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ST Engineering

Digital Twins
for Advanced Manufacturing

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"Skill vs Technology"

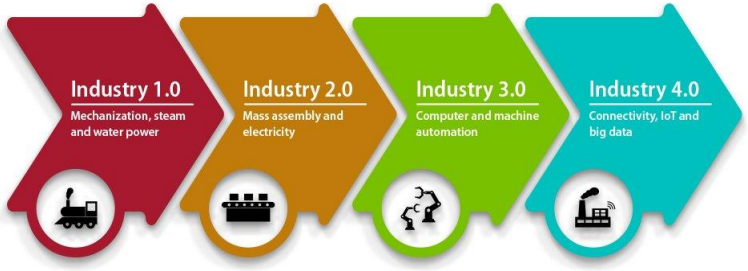
New Definitions of Human Capital

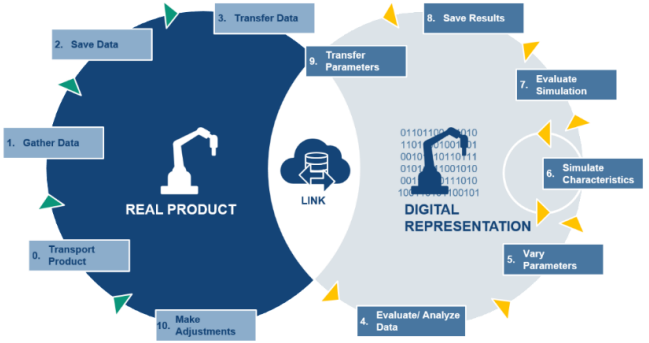
Emerging Advanced Manufacturing Technologies	Emerging Skills
1 Lights Out Manufacturing enabled by advanced robotics and intelligent automation	Robotics programming, automation design, computer vision, human-machine interaction
2 Smart horizontal and vertical integration enabled by manufacturing platform, IIoT and connected technologies	Smart manufacturing platforms, IIOT management, sensorization, shopfloor connectivity
3 Predictive maintenance applied in more manufacturing industries, enabled by machine learning and advanced analytics	Machine learning, data mining, artificial intelligence
4 Digital twins (digital design, simulation and integration) at the core of product and process development	Product and process modelling and simulation
5 Additive manufacturing making product innovation and production more effective and efficient	Additive manufacturing (product design, processes and safety)
6 Immersive collaboration and training enabled by extended reality and metaverse technologies	AR/VR, virtual collaboration
7 Increasing use of advanced materials developed using computational methods	Advanced materials, computational materials development
8 Increasing focus on sustainability in product design and manufacturing operations	Sustainable manufacturing transformation

The Time for Digital Twins is Now

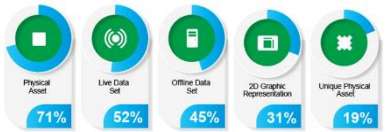
For Productivity Improvement and Process Optimisation

A. IoT and interfaces for interconnectivity and smart automation

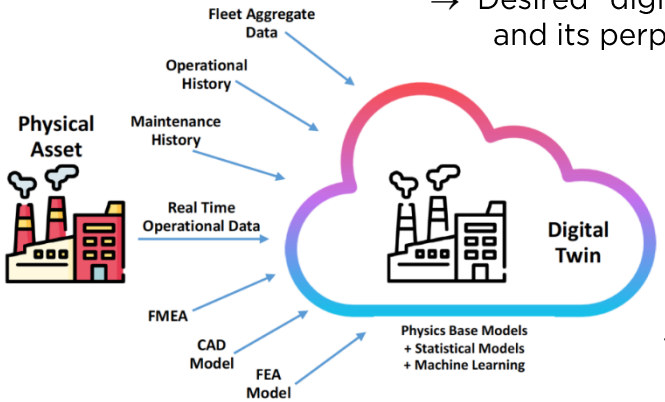




→ Desired "digital thread" for the asset livecycle and its perpetual cycle of improvements



