

I-90 Digital Twin Proof of Technology Evaluation & Cybersecurity Roadmaps

Presented to:

NWCCC Annual Conference 2024

November 14, 2024

Carrie Sturts Dossick

John E. Schaufelberger Professor of Construction Management

Cdossick@uw.edu



Department of Construction Management, College of Built Environment



MOBILITY
INNOVATION
CENTER

Agenda

- Overview of the project
- The backstory – how we got here
- Cybersecurity Roadmap



MOBILITY
INNOVATION
CENTER
at the
UNIVERSITY of WASHINGTON



Department of Construction Management, College of Built Environment

UW academic team



Dr. Travis Thonstad



Dr. Michael Motley



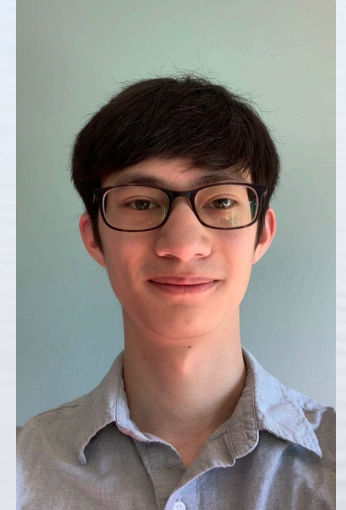
Dr. Carrie Sturts
Dossick, P.E.



Bart Treece, PTP



Ori Borjigin,
PhD Student



Timothy Bernard,
MS Student



MOBILITY
INNOVATION
CENTER
at the
UNIVERSITY of WASHINGTON



Department of Construction Management, College of Built Environment

What is a Digital Twin?

“digital equivalent to a physical product”

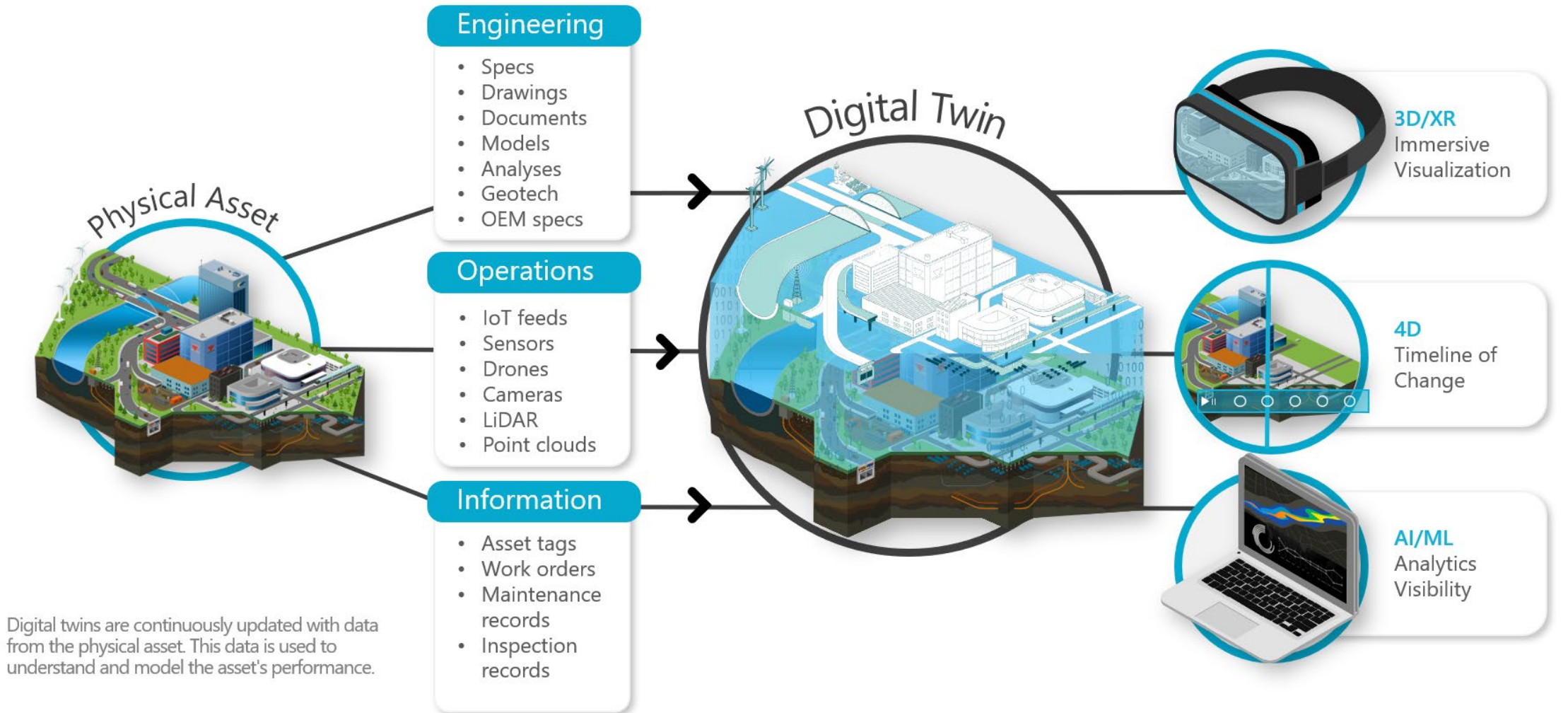
2003 Michael Grieves at
the University of Michigan



Mars Curiosity Rover

Landed on Mars August 5, 2012

What is a Digital Twin?



