Ottawa, Library and Archives Canada

Digital Twins: Preserving Components of a Social and Technical Assemblage

Keeping Evidence: Archives, AI and Trust in Public Records
Thursday October 29, 2026, 15:00-15:30, Pellan Room

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ToC

1. Infrastructure
2. Digital Twins – Definitions
3. Governance
4. Digital Twin Research
5. Final Remarks

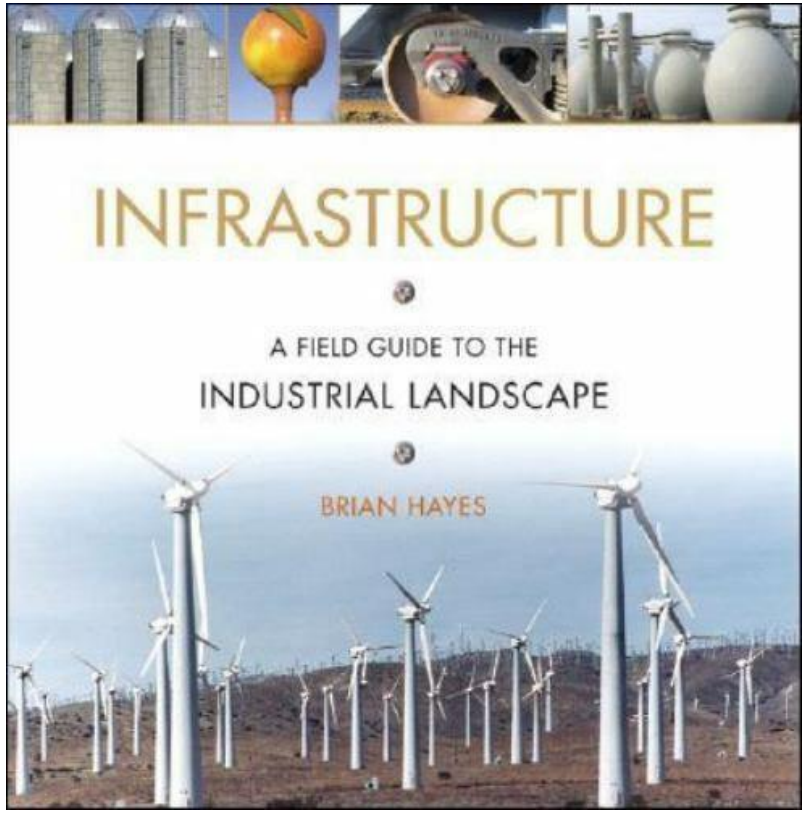
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1. Infrastructure

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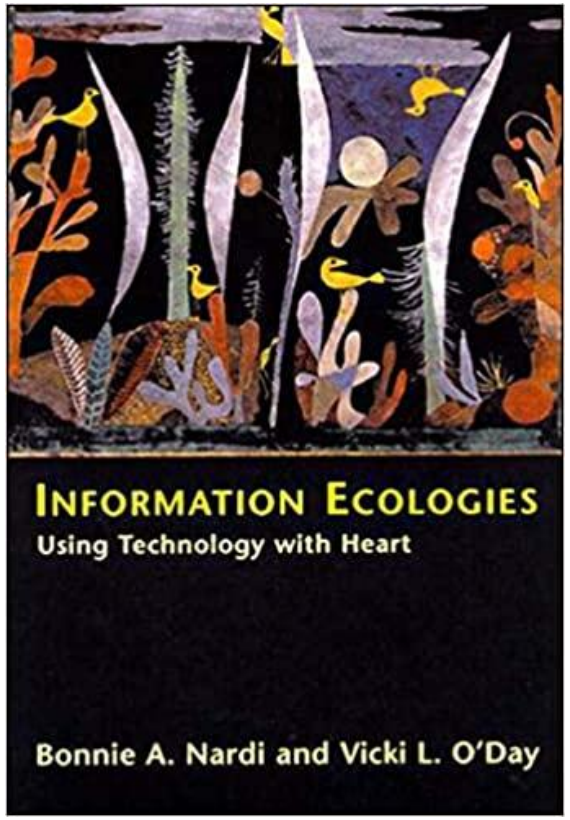
Infrastructure



“the technological fabric of society” or “the hardware that goes into making a civilization”

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Infrastructure as an information ecology



"a system of people, practices, values, and technologies in a particular local environment"

"In information ecologies, the spotlight is not on technology, but on human activities that are served by technology"

"Systems with diverse actors that coevolve with keystone species and locality"

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Critical Infrastructure

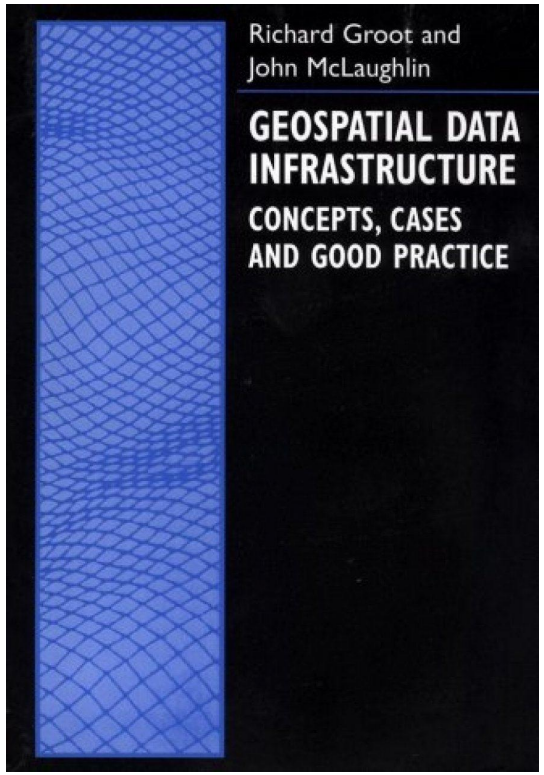
Wilson & Smith 2024

> “material resources, services, information technology systems, networks and infrastructure assets that, if damaged or destroyed, would cause serious repercussions on the crucial functions of society, including the supply chain, health, security and the economic or social well-being of the state and the population”

Hardware, software, facilities, networks, servers and organizations, institutions, policies, regulation, finance and user access

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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.

