WISCONSIN CHEESE MAKERS ASSOCIATION

EST. 1891

AI for Dairy Processing

February 13, 2025

Agenda

➢ Intelecy AI: Use the Potential of Your Production Data and Optimize Operations
  ➢ Speaker: Erik Søndergaard, Au2mate

➢ Using Industrial AI to Address Process Challenges
  ➢ Speaker: Chris Barnes, Rockwell Automation

➢ The Acceleration of Artificial Intelligence and Automation in Food Production
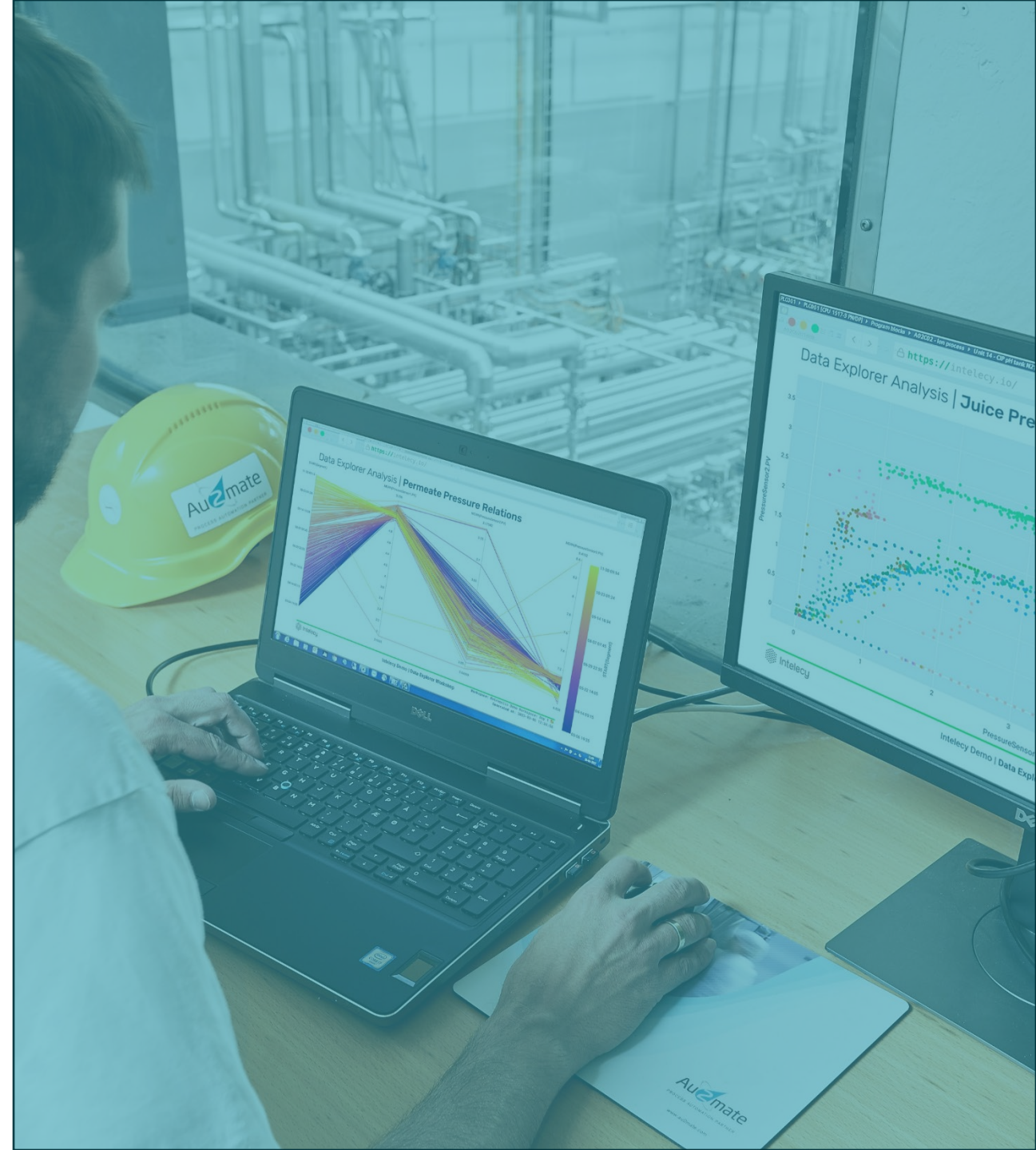 ➢ Speaker: Crystal Cristescu, Tetra Pak

➢ Q&A

Featured Speaker:
Au2mate A/S

INTELECY AI

Use the potential of your production data and optimize operations with AI

Agenda

1. Welcome & Introduction

2. The Role of AI in the Process

3. Industry Identifying Industry Needs & Challenges

4. Summary & Next Steps

- **Challenges:**
  - **Data availability:** Only 1-5% of data in productions is actively used.
    Varians: Large fluctuations in capacity and quality can be expensive and difficult to manage.
  - **Maintenance:** Unexpected breakdowns and inadequate prediction models create bottlenecks and increase costs.
    Solutions: Implementation of data quality management and advanced models for predictive maintenance.

  Solution is the use of cloud-based systems for data analysis and contextualization

KEY FEATURES

EASY TO USE AND LIGHTNING-FAST TREND TOOL ACCESSIBLE TO ALL

Discover and analyze patterns, trends and correlations in multivariable time series data.
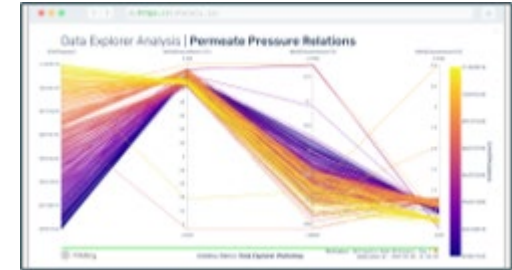

BUILD AND USE MACHINE LEARNING MODELS TO IDENTIFY ANOMALIES

Detect where anything is deviating from the expected behavior, leveraging Anomaly detection models.

**BUILD MACHINE LEARNING MODELS TO FORECAST THE FUTURE**

Predict what has not happened yet and let you make adjustments before it to late, leveraging Forecast models.

INSTANT ADVANCED ANALYTICS AND VISUALIZATIONS

Data Explorer is a powerful set of analytics that enable deep insight into both what is happening in your processes and why it is happening.

Site: **Intelecy Demo | Data Explorer Workshop**
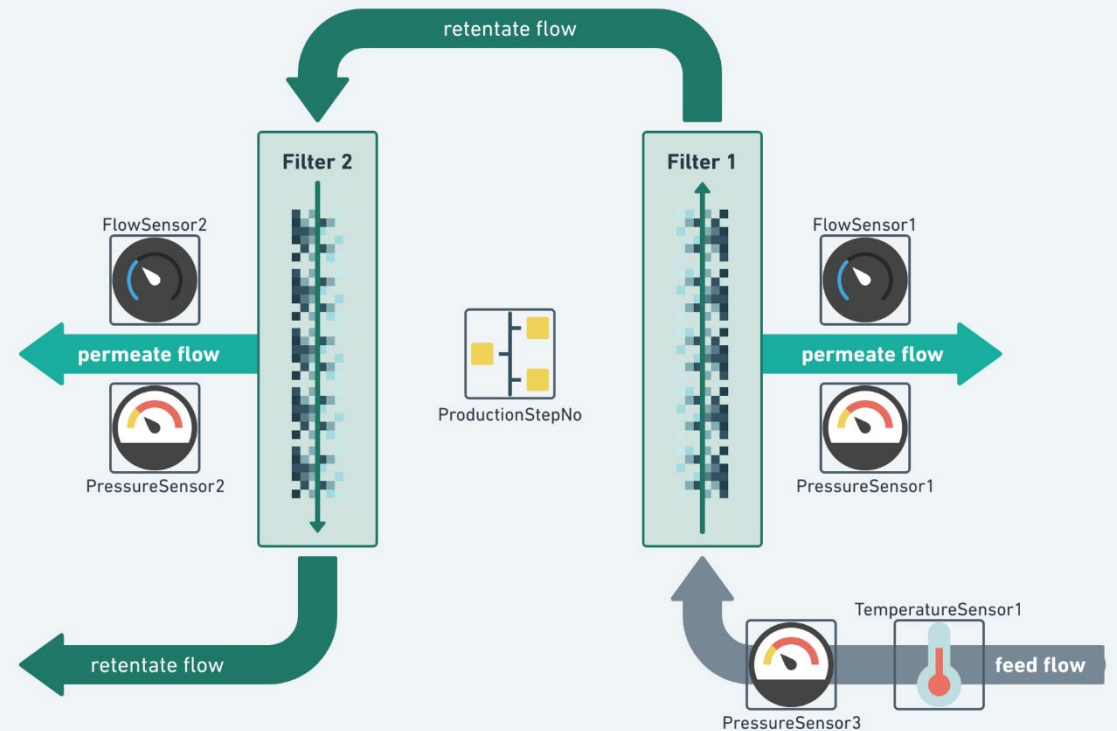
Filter by name, type, output tag or state...