OBJECTIVE

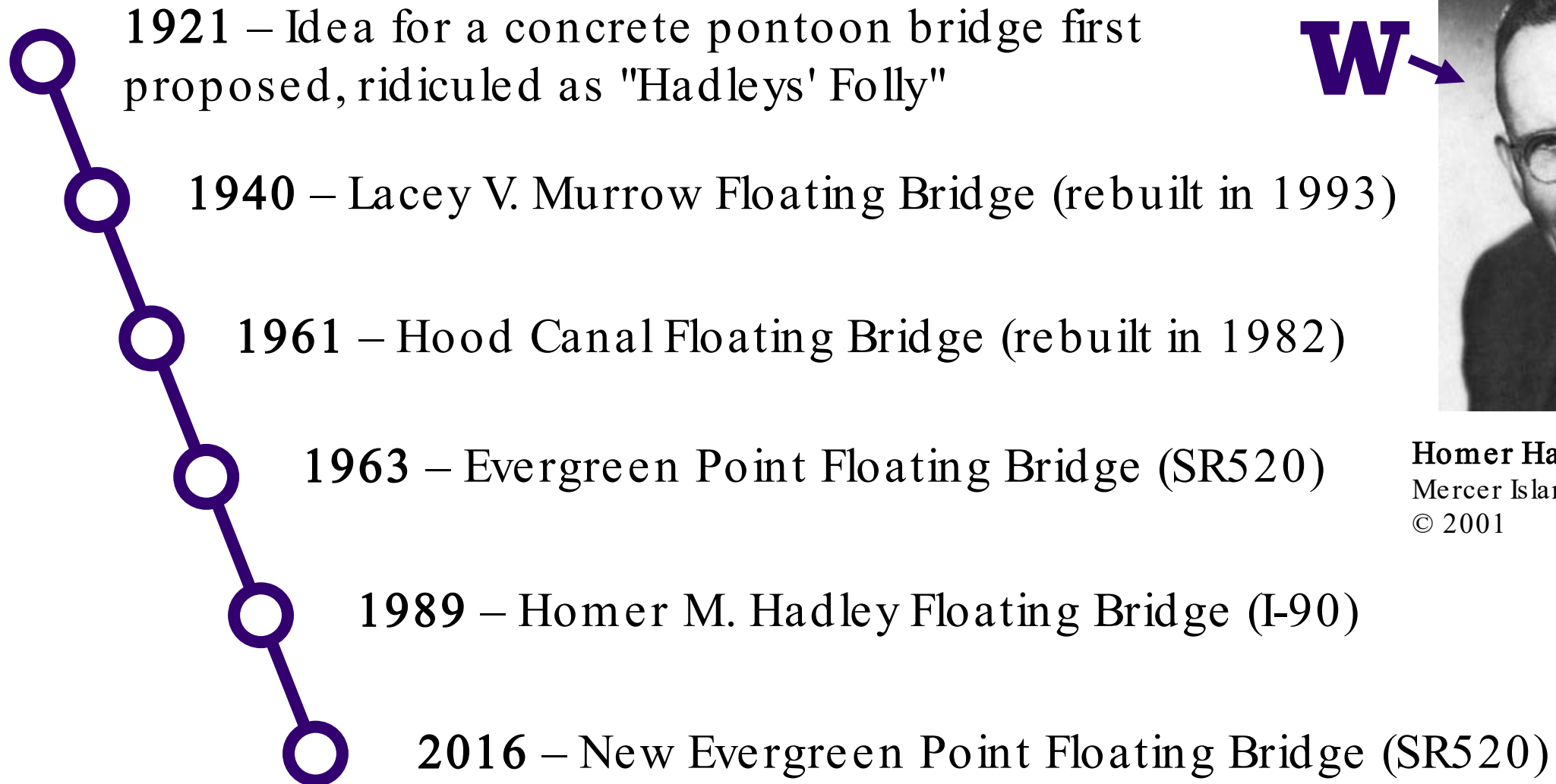
“Proof-of-technology” project

Evaluate the benefits, limitations, and tradeoffs that an agency or agencies could expect when using similar technologies for asset management, maintenance, and operations

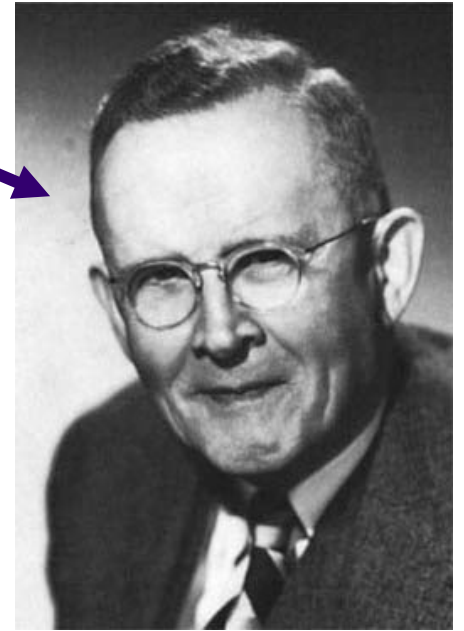
- Location and utility of IoT sensor types
- Ease of data retrieval and interpretation
- Integration of disparate data streams
- Ability to draw inferences for maintenance and operations decisions



