Bentley®

Advancing Infrastructure

Asset Management Strategic Direction – Beyond BIM

Frederik Boersma, Utilities Solutions Director, Bentley Systems

Bentley® Advancing Infrastructure

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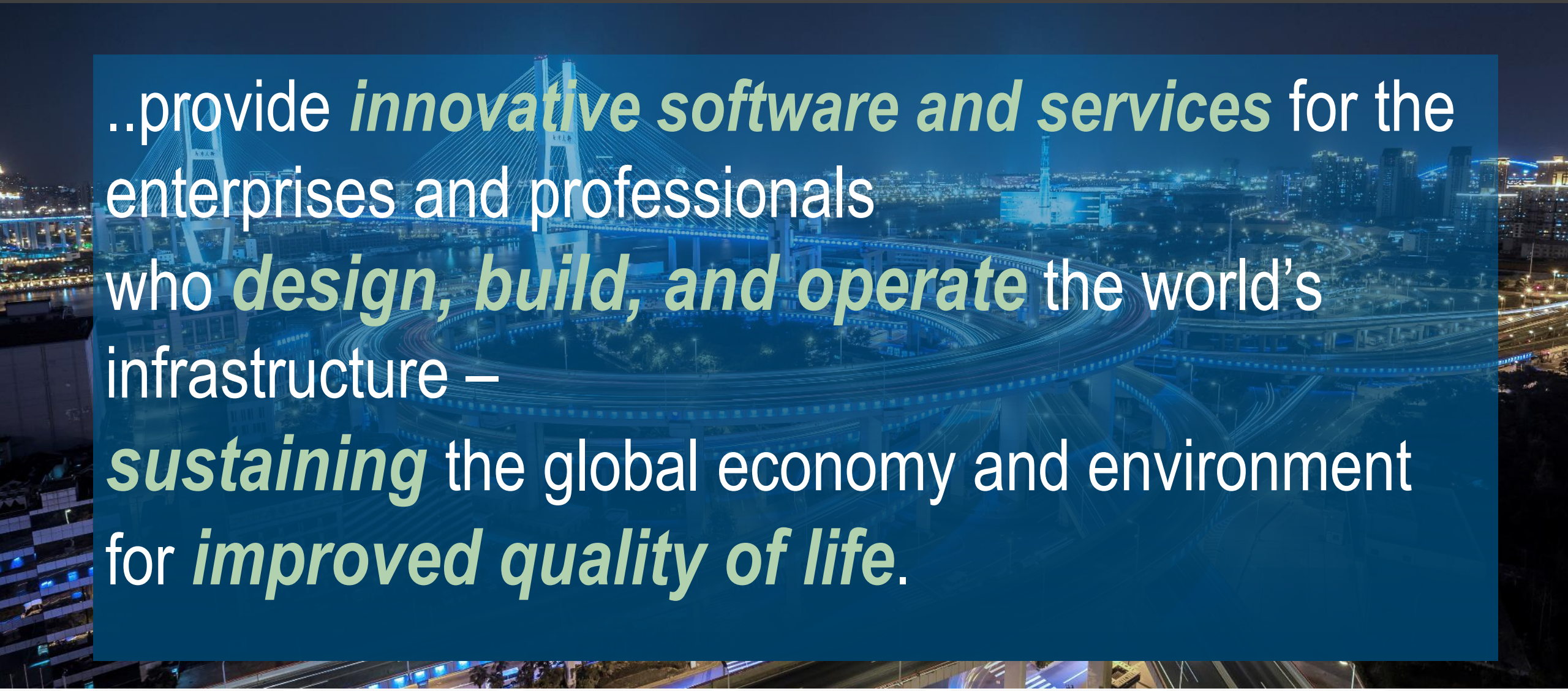
Bentley's mission is to provide ***innovative software and services*** for the enterprises and professionals who ***design, build, and operate*** the world's infrastructure – ***sustaining*** the global economy and environment for ***improved quality of life***.



..provide ***innovative software and services*** for the enterprises and professionals who ***design, build, and operate*** the world's infrastructure – ***sustaining*** the global economy and environment for ***improved quality of life***.

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Bentley is Infrastructure

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NAVIGATOR | MOBILE APPS: Bentley Map Mobile | ProjectWise WorkSite | Field Supervisor | Navigator Mobile | InspectTech Collector Mobile | ProjectWise Explorer Mobile | ...
BENTLEY'S PROJECT PLAYBOOKS
CAMPUSES
• Bentley Map
• AECOsim
• Descartes
• RAM
• STAAD
• GEOPAK
• InRoads
• MXROAD
• gINT
• SITEOPS
MINING
• MineCycle
• OpenPlant
• AssetWise APM
• Amulet
• STAAD
• Promis.e
• Bentley Map
• Descartes
• Acute3D
• InRoads
• GEOPAK
• gINT
WATER & WASTEWATER
• WaterGEMS
• SewerGEMS
• OpenPlant
• AutoPLANT
• STAAD
• RAM
• OpenPlant Support Engineering
• gINT
• OpenUtilities
• Subsurface Utilities Engineering
CITIES
• Bentley Map
• Descartes
• InRoads
• AECOsim
• GEOPAK
• Subsurface Utilities Engineering
• SITEOPS
• Acute3D
NUCLEAR POWER
• AutoPIPE
• OpenPlant
• STAAD
• AssetWise APM
• Acute3D
COMMUNICATIONS NETWORKS
• OpenUtilities
• Bentley Fiber
• Bentley Coax
• Bentley Map Mobile
• Bentley Inside Plant
ROADS
• InRoads
• GEOPAK
• MXROAD
• LEAP Bridge Steel
• RM Bridge
• gINT
• InspectTech
• SUPERLOAD
• Exor
• Descartes
• SITEOPS
BRIDGES
• RM Bridge
• LEAP Bridge Steel
• InspectTech
• SUPERLOAD
• GEOPAK
• InRoads
• MXROAD
• gINT
• ProStructures
BUILDINGS
• AECOsim
• RAM
• STAAD
• ProStructures
• Hevacomp
• speedikon
• gINT
• Subsurface Utilities Engineering
• SITEOPS
POWER PLANTS
• OpenPlant
• AutoPLANT
• AutoPIPE
• Promis.e
• STAAD
• ProStructures
• OpenPlant Support Engineering
• AECOsim
• AssetWise APM
• gINT
• Descartes
• Acute3D
• GEOPAK
• InRoads
• Amulet
SUBSURFACE UTILITIES
• OpenUtilities
• WaterGEMS
• SewerGEMS
• Exor
• GEOPAK
• InRoads
• MXROAD
• gINT
• Subsurface Utilities Engineering
CONSTRUCTION
• Navigator
• ConstructSim
• PW Construction Work Package Server
• ProStructures
• Field Supervisor App
• AECOsim
• Descartes
• InRoads
PROCESS PLANTS
• OpenPlant
• AutoPLANT
• AutoPIPE
• OpenPlant Support Engineering
• Promis.e
• ProStructures
• STAAD
• AssetWise APM
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• GEOPAK
• InRoads
• SITEOPS
• Acute3D
UTILITY NETWORKS
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• Substation
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• SewerGEMS
• STAAD
• Descartes
• AssetWise APM
• Amulet
• Acute3D
RAIL & TRANSIT
• Bentley Rail Track
• Optram
• GEOPAK
• InRoads
• MXROAD
• RM Bridge
• LEAP Bridge Steel
• gINT
• Promis.e
WIND FARMS
• SACS
• MOSES
• MAXSURF
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• OpenPlant
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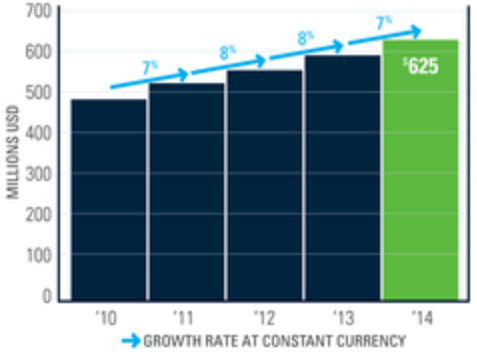
• Acute3D
OFFSHORE STRUCTURES
• SACS
• MOSES
• MAXSURF
• AutoPIPE
• ProSteel
• ConstructSim
• OpenPlant
• AssetWise APM
• Acute3D
• Amulet
New Products
BENTLEY'S COMMON PLATFORM: MICROSTATION | PROJECTWISE | ASSETWISE
Bentley
Bentley's 2014 Annual Report | 2

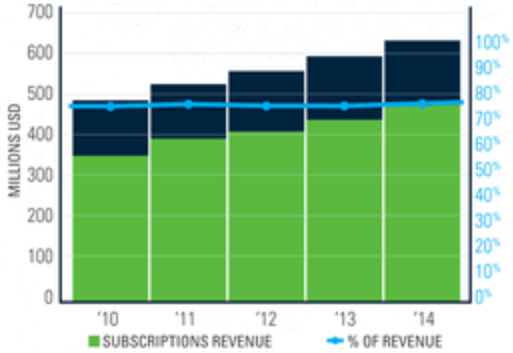
PERFORMANCE HIGHLIGHTS

- **Historical revenue grew 7%** (in constant currency), **with 7% organic revenue growth**
- Revenue growth led by **Middle East and Africa, Southeast Asia, Greater China, and India**
- **Subscriptions revenue** (as % of total) **grew to 76%**
- The number of **Enterprise License Subscriptions grew to 285 accounts, contributing 26% of revenue**
- **Subscription revenue retention** exceeded **97%**
- **Operating cash flow** continues to exceed **$100 million** annually
- Since 2008, **over $1 billion invested in R&D and acquisitions**

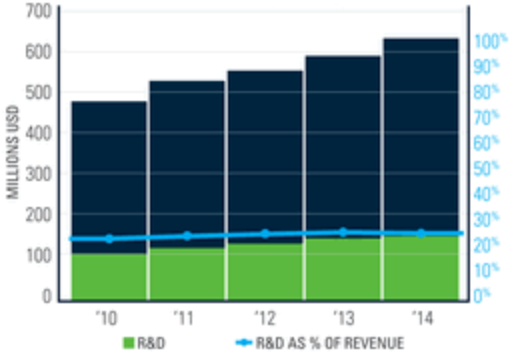
HISTORICAL REVENUE*



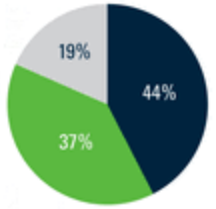
SUBSCRIPTIONS REVENUE



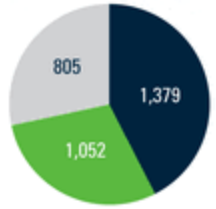
R&D INVESTMENT



REVENUE



COLLEAGUES



ASIA EUROPE, MIDDLE EAST, AFRICA AMERICAS

*Historical revenues are unaudited and presented on a basis that consistently records subscriptions ratably, licenses as booked, and services as delivered.

MARKET RESEARCH

MicroStation

Information Modeling

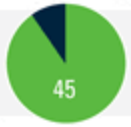
Bentley's *MicroStation* applications subscribers among *ENR Top Design Firms*

*Combined 2014 ENR Top 500 Design Firms and ENR Top 150 Global Design Firms, with duplicates removed

ProjectWise

Integrated Projects

Bentley's *ProjectWise* subscribers among *ENR Top Design Firms*



Bentley INFRASTRUCTURE 500 TOP OWNERS

Bentley Infrastructure 500

A ranking of the ***world's top owners of infrastructure*** published annually

www.bentley.com/500

AssetWise

Intelligent Infrastructure

Bentley's *AssetWise* subscribers among *Bentley Infrastructure 500* Top Owners

ARC Advisory Group

www.arcweb.com

ARC Advisory Group Market Research Study* as reported Septembe

"Engineering Design Tools for Plants and Infrastructure"

- #1 *For EPC (Engineering, Procurement, and Construction) and AEC (Architecture, Engineering, and Construction)*
- #1 *Software on Demand*
- #1 *Software as a Service*
- #1 *Electric Power G*
- #1 *Electric Power Transmission, Di & Communicatio*
- #1 *Mining and Meta*
- #1 *Water Distributio Wastewater Colle*

ARC Research Study as reported October 12, 2014

"Geographic Information Systems"

- #1 *Software as a Service*

Beyond BIM

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Source: http://miltoncontact.co.uk/bim

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Building information modeling

From Wikipedia, the free encyclopedia

This article is about Building information modeling. For other uses, see Bim (disambiguation).

Building information modeling (**BIM**) is a process involving the generation and management of digital

BIM software is used by individuals, businesses and government agencies who plan, design, construct, operate and maintain diverse physical infrastructures, such as water, refuse, electricity, gas, communication utilities, roads, bridges, ports, tunnels, etc.

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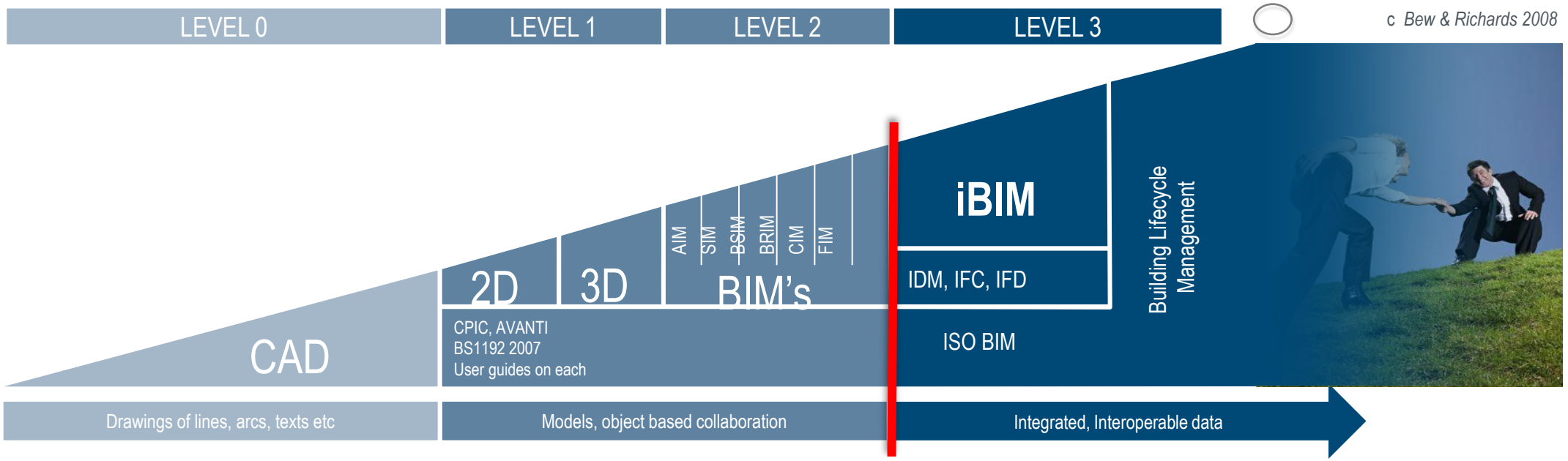