B. Availability of digital data from production and operation



C. New computation resources for simulation, analytics and A.I.

Operation Process Digital Twin

Performance Monitoring with Visual and Computational Modelling as Basis

Actual System Configuration

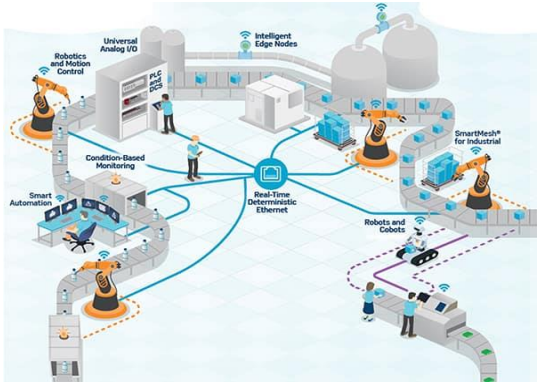
System Operation

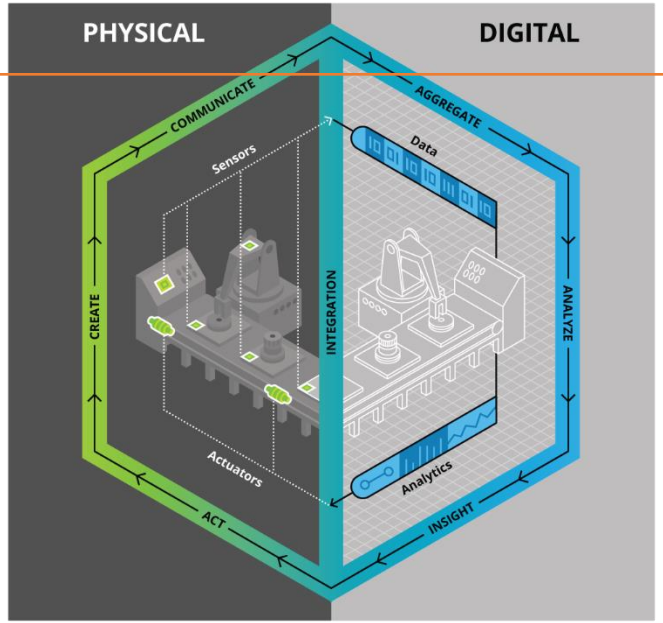
Measurements from Sensors

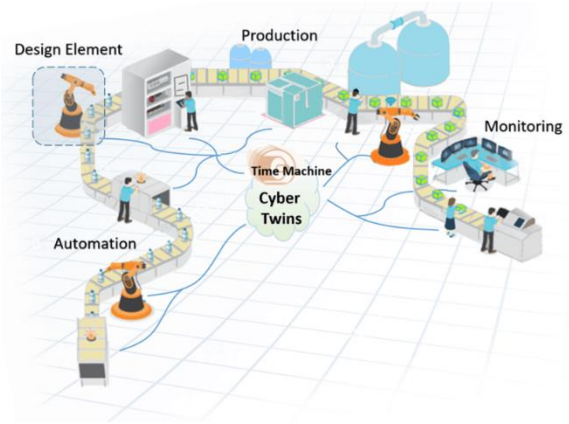
Process Visualisation

Event Data Inputs

Live Monitoring + Data Capture







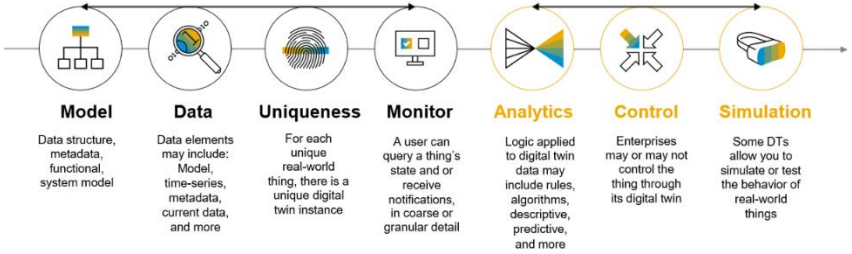
Physical-Digital Mirroring

Concept of the Asset Digital Twin

