Digital Twins: Driving Better Outcomes Across the Rail and Transit Lifecycle!

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Bentley
Advancing Infrastructure

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Challenges

Aging Infrastructure

Project Complexity

Decarbonization

Siloed Data & Systems

Skilled Labor Shortage

Maximizing Productivity

Shorter Deadlines & Tighter Budgets

Reliability & Safety

Big data, IoT, AI, ML

Virtualization & Simulation

4D / 5D Construction

Predictive Maintenance

Digital Project Delivery

Digital Automation

Opportunities

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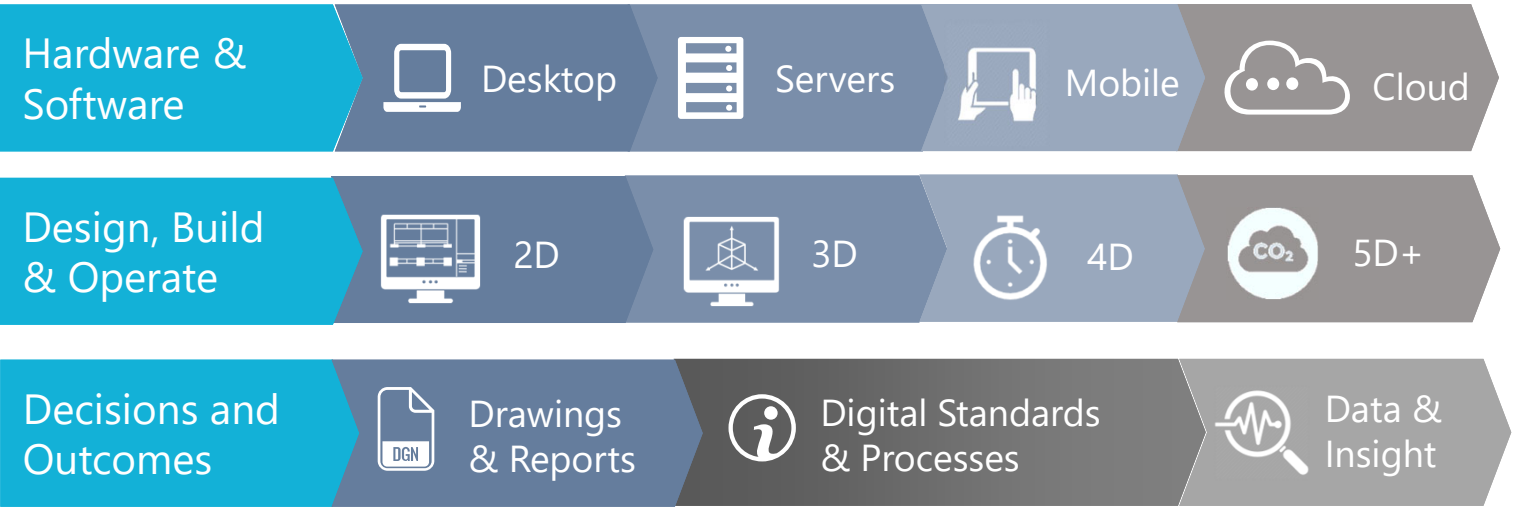

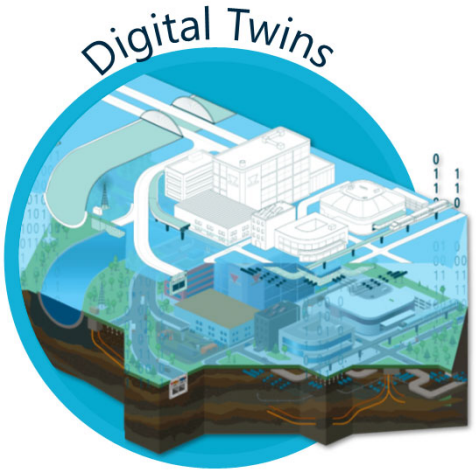

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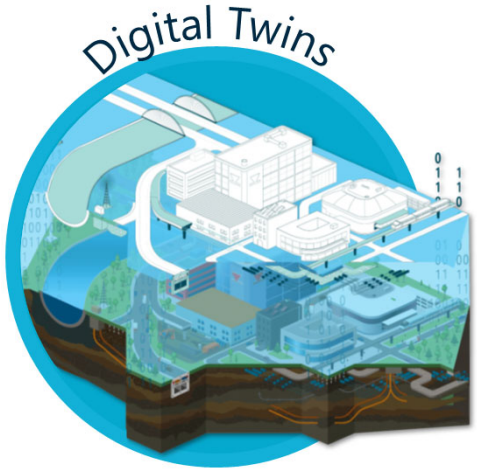
Cloud

5D+

Data & Insight



Digital twins are realistic and dynamic digital representations of physical assets, processes, or systems in the built or natural environment, connecting the physical and digital worlds where the digital dynamically reflects changes in the physical.

