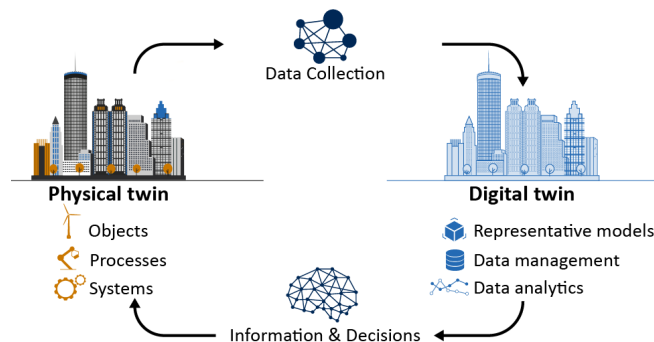
Digital

Bidirectional
AI/Alert

Interaction/Simulation

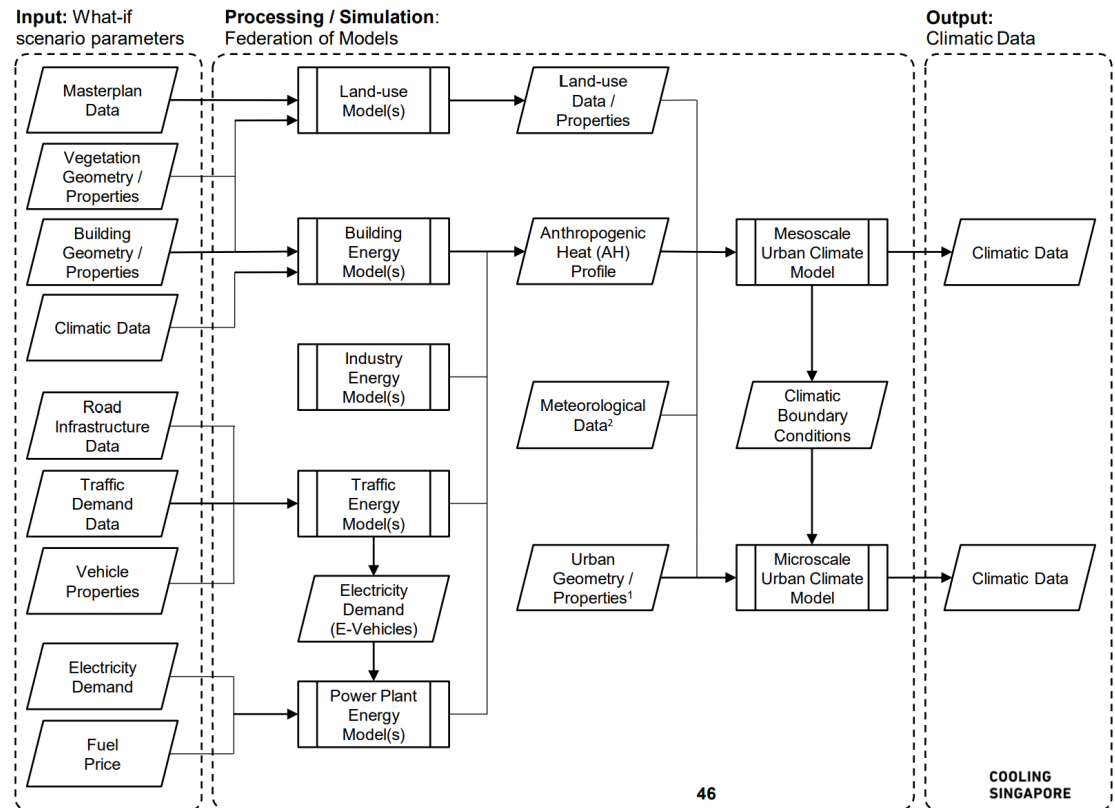
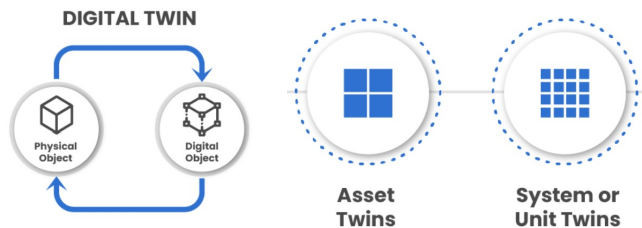
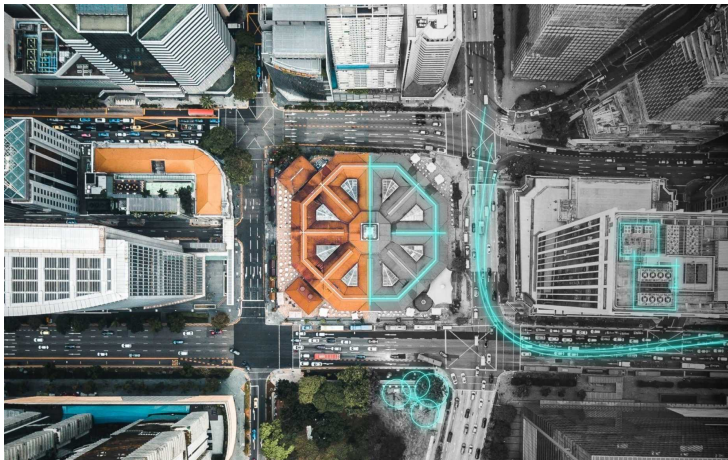
Spatial Digital Twin

- Includes a specific spatial context and provide a dimensional and location-based representation of assets, infrastructure and systems
- Various levels of accuracy, detail and aggregation
- It is multiscalar from buildings to clusters of buildings or other infrastructure, networks, cities, countries and the globe
- Often used for planning, lifecycle management and monitoring