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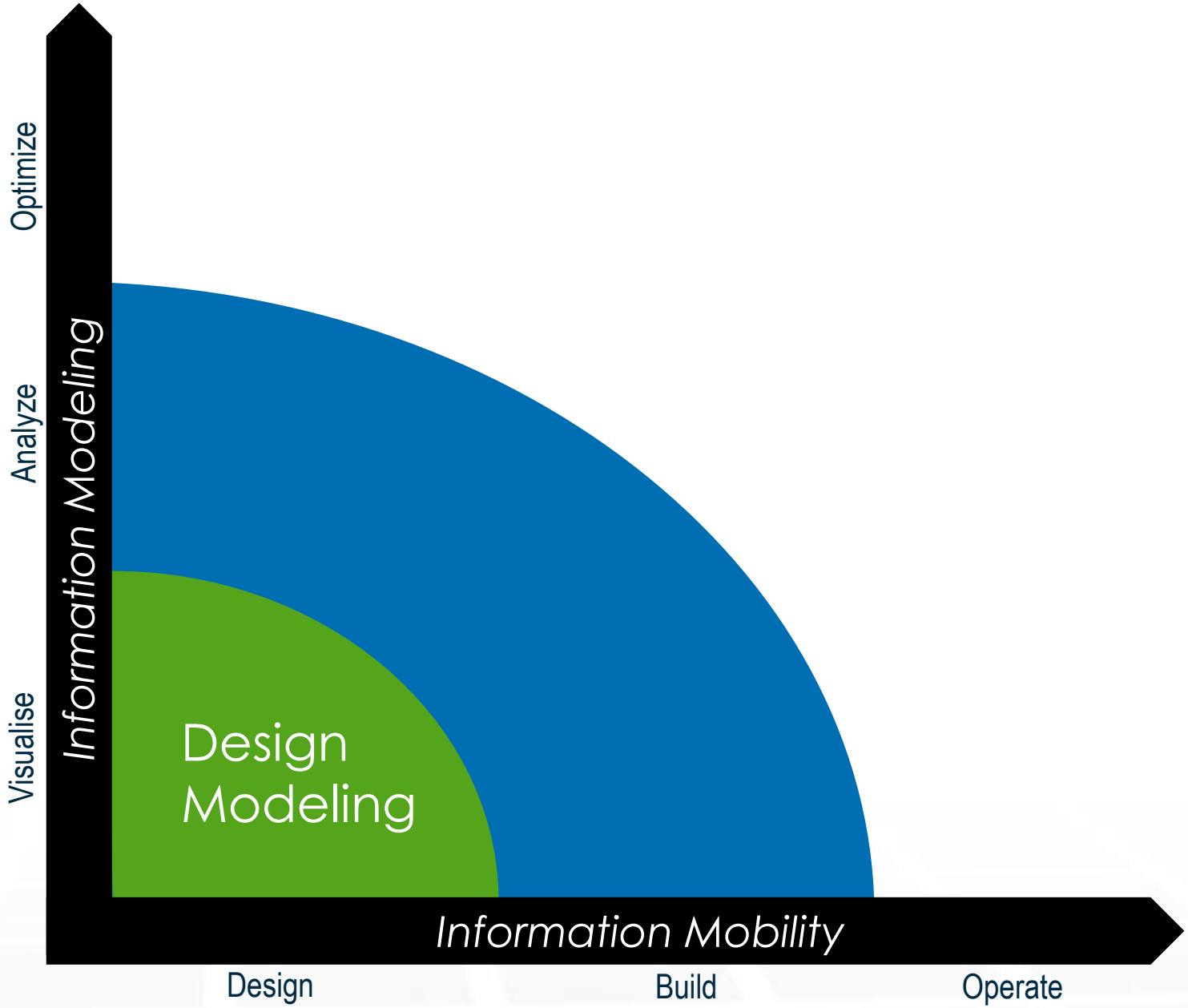
Since 1984

ProjectWise

MicroStation



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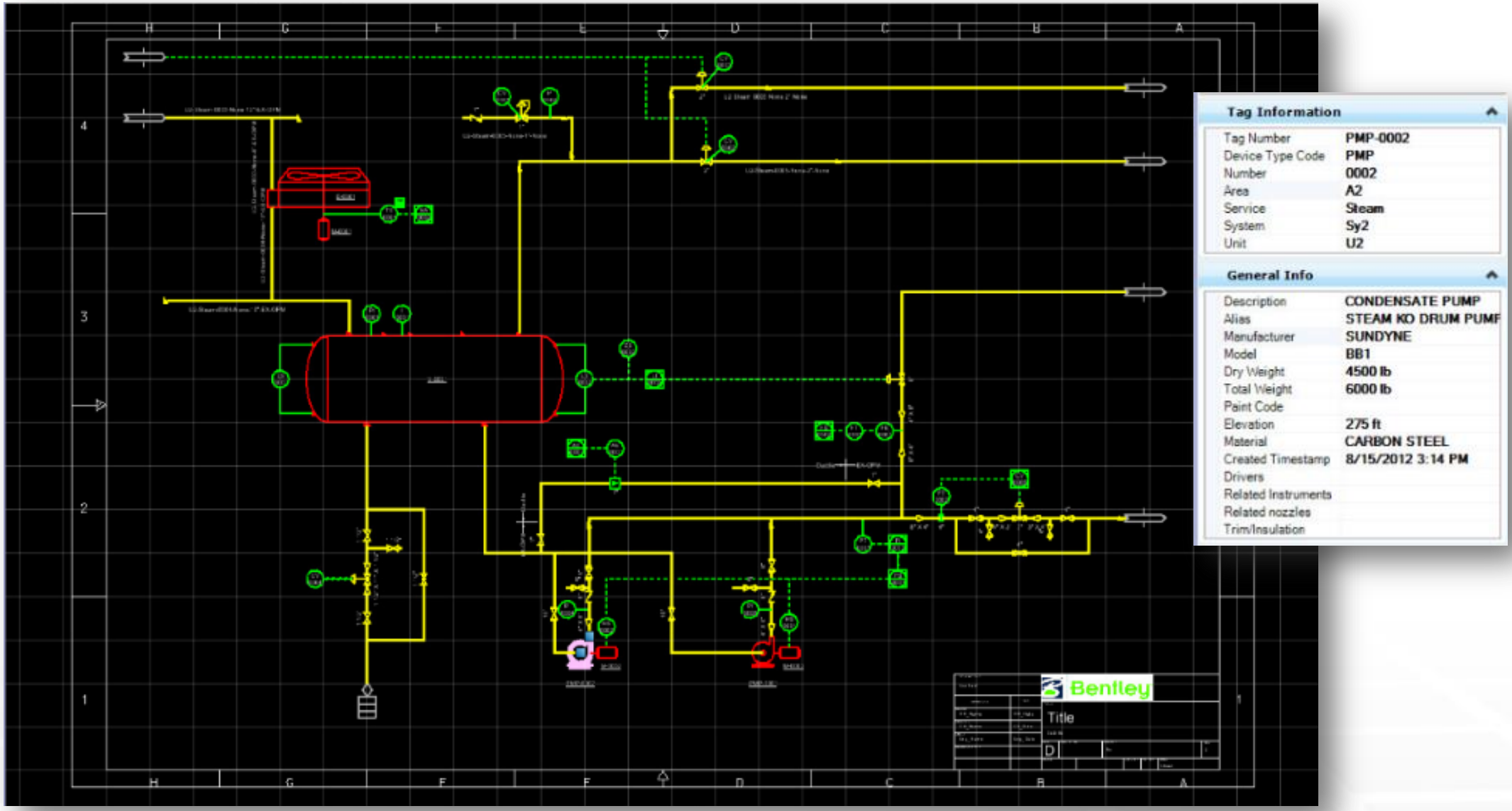
2D: Intelligent P&ID's



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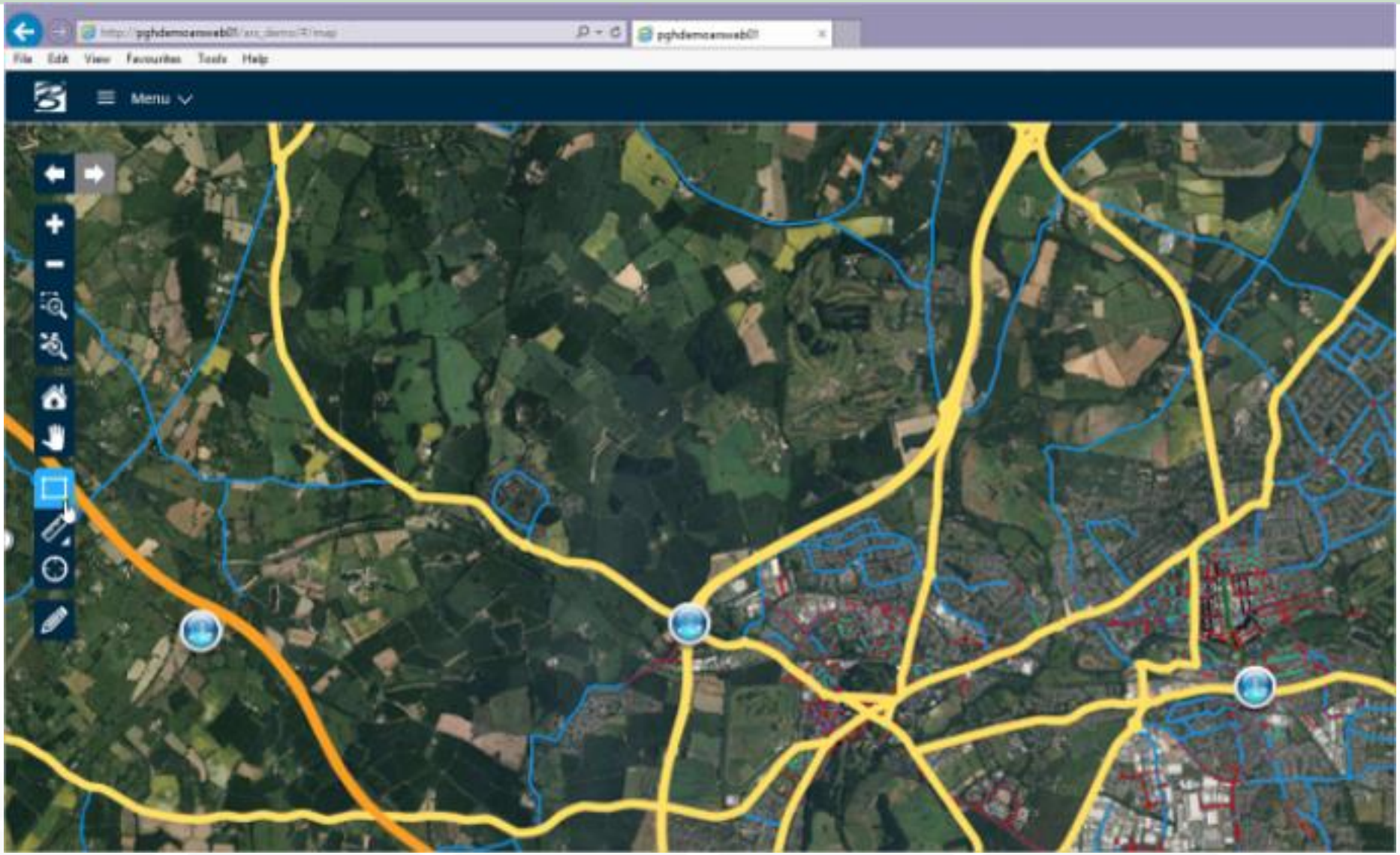
Spatial aspects of Assets



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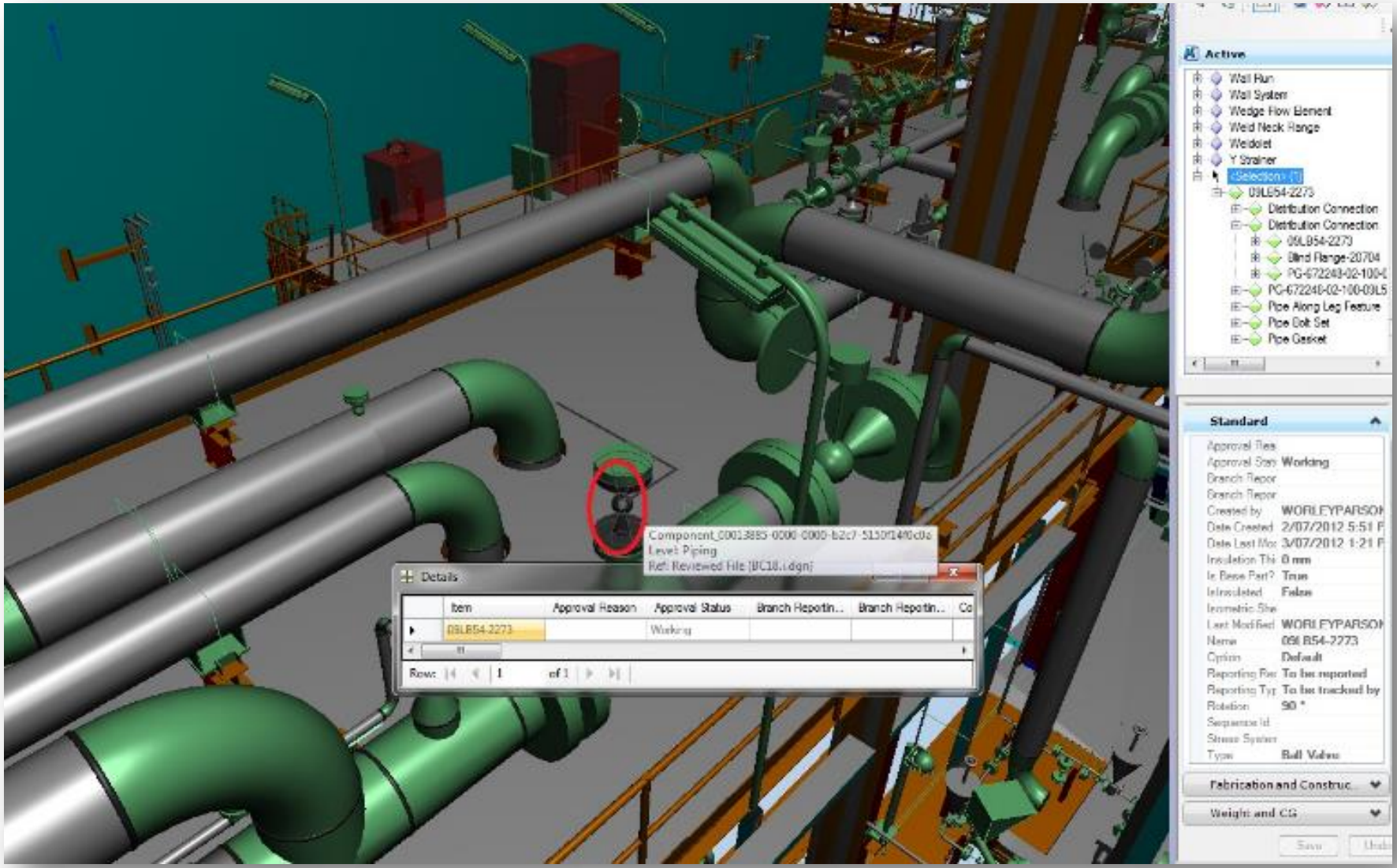
3D: Intelligent Models