Virtual representation of asset over its lifecycle and in operations

Digitising the asset with visual and computational modelling

+ Capturing data in real time

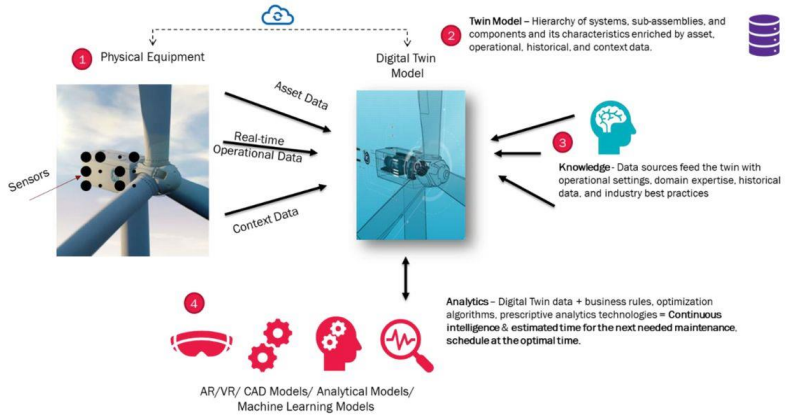


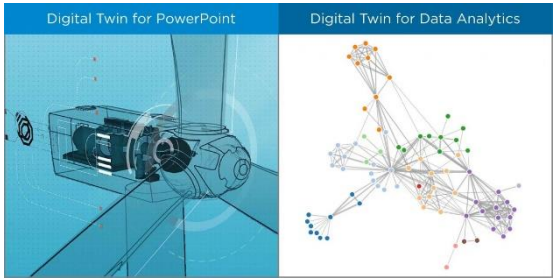
+ Predicting future states of the asset based on data

Data-based Operations
Information on entity state…
at current or historical point in time

Analysis for Insights
- Data Analytics
- Predictive Simulations

Information Management
- Meaningful view of the subject
- Understanding the physical world





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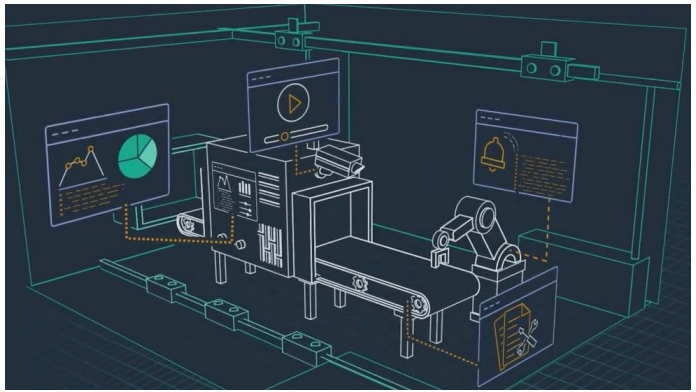
aws ST Engineering

