

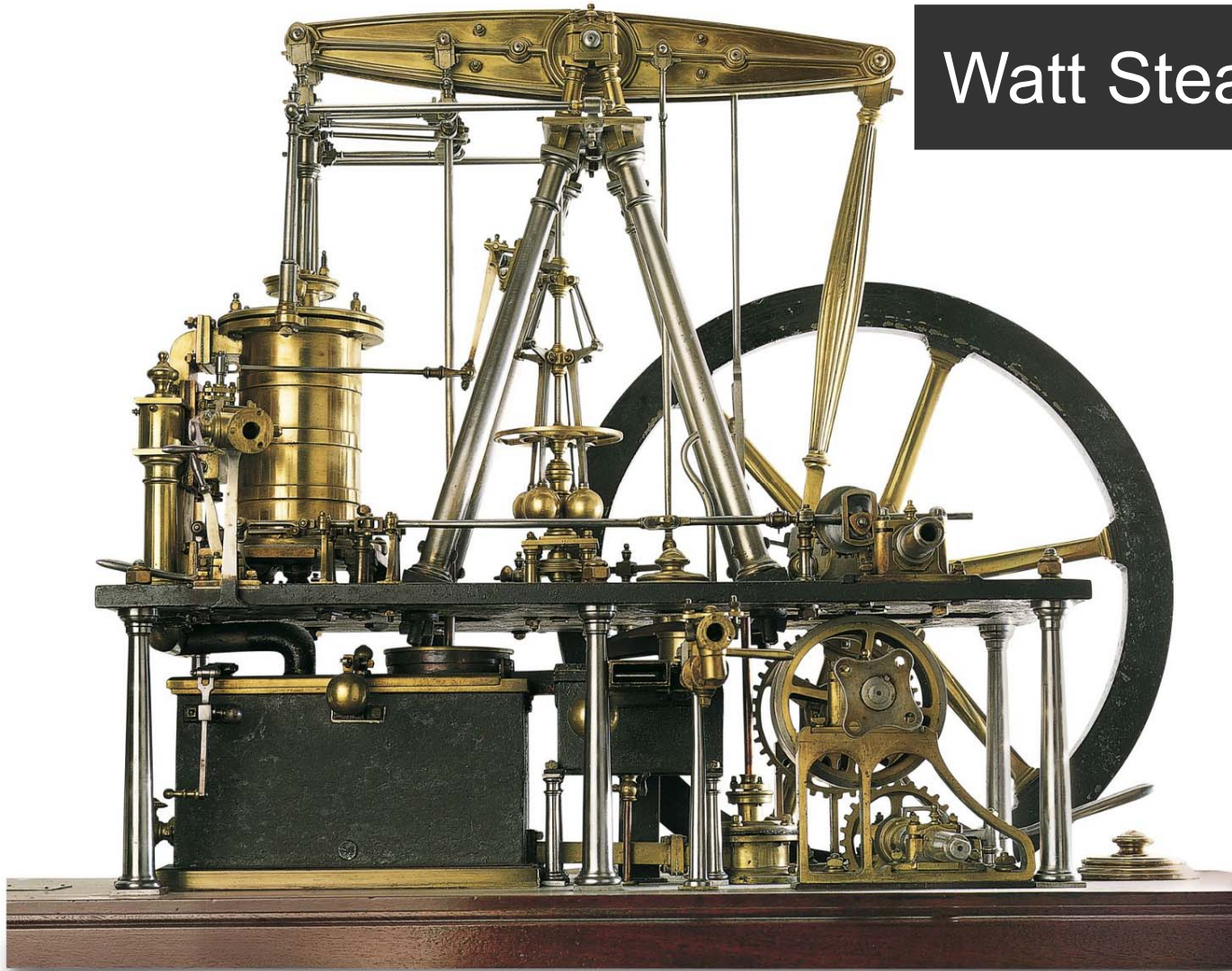
MATLAB EXPO 2019

Beyond the “I” in AI

Loren Dean



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

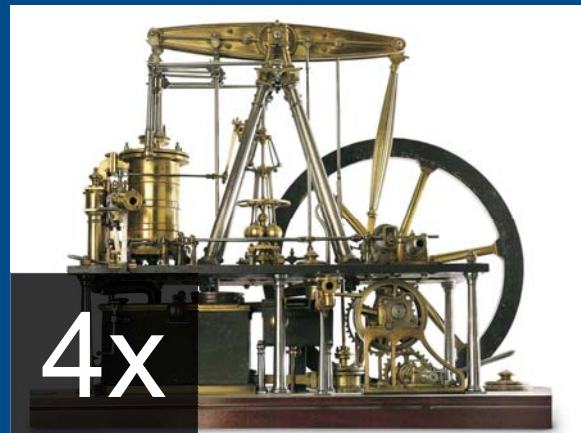
AI will create \$13 trillion in value by 2030

based on McKinsey's latest AI forecast – September 2018

AI has tremendous potential to increase productivity



=



Yet AI is struggling



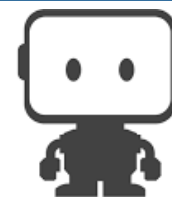
Most AI Projects Fail. Here's How to Make Yours Successful.