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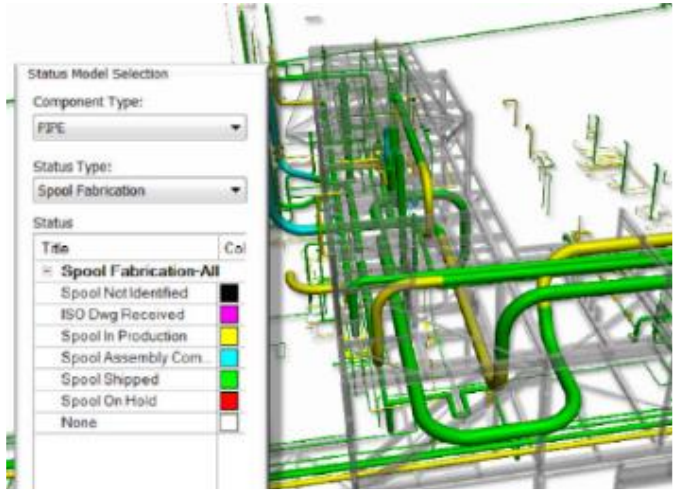
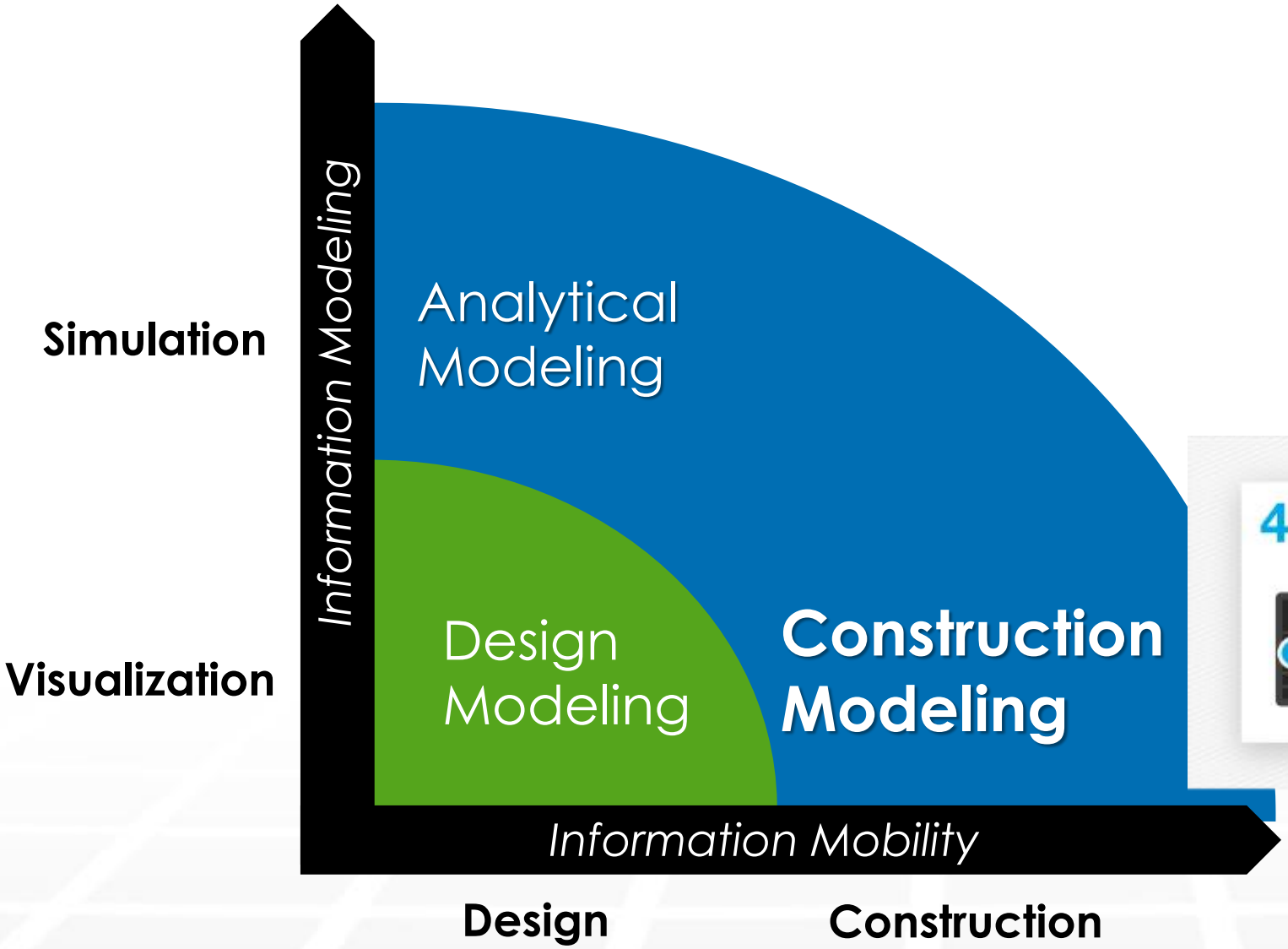
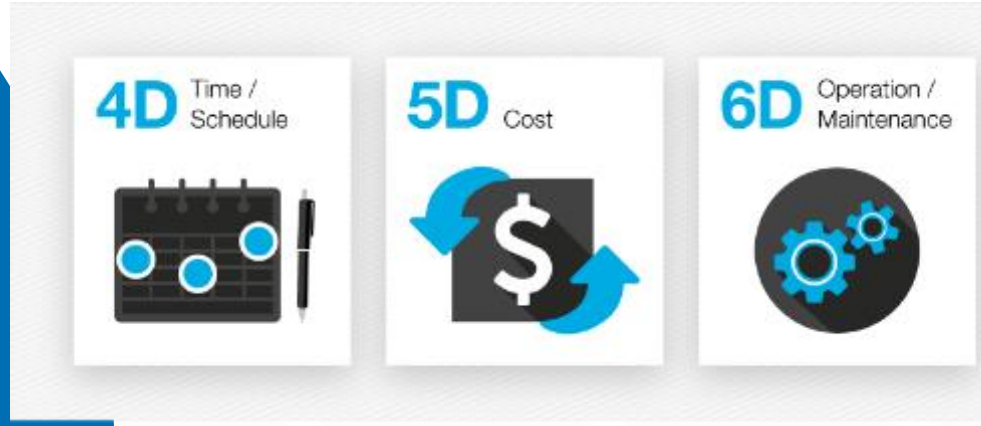
BIM Level 2







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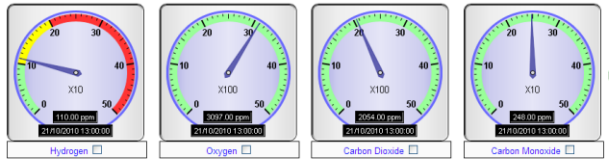
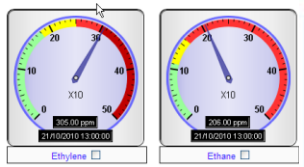
BIM Level 3

Operations





6D
(Building Lifecycle Information)

eLibrary:
- Who?
- When?
- Where?
- How much?

Reaction

Simulation

Visualization

Information Modeling

Asset Performance

Analytical Modeling

Design Modeling

Construction Modeling

Information Mobility

Design

Construction

Operations

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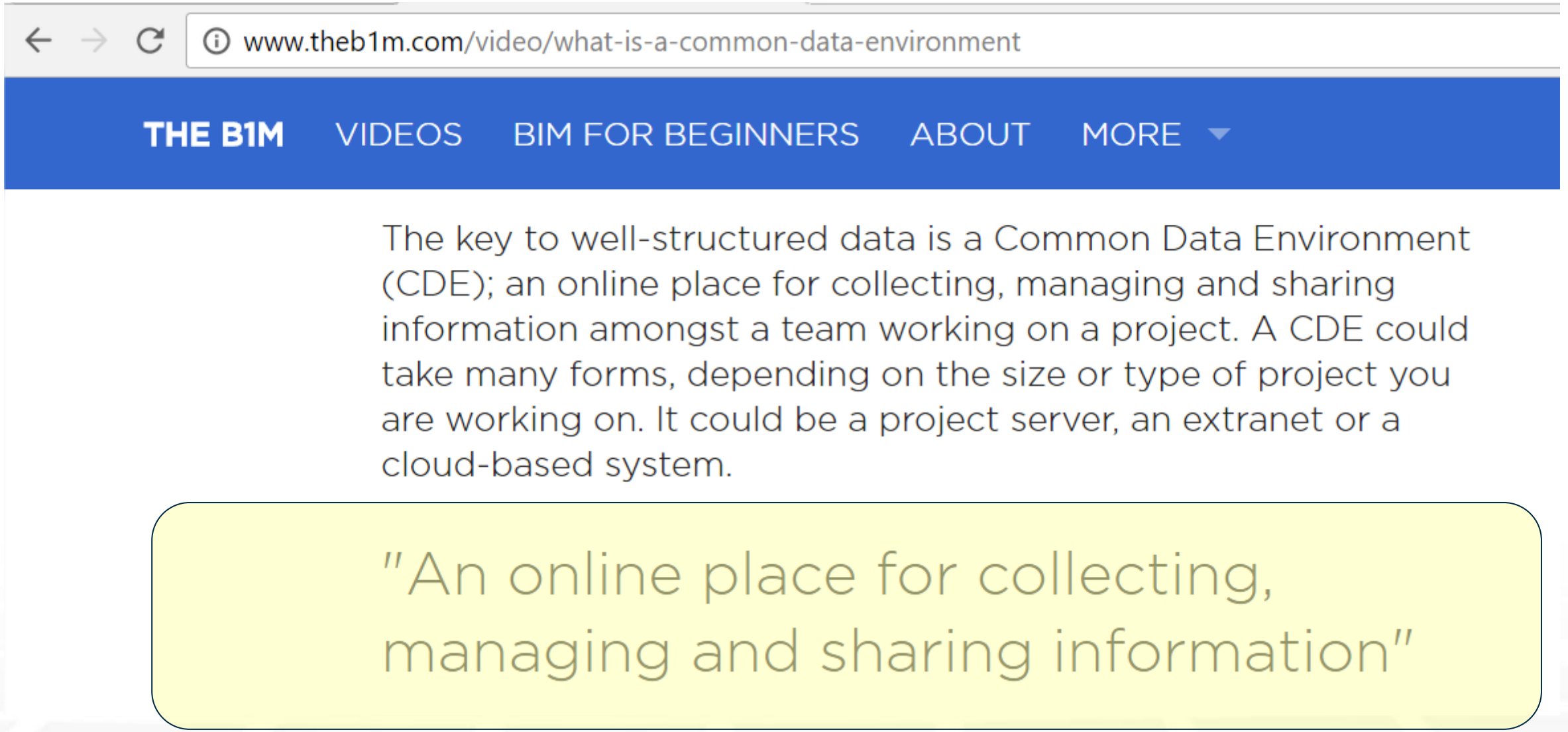
Common Data Environment



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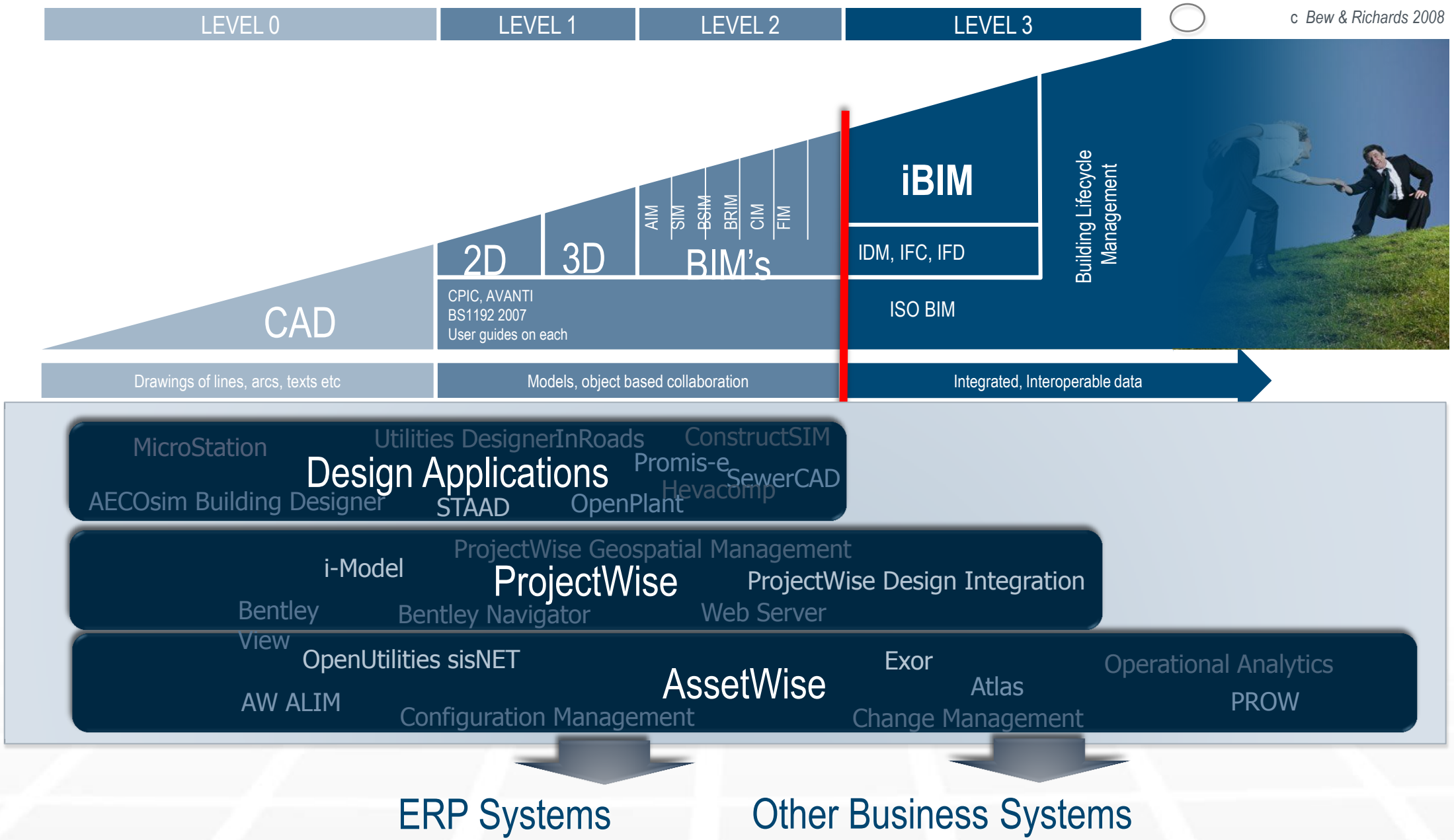

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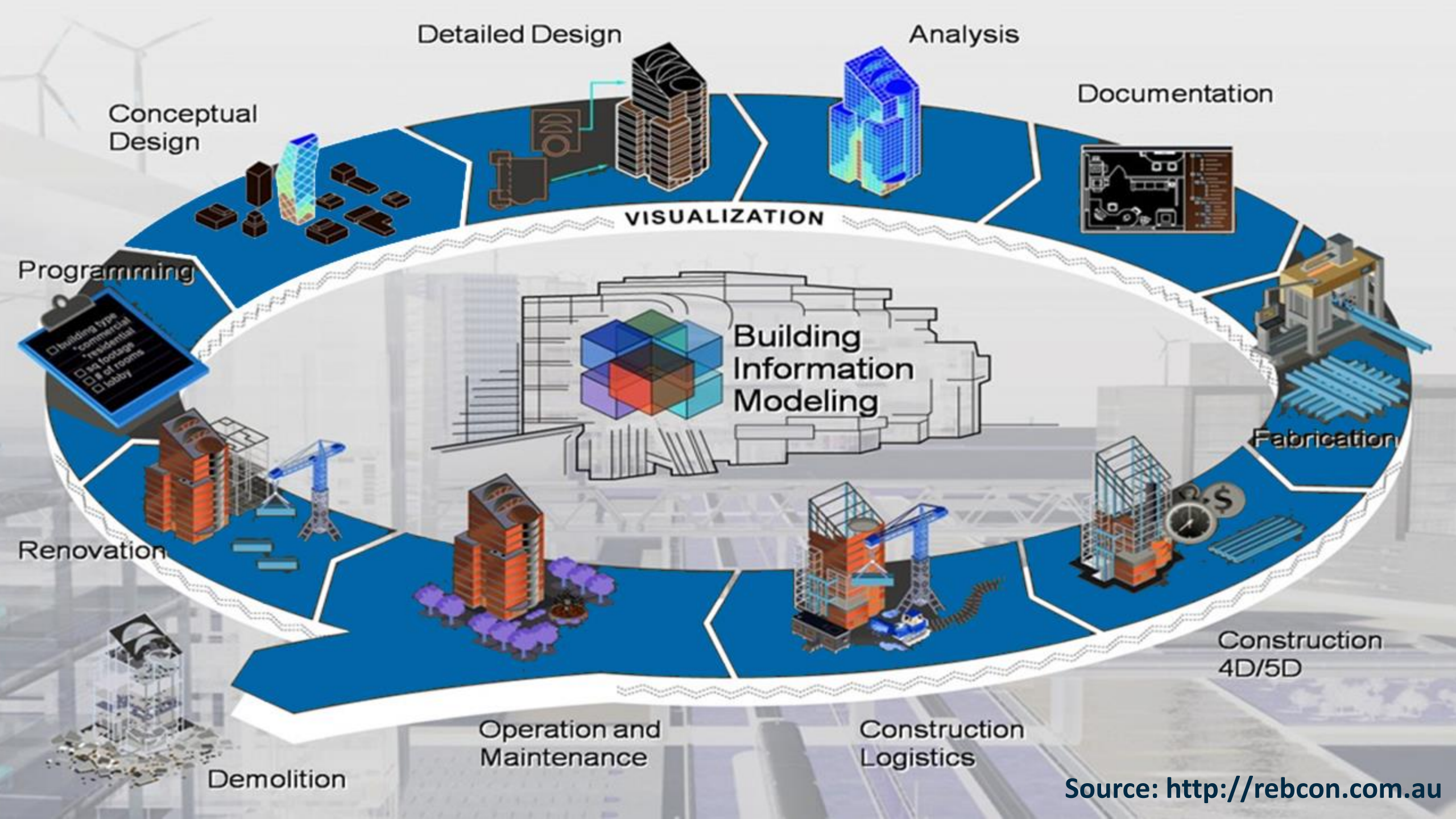
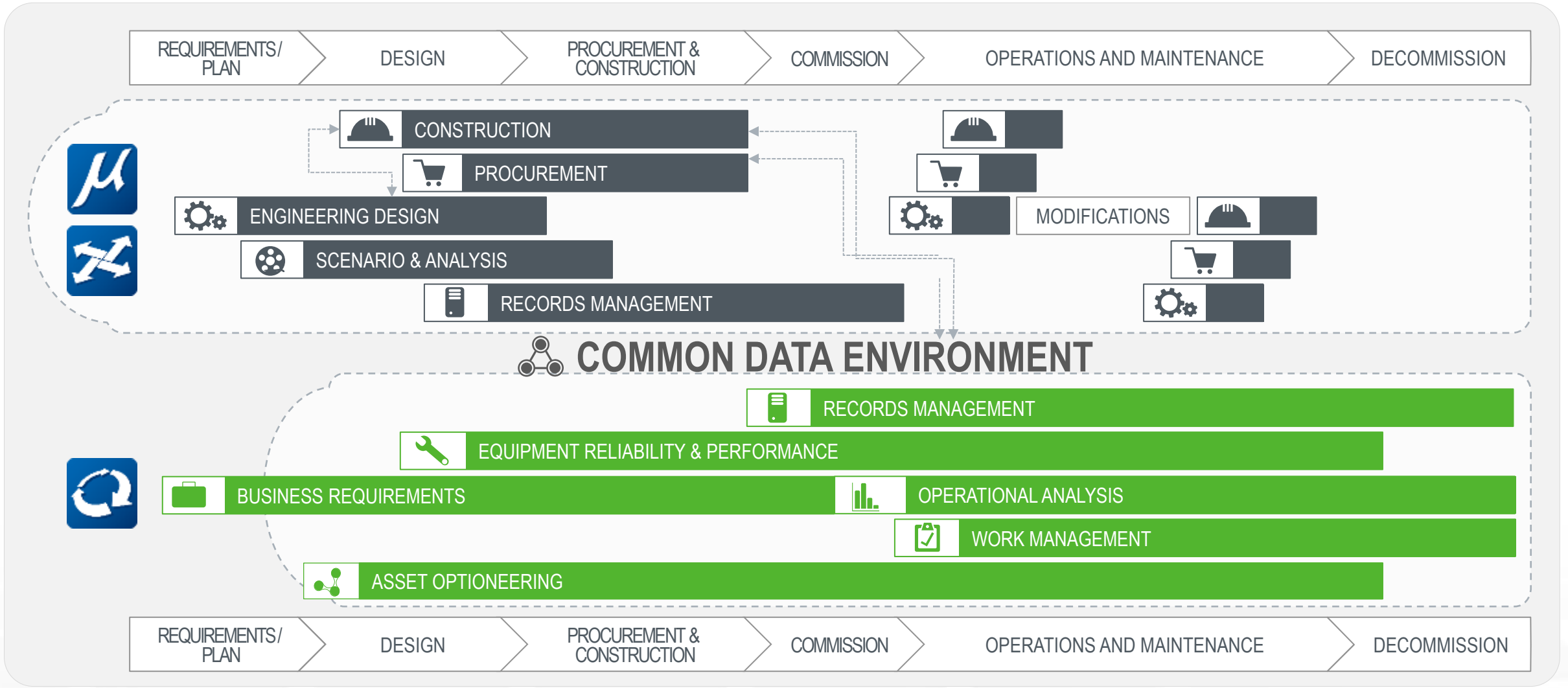

