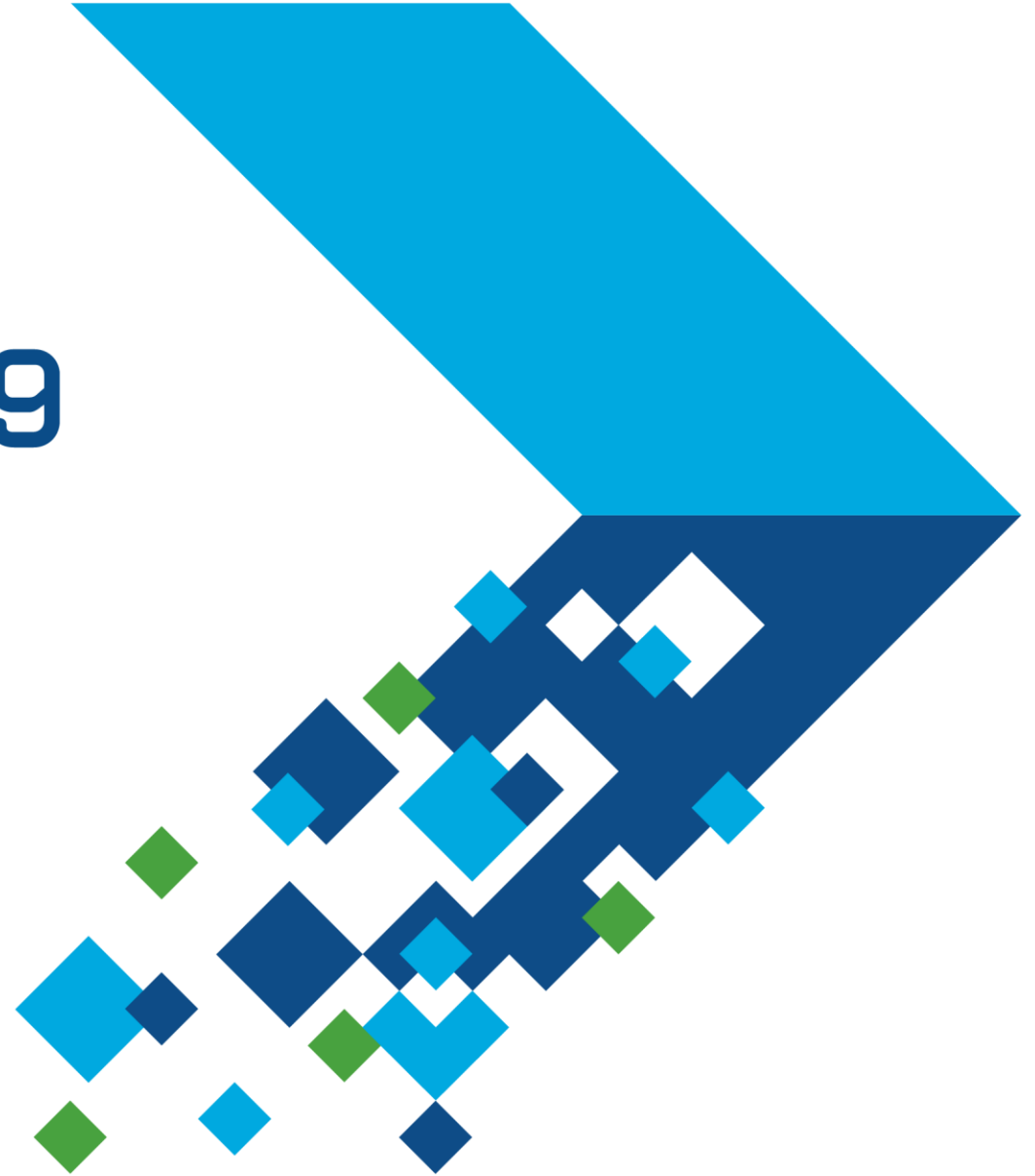


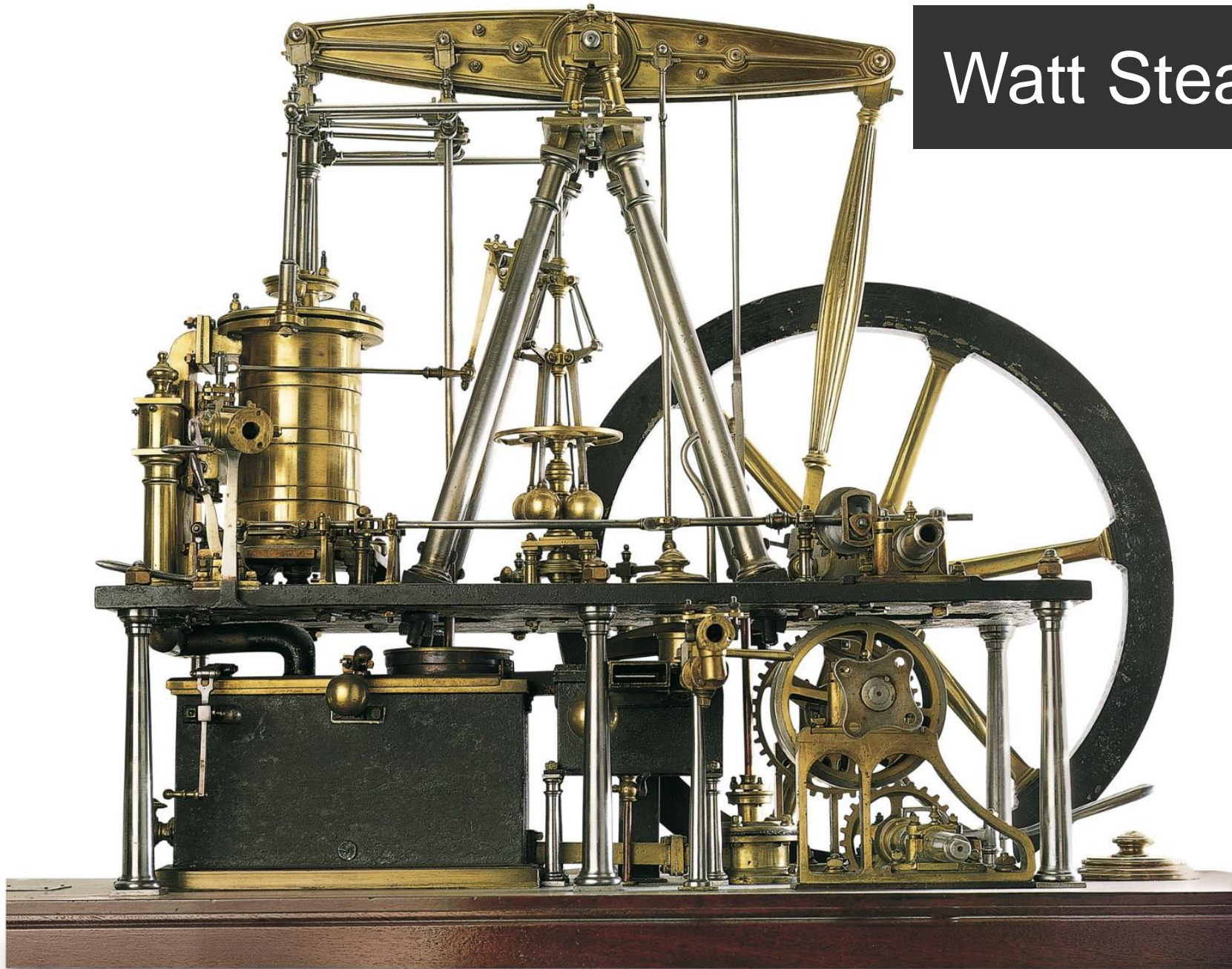
# MATLAB EXPO 2019

## Beyond the “I” in AI

Chris Hayhurst

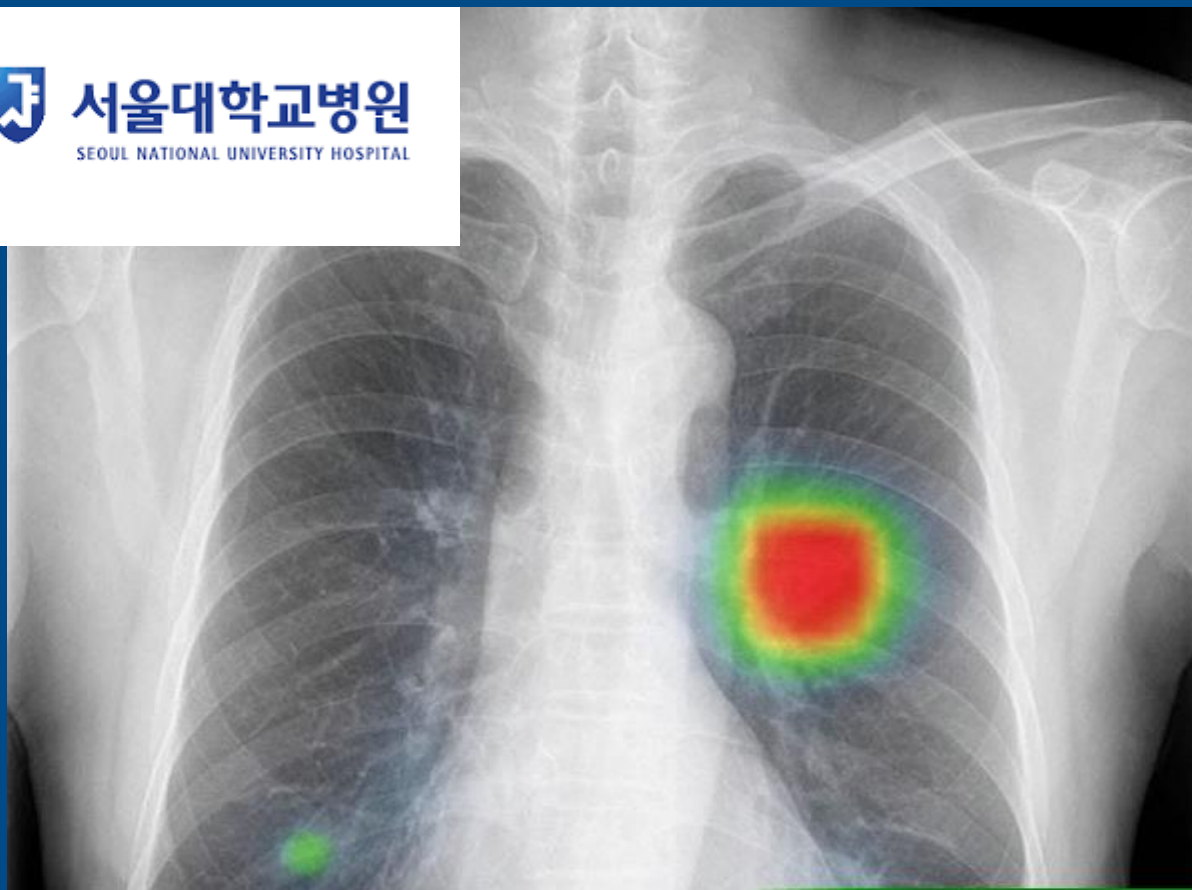


# Watt Steam Engine



# Artificial intelligence is a transformative technology

**SNUH** 서울대학교병원  
SEOUL NATIONAL UNIVERSITY HOSPITAL



## AI will create \$13 trillion in value by 2030

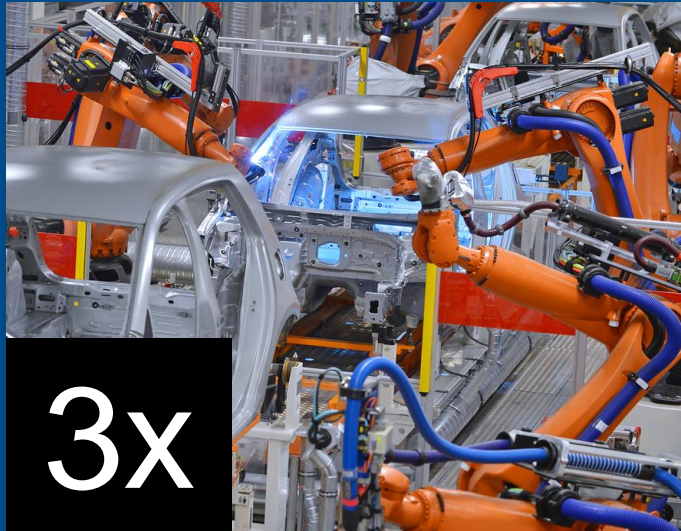
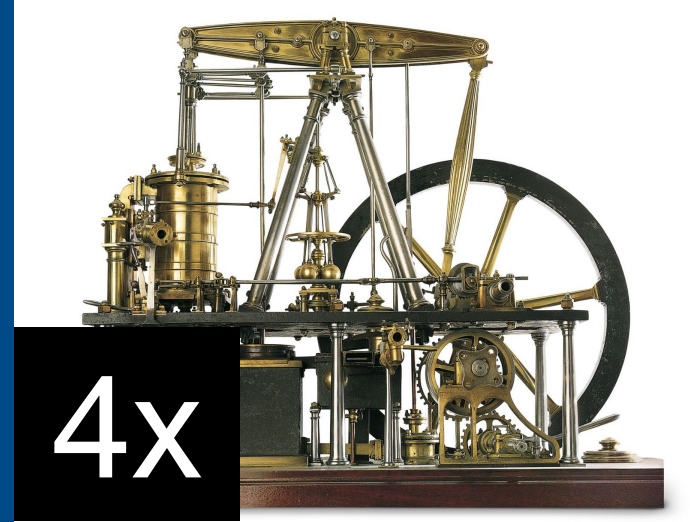
based on McKinsey's latest AI forecast – September 2018



# AI has tremendous potential to increase productivity



=



# Yet AI is struggling



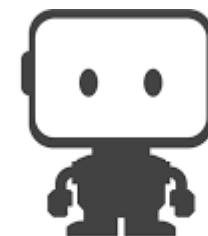
Most AI Projects **Fail**. Here's  
How to Make Yours Successful.

