
# Pragmatic Digital Transformation

## Through the Systematic Use of Data and Models

*Jim Tung*
*MathWorks Fellow*

# Consider the doorbell

Access to the cloud

Add a camera

*Is this still a doorbell?*

Add a motion sensor

 

# Digital transformation has changed the doorbell

## Digital technology

- HD video
- Motion detection
- Smartphone interface
- AWS Cloud


 

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## Business value

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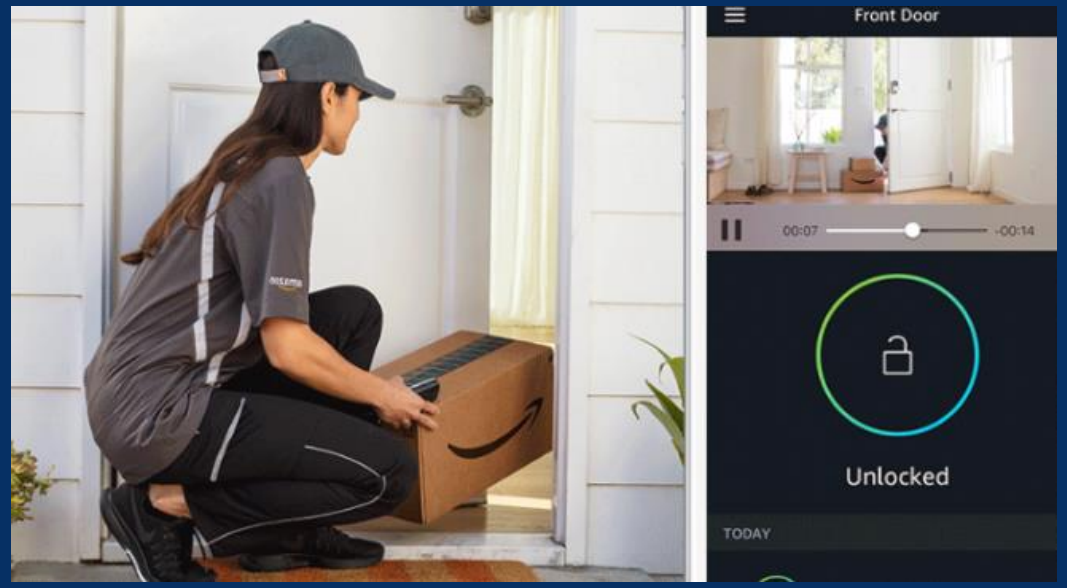
- Amazon buys Ring for $1.2 billion+ in 2018

## New revenue opportunities

- “Ring Protect” subscription plans ($99-$499)
- Additional security with Ring Alarm kit
- More secure delivery through Amazon Key



# Who and what were required to undergo this transformation?

App developers

Smartphone interfaces

Data engineers

System architects

Computer vision

Cloud experts

Wireless systems

Software engineers

Algorithm designers

Image processing

IoT platform

Enterprise systems

Data analytics

Business partnerships

Controls design

Logistics

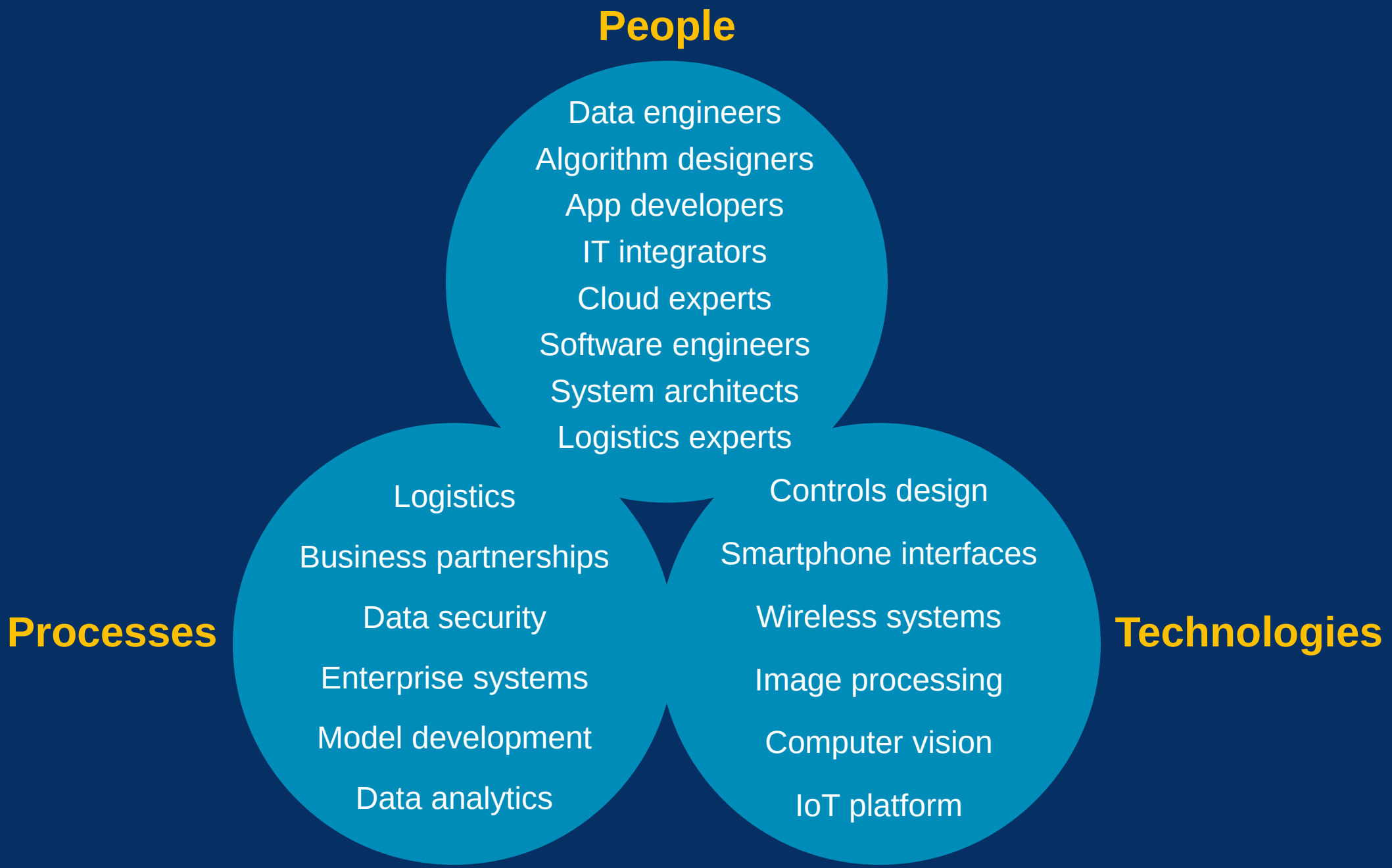
IT integrators

Logistics experts

Model development

Data security



# More than just doorbells …

## Industrial Automation

Individually customized manufactured units

## Automotive


Fully autonomous driving capabilities

## Utilities & Energy

Increased energy efficiency with predictive maintenance

## Medical


Wearable devices to monitor mental health

## Aerospace

Global management of aircraft fleet

## Finance

Real-time data analytics for predictive insights

# Why Digital Transformation?

**Do things better**
**Optimization**

- Optimize design performance in-operation
- Predict when system needs maintenance
- Manage a fleet of connected systems

**Do new things**
**Transformation**

# Why Digital Transformation?

## Do things better
## Optimization

- Optimize design performance in-operation
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## Do new things
## Transformation

- Go into new industries and markets
- Expand into an entire platform service
- Provide unique value to your customer