100 YEARS OF PIONEERING INNOVATION IN WASHINGTON STATE (4 of 20 floating bridges)

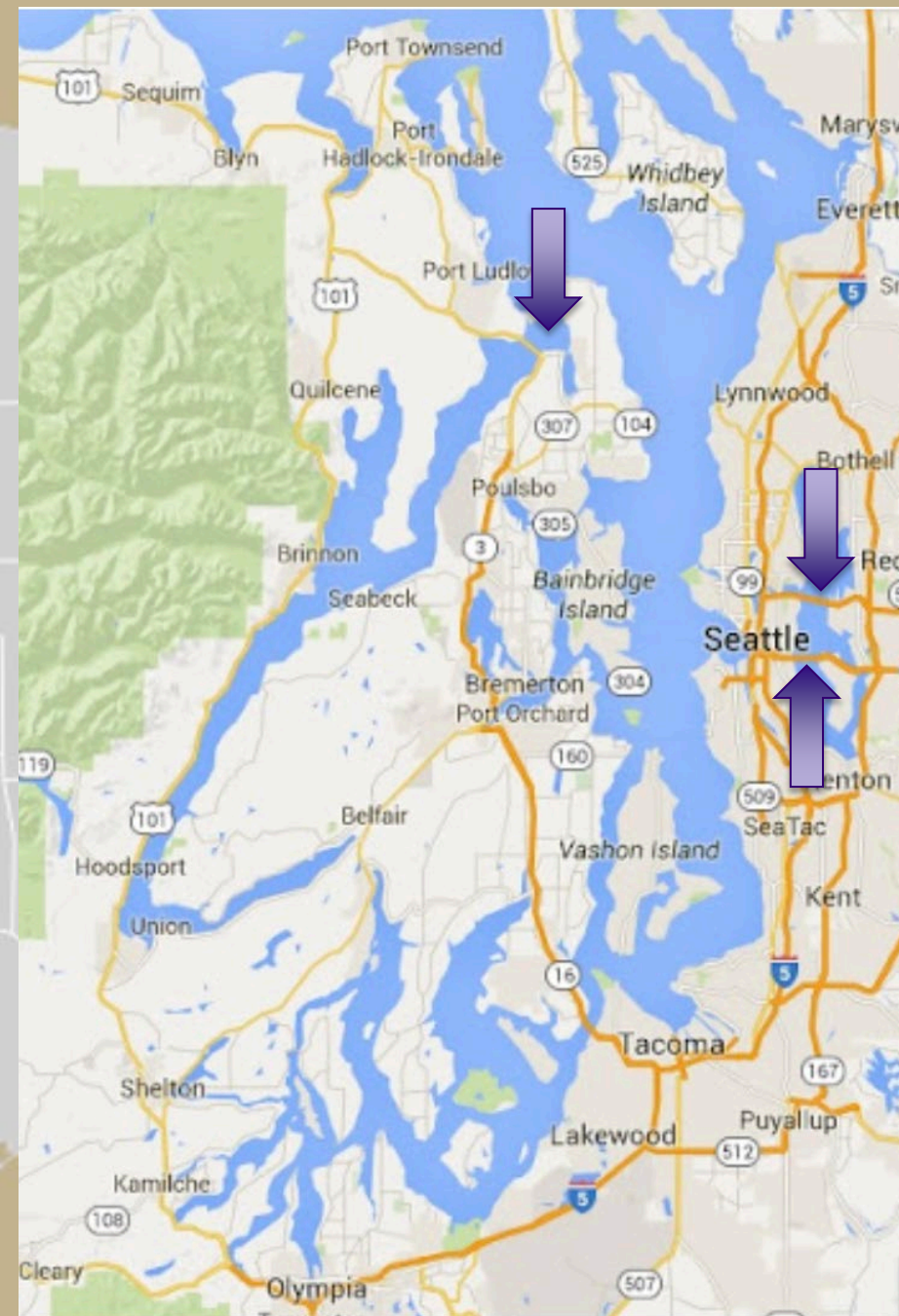


W →



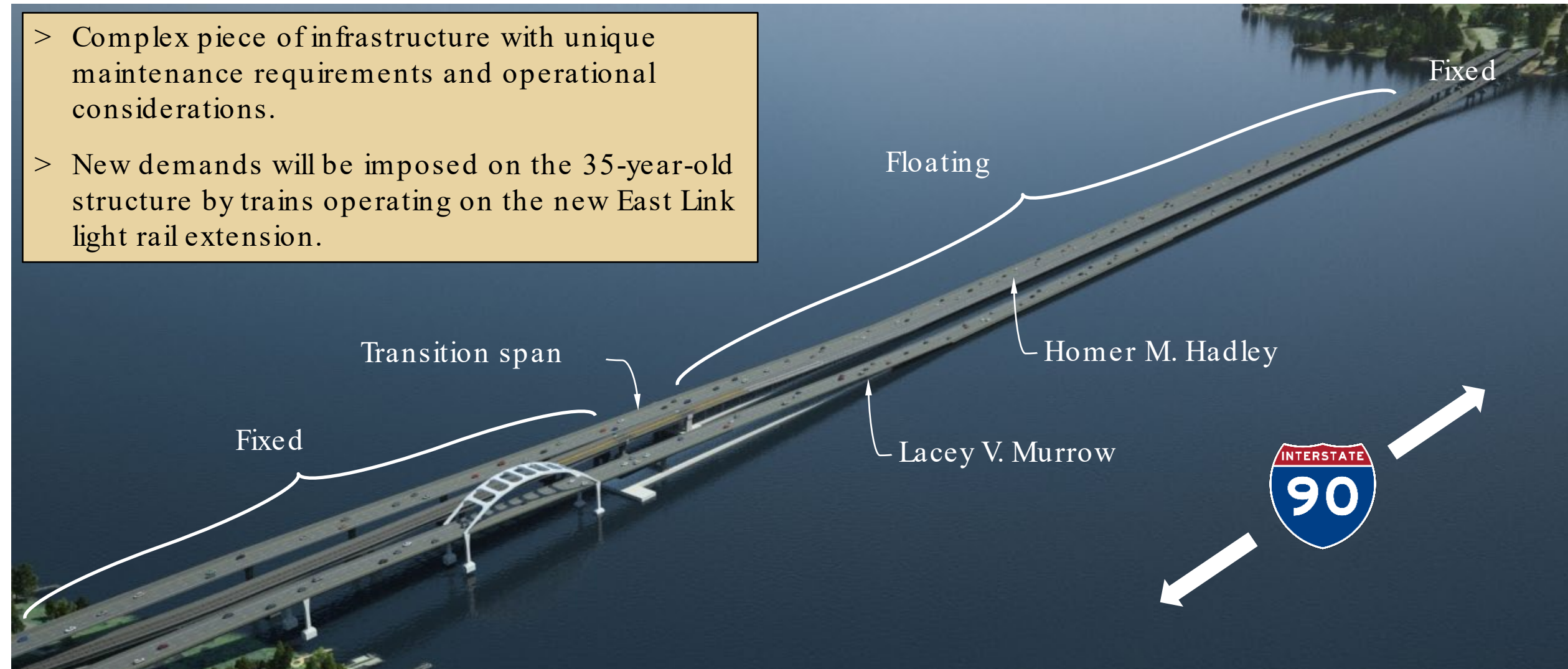
Homer Hadley (1885-1967)
Mercer Island Historical Society
© 2001