☐ Show only mine ☐ Show favorites

+ Create new model

ⓘ **Credits:** 17 / 100

Name ↓	Type	Output Tag	Created	State
test model 2	Forecast 4 hours	FlowSensor1.PV AI Flow sensor 1 (l/h)	11 Mar 2024, 13:37 10 hours ago	Inactive
test au2test	Anomaly Detection Nowcast	PressureSensor2.PV Pressure Sensor 2 (bar)	07 Nov 2023, 10:28 4 months ago	Inactive
test	Forecast 1 hour	PhExit.PV pH measurement (pH)	21 Dec 2023, 19:55 3 months ago	New
pma_forecast	Forecast 2 hours	PhExit.PV pH measurement (pH)	20 Sep 2023, 12:34 6 months ago	Active
pma_anomaly	Anomaly Detection Nowcast	PressureSensor2.PV Pressure Sensor 2 (bar)	20 Sep 2023, 12:58 6 months ago	Active
ph demo take3	Forecast 1 hour	PhExit.PV pH measurement (pH)	07 Mar 2024, 12:15 4 days ago	Inactive
ph demo 2	Forecast 1 hour	PhExit.PV pH measurement (pH)	07 Mar 2024, 11:11 5 days ago	Inactive
pH demo HSL	Forecast 1 hour	PhExit.PV pH measurement (pH)	14 Dec 2023, 10:03 3 months ago	Inactive
openx	Anomaly Detection Nowcast	PressureSensor2.PV Pressure Sensor 2 (bar)	08 Nov 2023, 09:56 4 months ago	Awaiting user input
lime usage forecast	Forecast 1 hour	PhExit.PV pH measurement (pH)	06 Mar 2024, 10:49 6 days ago	Inactive

Intelecy

Dashboard

Trend

Data Explorer

Models

Forecast

Anomalies

Assets

Labs

Docs

App Build: 20240305.3

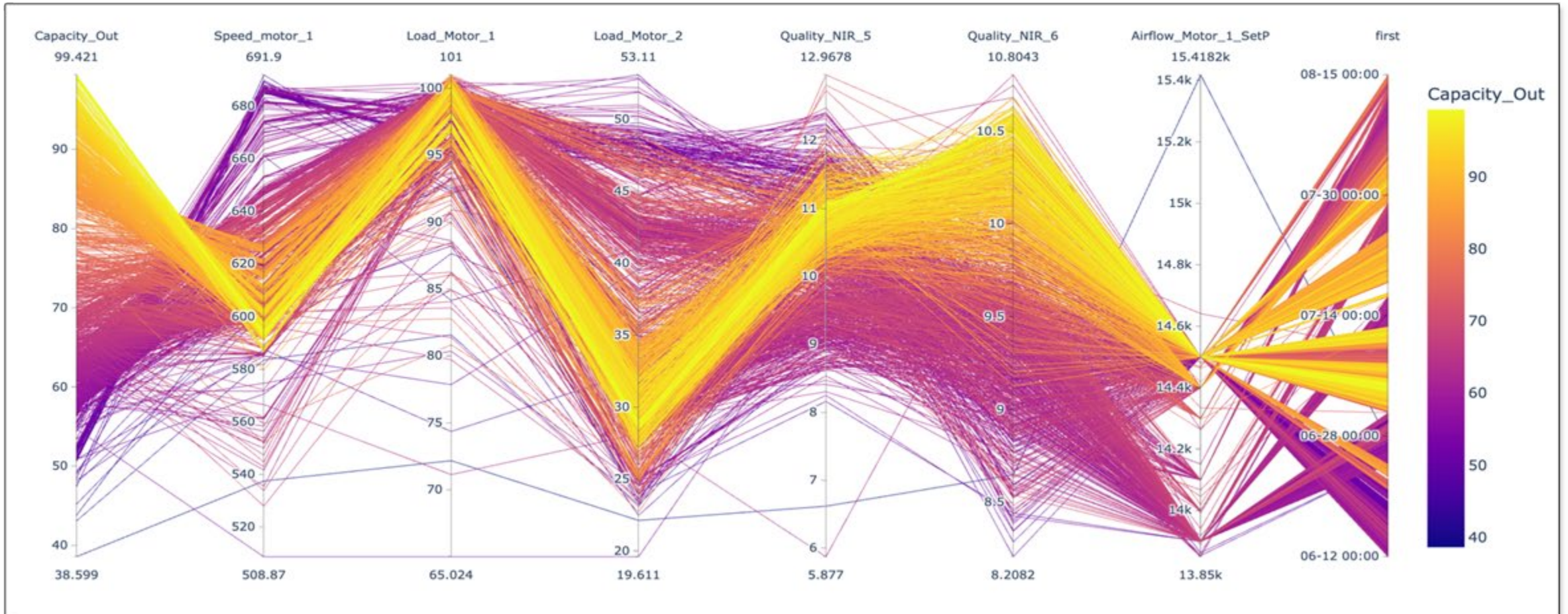Items per page 10

1 to 10 of 84

Page **1** of **9**

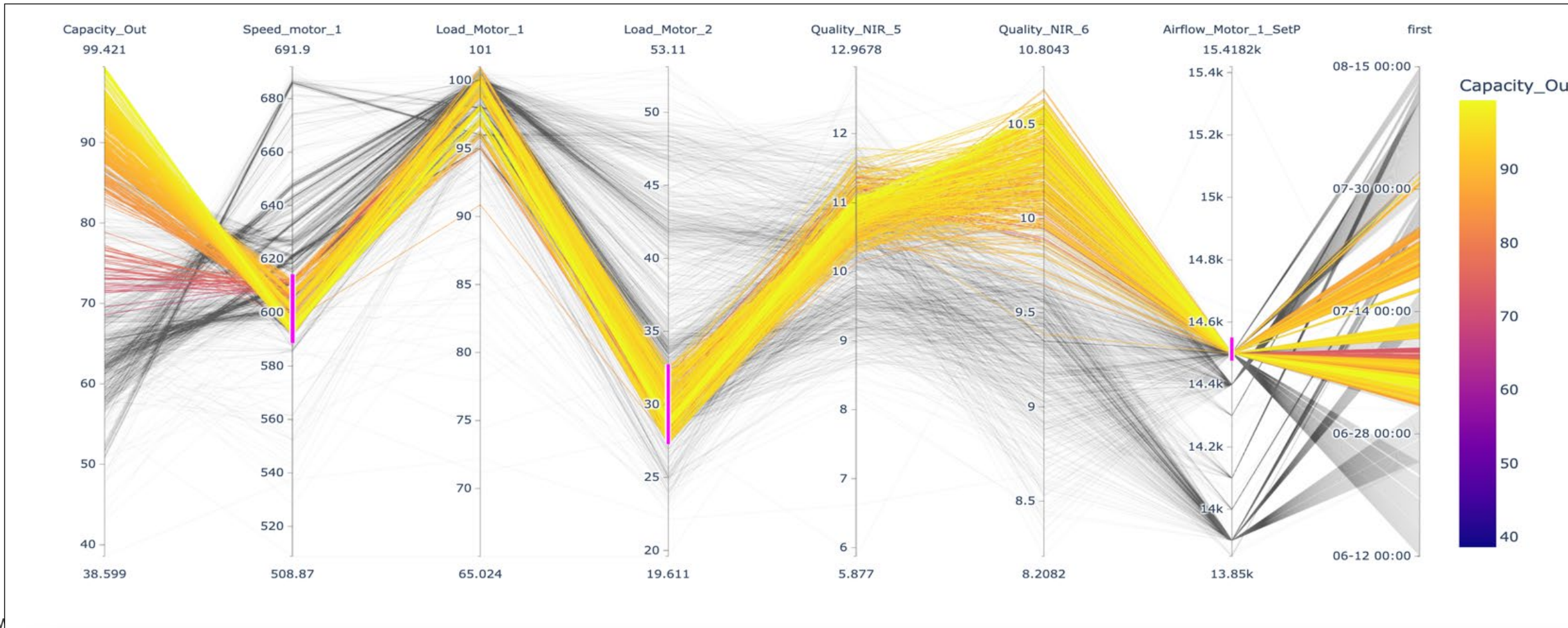Increase capacity without reducing quality