**The doorbell illustrates both types**

Plan and Pilot **Launch!**

**Expected project duration**

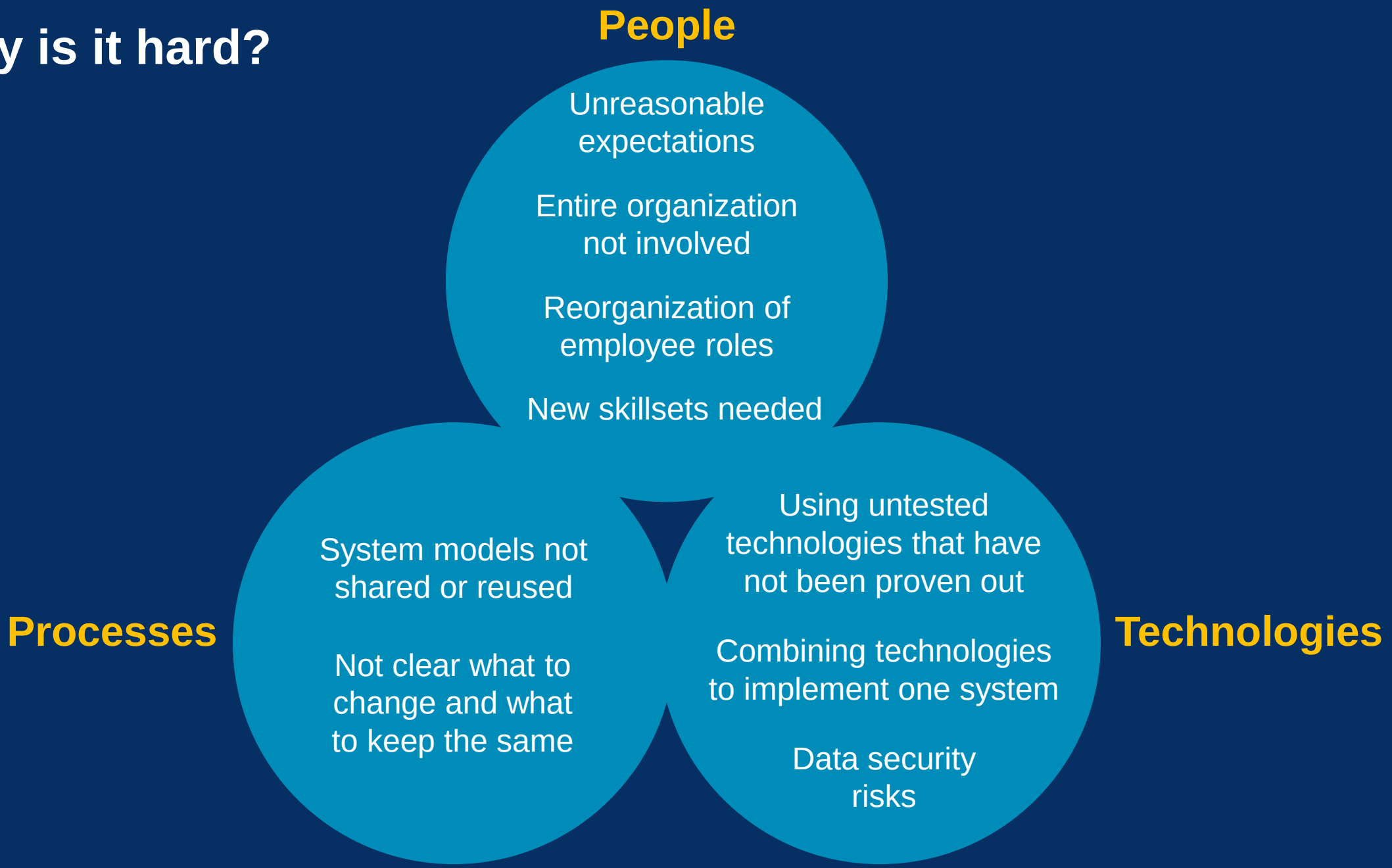
**Actual project duration**

Plan | Plan Some More | Pilot | Keep Piloting | **Launch?**

**< 20% of organizations are on target with their digital transformation objectives**

Source: McKinsey, *Can IT Rise to the Digital Challenge?*, October 2018.

# Why is it hard?



# What approaches have people tried?

**Big Bang Approach**

Build complete infrastructure first

Value not delivered to customer

Risky

**Pragmatic Approach**

Build on models you already have

Extend beyond siloed use of data

Unleash untapped value

**Siloed Approach**

Each group works in own silo

Stuck in business model

Obsolete

# Pragmatic Digital Transformation

**Systematic** use of data and models
to **create** and **deliver** superior value to customers
**throughout the entire lifecycle**

# Systematic Use of Data

# Data centralization has made engineering even more difficult

Field data

System data

User data

Environment data

Big Data

databricks hadoop CLOUDERA

Cloud Platforms

docker amazon web services Azure

## Data diversity complexity

- Engineering, Scientific, and Field
- Business & transactional
- Noisy, Outliers, Missing data
- Time series synchronizing

## Modern data management multiplies complexity

- Proliferation of data systems
- More siloes
- Cloud, on-premise, hybrid
- Big Data

# Example: GSK Consumer Healthcare

## Using big batch process data to make better products


**£1 billion brand**

~8% growth

Close to capacity at all 20+ factories


"Trying to squeeze every last drop of efficiency …
Last thing we want to do is build another toothpaste factory"
Dr. Bob Sochon

# Challenge #1: Big data lives in many siloes

**Formulations Archive**

Mix
Formulation
Year, month, date, time
Operators

**Production Process**

Every process variable!
Vessel temperature
Batch properties
Mixer/formula concentrations