Detailed Design
Analysis
Conceptual Design
Documentation
VISUALIZATION
Programming
Building Information Modeling
Fabrication
Renovation
Construction 4D/5D
Operation and Maintenance
Construction Logistics
Demolition
Source: http://rebcon.com.au

ProjectWise and AssetWise spanning Lifecycle



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Tools for improving Asset's Lifecycle – costs and quality

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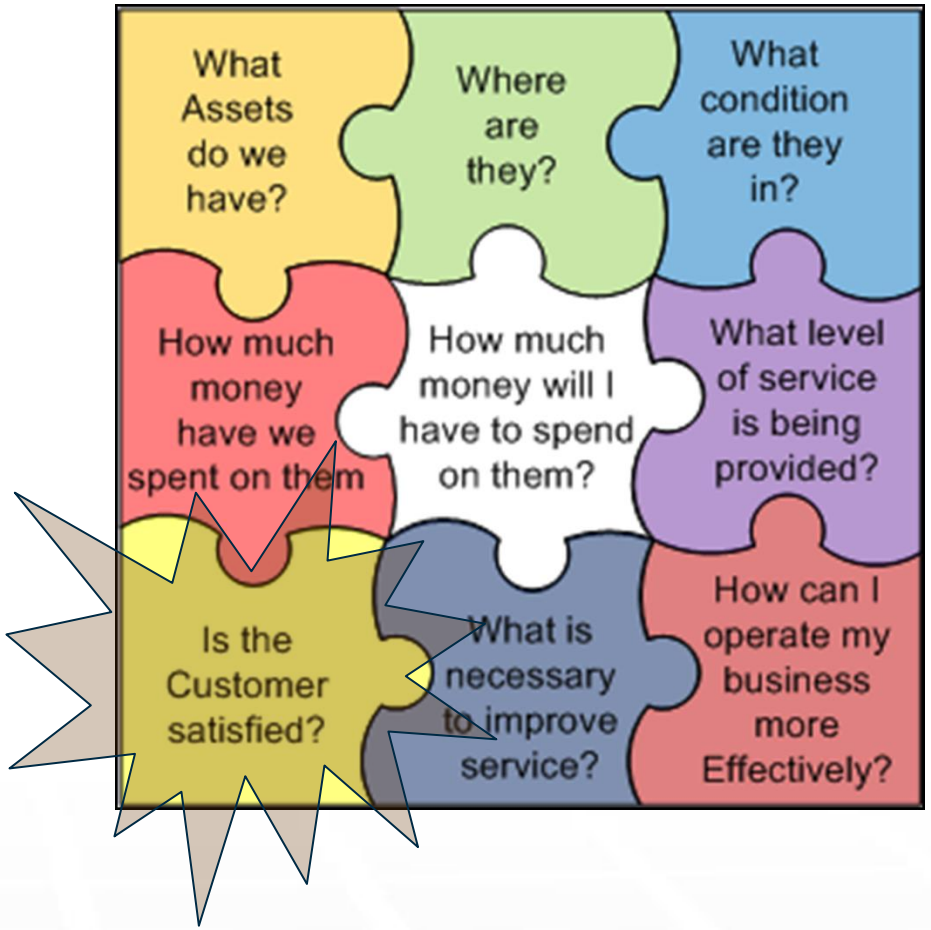
Five core questions of Asset Management

1. **What is the current state of my assets?**
   - What do I own?
   - Where is it?
   - What condition is it in? What is its performance?
   - What is its remaining useful life?
   - What is its remaining economic value?
2. **What is my required level of service?**
   - What is the demand for my services by my stakeholders?
   - What do regulators require?
   - What is my actual performance?
3. **Which assets are critical to sustained performance?**
   - How does it fail? How can it fail?
   - What is the likelihood of failure?
   - What does it cost to repair?
   - What are the consequences of failure?
4. **What are my best O&M and CIP investment strategies?**
   - What alternative management options exist?
   - Which are the most feasible for my organization?
5. **What is my best long-term funding strategy?**



Source: USEPA

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Asset Centric Information Management - Biography

Infrastructure – **“Know what you own and where it is located”**

Asset register, class libraries, data standards, documents

Inspections - **“Know what condition and remaining life”**

Condition Assessment - includes CCTV inspections, manhole inspections

Mapping/Asset Capture/Locating Surveys - manhole surveys, GPS, CCTV, visual, surveys

Inflow/Infiltration Tests - dye tests, smoke tests, flow monitoring/isolation, I/I property tests

Incident Failures – **“Know how it is performing and how it fails”**

Pollution (CSO, SSO), flooding, blockages, collapses, odor, customer complaints

Interventions – **“Know what you are going to do to improve performance”**

General maintenance, pipe cleaning (e.g. jetting), pipe repairs (e.g. cure-in-place liners), manhole repairs

Inhabitants – **“Know what service you deliver to your customers”**

How has investment/activities helped improve service (e.g. reduction in basement flooding etc.)

Inventory

- Asset infrastructure
- Know what you own and where it is

Inspection

- Condition
- Performance
- Location

Incident

- Performance
- Serviceability

Intervention

- Repair, Rehabilitation, Renewal, Replace
- Clean

Inhabitants

- Customers
- Stakeholder

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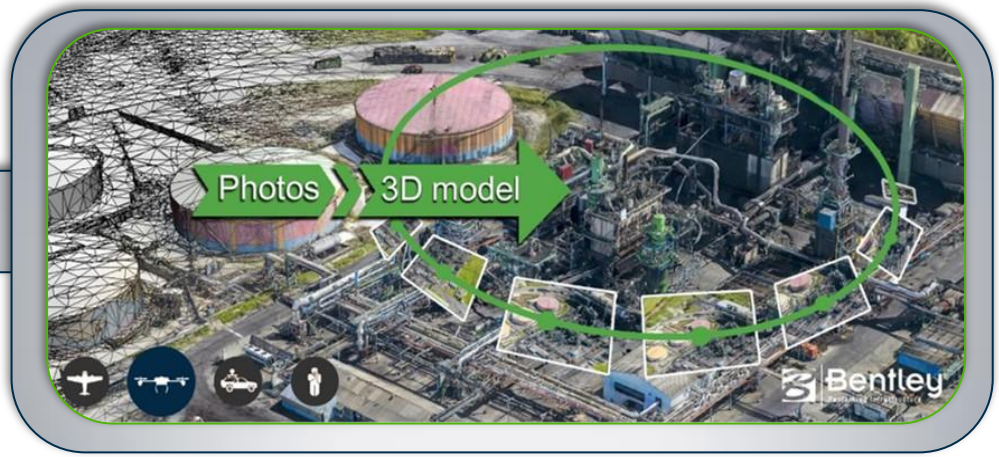
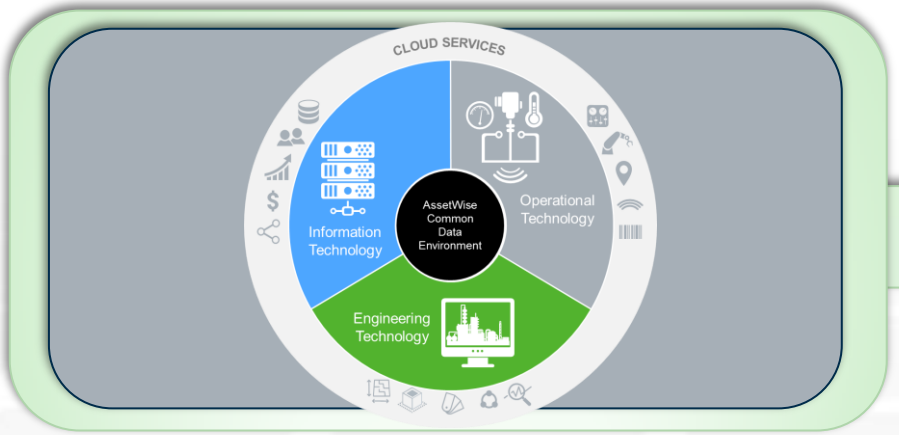
Innovation Themes

Demonstrate new values of BIM

Continuous Drone Capture





Convergence of IT – OT – ET

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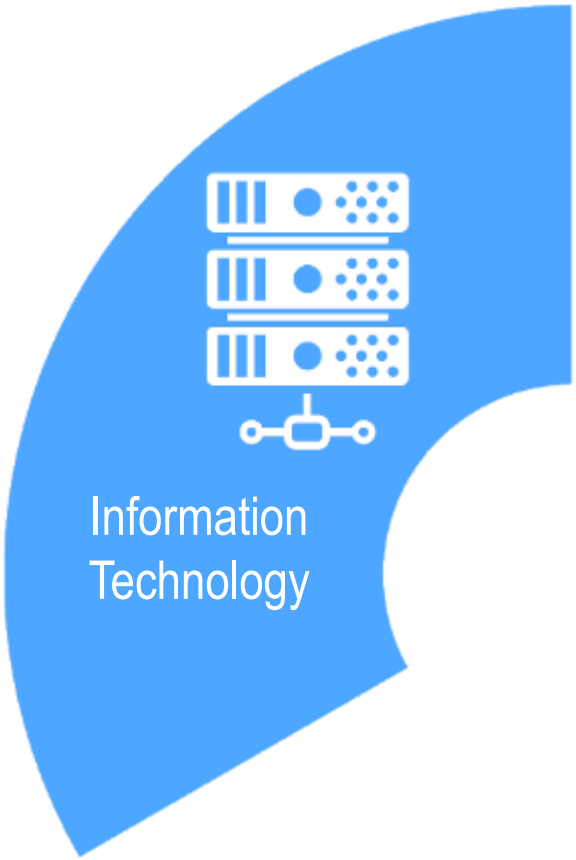
Asset Information and Data Management for Smart Infrastructure

IT



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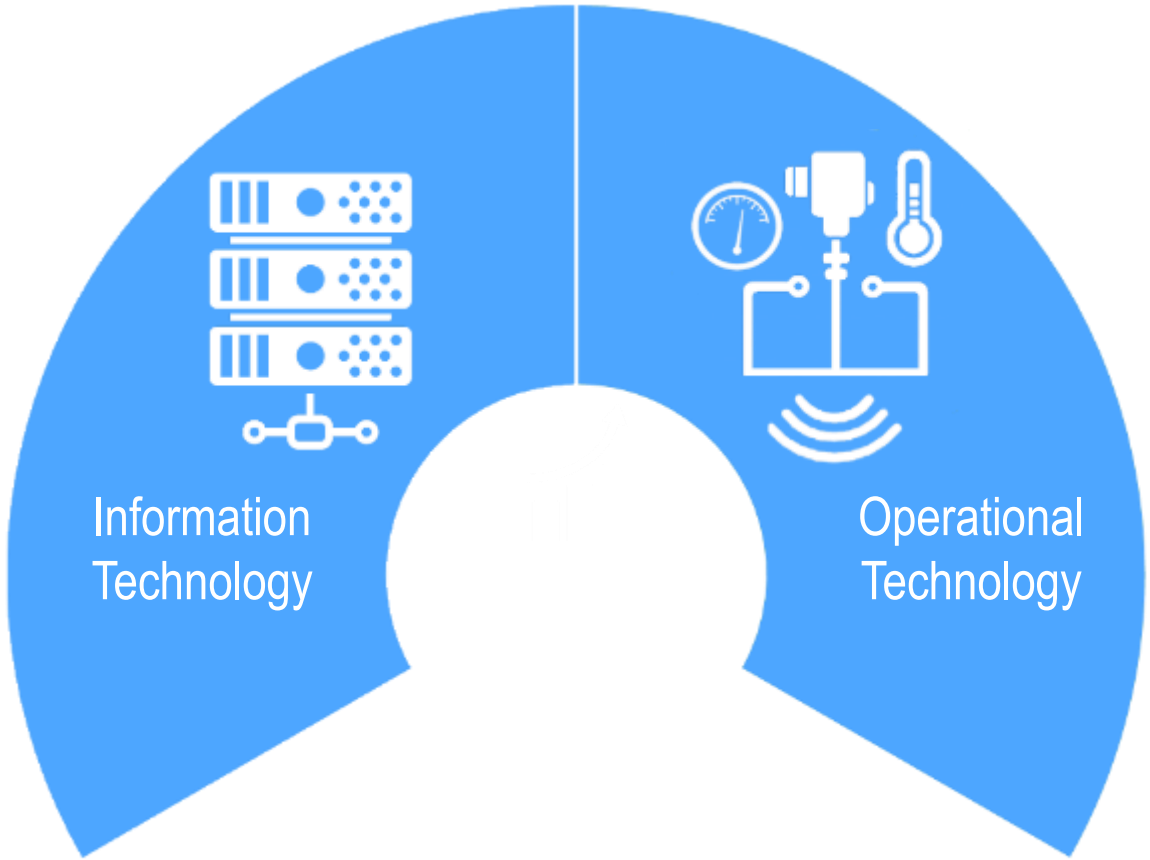
Asset Information and Data Management for Smart Infrastructure