Cooling Singapore – Digital Urban Climate Twin

Singapore-ETH Centre



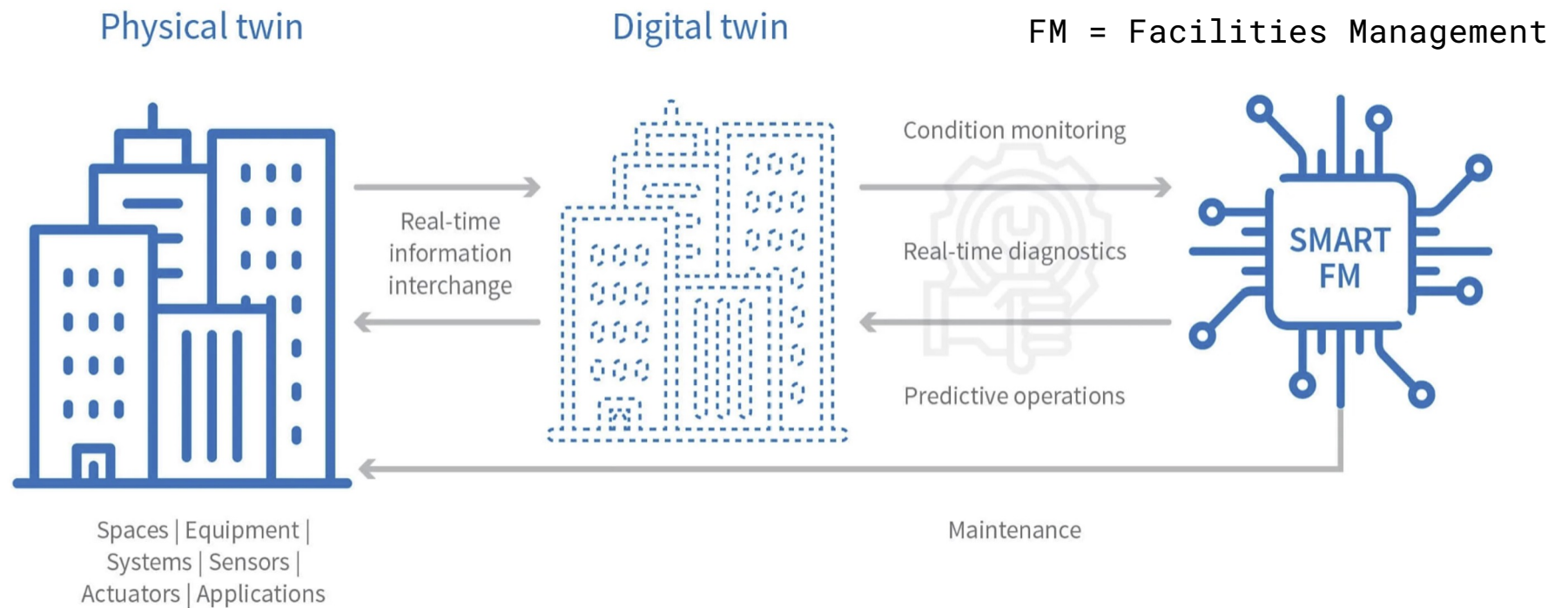
Our Case Study Examines

A spatial digital twin for the architecture, engineering, construction and owner operated (AEC00) sector in Ottawa, Canada that is based at Carleton University

Assumption:

- a digital twin is one artifact under the authority of one organization.

What we thought we were studying



Joins 2 RESEARCH PROJECTS

1. 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, Canada)

- Identify specific AI technologies that can address critical records and archives challenges;
- Determine benefits/risks of using AI technologies on records and archives;
- Ensure archival concepts and principles inform the development of responsible AI;
- Validate outcomes through **case studies** and demonstrations



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

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.



NATIONAL



INCLUSIVE



MULTIDISCIPLINARY



TECHNICAL

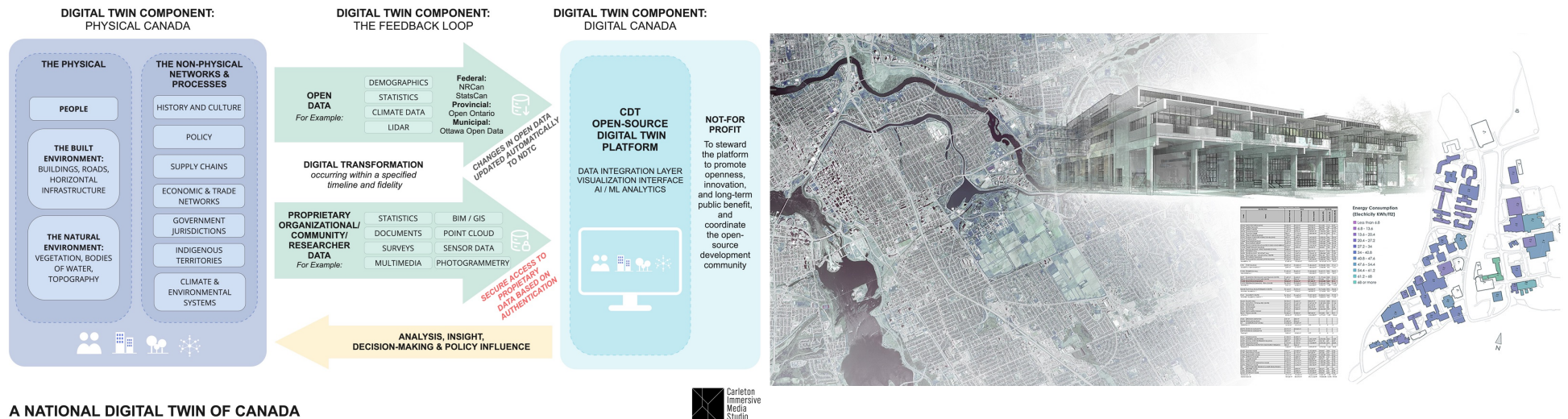


CULTURAL



ETHICAL

CIMS National (spatial) Digital Twin Platform



CS04 – Research Questions

- 1.If digital twins intermediate and automate actions and decisions that affect people and property, how ought records about those actions, decisions and processes be managed and archived?
- 2.Can AI/ML enable that preservation?
- 3.And how would one archive AI/ML processes?

We also wanted to know

The epistemic concerns of those involved?

- Architecture, engineering, construction, owner and operated (AEC00)
- Finance, builders, plant management etc.

Are Digital Twins public spaces? Public Goods?

What good governance practices from other fields can be considered?
Open Data? Open Science? Etc.

What data and technological politics are embedded in the system?

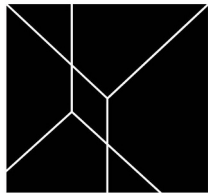
- Business models / governance models
- Institutions
- Public access & ability to use and contribute to?
- Governance
- Ownership

4 Interrelated Theoretical Frameworks & Concepts

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

Hybrid Methodological Approach

- 13 semi-structured interviews guided by a survey instrument designed to collect data and information from a digital diplomatics and social and technical assemblage point of view.
- 4 technological walkthroughs/Records Forensics
 - Carleton Immersive Media Studio
 - Carleton University Facilities, Plant & Control Rooms
 - Carleton Engineering Design Centre Building Labs
 - Ottawa City Archives
- Mapped social and technological assemblages & sought records
- Validation of comparative analytical tool w/Archivists