July, 2018



3 Common Reasons Artificial  
Intelligence Projects **Fail**

May, 2018



**DataRobot**

Why Most AI Projects **Fail**

Oct, 2017

# TayTweets AI project taken down within 24 hours



## The New York Times

---

*Microsoft Created a Twitter Bot to Learn From Users. It Quickly Became a ... Jerk.*

March 24, 2016

# 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

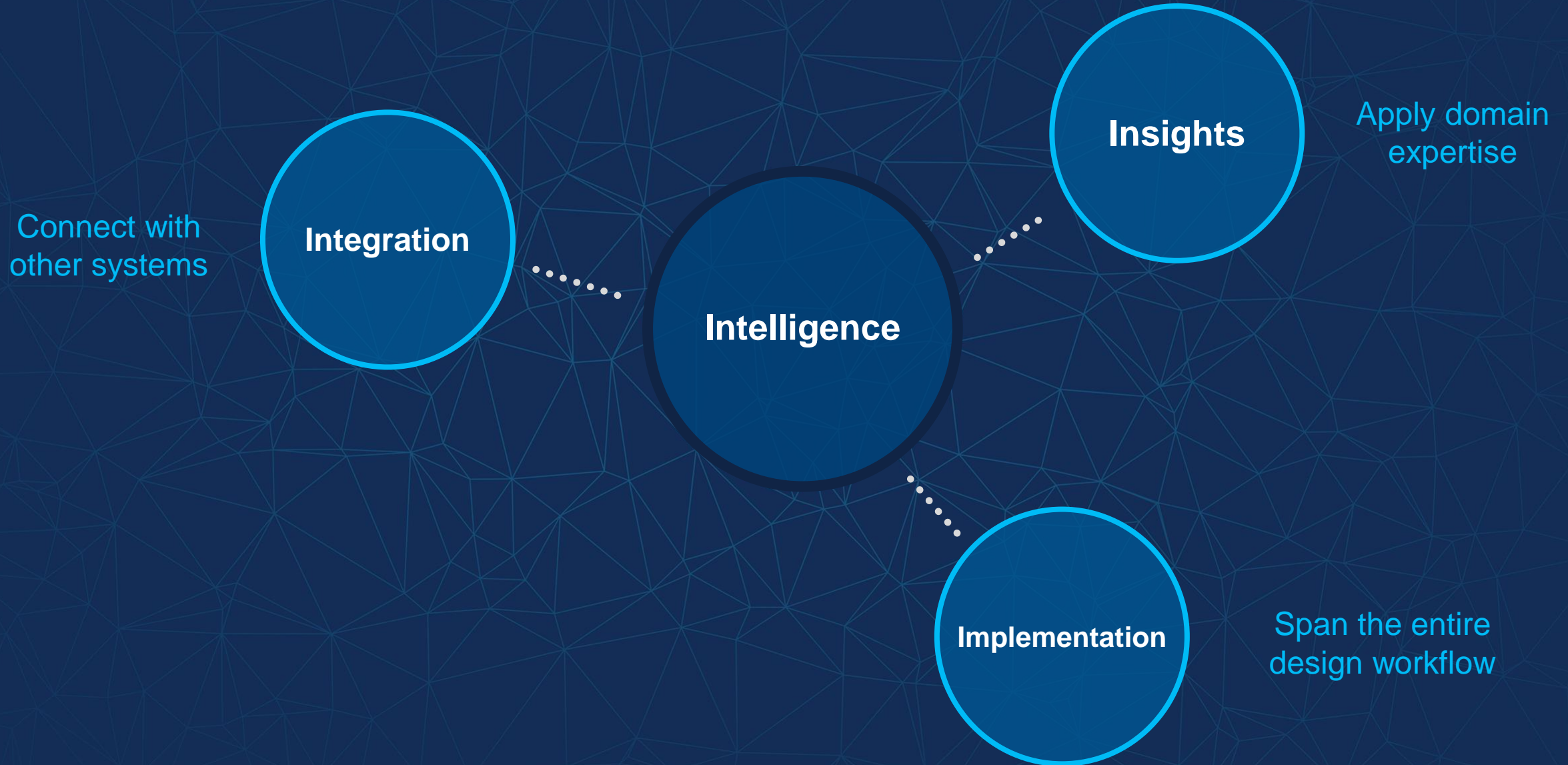
Problem is a  
poor fit for AI

Can't integrate with  
other systems

Problem is  
unsolvable



# AI is more than just the intelligence of the algorithm





Connect with  
other systems

**Integration**

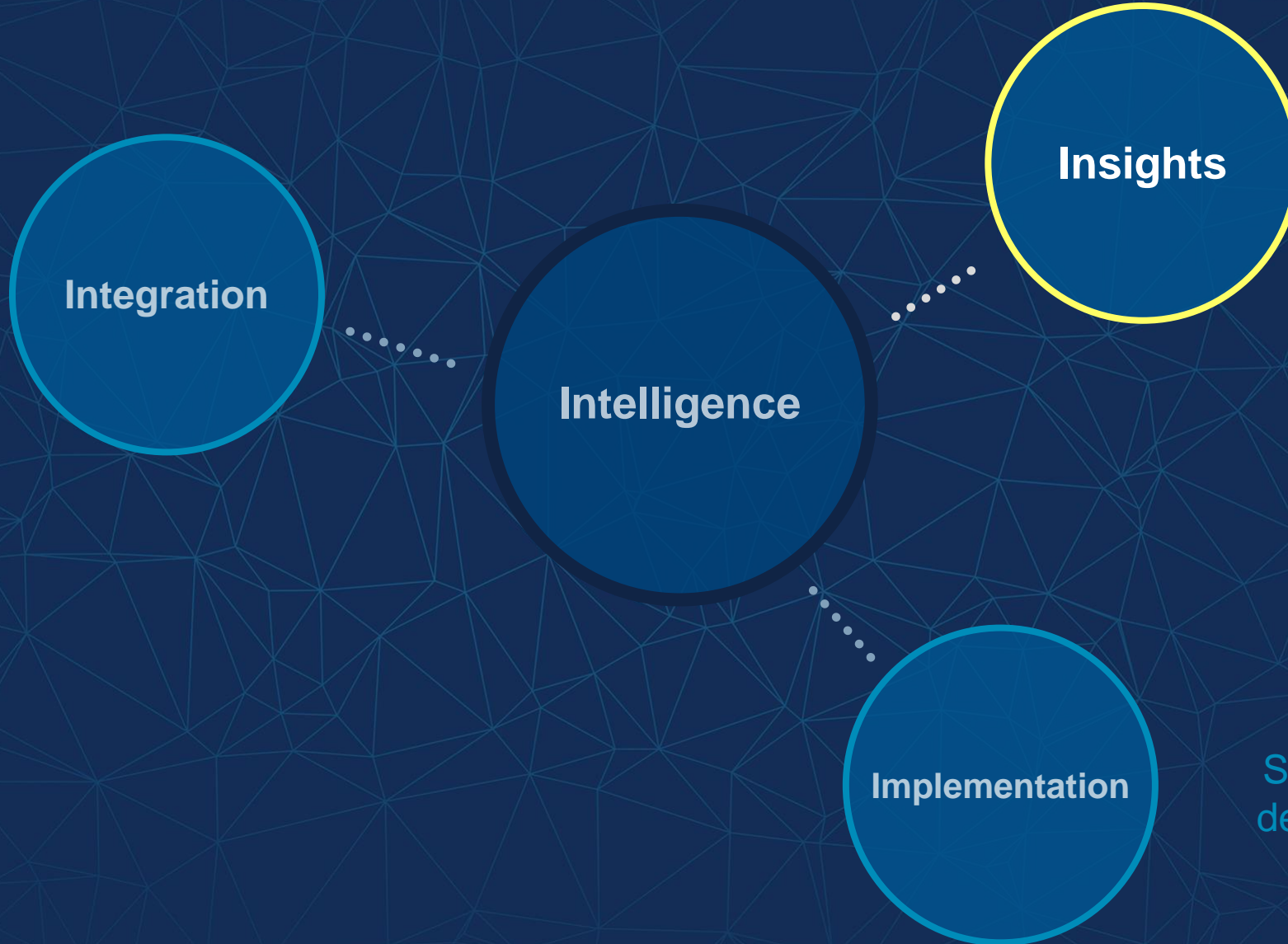
**Intelligence**

**Insights**

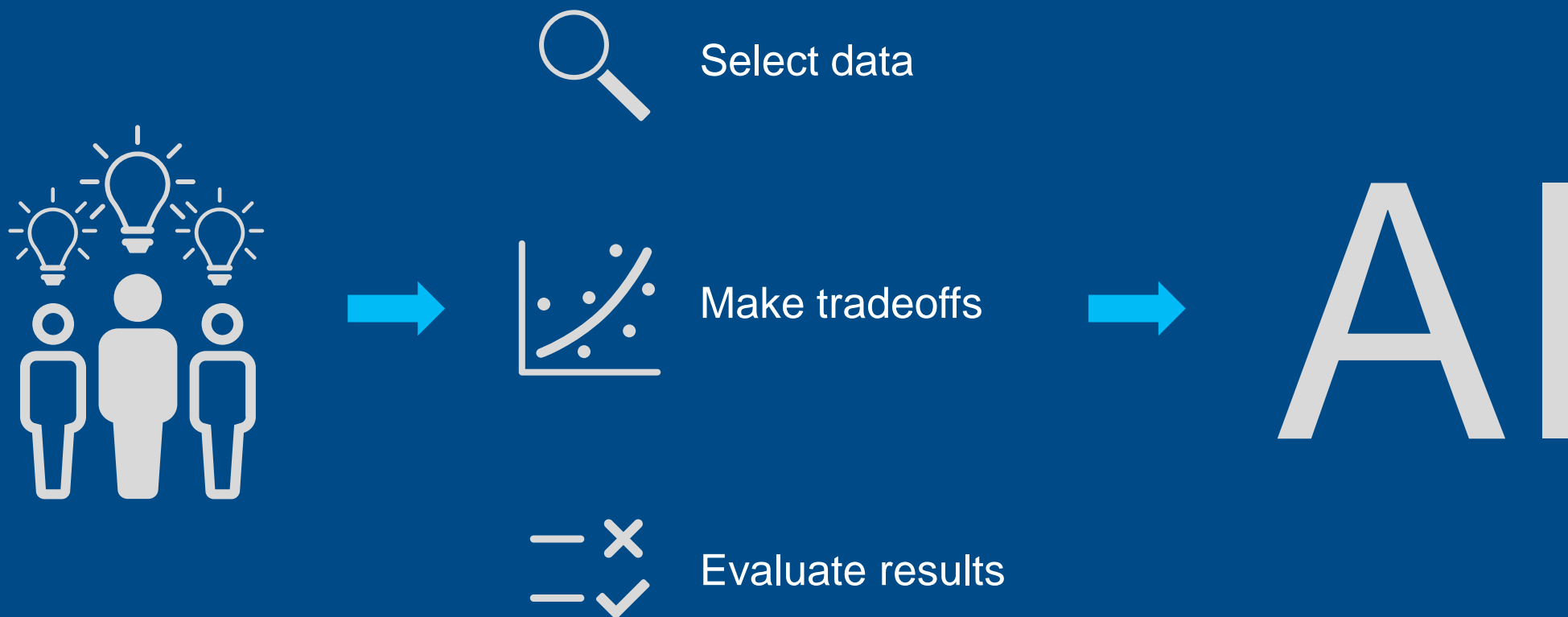
Apply domain  
expertise

**Implementation**

Span the entire  
design workflow



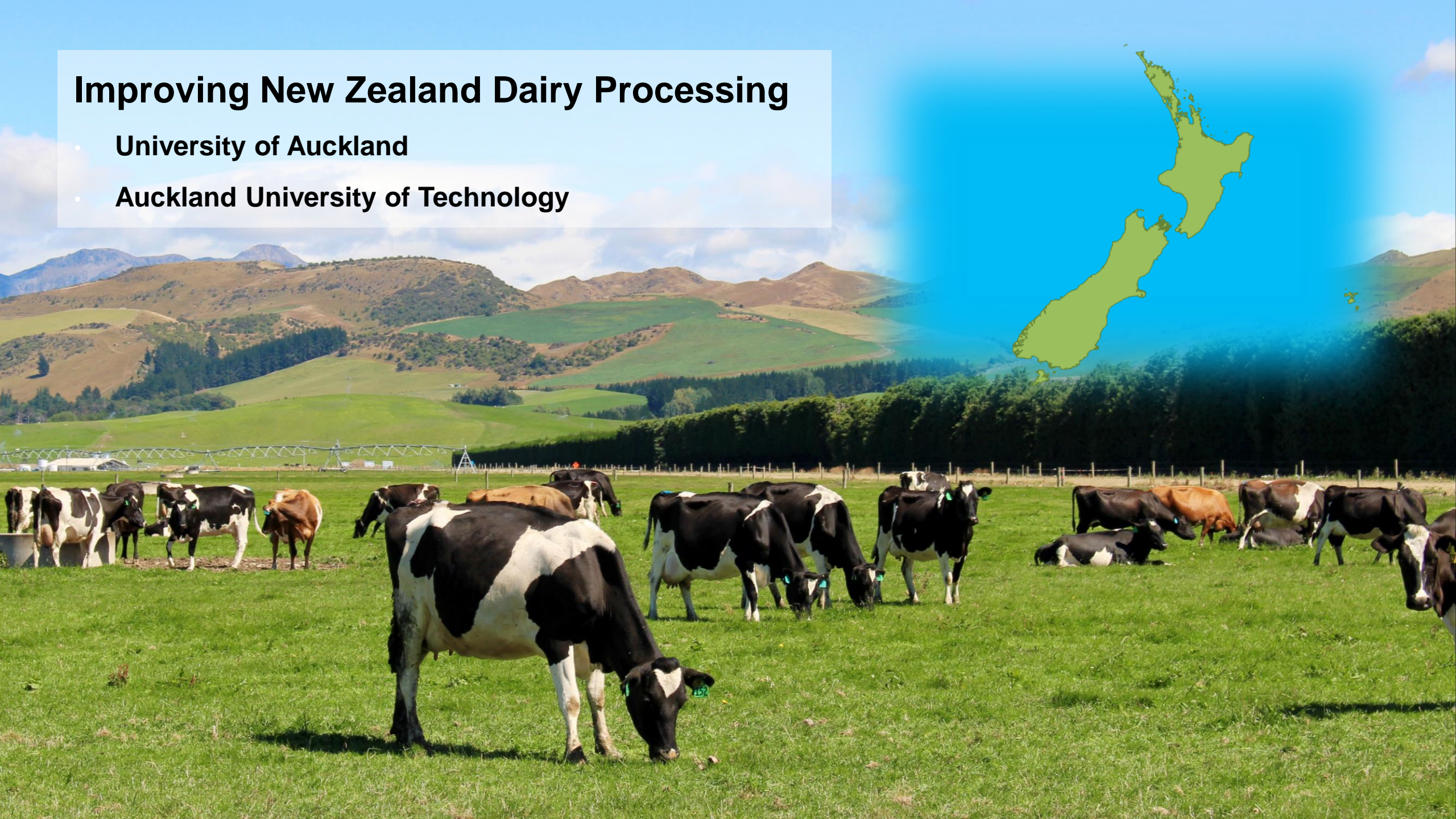
# Bring human insights into AI



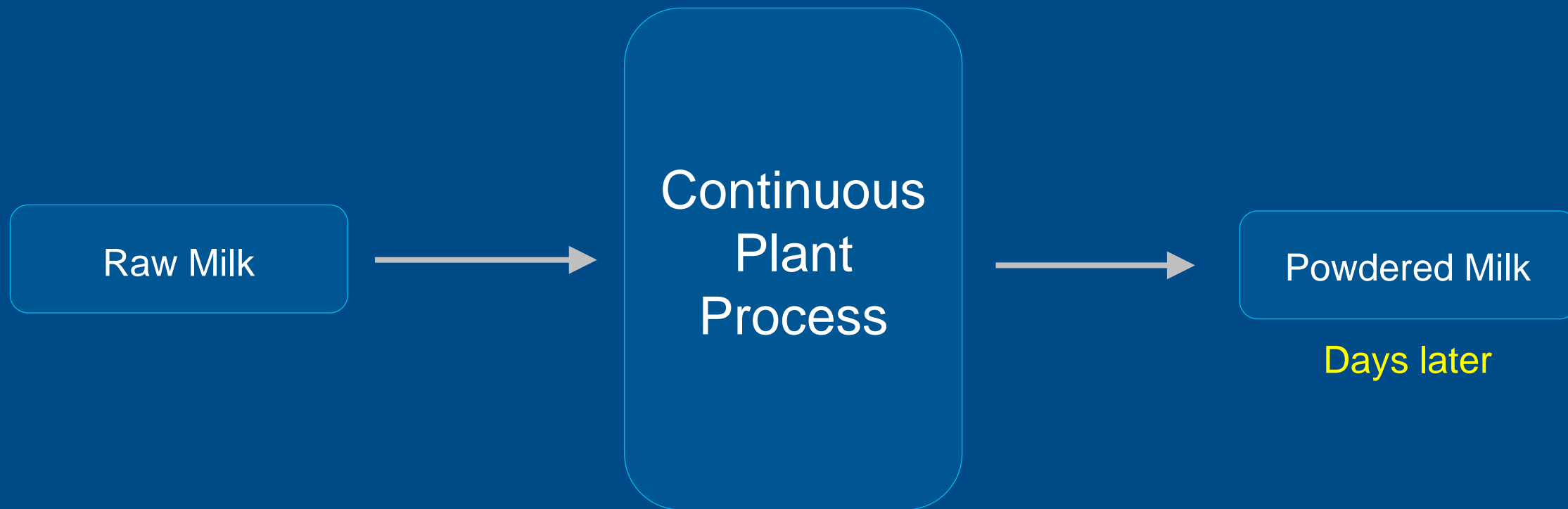


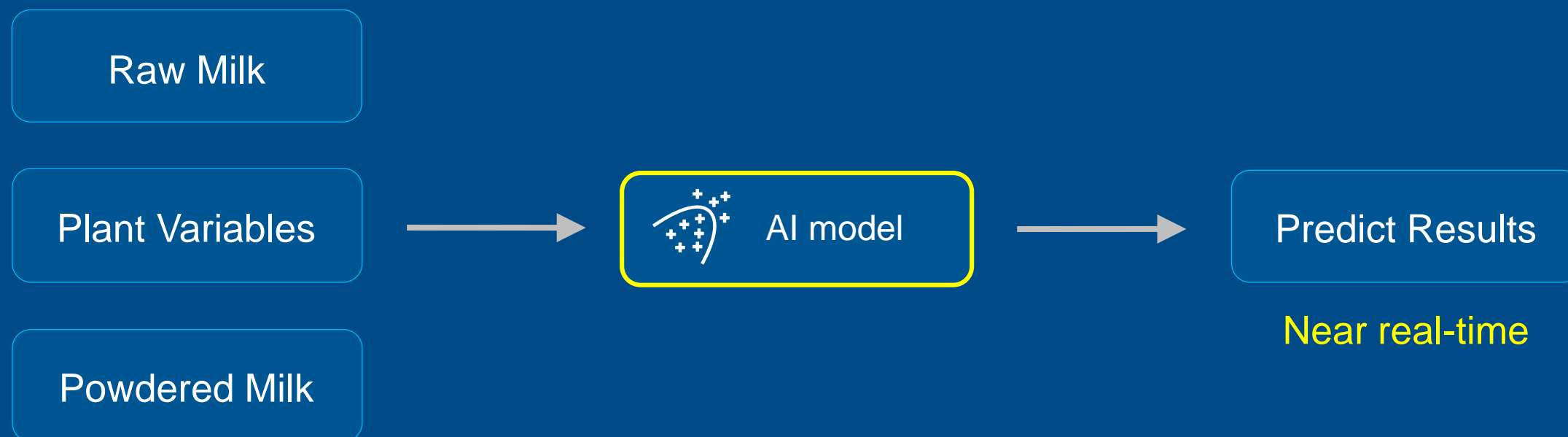
# Improving New Zealand Dairy Processing