20 factories
5 years of data
Top-10 formulations

10,000 batches

**Terabytes of data**

**Sales History**

What people are buying
What stores are selling
What time made

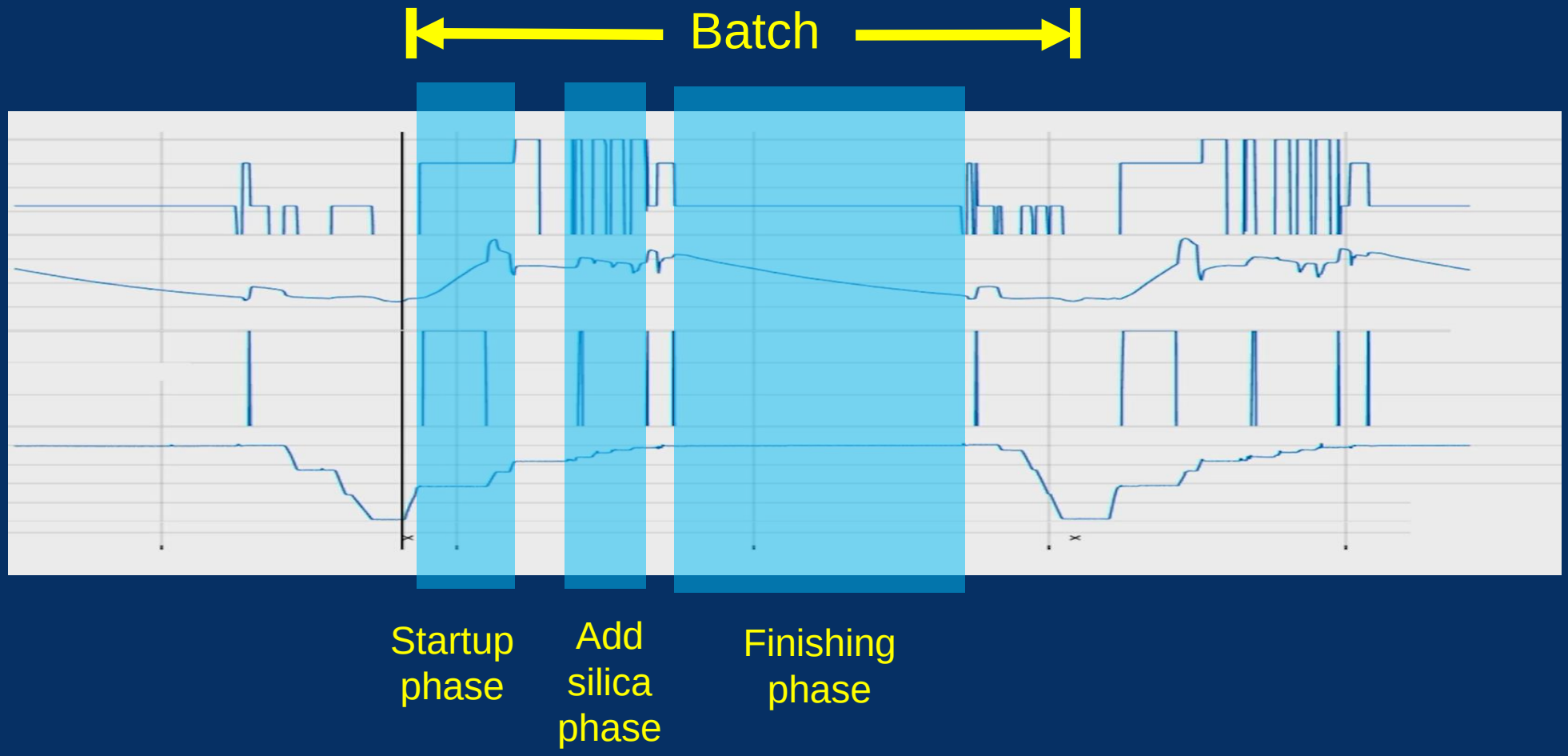
**Excel Files**

Miscellaneous
Historical

## Used MATLAB to combine and clean data

# Challenge #2: Need systematic pre-processing

**Production Process**




**Used MATLAB to sort and tag data by phase**

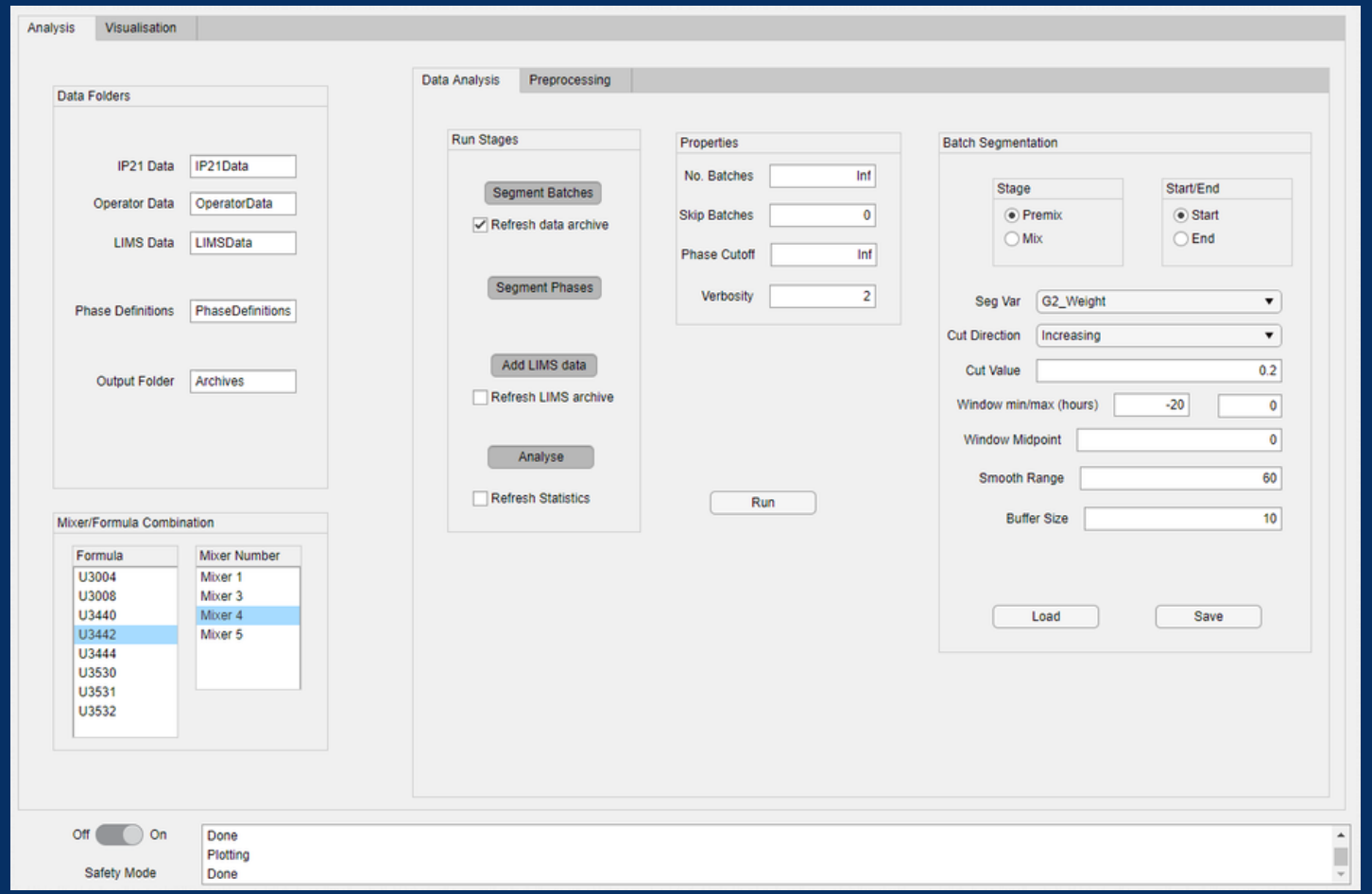
# Challenge #3: Need systematic views of data

**Formulations Archive**

**Sales History**

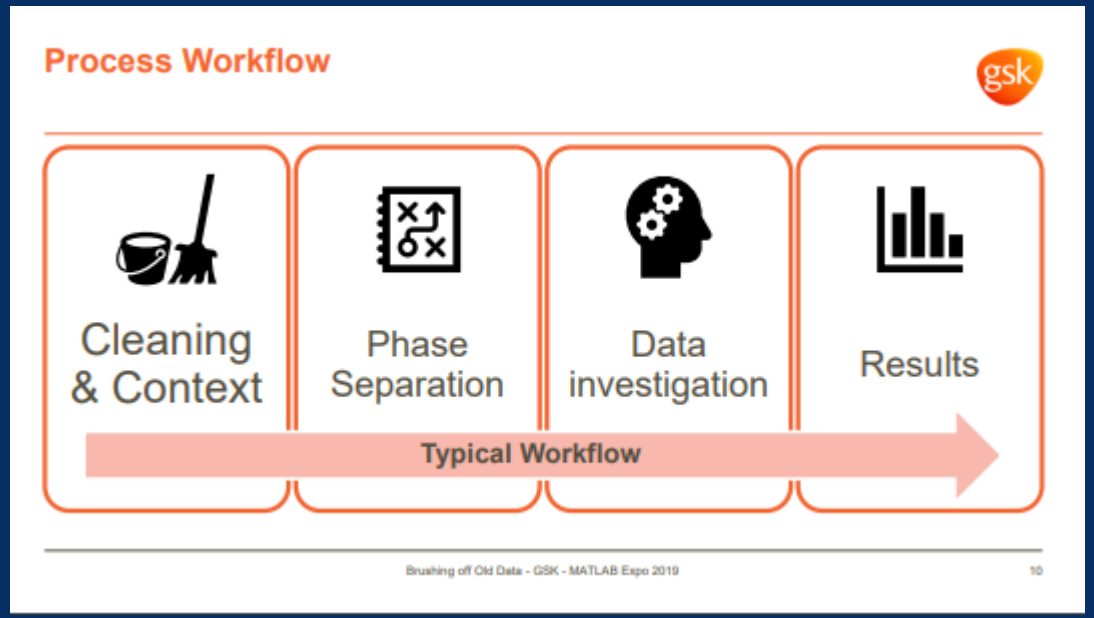
**Production Process**

**Excel files**




**Used MATLAB to build views**

# Results of Digital Transformation at GSK




## Systematic use of data

- Combine siloed data
- Sort and tag
- Views to select

## Can now use data to answer questions

- What affects the process
- How is each phase performing
- What happens if we adjust parameters