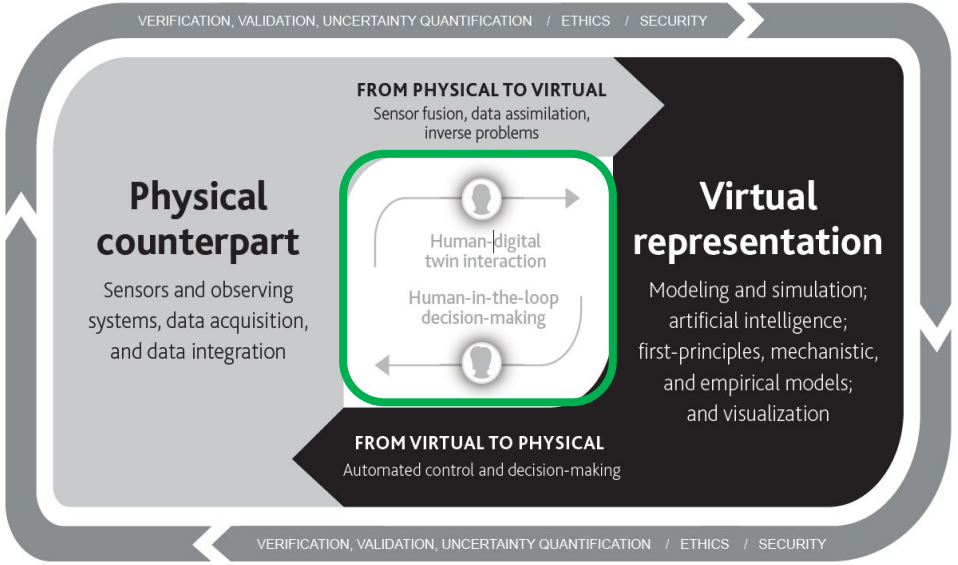


2. Digital Twins

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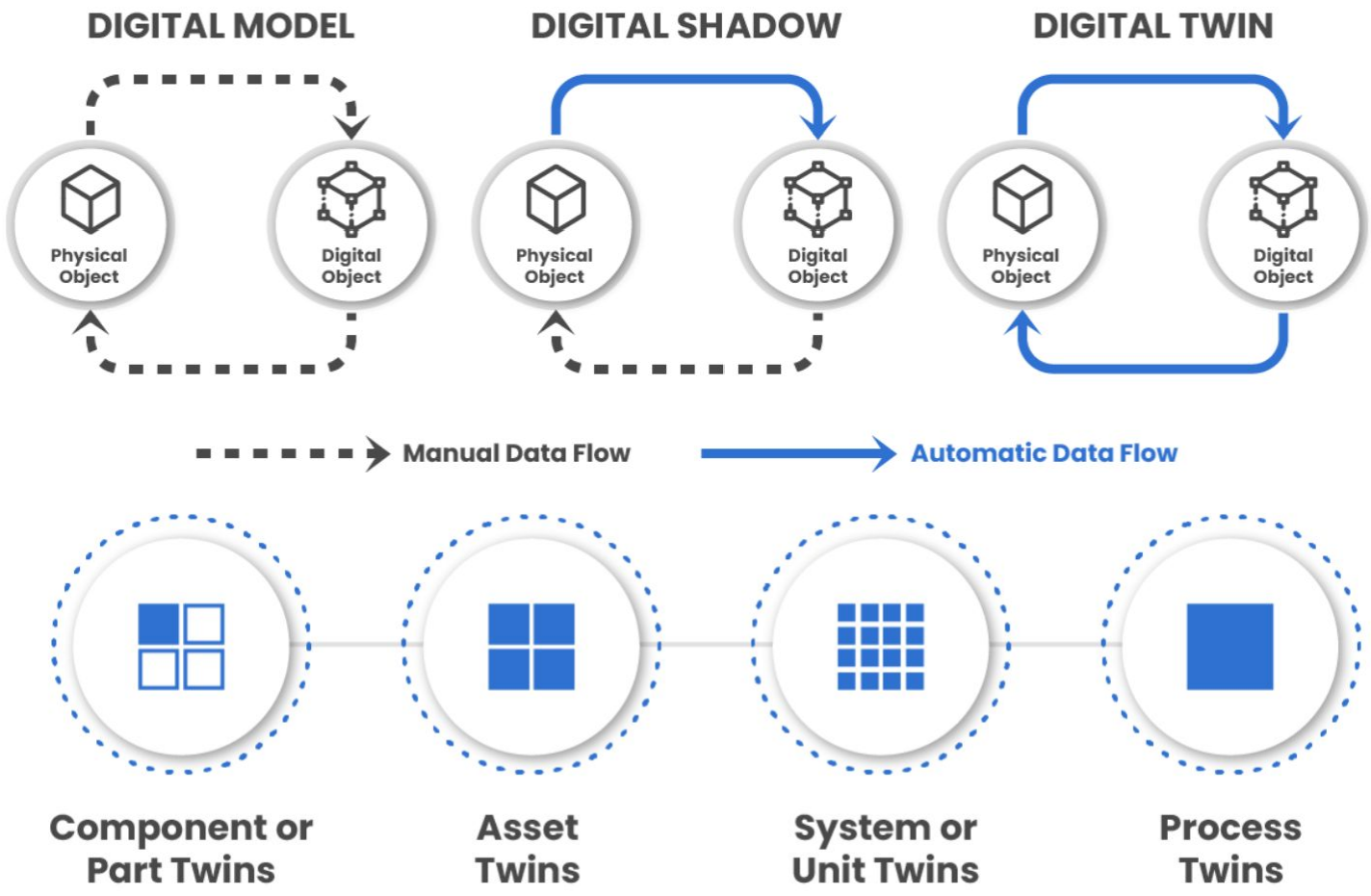
Digital Twin Definition

"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)



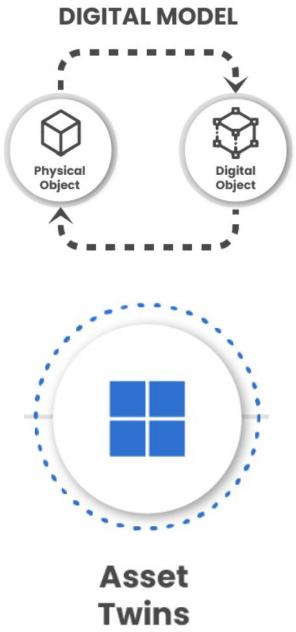
Digital Twins Explained (data view)

vidyatec.com



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Butsuden hall Eiheiji Temple
Digital Model





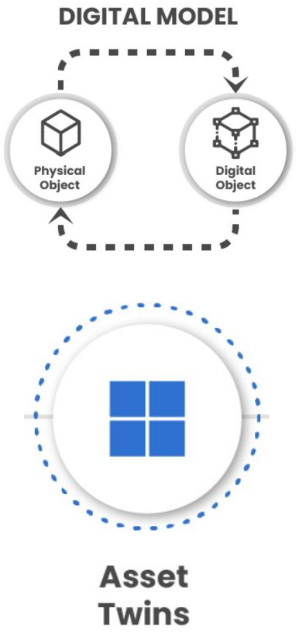
Digital

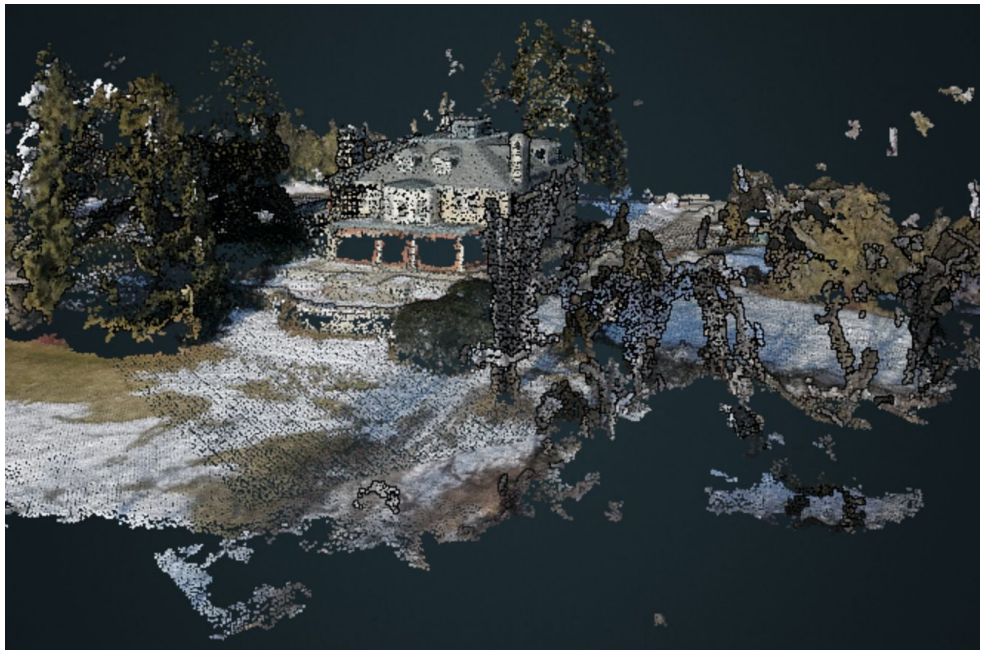
Physical



Image Source: Shimizu Corporation in the Asahi Shimbun 2024

Paletta Mansion Paletta Lakefront Park
Point Cloud





Digital

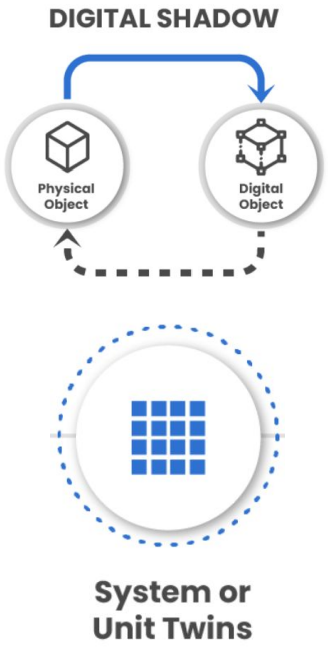
Physical



Image Source: AerialModel.com

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Carleton University Campus
Digital Shadow