- University of Auckland
- Auckland University of Technology









# They had **lots** of data

Raw Milk

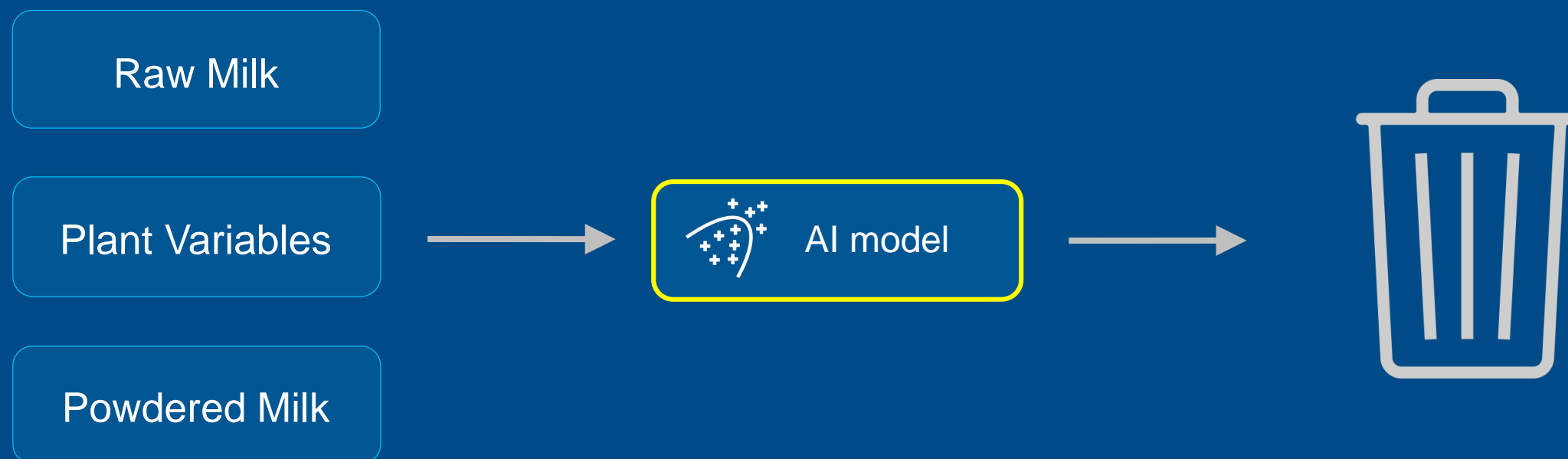
Plant Variables

Powdered Milk

- Millions of data points
- 3 plants
- 6 years



# But...



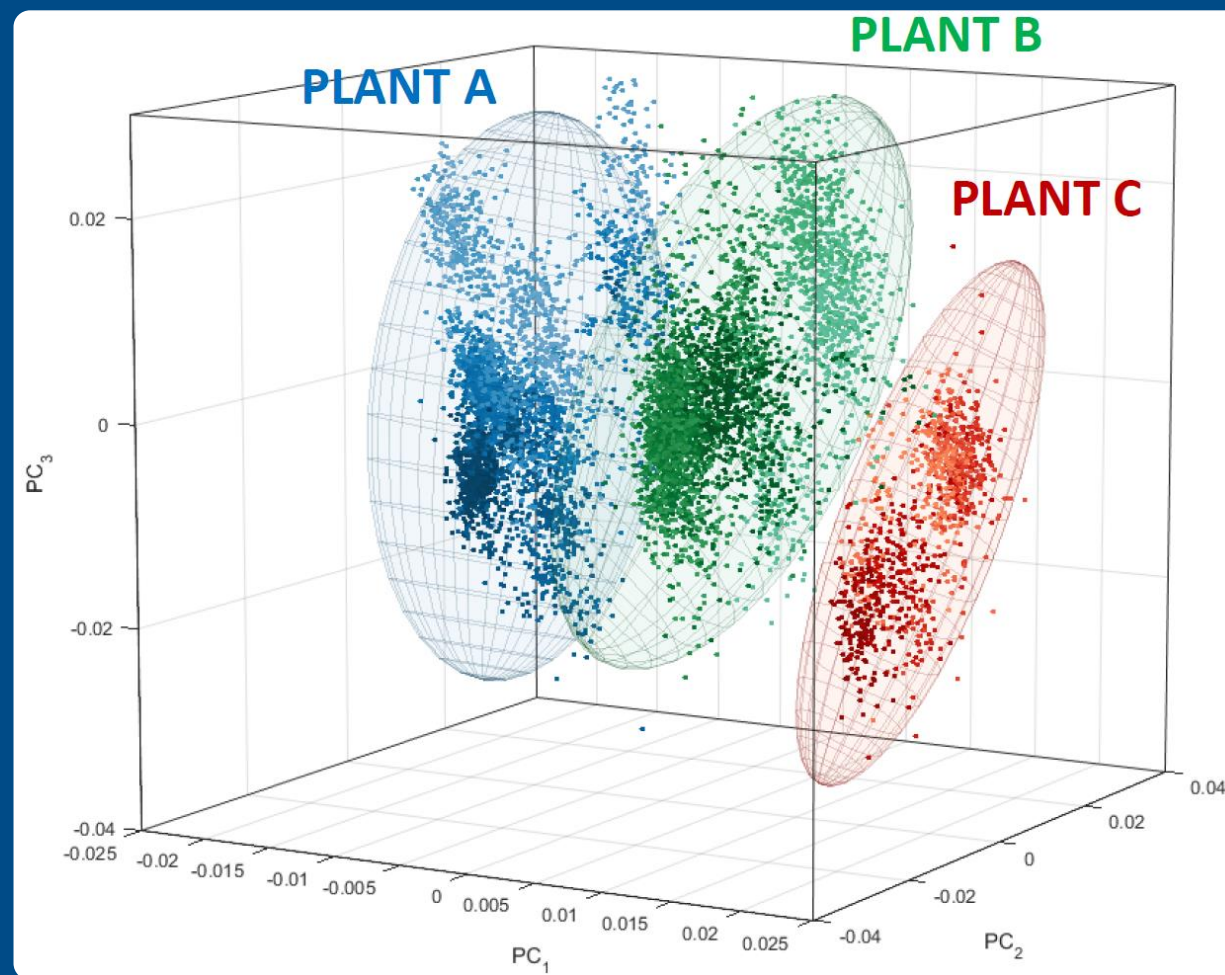
# Key Insights Made

1. Predictions were wrong

# Key Insights Made

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

Plants **behaved differently**  
from each another

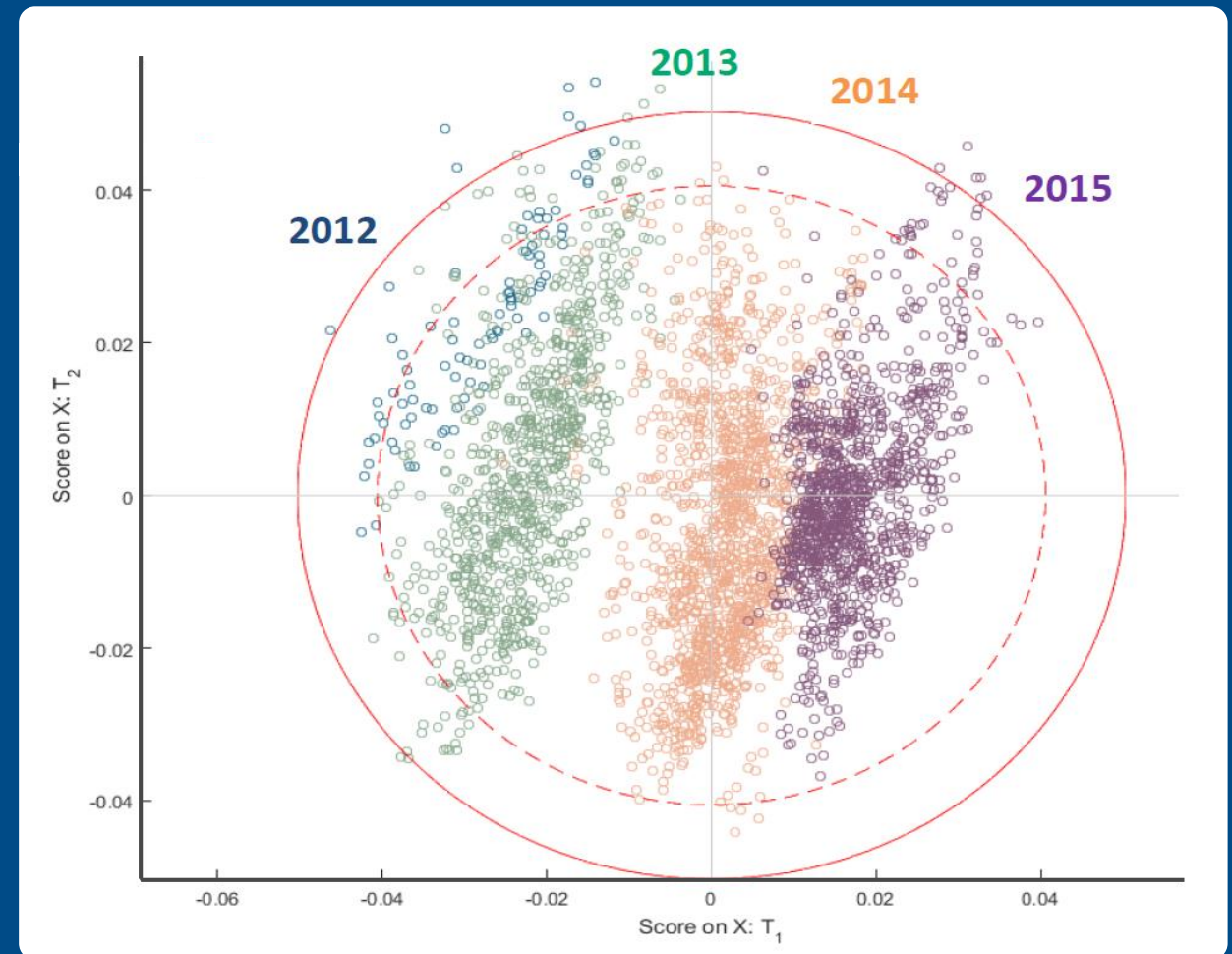




# Key Insights Made

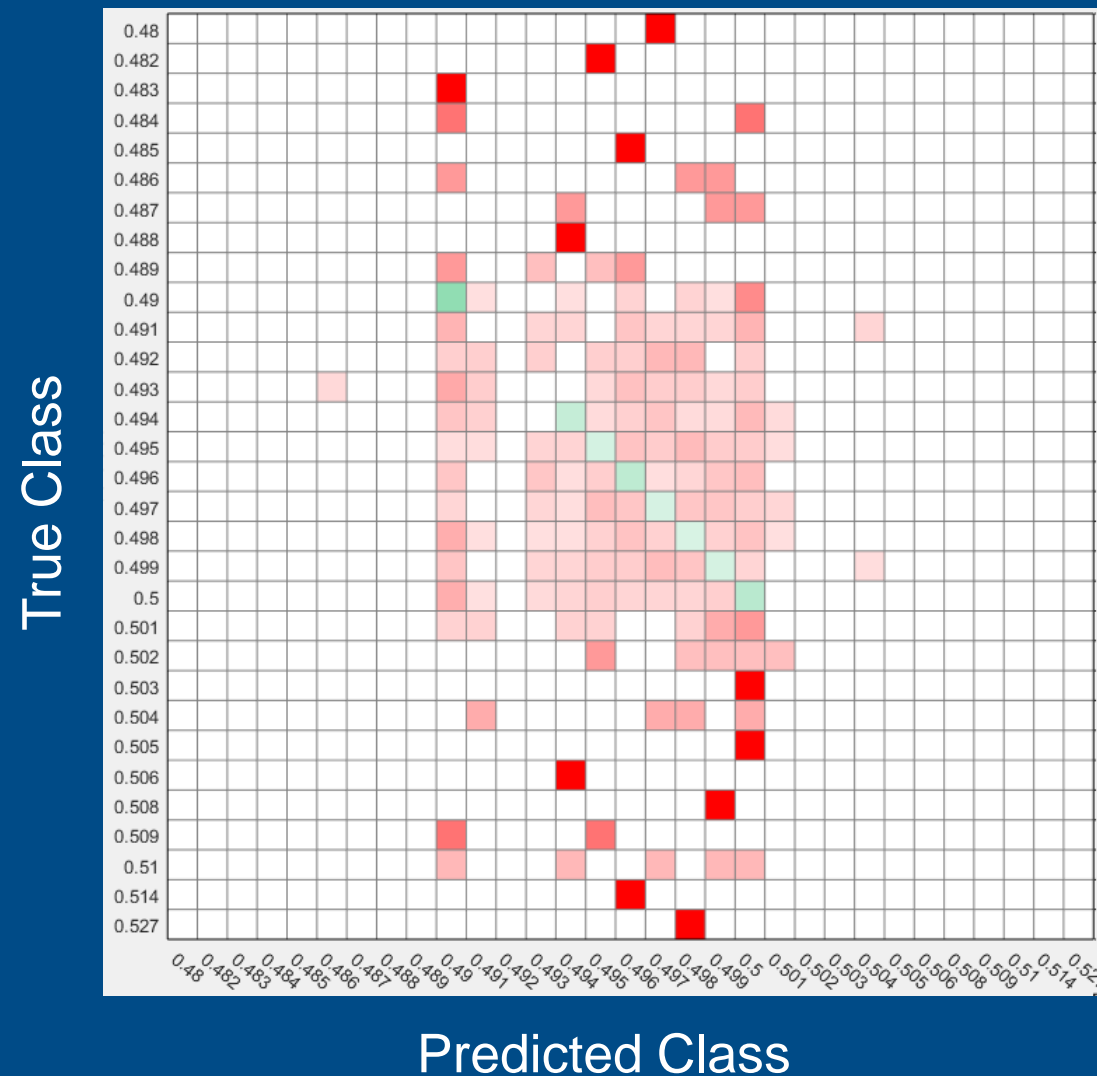
1. Predictions were wrong
2. Need to build a separate model for each plant