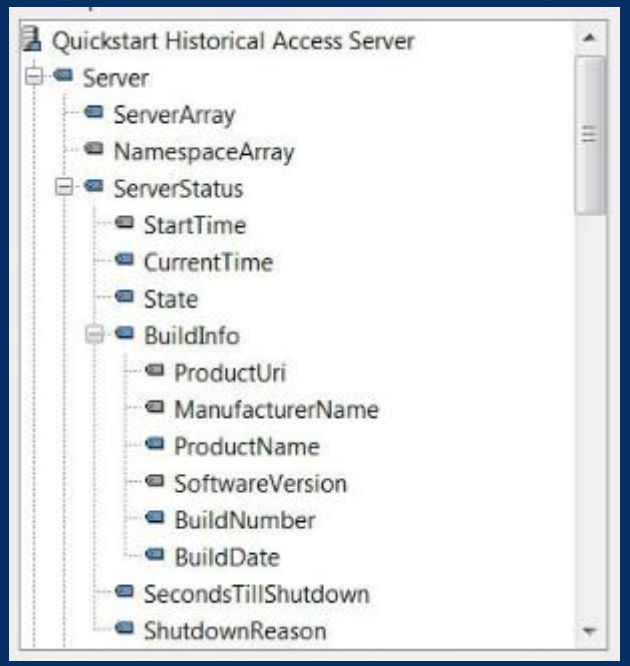
## Benefits

- Reduced time to market for new formulas
- Automated reports for process improvement
- Added capacity without building a new factory

# What is new to make this easier?

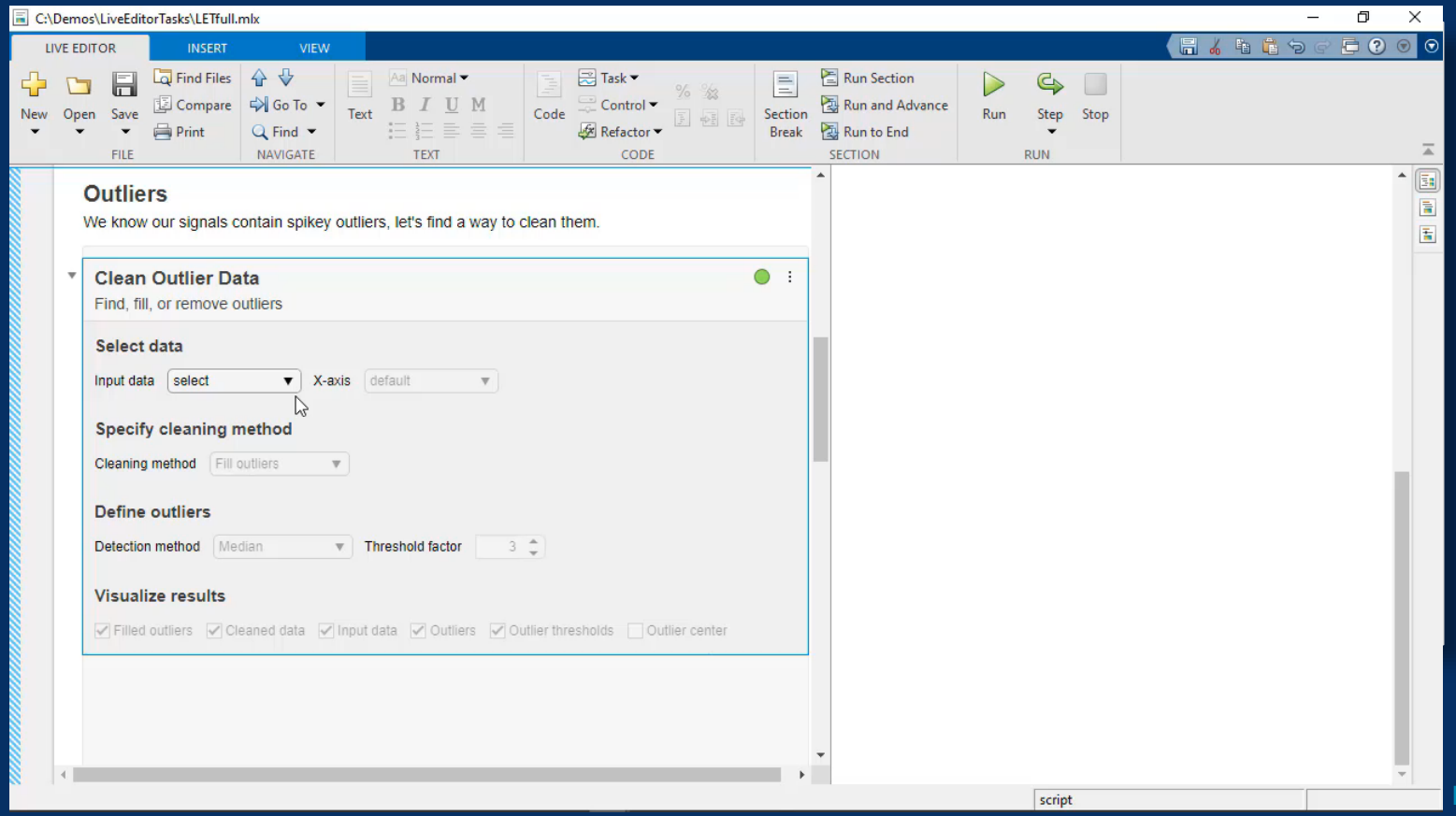
## OPC UA

Access plant data securely from OPC UA-compliant servers.




## Live Editor Tasks

Apps that help you reduce development time and errors



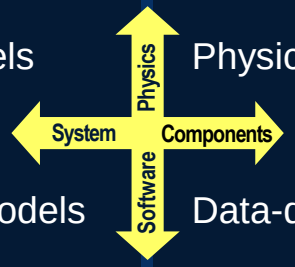

## Predictive Maintenance Toolbox

Design condition indicators and estimate RUL of machinery

# Systematic Use of Models

# Model-Based Design: Systematic Use of Models in Development

| System Requirements | System Functionality and Architecture | Subsystem Design | Subsystem Implementation | System Integration and Qualification |
|---|---|---|---|---|
| Use Cases | Behavior models | Physics-based | C,C++ | Model-based V&V |
| Docs & models | | | VHDL, Verilog | Code-based V&V |
| | Architecture models | Data-driven | GPU code | Certification workflows |
| | | | Structured text | |