By identifying what you should change

Artificial Intelligence

Quality analysis Root-cause analysis and causality (Desired outcome vs undesired outcome) "Golden batch"
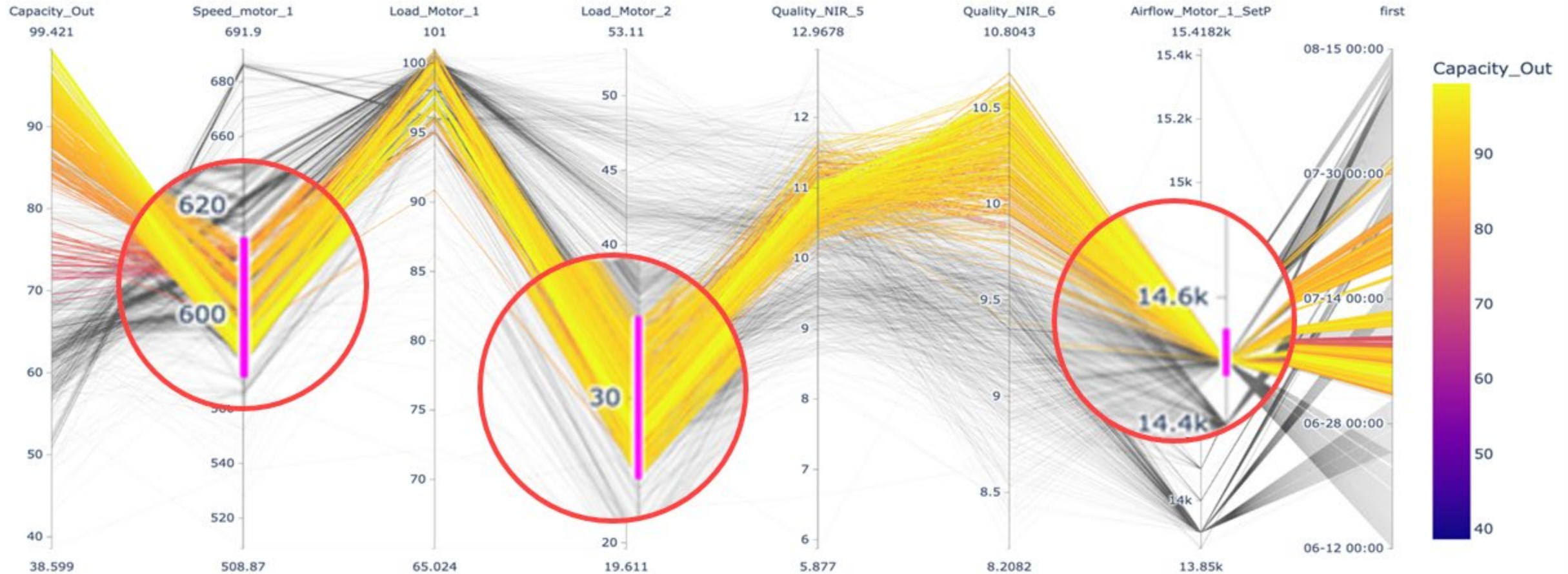
20% Increase and it only took 1 day to to get this knowledge
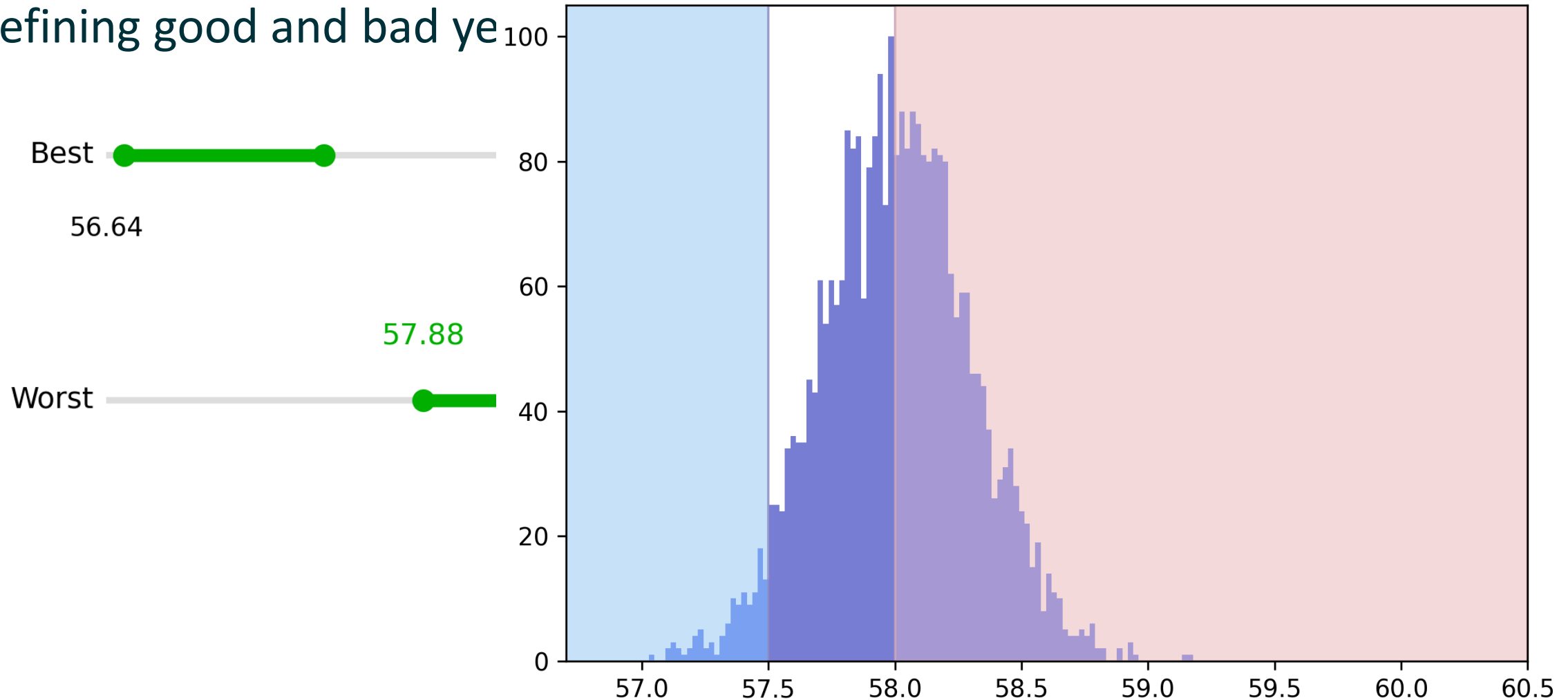
How much can be explained
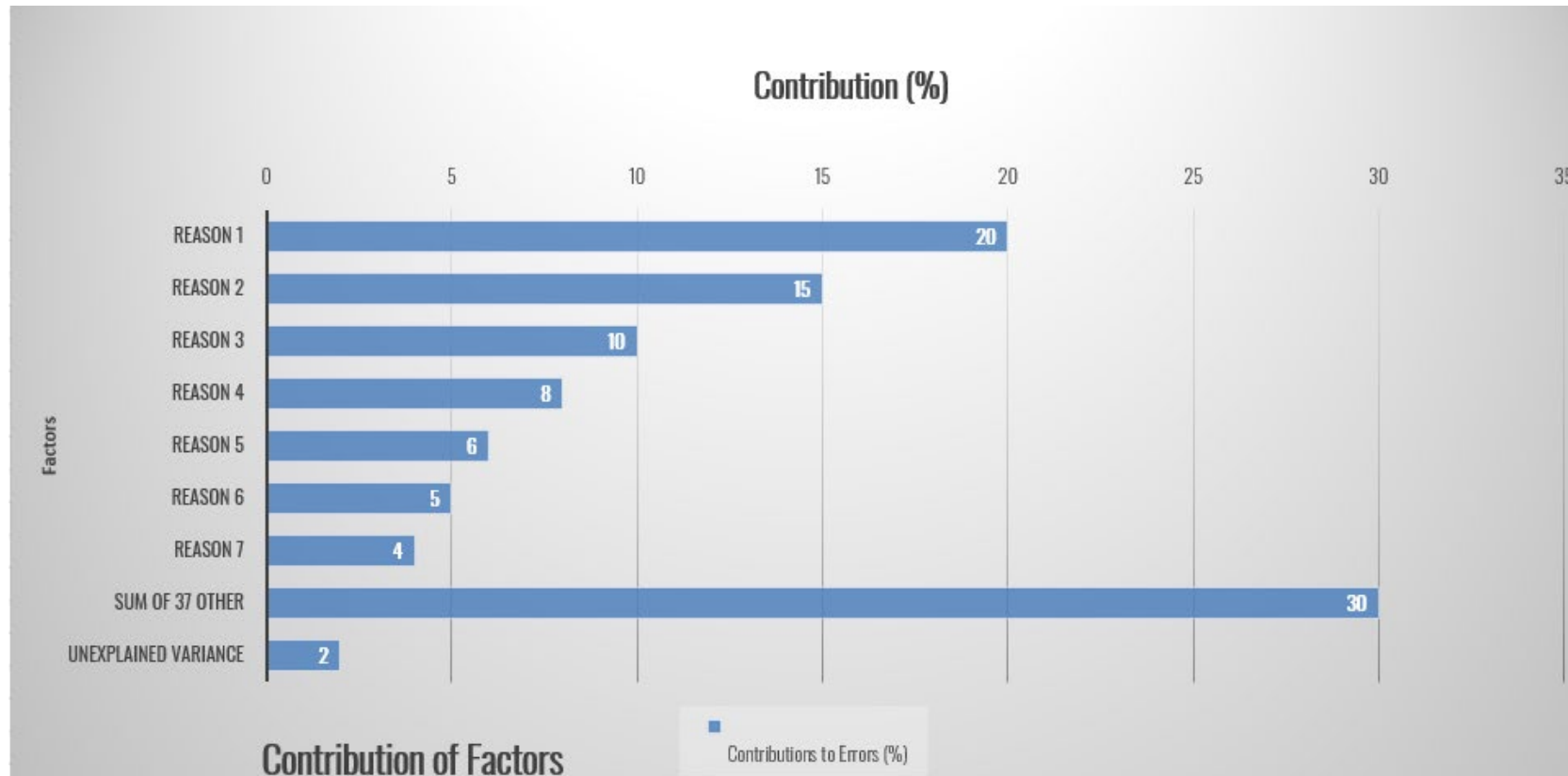
TINE Jæren

The largest dairy in Norway

Started production in 2014

40 000 tags streaming data continously
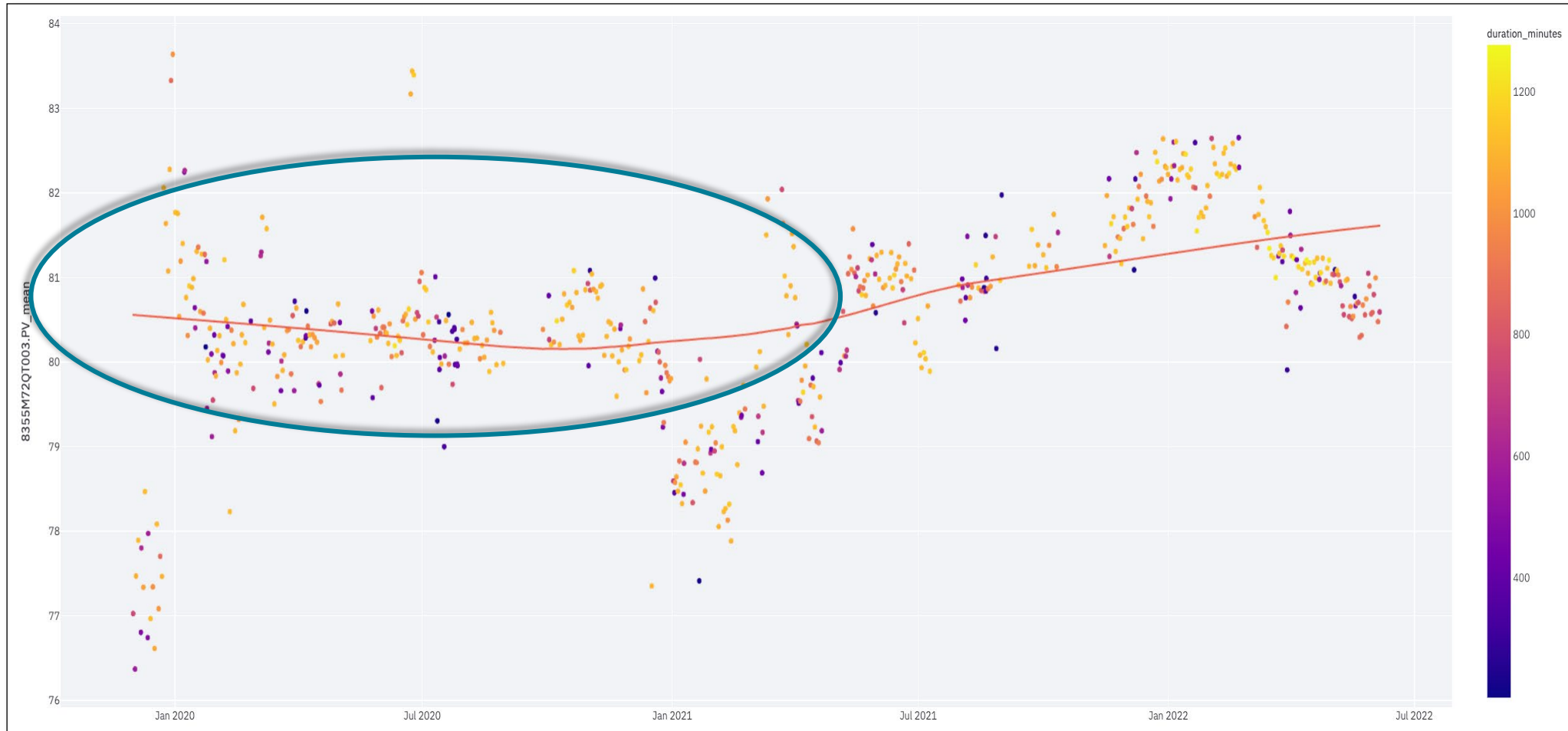
Over 200 million rows of data every day

Correct protein content
And less variation...