★
SEATTLE



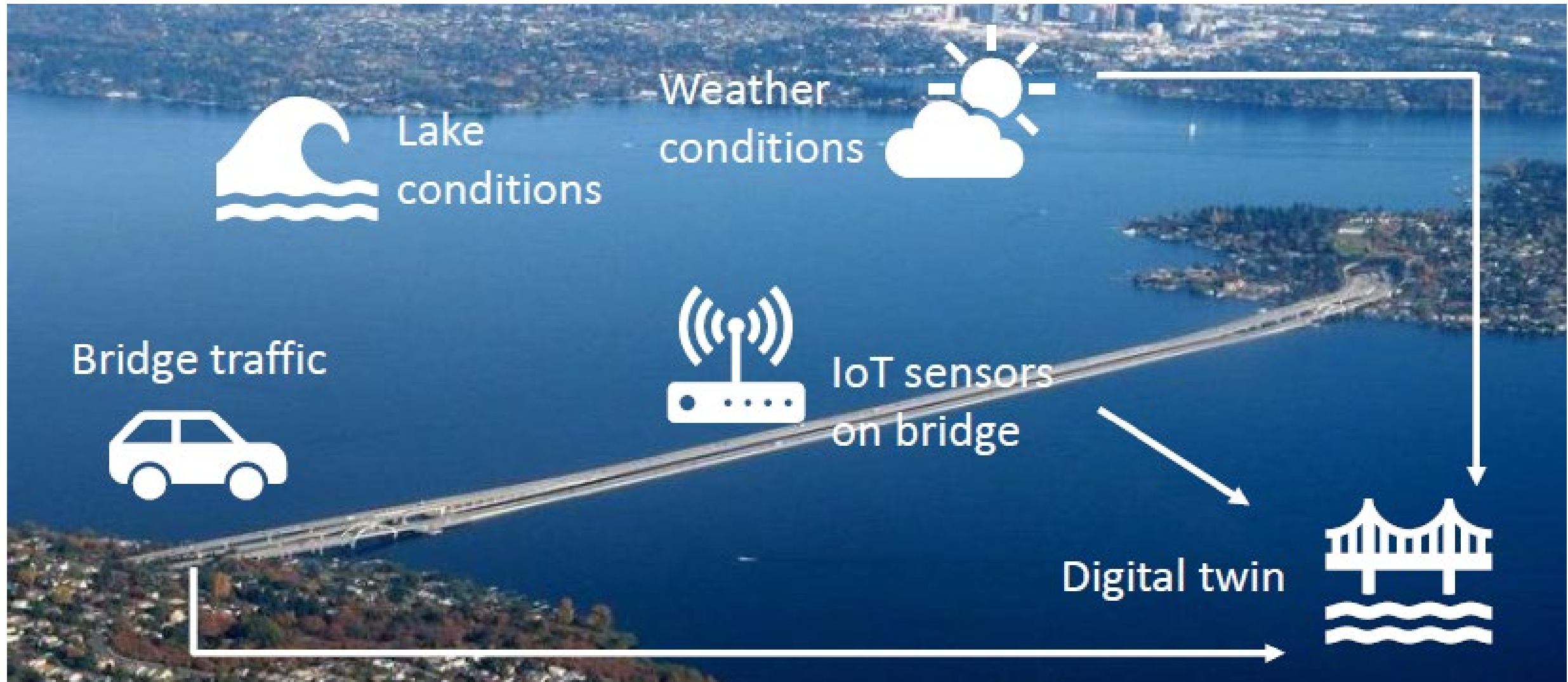
HOMER M. HADLEY MEMORIAL BRIDGE

- > Complex piece of infrastructure with unique maintenance requirements and operational considerations.
- > New demands will be imposed on the 35-year-old structure by trains operating on the new East Link light rail extension.