**Digital Thread**

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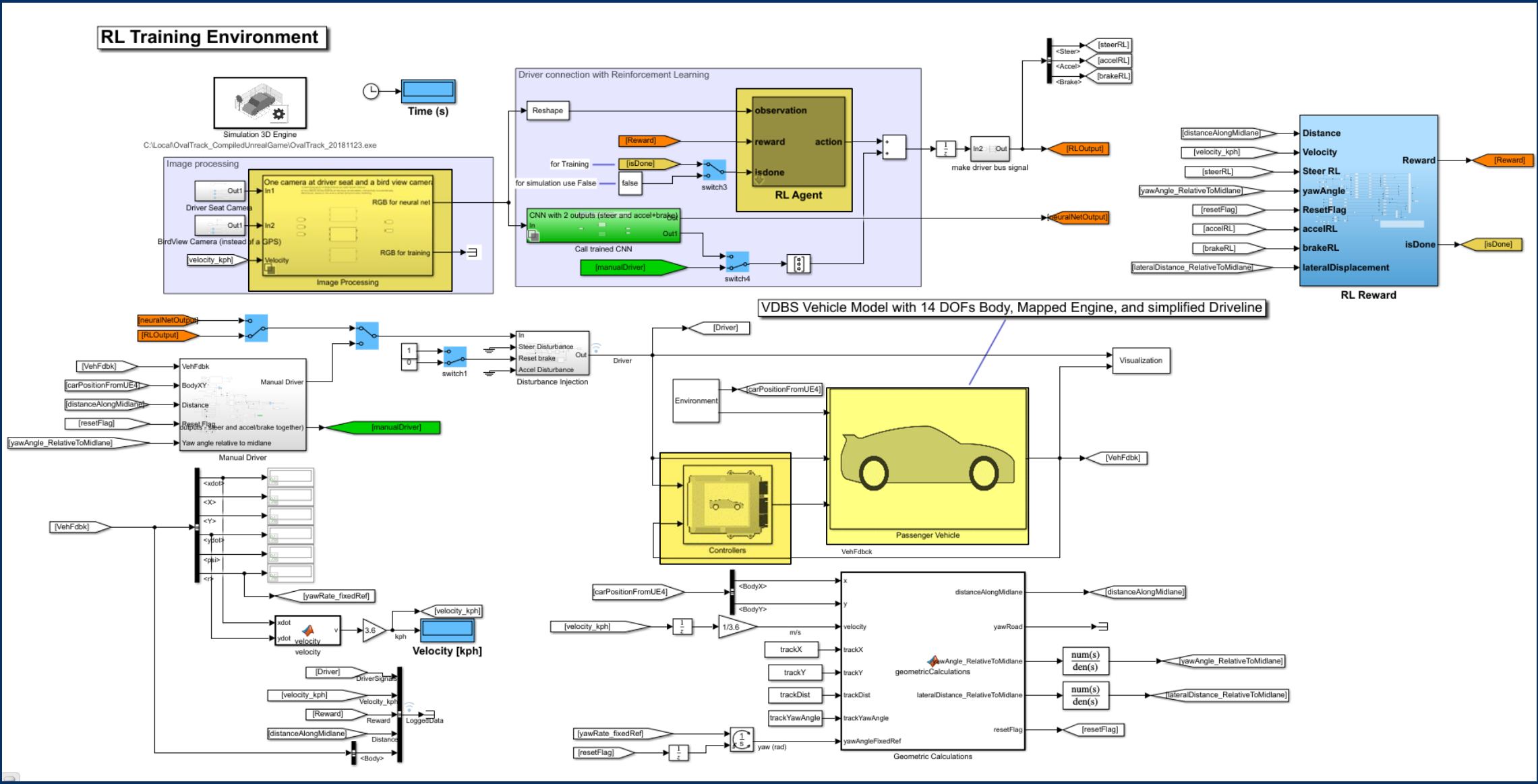
| | AI  | Data labeling<br>Training<br>Quantizing | C,C++<br>GPU code | AI Integration in Simulink models |