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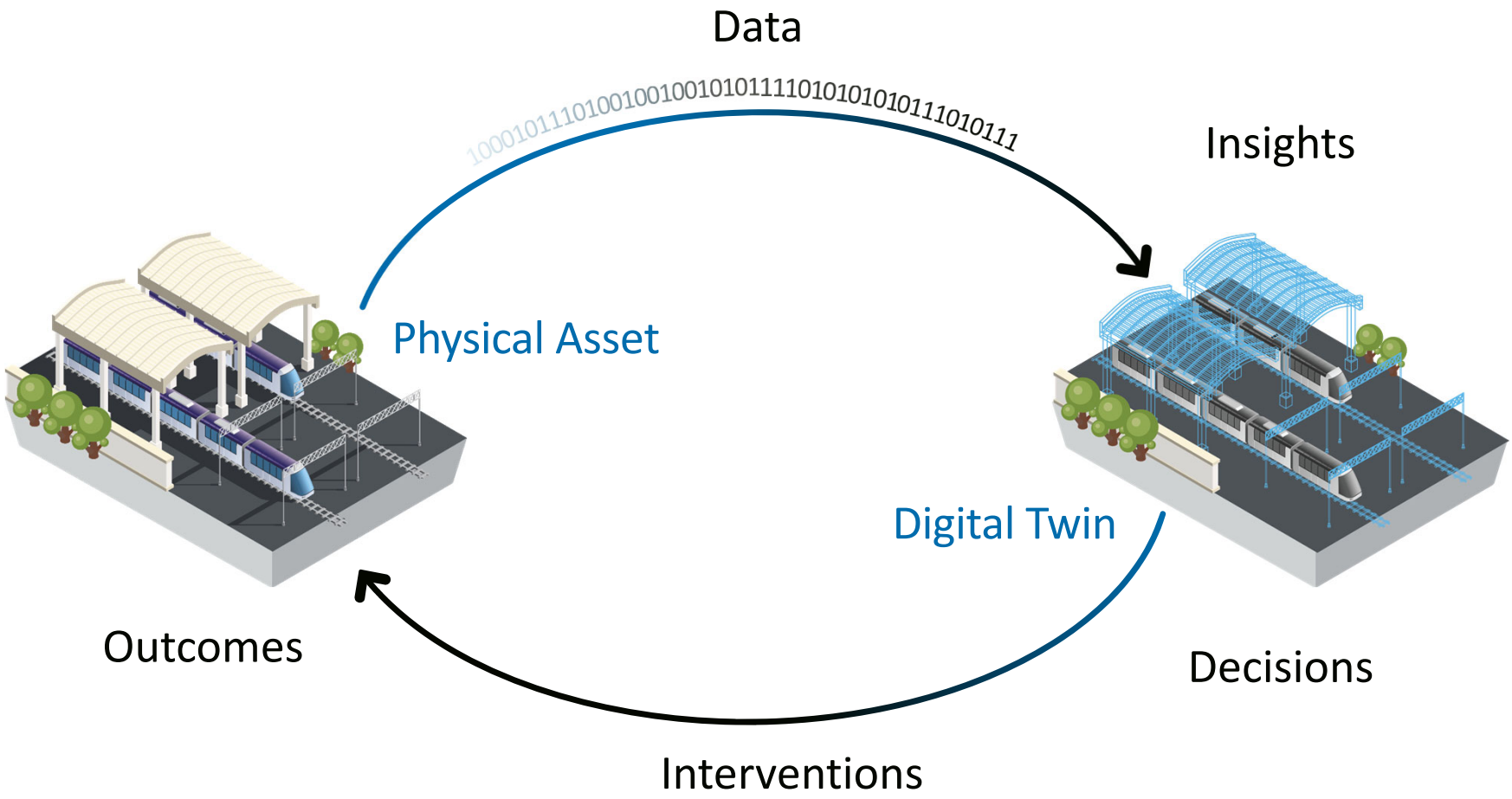