3. Plant's operating state changes each year

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



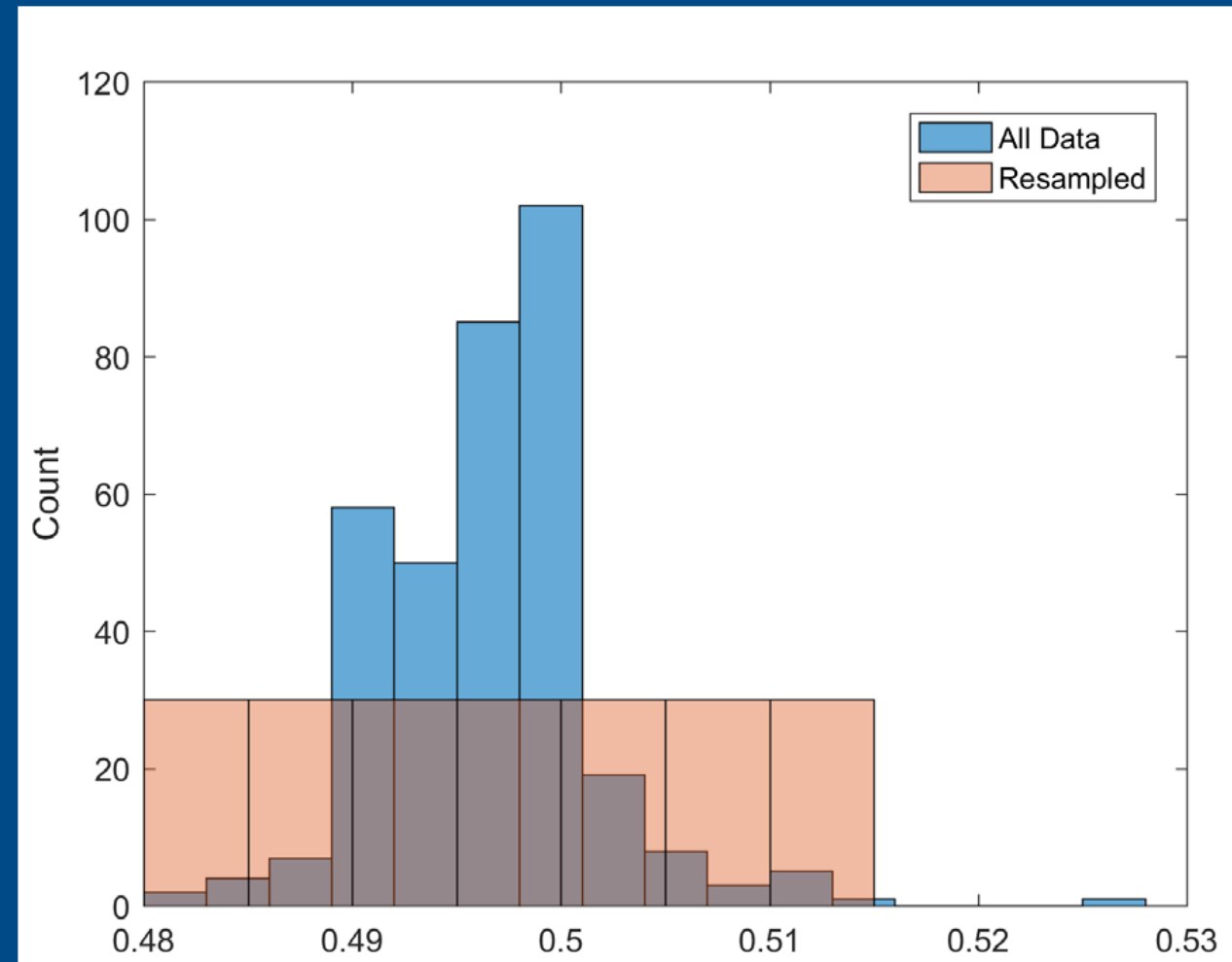
# Bulk density prediction results were inaccurate

- Many false positives
- Unused classes



# Key Insights Made

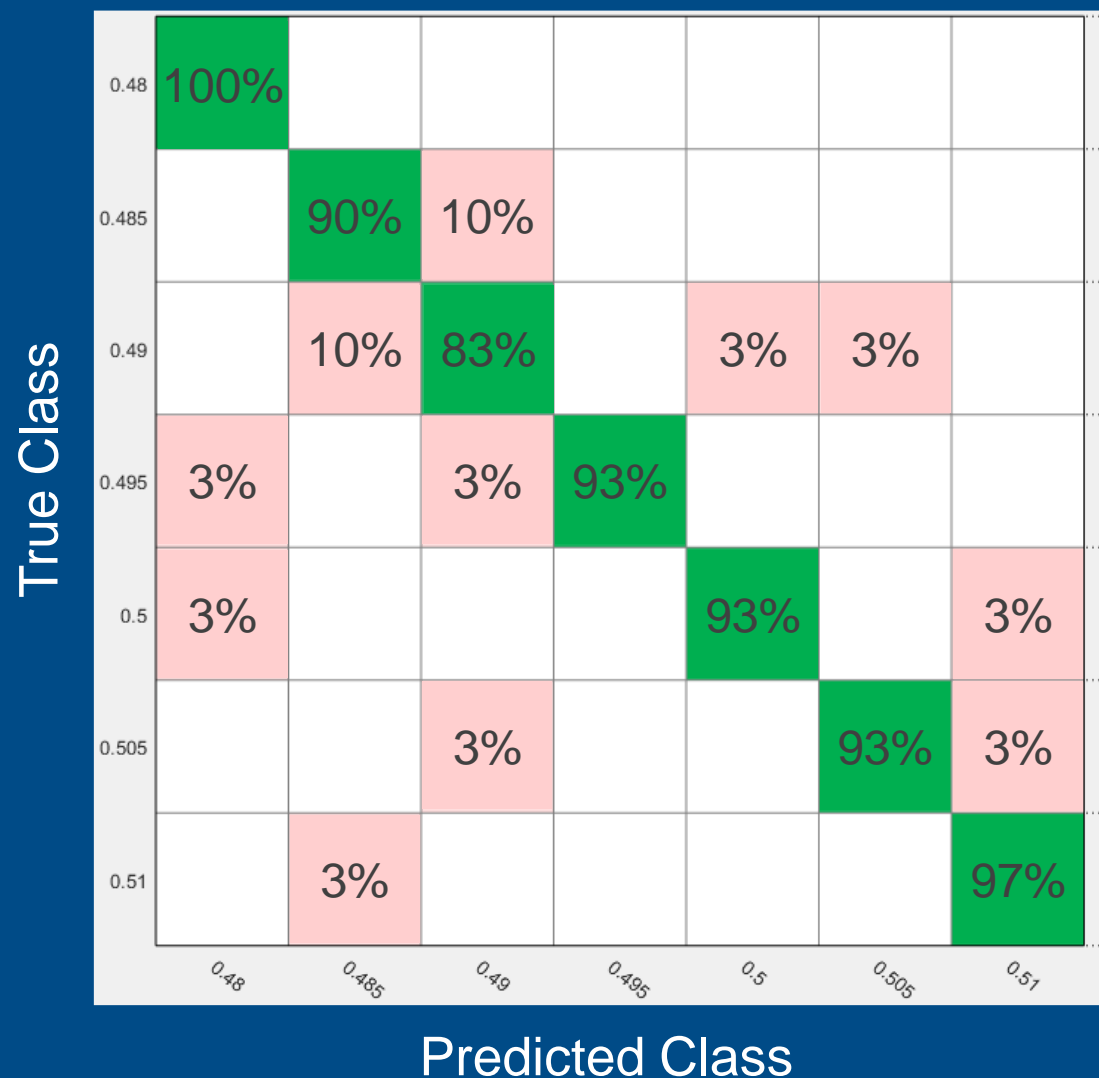
1. Predictions were wrong
2. Need to build a separate model for each plant
3. Plant's operating state changes each year
4. Training data was biased






# Resampling data resulted in higher predictive accuracy

- Resampled data
- Reduced the number of bins







“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.”