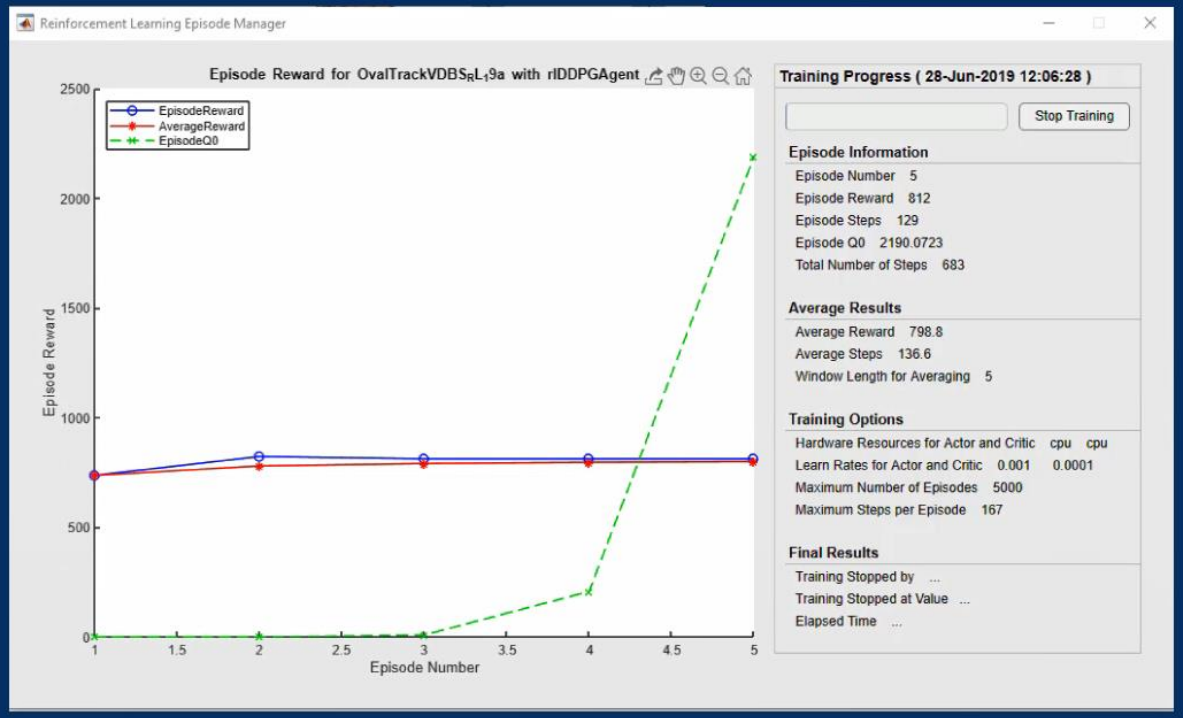


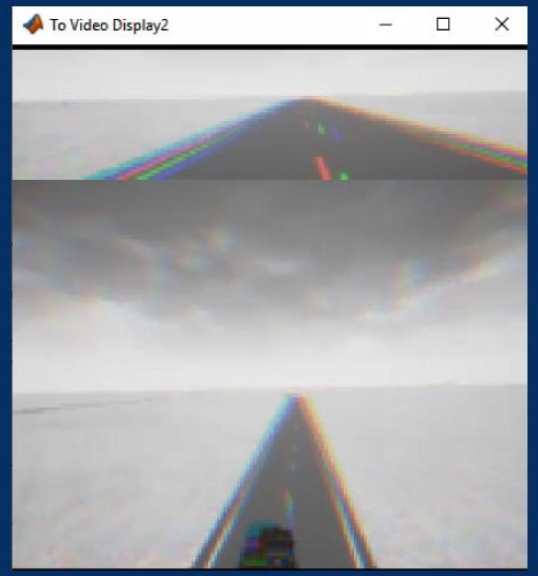
 

# Example: Reinforcement Learning for Autonomous Vehicles

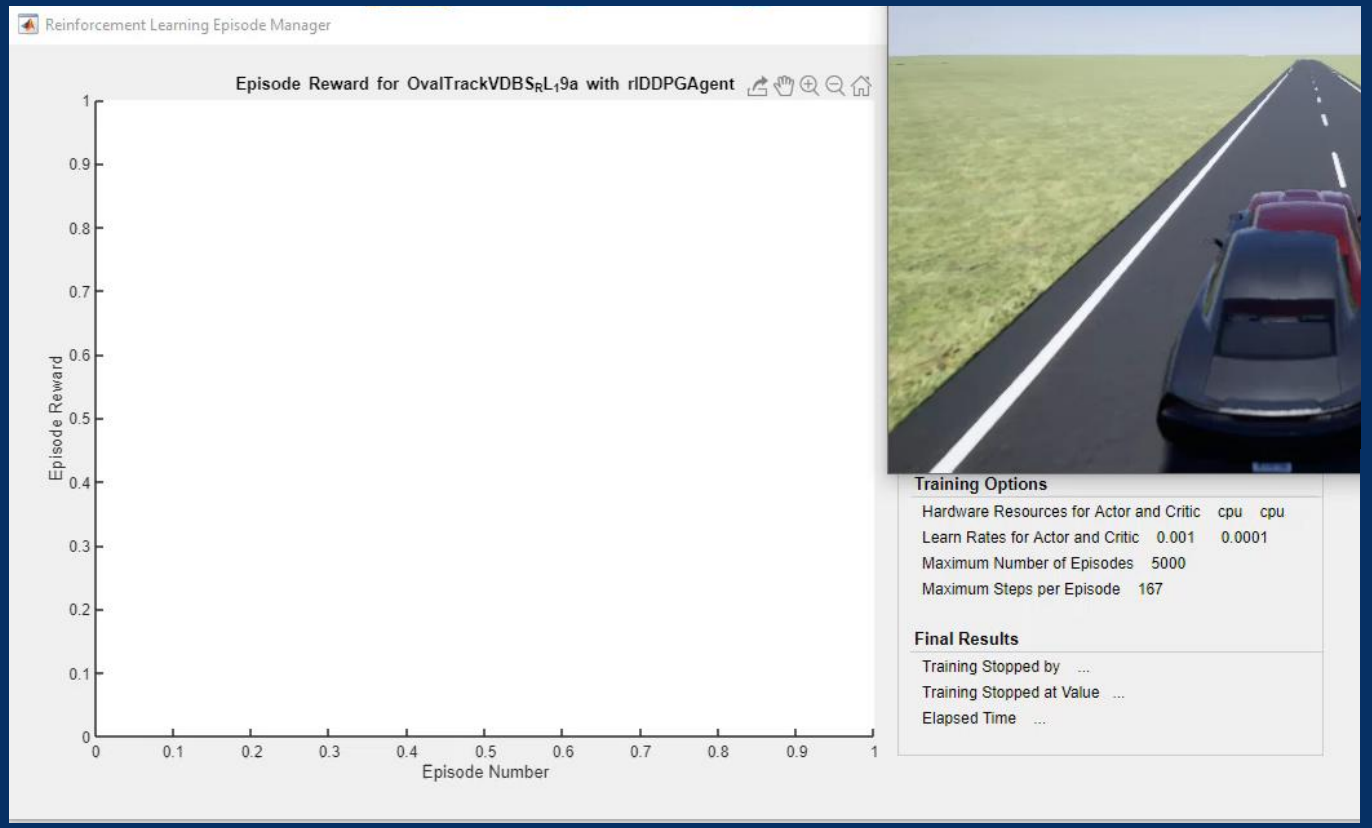


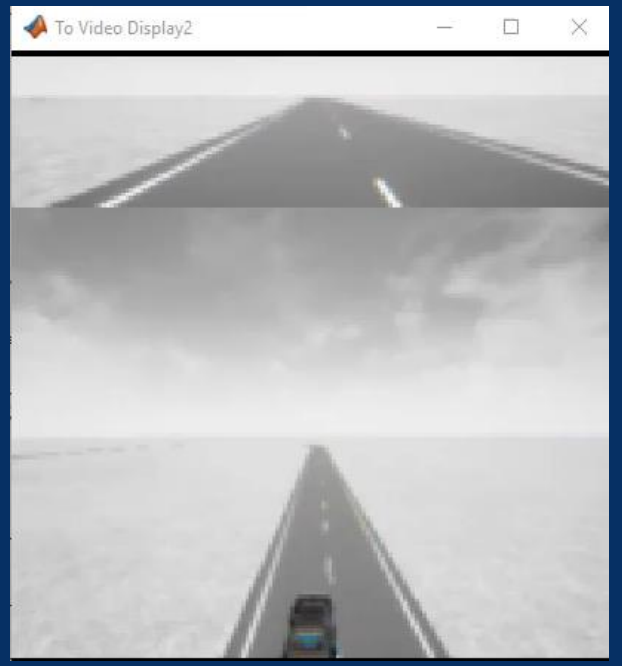

 



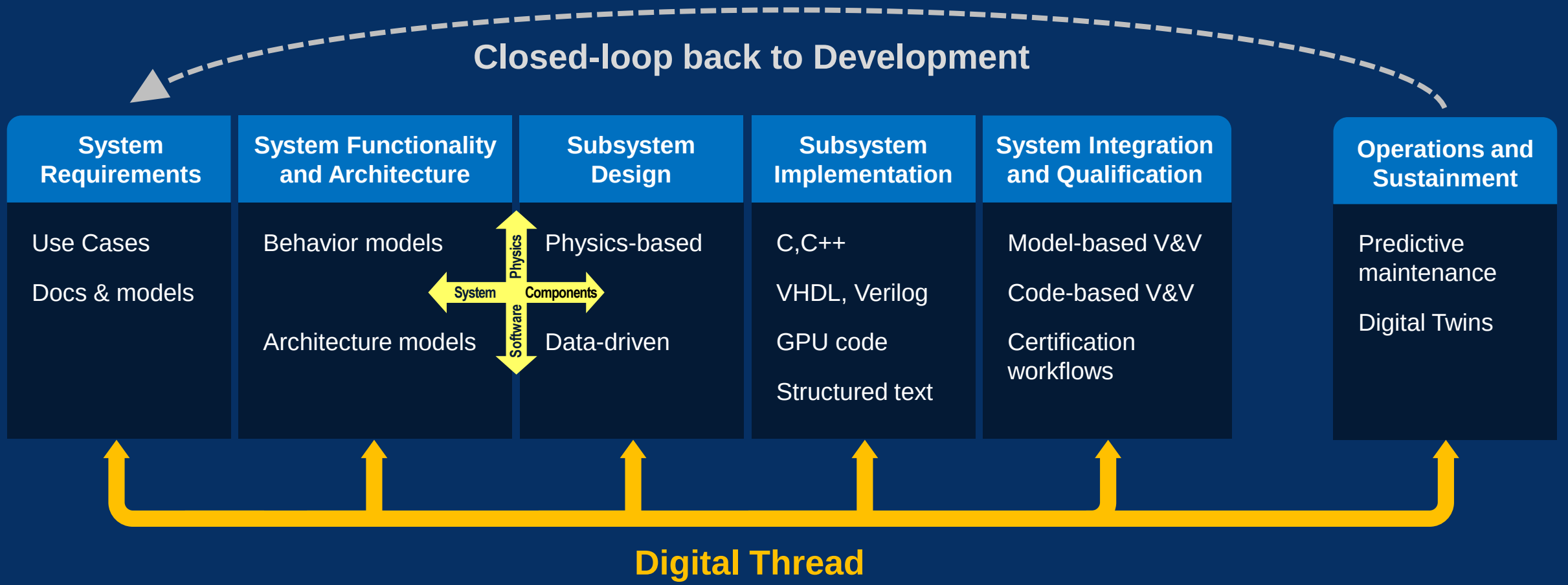

 



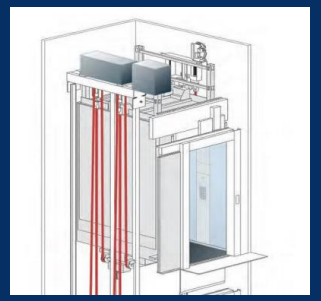
# Extending Through the System's Lifecycle



# Case Studies: Use of Data and Models in Operation

Atlas Copco: Digital thread for compressor systems



Schindler Elevator: Virtual commissioning

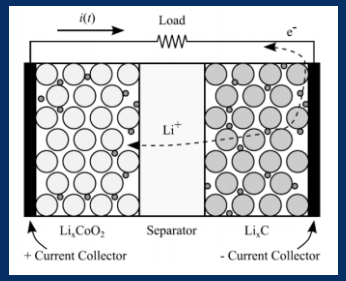
BuildingIQ: Predictive energy optimization