Source: adapted from CDBB

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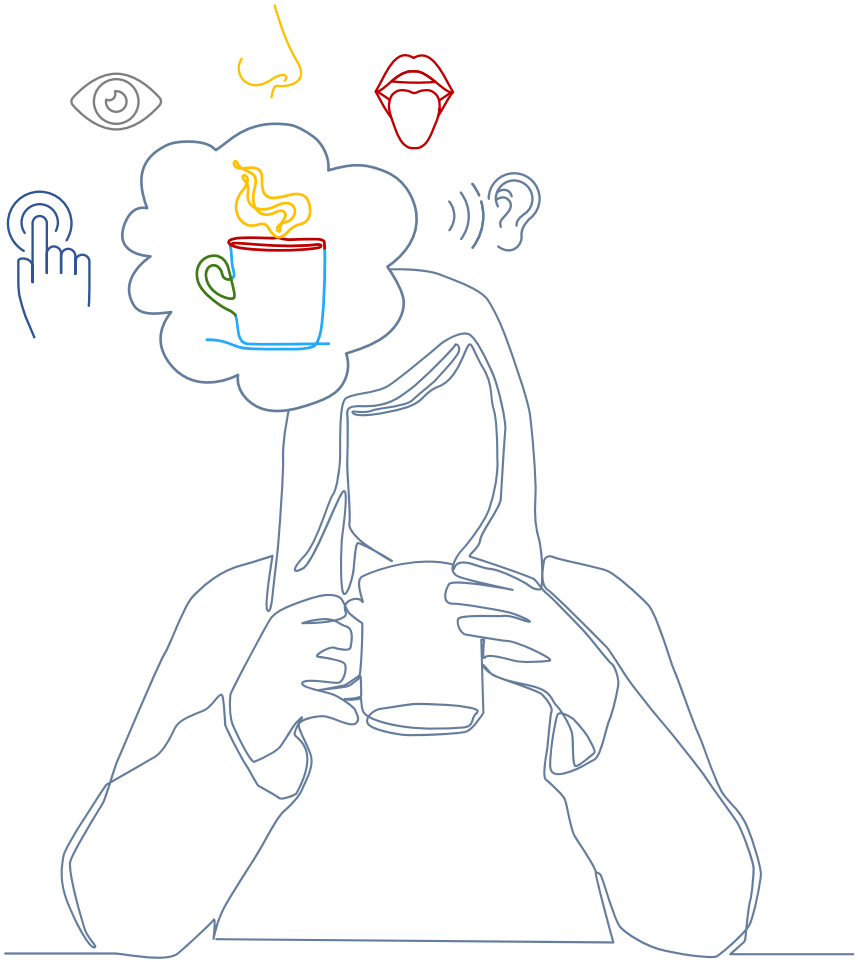

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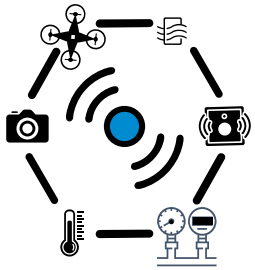
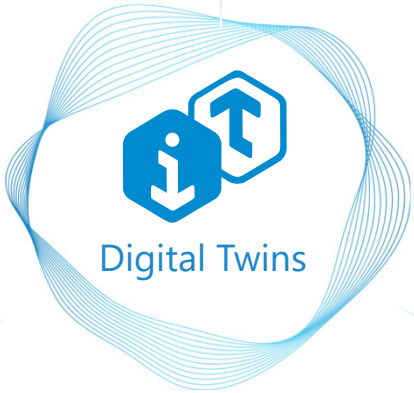
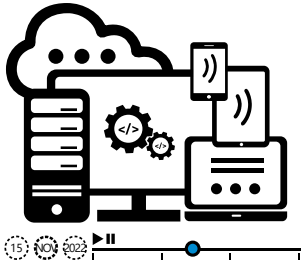
OT Operational Technology