July, 2018



3 Common Reasons Artificial Intelligence Projects Fail

May, 2018



DataRobot

Why Most AI Projects Fail

Oct, 2017

Google Photos AI fail goes viral



engadget

AI's intelligence and
stupidity in one photo
stitch fail

01.23.2018

THE VERGE

I can't stop looking at this
wonderfully bad Google
Photos panorama stitch

By [Natt Garun](#) | [@nattgarun](#) | Jan 18, 2018, 6:51pm EST

There are many ways Artificial Intelligence can fail

No data
scientists

Too much data

Poor ROI

Not enough data

Beyond the skill
of the team

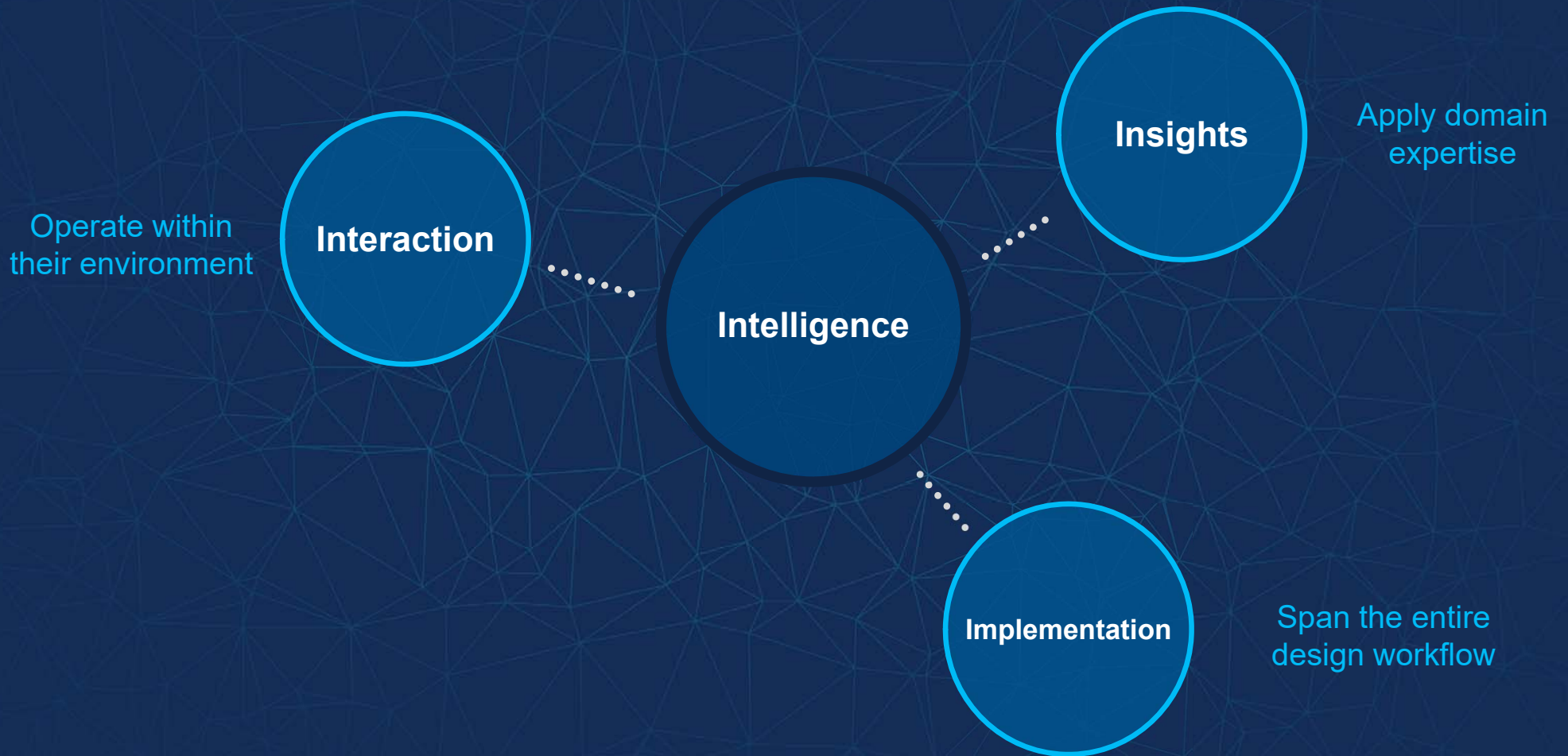
Incomplete
tools

Problem is a
poor fit for AI

Can't interact with
other systems

Problem is
unsolvable

AI is more than just the intelligence of the algorithm



Operate within
their environment

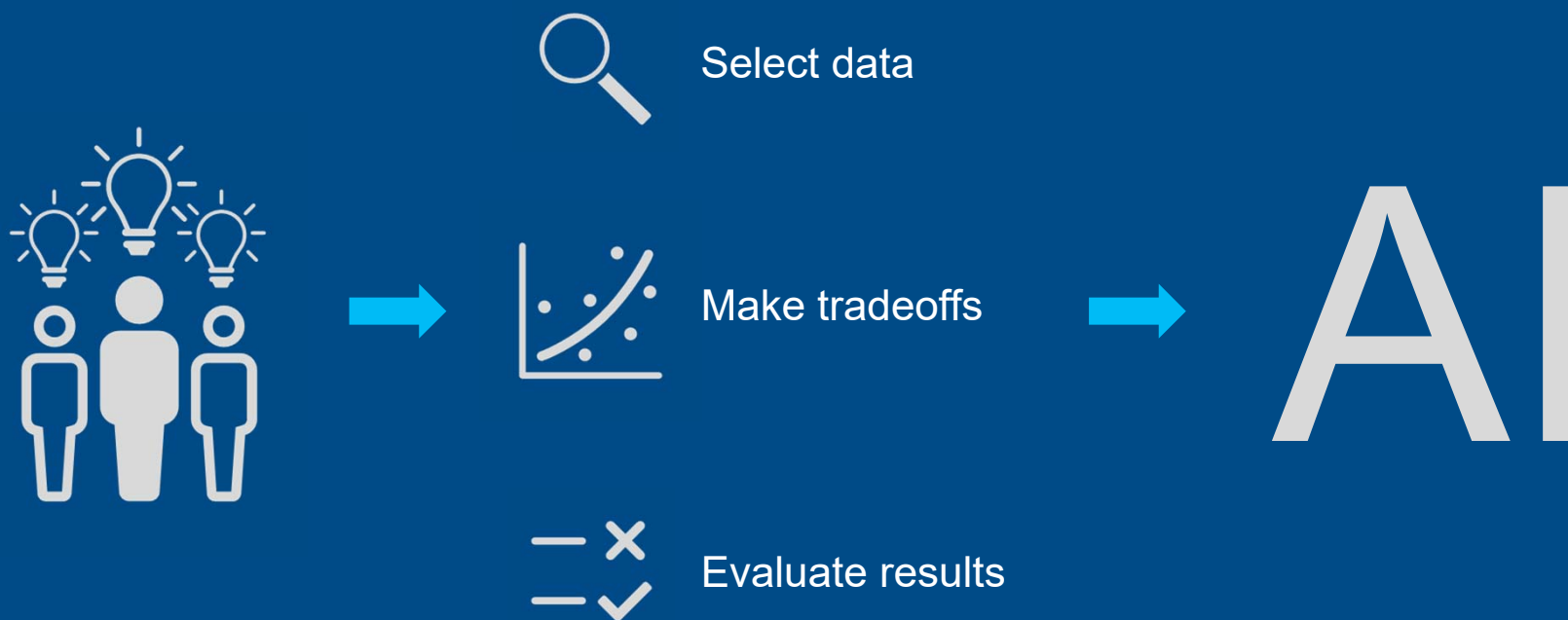


Apply domain
expertise



Span the entire
design workflow

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

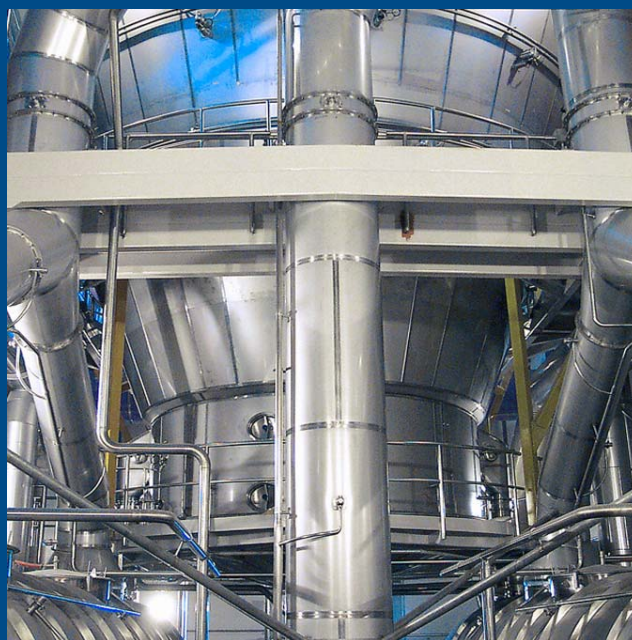
- University of Auckland
- Auckland University of Technology



Wanted to detect a bad product earlier

Continuous Plant Process

Raw Milk

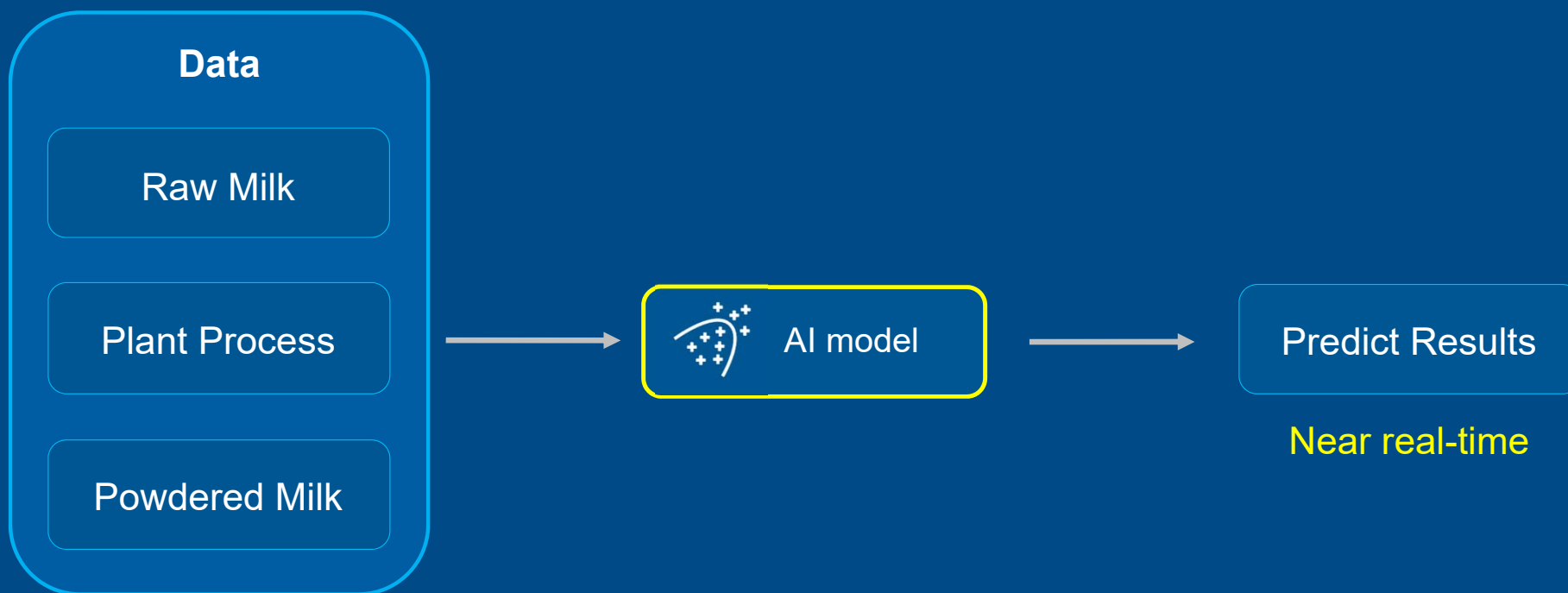


Powdered Milk



Days later

Wanted to detect a bad product earlier

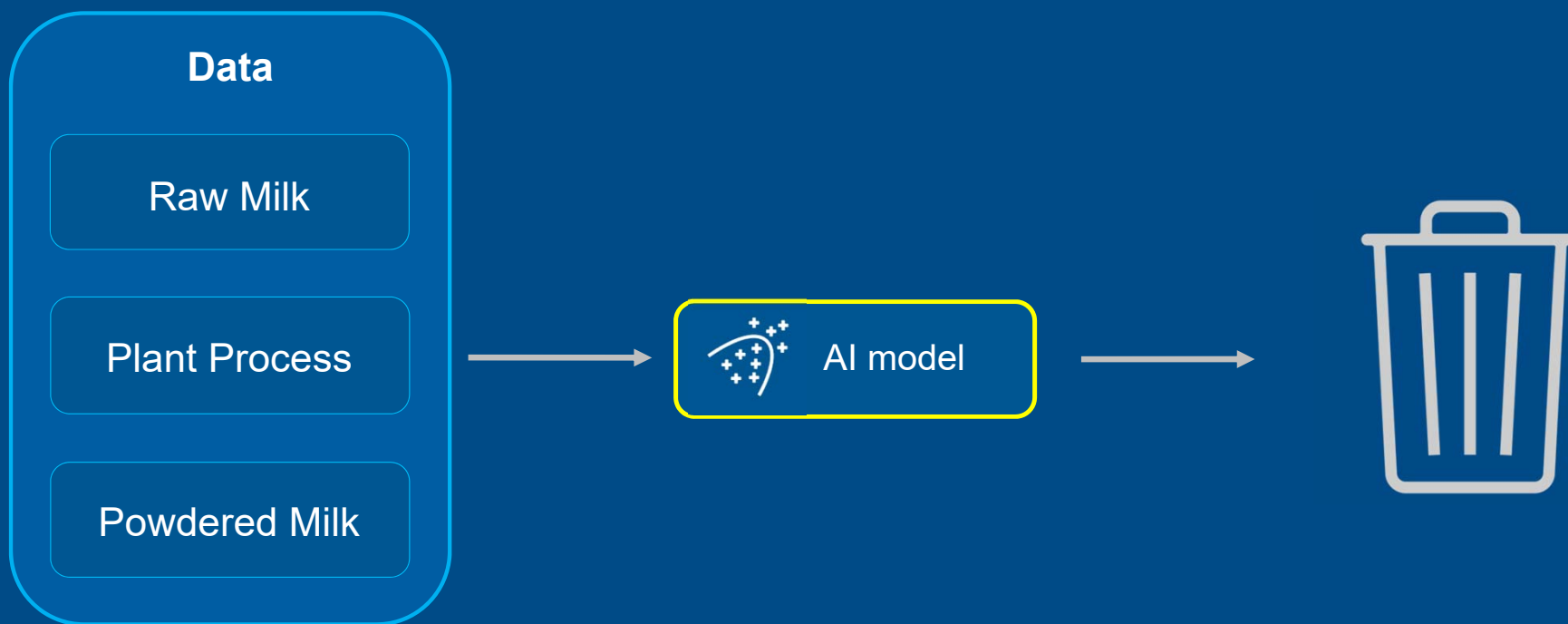


They had **lots** of data



- Millions of data points
- 6 years
- 3 plants

But...



