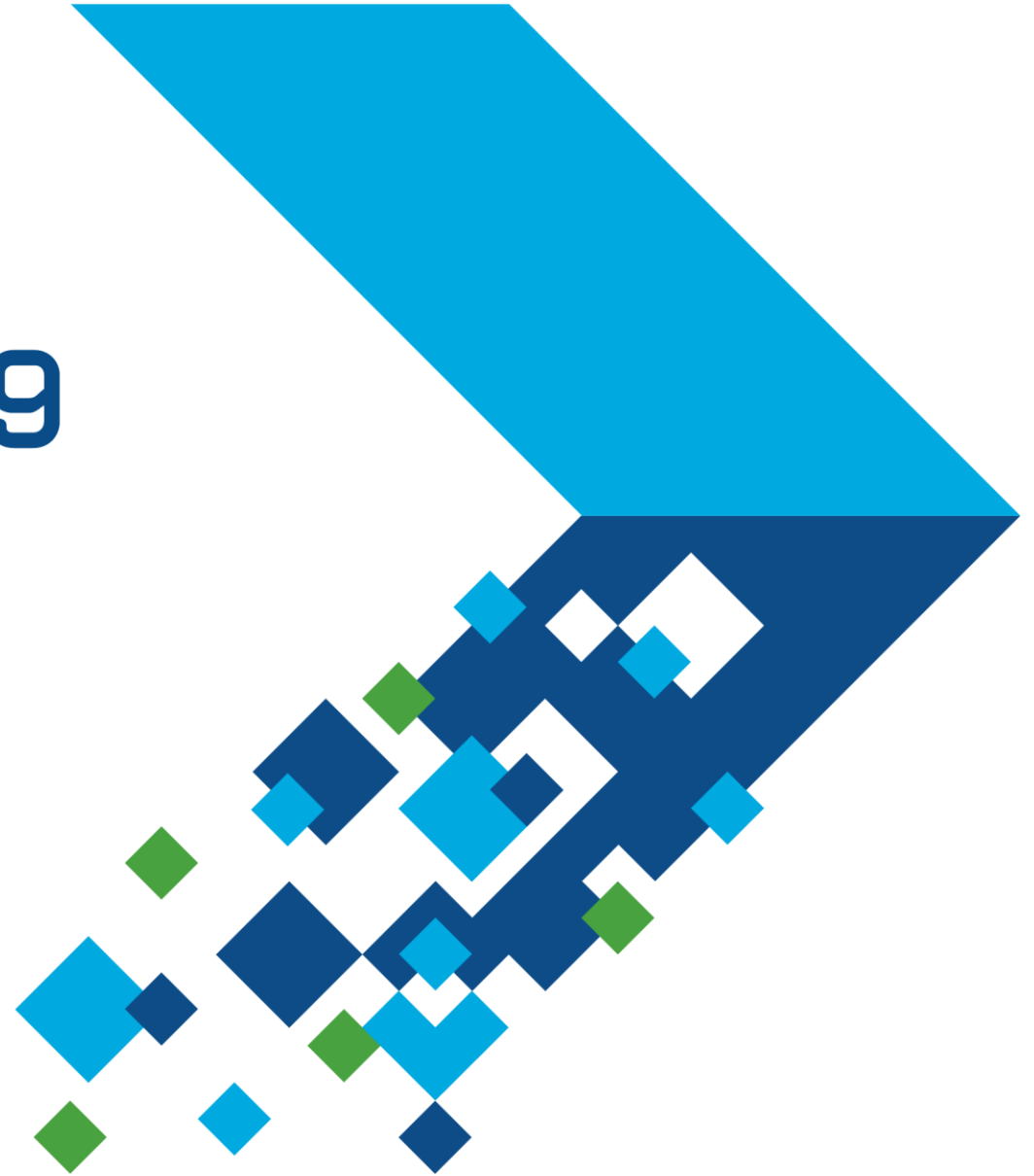


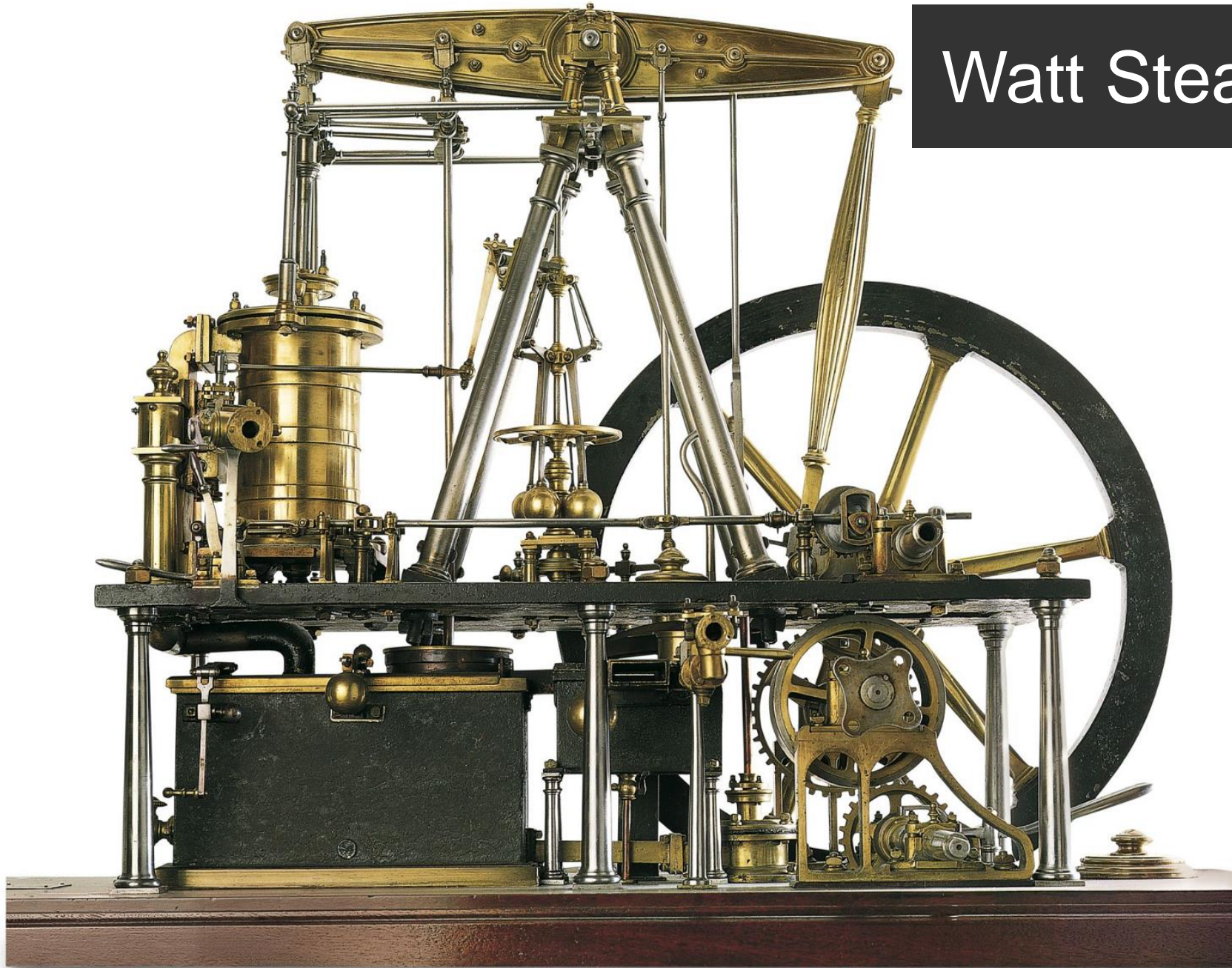
MATLAB EXPO 2019

Beyond the “I” in AI

Jim Tung
MathWorks Fellow



Watt Steam Engine



Artificial intelligence is a transformative technology

McKinsey Global Institute

Notes from the AI frontier: Modeling the impact of AI on the world economy

September 2018 | Discussion Paper

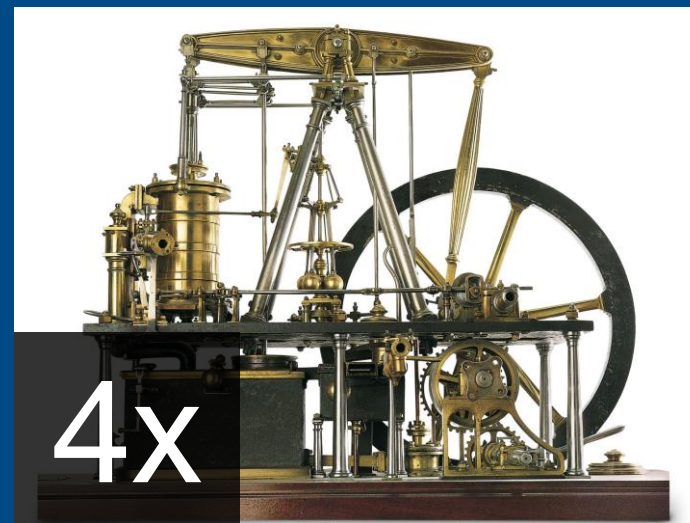
AI will create \$13 trillion in value by 2030

based on McKinsey's latest AI forecast – September 2018

AI has tremendous potential to increase productivity



=



Yet AI is struggling



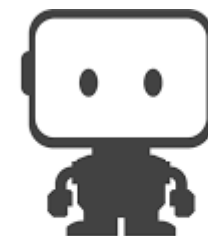
Most AI Projects Fail. Here's How to Make Yours Successful.