AWS IoT TwinMaker



with

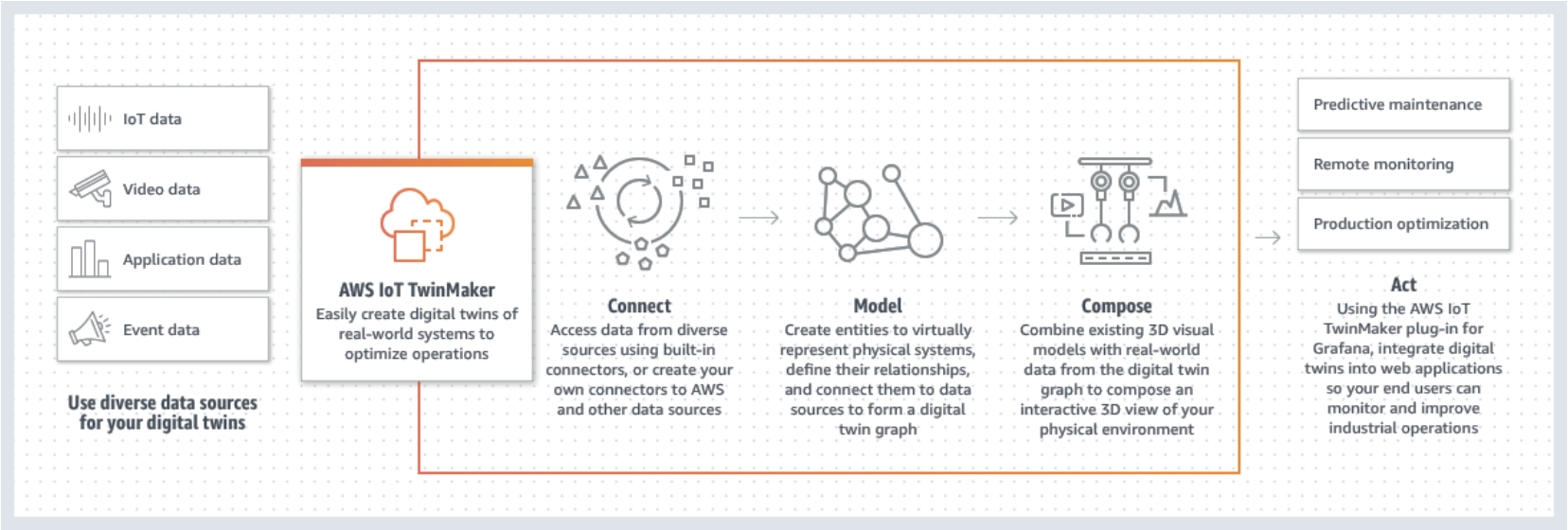
Dr Ronald Chung

Head of Specialist Solutions Architect

ASEAN Public Sector, Amazon Web Services

Building Digital Twins on the Cloud

Data Connectors, Entities, 3D Scenes and Visualisations

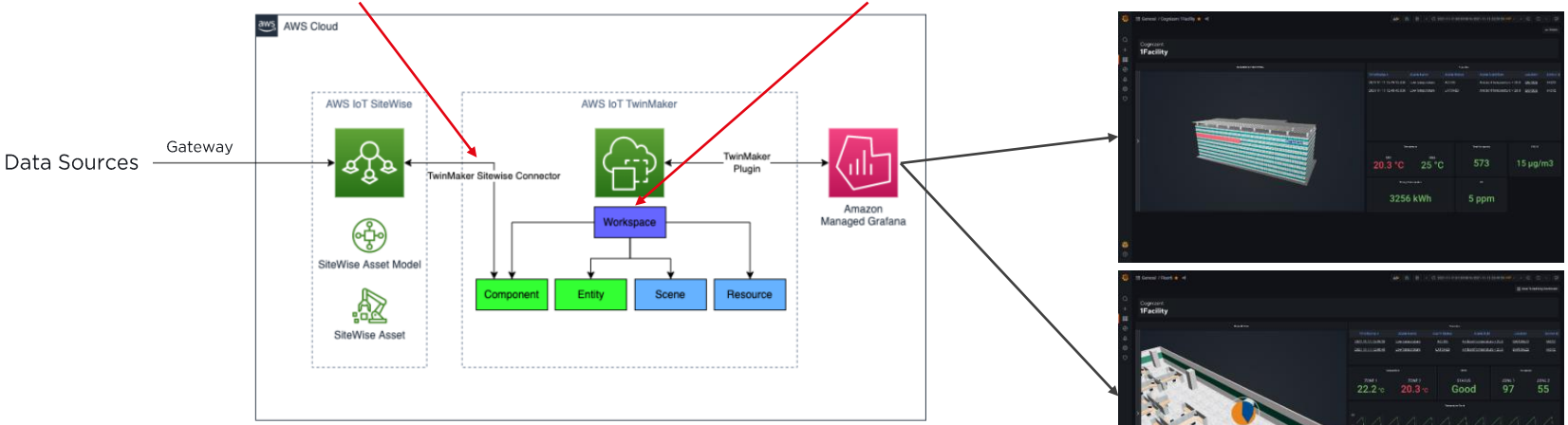