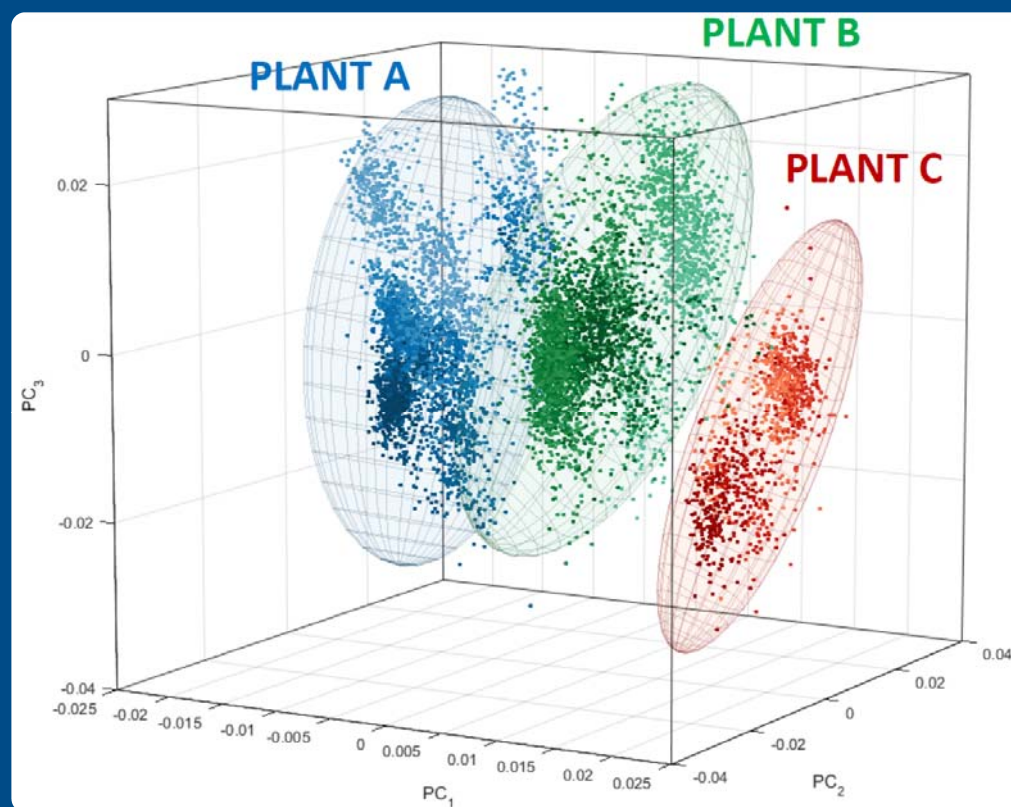
They made several key insights

1. Results were wrong

They made several key insights

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

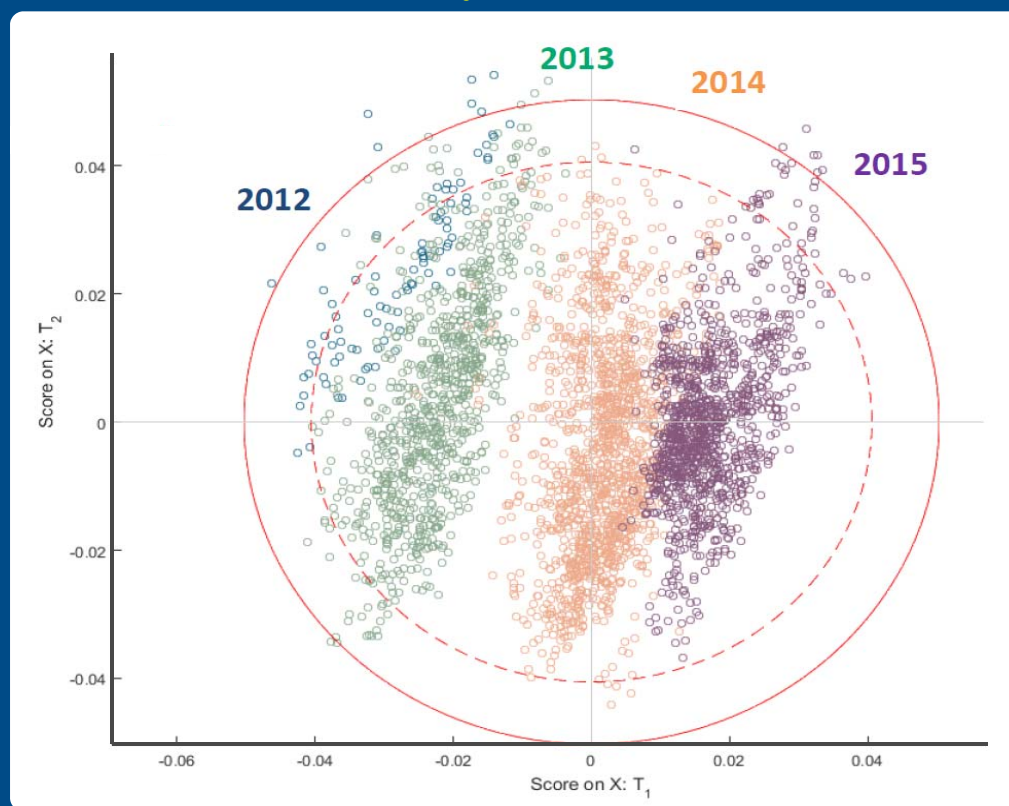
Plants **behaved differently**
from each another



They made several key insights

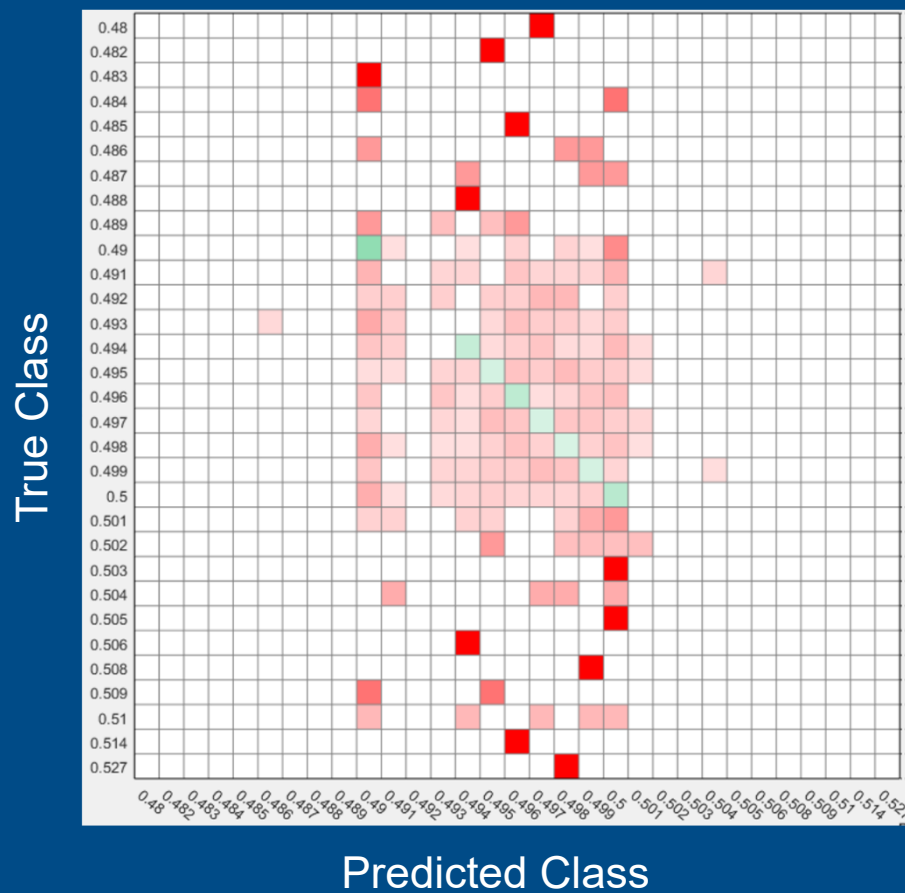
1. Results were wrong
2. Need to build a separate model for each plant
3. Plant's operating state changes each year