IT



OT

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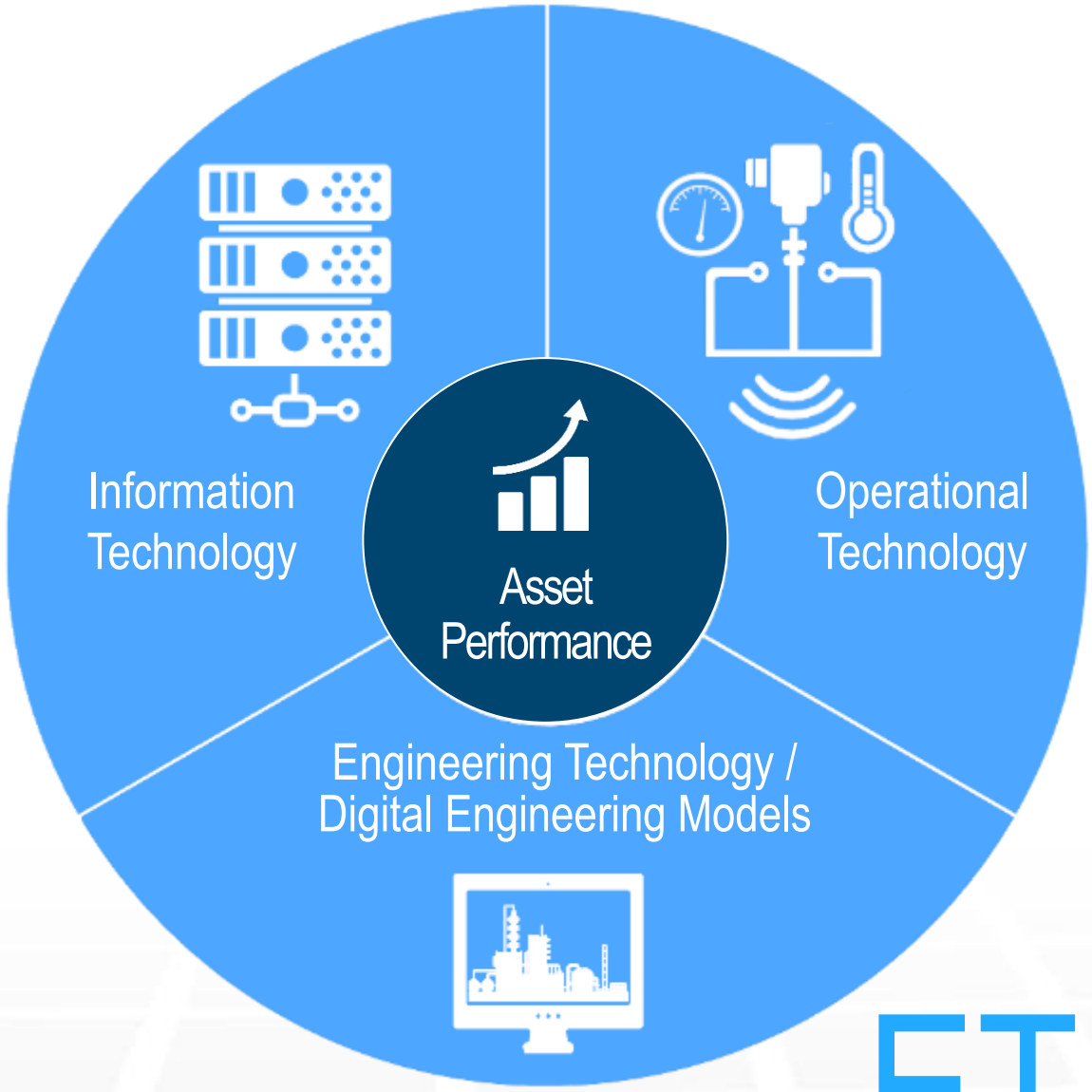
Asset Information and Data Management for Smart Infrastructure



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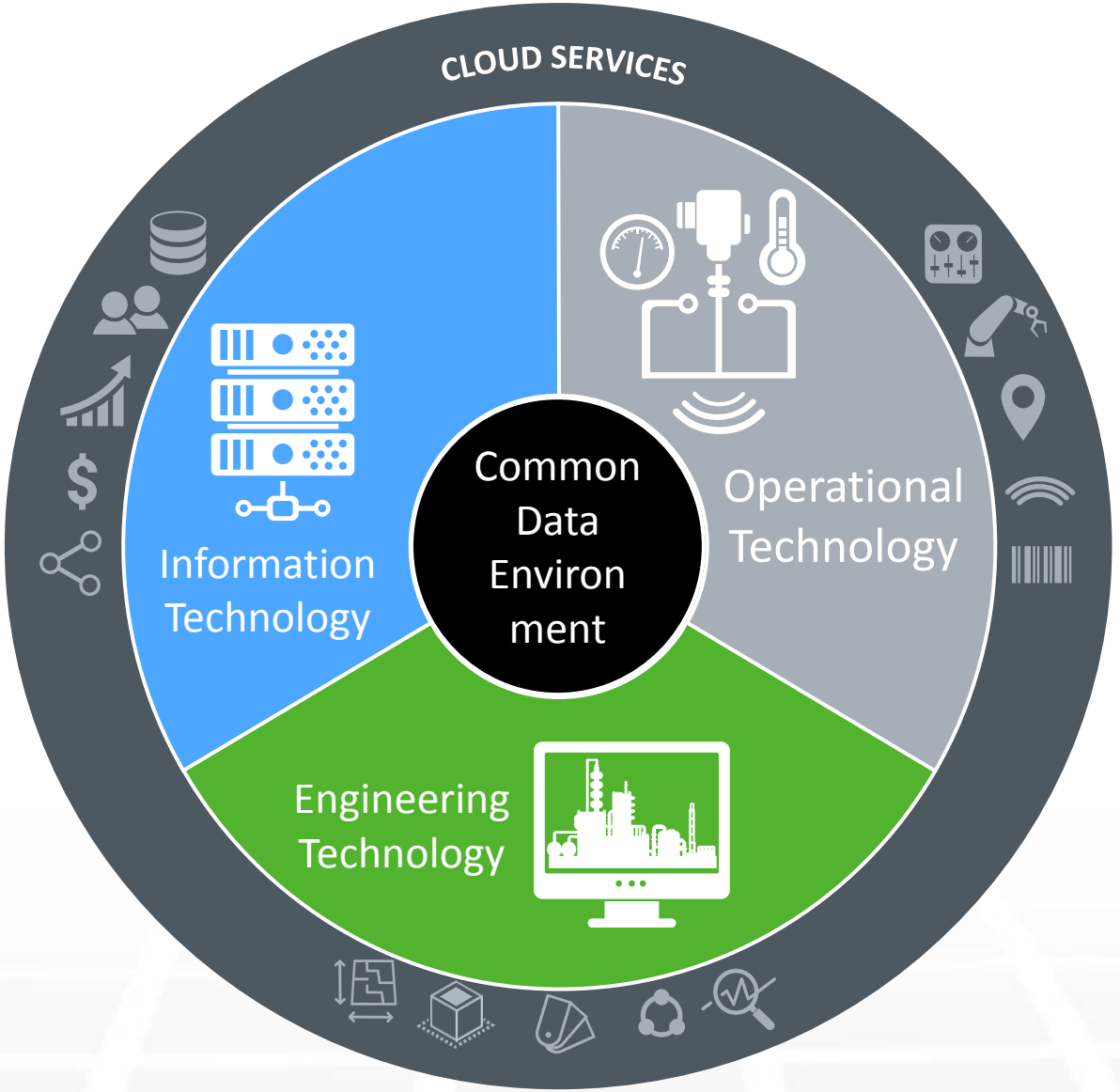
Asset Information and Data Management for Smart Infrastructure In the Cloud



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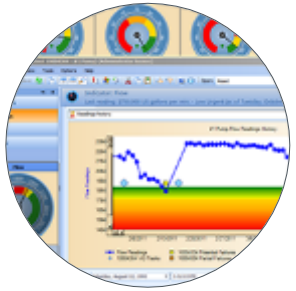
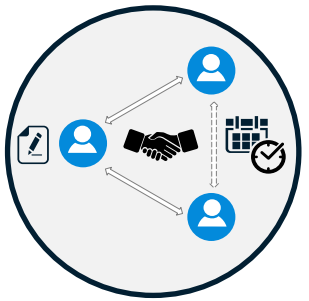
AssetWise CONNECT Edition

Converging IT, OT, and ET information for superior asset performance

CONNECTED ASSET PERFORMANCE

ALIM	Asset Reliability	Work Management	Operational Analytics	Asset Performance Modeling	Enterprise Interoperability
					

COMMON DATA ENVIRONMENT

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AssetWise Asset Lifecycle Information Management

Relevant and trusted information, when and where you need it

CONNECTED ASSET PERFORMANCE

ALIM	Asset Reliability	Work Management	Operational Analytics	Asset Performance Modeling	Enterprise Interoperability

COMMON DATA ENVIRONMENT

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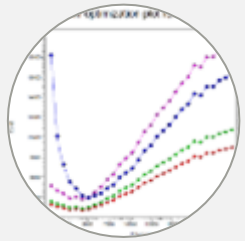
AssetWise Asset Lifecycle Information Management

Relevant and trusted information, when and where you need it

CONNECTED PERFORMANCE ENVIRONMENT

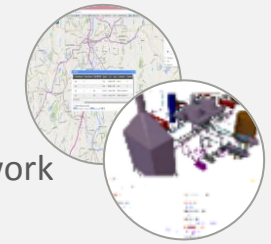
ALIM

Requirements Management

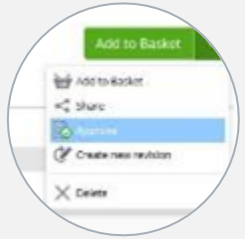


Asset Registry & Tag Management

Spatial & Network Management



Document Control



Records Management

Asset Change & Configuration Management

COMMON DATA ENVIRONMENT

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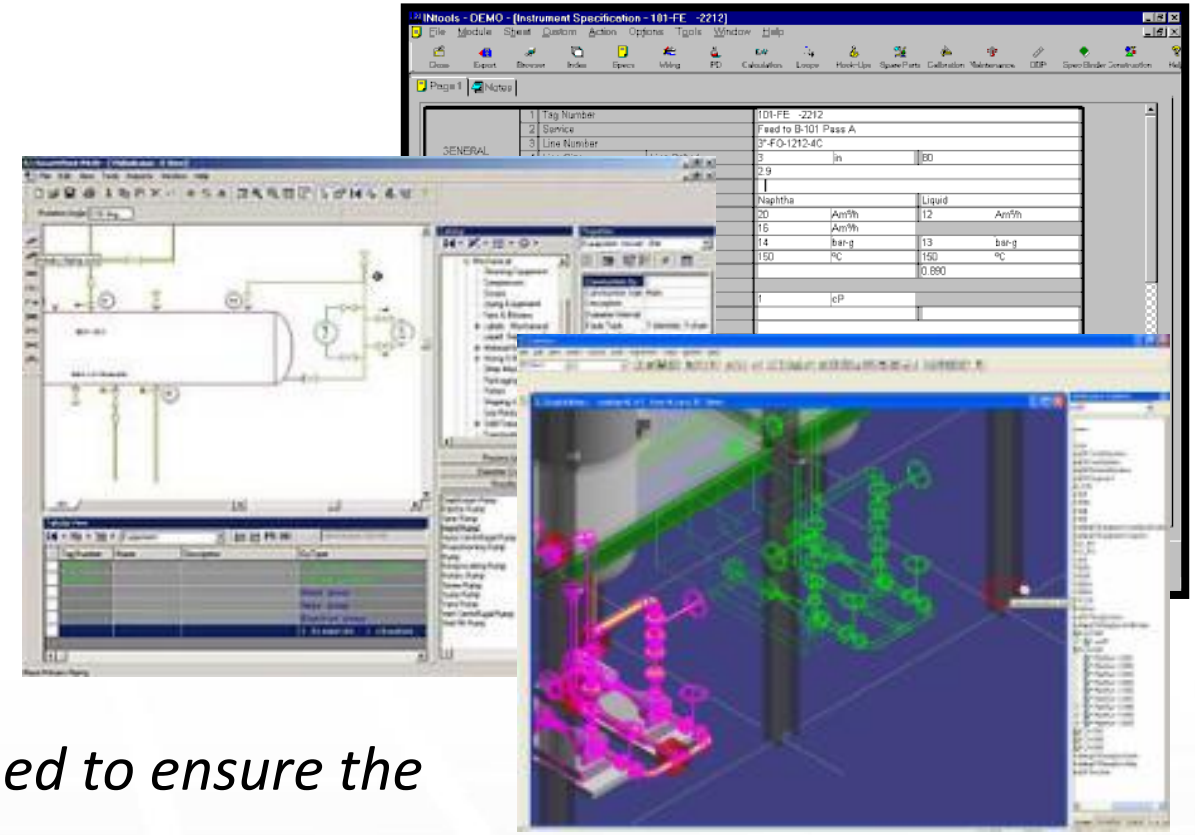
A Tale of two Assets

"Physical Asset"

"Information Asset"



Both "assets" need to be managed and sustained to ensure the integrity and safe operations.
Each needs to be an exact replica of the other!

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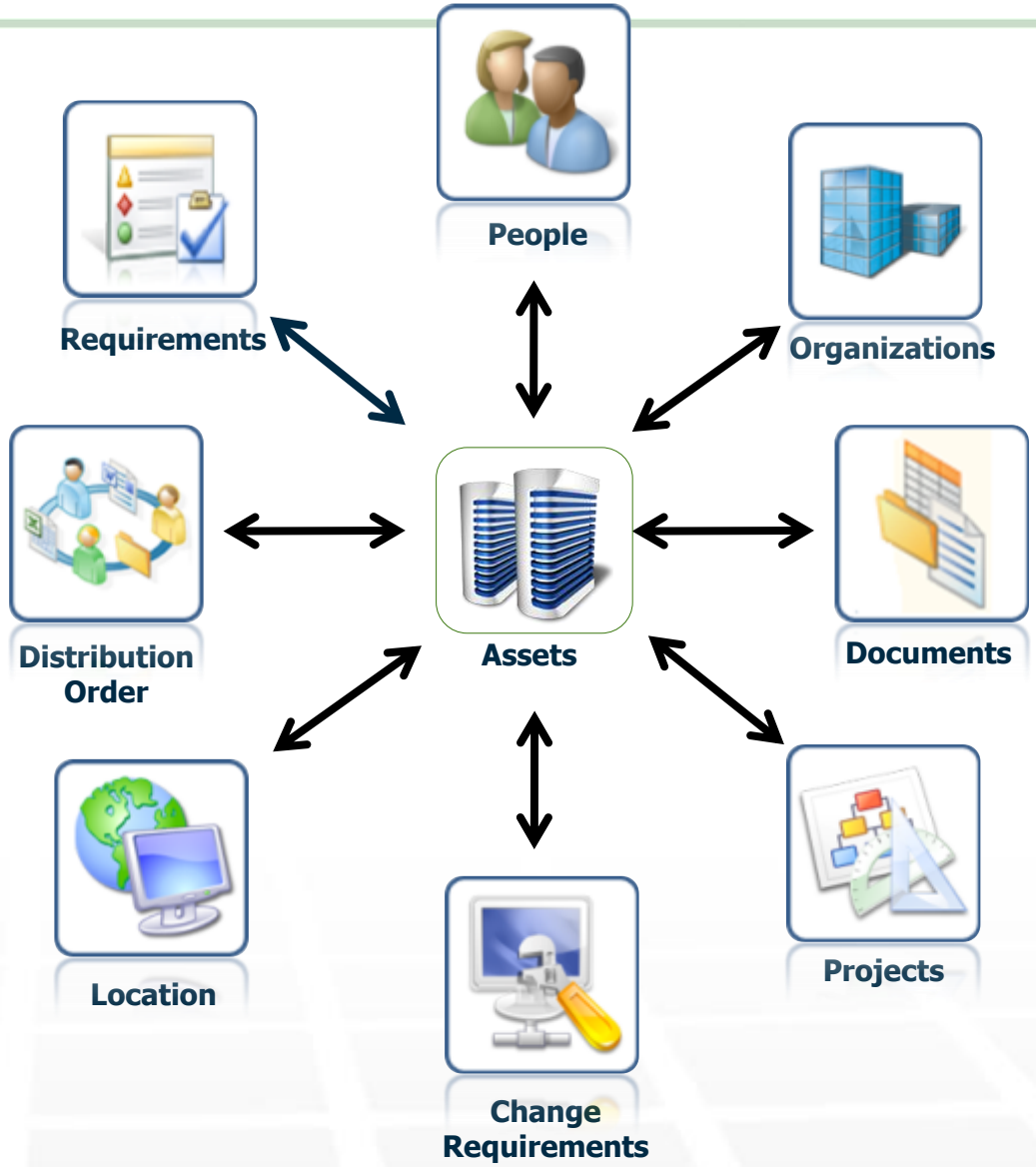
Contextual Awareness

- Classification
- Relationships
- Information Reach
- Templates
- Behavioral Control
- Presentation