Digital



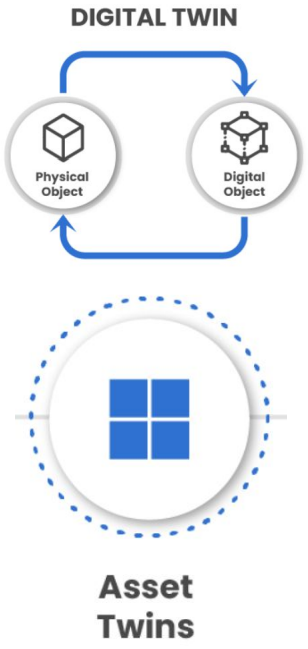


Physical

Interaction

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Bologna Garisenda
Digital Twin

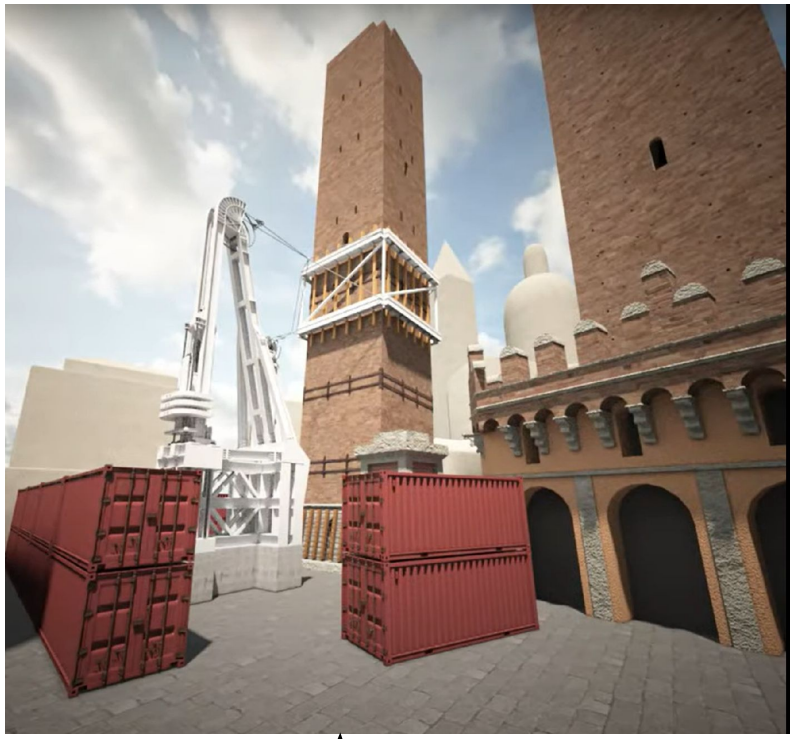


Bidirectional
AI/Alert

Digital



100 +/- Sensors



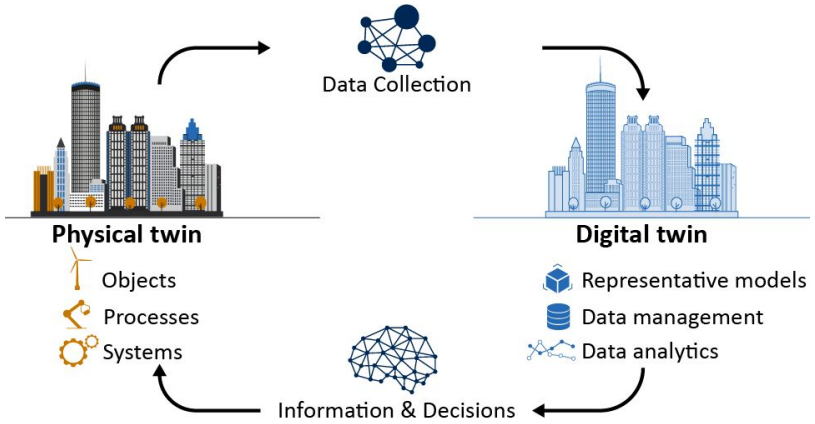
Physical

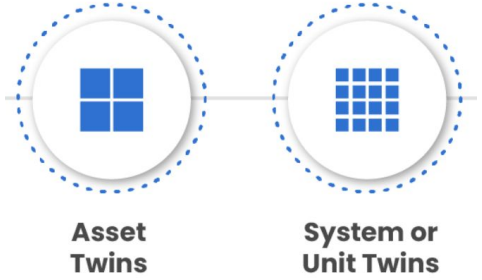
Interaction/Simulation

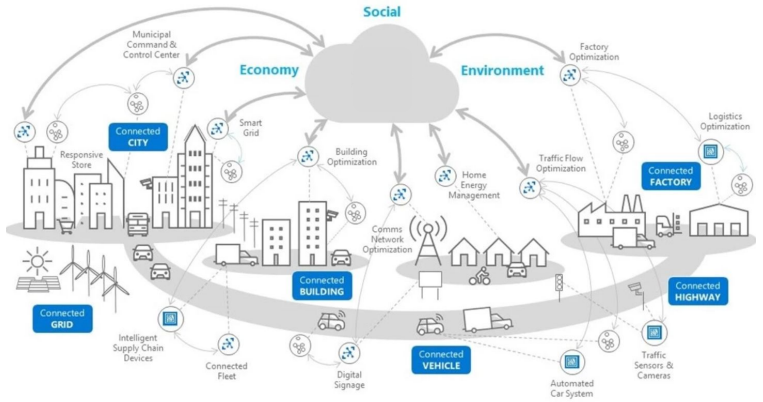
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Spatial Digital Twin