Digital Context

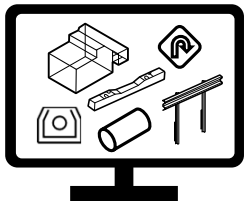


IT Information Technology



Digital Chronology

ET Engineering Technology



Digital Components

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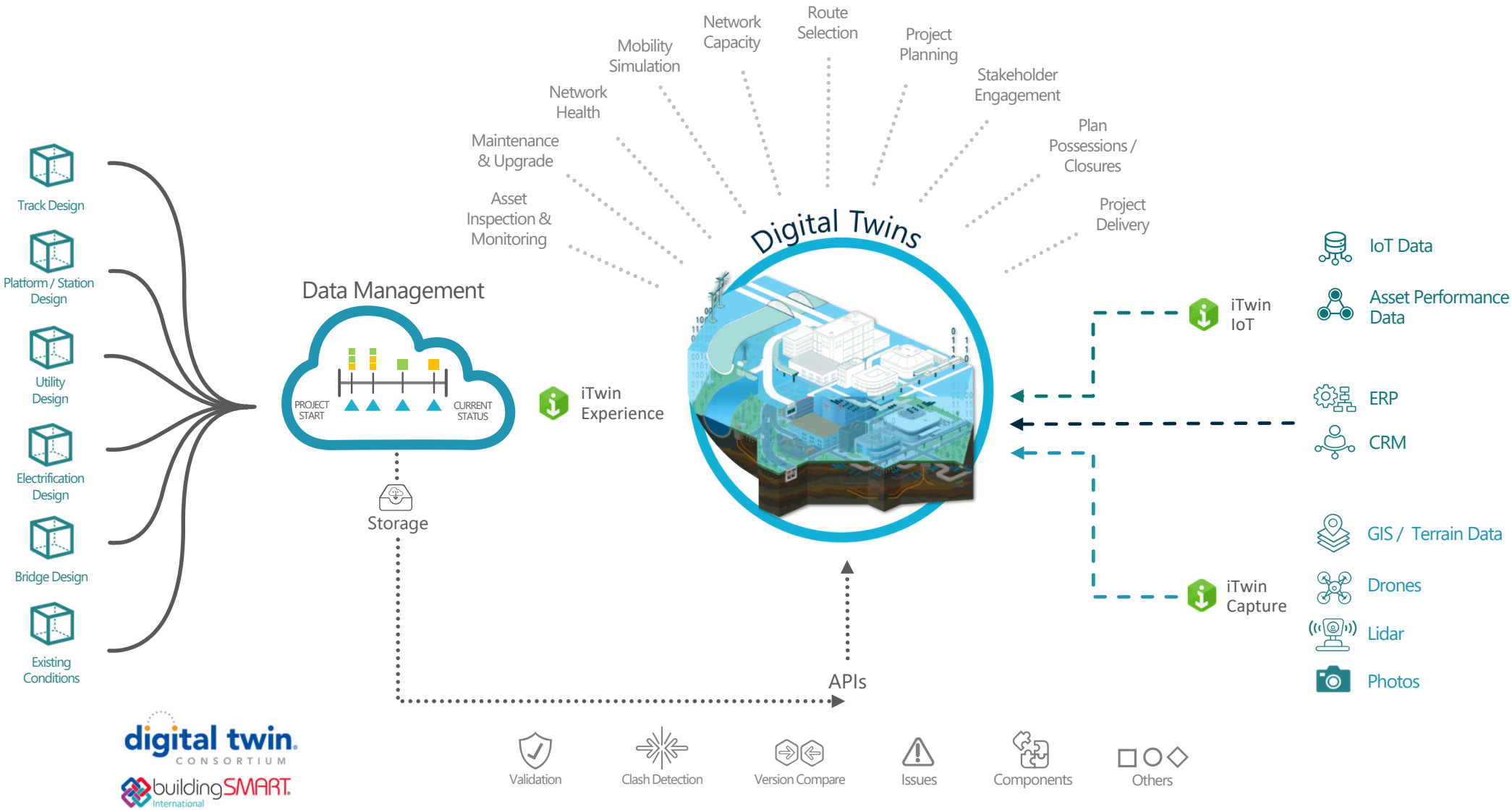

digital twin CONSORTIUM

buildingSMART International

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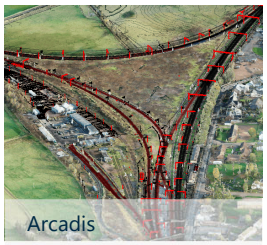
14 2022 Transportation Finalists

The Year in INFRASTRUCTURE and GOING DIGITAL AWARDS

7 Credit Digital Twins

HDR Inc

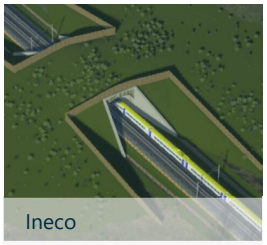

Arcadis

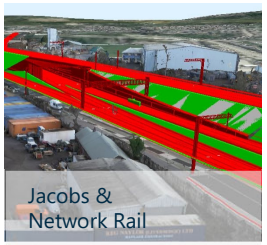
MRT Corp.