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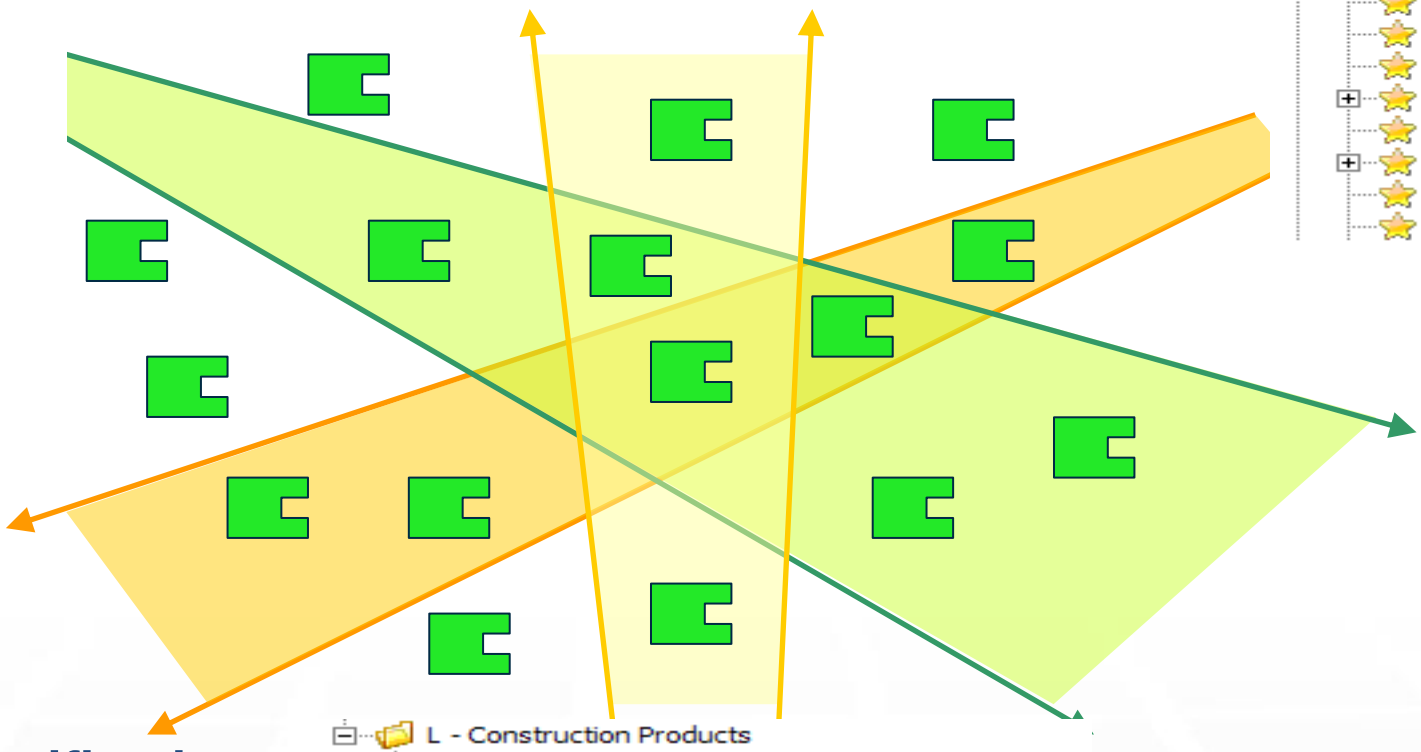
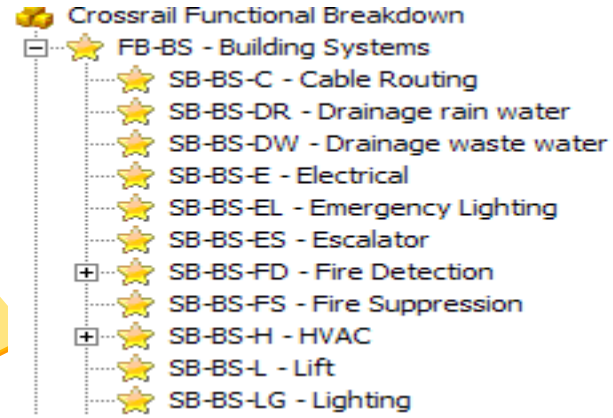
Understanding Asset Information Management

Location

Where is the asset?

Pool of Asset Tags



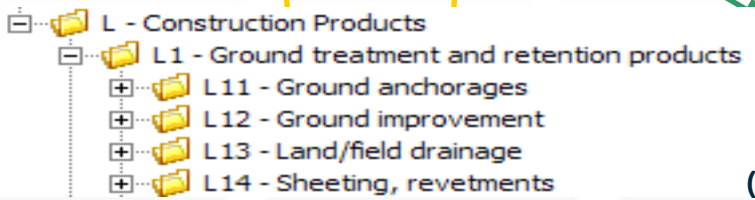


Function

What is the asset designed to perform?

Classification

What type of asset is it?



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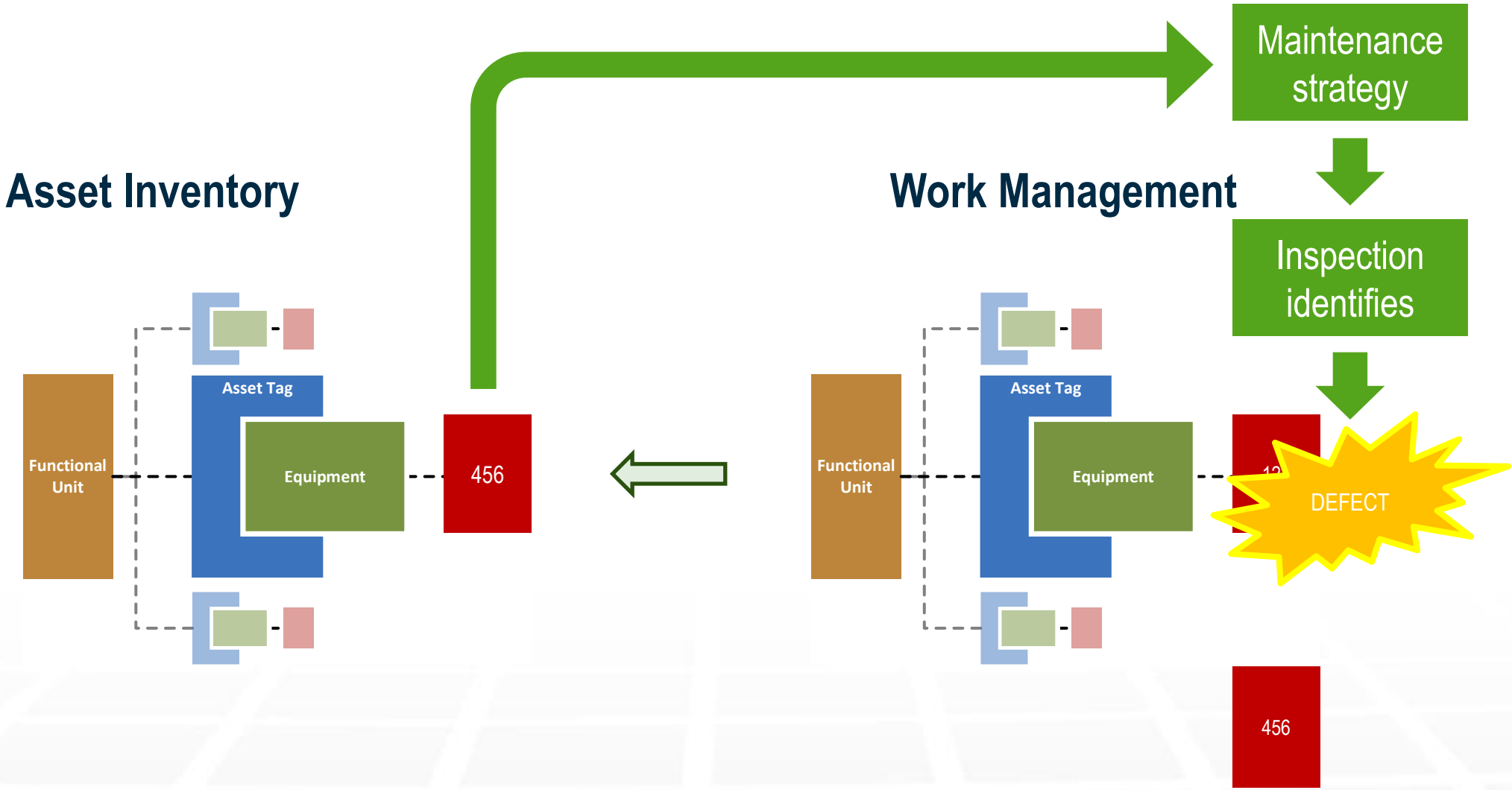
Like for Like Change (Maintenance)



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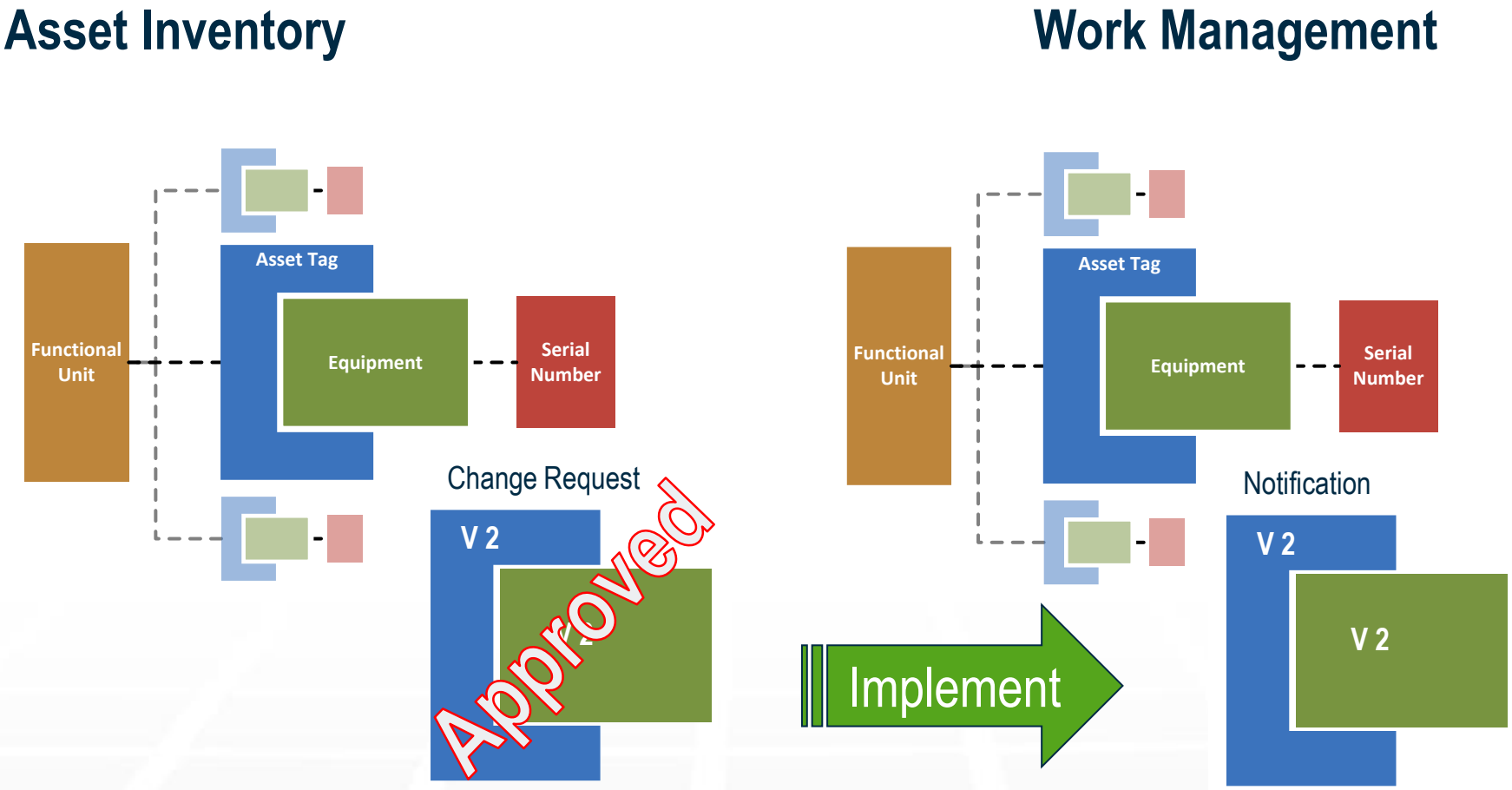
Design Configuration Change



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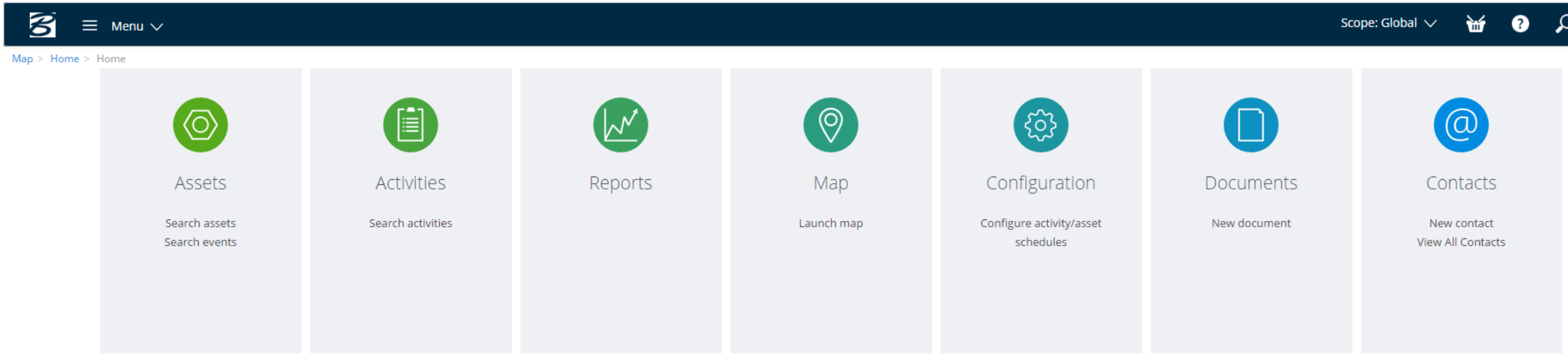
AssetWise CONNECT Edition

Role-based UI and work processes



Each user profile sees the tiles relevant for their role, configurable as desired

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Example: Wastewater Condition Monitoring and Assessment