July, 2018



3 Common Reasons Artificial Intelligence Projects Fail

May, 2018



DataRobot

Why Most AI Projects Fail

Oct, 2017

There are many ways Artificial Intelligence can **fail**

No data
scientists

Incomplete
tools

Beyond the skill
of the team

Can't interact with
other systems

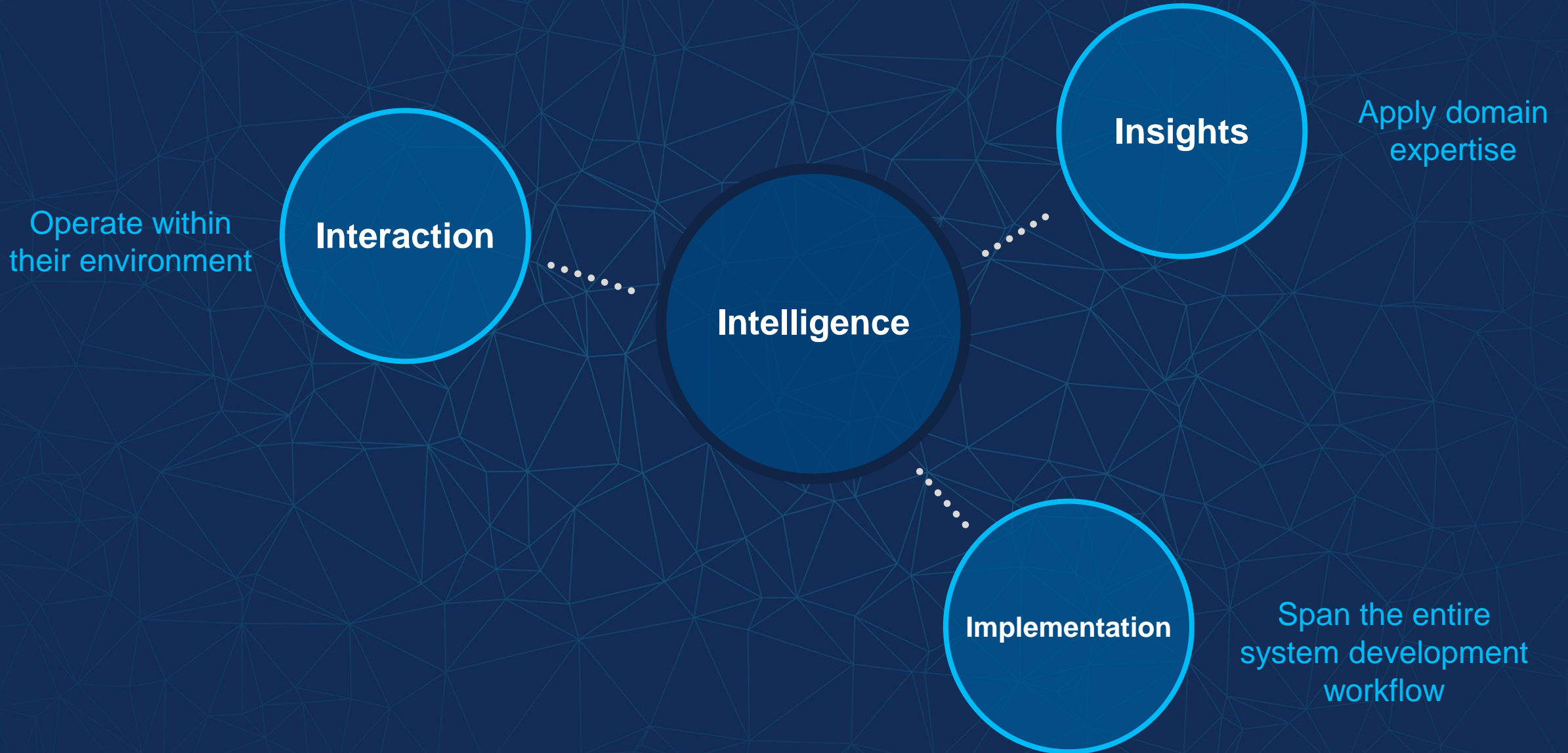
Too much data

Low ROI

Not enough data

Problem is a
poor fit for AI

AI is more than just the intelligence of the algorithm



Operate within
their environment



Interaction



Intelligence



Implementation

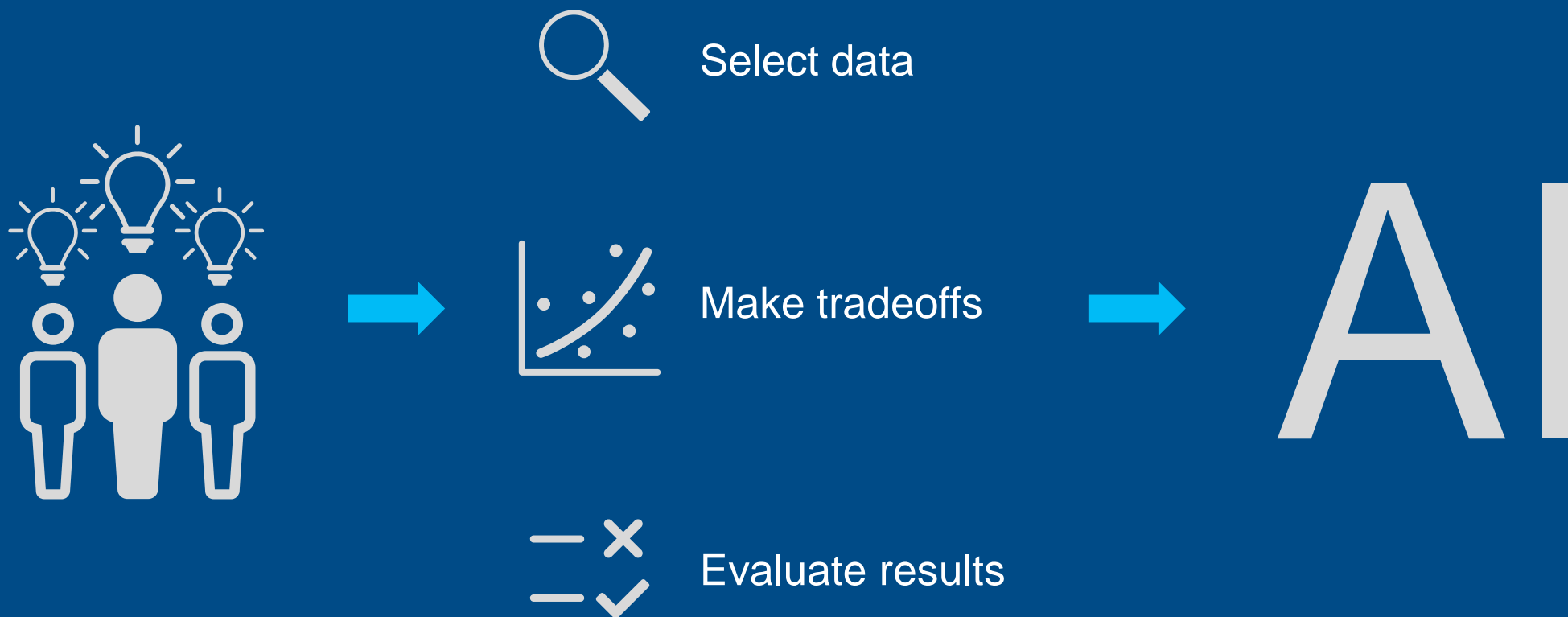
Span the entire
system development
workflow



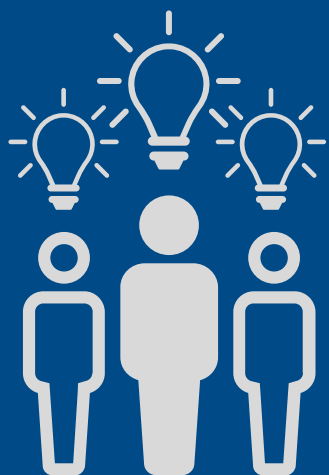
Insights

Apply domain
expertise

Bring human insights into AI



Bring human insights into AI



- We are the domain experts
- Shortage of data scientists
- We need the right tools