Carleton
Immersive
Media
Studio



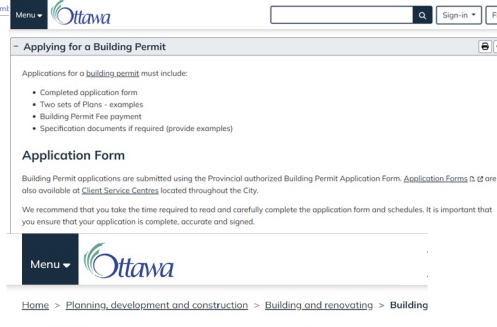
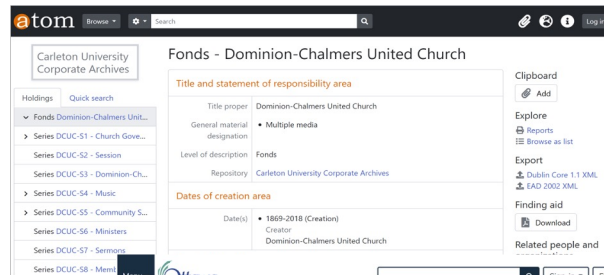
Facilities Management and Planning



Building Performance Research Centre



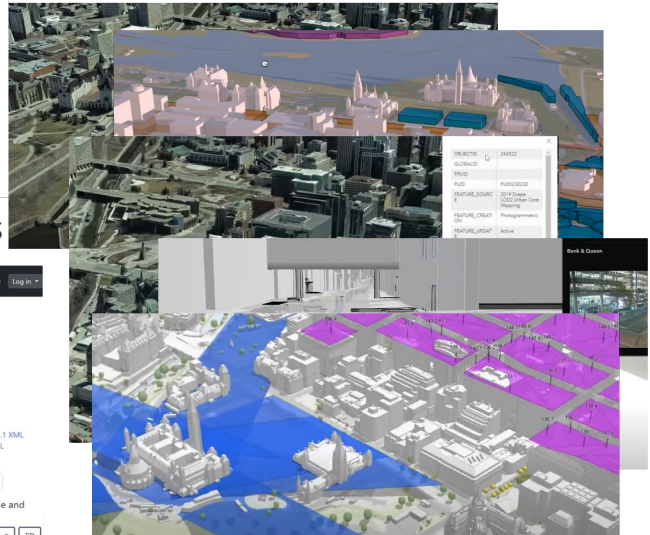
Corporate Records and Archives



Building permit approval process



Home > Planning, development and construction > Developing a property > Geomatic Services > Geospatial Analytics, Technology and Solutions (GATS)