Each year was like a
completely different plant



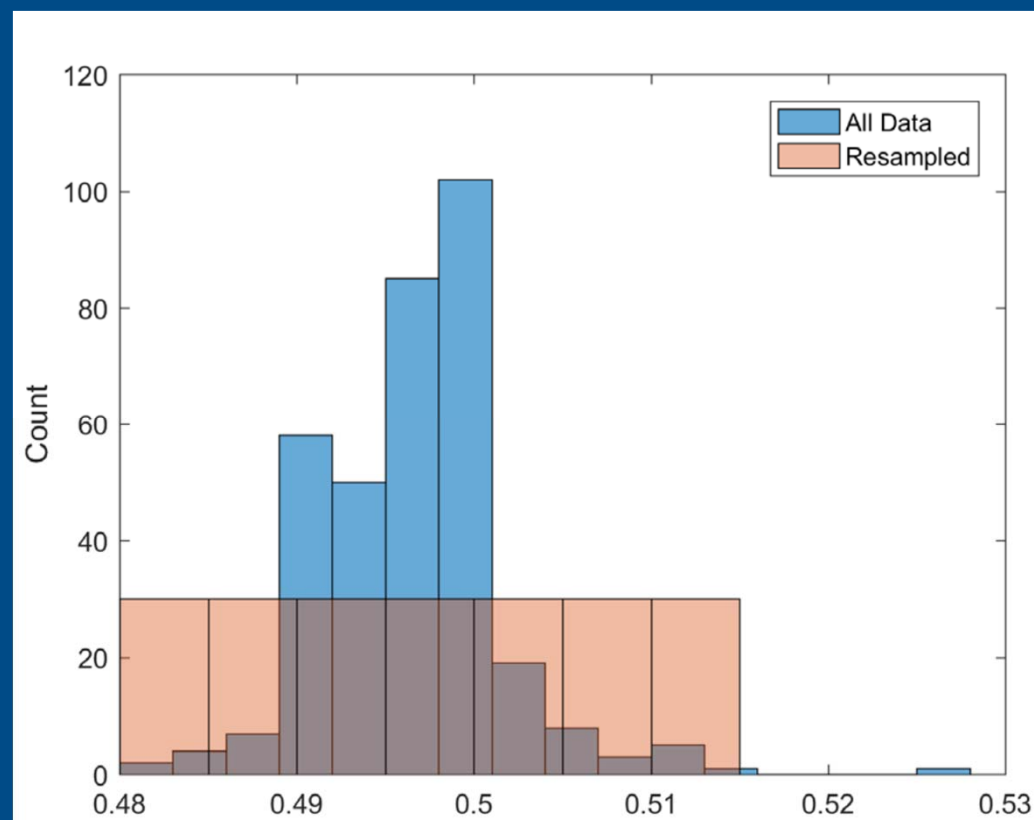
Bulk density prediction results were inaccurate

- Many false positives
- Unused classes



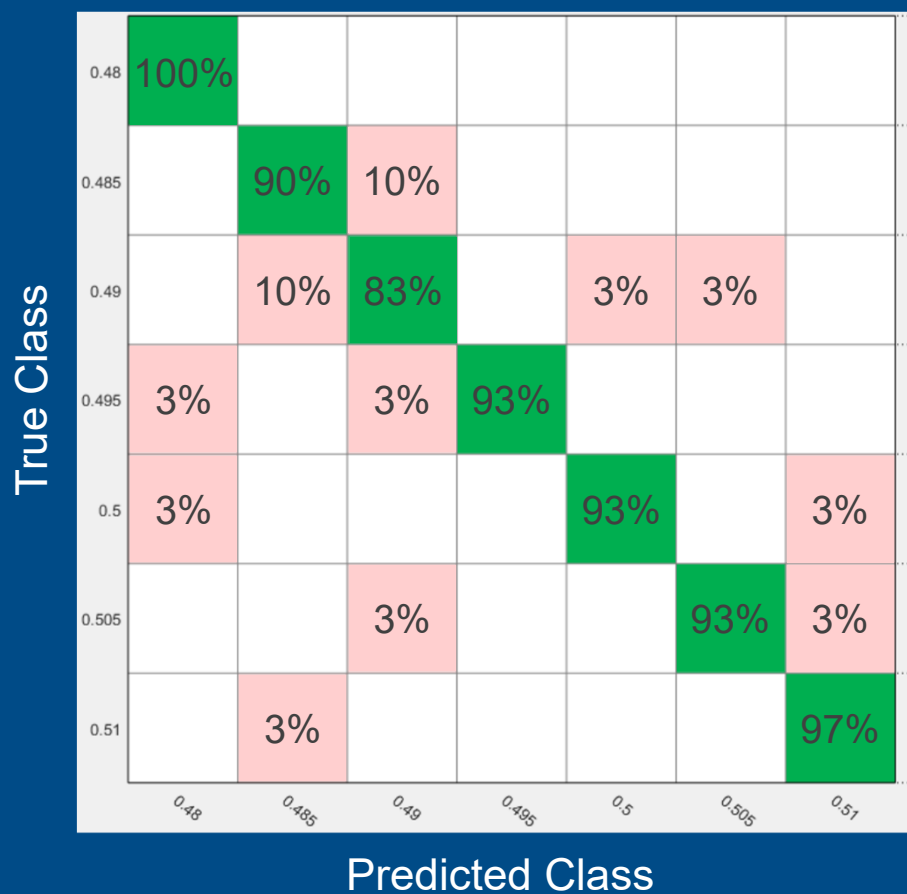
They made several key insights

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



Resampling data resulted in higher predictive accuracy

- Resampled data
- Reduced the number of bins



A photograph of a herd of cows grazing in a lush green field. In the background, there are rolling hills and mountains under a blue sky with some clouds. A semi-transparent dark box is overlaid on the top half of the image, containing text.