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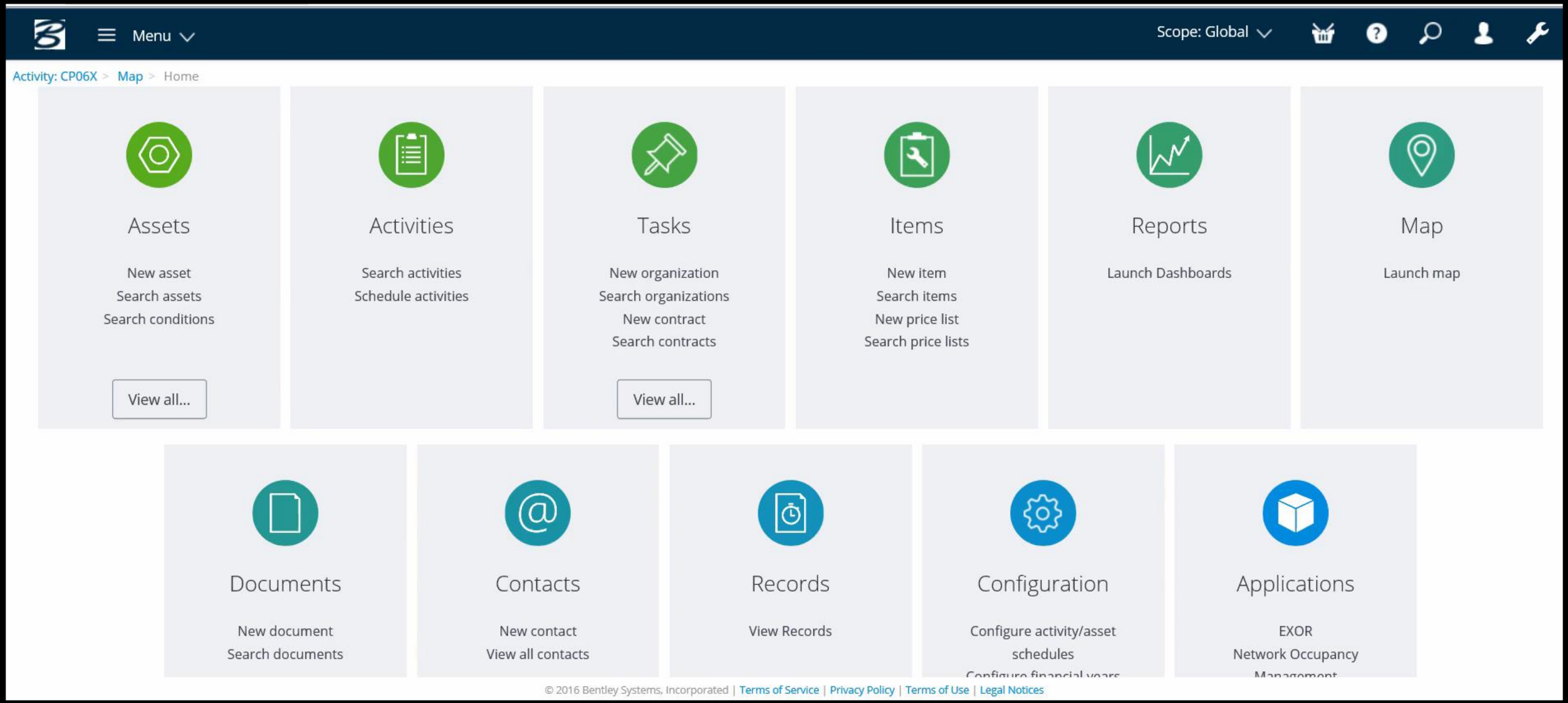
Menu
Scope: Global
Activity: CP06X > Map > Home
Assets
New asset
Search assets
Search conditions
View all...
Activities
Search activities
Schedule activities
Tasks
New organization
Search organizations
New contract
Search contracts
View all...
Items
New item
Search items
New price list
Search price lists
Reports
Launch Dashboards
Map
Launch map
Documents
New document
Search documents
Contacts
New contact
View all contacts
Records
View Records
Configuration
Configure activity/asset schedules
Applications
EXOR
Network Occupancy
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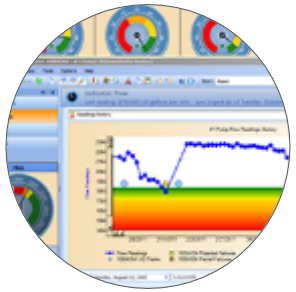
AssetWise Asset Reliability

Drive operational performance based on condition based maintenance

CONNECTED ASSET PERFORMANCE

ALIM	Asset Reliability	Work Management	Operational Analytics	Asset Performance Modeling	Enterprise Interoperability
					

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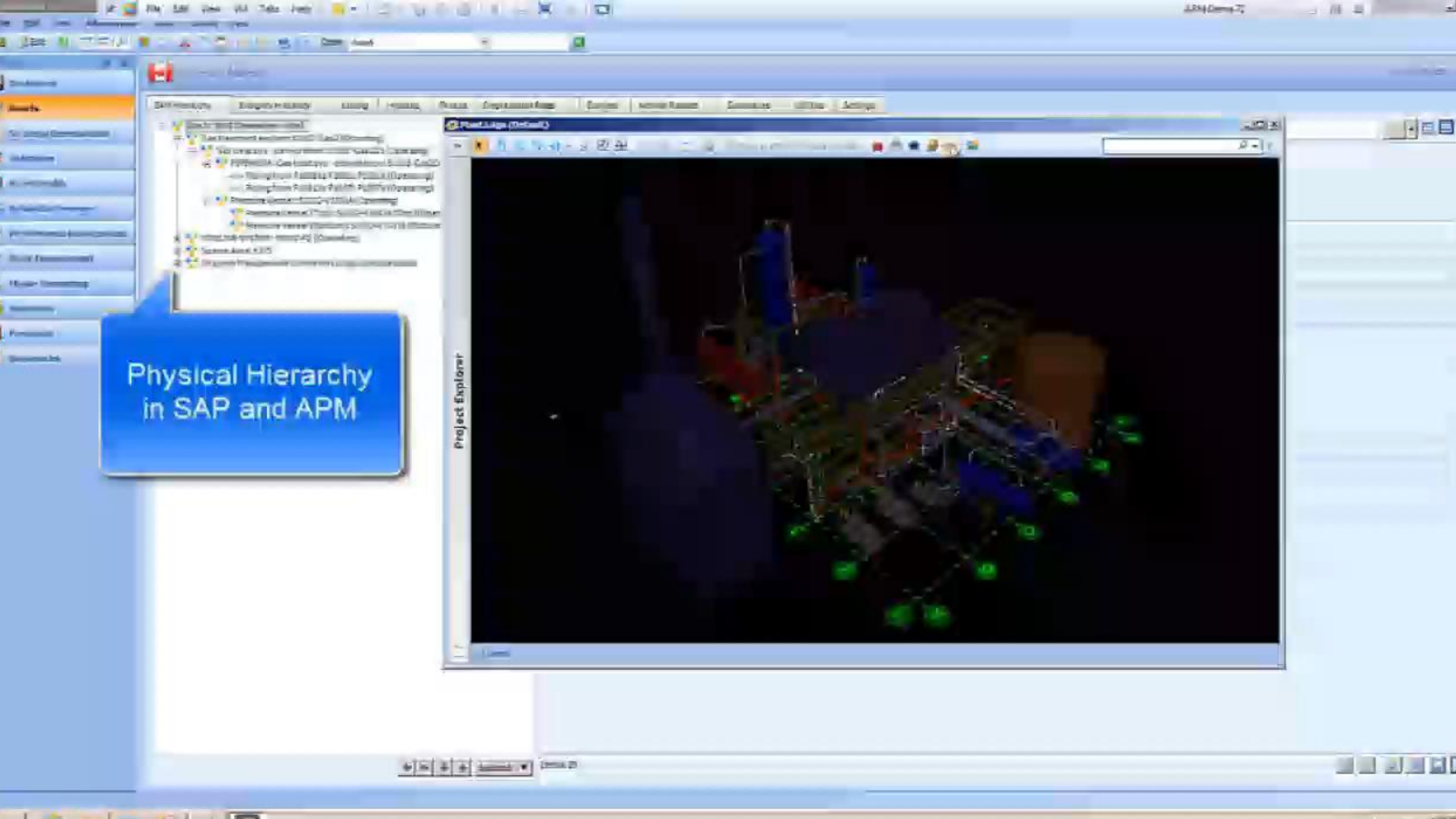
Physical Hierarchy
in SAP and APM
Project Explorer

AssetWise Operational Analytics

Drive operational performance with context, clarity, and confidence

CONNECTED ASSET PERFORMANCE

ALIM	Asset Reliability	Work Management	Operational Analytics	Asset Performance Modeling	Enterprise Interoperability

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AssetWise Operational Analytics

Drive operational performance with context, clarity, and confidence

CONNECTED PERFORMANCE ENVIRONMENT

Operational Analytics

Dashboard Visualization, KPIs and Reporting

Operational Monitoring and Control

Real-time Condition Assessment

Algorithms and Calculations

Connected Decision Support

Predictive Analysis & Forecasting

COMMON DATA ENVIRONMENT

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User Success Story – SA Water

CHALLENGE

- ✓ Make most use of new high capacity desalination plant and north-south interconnecting pipeline in terms of water demand and usage
- ✓ Predict demand and optimize water movement

SOLUTION

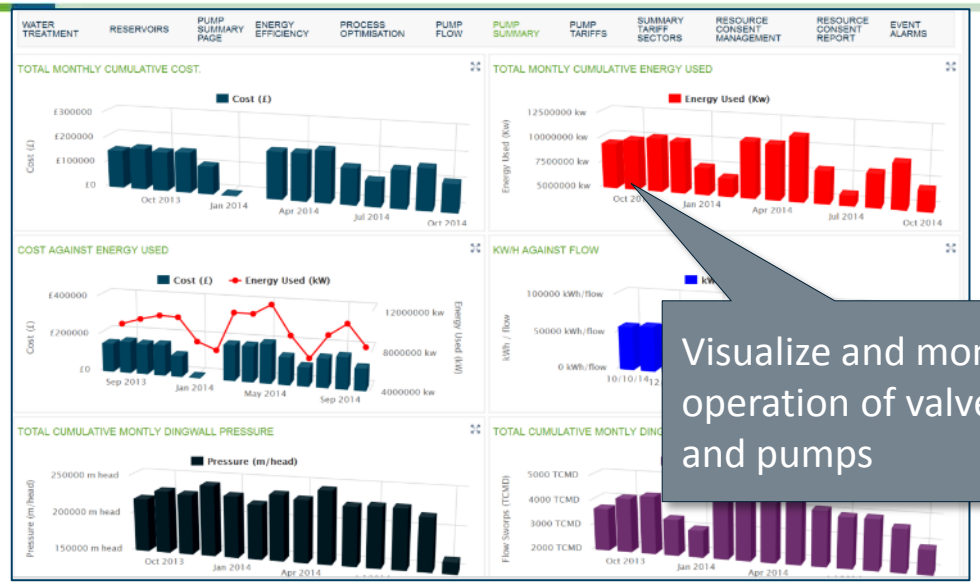
AssetWise comprehensive solution including:

- ✓ Forecast demand of water usage
- ✓ Optimization of water supply and transportation
- ✓ Prediction of energy tariffs

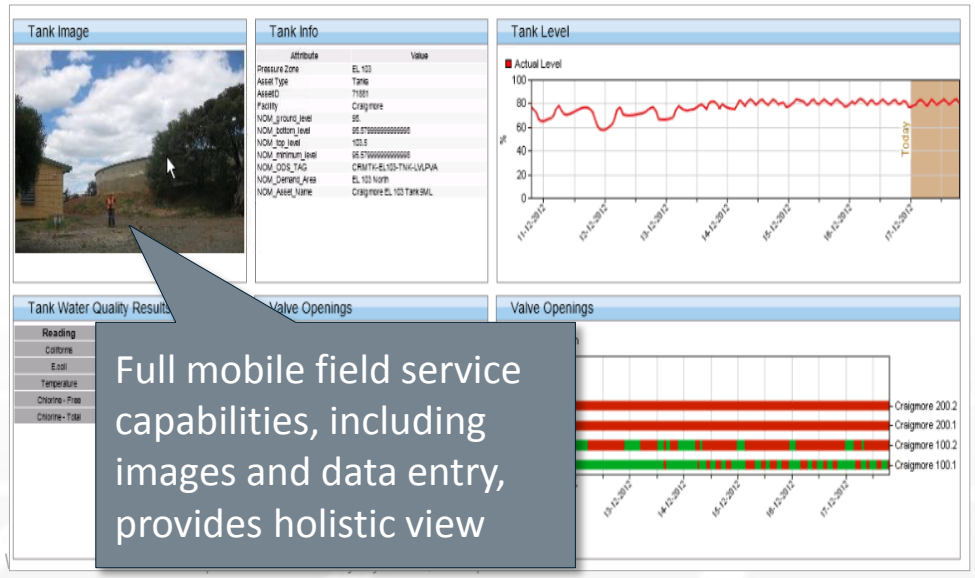
BENEFITS

- ✓ Reduce energy costs
- ✓ Savings in network expenditure
- ✓ Predict short and long term demand levels
- ✓ Reduction in repair/shutdown issues

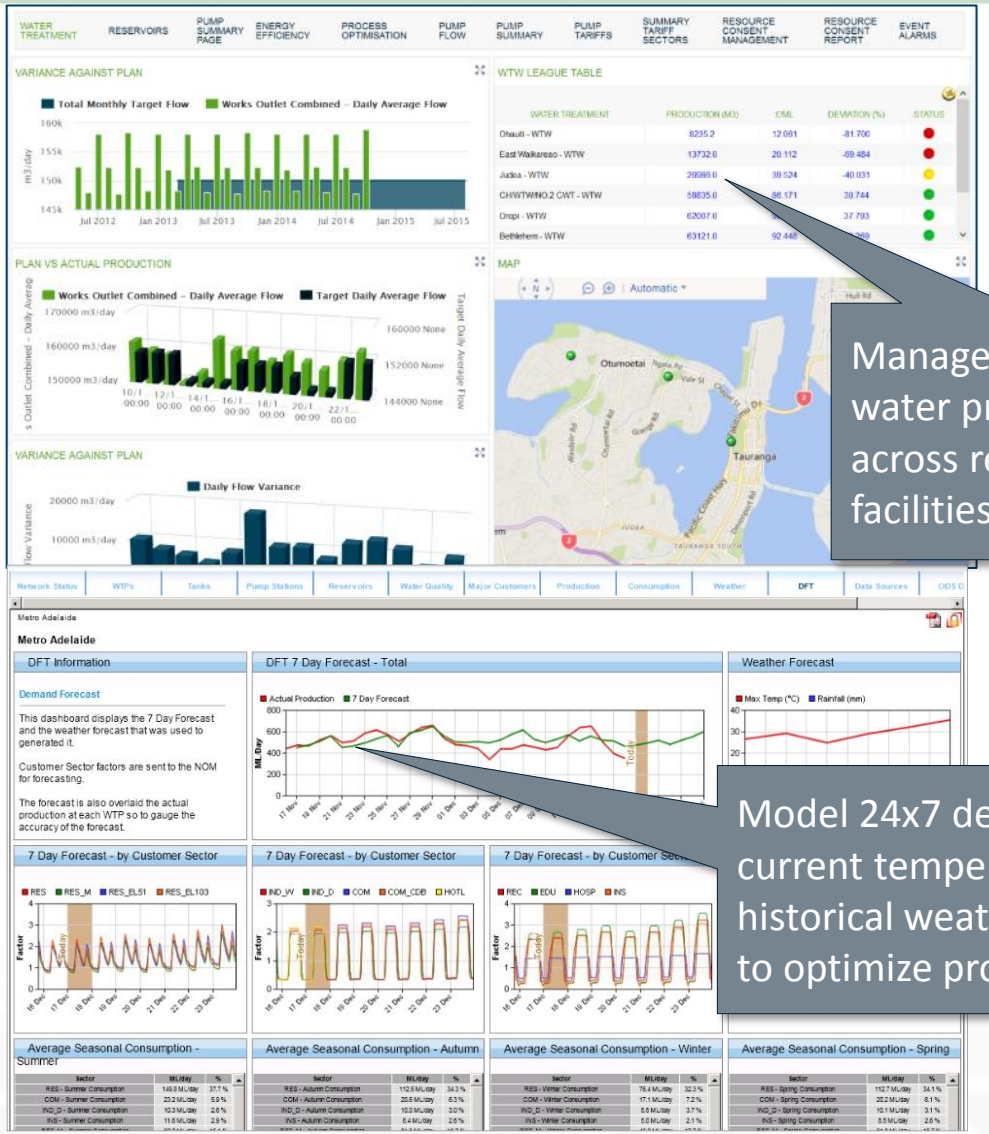
Operational Analytics for Water Operations Support



Visualize and monitor operation of valves and pumps



Full mobile field service capabilities, including images and data entry, provides holistic view



Manage and predict water production across reservoirs and facilities

Model 24x7 demand using current temperatures and historical weather patterns to optimize production

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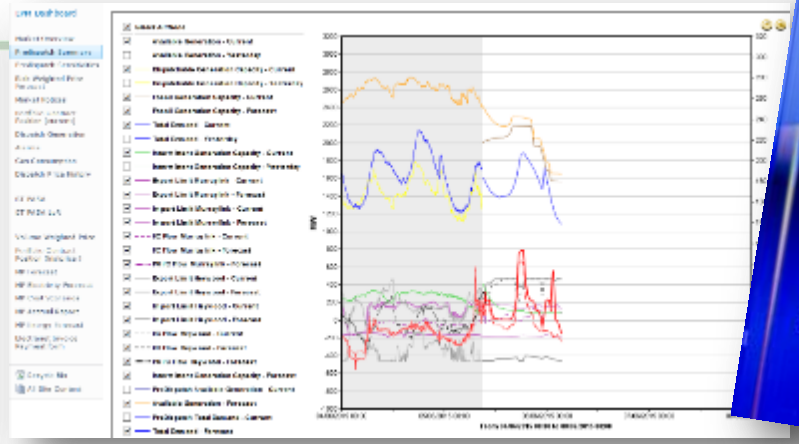
Case Study: South Australia Water



FY13/14 Savings:

- **$3 million (AUD)** in energy
- **$800k (AUD)** in network ops

2015 *Be Inspired* WINNER:
Innovation in Asset Performance

South Australia Water
Predictive and Operational Analytics Tools for the Adelaide Metropolitan Water Distribution Network Adelaide, Australia

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Network Navigation

WTP Area

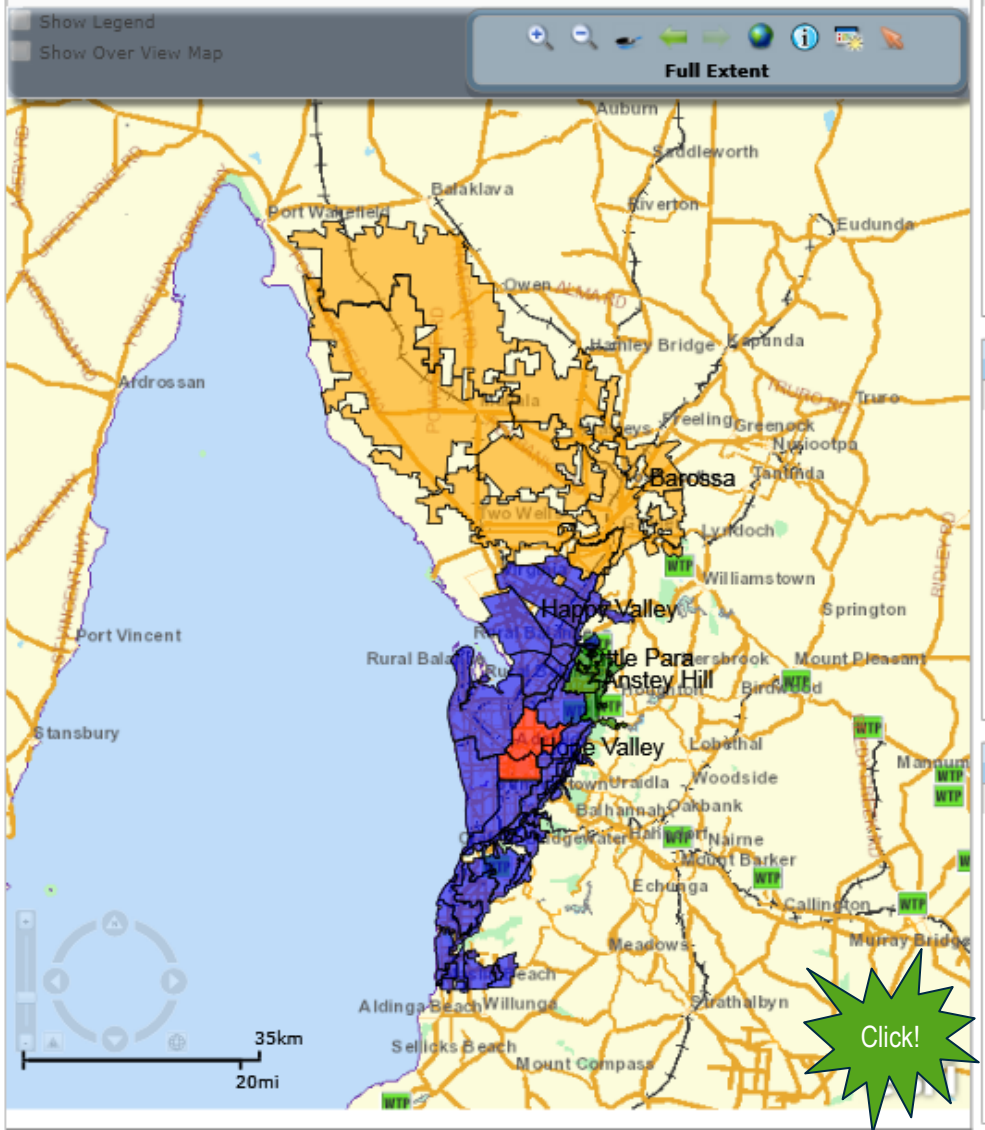
- Metro Adelaide
  - Anstey Hill
    - EL 227 AH North
    - EL 227 Anstey Hill Central
    - EL 278 AH Banksia Park
    - EL 278 AH Central
    - EL 278 AH North
    - EL 278 AH West
    - EL 278 AH Yatala Vale
    - EL 315
    - EL 336
    - EL 350
  - Barossa
  - Happy Valley
  - Hope Valley
  - Little Para

Network Status | WTPs | Tanks | Pump Stations | Flow Meters | Reservoirs | Water Quality | Major Customers | WTP Production | Consumption | Weather | DFT

Metro Adelaide

Metro Adelaide

GIS Map



Adelaide Forecast

Monday	Tuesday	Wednesday	Thursday
Possible show er 8°C - 15°C	Mostly sunny 6°C - 15°C	Possible show er 7°C - 17°C	Possible show er 10°C - 19°C

Current **Temperature:** 11.0°C
Feels like: 11.0°C
Relative humidity: 85%
Wind: CAL at 0 km/h, gusting to 0 km/h
Rain: 0.0mm since 9am

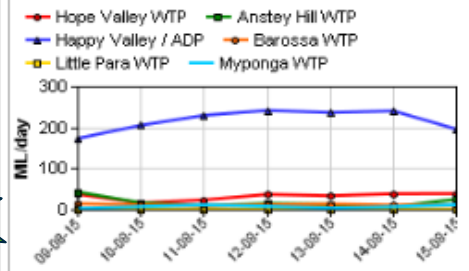
Current Production

WTP	Forecast For Today (ML)	Actual Since Midnight (ML)
Anstey Hill WTP	16.8	49.7
Barossa WTP	12.2	11.1
Happy Valley / ADP	256.5	129.7
Hope Valley WTP	44.9	31.4
Little Para WTP	0.0	0.0
My ponga WTP		3.3

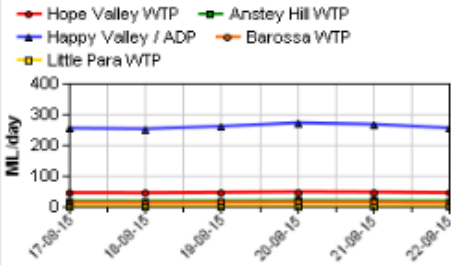
Asset Details - From Hydraulic Model

Please click on an asset in the Map to view its details.

Production Actuals Last 7 Days

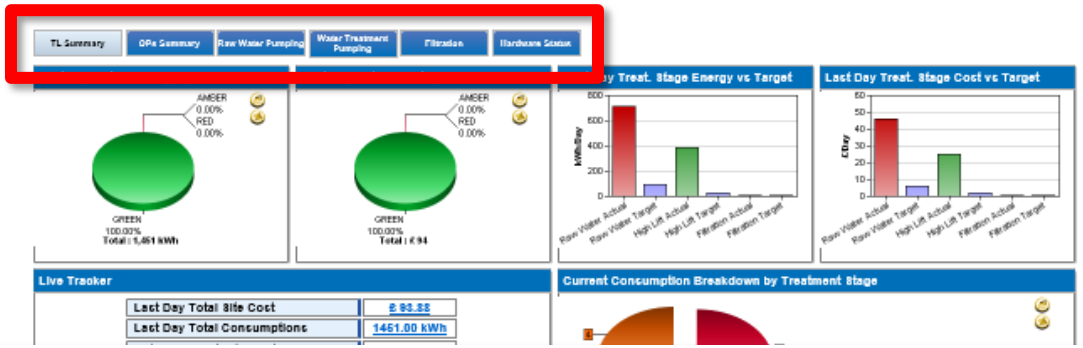


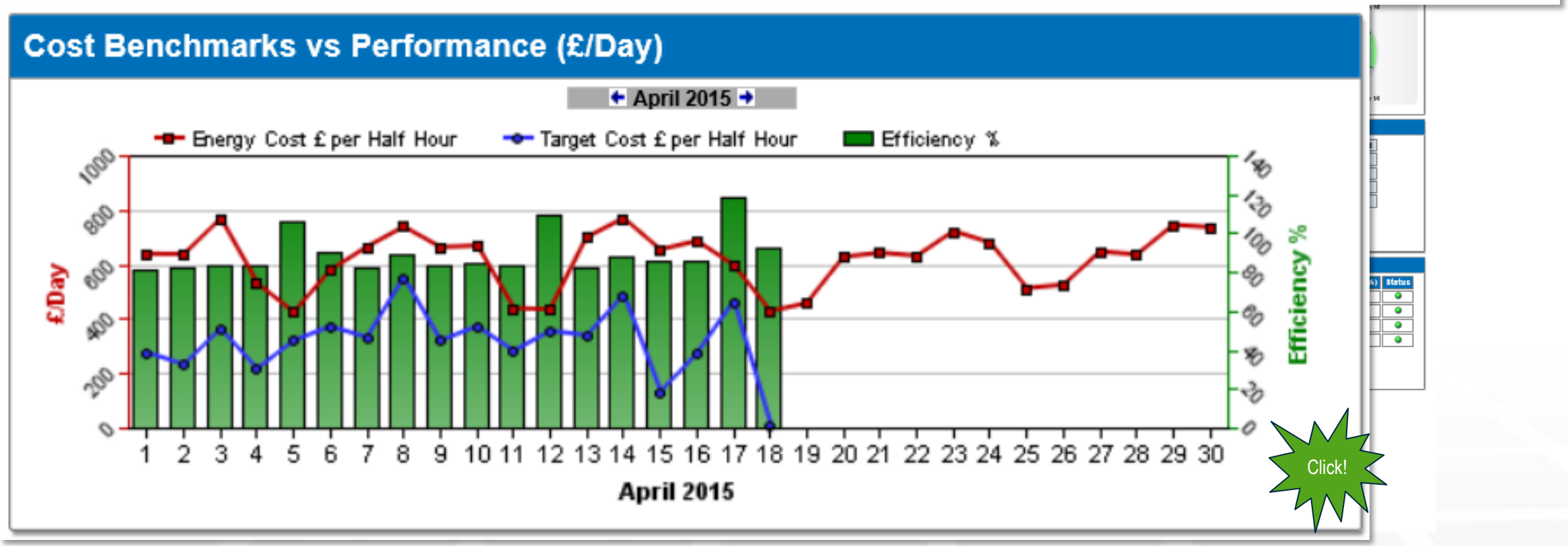
Production Forecast Next 7 Days



Case Study

- Major European Utility





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AssetWise Asset Performance Modeling

CONNECTED ASSET PERFORMANCE

ALIM	Asset Reliability	Work Management	Operational Analytics	Asset Performance Modeling	Enterprise Interoperability

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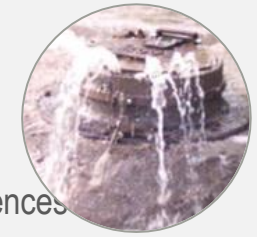
AssetWise Asset Performance Modeling

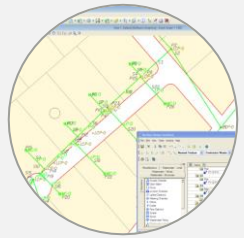
CONNECTED ASSET PERFORMANCE

Asset Performance Modeling

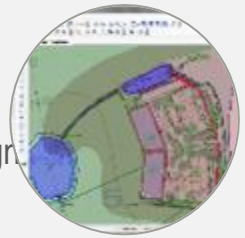
Consider External Influences



Evaluate Planning Scenarios



Evaluate Design Scenarios



Evaluate Operation & Maintenance Scenarios

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AssetWise Enterprise Interoperability

The federated view of asset information across multiple data sources

CONNECTED ASSET PERFORMANCE

ALIM

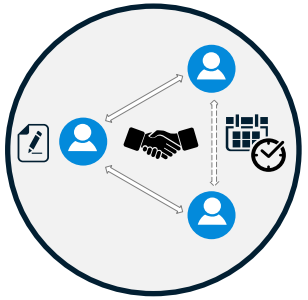
Asset Reliability

Work Management

Operational Analytics

Asset Performance Modeling

Enterprise Interoperability



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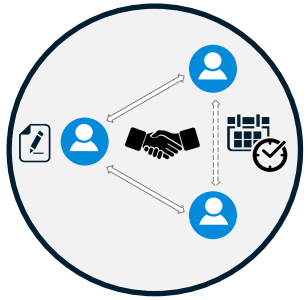
AssetWise Enterprise Interoperability

The federated view of asset information across multiple data sources

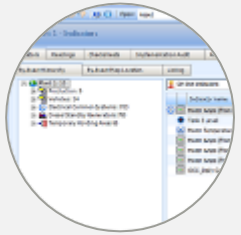
CONNECTED ASSET PERFORMANCE

Enterprise Interoperability



GIS Connector

ERP/EAM System Connectors



Online Data Collection Connectors

Automation and Control System Integration

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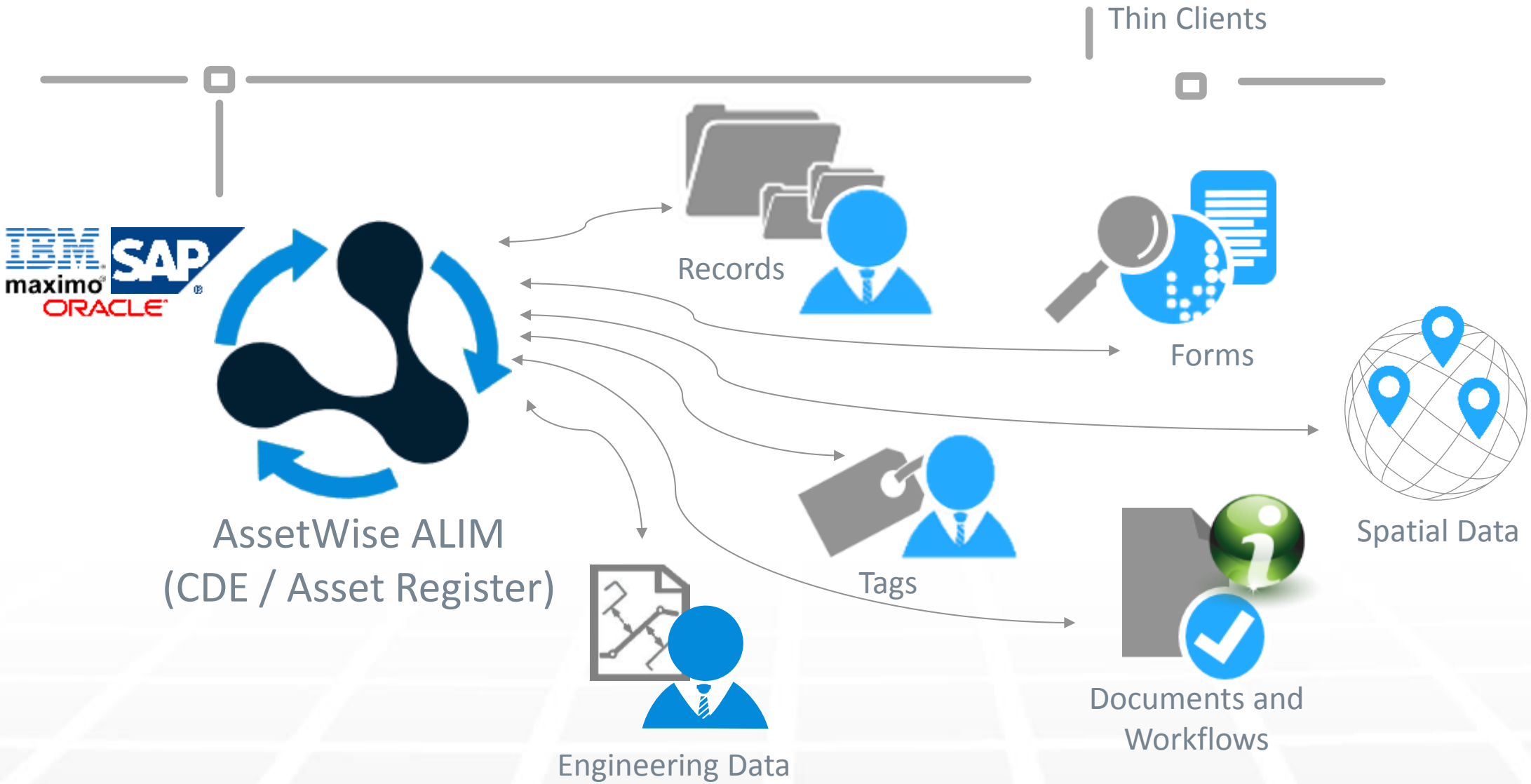
AssetWise ALIM - Common Data Environment



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