Tata Steel: Controller optimization

Fuji Electric: Real-time analysis of Smart Grid

Lockheed: Aircraft fleet management

Mining company: Fault detection and predictive maintenance




NIO: Battery management for electric vehicles

# Atlas Copco: Challenges

Air Compressor System

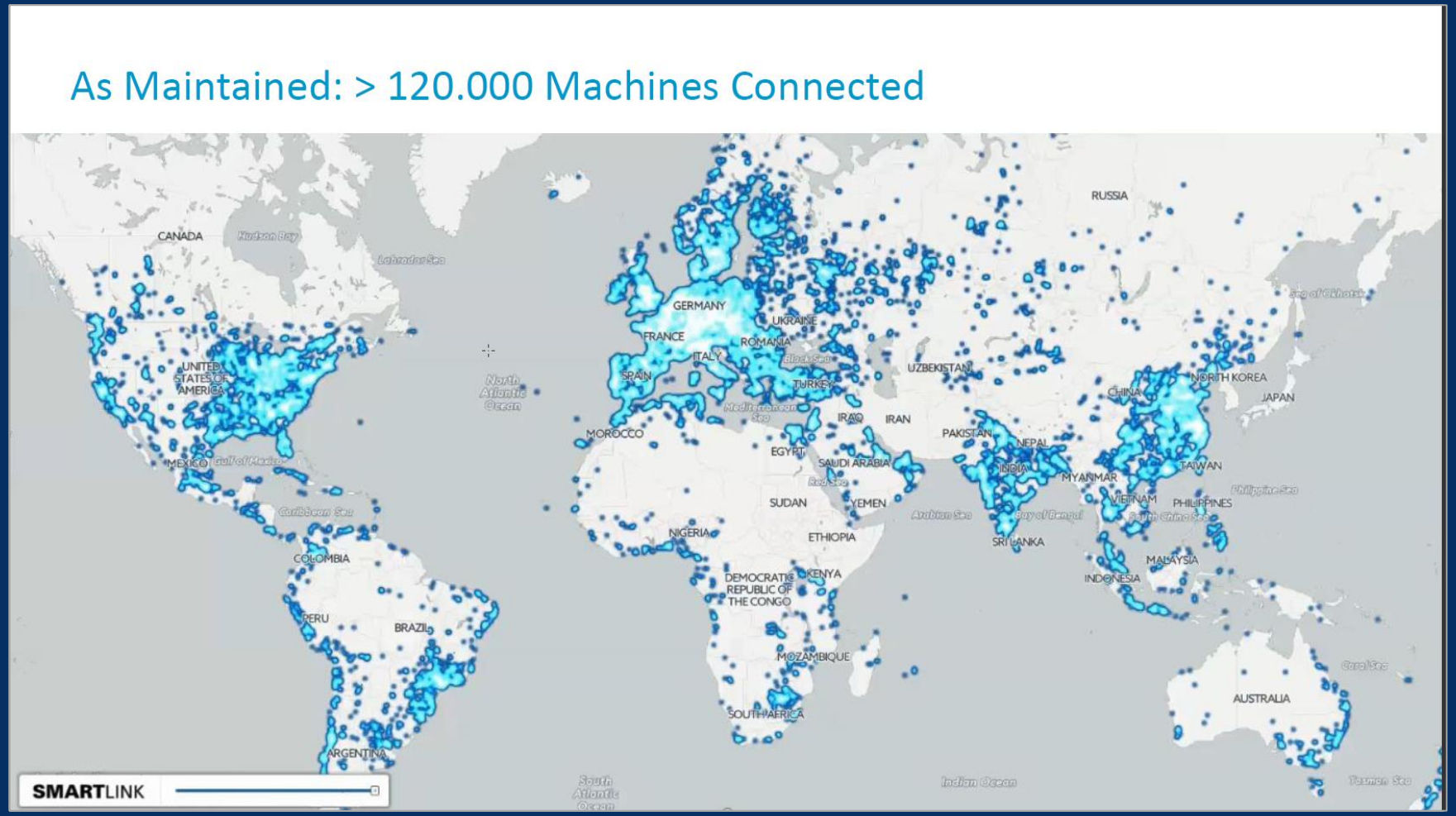
- Shorter Time to Market
- Cross divisional development
- Improve reliability and efficiency
- Control total development, production and service costs
- High product variability

# Atlas Copco

## System Lifecycle Use with MATLAB & Simulink

**As Designed**
**As Configured**
**As Produced**
**As Maintained**



# As Achieved: Standardized Model Based Engineering Platform

**Process**

- Company-wide workflow
- Used throughout product lifecycle
- Optimized maintenance and Data Analytics platform
- Continuously updated digital twins

**People**

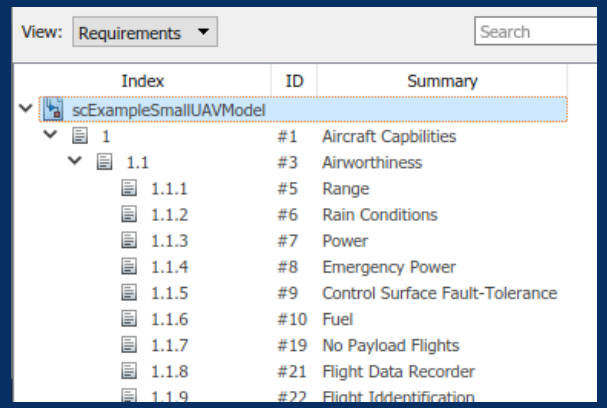
- Collaboration platform for efficient communication
- Standardized accurate configuration tool used by global sales

**Results**

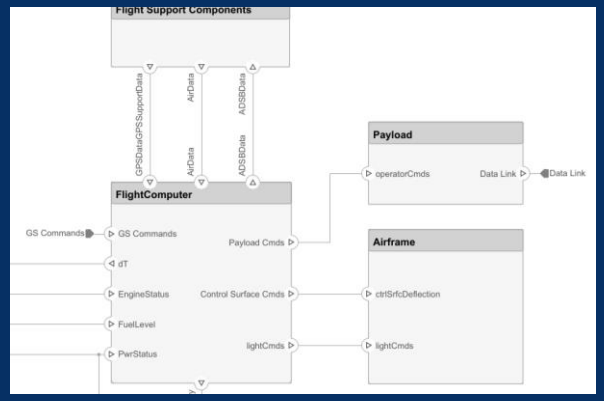
- 120k+ connected machines
- Quick implementation of upgrades
- Re-establishing Atlas Copco as undisputed global market leader

# What is new to make this easier (more powerful/effective)?

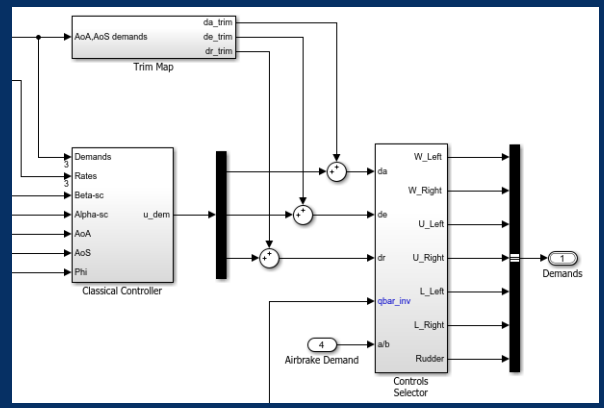
## Simulink Requirements




## System Composer




## Simulink



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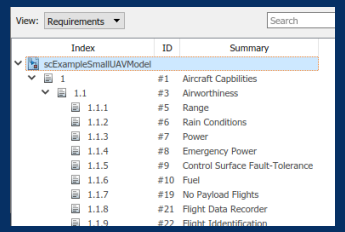