- *David Wilson, Industrial Information and Control Centre*



# To be successful with AI, you must ...

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

Connect with  
other systems

**Integration**

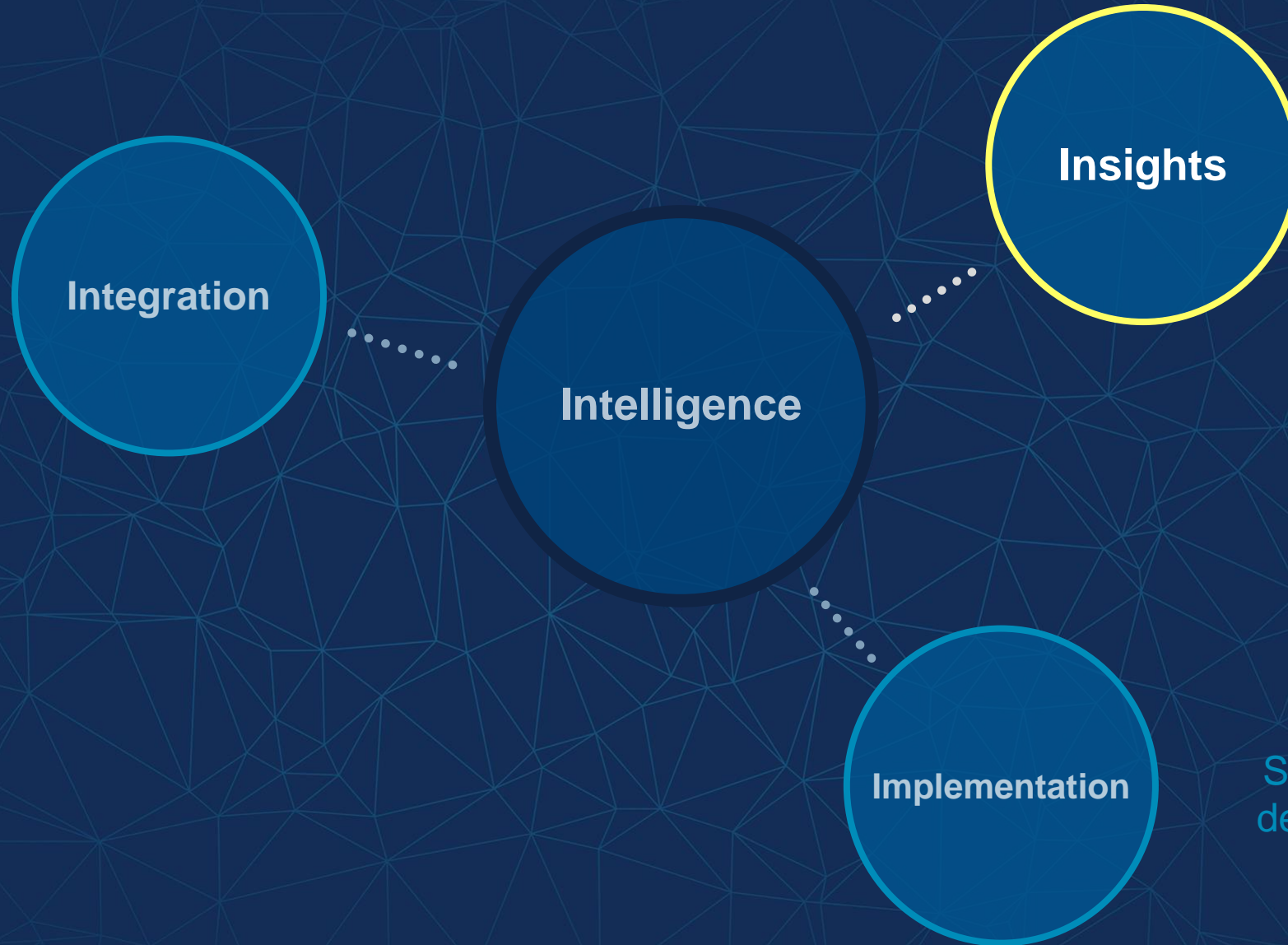
**Intelligence**

**Insights**

Apply domain  
expertise

**Implementation**

Span the entire  
design workflow



Connect with  
other systems

**Integration**

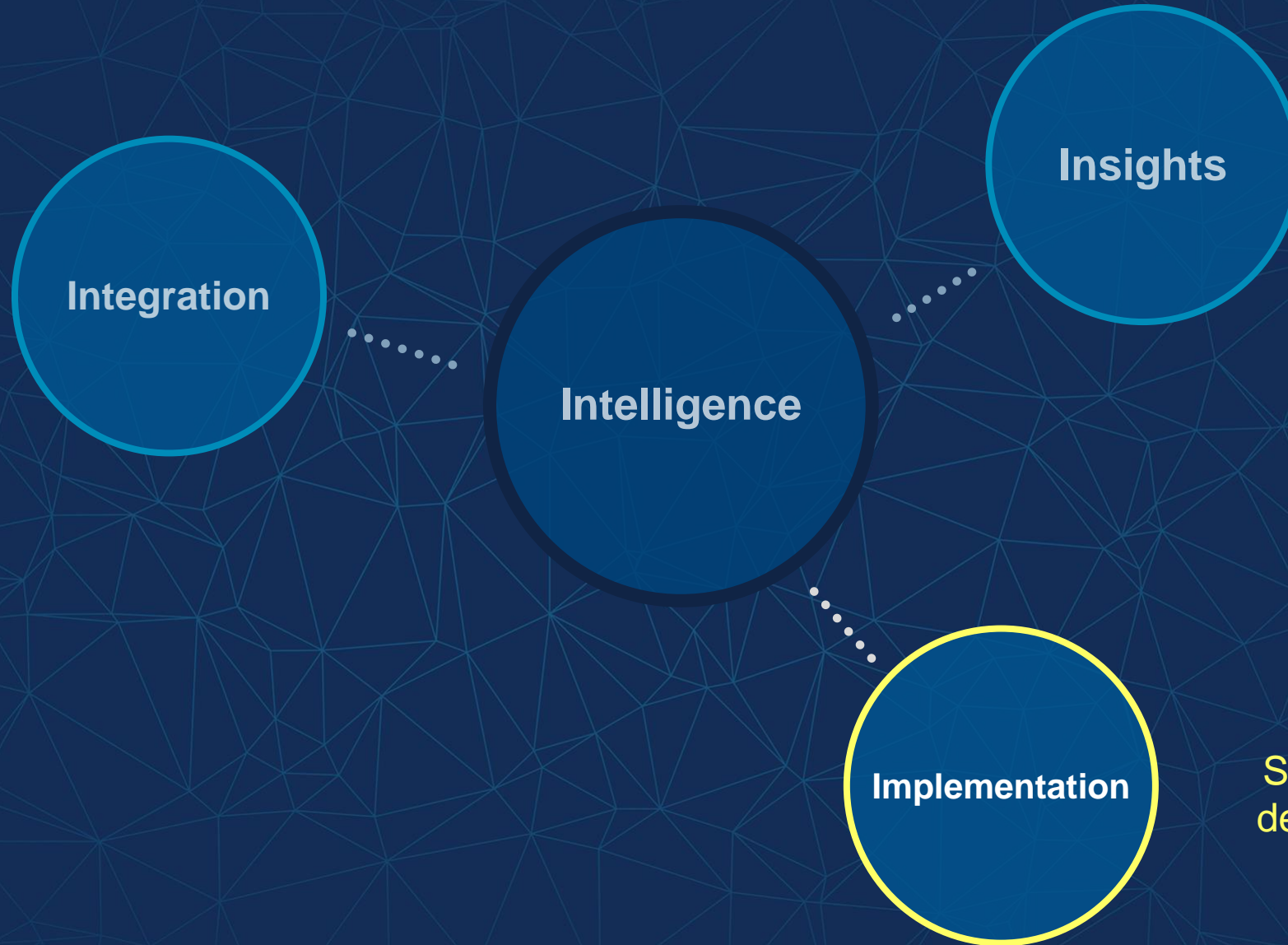
**Intelligence**

**Insights**

Apply domain  
expertise

**Implementation**

Span the entire  
design workflow





# Implementation is about designing 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



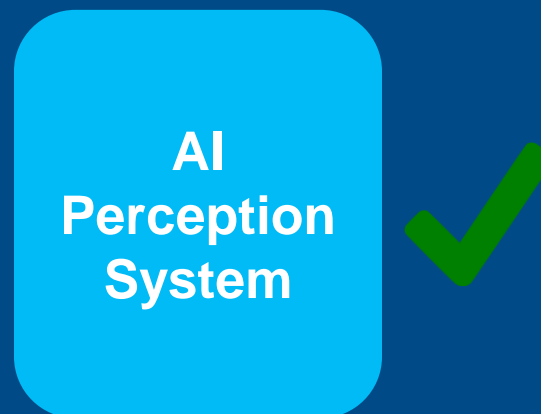
# Voyage's goal was to quickly get to market

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

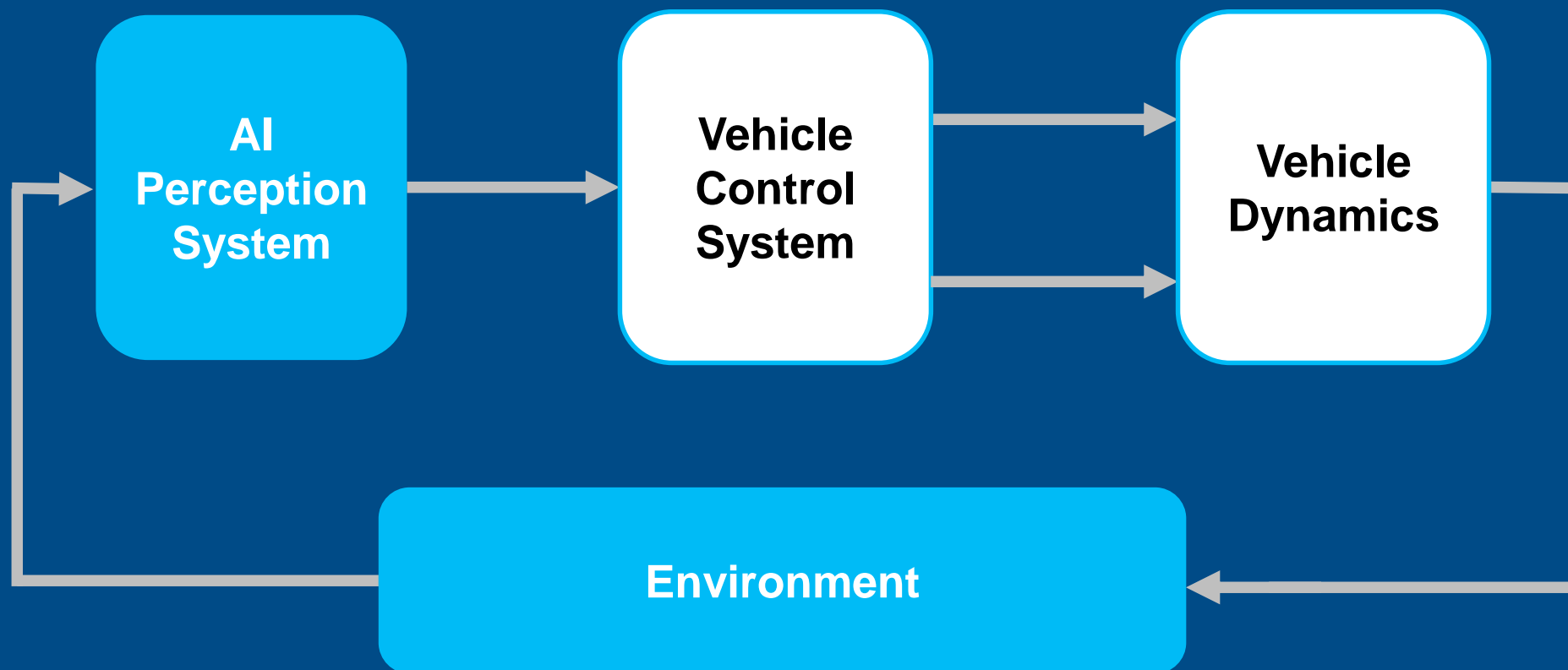
The LUMINAR logo, with the word 'LUMINAR' in a black sans-serif font. The letters 'I' and 'N' are colored red and blue respectively.The CARMERA logo, featuring a stylized orange and purple infinity symbol above the word 'CARMERA' in a black sans-serif font.The ROS logo, featuring a 3x3 grid of dots above the word 'ROS' in a large black sans-serif font, with 'Robot Operating System' in a smaller black sans-serif font below it.