Home > Arts, heritage and events > City of Ottawa Archives

City of Ottawa Archives

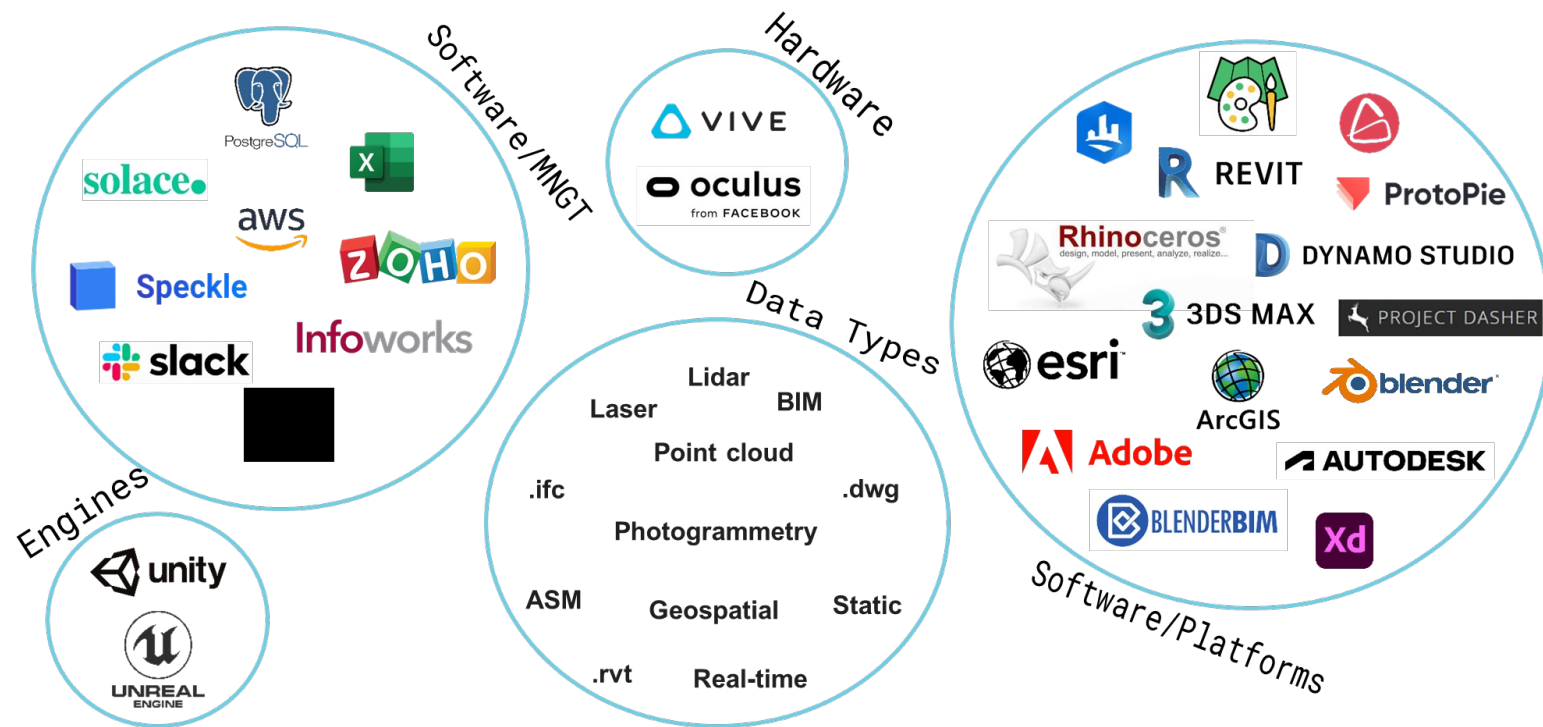


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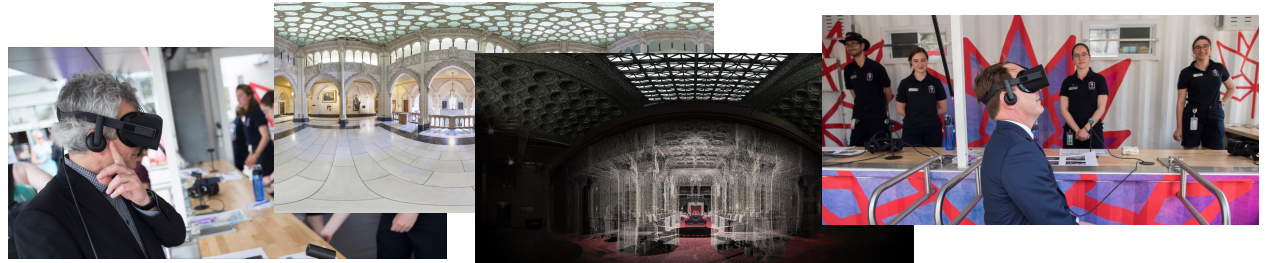
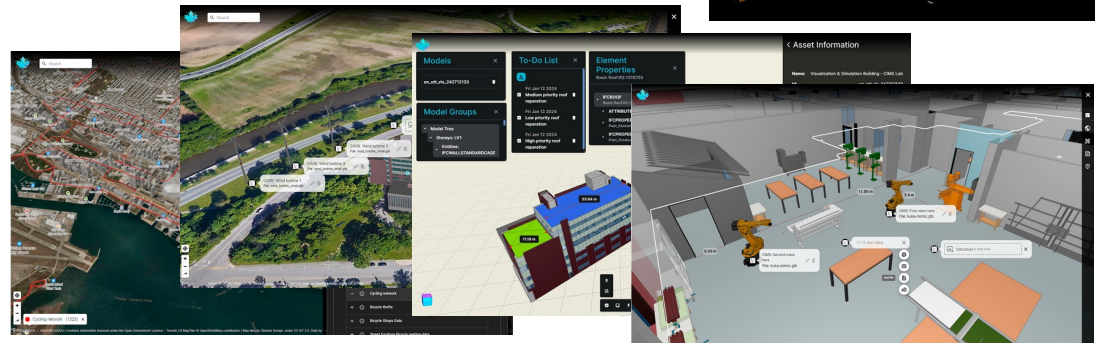
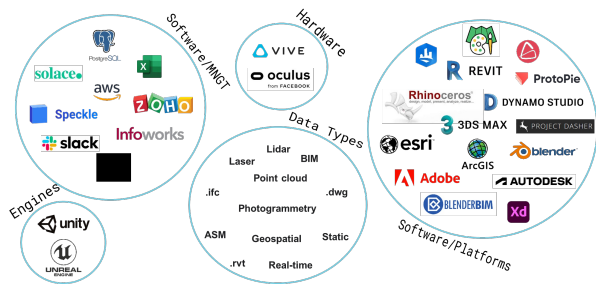
I Trust AI Symposium in Ascoli Piceno

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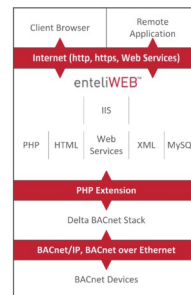
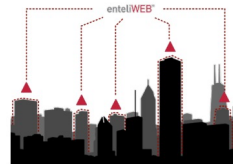
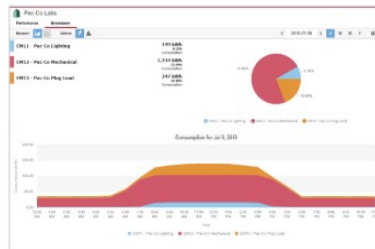
What we observed at CIMS – Architecture View