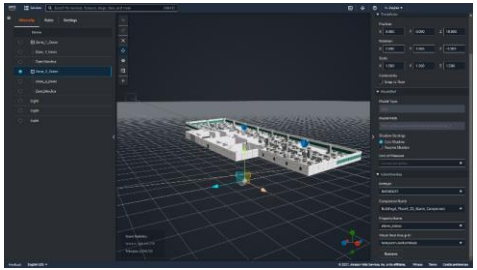
From Data to Dashboards

Generated System Knowledge Graph with Binding to Data Sources

Time-series connectors to time-series databases such as AWS IoT SiteWise

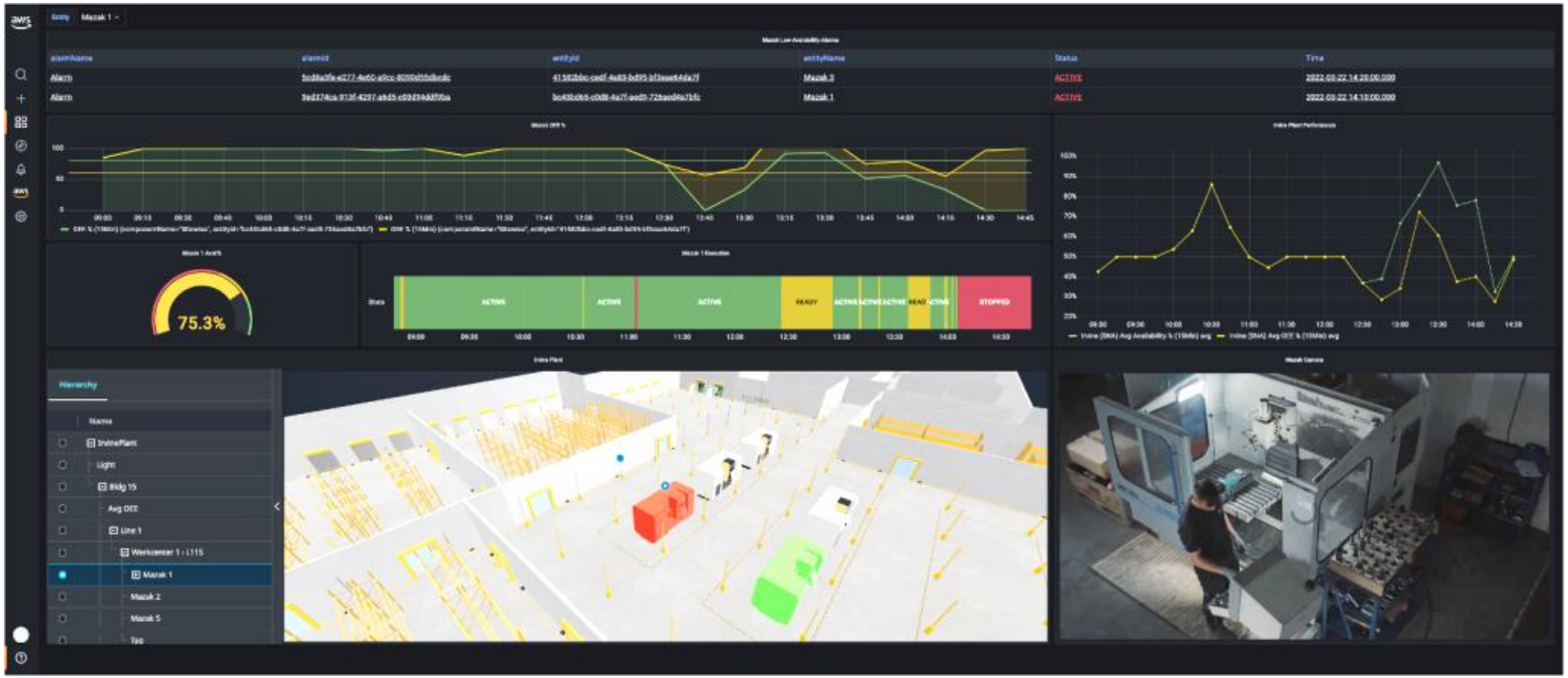
Hierarchy connectors to sync an external model to AWS IoT TwinMaker