“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**

Operate within
their environment



Apply domain
expertise



Span the entire
design workflow

Operate within
their environment

Interaction

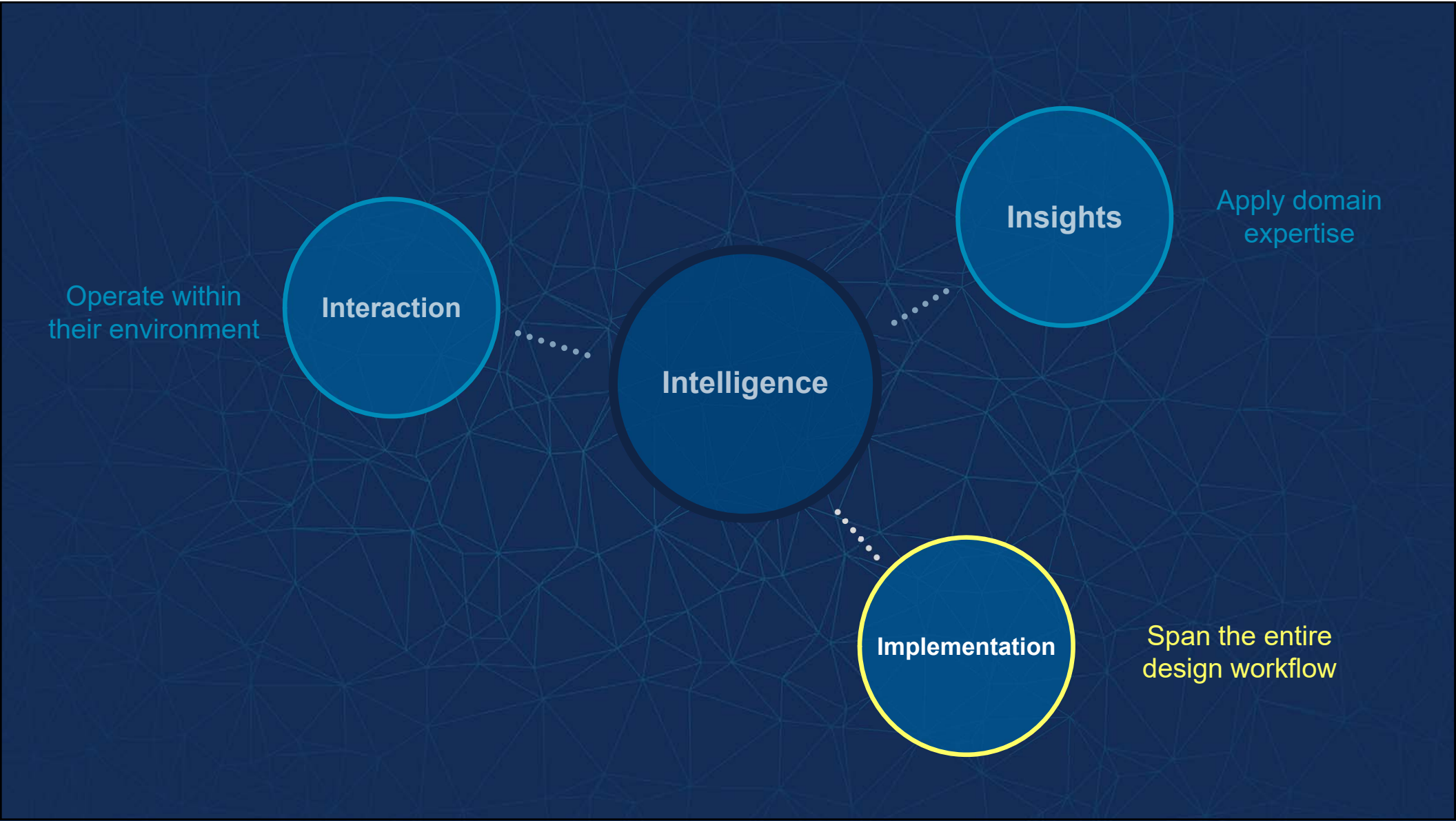
Intelligence

Insights

Apply domain
expertise

Implementation

Span the entire
design workflow



Implementation is about designing the solution

Research



Testing
Data analysis
Reporting

Manufacturing



Developing concept
Prototyping
Deployment

Autonomous System



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



LUMINAR

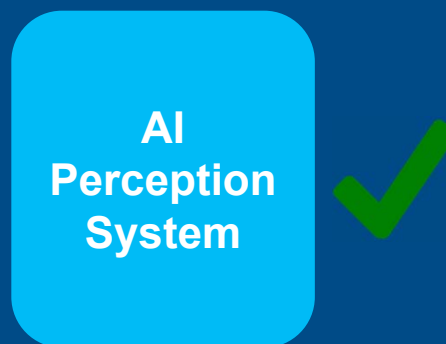


CAMERA

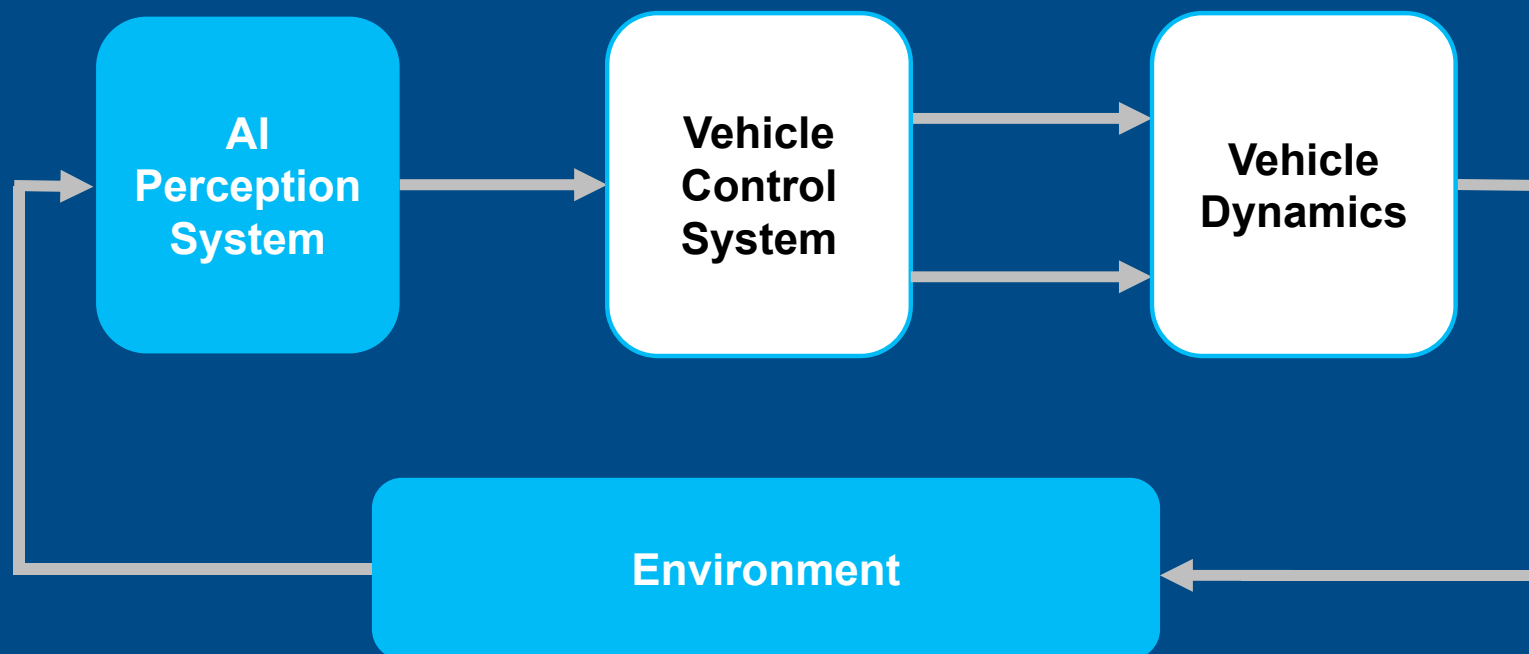
ROS
Robot Operating System



Voyage completed their AI system first



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. The main header is 'MATLAB Examples' with a search bar and a dropdown menu. Below the header is a breadcrumb trail: 'Examples Home > MATLAB Family > Control Systems > Model Predictive Control Toolbox > Automated Driving Applications'. The main content area features the title 'Adaptive Cruise Control with Sensor Fusion' in orange. Below the title 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. To the right of the main content is a sidebar with 'By MathWorks' and a pin icon, 'Explore:' with a link to 'Model Predictive Control Toolbox', 'This example also uses:' with links to 'Embedded Coder', 'Simulink', and 'Simulink Control Design', and a 'Try it in MATLAB' button.

MathWorks®

MATLAB Examples

Search Examples Examples Q

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.

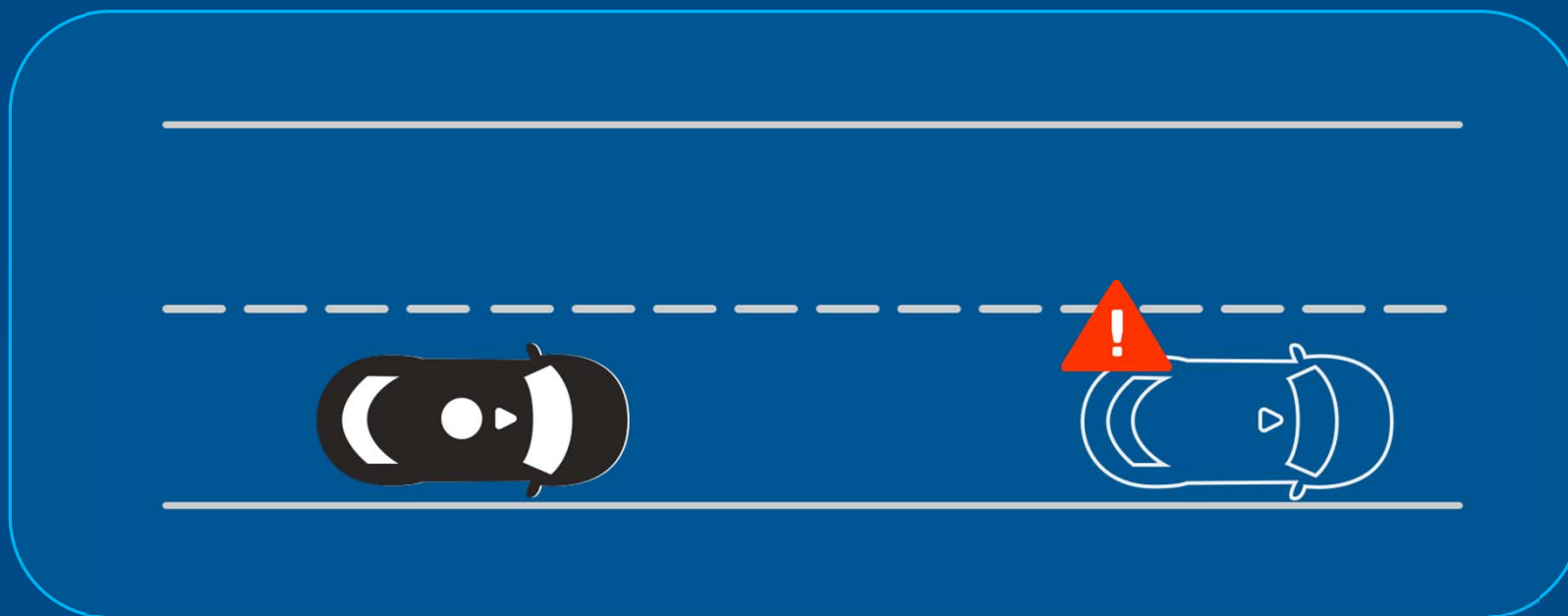
By MathWorks

Explore:
[Model Predictive Control Toolbox](#)

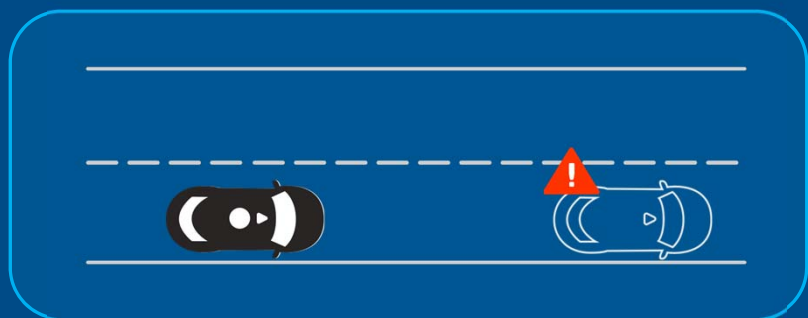
This example also uses:
[Embedded Coder](#)
[Simulink](#)
[Simulink Control Design](#)

Try it in MATLAB

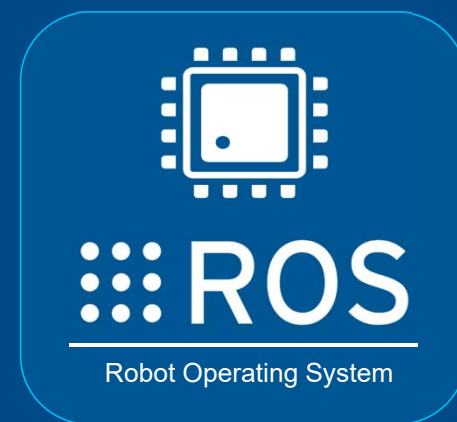
Injected simulated vehicles to interact with while driving