Artificial Intelligence - Forecast
Estimate and predict protein content before you can measure it

Enkel proteinmodell 1h   Edit

ID: MA5ZMVYWBJ8
Type: Forecast, 1 hour
Created By: Gunn Marit Solli
Training period: 01 Jun 2020 – 29 Nov 2020
State: Active
Created: 11 Jun 2021, 09:39 (4 months ago)
Error score: 0.0241 (?)
R-squared: 0.861 (?)

View model data in trend

Copy model

Go to forecast

Deactivate model

Delete model

🧪 Model Analysis

Output tag and historical forecast

← | 06 May 2021, 17:31 to 07 May 2021, 03:44 ∨ | → | 🔍 | 🔍 | ↩

8355M72QT003.PV, description: Protein i Tørrstoff, unit: %   ■ Actual value ■ Historical forecast (offset 30 min) ⚙

06/05/2021
22:10:00
■ 80.437
■ 80.396

PREDICT PROTEIN CONTENT 30 MINUTES BEFORE MEASURED

Au2mate
PROCESS AUTOMATION PARTNER

Enkel proteinmodell 1h   Edit

ID: MA5ZMVYWBJ8
Type: Forecast, 1 hour
Created By: Gunn Marit Solli
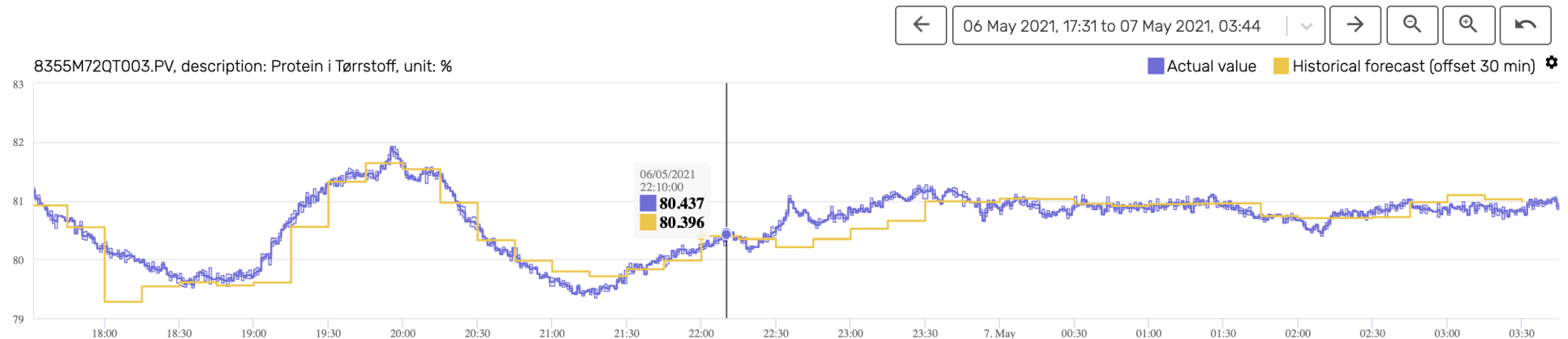Training period: 01 Jun 2020 - 29 Nov 2020
State: Active
Created: 11 Jun 2021, 09:39 (4 months ago)
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View model data in trend
Copy model
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06/05/2021
22:10:00
■ 80.437
■ 80.396

www.au2mate.com
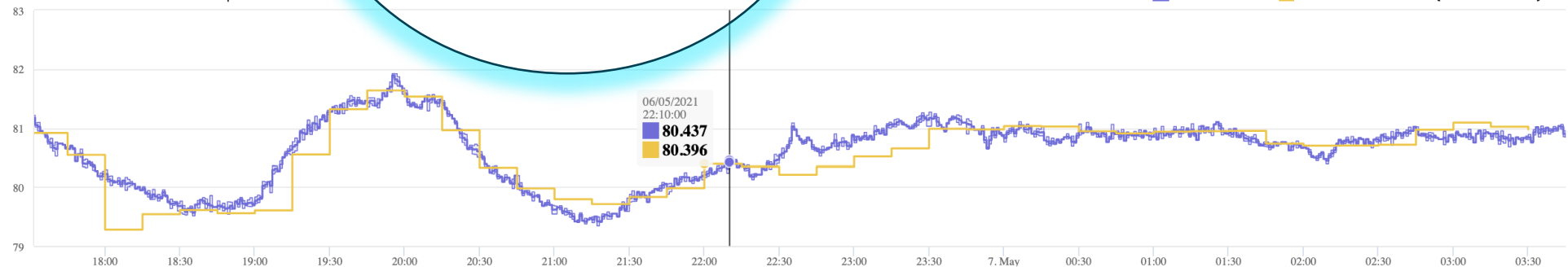
# INTEGRATE TO OPERATOR LEVEL

www.au2mate.com
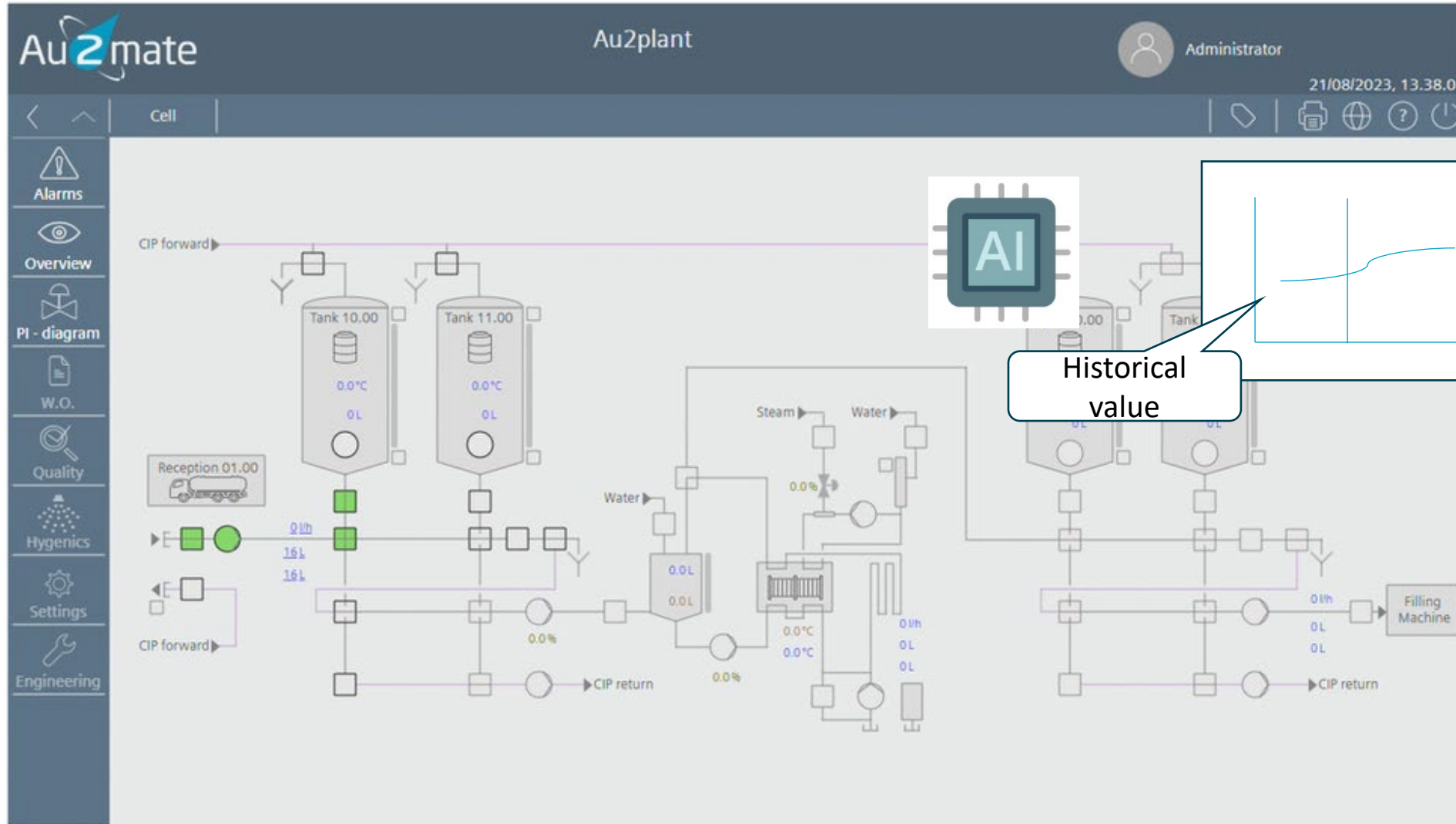
Typical issues part 1 of 2

1. We often keep a little too much distance from the limit values for our products to be on the safe side, and our productions have a lot of variance. Unfortunately, this means that it costs us a lot of money to be so careful.

2. We have a lot of data at our disposal, but often it happens that we cannot use it effectively. Either it requires too much processing power, or we lack access to the right data when we need it.

3. We find that there can be deviations in the quality of production. It takes us a long time to find the causes, and sometimes we don't find them at all, which can be quite frustrating.

4. It also happens that we see large fluctuations in our capacity at times. It is time-consuming and complex to find out what causes it, and of course it affects production.

5. There is a clear feeling that we could save a lot of energy, but with the current systems we cannot create the overview needed to find the obvious focus areas.

Typical issues part 2 of 2

6. When there are changes in processes, we cannot always react quickly enough. This means that we sometimes lose both efficiency and output.

7. We also have challenges with maintenance. Often, machines come to a standstill because we can't predict when components will start to fail. Unfortunately, this results in some unnecessary production stoppages.

8. Something similar happens with our filters, where we detect clogs too late. This creates bottlenecks and slows down production.