What we saw at CIMS



What we Experienced w/Owner operators



Building
Environment View

Régulvar



Delta
CONTROLS

enteliWEB



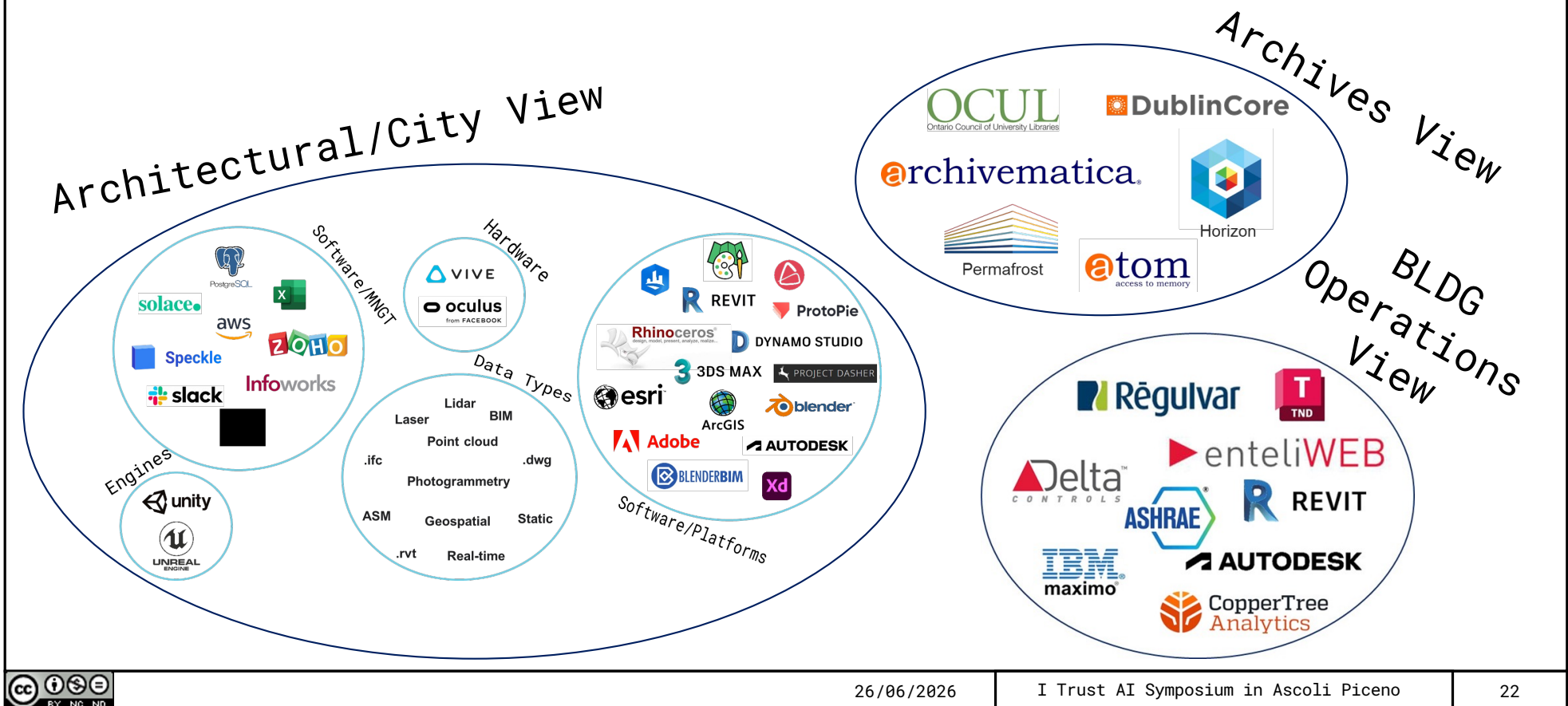
REVIT

IBM
maximo

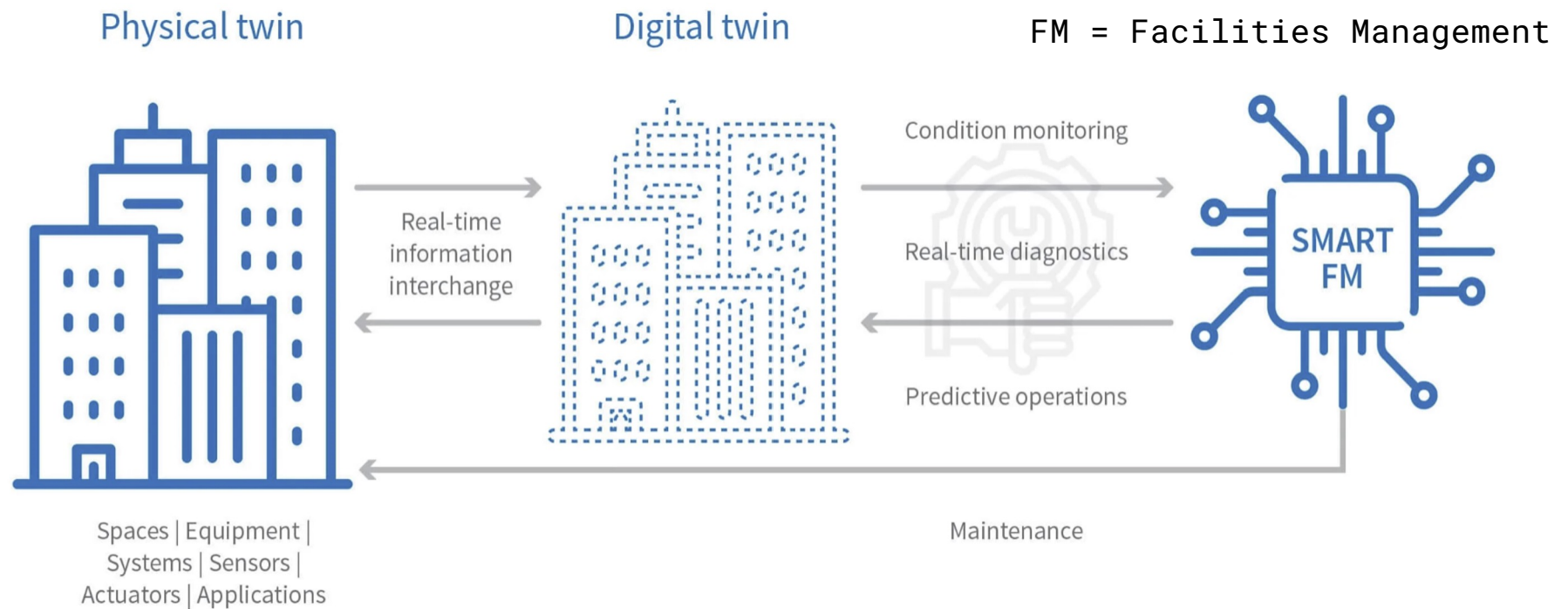
AUTODESK

CopperTree
Analytics