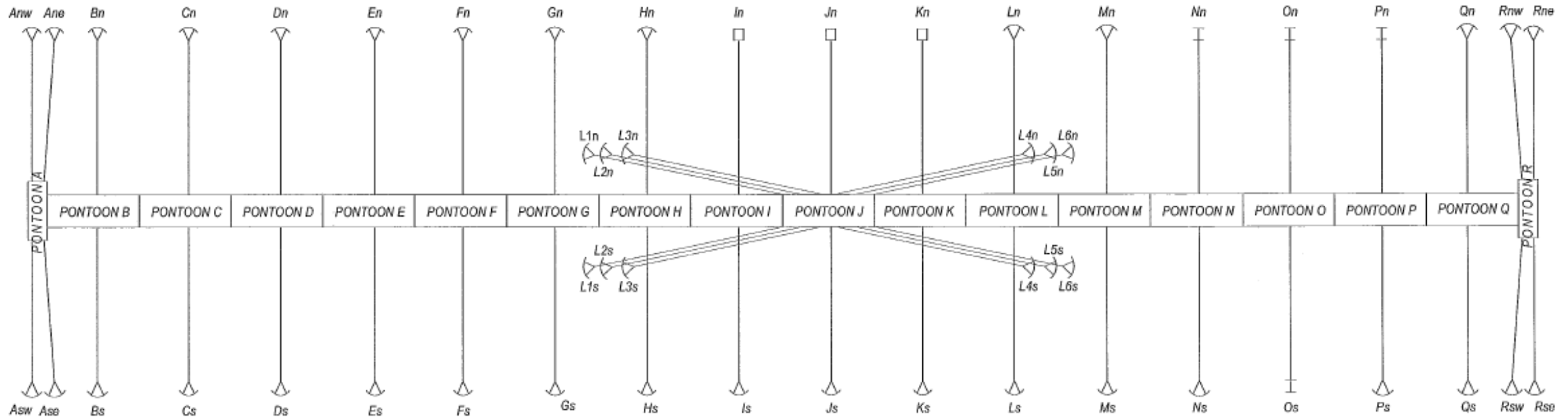
Courtesy: WSP USA

DIGITAL TWIN TECHNOLOGY



HOMER M. HADLEY MEMORIAL BRIDGE

Floating portion of bridge restrained by 52 anchor cables



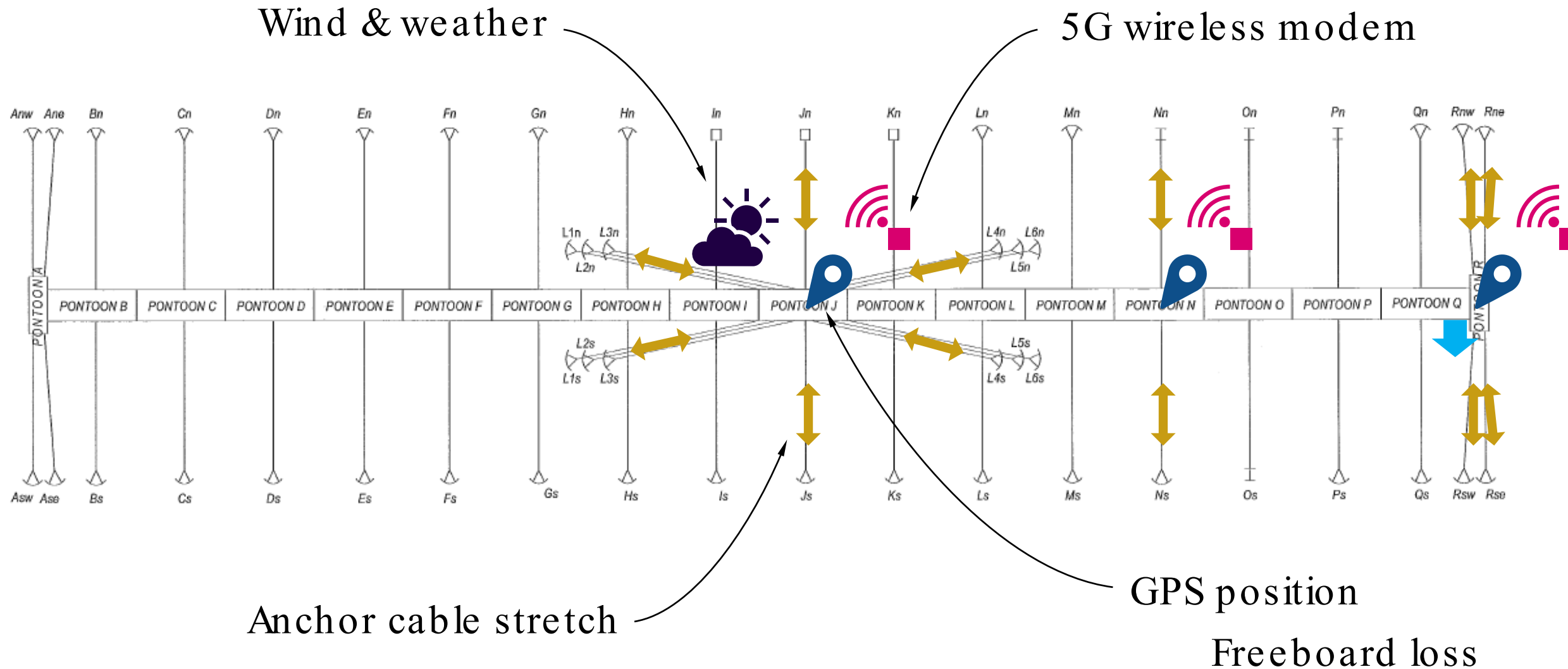
ASSET MANAGEMENT – ANCHOR CABLE REPLACEMENT