9. When we look at monitoring pumps and bearings, this is also a problem. It often turns out that we only discover the damage when it has already been done, and we would like to change that.
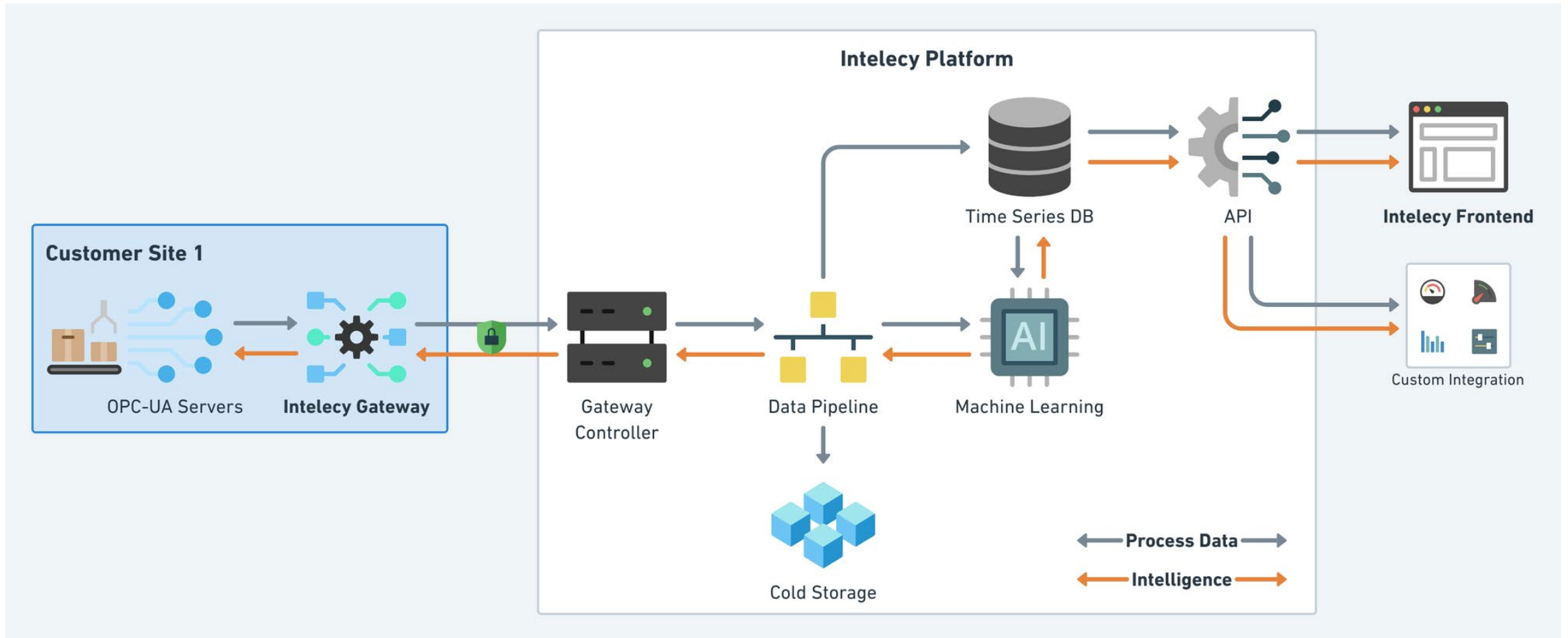
Key Takeaways: Why AI in Dairy Processing?

- **Optimized Production** – Reduce variations and improve efficiency
- **Predictive Maintenance** – Minimize downtime and unexpected failures
- **Quality Assurance** – Maintain high product consistency with AI-driven insights
- **Data-Driven Decisions** – Turn raw data into actionable intelligence

💡 **ROI: 3X - 10X** your investment in the first implementation!
- Faster decision-making
- Reduced waste & improved yield
- Scalable automation for long-term impact

Let's Stay Connected!

- **Any Questions?**

- Let's stay connected!

- Scan the QR code to connect with me on LinkedIn, where I regularly share insights on AI and MES, with a special focus on the dairy industry.

- Your feedback is highly valued— don't hesitate to reach out!

Erik Søndergaard
Divisional Director Sales – Production IT/OT
Mobile: +45 29223064
e-mail: eso@au2mate.dk

Featured Speaker:
Rockwell Automation

KALYPSO
A **ROCKWELL AUTOMATION** BUSINESS

WCMA Webinar:
AI for Dairy Processing

February 13, 2025

Chris Barnes

Sr. Manager, Data & AI Consulting
Kalypso, a Rockwell Automation Business

chris.barnes@rockwellautomation.com

High-Value Use Cases Delivering **Quality & Capacity Improvements**

Model Predictive Control

Minimize process variability and optimize outcomes using online process models and ML.

Case Study:

*Standardizing process in milk powder industry realized **60% reduced protein variability** and **10% production uplift** with MPC, netting **>$1M p.a.***

Perfect Fill

Minimize giveaway and rework by using AI feedforward to reduce process variability.

Case Study:

*Filling operation running at 0.2 seconds per dose realized a **52% reduction in giveaway** using soft sensors & feedforward control.*

Golden Batch

Identify an ideal output and optimize the manufacturing process to replicate conditions that produce it.

Case Study:

*AI learned the perfect manufacturing recipe for tortilla production, combining 21 control points, **reducing standard error by 73%.***

Simulation Optimization

Dynamically adapt the operating plan with Digital Twin scenario analysis to optimize automation systems.

Case Study:

*Routing for a fleet of 45 AMRs was optimized to achieve a **13% increase in throughput**.*

Predictive Maintenance

Preempt asset degradation that causes quality, throughput and availability loss, using advanced condition sensing.

Case Study:

*A filling/sealing process **avoided 3 asset failures** by using high-frequency data from Kinetix servo drives for early detection of asset wear.*

Vision Inspection

Automate and improve the accuracy of visual inspections with integrated camera systems.

Case Study:

*100% inspection rate was achieved with an automated vision system to detect 4 types of defects, **freeing human inspectors for other value-add tasks**.*

Automation Copilots

Augment human decision-making in automation tasks with AI copilots that provide real-time guidance, analysis, and documentation.

Case Study:

*AI copilot reduced troubleshooting time from **hours to minutes** by automatically analyzing equipment alarms & recommending resolution procedures.*
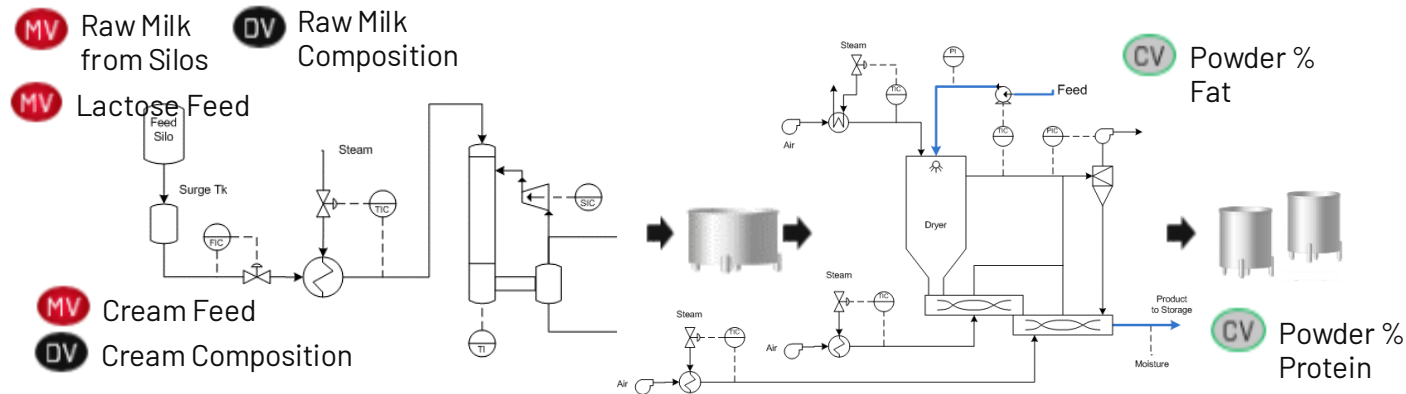
AI Improved Quality with a 60% reduction in product variability

Challenge

- Standardization is a **complex component balance** of fat, protein, lactose, and moisture

- **Traditional control strategies 'compete'** (increase in fat means decrease in protein)

- System of **multiple control loops**

- High variability = **giveaway & yield loss**

Process

- **MV** Raw Milk from Silos
- **DV** Raw Milk Composition
- **MV** Lactose Feed
- **CV** Powder % Fat
- **MV** Cream Feed
- **DV** Cream Composition
- **CV** Powder % Protein

Solution

Controlled Variables
- Powder % Fat
- Powder % Protein

Manipulated Variables
- Raw Milk from Silos
- Lactose Feed
- Cream Feed

Processing Steps
- Standardization
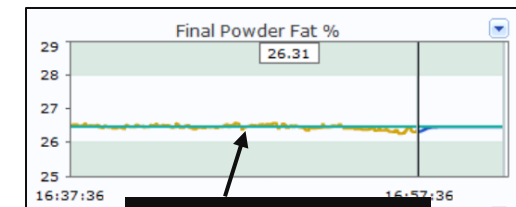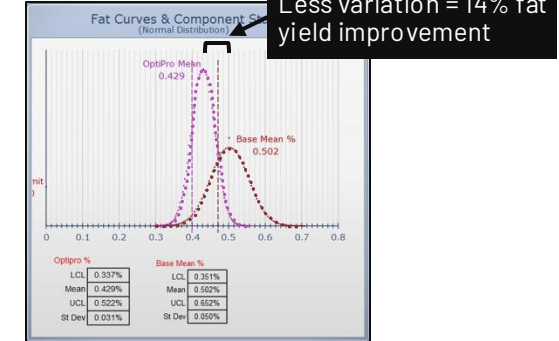- Evaporation
- Drying

Liquids Controls

	Total Standardized Milk Flow	Milk Fat/SNF	Milk Protein/Lactose
MV Raw Milk from Silos	X	X	X
MV Lactose Feed	X	X	X
MV Cream Feed	X	X	X
DV Raw Milk Composition		X	X
DV Cream Composition		X	X