Mutually Distinct Systems & Juridical Contexts

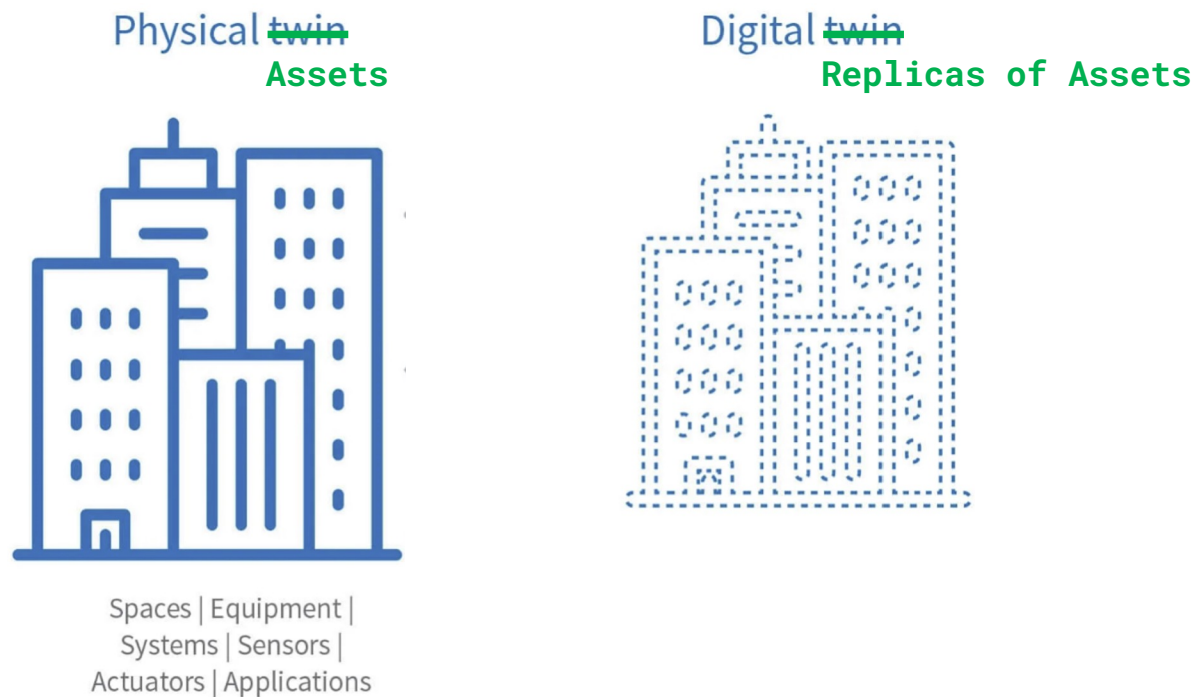


What we thought we were studying



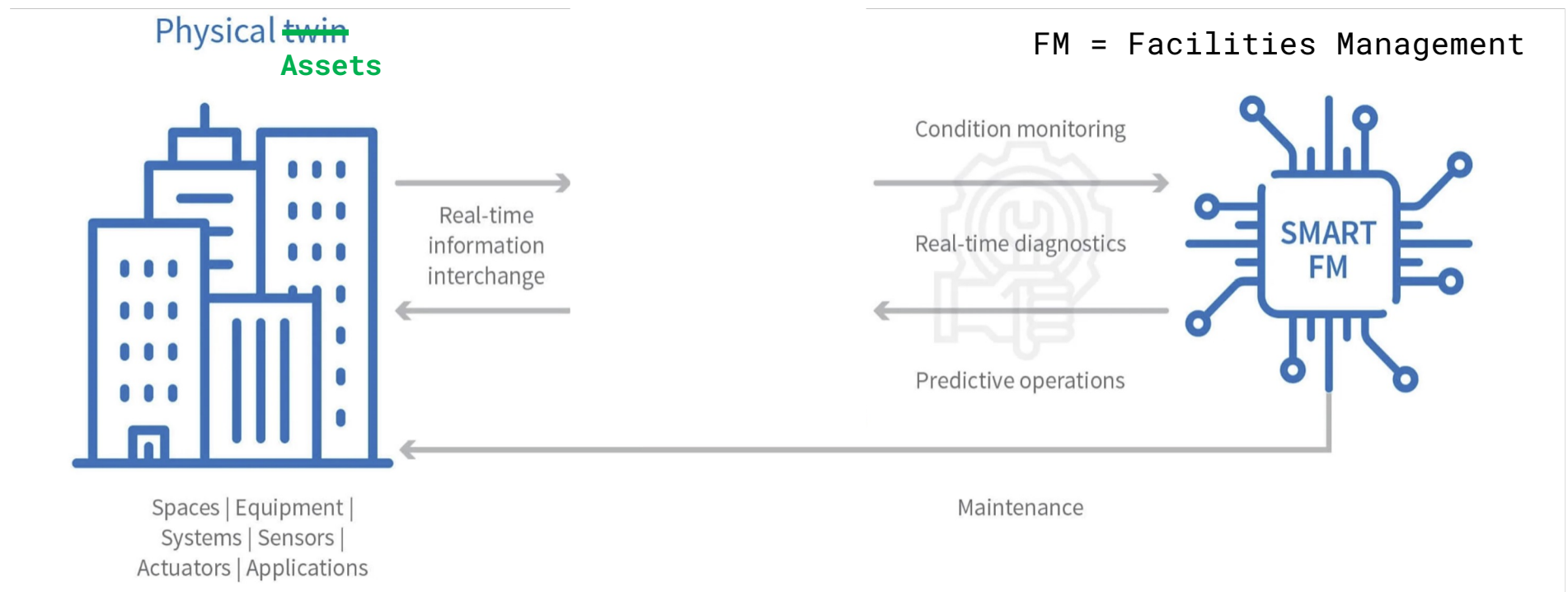
What we saw

Architecture/City - spatial



We also saw

Owner Operated - FM

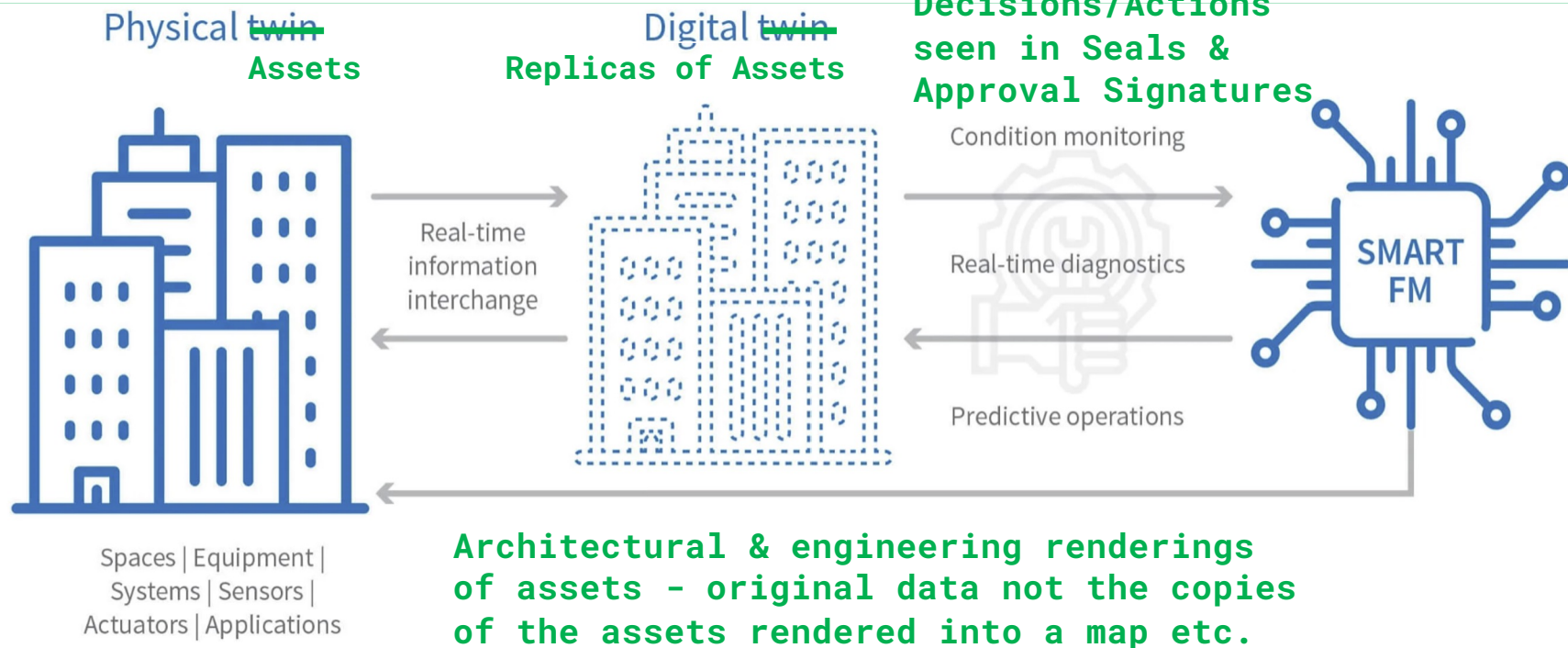


What is the record?