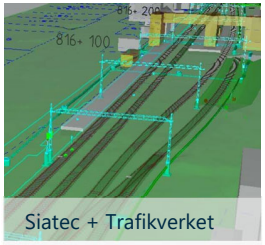
Sweco NL

Oriental Consultants Global

SMRT


Ineco


Jacobs & Network Rail


Siatec + Trafikverket

Arcadis

PT Waskita

Italferr

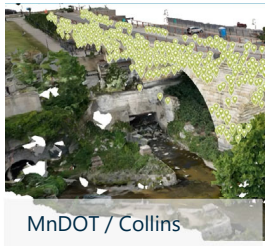
Network Rail

POWERCHINA Huadong

PT Wijaya Karya

MRT Jakarta

Rail Infrastructure Alliance


MnDOT / Collins

DESIGN AND ENGINEERING | CONSTRUCTION | OPERATIONS

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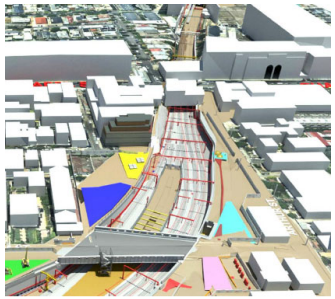
Driving Better Outcomes Across the Asset Lifecycle!

Optimizing Asset Performance
SMRT, Singapore

Real-time Design Review and Approval
Arcadis, Ontario, Canada

4D Construction Planning
Rail Infrastructure Alliance, Melbourne, Australia



Bridge Inspection and Monitoring
Collins Engineers, USA

Operations | Design & Engineering | Construction | Maintenance & Upgrade

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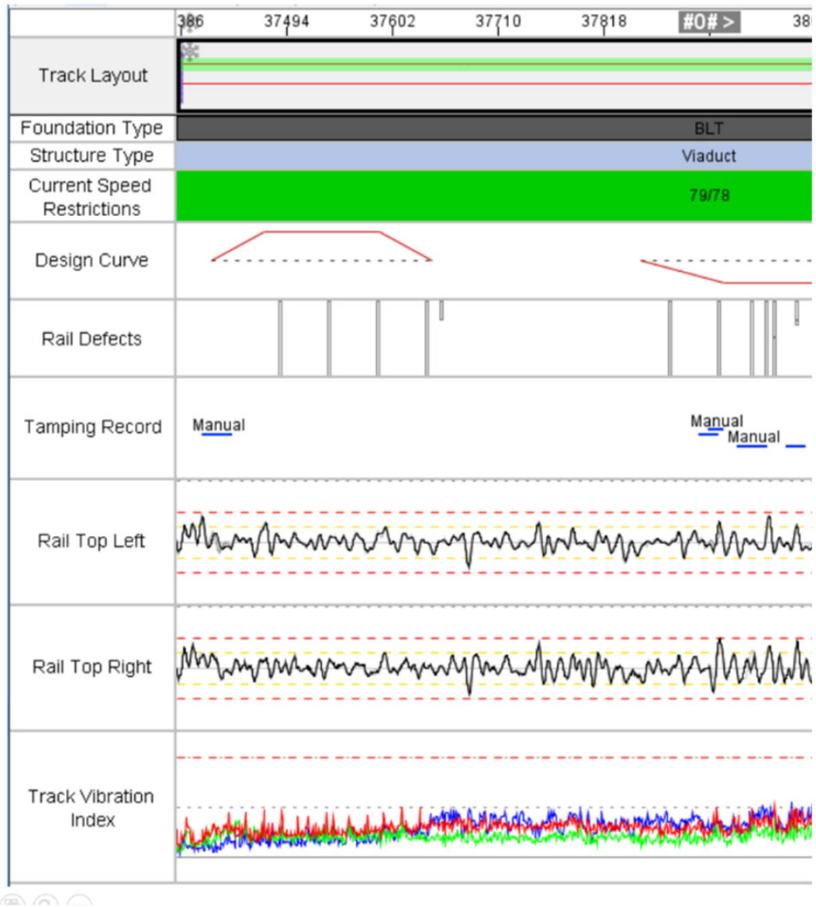
SMRT Trains Improves Rail Reliability Across 281 Km of Track

- Fast Facts:
  - SMRT operates and maintains 4 lines, totaling 281 kilometres, serving 2 million passengers a day
  - Wanted to upgrade inefficient processes and improve maintenance strategy to keep tracks in good state
  - Reliability target of 1 million MKBF across all lines
    - MKBF = Mean Kilometers Between Failure
    - 7,000 times between 5-minute delays

- Improved Outcomes / ROI:
  - Overlay multiple data sources in **seconds not hours**
  - **Double the speed** of data correlation
  - Streamline multiple analyses including cutting time for Route Cause Analysis from **hours to seconds**
  - Cut hundreds of manual planning hours and **save about 20 maintenance train deployments annually**
  - **Optimize maintenance crew capacity** during each shift to ensure **safety and reliability of rail network**