Powder Controls

	Powder %Fat	Powder %Protein
MV Milk Fat/SNF	X	X
MV Milk Protein/Lactose		X

Results

Less variation = 14% fat yield improvement

Consistent running at low end of control limits

Production Test Results

➡ **60%** reduced variability

➡ **10%** production rate increase

➡ **12%** energy reduction

➡ **14%** protein & fat yield increase

➡ **>$1M p.a.** production uplift

AI Improved Capacity with a 52% reduction in giveaway

Challenge

- Mayonnaise filling
- **300 bottles/minute**
- Viscous material
- Fill heads **lose accuracy over time**
- Strict **lower limit**
- Inaccuracies in fill level = **product giveaway**
- **Frequent operator adjustments** to keep near fill limit

Process

Variable of Interest
- Dosed Weight

Manipulated Variables
- Setpoint of Weight
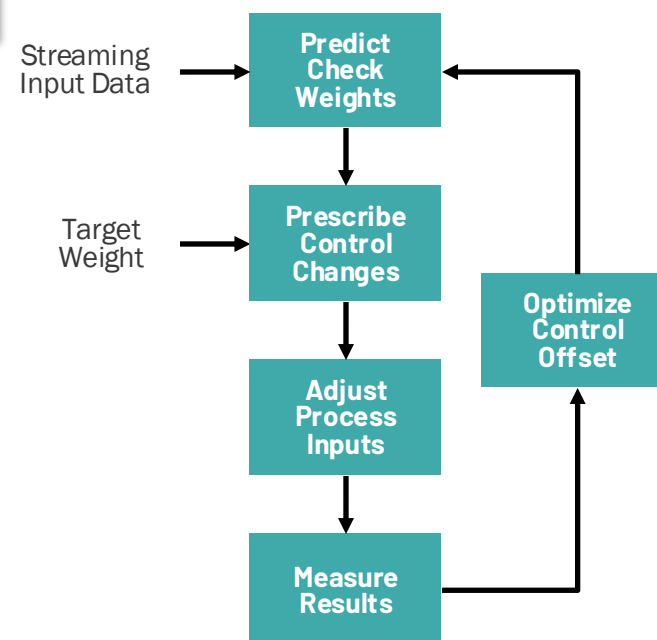
Controlled Variables
- Tank level
- Batch process data
- Temperatures
- Instrument data

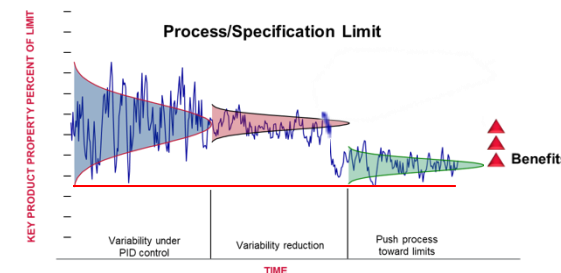**Disturbance Variables (unable to measure)**
- Raw material viscosity

Solution

- Self-learning AI module **deployed to the edge**
- Learned the **contributing variables and coefficients**, trained on historical and real-time streaming data
- ML model **predicts fill weights**
- **Optimizer adjusts control setpoints** to minimize error (closed-loop)

Streaming Input Data → **Predict Check Weights**

Target Weight → **Prescribe Control Changes**

Adjust Process Inputs

Measure Results

Optimize Control Offset

Results

Separation between fill heads with & without model running

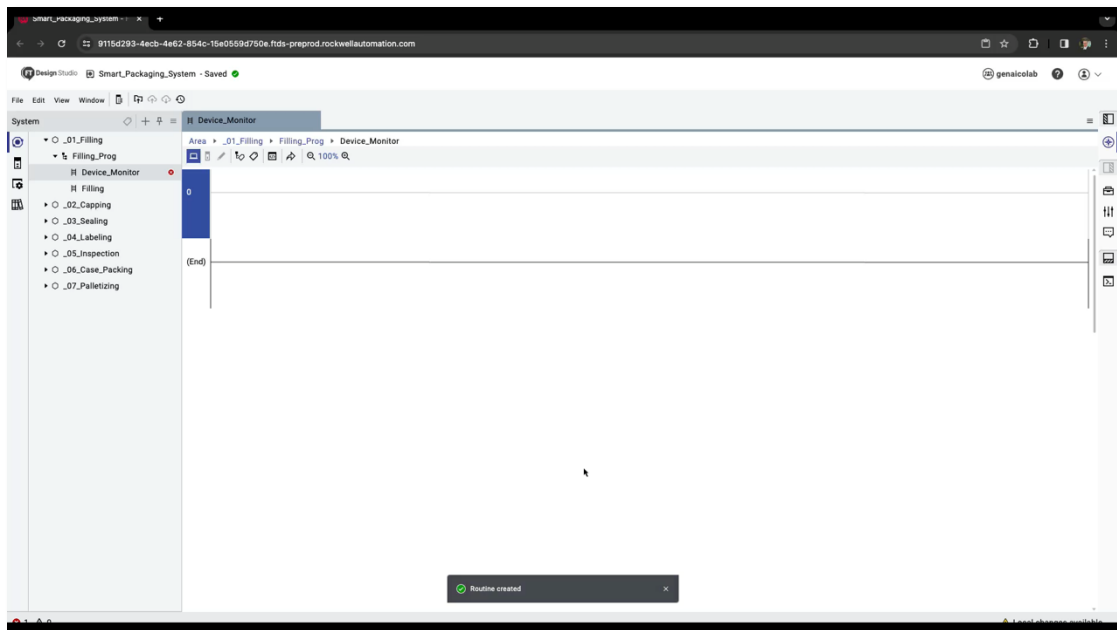**Production Test Results**

- **96%** prediction accuracy
- **52%** reduction in giveaway
- **67%** elimination of underfill
- **0.4 second** prediction window

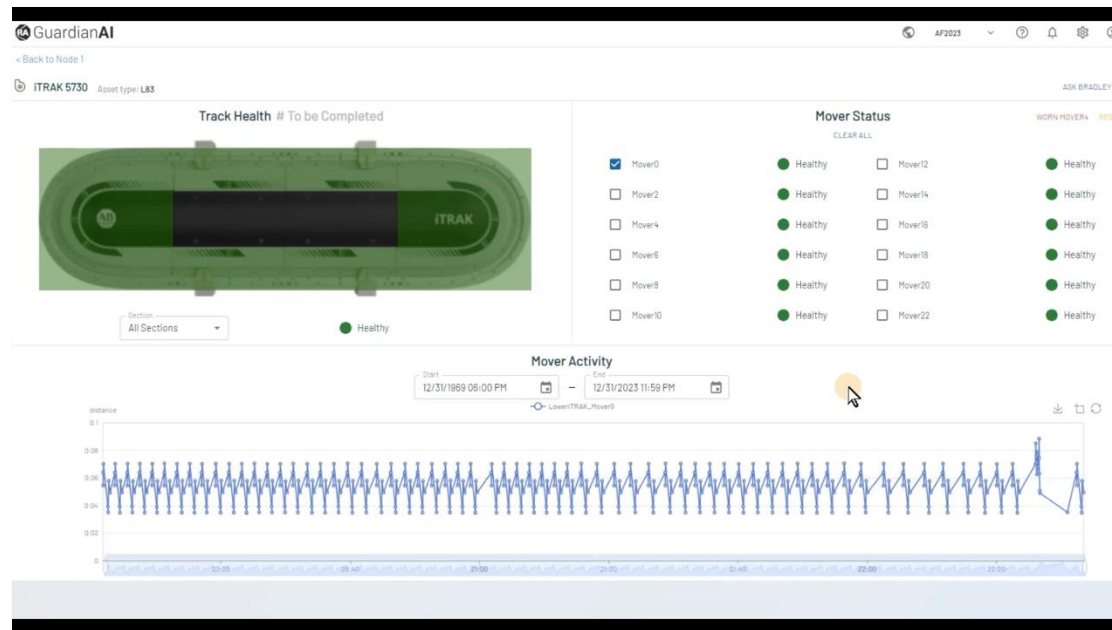# **AI Improves Worker Capacity & Quality** with automation copilots

Integrated AI Assistant allows engineers to stay focused as they design & develop the system

Copilot can answer questions and provide guidance on how to perform tasks

Natural language prompts can **generate and help edit Ladder Logic Code**

"Ask Bradley" **Generative AI Assistant**

GenAI receives the error code and can **offer root cause or troubleshooting checklist to resolve**

Troubleshooting steps are directly **sourced from trusted, pre-defined data store**

Design Studio™ Copilot

iTRAK® Maintenance Copilot Beta

Proven methodology for executing your AI strategy and vision

1 **Opportunity & Value Analysis**
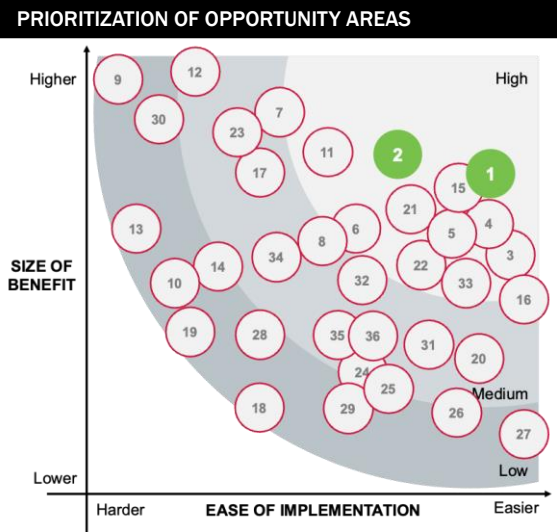
2 **Enabling Technology Architecture**
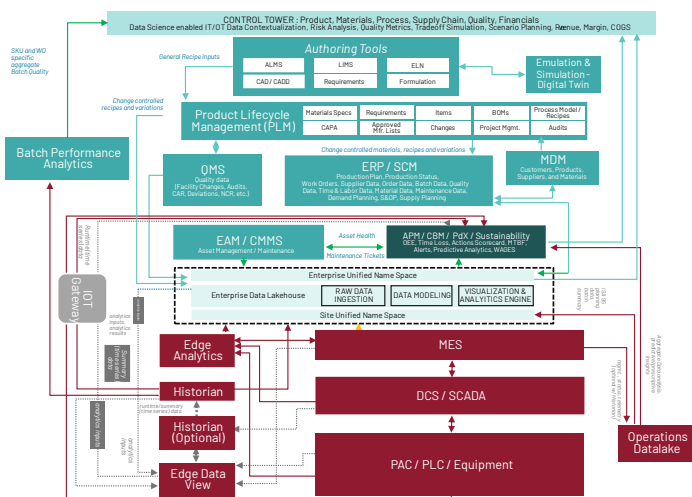
3 **Value-Based Implementation Roadmap**