Applications for Performance Monitoring

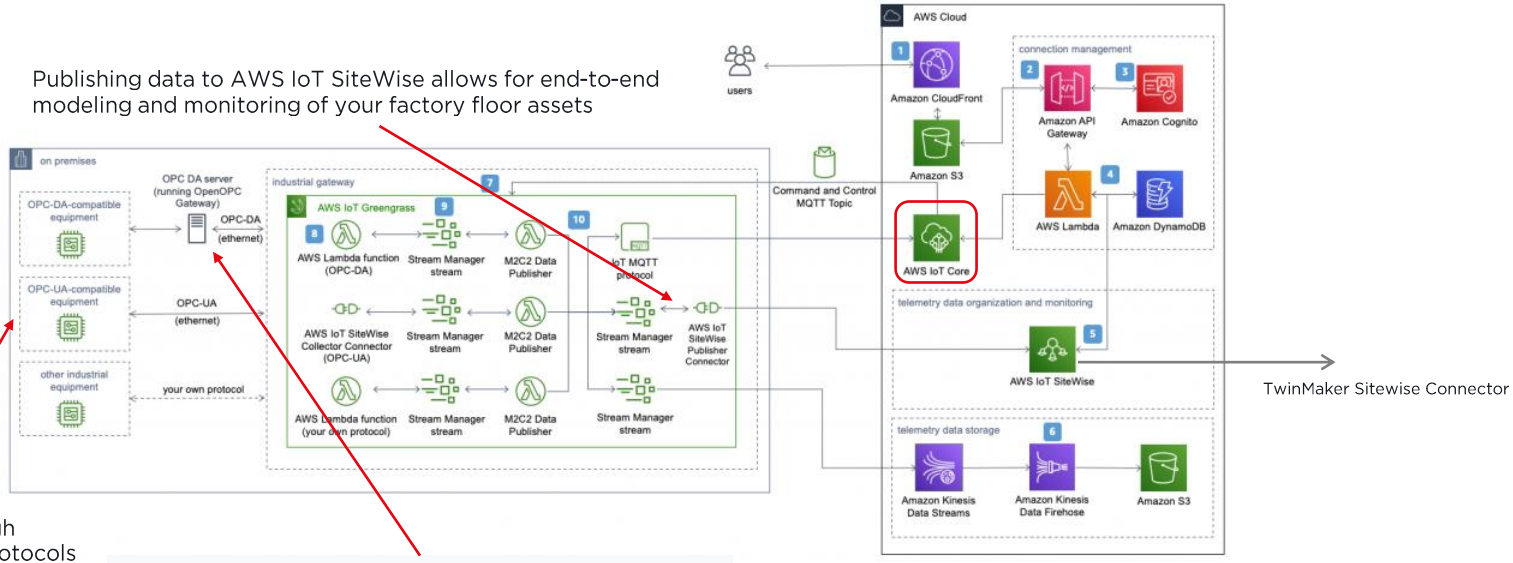
Example Manufacturing Dashboard



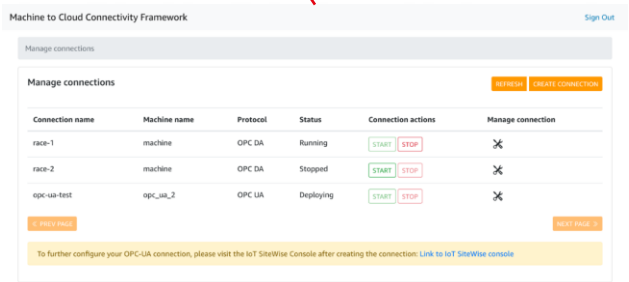
Machine-to-Cloud Connectivity

Ingesting Industrial Data for Equipment Telemetry

Publishing data to AWS IoT SiteWise allows for end-to-end modeling and monitoring of your factory floor assets