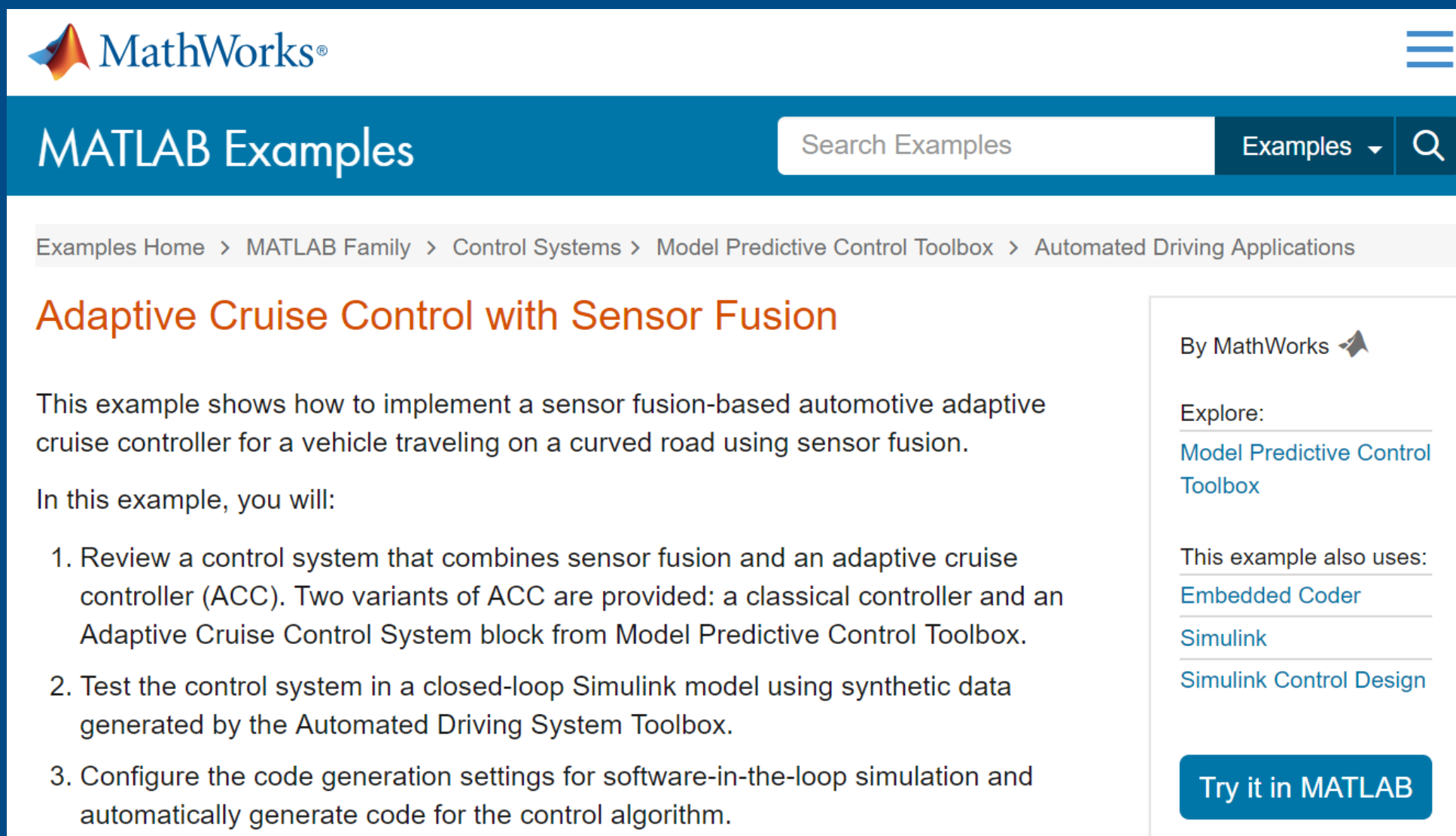
# Voyage completed their AI system first



# 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 website. The header includes the MathWorks logo and a search bar. The main navigation bar is blue with the text 'MATLAB Examples'. Below this is a breadcrumb trail: 'Examples Home > MATLAB Family > Control Systems > Model Predictive Control Toolbox > Automated Driving Applications'. The main content area is titled 'Adaptive Cruise Control with Sensor Fusion' in orange. It describes an example of implementing a sensor fusion-based automotive adaptive cruise controller. A list of three steps outlines the example's goals: reviewing a control system with ACC, testing it in a Simulink model, and configuring code generation. On the right, a sidebar lists related resources: 'Model Predictive Control Toolbox', 'Embedded Coder', 'Simulink', and 'Simulink Control Design'. A 'Try it in MATLAB' button is at the bottom right.

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](#)

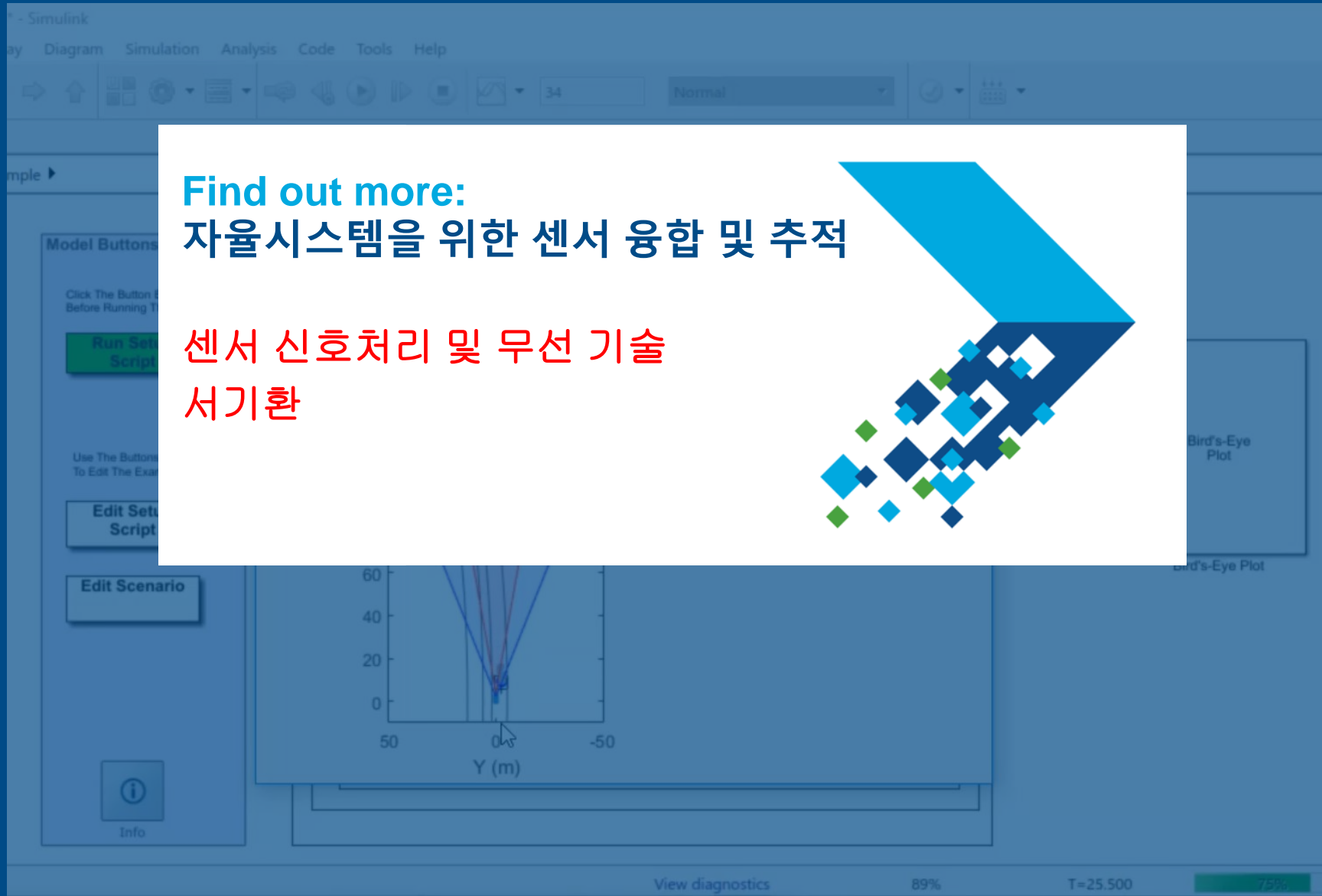
Try it in MATLAB

# Started with Simulink example that they could build upon

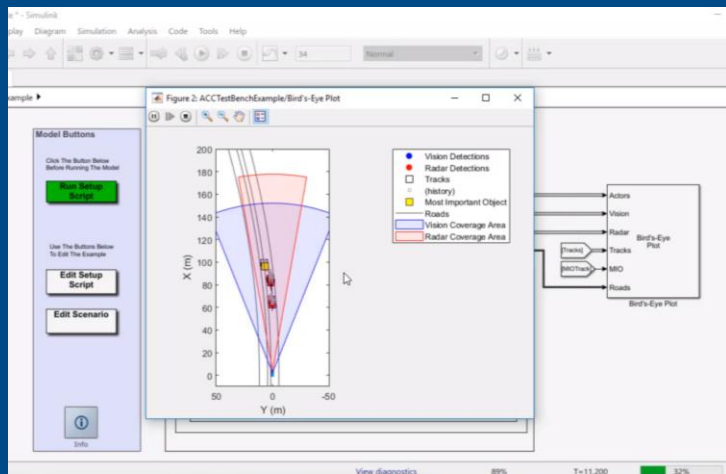
Find out more:

자율시스템을 위한 센서 융합 및 추적

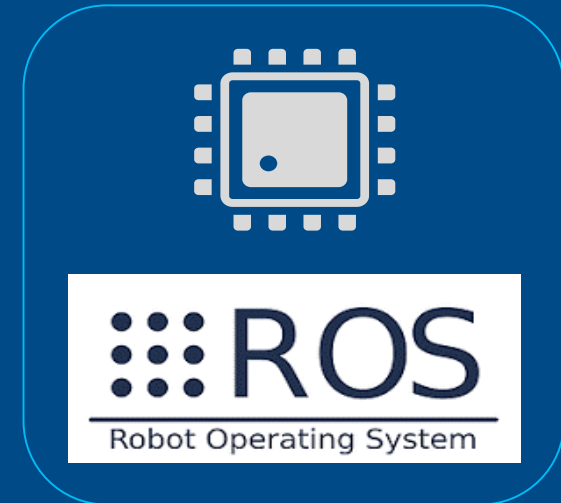
센서 신호처리 및 무선 기술  
서기환



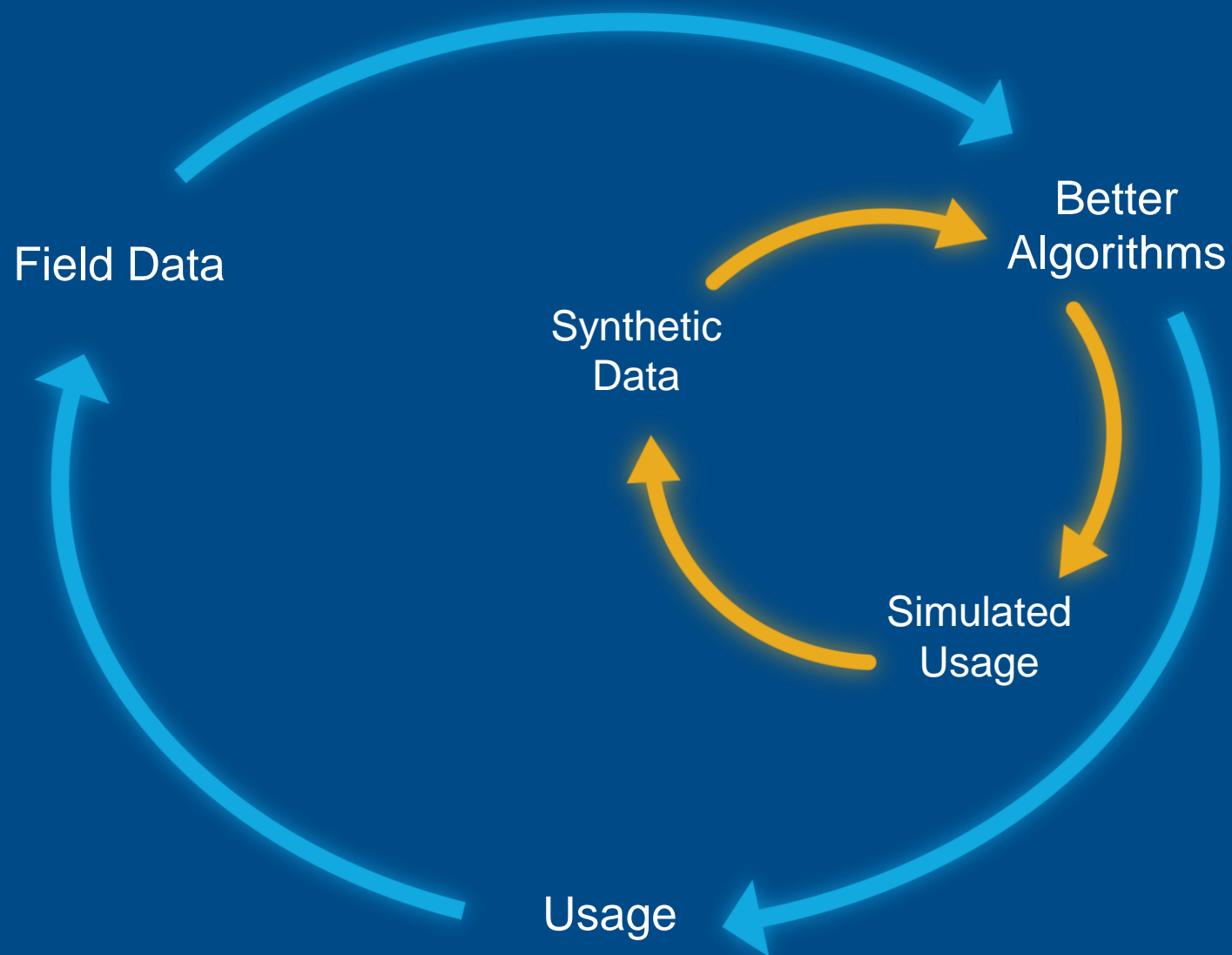
# Deployed controller as ROS node and generated code