In 2022, 38 anchor cables were replaced at a cost of ~\$9 million



Photos courtesy of WSDOT

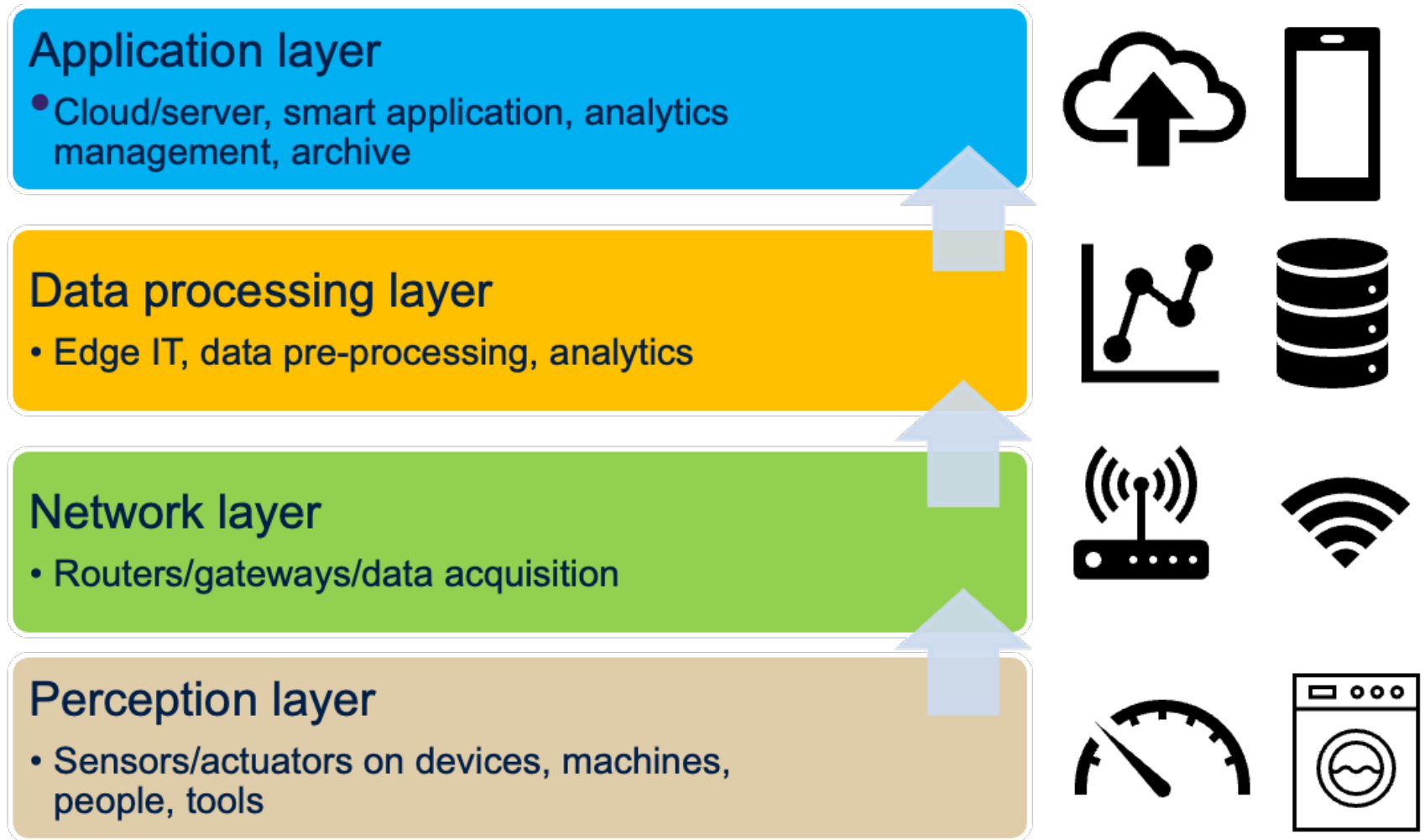
Revised MEASUREMENT LOCATIONS



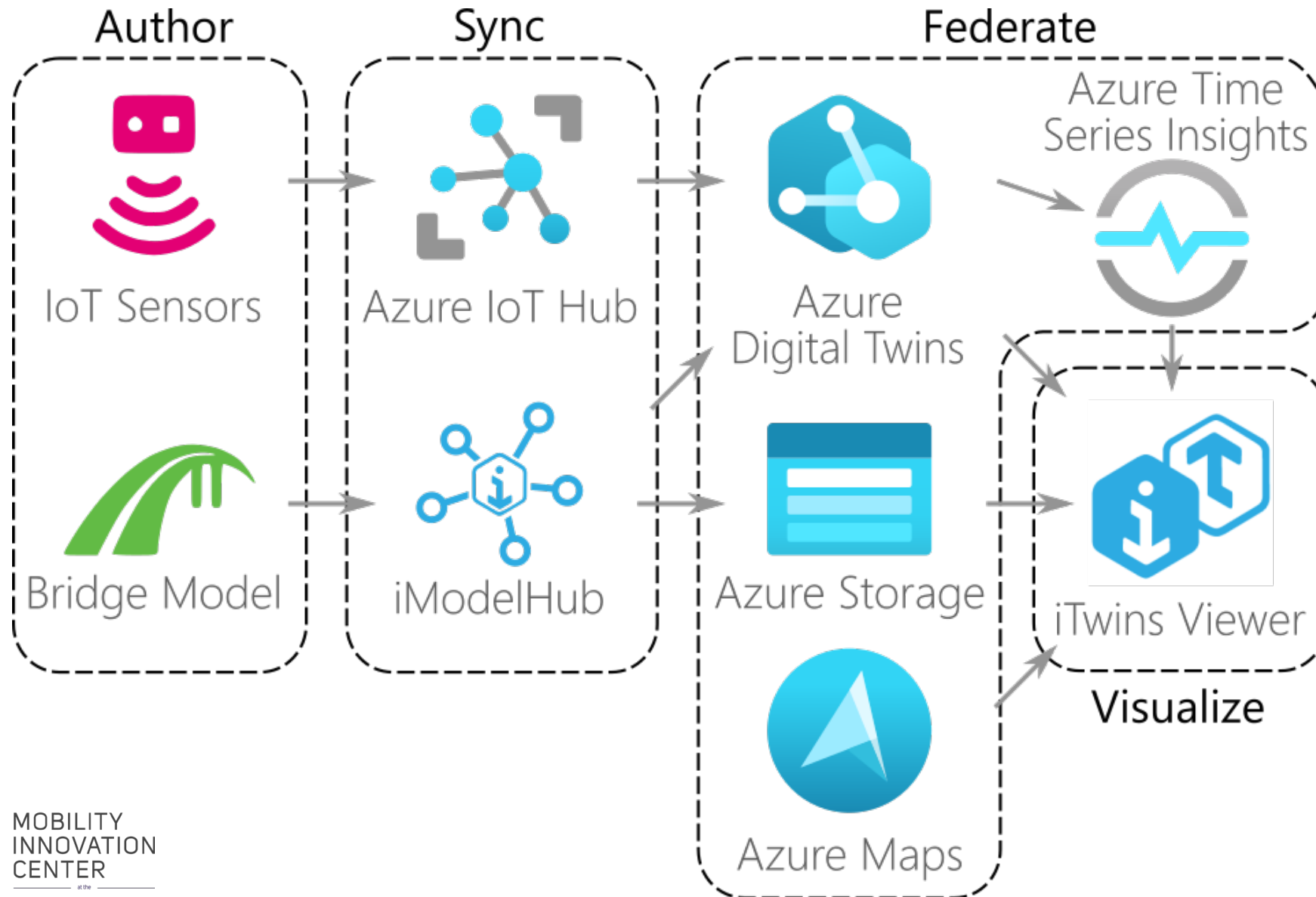
Timeline



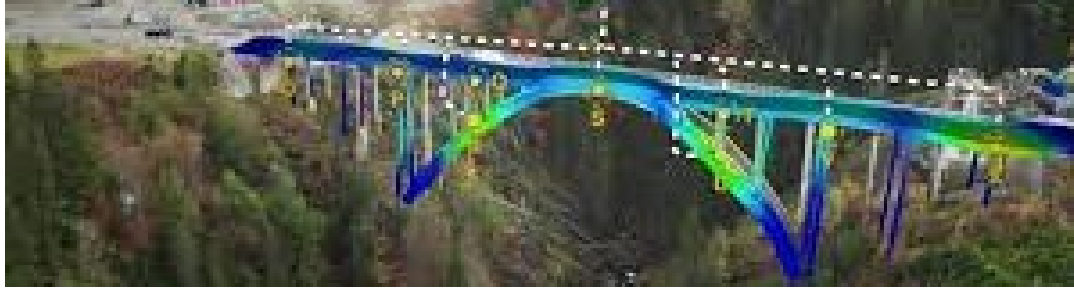
Digital Twin Architecture, Cybersecurity Risks & Attack Surfaces



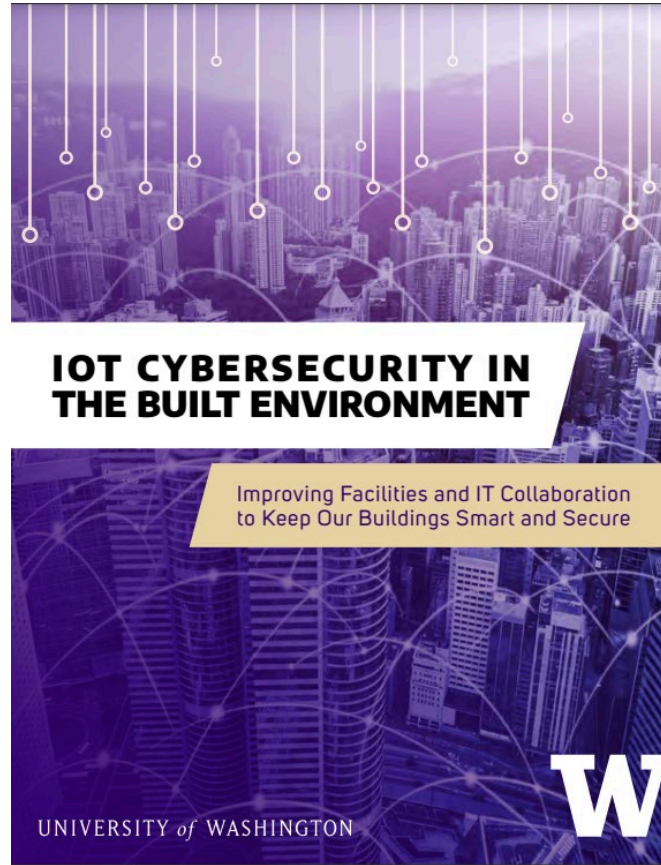
I-90 Twin Preliminary Project Architecture