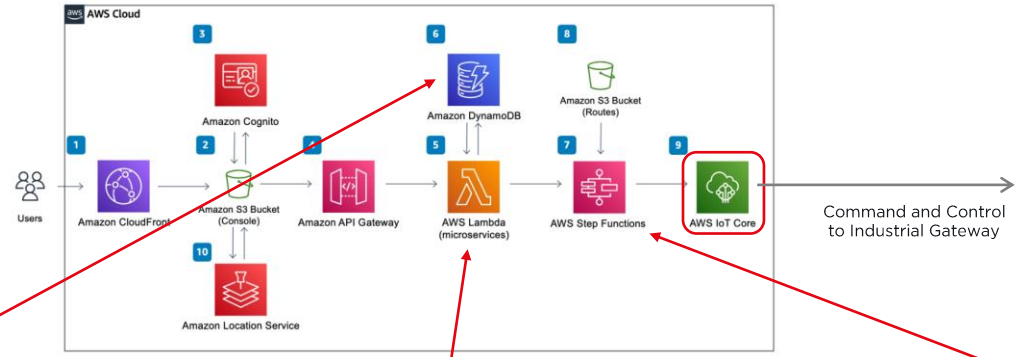
Collection of data through OPC-DA and OPC-UA protocols



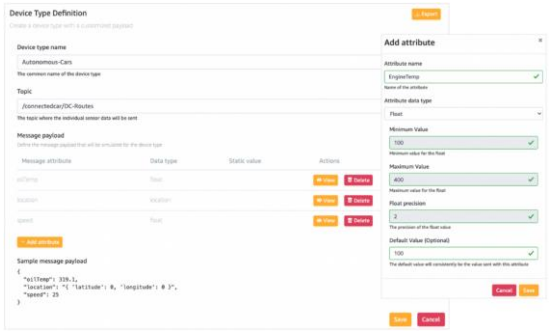
Machine to Cloud Connectivity Framework (M2C2) to monitor and review the current state of connections.

IoT Device Simulation

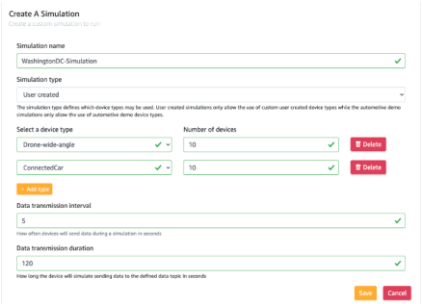
Test Device Integration and Backend Services... or Evaluate Scenarios



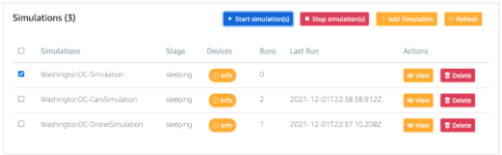
Create device types and data attributes



Create and Manage simulations over number of devices



Run multiple simulations and use data generated for Test and Evaluation



Recap: Operation Process Digital Twin

Performance Optimisation using Generated Data from Simulation

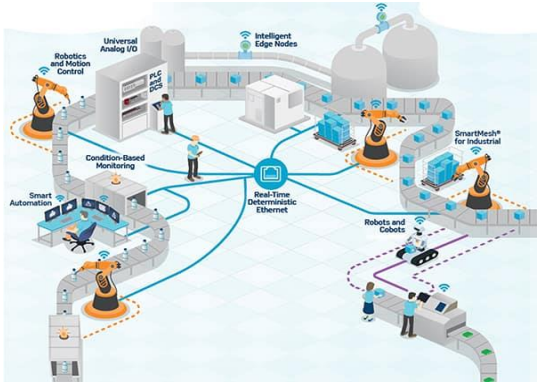
Process Implementation **(Process Optimisation Loop)** **Virtual Testing**