Project Playbook: AssetWise Linear Analytics

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Arcadis Accelerate Design on the Hurontario Light Rail Project

- Fast Facts:
  - 18 kilometer long, CAD$ 13 million project includes 16 LRT stops, 3 large terminus stations, of which one is underground
  - LRT line will bring a new, environmentally friendly and reliable method of transportation to rapidly growing region
  - Will operate in its own dedicated lane ensuring a smooth, reliable and convenient ride along the region's busiest street
  - Complex project needed close cross-discipline collaboration within a team located across six different time zones

- Return on Investment:
  - Semi-automated workflows **significantly reduced modeling time** and **improved visualization**
  - Enabled team **to investigate in real-time and accept design modifications** across the globe
  - **Quadrupled speed of design modifications** as a result of material shortages in Ontario due to pandemic

Project Playbook: MicroStation, OpenBuildings, OpenRail, OpenRoads, ProjectWise

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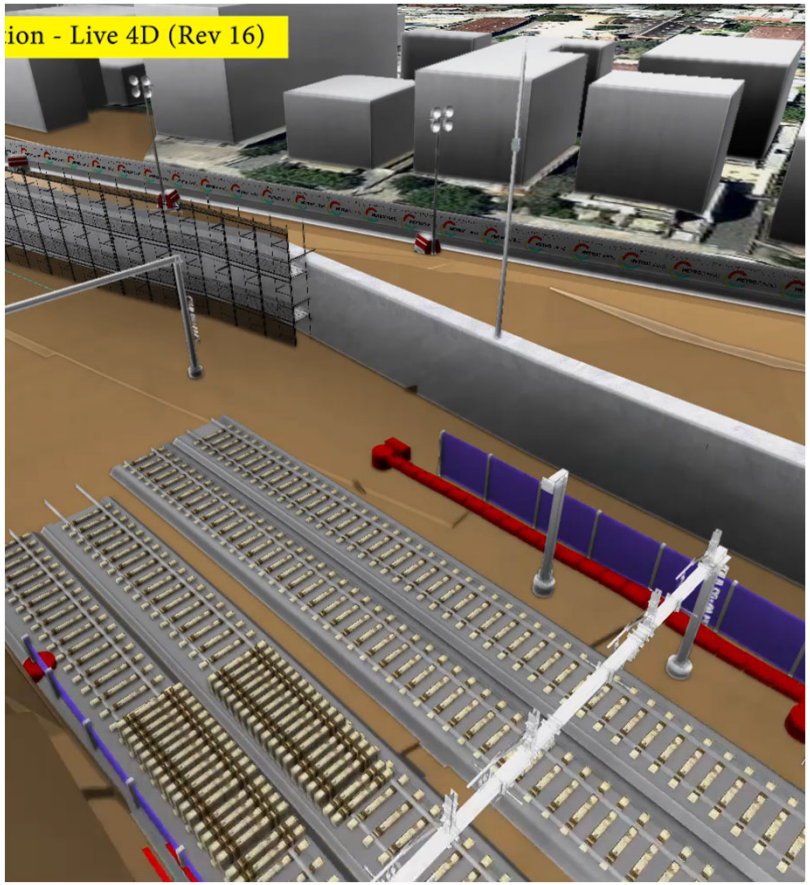
The Rail Infrastructure Alliance Optimizes Delivery of Melbourne's Metro Tunnel

- Fast Facts:
  - Metro Tunnel Project will untangle the City Loop by taking three of Melbourne's busiest train lines through a new tunnel under the city
  - New Sunbury to Cranbourne / Pakenham train line will have twin 9 Kilometre tunnels and 5 new underground stations
  - Major works in densely populated areas, with thousands of residents, commuters and businesses in close proximity

- Improved Outcomes / ROI:
  - 4D animations used to **improve safety for construction teams and broader community** impacted by works
  - 4D modelling **highlighted potential clashes of people, plant and equipment** in the proposed construction program
  - Subcontractors able to provide **feedback on access and sequencing** prior to occupations, **enabling review and optimization**
  - Demonstrated **value of digital twins and 4D construction inspired other organizations** in the region to leverage 4D design



Project Playbook: iModel.js, MicroStation, OpenBuildings Designer, ProjectWise, SYNCHRO 4D, SYNCHRO Field