Improving New Zealand Dairy Processing

- University of Auckland
- Auckland University of Technology



Wanted to detect a bad product earlier

Continuous Plant Process

Raw Milk

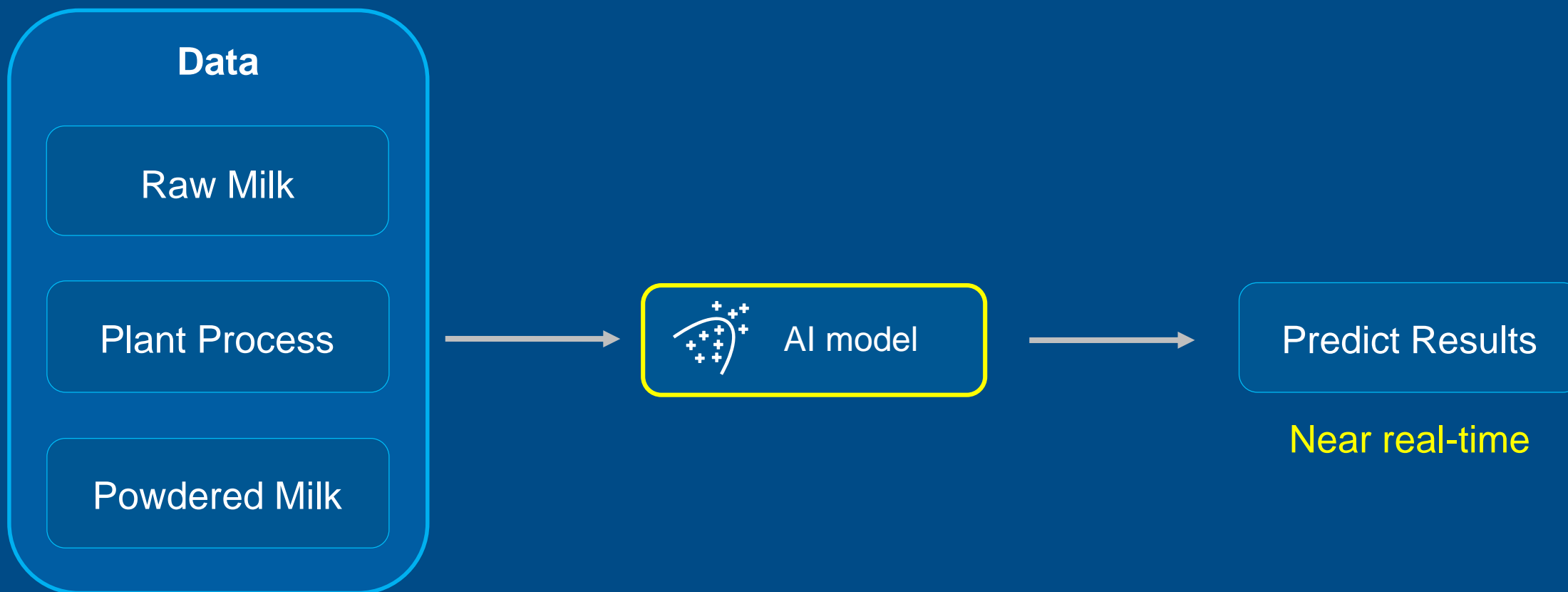


Powdered Milk

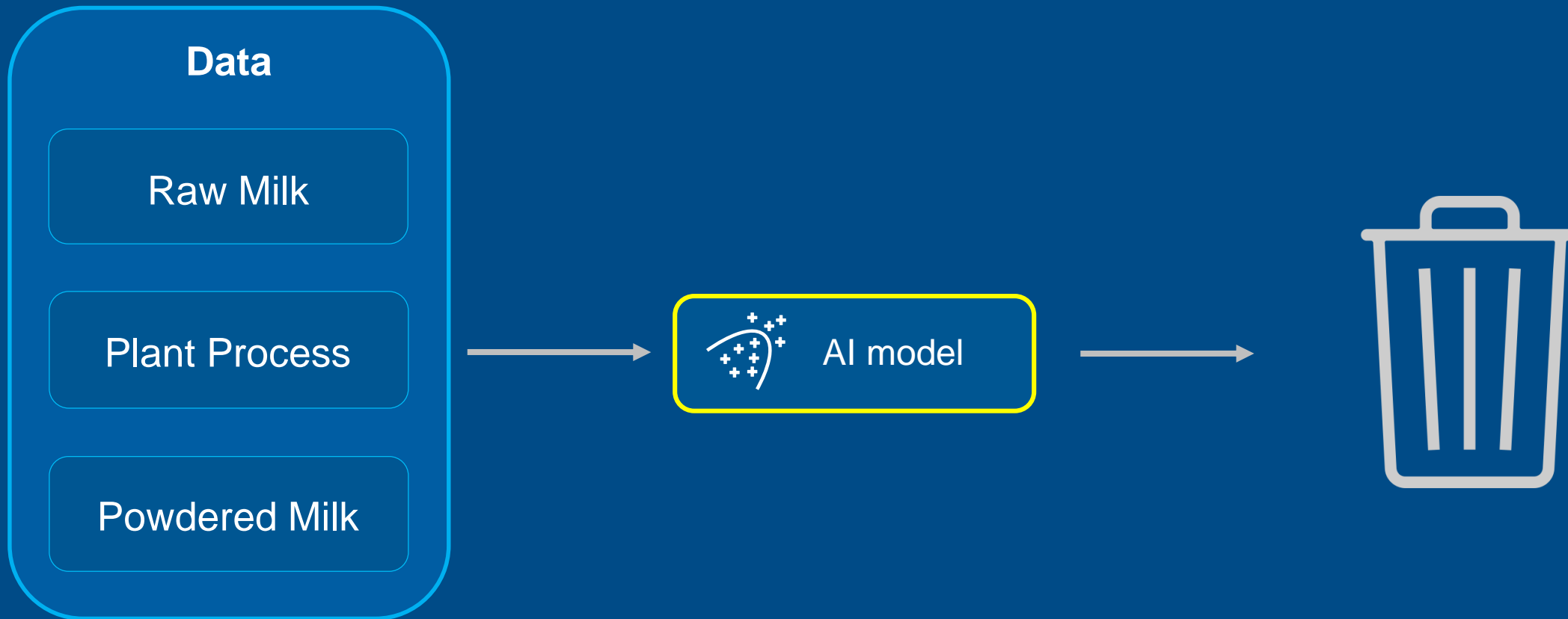


Days later

Wanted to detect a bad product earlier



But...



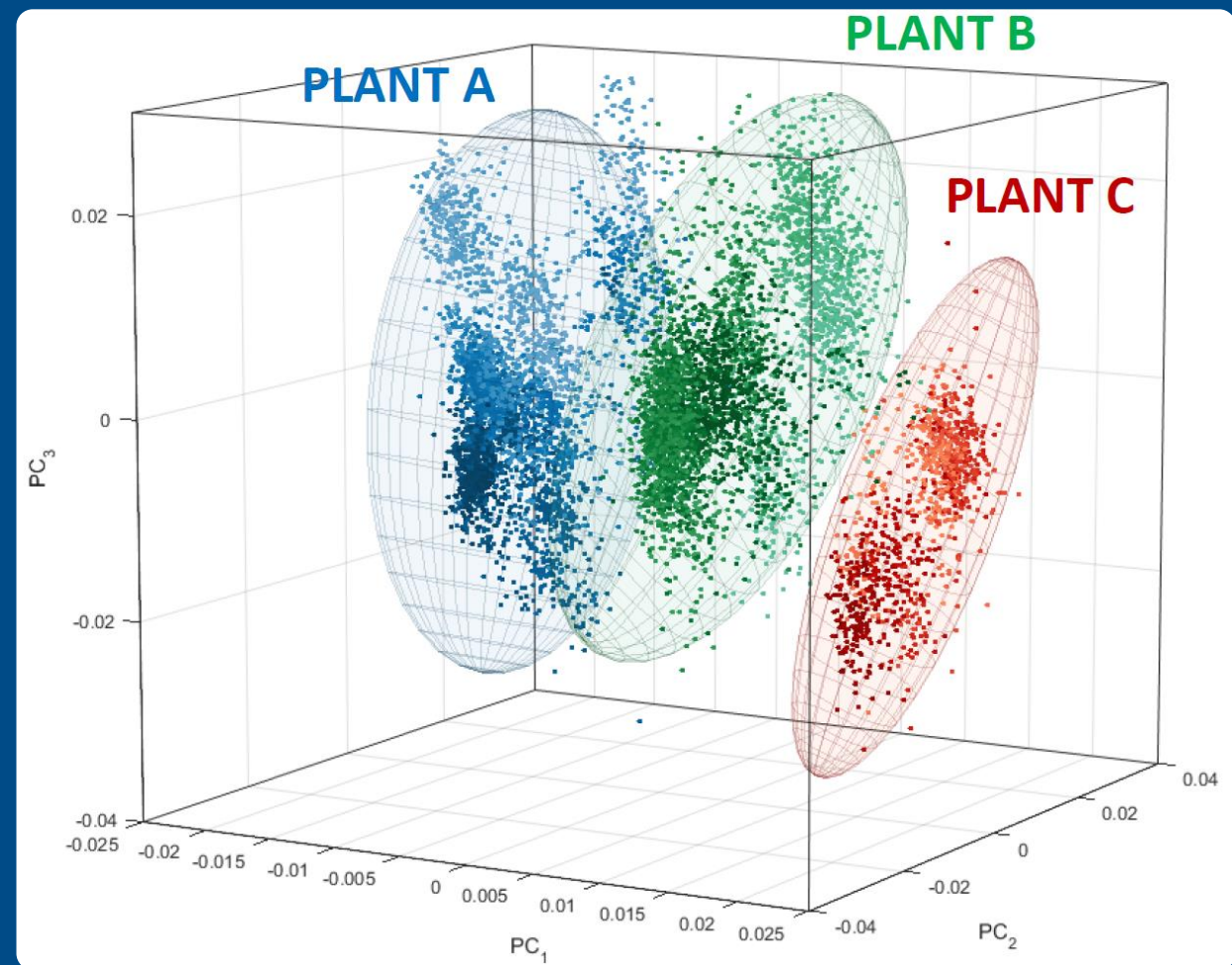
They made several key insights

1. Results were wrong

They made several key insights

1. Results were wrong
2. Need to build a separate model for each plant

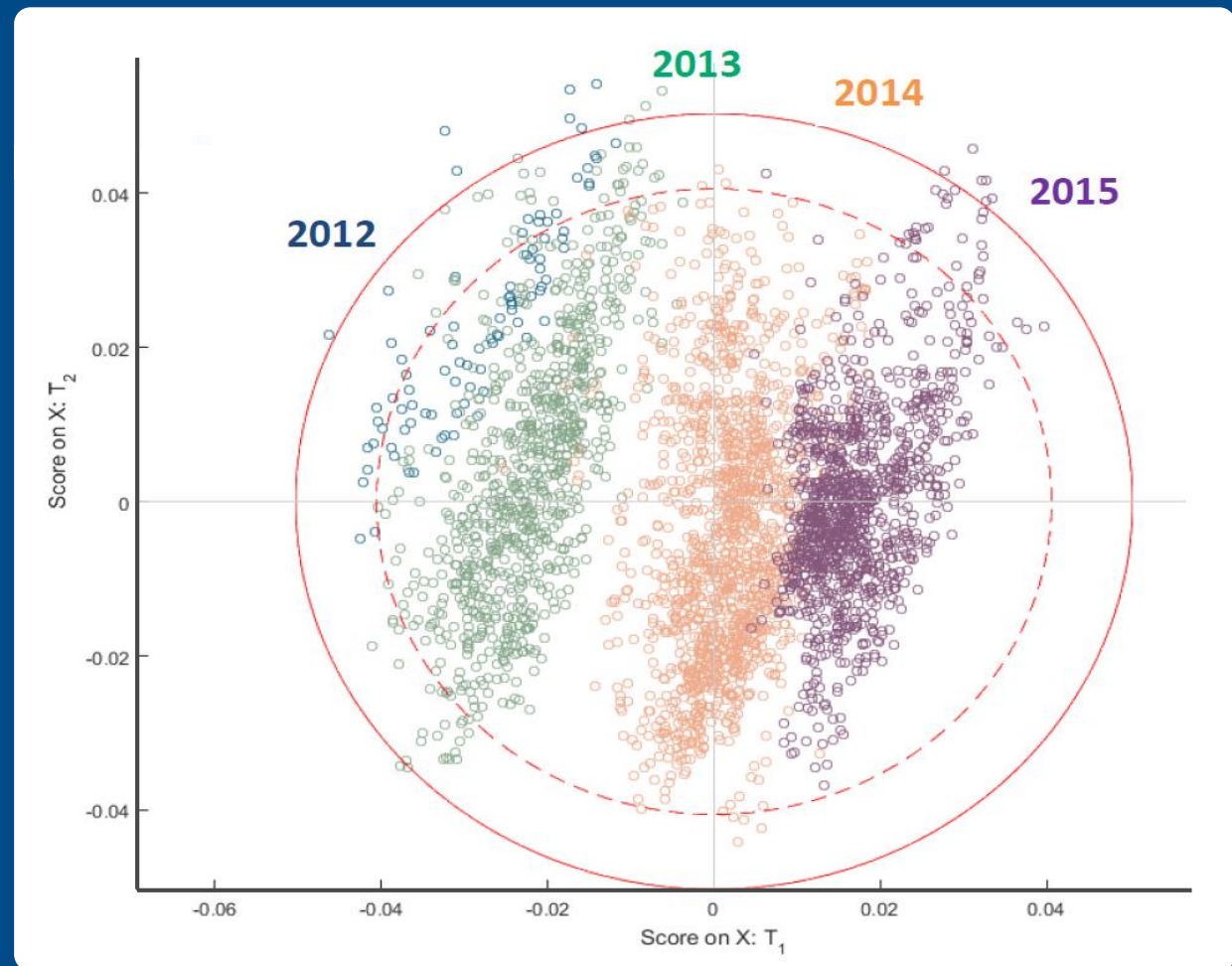
Plants **behaved differently**
from each another