INNOVATION AND PARTNERSHIPS



Cybersecurity Roadmap for Construction



<http://cyber.be.uw.edu>



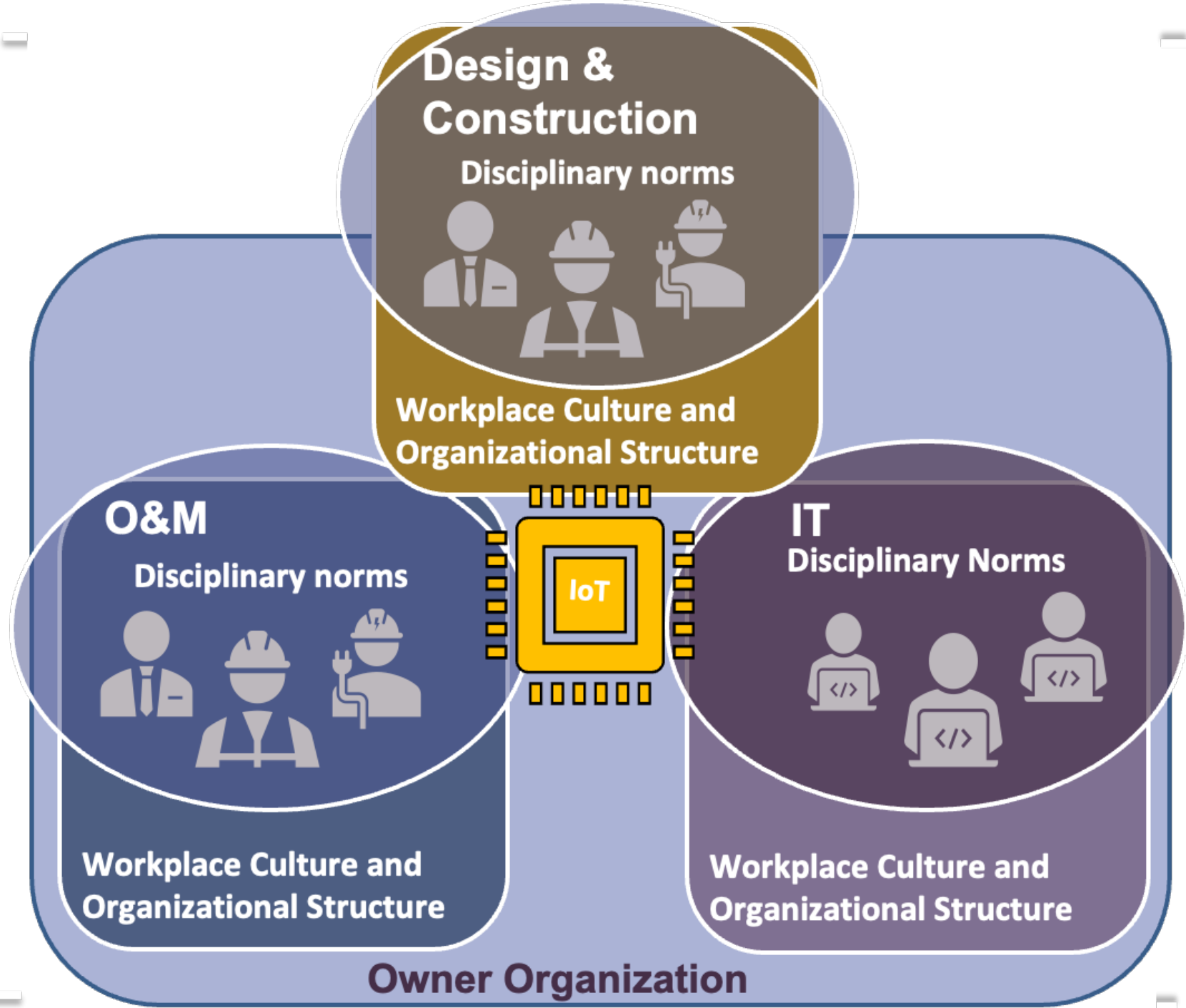
MOBILITY
INNOVATION
CENTER
at the
UNIVERSITY of WASHINGTON



Department of Construction Management, College of Built Environment

Cybersecurity culture

Public Policy on Privacy/Security, Energy
Policies, Codes and Standards



IoT marketplace: vendor products, security
considerations, customer needs

Cybersecurity Risks

		OT	IoT Risks	IT
Technological	Purpose	Control/manage physical devices	Potential disruptions; data vulnerabilities	Manage information
	Connectivity	Often stand-alone applications	Connectivity creates risk that can disrupt OT and IT	Interconnected (applications)
	Architecture	Often closed, proprietary, task specific	Bad actors can reprogram many devices	Frequently more open, standards based
	Life Span	Long (10 - 20 years)	May not be patched; disruptive upgrades	Frequent, systematic patches and upgrades
	Discipline	Engineering, skilled trades	Different terminologies and siloed practices	Computer science
Organizational	Governance	O&M, engineers, technicians	Unclear responsibility when systems overlap	IT department
	Technical Knowledge	Many workers only know older technology	Few have IT and O&M skillsets needed for IoT	Emphasis on keeping up with latest technology
	Practice	Interventions not required daily	Different views on how and when to support IoT	Needs daily human and automated support
	Culture	Maintaining/managing physical processes	Difficulties aligning agendas/needs for IoT	Maintaining and securing information
	Policy Expertise	Building codes and standards	Lack of expertise on laws that impact IoT	Data security and privacy laws

Table 1: How technological and organizational differences in IT and OT systems impact IoT risk

ROADMAP NEEDS TO ADDRESS CHALLENGES, STRATEGIES, AND RECOMMENDATIONS



1.

Design and construction
(D&C) of new construction
or renovation projects



2.

Vendor procurement in
the built environment



3.

Management of IoT
operations and future
operations planning

Note: this research was funded by the National Science Foundation (NSF #1932769) SaTC: CORE: Medium: Knowledge Work and Coordination to Improve O&M and IT Collaboration to keep our Buildings Smart AND Secure.