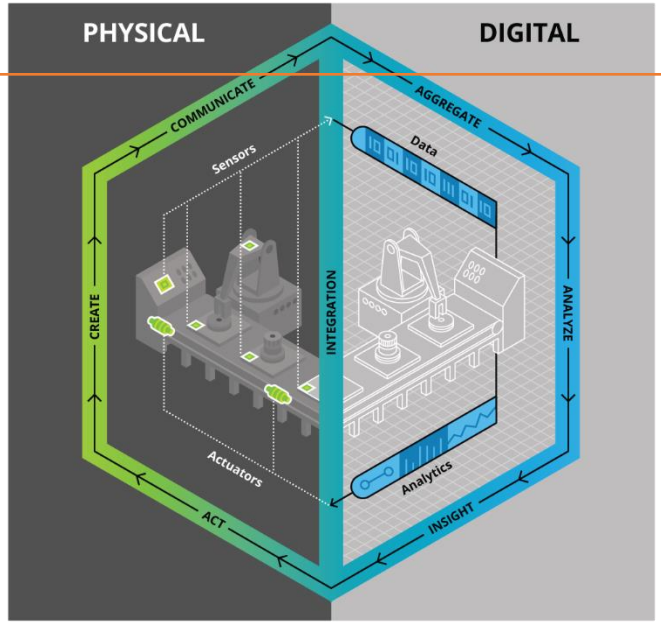
Actual System Configuration → Process Simulation

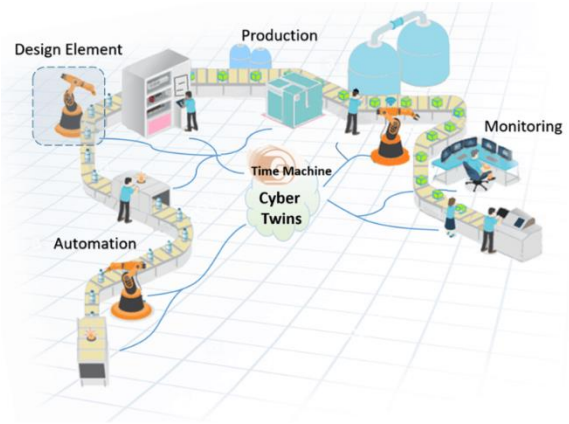
System Operation ↓

Measurements from Sensors → Live Monitoring + Data Capture

Event Data Inputs







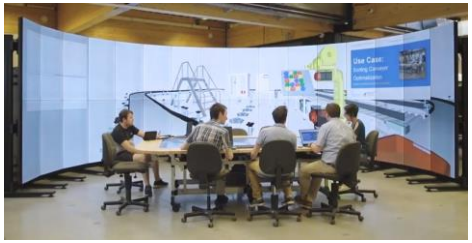
Physical-Digital Convergence

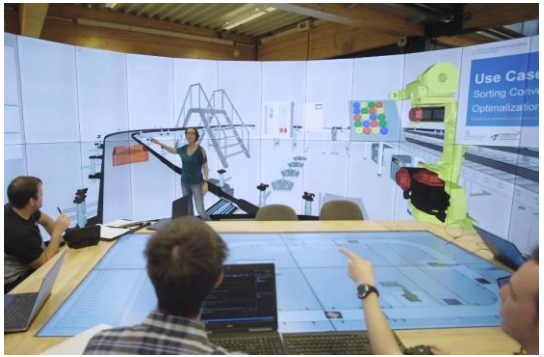
Welcome to
Digital Enterprise Performance

Next: Insights from Analytics & A.I.

Planning and Training with Digital Twins

Leveraging the Visualisation and Simulation Functionality





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www.press.bmwgroup.com/global/article/detail/T0294345EN/

Sustainability with Digital Twins

Load Optimisation of Power Consumption Performance

Desired Outcome: the most efficient combination of equipment to achieve the lowest power consumption while satisfying the load

Opportunity: Equipment Configuration AND Telemetry in a Digital Twin

A. Starting with equipment performance maps as a data-driven model
   - Correlation between equipment input and output, with reference to varying loads
   - Evolve in conjunction with the system conditions and the addition of new data
     1. Review and compare equipment performance maps;
     2. Determine the best equipment settings and configuration;
     3. Sort all valid combinations by calculated totalized power;
     4. For a given load, select a set of maps for **lowest power consumption**

B. Updating a Digital Twin with actual performance data from operations

C. Using a Digital Twin application for load optimisation
   - Maintain a scorecard of performance results.
   - Determine which results are better (than existing performance maps)
   - For a given load, automatically implement the **best calculated combinations**