- 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



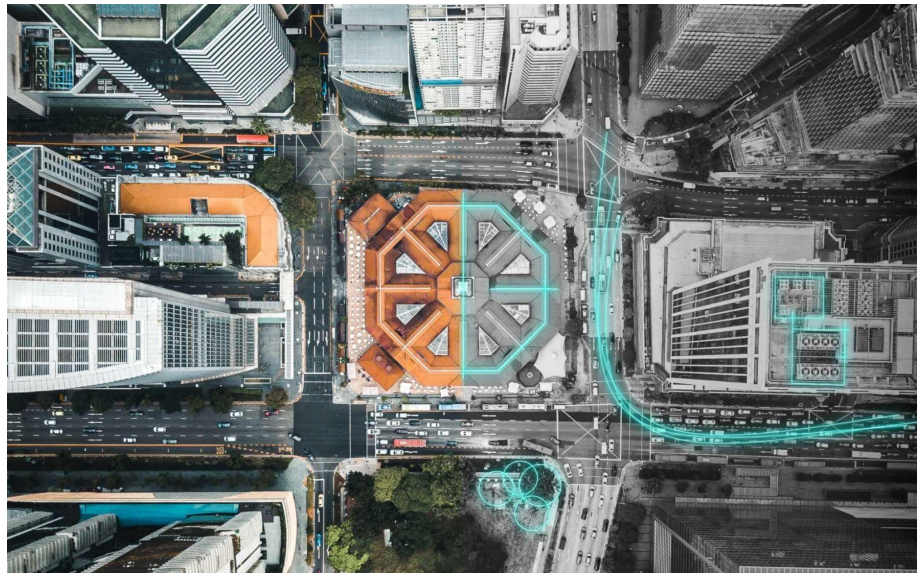


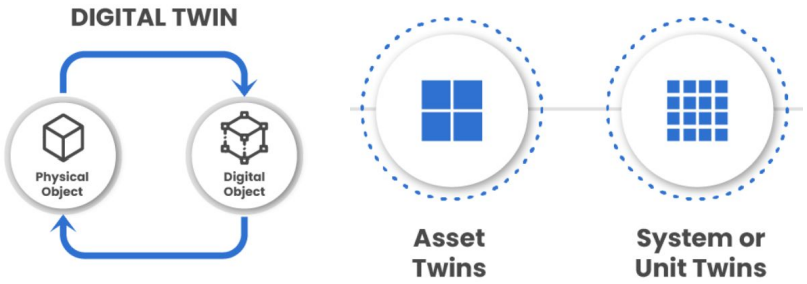


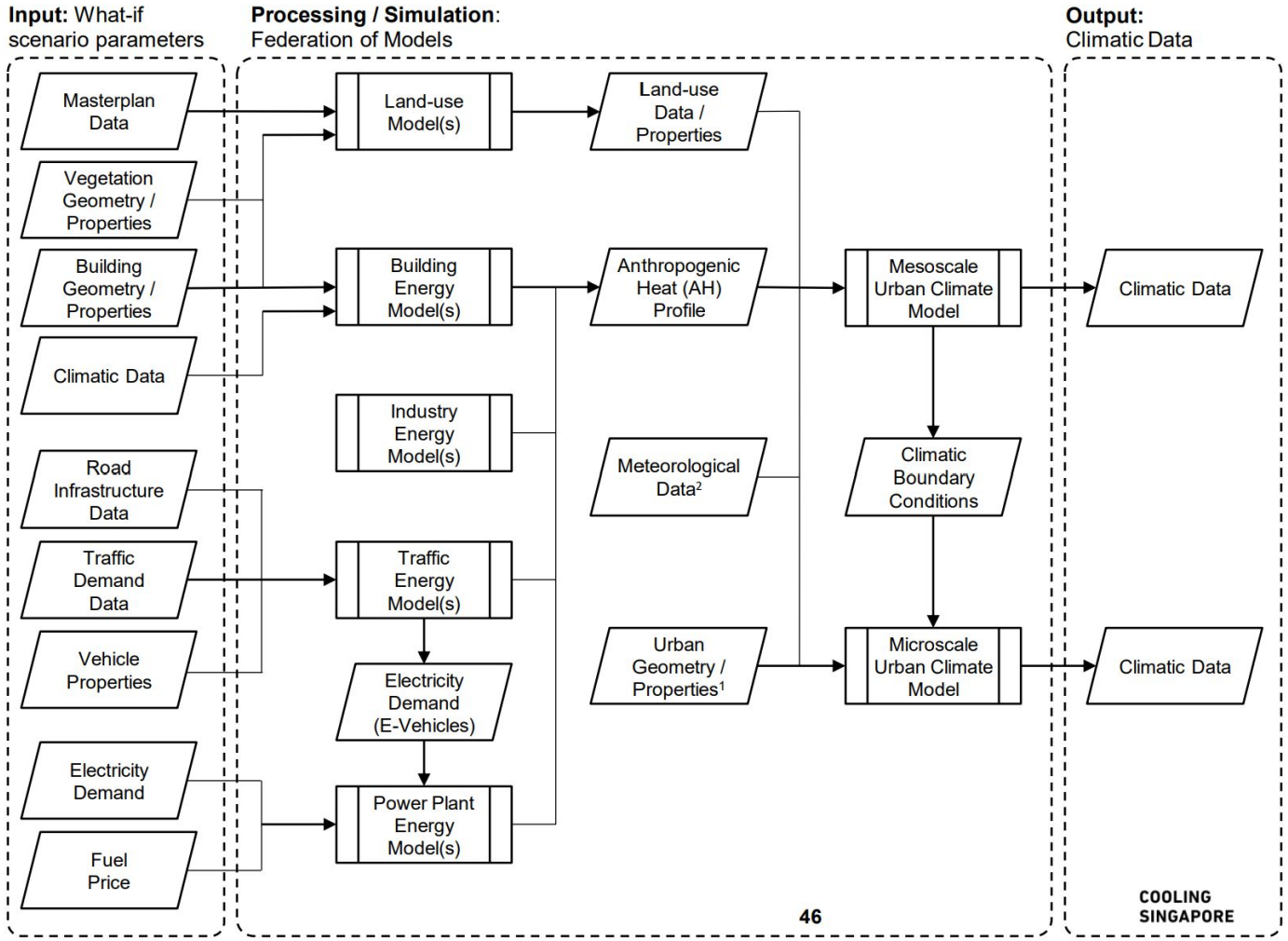
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Cooling Singapore – Digital Urban Climate Twin

Singapore-ETH Centre







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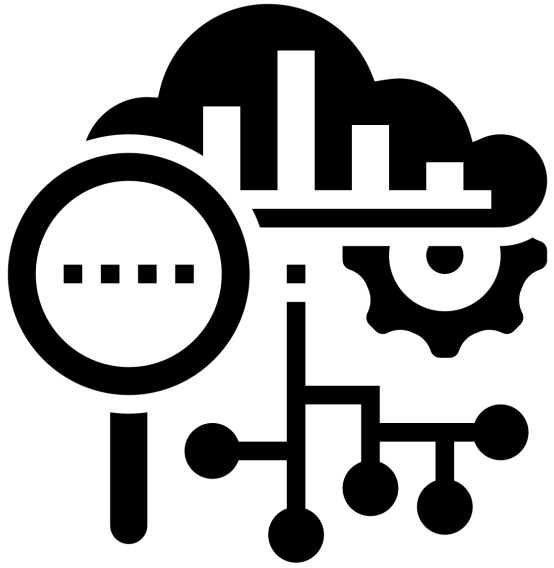


3. Governance

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Data Governance

Plotkin 2021



“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”

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Governance of Spatial Digital Twins

Governing Digital Twin as Shared Space

Is it public space?

Is it a public good?

Public & private?