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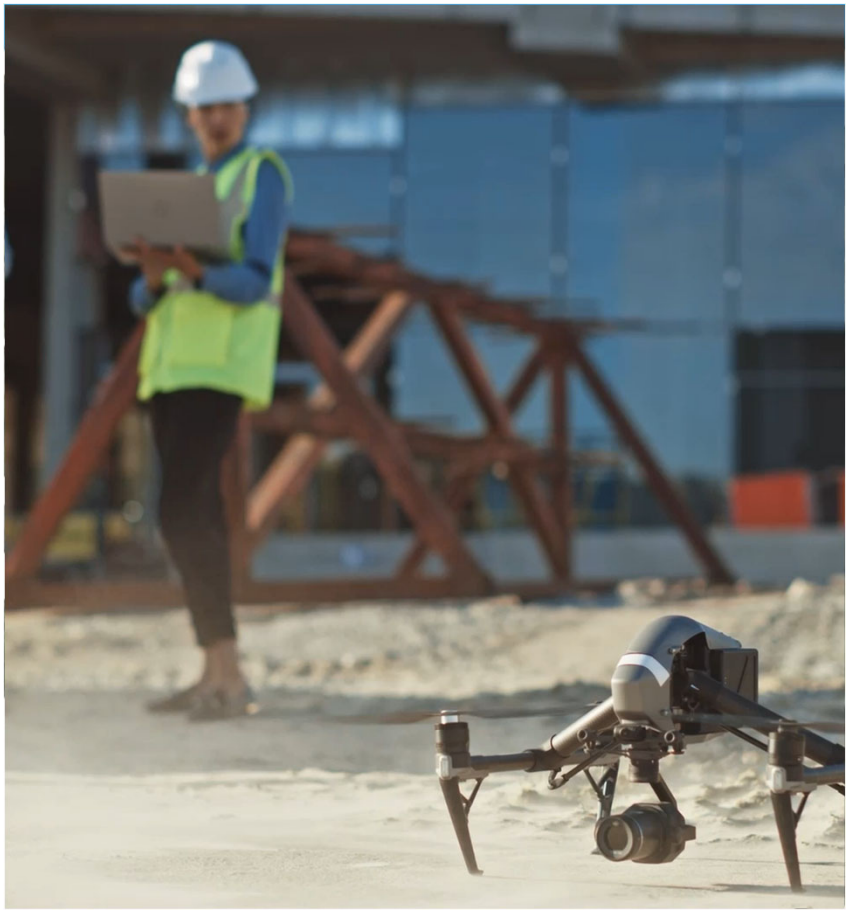
Collins Engineers Advances Bridge Inspection and Monitoring in Minneapolis

- Fast Facts:
  - The Stone Arch Bridge is a former railroad bridge crossing and now a pedestrian pathway in Minneapolis
  - MnDOT hired Collins Engineers to assess and restore the structural integrity of the 140-year-old masonry bridge
  - Leveraging Bentley applications in a mixed reality environment enabled improved collaboration among the team and the public

- Return on Investment:
  - Created **3D model as basis of a digital twin** from 13,000 drone-captured images, **improving quality and quantity of data**
  - Digital twin applications **saved 20% in field inspection time** and **limited bridge closure to just four days**
  - Digital twin solution will **reduce construction risks** that are **expected to save MnDOT 10% to 15% in costs**



Project Playbook: AssetWise Inspections, ContextCapture, MicroStation, ProjectWise

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Driving Better Outcomes Across the Asset Lifecycle!

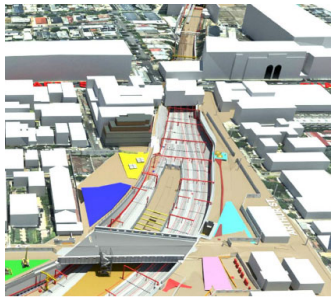
Optimizing Asset Performance
SMRT, Singapore

RCA time cut from **hours to seconds**, and **saved 20 maintenance train deployments** annually

Real-time Design Review and Approval
Arcadis, Ontario, Canada

Accelerated modeling and **real-time approval of design changes** across global team

4D Construction Planning
Rail Infrastructure Alliance, Melbourne, Australia



4D construction schedule **eliminated potential clashes**, **improved safety,** and **reduced costs**

Digital Bridge Inspection and Rehabilitation
Collins Engineers, USA

Digital twin applications **saved 20% in field inspection time** and expected to **save MnDOT 10 to 15% in construction costs**

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INFRASTRUCTURE VALUE CHAIN
(Transportation)

Outcomes

Empower sustainable development goals, resilient infrastructure and predictable results