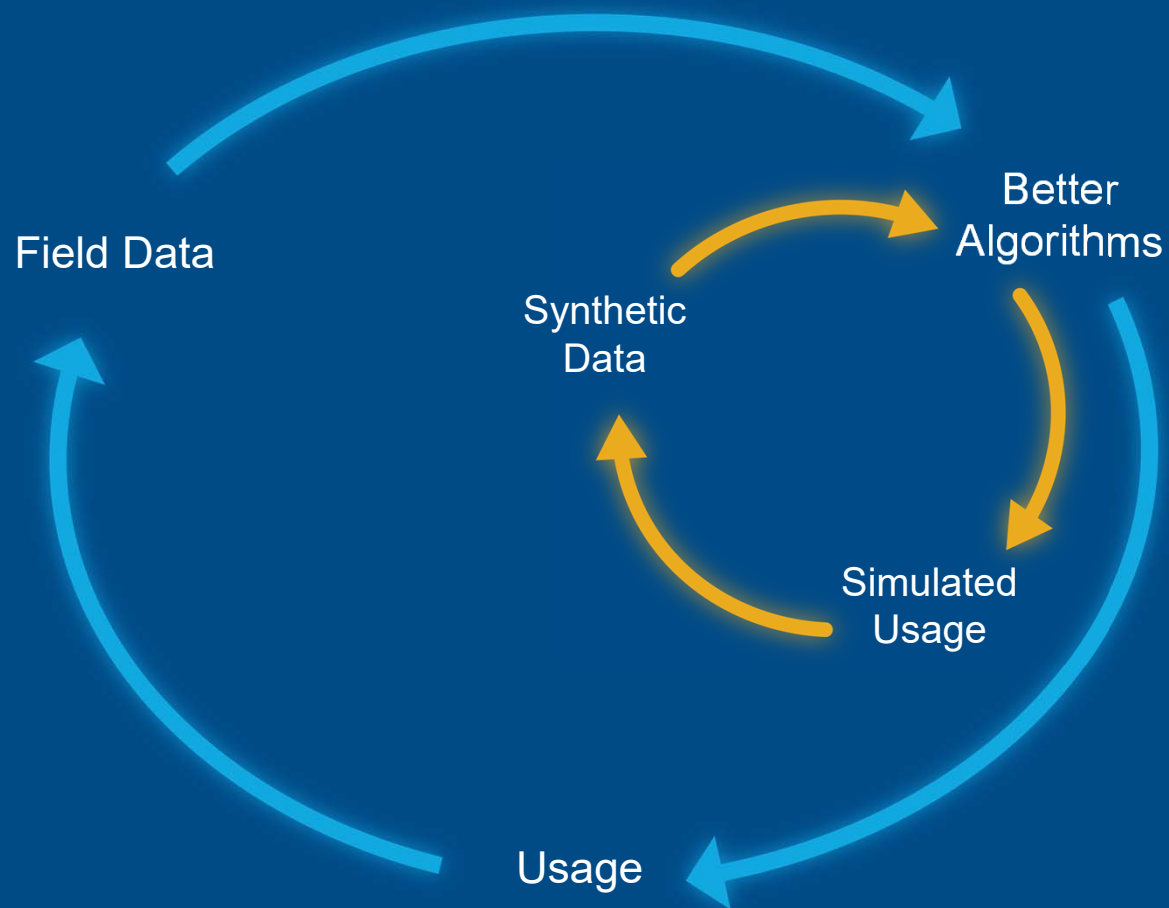
Deployed controller as ROS node and generated code