Governing the Digital Twin Organization

Commons

Consortium

Cooperative

Trust

Government

Private

Governing Digital Data / System

Public Data

Private Data

Open Data

All the above

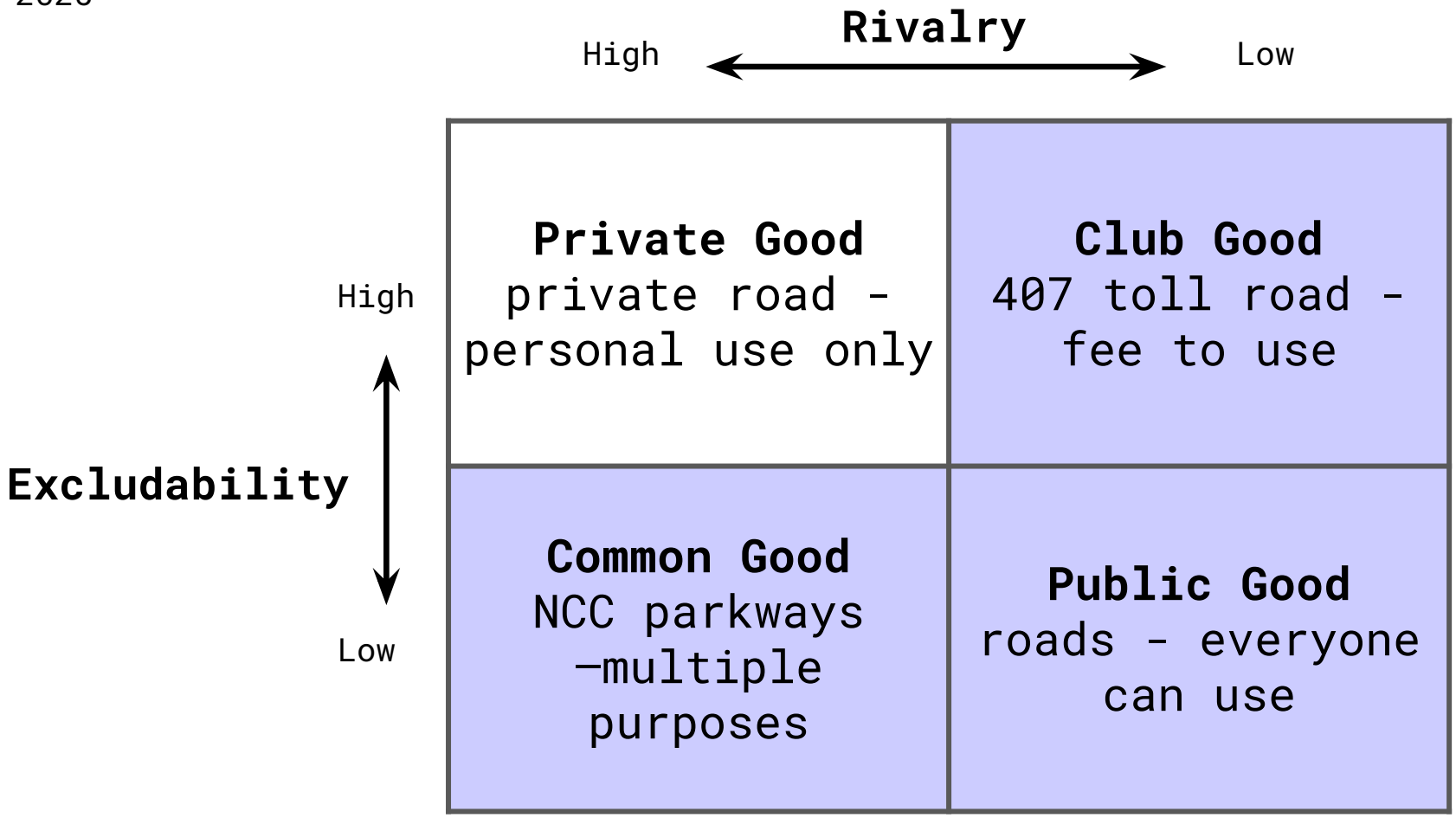
Centralized / Federated / Hybrid

Literature on digital twins does not discuss governance, it is derivative, technologically solutionist and optimistic.

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Public Good

Rao 2025



Digital Twin

Rao 2025

	Rival in consumption	Non-rival in consumption
Excludable	**Private good** (Closed/complete exclusion, only for internal use, or for limited designated users) • DT technical enablers e.g., the cloud, internet server, data center • Sensitive information concerning privacy & public safety	**Club good** (Selective mechanism with artificially imposed criteria, only open for eligible members) • e.g., monthly subscription, consortium fees, data products with paywall
Non-excludable	**Common good** (Opens to all members in the community. Selective mechanism exists by defining the scope of community) • e.g., a free open platform (w/ restrictions on certain sensitive info) only for the registered members of an organization	**Public good** (Almost impossible to exclude access & therefore fully open to everyone) • e.g., datasets posted online without restrictions. *risk of individuals' information and data being leaked to the public

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Rao 2025

	Pure Public Good	Pure Private Good	Common Good	Club Good
Info Openness	Fully open free of charge & access barrier	Not open to public or no free access	Fully open to the community without charge & access barrier	Conditional access varies to types of membership or payment requirement
Regulation	NO (Assume a non deteriorating resource & impose regulation)	N/A (Completely managed by private resource owner)	YES (Regulate to avoid harm led by anticipated rivalrous behaviors)	YES (Regulate for self-imposed causes)
Ownership Attribution	By state/ government	By private owner of the resource	Collective ownership to community members	By platform operator (either private or collective)
Decision making power	By state as public representative	By individuals or institutions	Collectively by all community members, or community representing all members	By platform operator, or by enrolled/eligible members
Typical funding source	Public sector	Privately funded	Publicly funded by specific community	Mixed private and public funding



4. Digital Twin Research

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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

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I Trust AI – Case Study 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 the AI/ML processes and the data in these systems?

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We also wanted to know

The epistemic concerns of those involved?

- Architecture, engineering, construction, owner and operated (AECOO)
- 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? Archival 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, and etc.

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4 Interrelated Theoretical Frameworks & Concepts

1. Critical Data Studies (Kitchin & Lauriault, 2018)
2. Digital diplomatics (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)

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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

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Imagining Canada's Digital Twin

Carleton Immersive Media Studio

IMAGINING CANADA'S DigitalTwin

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.