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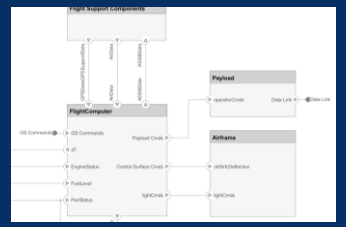

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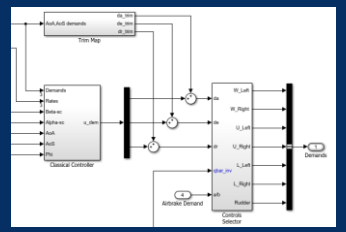

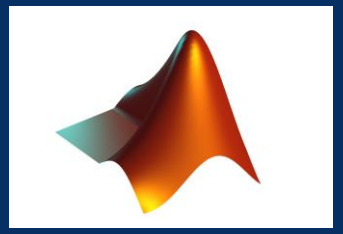

**MATLAB**

## Digital Twins and Predictive Maintenance

**Big Data/Dashboards**

Power BI, tableau, TIBCO Spotfire, databricks, hadoop, CLOUDERA

**Cloud**

docker, amazon web services, Azure, kafka, Amazon Kinesis, Azure Stream Analytics

**Edge**

Windows, SCADA, Modbus, TCP/IP, MQTT

**Embedded**

intel, ARM, NXP, STM, NVIDIA, XILINX

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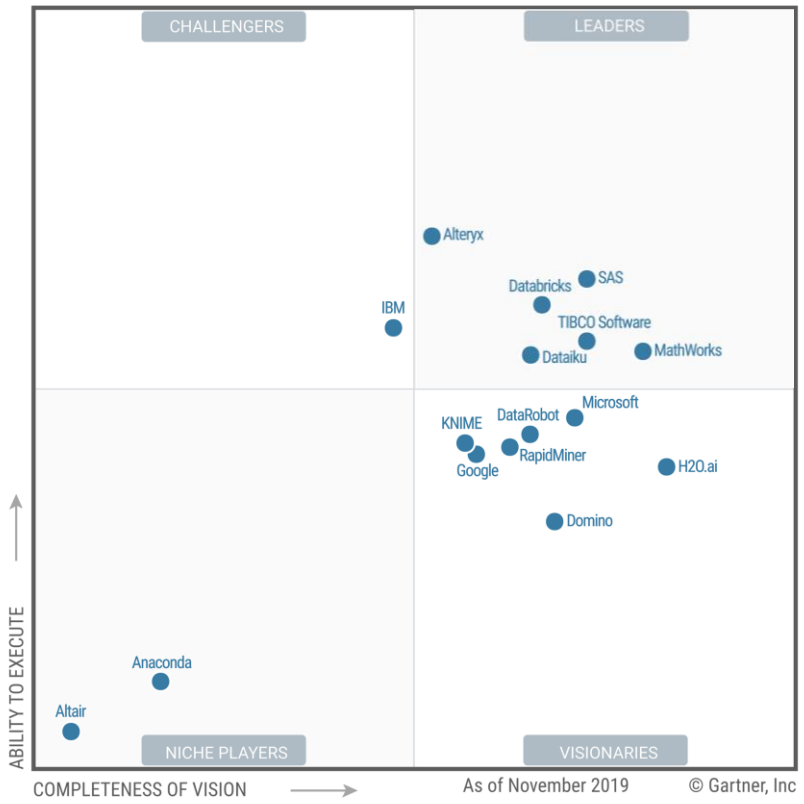
# A **Leader** in the Gartner Magic Quadrant for 2020 Data Science and Machine Learning Platforms

**Figure 1. Magic Quadrant for Data Science and Machine Learning Platforms**




Source: Gartner (February 2020)

*Gartner Magic Quadrant for Data Science and Machine Learning Platforms, Peter Krensky, Erick Brethenoux, Jim Hare, Carlie Idoine, Alexander Linden, Svetlana Sicular, 11 February 2020 .

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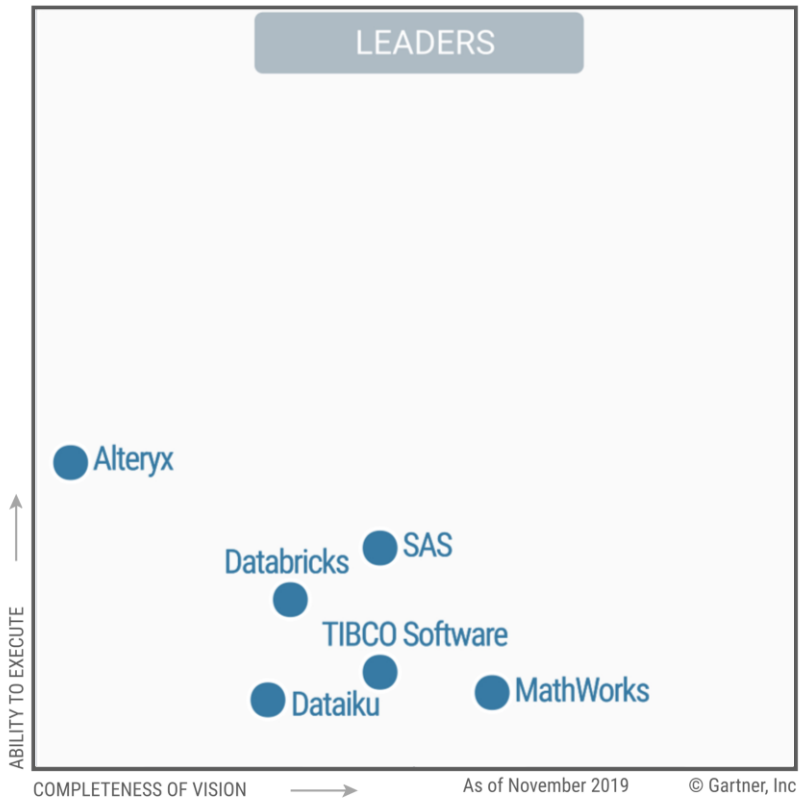
# A **Leader** in the Gartner Magic Quadrant for 2020 Data Science and Machine Learning Platforms

*We believe this recognition demonstrates our ability to:*

- Empower teams, even those with limited AI experience
- Support entire AI workflows
- Deploy to embedded, edge, enterprise, and cloud
- Tackle integration challenges
- Manage risk in designing AI-driven systems

**Figure 1. Magic Quadrant for Data Science and Machine Learning Platforms**

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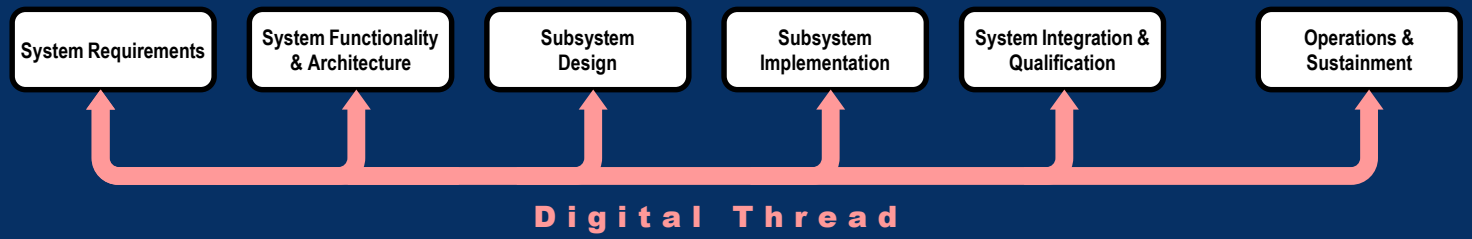
# Why MathWorks for Pragmatic Digital Transformation?

Systematic use of data and models

MATLAB® & SIMULINK®

to create and deliver superior value to customers

throughout the entire lifecycle



Keep in mind today:

How can you systematically use models and data as part of your pragmatic digital transformation?

Enjoy the Conference!