Robotics System Toolbox
Embedded Coder

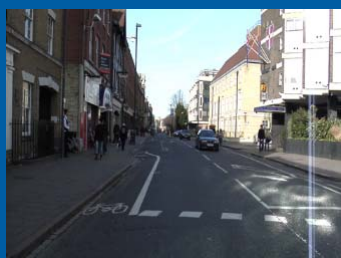


Train your AI faster with tight simulation loops

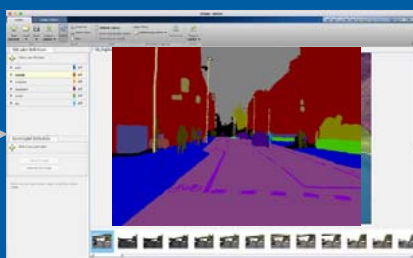


One example of leveraging simulation for data synthesis

Traditional deep learning workflow



Record



Label



AI model

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 design workflow

Operate within
their environment

Interaction

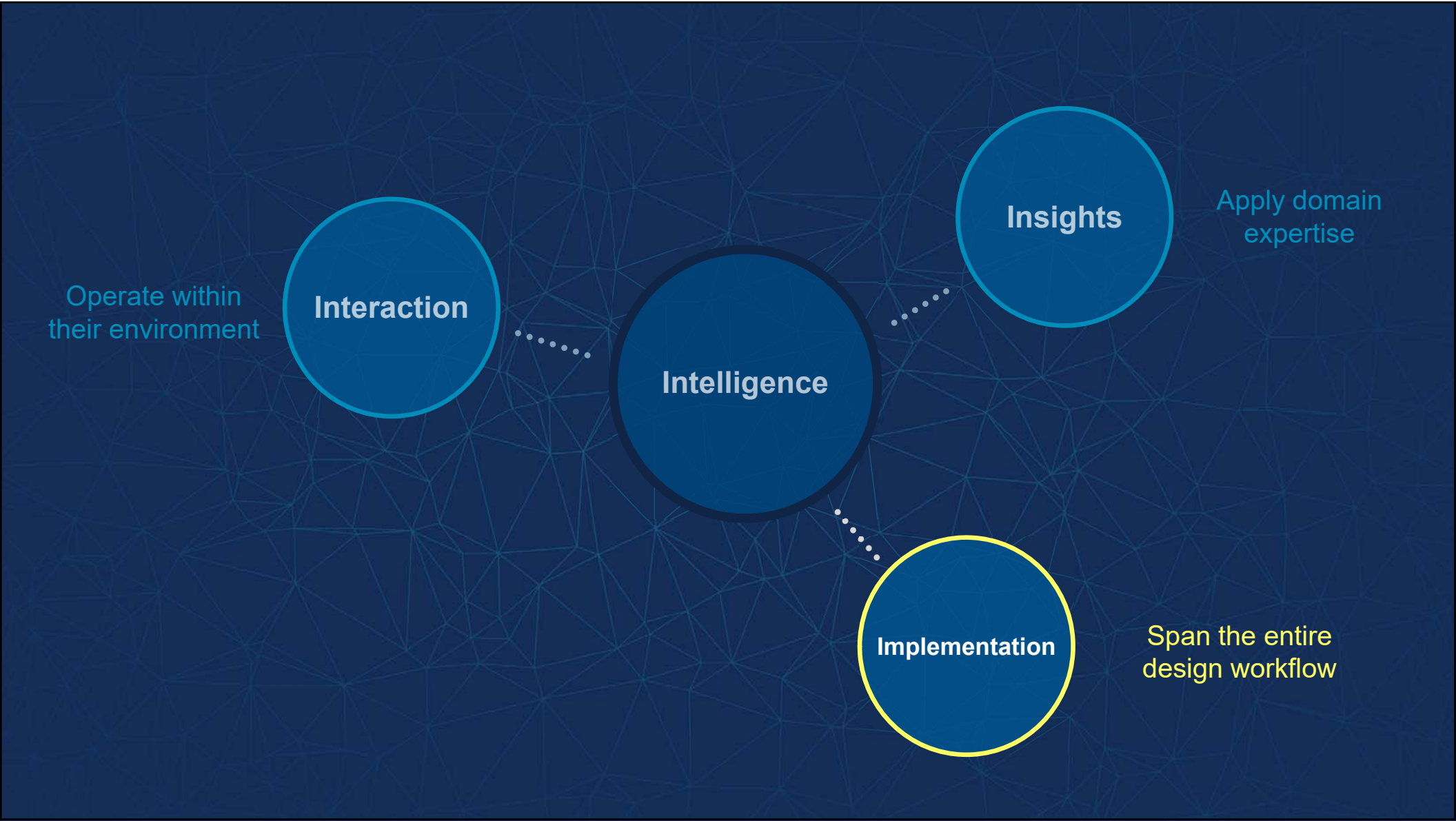
Intelligence

Insights

Apply domain
expertise

Implementation

Span the entire
design workflow



Operate within
their environment



Apply domain
expertise

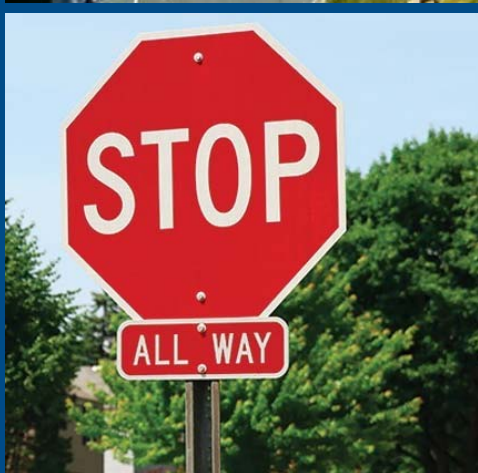


Span the entire
design workflow

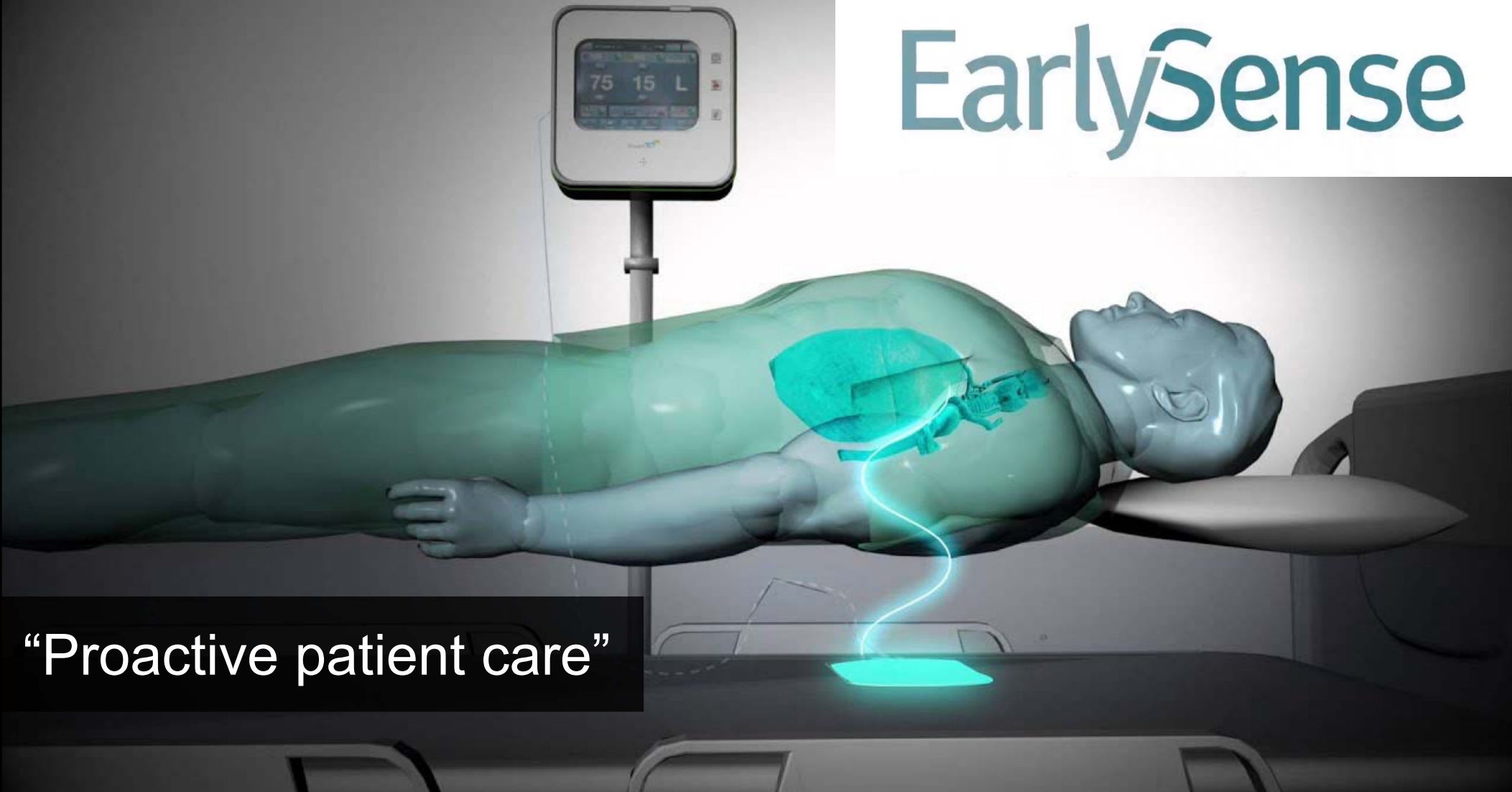


Interaction within complex environments

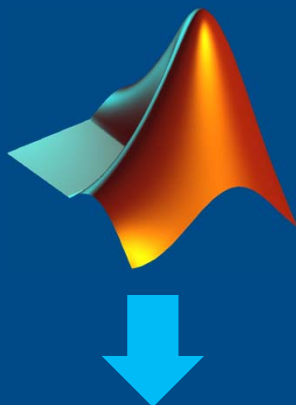
What was the larger system the vehicle had to operate in?



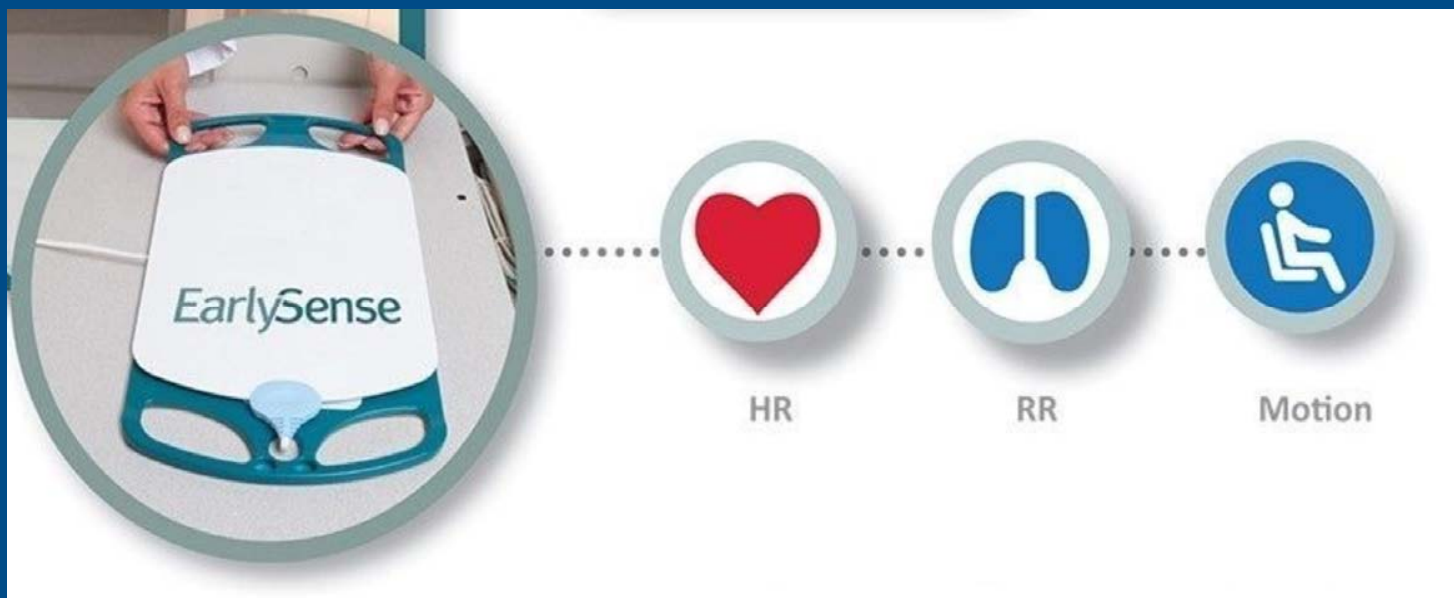
EarlySense



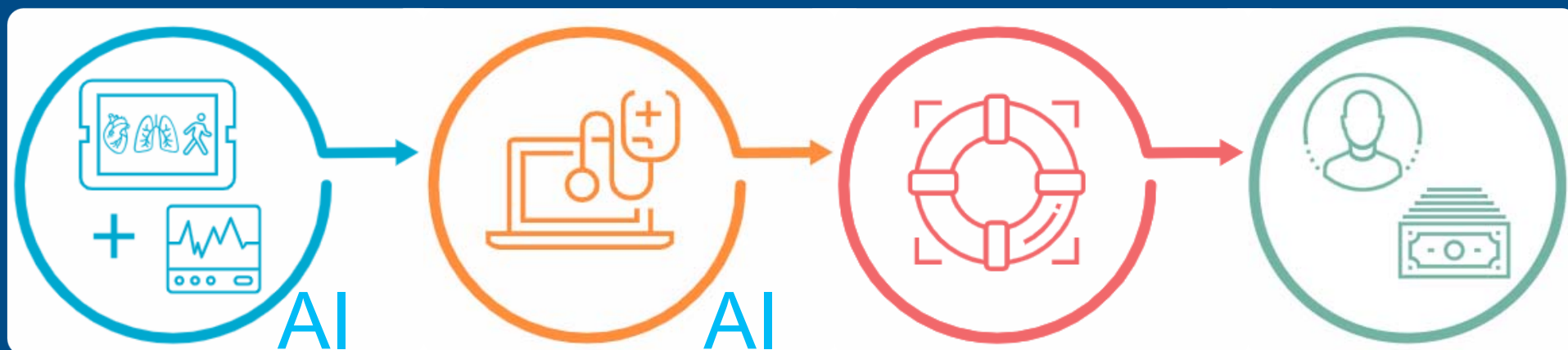
“Proactive patient care”