They made several key insights

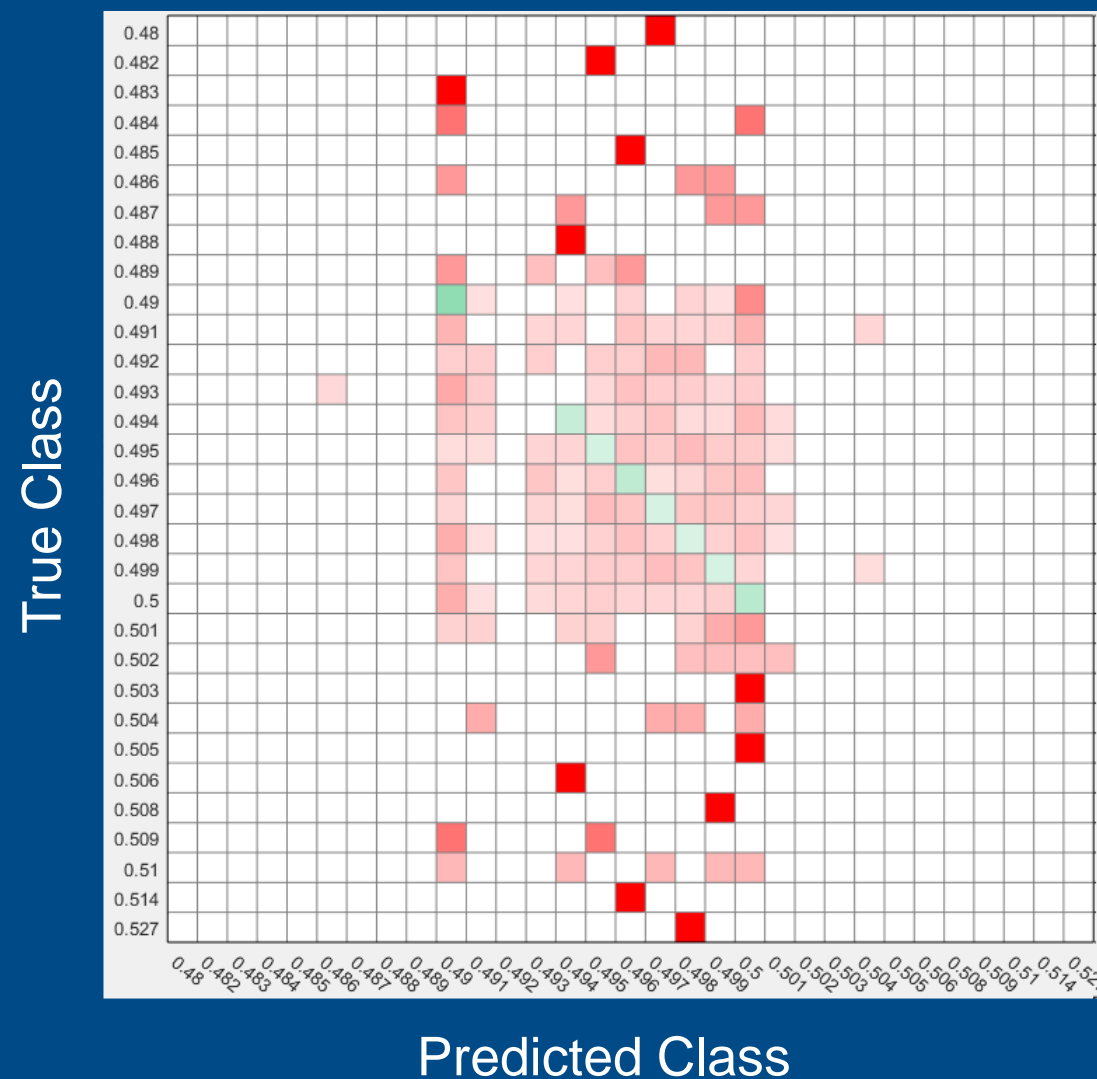
1. Results were wrong
2. Need to build a separate model for each plant
3. Plant's operating state changes each year

Each year was like a **completely different plant**



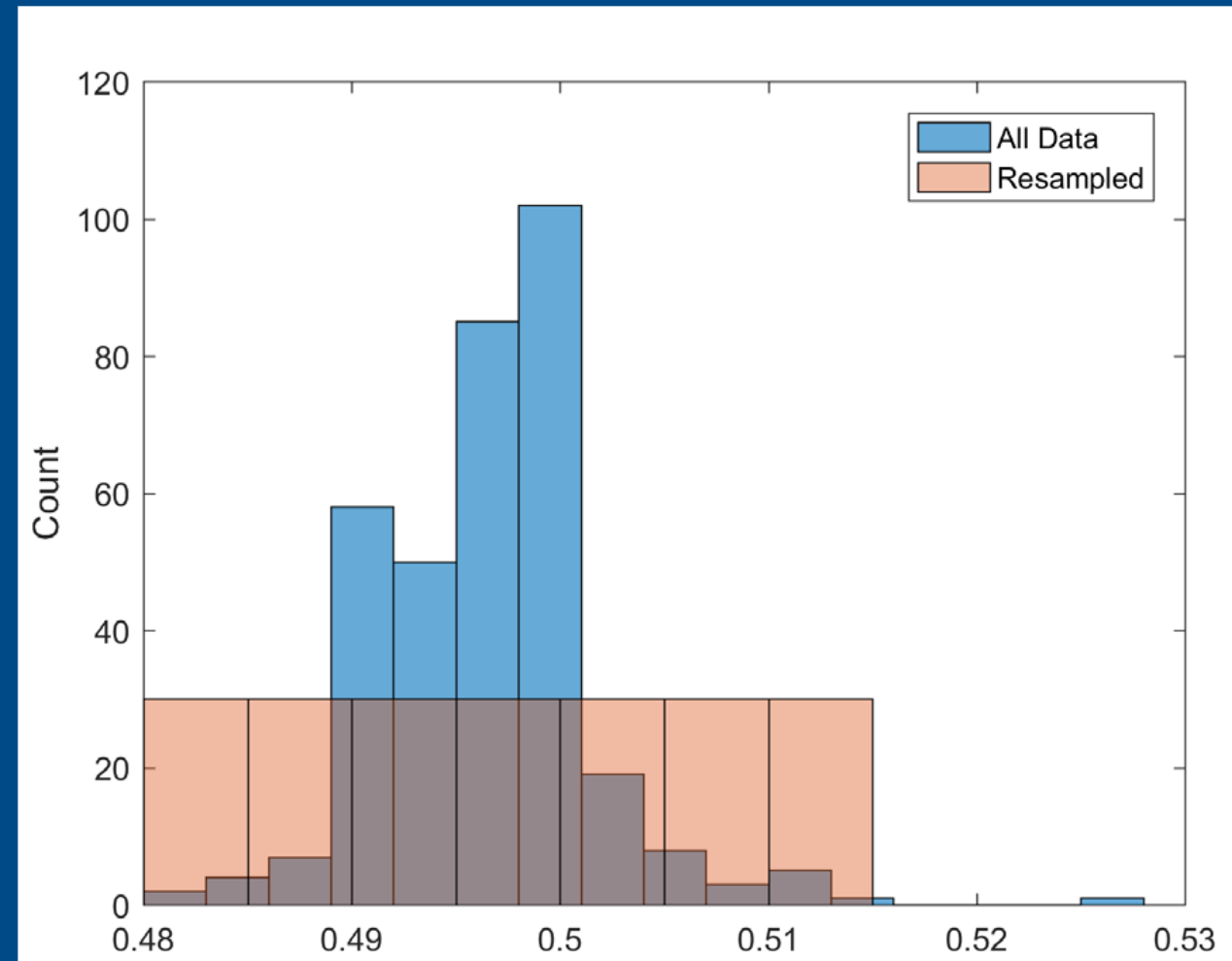
Bulk density prediction results were inaccurate

- Many false positives
- Unused classes



They made several key insights

1. Results were wrong
2. Need to build a separate model for each plant
3. Plant's operating state changes each year
4. Training data was biased



