IABMAS 2026 · Workshop

Digital Twins for Bridge Engineering

Toward Standardization and Practical Implementation

Scope & Motivation

Digital twin (DT) technology holds significant promise for transforming how bridges are designed, monitored, maintained, and managed over their life cycle. By integrating real-time sensor data, structural models, inspection records, and geospatial information into a living, dynamic representation of a structure, digital twins can enable more informed decision-making, predictive maintenance, and optimized asset management.

Despite this potential along with recent research and commercial products, the bridge engineering community currently lacks a shared understanding of what constitutes a digital twin, how it should be developed and maintained, and how it can be practically implemented by asset owners and practitioners. Questions about interoperability, data standardization, software licensing, and role-specific access remain largely unresolved.

This workshop, organized under the auspices of the IABMAS' Technical Committees, aims to bring together experts from research including from different domains, practice, and bridge ownership to establish a common foundation, working toward a community definition, standardization guidelines, and a roadmap for practical adoption.

Workshop Objectives

- Develop a clear and practical definition of digital twins for the bridge engineering community
- Identify the needs and expectations of bridge owners and other stakeholders when interacting with a digital twin
- Review current data formats, tools, and platforms (FEM models, openBIM, DICONDE, SHM, NDE) and their integration challenges
- Define the necessary inputs and actionable outputs of a bridge digital twin
- Identify barriers to adoption, including software licensing, versioning, and interoperability
- Contribute to the development of a white paper and potential standardization recommendations

Invited Presentations

The workshop will feature three presentations (~20 minutes each) from leading experts across multiple sectors. We seek contributions that illuminate lessons learned and opportunities across the following perspectives:

- Other industries (e.g. entertainment, aerospace, defense, manufacturing): general applicability and lessons learned from mature DT implementations
- Civil infrastructure: successful case studies and current challenges in infrastructure DT deployment
- Bridge ownership: integration with bridge management systems, return on investment, and practical needs (perspectives from FHWA, DOTs, national agencies, and other owners welcome)
- Research: current frontiers and gaps relevant to bridge engineering practice

Tentative Outline

The workshop will take place in a half-day format (1:00 – 5:00 PM), followed by committee meetings and an evening reception on July 6, 2026.

1:00 – 2:00 PM	Invited presentations (3 × 20 min) ▪ Başak Bektaş, Workshop Introduction ▪ Carolina Cruz-Neira, PhD, NAE, Executive Director of Institute of Simulation & Training, UCF ▪ Barritt Lovelace, Vice President, UAS/AI/Reality Modeling, Collins Engineering ▪ Chad Brown, Spaceport Chief Strategist, Kennedy Space Center, NASA
2:00 – 2:30 PM	Panel discussion (30 min) Moderator: Sreenivas Alampalli
2:30 – 2:45 PM	IABMAS DT Working Group update & E-Survey, Başak Bektaş (15 min)
2:45 – 3:00 PM	Break
3:00 – 4:00 PM	Breakout sessions (2 parallel groups, 60 min) — see topics below
4:00 – 4:30 PM	15-minute summaries per group
4:30 – 5:00 PM	Discussion for next steps + closing remarks

Breakout Session Topics

Participants will self-select into one of two working groups, each comprising a mix of practitioners, researchers, bridge owners, and industry representatives. Each group will prepare a 10-minute summary for the plenary. Groups are designed to address the most critical gaps identified in the IABMAS Working Group survey and recent literature.

Group A — Definition, Users, and the Bridge Owner Perspective

The survey showed that bridge owners hold widely diverging views on what a digital twin is, ranging from simple 3D visualizations to fully coupled, real-time model-updating systems. This group will work toward a shared, practical definition that is appropriate for bridge management and link that definition to who uses a DT and how.

Focus questions:

- Which stakeholders interact with a bridge DT (owners, inspectors, designers, maintenance teams, regulators), and what does each group need from it in terms of views, outputs, and level of detail?
- What organizational and human-factor barriers (staff changes, digital skills, resistance to workflow changes) most impede adoption, and how can they be addressed?
- What is the minimum set of characteristics (e.g. data, models etc.) that qualifies a system as a Bridge Digital Twin as distinct from a BIM model, a digital shadow, or a conventional BMS?
- How can the BMS and BDT coexist and interoperate? Should the DT replace, extend, or sit alongside the existing BMS?

- How should a DT scale across a bridge network? What is realistic for agencies with large inventories and limited resources?
- Should the community adopt, adapt, or replace the Working Group's proposed definition and what is missing or imprecise?

Group B — Data, Standardization, and Inputs / Outputs

The survey and literature both identify data fragmentation, lack of interoperability, and unclear implementation pathways as primary obstacles. This group will focus on what data a bridge DT needs, how it should be structured and maintained, and what outputs must be delivered to bridge owners to support decision-making.

Focus questions:

- Which data inputs are essential vs. optional and how should sensor data, inspection records, NDE/NDT, load tests, and GIS be prioritized and integrated?
- What role can crowdsensing, drive-by monitoring, and low-cost sensing play in making network-level digital twins economically feasible?
- What outputs does a bridge DT must deliver, and what does actionable intelligence look like for inspection, maintenance, load rating, and lifecycle decisions?
- How should a DT be updated over time continuously, periodically, or event-driven? What triggers a meaningful update for a bridge owner?
- What barriers prevent adoption of open formats (IFC/BrIM, openBIM, DICONDE), and what would it take to overcome them?
- How should a bridge DT handle software licensing, versioning, and long-term platform operability and who is responsible when platforms change?

Expected Outcomes

- A community-endorsed working definition of digital twins for bridge engineering
- A structured set of user requirements and stakeholder interaction models by role
- An inventory of critical data standards, gaps, and interoperability barriers
- A framework for DT inputs, outputs, and decision-support functions aligned with owner needs
- A set of scalable implementation guidelines, including network-level considerations
- Draft contributions to the Working Group white paper on DT standardization for bridges
- Identified next steps, priorities, and standardization bodies to engage (ISO, CEN, TRB, AASHTO, fib)

Workshop Organizing Committee

This workshop is organized by some of the members of the IABMAS Digital Twins Working Group:

- Başak Bektaş (InfraFortis Consulting LLC and Minnesota State University, USA)
- Eva Lantsoght (Universidad San Francisco de Quito, Ecuador and Delft Univ., Netherlands)
- Necati Catbas (University of Central Florida, USA)
- Kamyab Zandi (TIMEZYX, Canada/Sweden)
- Rolando Chacón (UPC, BarcelonaTECH, Spain)
- Alfred Strauss (University of Natural Resources and Life Sciences, Vienna, Austria)
- Eleni Chatzi (ETH, Switzerland)
- Mustafa Gul (University of Alberta, Canada)
- Reed Ellis (Stantec, Canada)