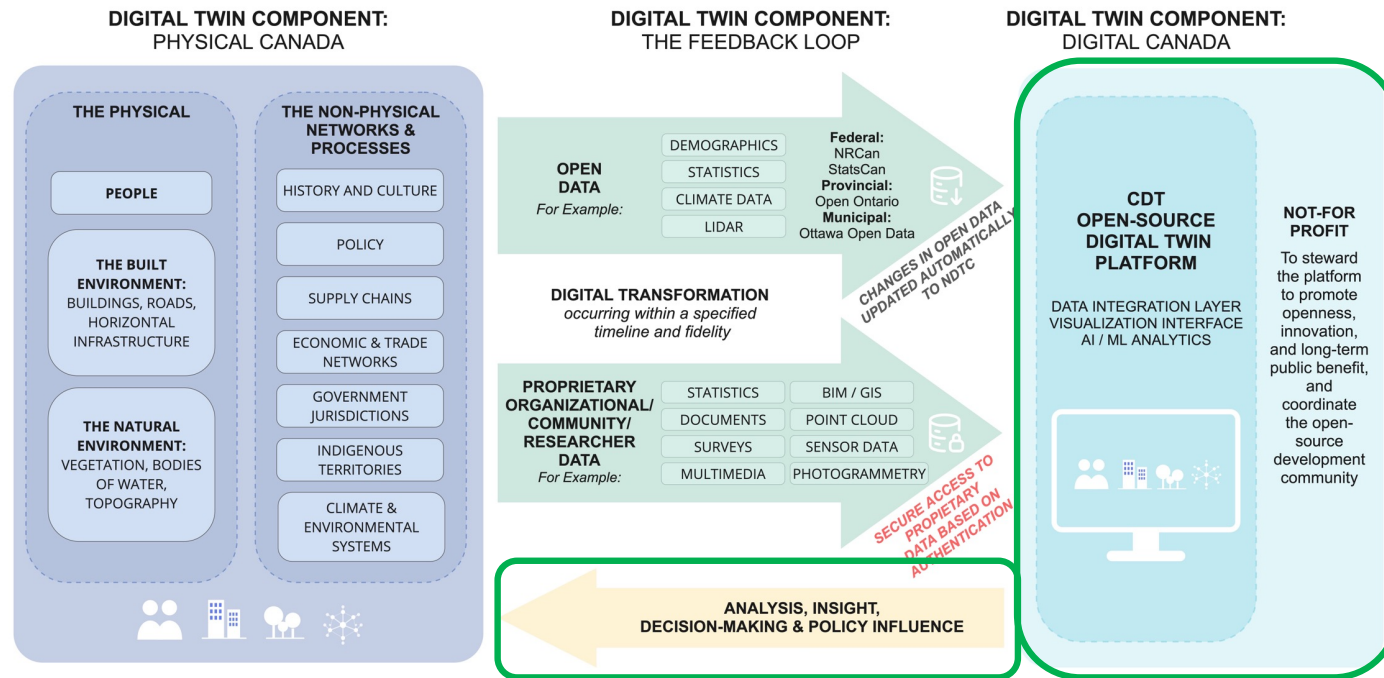
Contracts, invoices,
receipts, etc.

Data, Logs,
Indicators Reports
Generated by the
Sensors +
Decisions/Actions
seen in Seals &
Approval Signatures

Archives



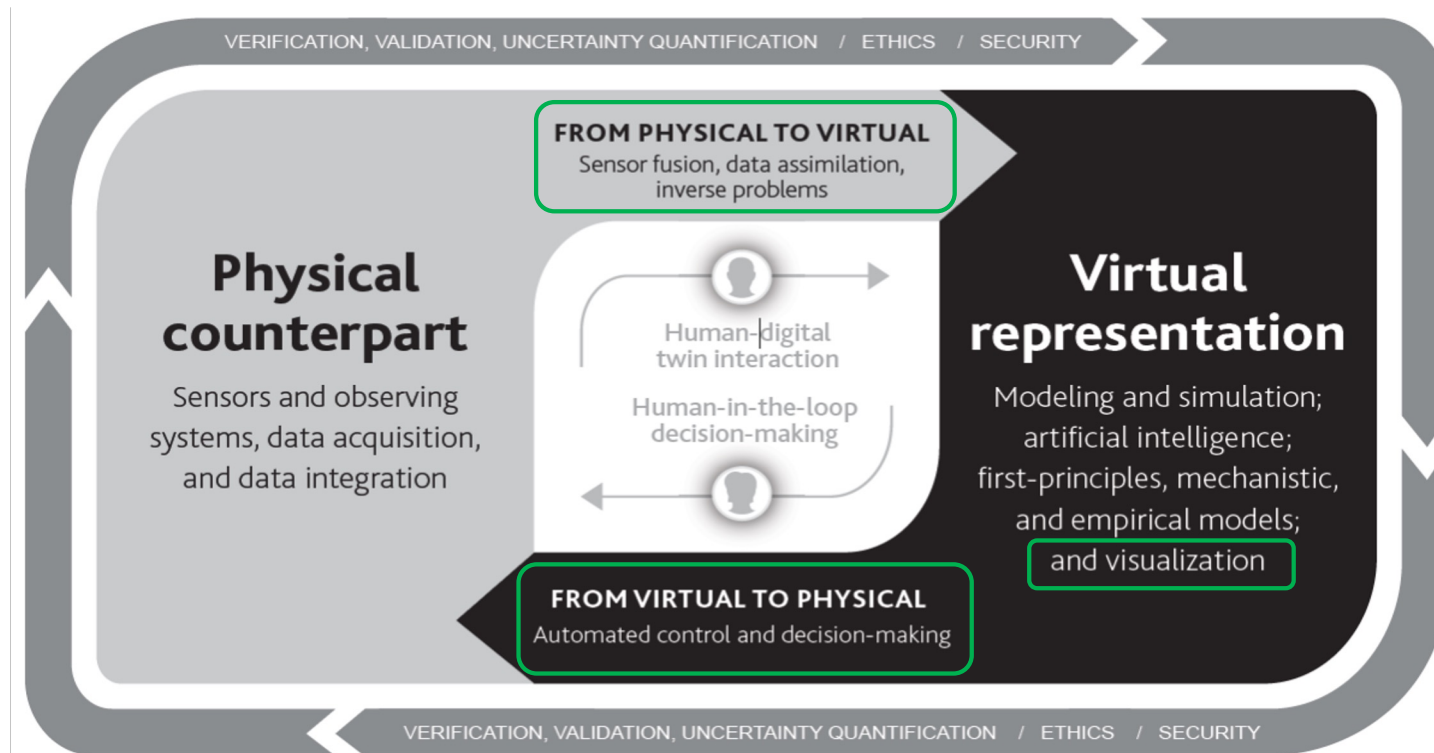
CIMS National Digital Twin of Canada



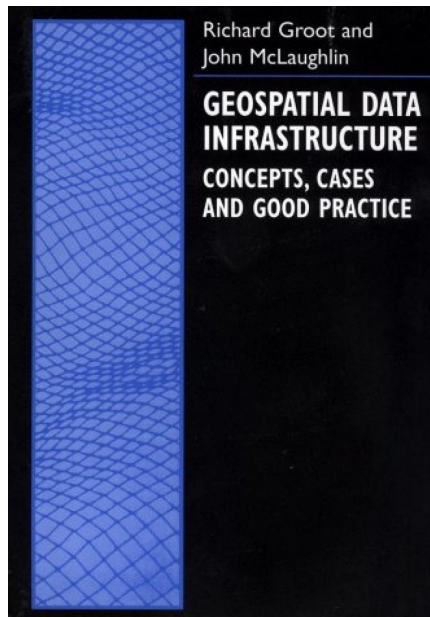
A NATIONAL DIGITAL TWIN OF CANADA



Bidirectional?