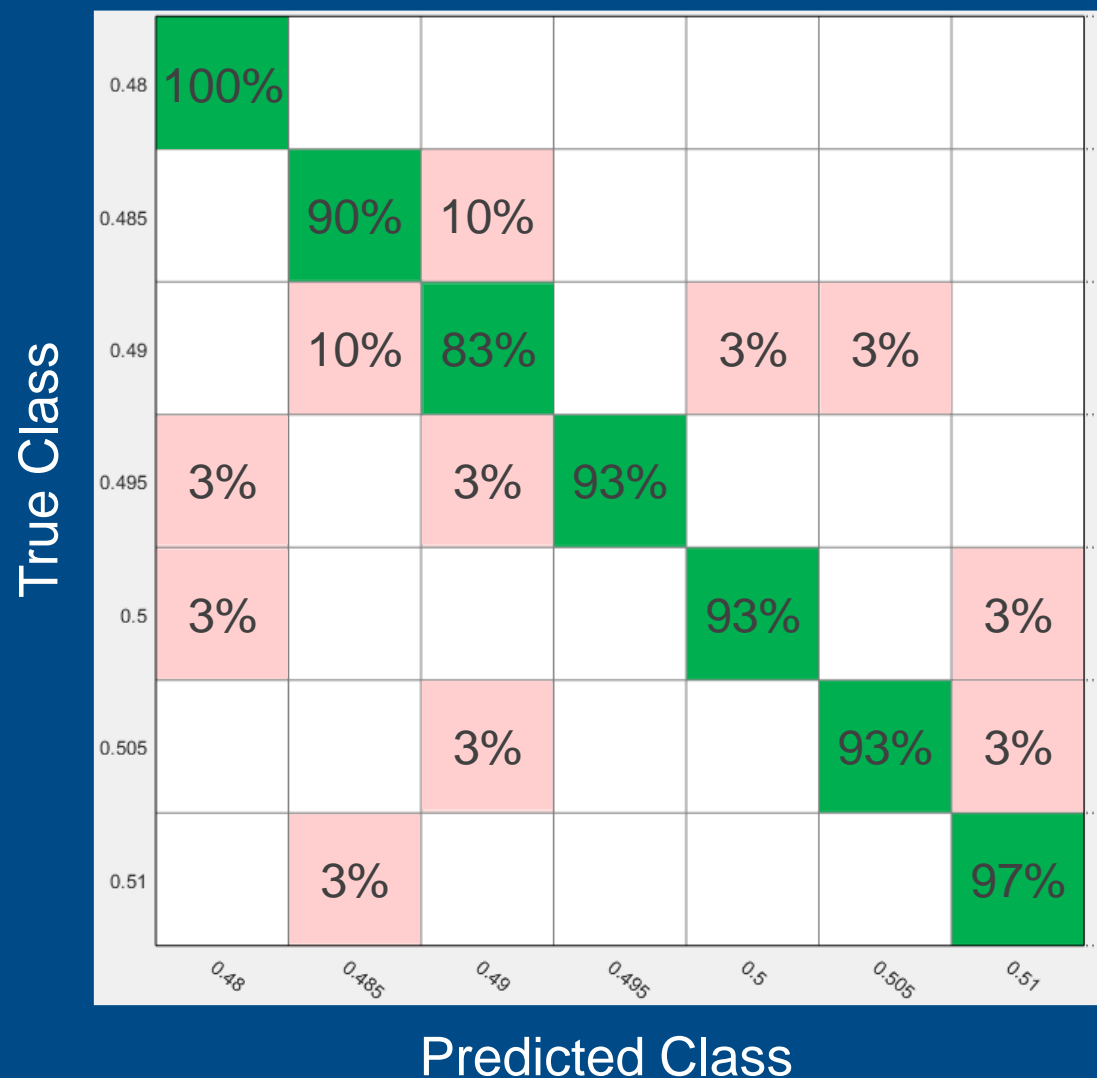
They had **lots** of data

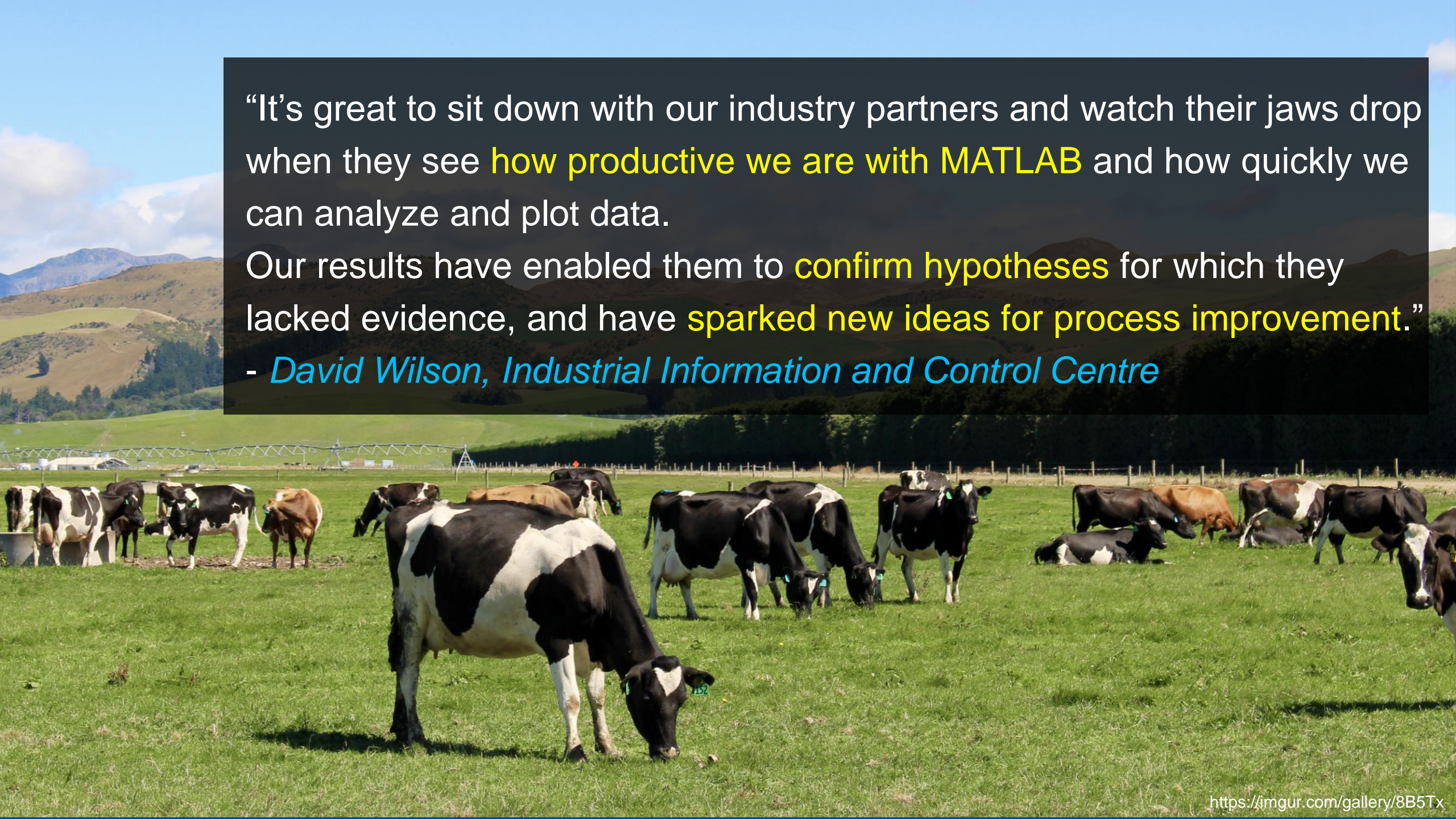


- Millions of data points
- 6 years
- 3 plants

Resampling data resulted in higher predictive accuracy

- Resampled data
- Reduced the number of bins



A herd of cows of various breeds, including black and white Friesians and brown cows, are grazing in a lush green field. In the background, there are rolling green hills and mountains under a clear blue sky with some light clouds. An irrigation system is visible in the distance.

“It’s great to sit down with our industry partners and watch their jaws drop when they see **how productive we are with MATLAB** and how quickly we can analyze and plot data.

Our results have enabled them to **confirm hypotheses** for which they lacked evidence, and have **sparked new ideas for process improvement.**”

- *David Wilson, Industrial Information and Control Centre*

To be successful with AI, we must ...

Combine AI model building
with **scientific and engineering insights**

Along with **tools** that span
both the **science and engineering** and the **data science**

To be successful with AI, we must ...

**Find out more:
Deep Learning Masterclass**

**Dr. Yvonne Blum
MathWorks**



both the science and engineering and the data science

Operate within
their environment



Interaction



Intelligence



Insights

Apply domain
expertise



Implementation

Span the entire
system development
workflow

Operate within
their environment



Interaction



Intelligence



Insights

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expertise



Implementation

Span the entire
system development
workflow

Implementation is about creating the solution



Testing
Data analysis
Reporting



Developing concept
Prototyping
Deployment



Requirements building
Modeling and simulation
Verification and validation

Implementation is about creating the solution



Testing
Data analysis
Reporting



Developing concept
Prototyping
Deployment



Requirements building
Modeling and simulation
Verification and validation

“Deliver on the promise of self-driving cars **today.**”



Voyage's goal was to quickly get to market

1. Target retirement communities



Voyage's goal was to quickly get to market

1. Target retirement communities
2. Use off-the-shelf components wherever possible



Voyage's goal was to quickly get to market

1. Target retirement communities
2. Use off-the-shelf components wherever possible
3. Bring in the right software tools across the entire workflow



The LUMINAR logo, with the word 'LUMINAR' in a black sans-serif font. The letters 'U' and 'I' are highlighted in red and green respectively.

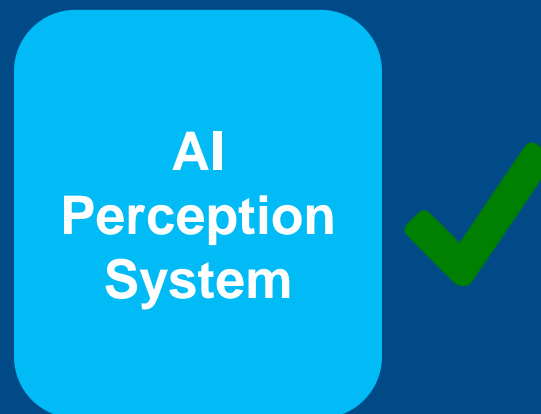


The CARMERA logo, featuring a stylized infinity symbol icon in orange and purple above the word 'CARMERA' in a black sans-serif font.

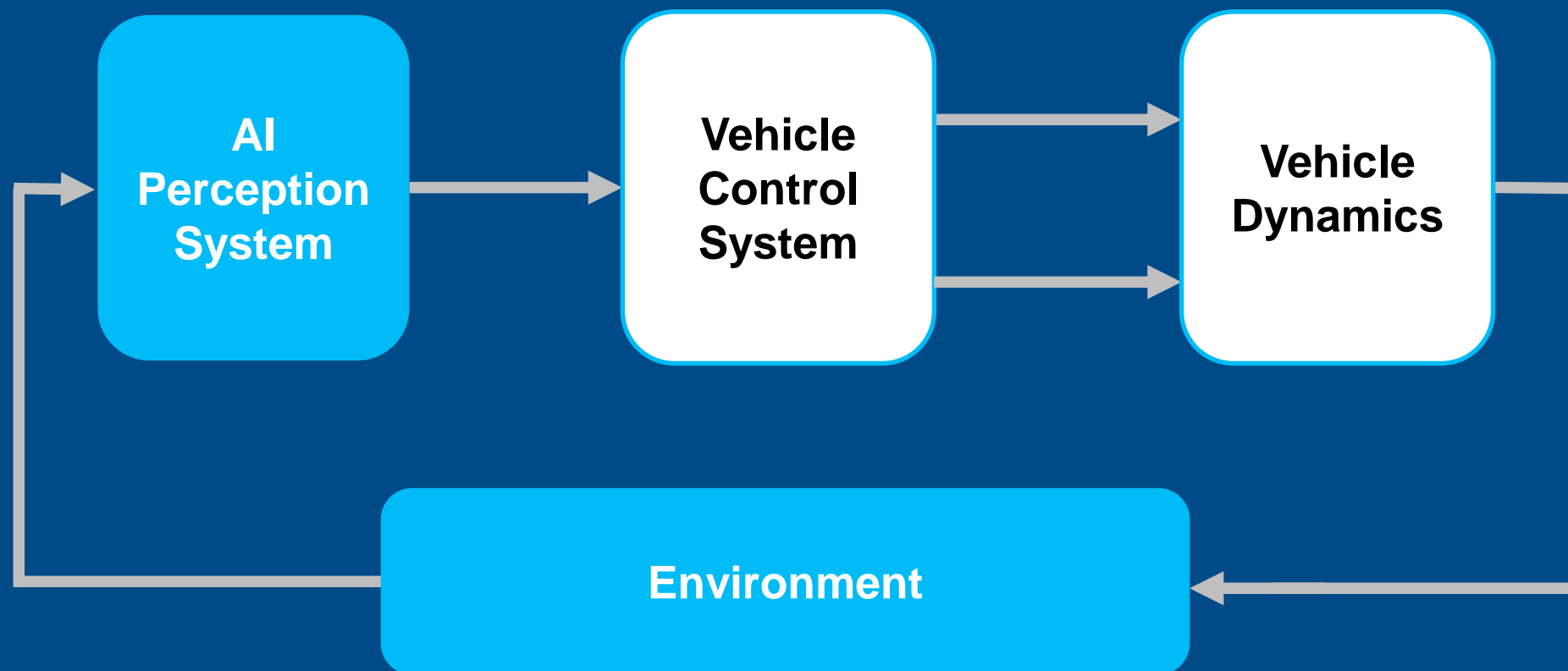
The ROS logo, featuring a grid of dots icon to the left of the text 'ROS' in a large black sans-serif font, with 'Robot Operating System' in a smaller font below it.