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

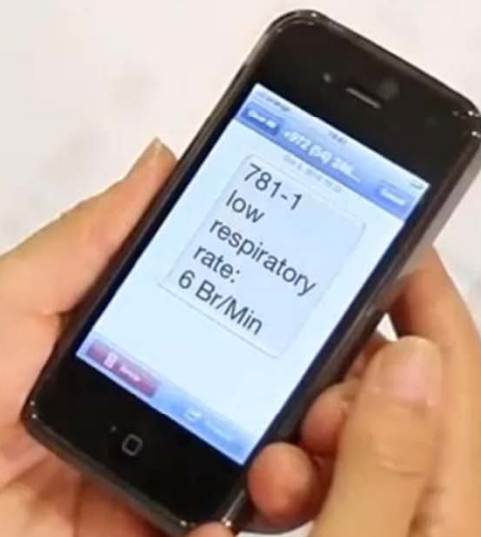
Early
Intervention

Better
Outcomes

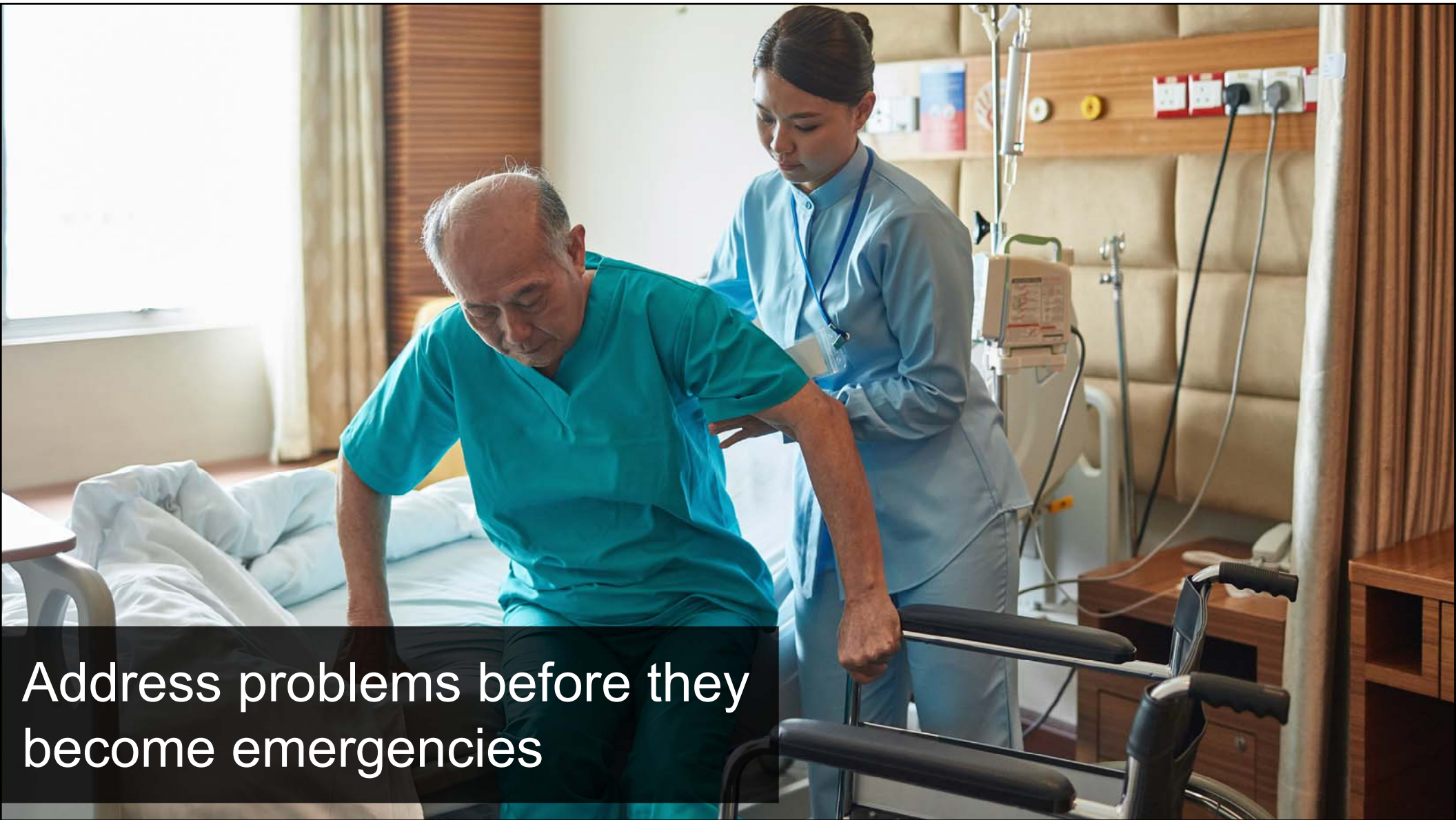
Dashboards at nurses' stations and on hallway monitors



Alerts on hand-held devices carried by staff



EarlySense



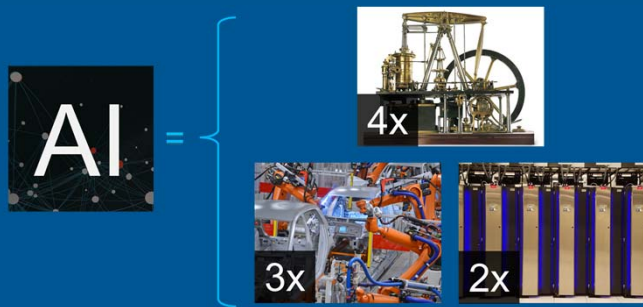
Address problems before they become emergencies

To be successful with AI, we must ...

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

Success requires more than just intelligence

AI is a transformative technology



But AI projects can and do fail

DigitalTonto
At the Crossroads of Media, Marketing and Technology...

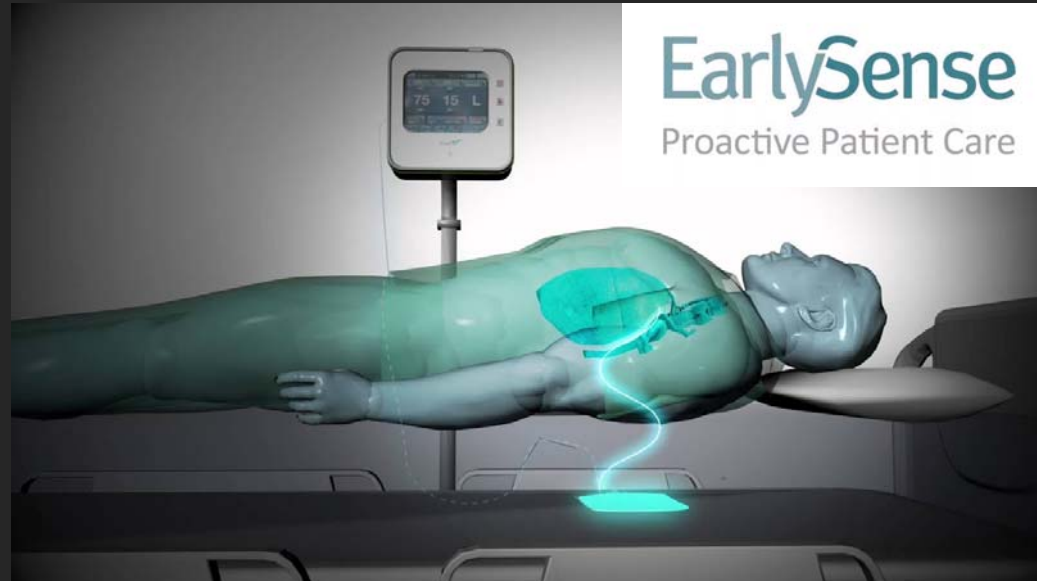
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Oct, 2017

CMS WiRE

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May, 2018



Operate within
their environment

Interaction

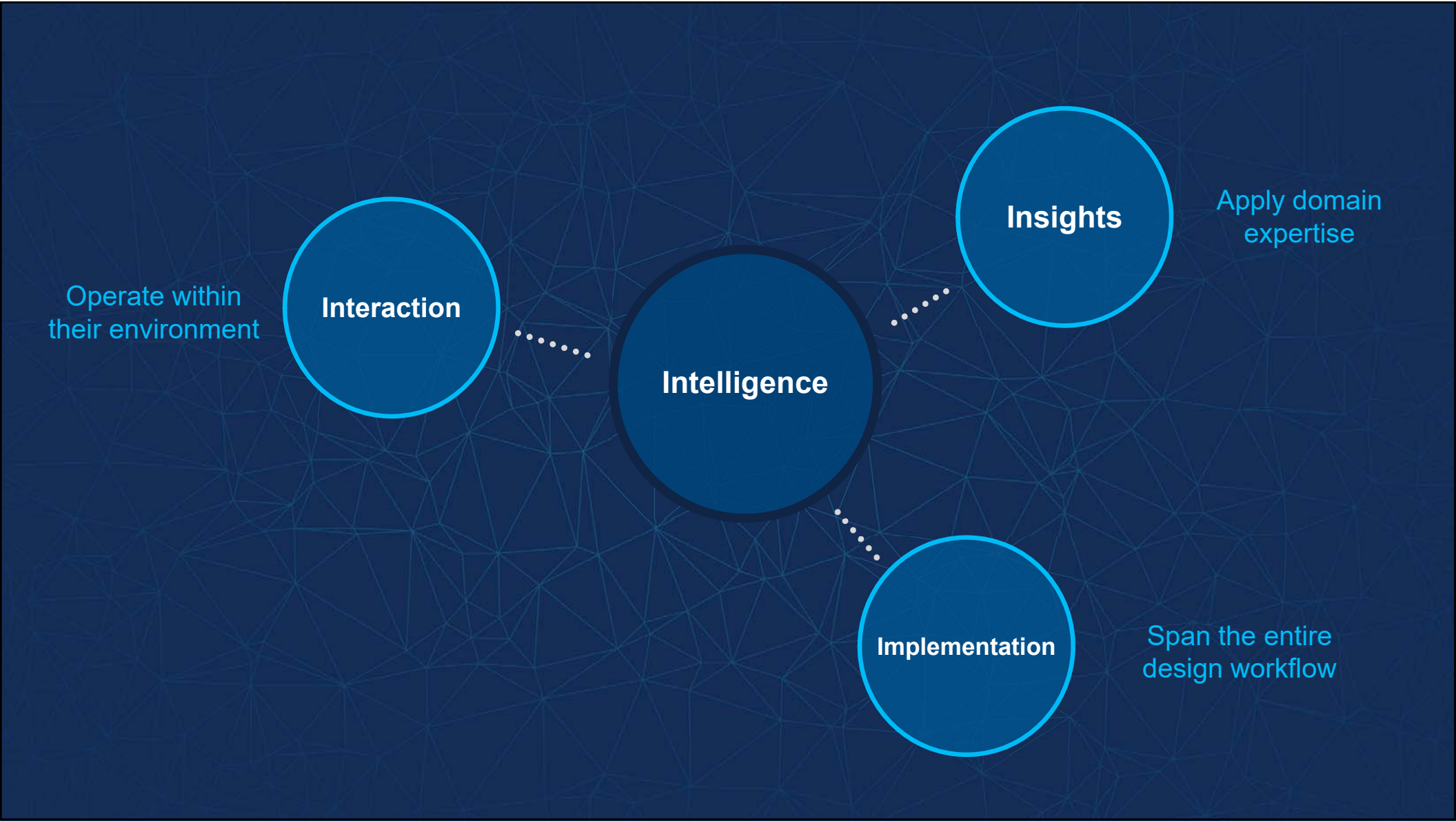
Intelligence

Insights

Apply domain
expertise

Implementation

Span the entire
design workflow



How will you apply AI to your projects?

Operate within
their environment

Interaction

Intelligence

Insights

Apply domain
expertise

Implementation

Span the entire
design workflow

**MATLAB[®]
& SIMULINK[®]**

MATLAB Expo 2019

Go Beyond the “I” in AI

**MATLAB[®]
& SIMULINK[®]**