Solutions & Blueprints

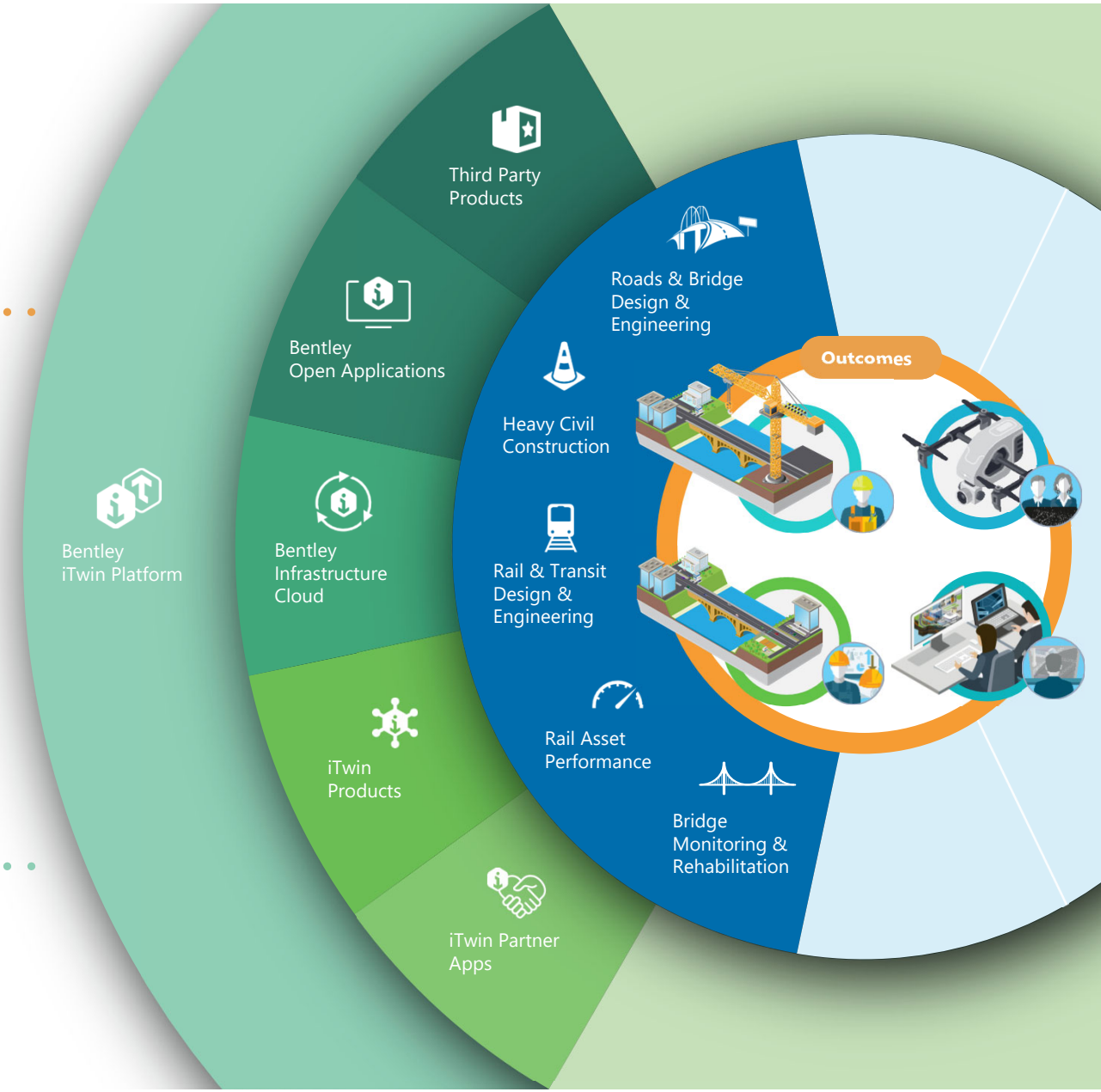
Deliver defined outcomes based on industry best practices and Bentley expertise

Products & People

Enable teams to **collaborate** throughout the entire infrastructure lifecycle and value chain

Digital Twin Platform

Create and leverage digital twins in design, construction, and operations workflows



Global Top 100 Software Company

FOCUSED ON INFRASTRUCTURE ENGINEERING

39
years in operation

>5,200
colleagues in 40 countries

>1,400
colleagues with doctoral and master's degrees

87%
colleagues recommend as a place to work

~$1.1B
annual revenue

>194
countries where BSY solutions are in use

$664M
in R&D in past 3 years

290
patents granted or pending

72%
Bentley Infrastructure Top 500 Owners

93%
ENR Top 250 Engineering Firms

BSY Nasdaq Listed
initial public offering September 2020

SUSTAINABLE DEVELOPMENT GOALS
advancing sustainable infrastructure

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By going digital and leveraging data, the rail and transit industry is building better infrastructure and building infrastructure better
Bentley