Geospatial Data Infrastructure



Complex network of:

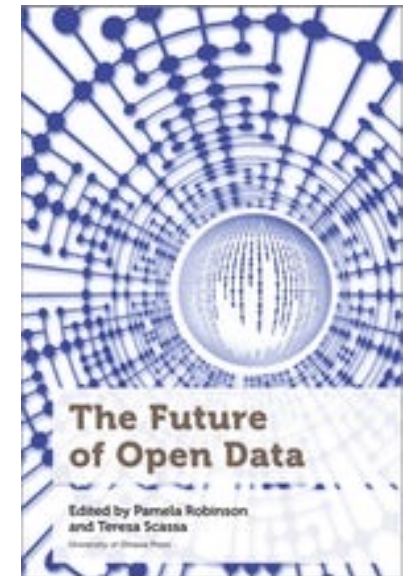
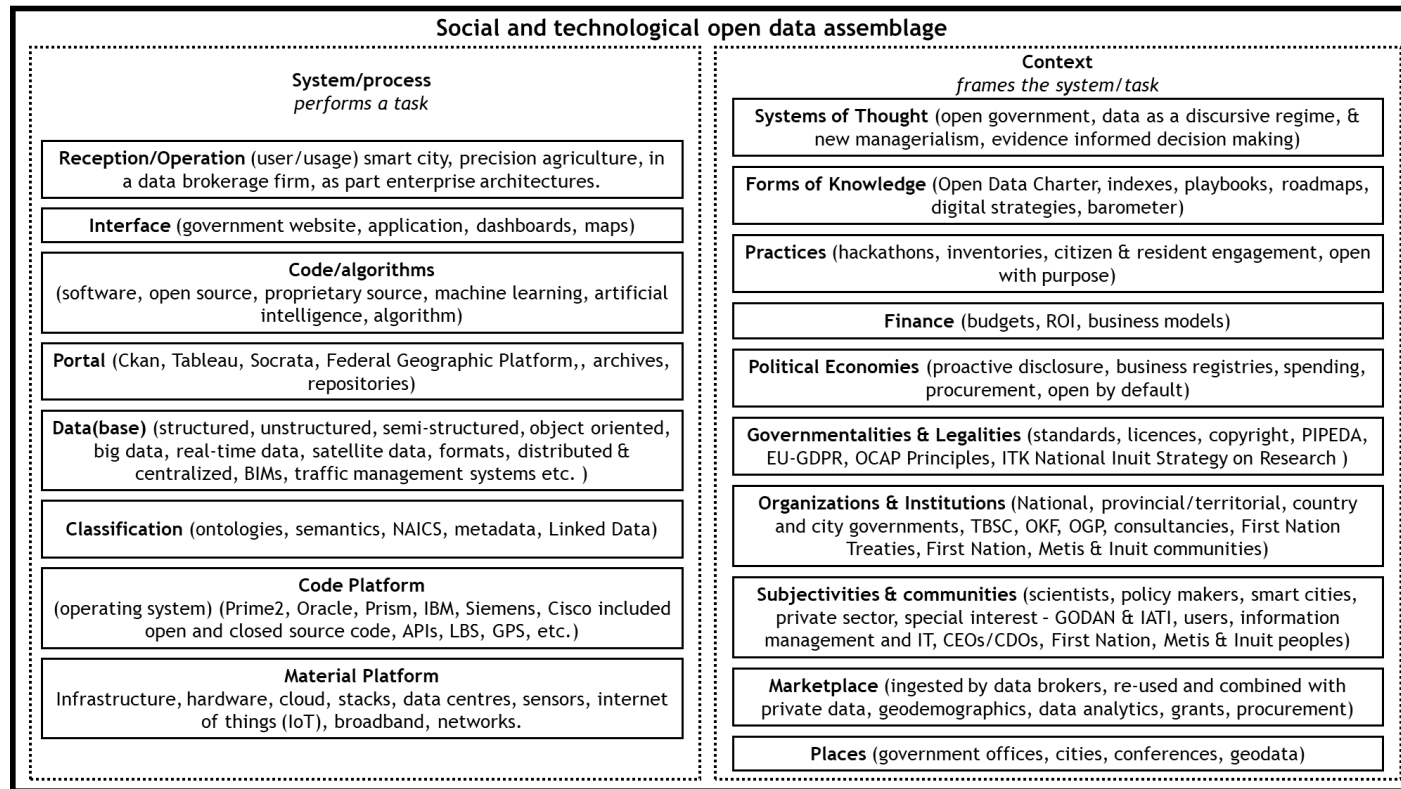
- institutional
- organizational
- technological
- human and economic resources

which interact with one another to underpin the design, implementation and maintenance of mechanisms that facilitate the:

- sharing
- access to and
- responsible use of data

for a **specific application domain** or enterprise Infrastructures are viewed as a **legitimate function for government support**, because they provide a common, consistent infrastructure upon which a variety of government, private sector, economic, academic and community activities can take place.

Social & Technological Data Assemblage



Lauriault, T. P. Looking Back Toward A "Smarter" Open Data Future,

I Trust AI - RESEARCH QUESTIONS

1. If digital twins intermediate and automate **actions and decisions** that affect people and property, how ought **records** about those **actions, decisions and processes** be managed and archived?
 - The parts and not the whole
 - Code, AI/ML and the data
 - Transactions/Actions – Juridical actors
 - Platform - Enabling document? Bounded variability?
2. Can AI/ML enable that preservation?
 - Sure, but of records, maybe not the publication
3. And how would one archive AI/ML processes?
 - Stay tuned?

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
 - **Anna-Lena Theus**, PhD Candidate at Carleton University (Project GAA)
- **Carleton Immersive Media Studio (CIMS)**
 - **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)
 - **Mario Santana Quintero**, Professor in Architectural Conservation and Sustainability Engineering
 - **Nicolas Arellano**, PhD Candidate
- **Building Science Engineering and Sustainability Engineering**
 - **H. Burak Gunay**, Assistant Professor in Building Science, Department of Civil and Environmental Engineering
 - **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
- **Carleton University**
 - **Travis Kinnear**, MLIS, Digital Archivist, Corporate Records & Archives, University Secretariat, Carleton University
 - **Chris Trainor**, Archives & Special Collections, MacOdrum Library