Robotics System Toolbox  
Embedded Coder



# Train your AI faster with tight simulation loops



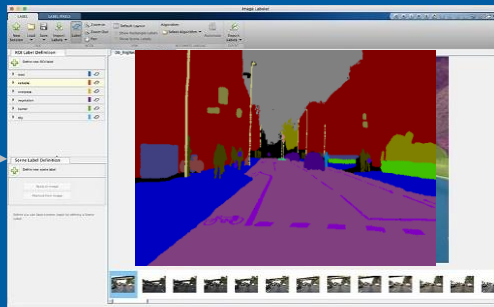


# One example of leveraging simulation for data synthesis

## Traditional workflow



Record



Label



AI model

## Simulation workflow



Simulate



Auto-label



Preliminary  
AI model



Transfer  
Learning

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

***– Alan Mond, Voyage***



# To be successful with AI, you must ...

Use tool chains that **span  
the entire design workflow**



Connect with  
other systems

**Integration**

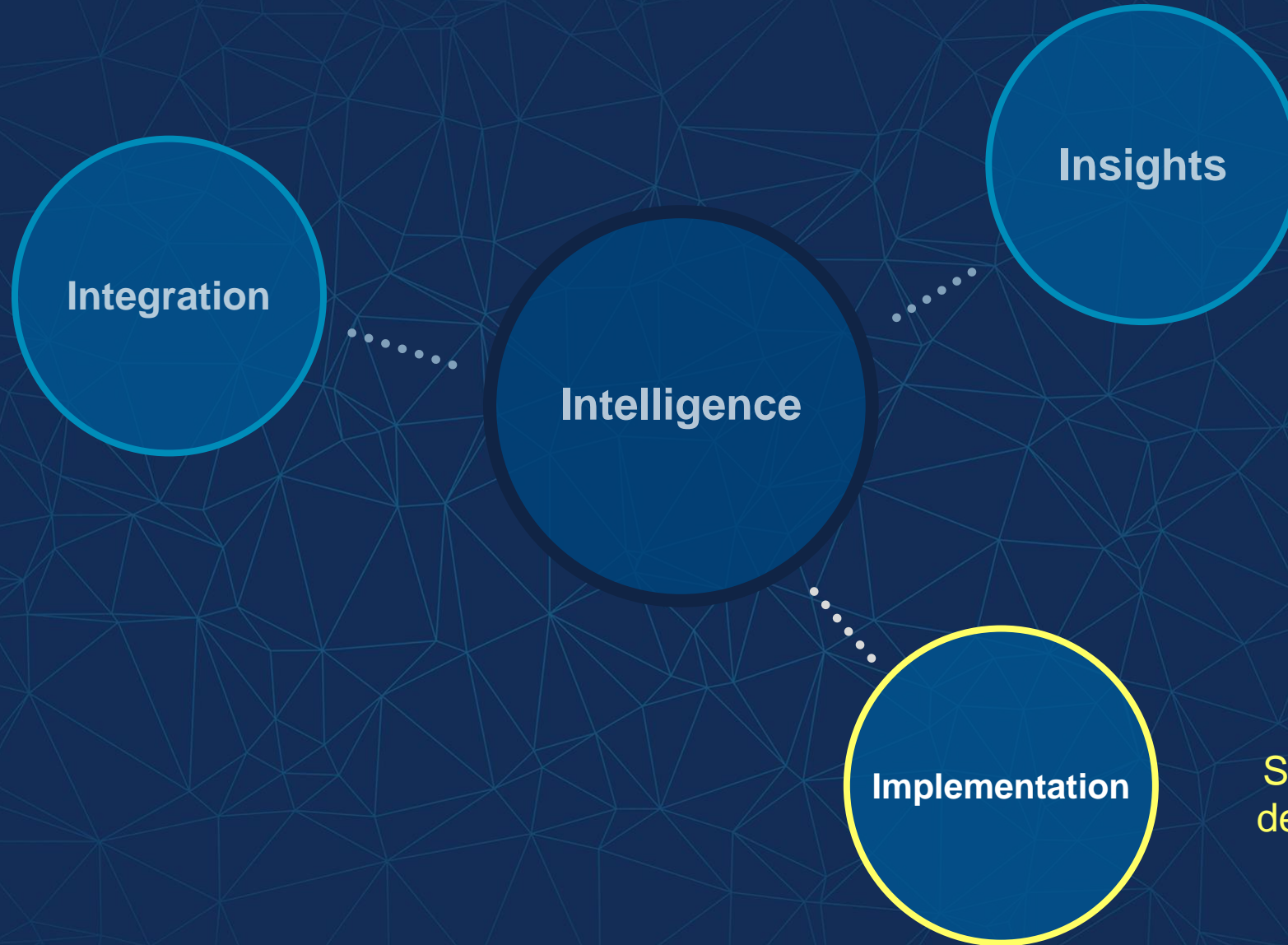
**Intelligence**

**Insights**

Apply domain  
expertise

**Implementation**

Span the entire  
design workflow





Connect with  
other systems

**Integration**

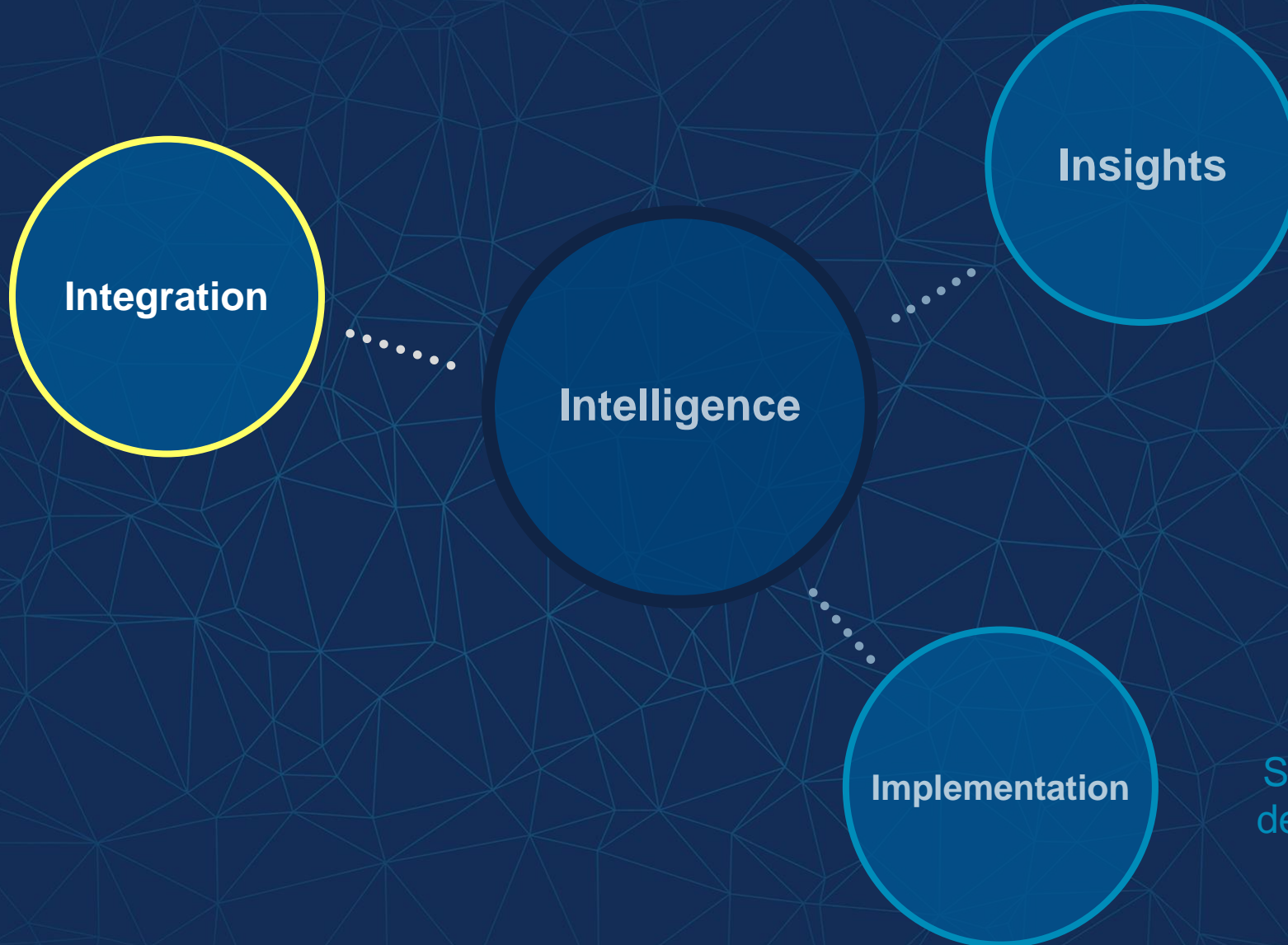
**Intelligence**

**Insights**

Apply domain  
expertise

**Implementation**

Span the entire  
design workflow



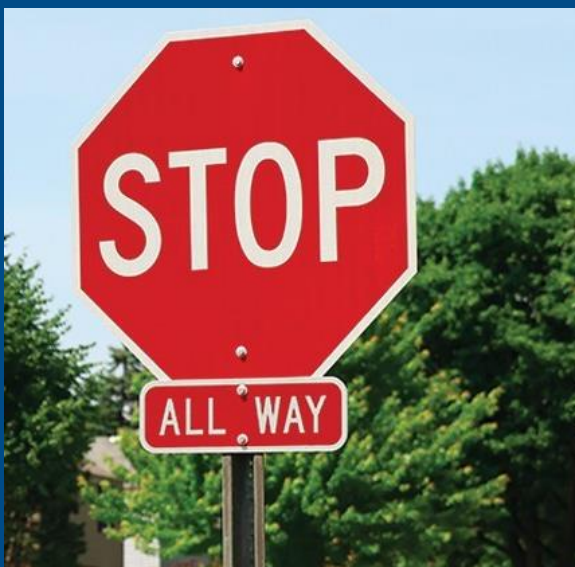




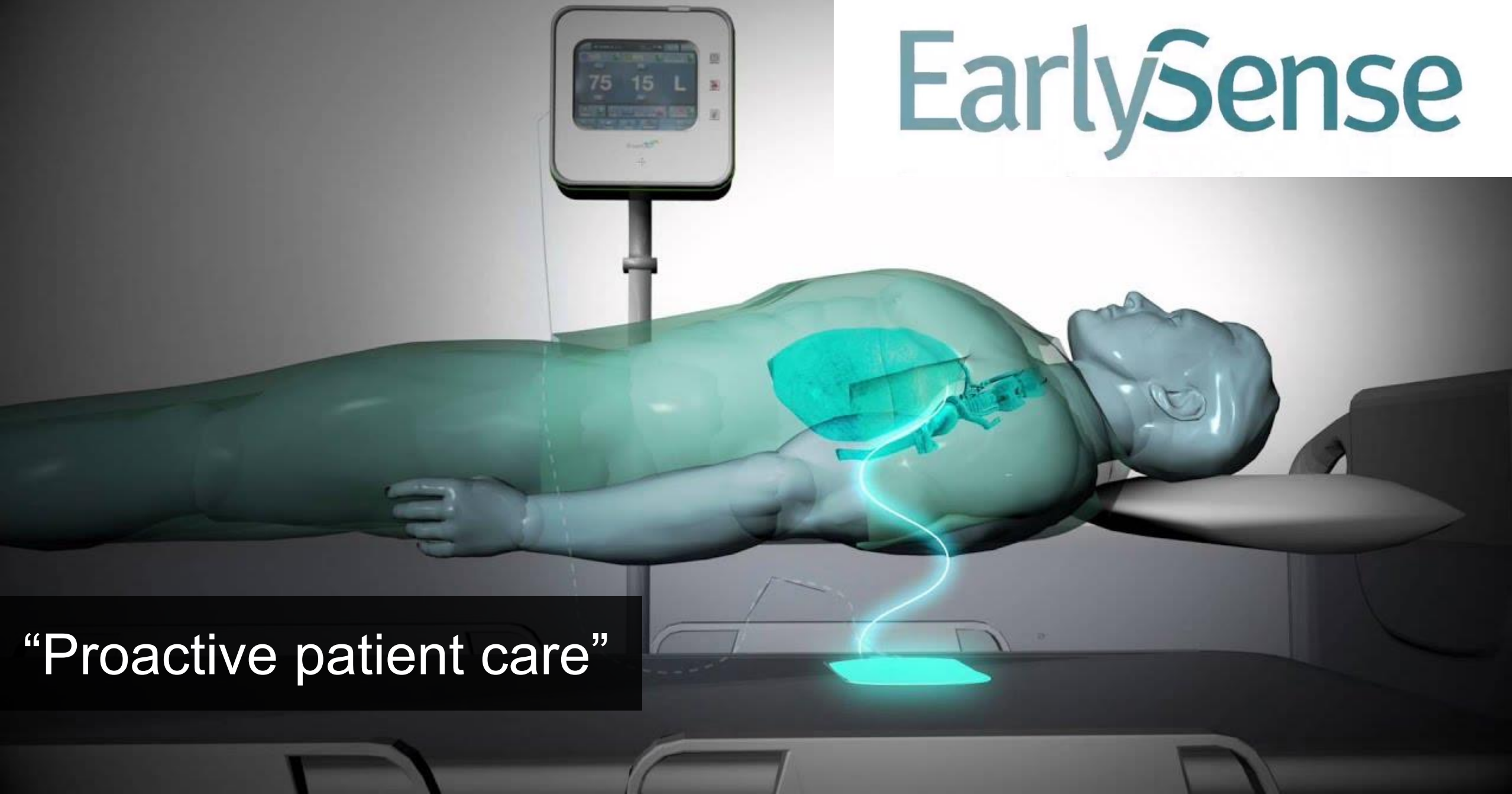
Integration with complex systems



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

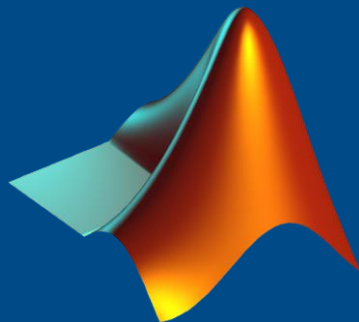


# EarlySense

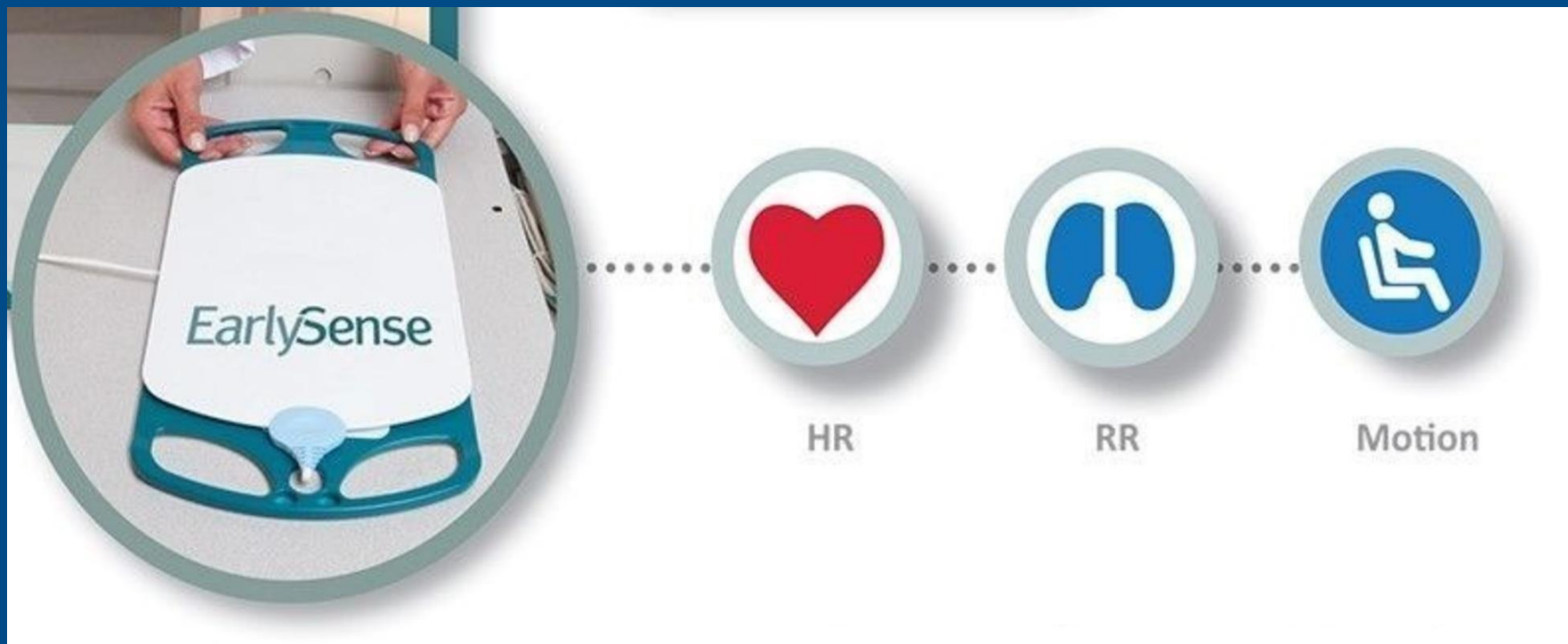