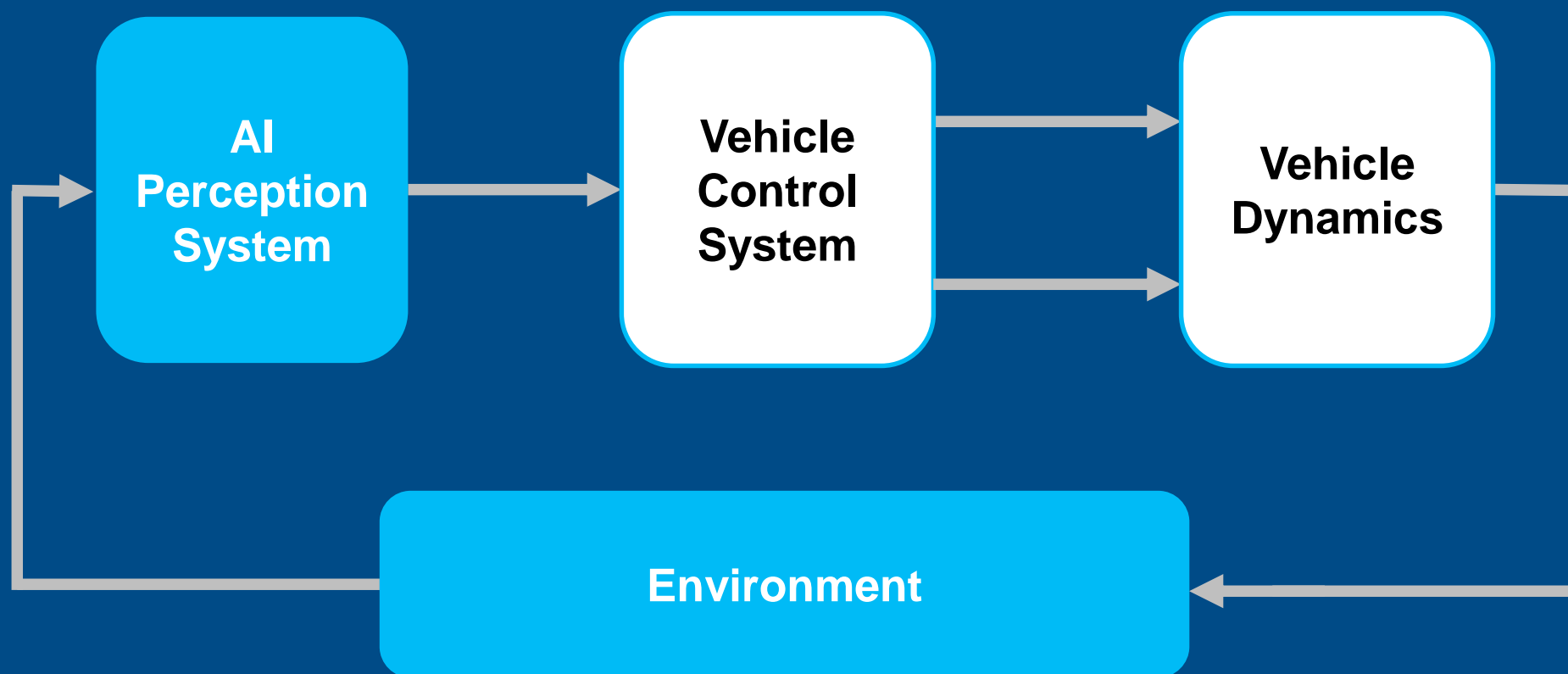
Voyage completed their AI system first



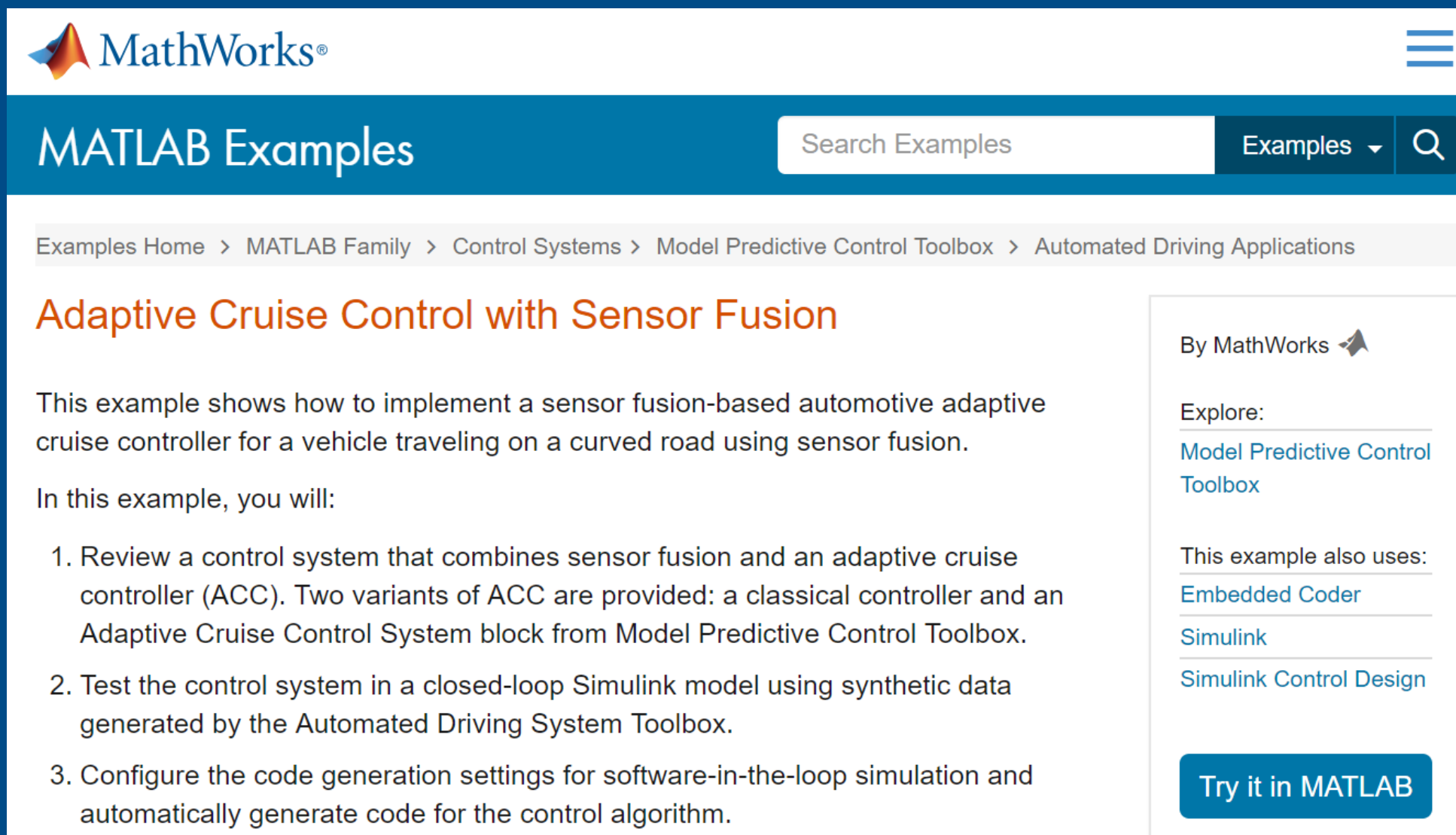
But they needed to connect the AI to the rest of the system



But they needed to connect the AI to the rest of the system



Started with Simulink example that they could build upon



The screenshot shows the MathWorks MATLAB Examples page. At the top left is the MathWorks logo. To its right is a search bar labeled 'Search Examples' and a dropdown menu labeled 'Examples' with a search icon. Below the search bar is a breadcrumb trail: 'Examples Home > MATLAB Family > Control Systems > Model Predictive Control Toolbox > Automated Driving Applications'. The main heading is 'Adaptive Cruise Control with Sensor Fusion' in orange. Below the heading is a paragraph: 'This example shows how to implement a sensor fusion-based automotive adaptive cruise controller for a vehicle traveling on a curved road using sensor fusion.' This is followed by 'In this example, you will:' and a list of three steps. On the right side, there is a sidebar with 'By MathWorks' and a list of related links: 'Explore: Model Predictive Control Toolbox', 'This example also uses: Embedded Coder', 'Simulink', and 'Simulink Control Design'. At the bottom right of the sidebar is a blue button that says 'Try it in MATLAB'.

MathWorks®

MATLAB Examples

Search Examples Examples

Examples Home > MATLAB Family > Control Systems > Model Predictive Control Toolbox > Automated Driving Applications

Adaptive Cruise Control with Sensor Fusion

This example shows how to implement a sensor fusion-based automotive adaptive cruise controller for a vehicle traveling on a curved road using sensor fusion.

In this example, you will:

1. Review a control system that combines sensor fusion and an adaptive cruise controller (ACC). Two variants of ACC are provided: a classical controller and an Adaptive Cruise Control System block from Model Predictive Control Toolbox.
2. Test the control system in a closed-loop Simulink model using synthetic data generated by the Automated Driving System Toolbox.
3. Configure the code generation settings for software-in-the-loop simulation and automatically generate code for the control algorithm.