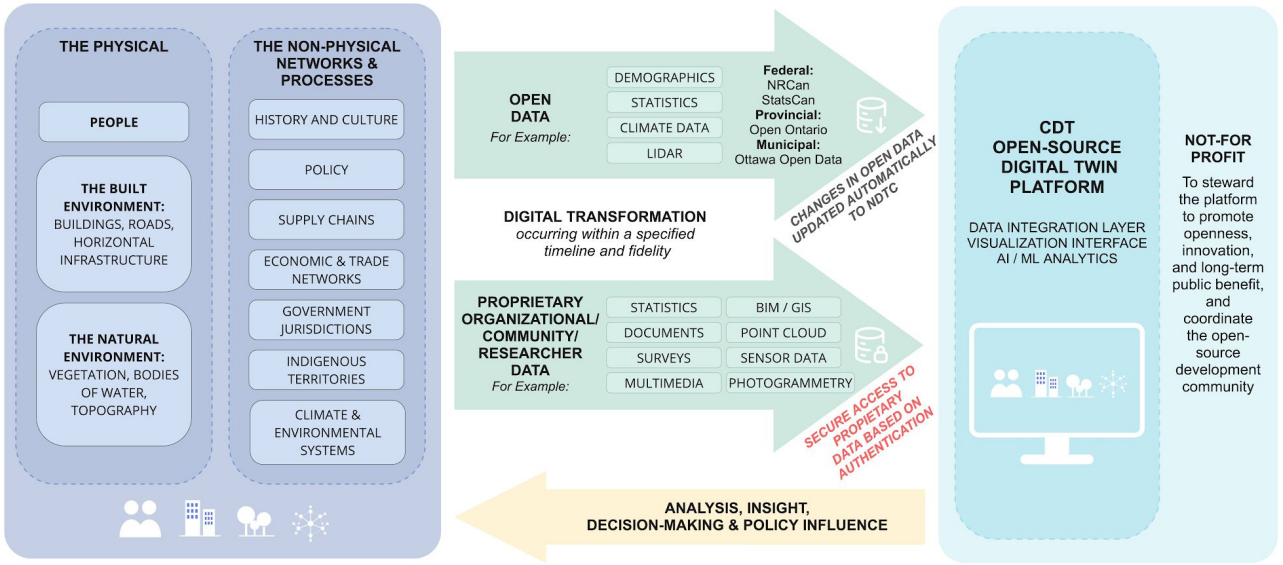


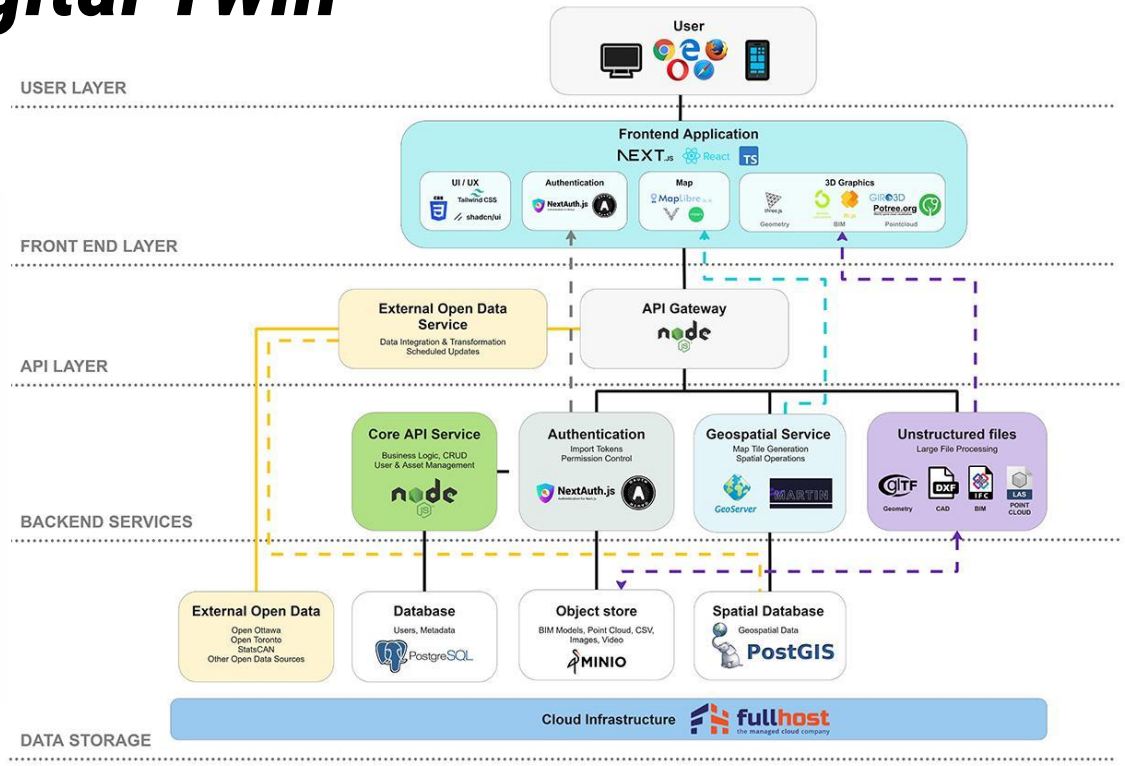


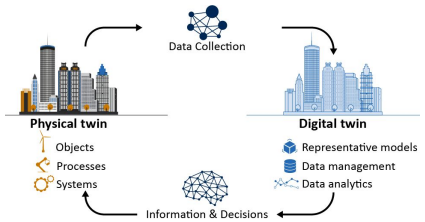
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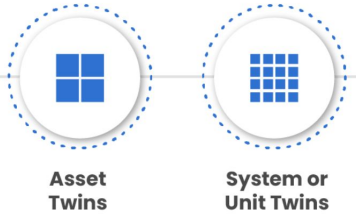
Carleton Immersive Media Studio (CIMS)

Digital Twin Platform - ***Spatial Digital Twin***









Carleton Immersive Media Studio

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Carleton Immersive Media Studio



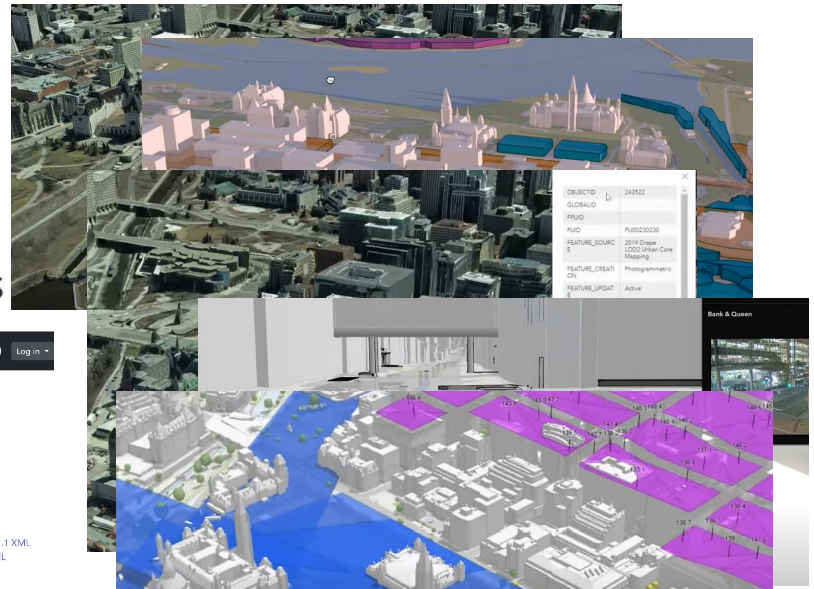
Delta CONTROLS
A Delta Group Company



Menu | Ottawa

Home > Planning, development and construction > Developing a property > Geomatic Services > Geospatial Analytics, Technology and S

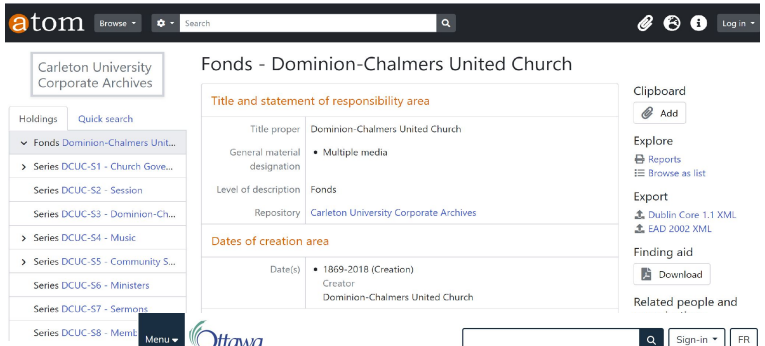
Geospatial Analytics, Technology and Solutions (GATS)



Facilities Management and Planning



Corporate Records and Archives



Building Performance Research Centre



Menu | Ottawa

Applying for a Building Permit

Applications for a building permit must include:

- Completed application form
- Two sets of Plans - examples
- Building Permit Fee payment
- Specification documents if required (provide examples)

Application Form

Building Permit applications are submitted using the Provincial authorized Building Permit Application Form. Application Forms are also available at Client Service Centres located throughout the City.

We recommend that you take the time required to read and carefully complete the application form and schedules. It is important that you ensure that your application is complete, accurate and signed.