<http://cyber.be.uw.edu>

Roadmap needs to address



1.

Design and construction
(D&C) of new construction
or renovation projects

CHALLENGES

IT AND FACILITIES MANAGEMENT
COLLABORATION



MOBILITY
INNOVATION
CENTER
at the
UNIVERSITY of WASHINGTON



Department of Construction Management, College of Built Environment

Roadmap needs to address



1.

Design and construction
(D&C) of new construction
or renovation projects

CHALLENGES

IT AND FACILITIES MANAGEMENT
COLLABORATION

STRATEGIES

CONSULT CYBERSECURITY AND FACILITIES
PROFESSIONALS IN DESIGN REVIEW AND
DECISION-MAKING

ESTABLISH PROCUREMENT VETTING COMMITTEES



MOBILITY
INNOVATION
CENTER
at the
UNIVERSITY of WASHINGTON



Department of Construction Management, College of Built Environment

Roadmap needs to address



1.

Design and construction
(D&C) of new construction
or renovation projects

CHALLENGES

IT AND FACILITIES MANAGEMENT
COLLABORATION

STRATEGIES

CONSULT CYBERSECURITY AND FACILITIES
PROFESSIONALS IN DESIGN REVIEW AND
DECISION-MAKING

ESTABLISH PROCUREMENT VETTING COMMITTEES

RECOMMENDATIONS

IDENTIFY IOT STAKEHOLDERS ACROSS THE LIFE CYCLE

UNDERSTAND IOT STAKEHOLDERS' NEEDS AND VALUES

ESTABLISH PROCESSES FOR STAKEHOLDER INPUT



MOBILITY
INNOVATION
CENTER
at the
UNIVERSITY of WASHINGTON



Department of Construction Management, College of Built Environment

Roadmap needs to address



2.

Vendor procurement in
the built environment

CHALLENGES

LACK OF CLEAR OWNER
CYBERSECURITY CRITERIA AND
STANDARDS FOR PROCUREMENT
PROCESSES, DATA GOVERNMENT,
AND ROLES AND RESPONSIBILITIES



MOBILITY
INNOVATION
CENTER
at the
UNIVERSITY of WASHINGTON



Department of Construction Management, College of Built Environment

Roadmap needs to address



2.

Vendor procurement in
the built environment

CHALLENGES

LACK OF CLEAR OWNER
CYBERSECURITY CRITERIA AND
STANDARDS FOR PROCUREMENT
PROCESSES, DATA GOVERNMENT,
AND ROLES AND RESPONSIBILITIES

STRATEGIES

CREATE CLEAR OWNER CYBERSECURITY CRITERIA
AND STANDARDS

INTEGRATE IT EXPERTS INTO PROCUREMENT
TEAMS



MOBILITY
INNOVATION
CENTER
at the
UNIVERSITY of WASHINGTON



Department of Construction Management, College of Built Environment

Roadmap needs to address



2.

Vendor procurement in
the built environment

CHALLENGES

LACK OF CLEAR OWNER
CYBERSECURITY CRITERIA AND
STANDARDS FOR PROCUREMENT
PROCESSES, DATA GOVERNMENT,
AND ROLES AND RESPONSIBILITIES

STRATEGIES

CREATE CLEAR OWNER CYBERSECURITY CRITERIA
AND STANDARDS

INTEGRATE IT EXPERTS INTO PROCUREMENT
TEAMS

RECOMMENDATIONS

INVEST IN MANUFACTURERS WITH HIGH CYBERSECURITY STANDARDS

INTEGRATE SECURITY AND GOVERNANCE INTO CONTRACTS AND DESIGN GUIDELINES

CONDUCT CYBERSECURITY REVIEWS DURING PROCUREMENT PROCESSES



MOBILITY
INNOVATION
CENTER
at the
UNIVERSITY of WASHINGTON



Department of Construction Management, College of Built Environment

Roadmap needs to address



3.

Management of IoT
operations and future
operations planning

CHALLENGES

UNCLEAR NETWORK GOVERNANCE

CONFLICTS BETWEEN IT AND
FACILITIES



MOBILITY
INNOVATION
CENTER
at the
UNIVERSITY of WASHINGTON



Department of Construction Management, College of Built Environment

Roadmap needs to address



3.

Management of IoT
operations and future
operations planning

CHALLENGES

UNCLEAR NETWORK GOVERNANCE

CONFLICTS BETWEEN IT AND
FACILITIES

STRATEGIES

IT AND FACILITIES COLLABORATE TO DEFINE
GOVERNANCE

ROUTINE COLLABORATION BETWEEN IT AND
FACILITIES



MOBILITY
INNOVATION
CENTER
at the
UNIVERSITY of WASHINGTON



Department of Construction Management, College of Built Environment

Roadmap needs to address



3.

Management of IoT
operations and future
operations planning

CHALLENGES

UNCLEAR NETWORK GOVERNANCE

CONFLICTS BETWEEN IT AND
FACILITIES

STRATEGIES

IT AND FACILITIES COLLABORATE TO DEFINE
GOVERNANCE

ROUTINE COLLABORATION BETWEEN IT AND
FACILITIES

RECOMMENDATIONS

ADDRESS DISCIPLINARY DIFFERENCES BETWEEN IT AND FACILITIES MANAGEMENT

CREATE SHARED GOVERNANCE BETWEEN IT AND FACILITIES MANAGEMENT

CLARIFY ROLES AND RESPOSIBILITIES IN IOT AND DIGITAL TWIN MANAGEMENT



MOBILITY
INNOVATION
CENTER
at the
UNIVERSITY of WASHINGTON



Department of Construction Management, College of Built Environment

Roadmap needs to address Challenges, Strategies, and Recommendations



1.

Design and construction
(D&C) of new construction
or renovation projects



2.

Vendor procurement in
the built environment



3.

Management of IoT
operations and future
operations planning

Note: this research was funded by the National Science Foundation (NSF #1932769) SaTC: CORE: Medium: Knowledge Work and Coordination to Improve O&M and IT Collaboration to keep our Buildings Smart AND Secure.

<http://cyber.be.uw.edu>

Thank you!



Carrie Sturts Dossick
Cdossick@uw.edu



**MOBILITY
INNOVATION
CENTER**
at the
UNIVERSITY of WASHINGTON



Department of Construction Management, College of Built Environment