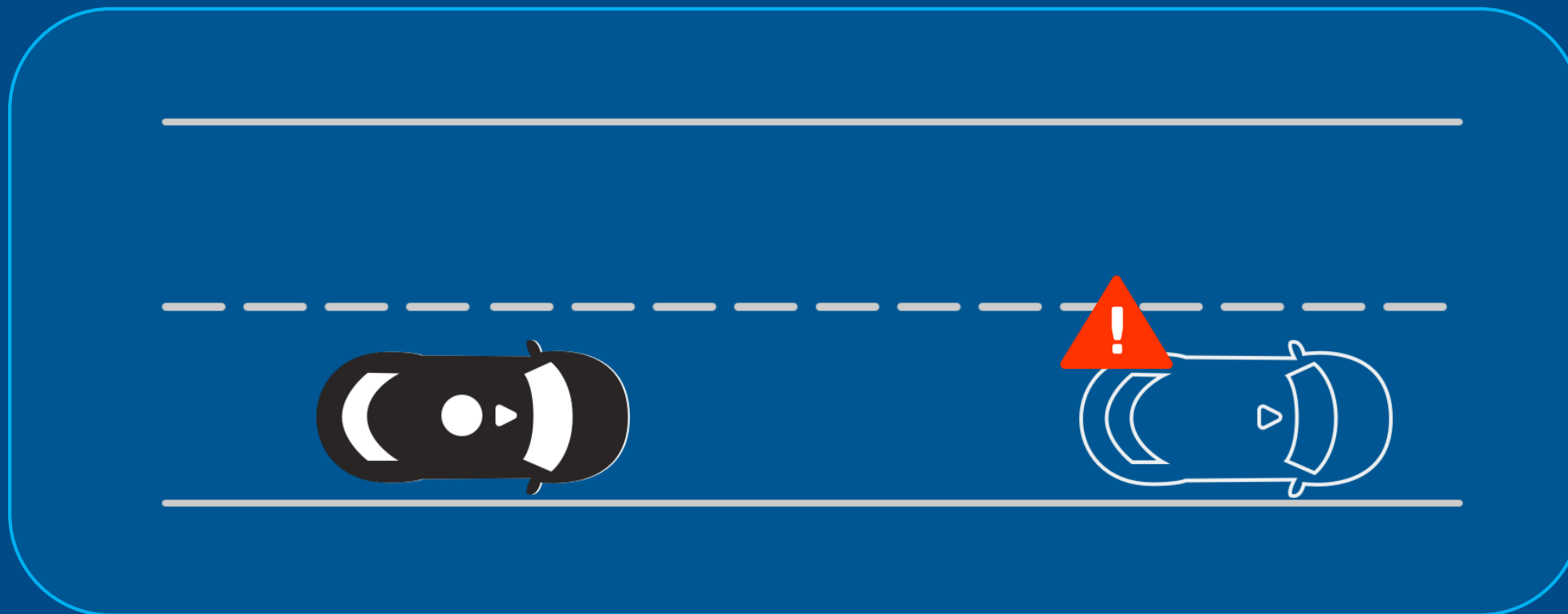
By MathWorks

Explore:
[Model Predictive Control Toolbox](#)

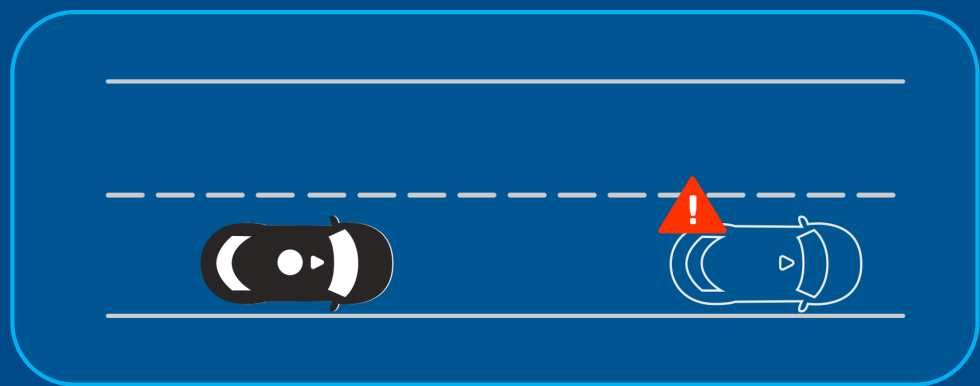
This example also uses:
[Embedded Coder](#)
[Simulink](#)
[Simulink Control Design](#)

Try it in MATLAB

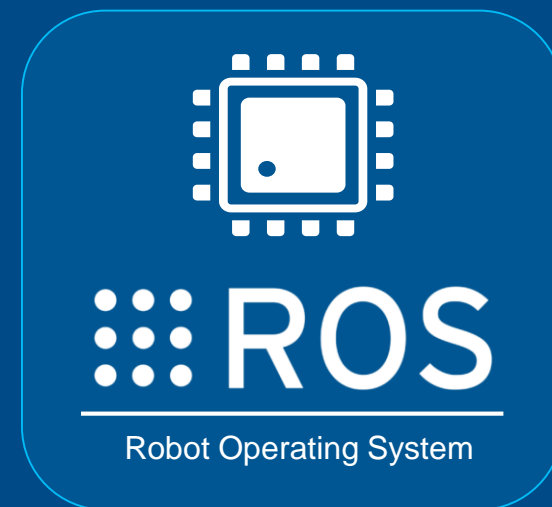
Injected simulated vehicles to interact with while driving



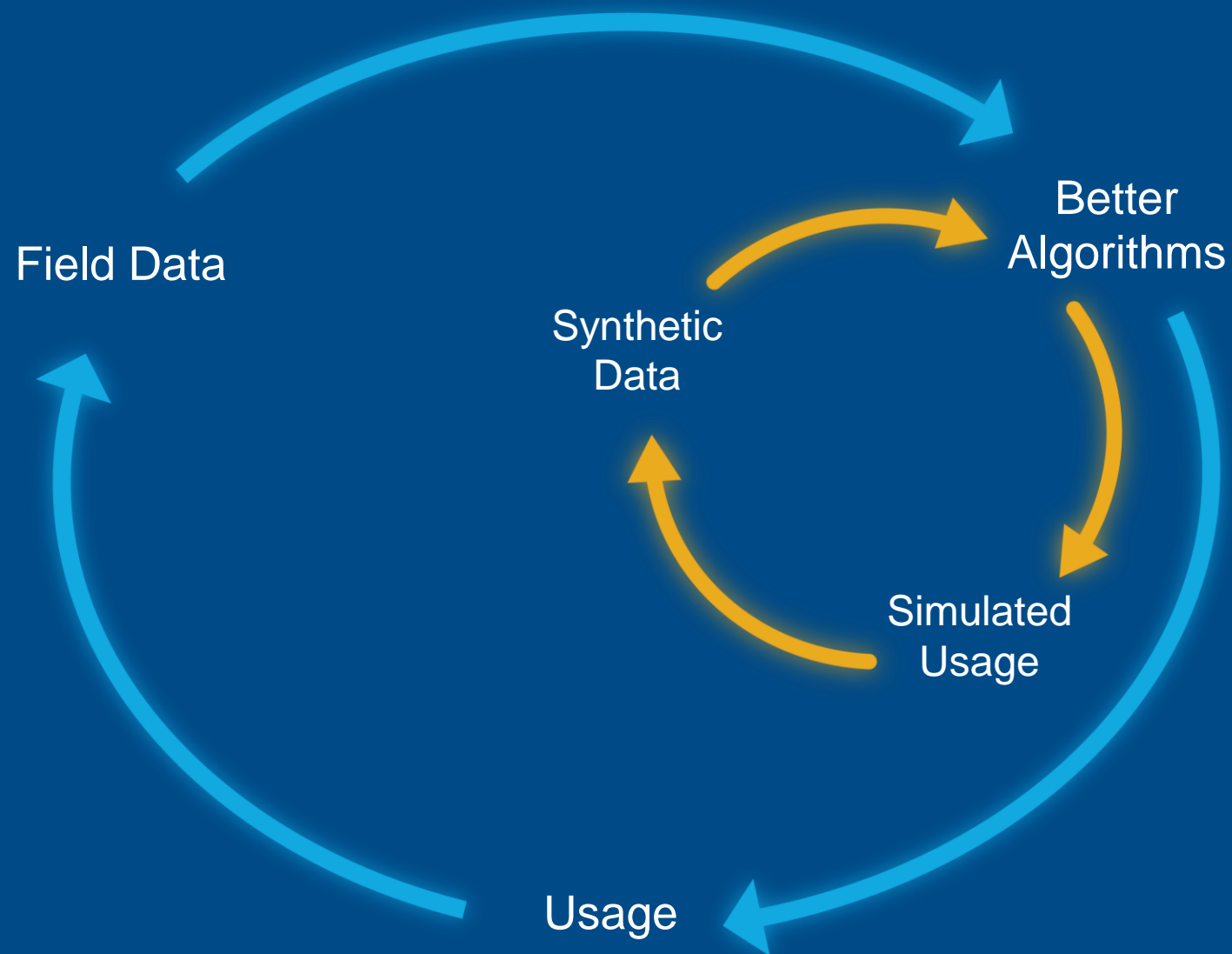
Deployed controller as ROS node and generated code