Menu | Ottawa

Home > Planning, development and construction > Building and renovating > Building

Building permit approval process

Menu | Ottawa

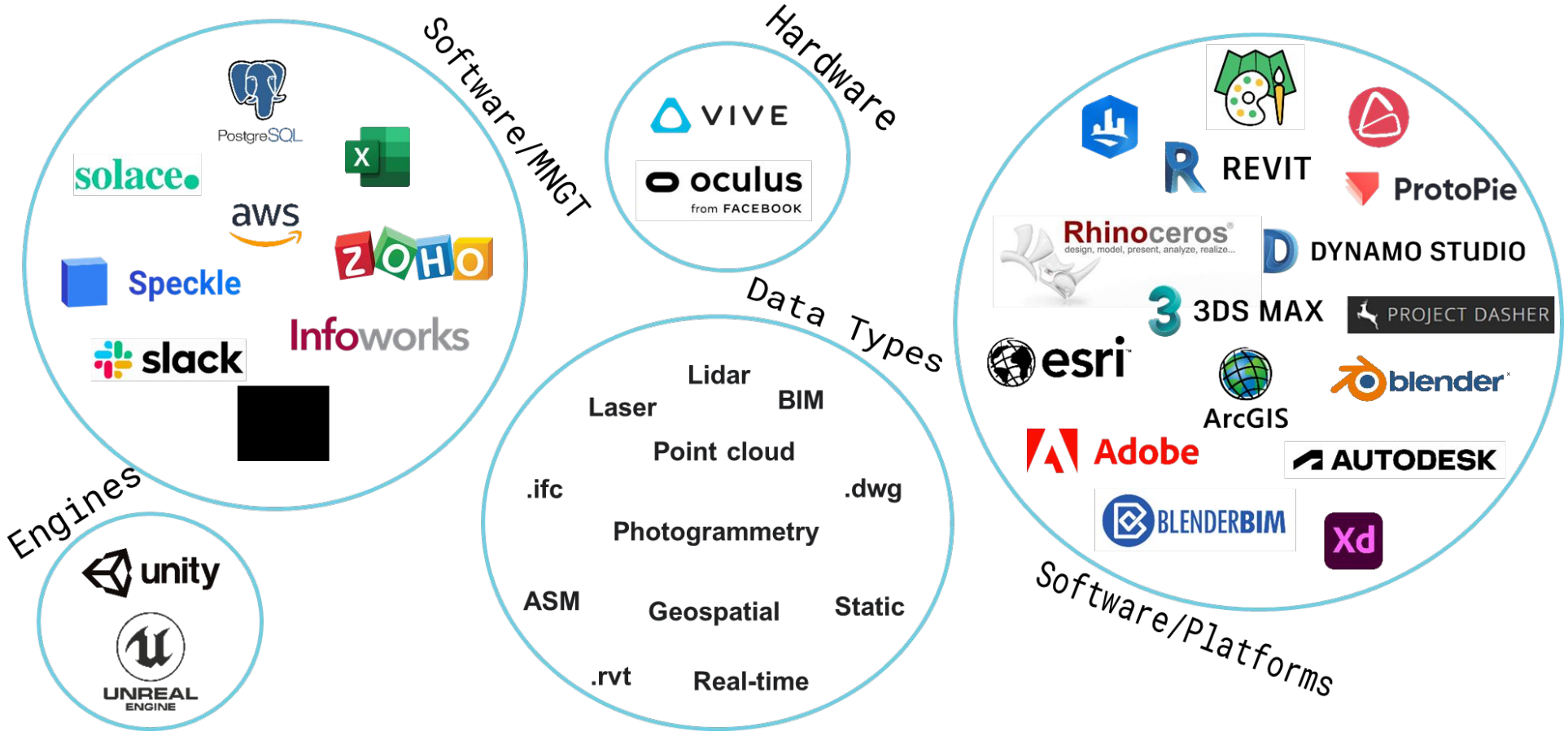
Home > Arts, heritage and events > City of Ottawa Archives

City of Ottawa Archives

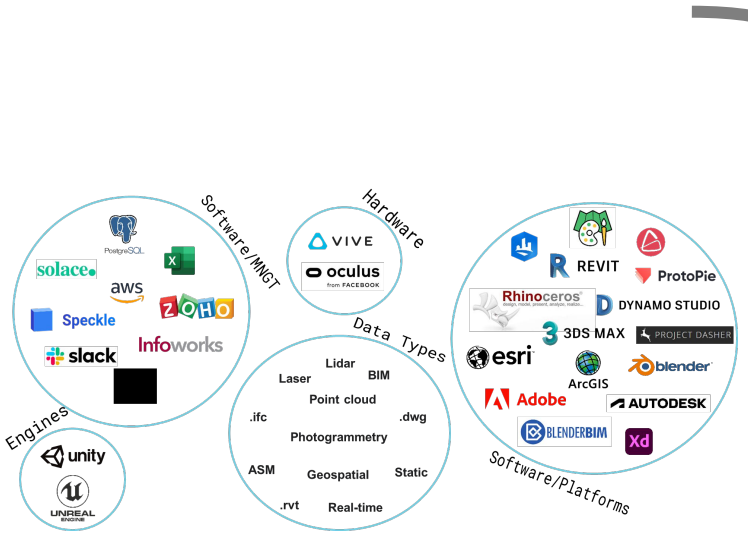


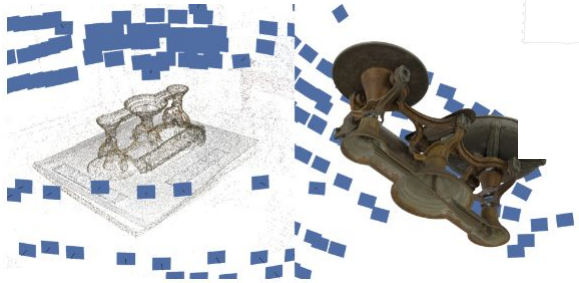
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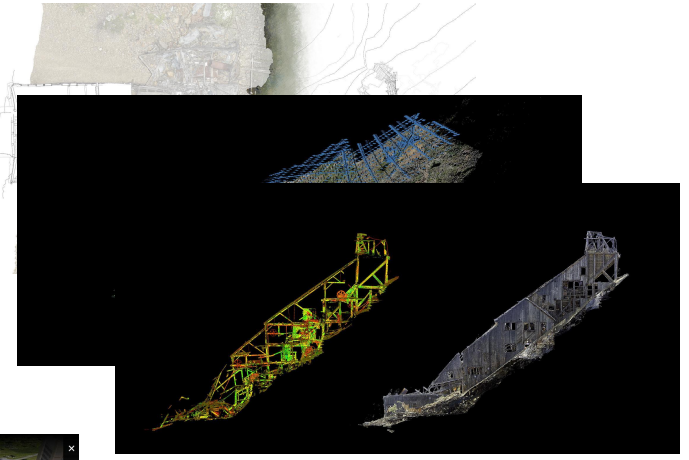
What we observed at CIMS – Architecture View



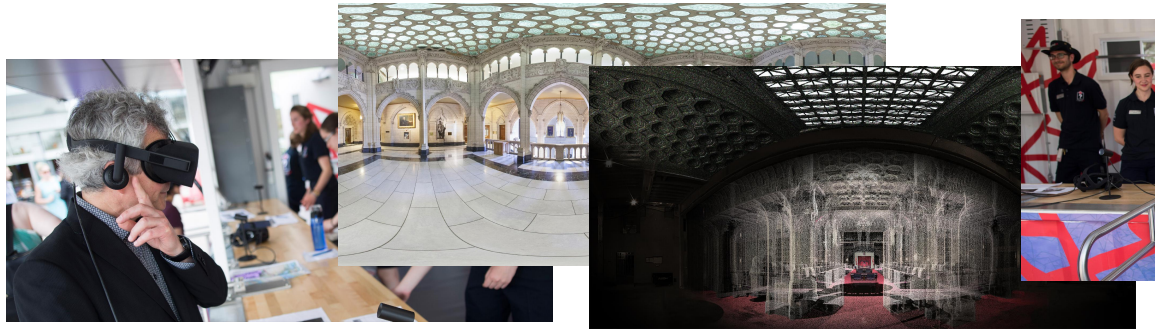
What we saw at CIMS













Carleton Immersive Media Studio

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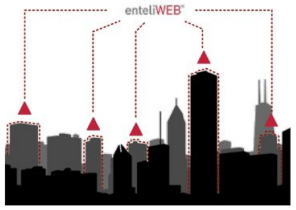
What we Experienced w/Owner operators