“Proactive patient care”

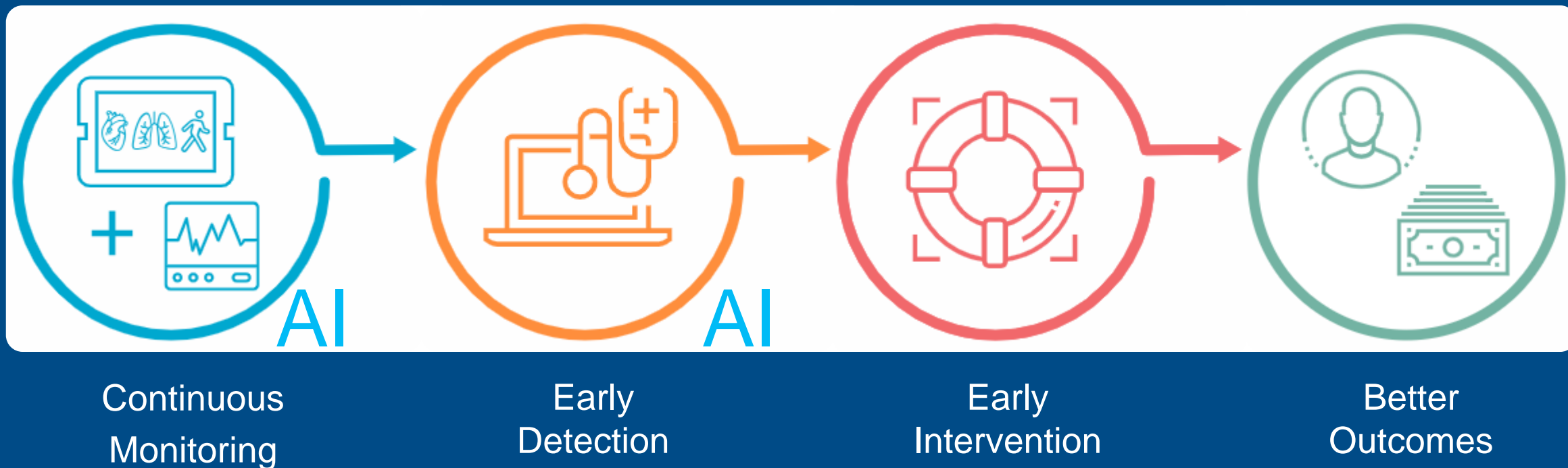




Statistics and Machine Learning Toolbox  
Signal Processing Toolbox  
MATLAB Coder  
Embedded Coder



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



Integrate into nurses' stations  
and hallway monitors



Integrate with hand-held  
devices carried by staff







Address problems before they  
become emergencies

# To be successful with AI, you must ...

Find out more:  
**딥러닝과 강화학습**

**인공지능과 딥러닝**  
**김종남**

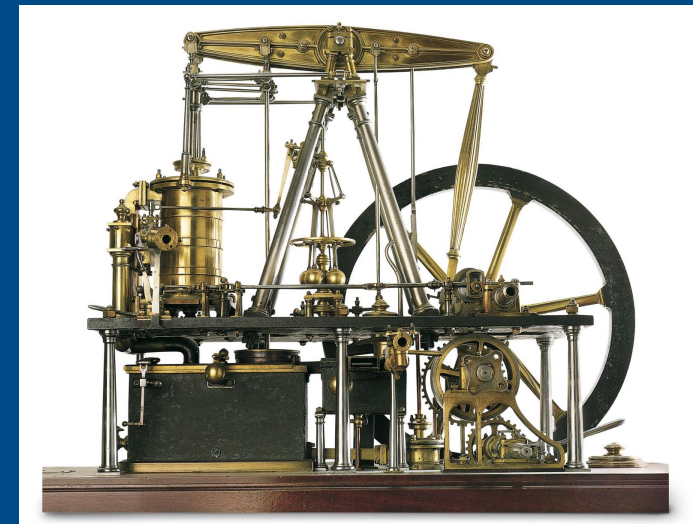


integra

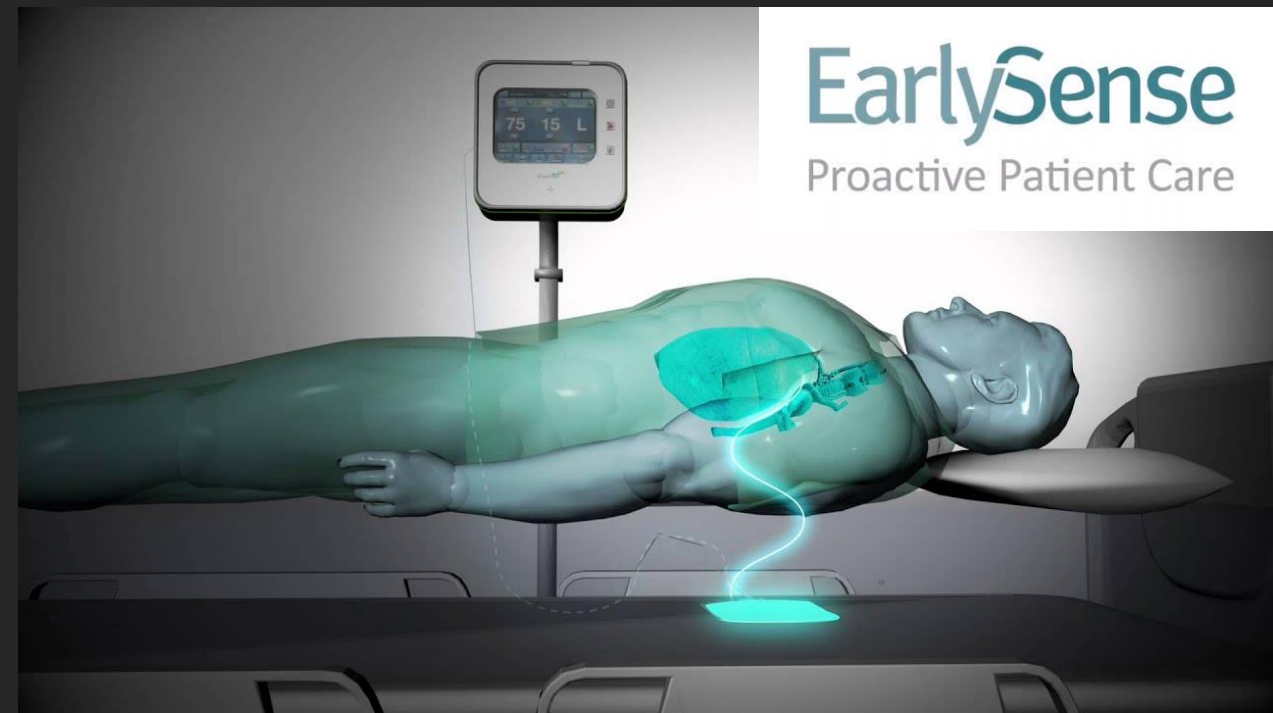
onment

# Summary

- AI is a transformative technology
- But AI projects can and do fail
- Success requires more than just intelligence









Connect with  
other systems

**Integration**

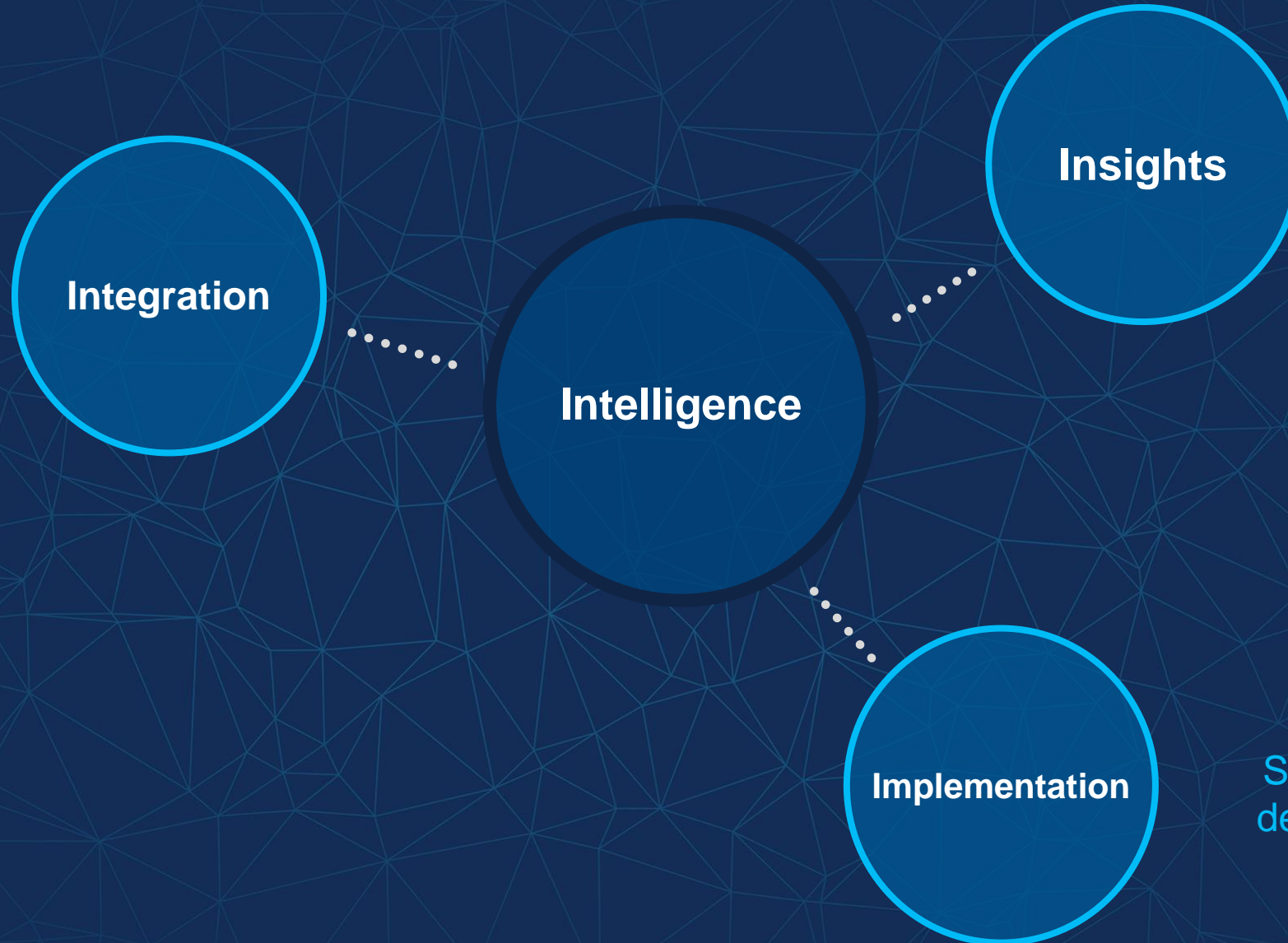
**Intelligence**

**Insights**

Apply domain  
expertise

**Implementation**

Span the entire  
design workflow



# How will you apply AI to your projects?

We have the right tools → MATLAB and Simulink

- Discover and apply **insights to** fully understand your system
- **Implement** your complete system across the entire workflow
- Design the systems which will **integrate** into a larger world