PRIORITIZATION OF OPPORTUNITY AREAS
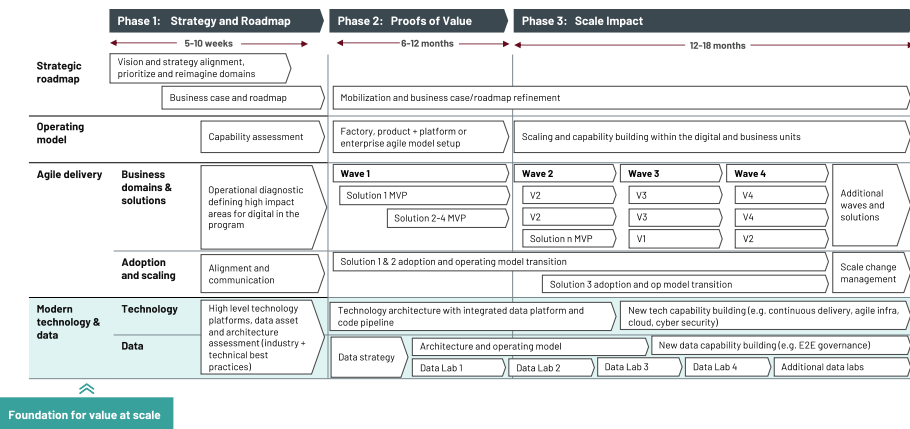
Thank You!

Chris Barnes

Sr. Manager, Data & AI Consulting
Kalypso, a Rockwell Automation Business

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WCMA Webinar:
AI for Dairy Processing

February 13, 2025

KALYPSO

Featured Speaker:
Tetra Pak

The acceleration of artificial intelligence and automation in food production

Crystal Cristescu

Sales Enablement Leader US/CA, Automation & Digital at Tetra Pak

13th February 2025

We are a world leading food processing
and packaging solutions company

Working closely with our customers and
suppliers, we provide safe, innovative and
environmentally sound products that each
day meet the needs of hundreds of millions
of people in more than 160 countries
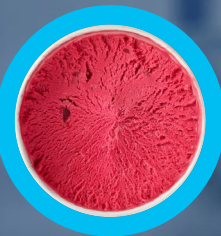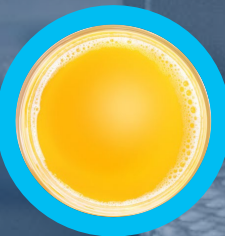
Dairy   Ice cream   Beverage   Prepared food   Cheese   Powder   Plant-based

The food & beverage industry is changing rapidly, with pressure to ….

Lower the cost of ownership

Increase sustainability and product innovation

Secure food safety and safeguard quality

Digitalize to address shortage of skilled labor

Transition installed legacy equipment to modern standards

Today, data in Smart Factories help us address these challenges

1 **Integration**
… means the seamless integration of automation and digital workflows at lowest engineering cost and start-up time

2 **Optimization**
… means eliminating operator work wherever possible, while focusing on improved product quality and lower costs

3 **Connection**
… means that we connect value from every available data point to targeted decision makers at the right time, with the right context

Automation typically leads to

7-20%

OEE improvements*

Over the next 5 years, Automation and digitization will account for

25%

of F&B companies' capital spending **

* Tetra Pak comparative study, 2020
** 2022 McKinsey Global Industrial Robotics Survey LINK

How we think about delivering Industrial Revolution 5.0

Operational excellence

Connect

Analyze The business
- Deliver actionable insights from data
- Scalable, flexible access to connected product and equipment experts

Orchestrate The factory
- End-to-end, scalable management of manufacturing processes from raw materials intake to product shipment
- Data orchestration across the factory

Optimize

Automate Equipment
- Standardized automation with embedded expertise
- Optimized cost
- Robust and secure foundation to unlock data provision

Reliable, robust production

Stand-alone equipment

Integrate

Value chain

A strong automation foundation is a mandatory baseline

For baselining operations on the factory floor

- Increases uptime
- Traceability
- Improves workforce utilization
- Standardization
- Reduces human error
- Competitive - ness
- Improves worker safety
- Flexibility
- Saves on materials
- Reduces carbon footprint

For continually optimizing performance

1 Operational Repeatability
… optimize based upon predictable operating envelopes and minimized human error

2 Reduced Variability
… allows you to drive the operational performance closer to the required limits/boundaries/constraints

3 Creates a Reliable Data Source
… data streamed from assets in a reliable, accurate way – all the time

Data Orchestration: from data to actionable insights
Clean, in-context data is critical to taking the next step into analytics

Orchestrate

1 Data **Collection and Cleansing**

2 Data **Preparation**

3 Data **Contextualization**

4 Data **Modelling, Analytics, Visualization**

5 Insights and **Decisions**

Time
Transactions
Events

Quality
Scheduling
Asset Management
Energy Management
Materials Management
Track and Trace
....

Decision Science and Analytics is a team sport
The aim is to accelerate and unlock the time to value of data

Business

Data

Facts

Code

Business Expert

Speed driver
- ► Decision challenge
- ► Total opportunity and business KPI´s
- ► Domain expert
- ► Value quantification

Data Engineer

Speed to good data
- ► Data quality input
- ► Cold data ingestion
- ► ETL automation

Data Scientist

Evidence driver
- ► Model owner
- ► Empirical Value
- ► Sustain model performance
- ► Evidence sign off

OT/IT Engineer

Scalable application
- ► Code development and maintenance
- ► Model scalability
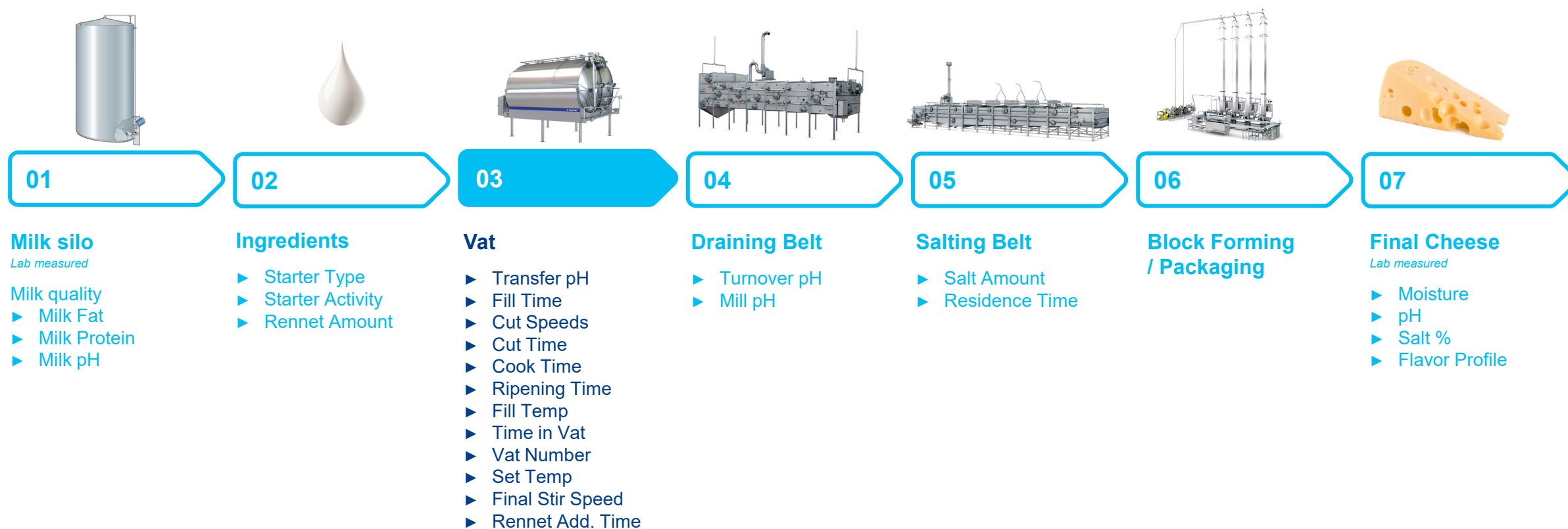- ► Infrastructure performance

Analyze

Opportunity: Elevating efficiency in the vat
To achieve superior moisture levels, improving product quality & yield

Variables in the cheese production process

01

Milk silo
Lab measured

Milk quality
- ► Milk Fat
- ► Milk Protein
- ► Milk pH

02

Ingredients

- ► Starter Type
- ► Starter Activity
- ► Rennet Amount

03

Vat

- ► Transfer pH
- ► Fill Time
- ► Cut Speeds
- ► Cut Time
- ► Cook Time
- ► Ripening Time
- ► Fill Temp
- ► Time in Vat
- ► Vat Number
- ► Set Temp
- ► Final Stir Speed
- ► Rennet Add. Time

04

Draining Belt

- ► Turnover pH
- ► Mill pH

05

Salting Belt

- ► Salt Amount
- ► Residence Time

06

Block Forming / Packaging

07

Final Cheese
Lab measured

- ► Moisture
- ► pH
- ► Salt %
- ► Flavor Profile

Cheese moisture optimization

Challenge

► Achieve superior moisture levels

► Decrease pH and moisture variability

► Improve overall product quality

► Increase yield

Solution

Scalable AI: easy deployment across multiple facilities.