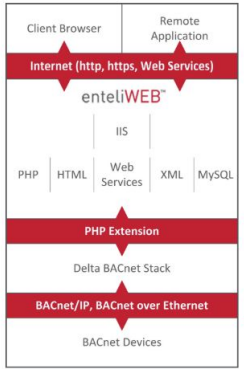










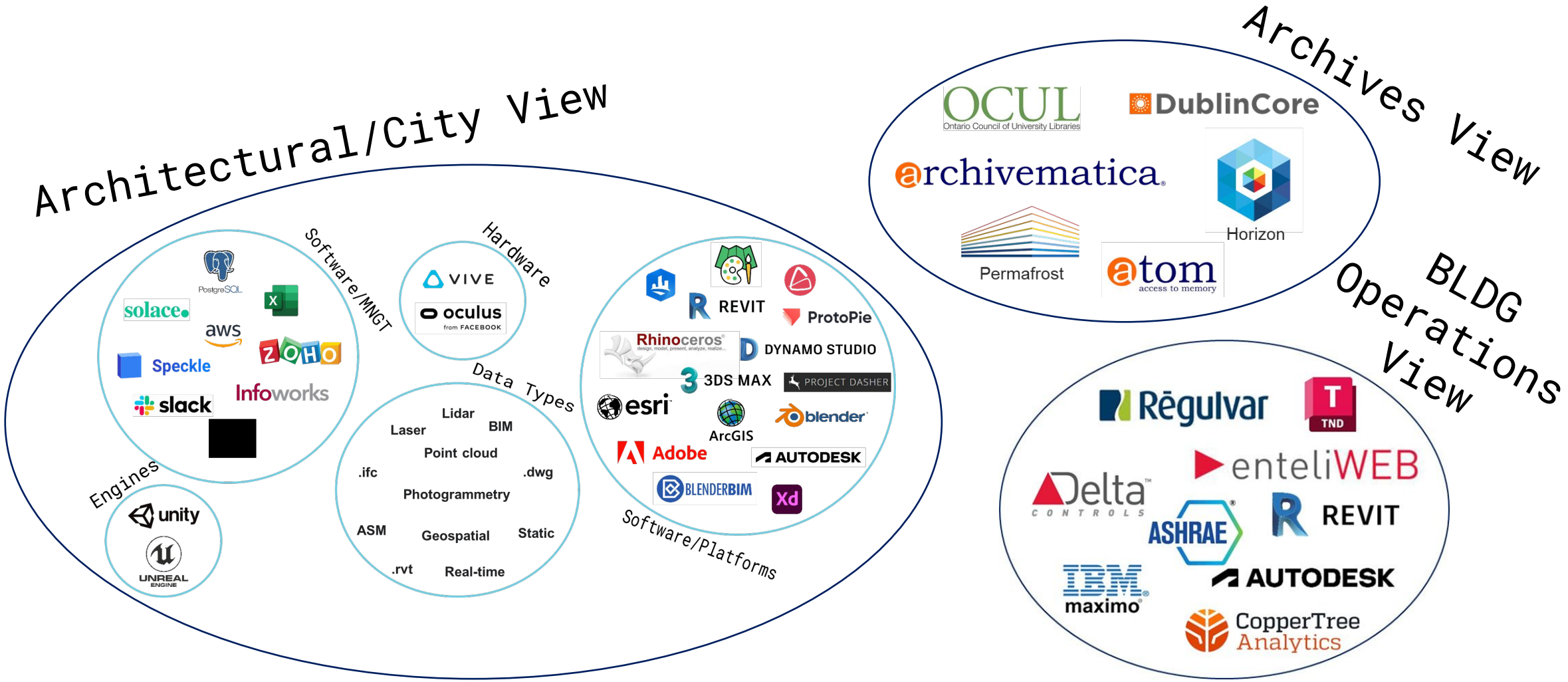


Building Environment View



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Mutually Distinct Systems & Juridical Contexts





5. Digital Twins as Public Good Infrastructures that ought to be preserved

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Digital Twins as Public Good Geospatial Data Infrastructures

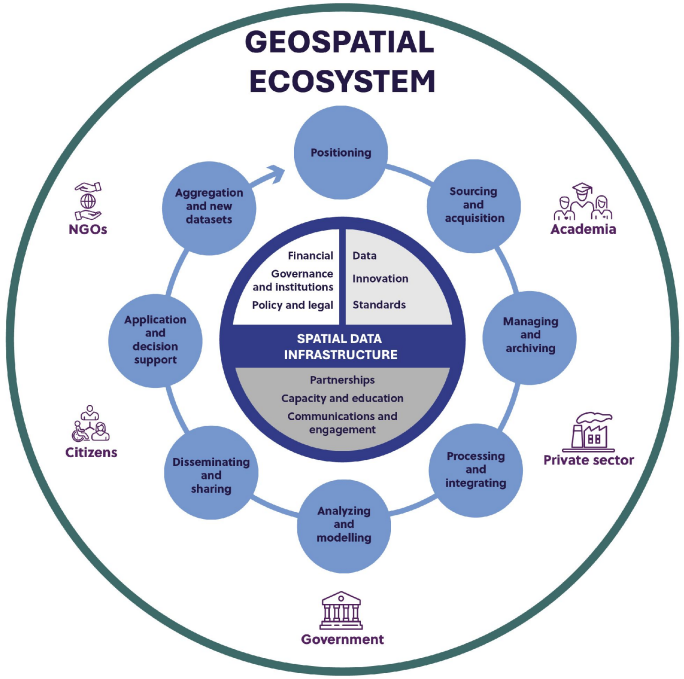
Within a particular sector/**domain** (epistemic community)

- Architecture, engineering, construction, owner and operated (AECOO)
- Finance, builders, plant management

Are they public spaces? Public Goods?

Ought we not extend the good governance practices developed over centuries of scientific and mapping collaboration? Open Data? Open Science? Open Gov. Etc.

What are the data and technological politics that need to be considered?



2026. ***Collaborative Geospatial Strategy for Canada***

Conclusion

- A Digital Twin is a system of systems that involves Interactive, Experiential & Dynamic Digital Records
- Interdisciplinary Hybrid methodological approaches work
  - IP2 + I Trust AI + Walkthrough + Archival + Critical Data Studies
  - Diplomatic Analysis - for Digital Twin the record depends on the juridical context of the digital entity
  - Validation with archivists is essential
  - Mutual shaping of knowledge during interviews
- Digital twins are infrastructure, are cultural artifacts and are comprised of records – we need to preserve complex contemporary artifacts and preservation ought to be part of the creation process!

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6. Acknowledgements

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CS04 - Digital Twin Case Study Team

- **Tracey P. Lauriault**, I Trust AI Lead, Associate Professor, Critical Media and Big Data, School of Journalism and Communication(SJC), Carleton University
  - **Anna-Lena Theus,** PhD Candidate at Carleton University, SJC (Project GRA)
- **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 & CIMS
  - **Nicolas Arellano**, PhD Candidate, CIMS
  - **Lara Chow**, CIMS
- **Building Science Engineering and Sustainability 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
  - **H. Burak Gunay**, Assistant Professor in Building Science, Department of Civil and Environmental Engineering
- **Carleton University**
  - **Travis Kinnear,** MLIS, Digital Archivist, Corporate Records & Archives, University Secretariat, Carleton University

Rao, Zijun. 2025. ‘Urban Digital Twins: A Public Good Infrastructure MA Thesis M.A. -

School of Journalism and Communication Carleton University. https://ocul-crl.primo.exlibrisgroup.com/permalink/01OCUL_CRL/1jui968/alma991023461323005153

Urban Digital Twins:
A Public Good Infrastructure?

by
Zijun Rao

A thesis submitted to the Faculty of Graduate and Postdoctoral Affairs in partial fulfillment of the requirements for the degree of Master of Arts

in

Communication and Media Studies, School of Journalism and Communication, Faculty of Global and Public Affairs

Carleton University
Ottawa, Ontario

2025, Zijun Rao