Robotics System Toolbox
Embedded Coder

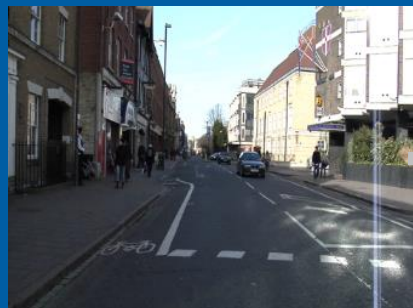


Train your AI faster with tight simulation loops

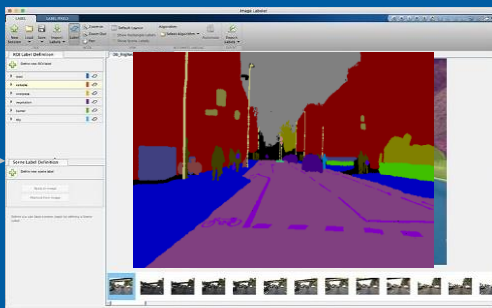


One example of leveraging simulation for data synthesis

Traditional deep learning workflow



Record



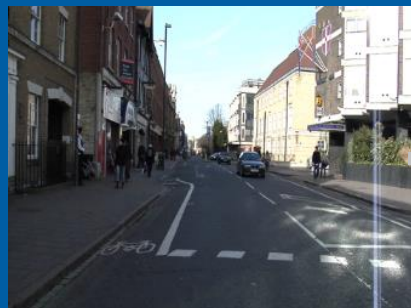
Label



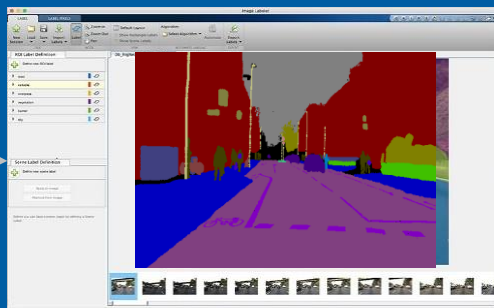
AI model

One example of leveraging simulation for data synthesis

Traditional deep learning workflow



Record



Label

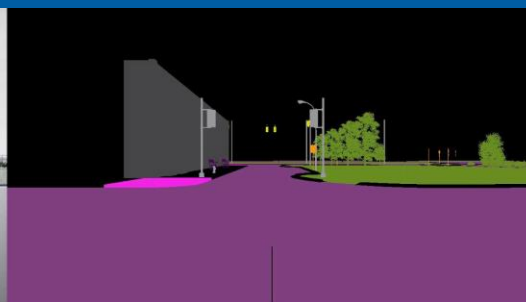


AI model

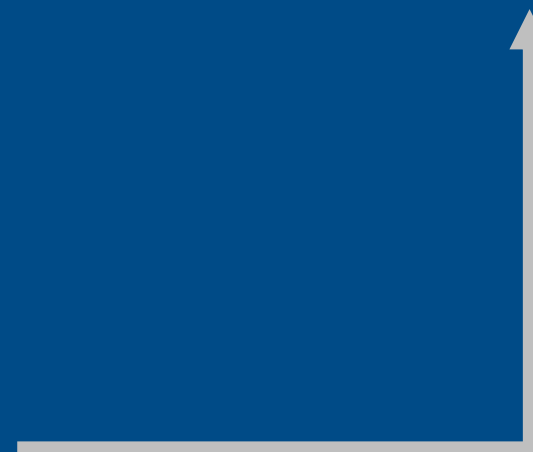
Simulation-based workflow



Simulate



Auto-label



“Simulink + ROS allowed us to deploy a Level 3 autonomous vehicle in less than 3 months.”

– Alan Mond, Voyage



To be successful with AI, we must ...

Use tool chains that **span**
the **entire system development workflow**

To be successful with AI, we must ...

**Find out more:
Machine Learning as a Service**

**Muhammad Faizan Aslam
Infineon Technologies AG**



the c

flow

Operate within
their environment



Interaction



Intelligence



Insights

Apply domain
expertise



Implementation

Span the entire
system development
workflow

Operate within
their environment



Apply domain
expertise

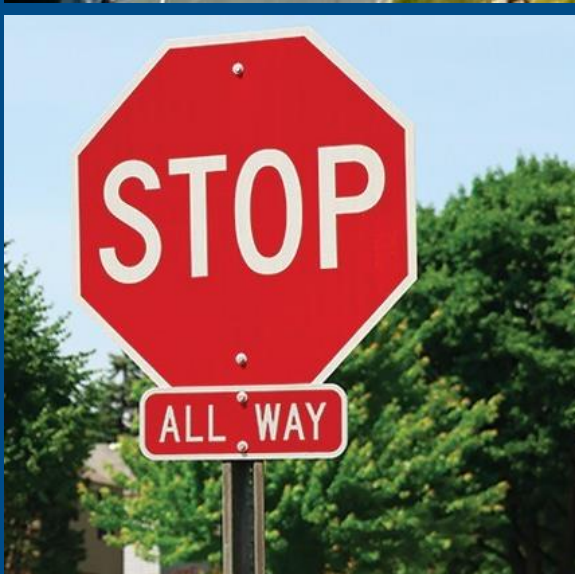


Span the entire
system development
workflow



Interaction within complex environments

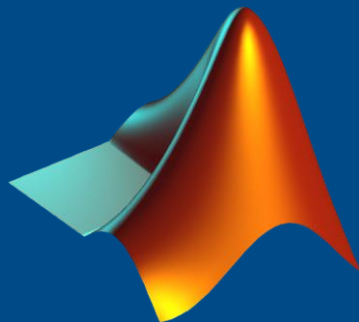
What was the larger system the vehicle had to operate in?



EarlySense



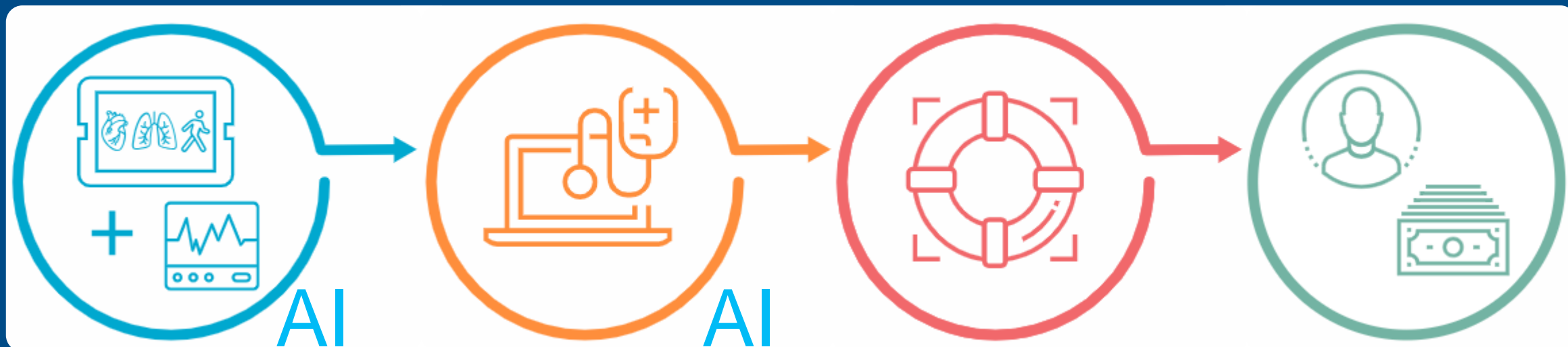
“Proactive patient care”



Statistics and Machine Learning Toolbox
Signal Processing Toolbox
MATLAB Coder
Embedded Coder



EarlySense's AI can **predict critical events** before they happen



Continuous
Monitoring

Early
Detection

Early
Intervention

Better
Outcomes

Dashboards at nurses' stations and on hallway monitors



Alerts on hand-held devices carried by staff





Address problems before they become emergencies



Address problems before they become emergencies

To be successful with AI, we must ...

Design how our systems will integrate
and **interact within their environment**

To be successful with AI, we must ...

**Find out more:
Age-Recognition Demo**

**Booth 25
MathWorks**

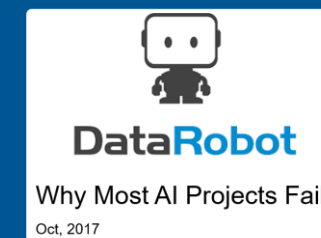


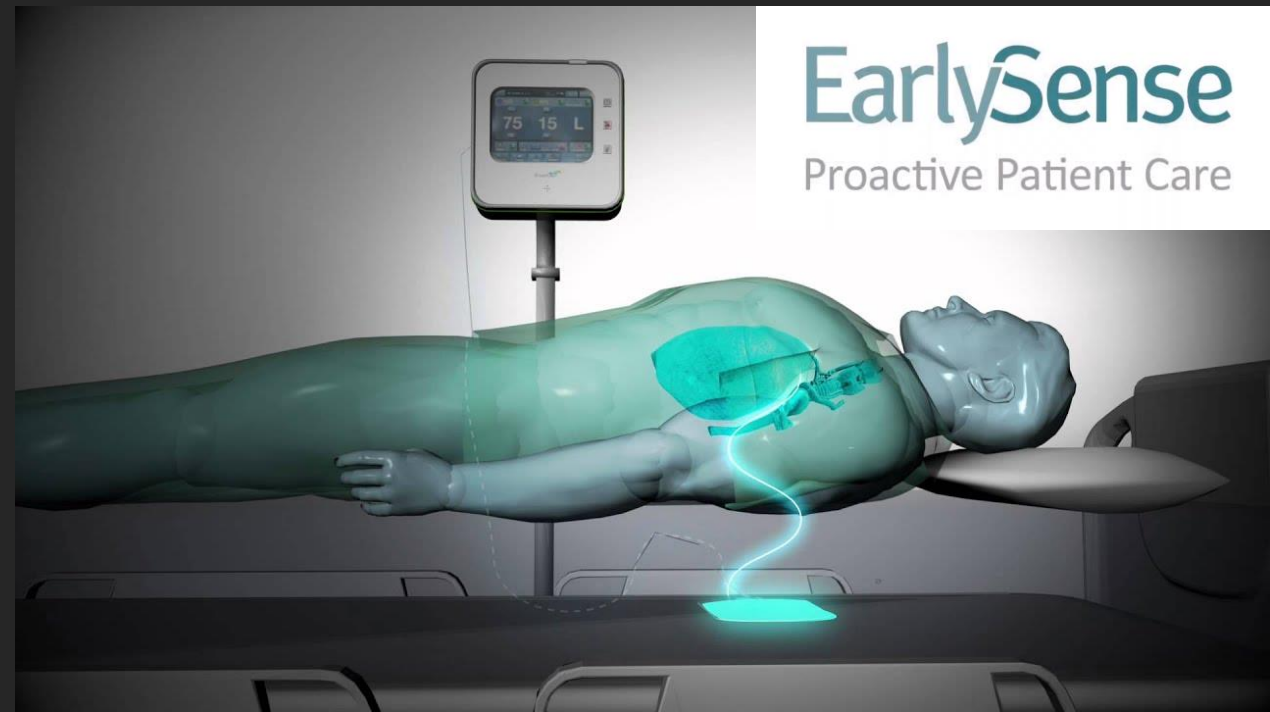
Success requires more than just intelligence

AI is a transformative technology



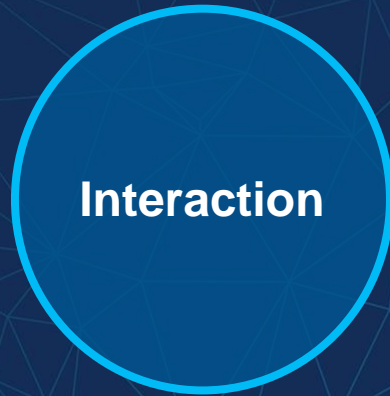
But AI projects can and do fail





EarlySense
Proactive Patient Care

Operate within
their environment



Interaction



Intelligence



Insights

Apply domain
expertise



Implementation

Span the entire
system development
workflow

How will you apply AI to your projects?



MATLAB Expo 2019

Go Beyond the “I” in AI

**MATLAB[®]
& SIMULINK[®]**