Proven Success
Validated through clinical trials

Seamless Integration
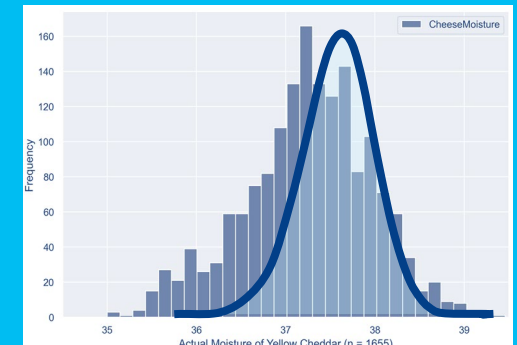Minimal disruption to existing processes

Tailored Implementation
Customized AI to fit unique production needs

Outcome

► Reduction of Moisture Variability

► Increase of Average Moisture

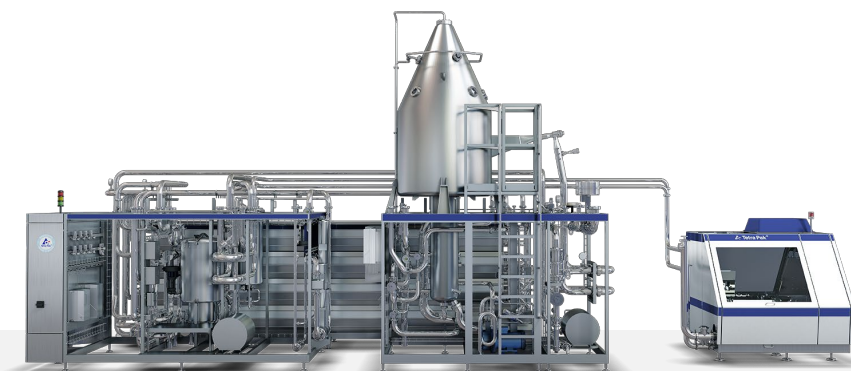► Reduction of pH Variability

$1.7-2M year/factory

Factory Capacity: 10 000 pounds of cheese / hour

Opportunity for optimizing frequencies and duration of cleaning-in-place

Formulation of high protein drinks (HPDs) tends to cause **higher levels of fouling**

Our aseptic processing unit for continuous Ultra High Temperature (UHT) processing of premium quality, aseptic products

Processing cleaning procedure optimization

Challenge

► Unplanned production halts

► Risk of contamination

Solution

AI-Driven CIP Recommendations
Our algorithm analyzes UHT and production data to predict the optimal timing for CIP, reducing unnecessary downtime and improving sustainability
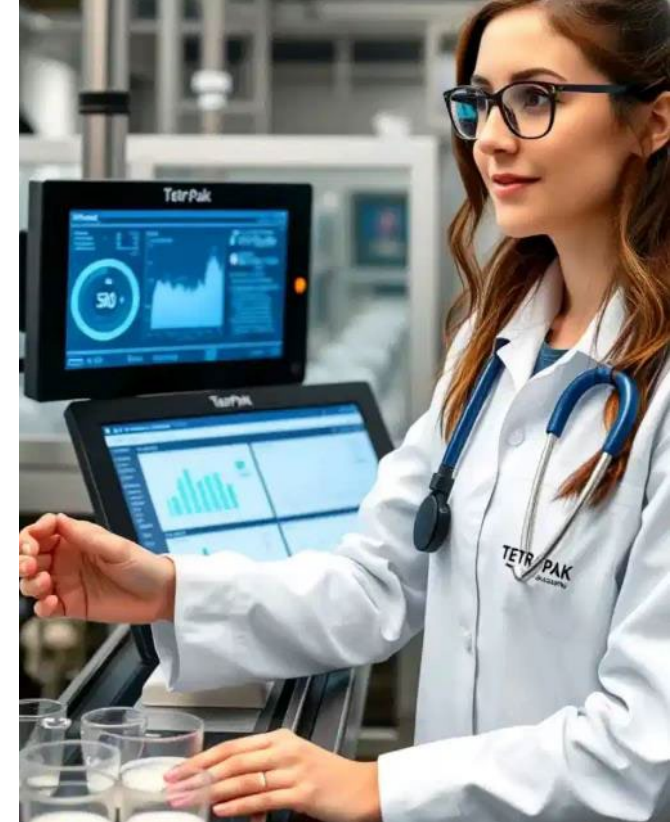
Realized Value

Increased Production Time
Extend machine runtime by 0.5 to 2 hours per cycle

Reduced Contamination Risk
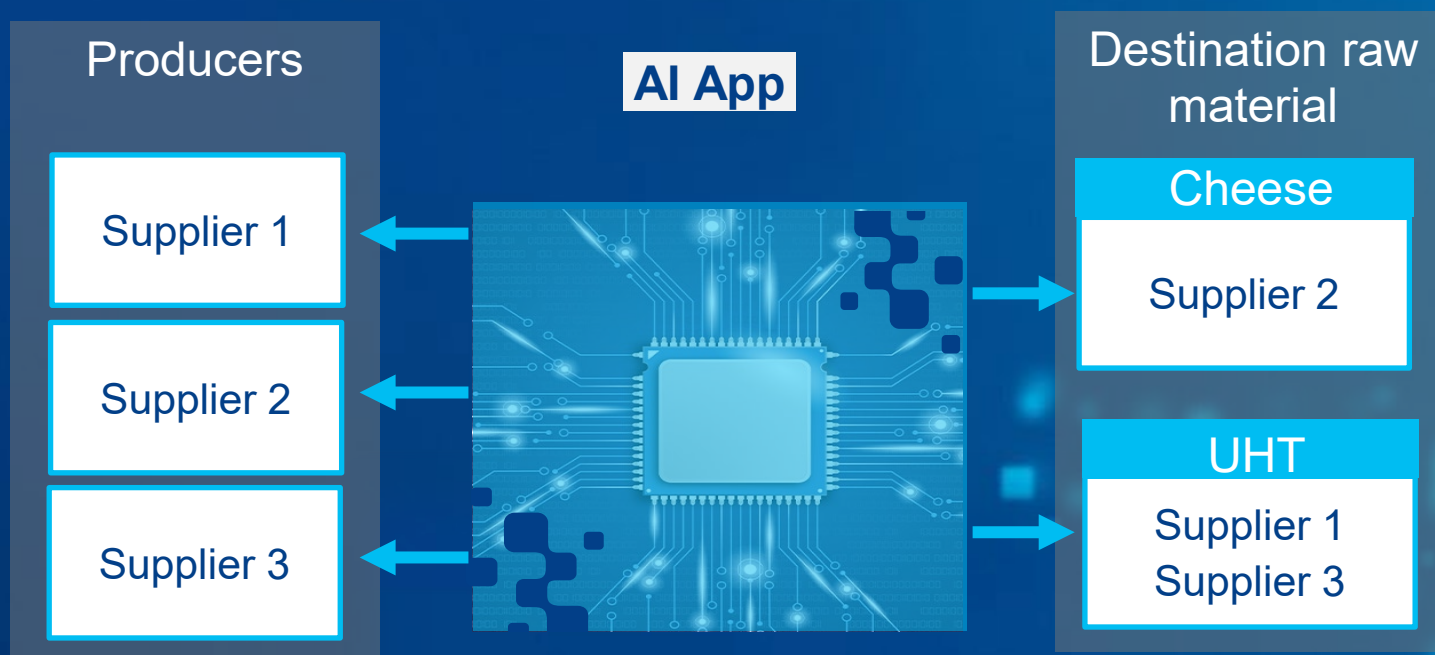Ensures timely cleaning, maintaining product quality and reducing waste

$1.3M revenue increase year/factory

Calculated for an average customer with 3 machines per factory

*Calculated for an average customer with 3 machines per factory.

Artificial intelligence in milk reception
Planned milk segregation by demand and production volume

Milk segregation at reception

Dairy
South America

Challenge

► Resource Limitation and Lack of Data

► Long time to analysis

► **Inability to create planning for segregation**

► Difficulty in classifying producers

Solution

Multidisciplinary team building
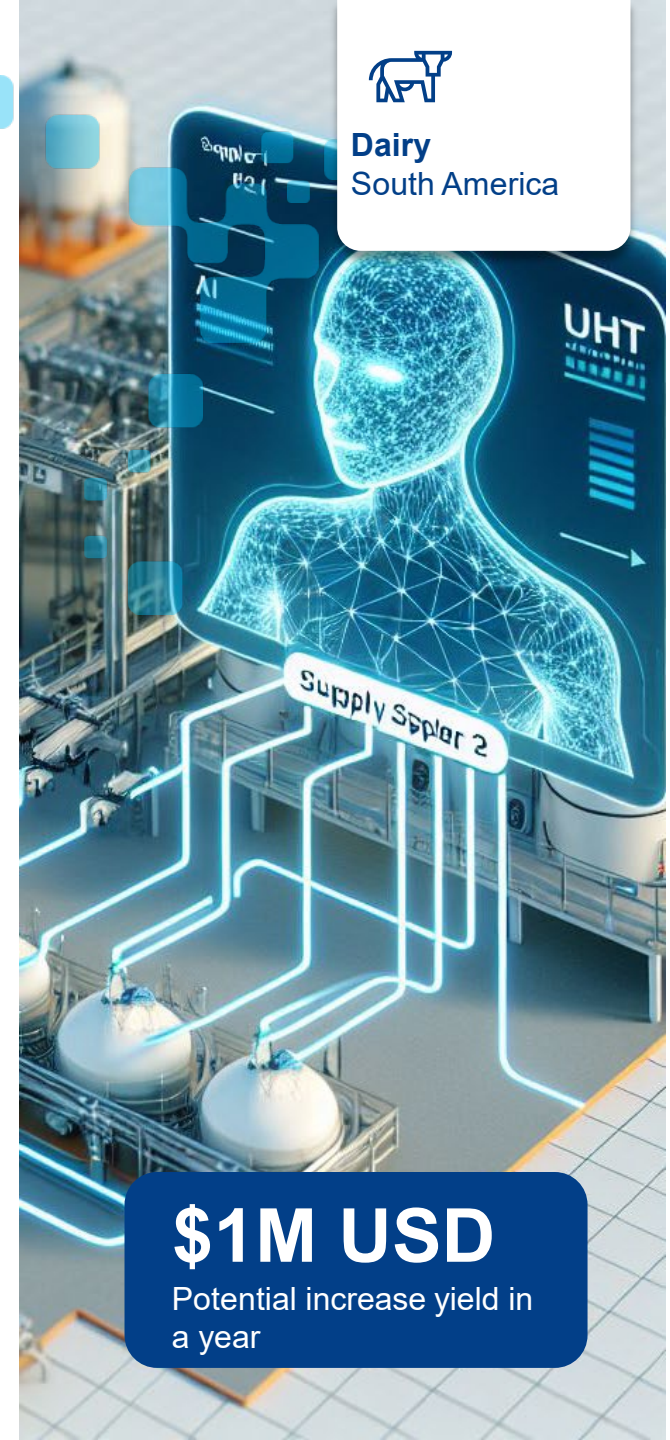
Data collection and processing

Data clustering

Algorithm development

Realized value

► What are my producer groups and how do they behave?

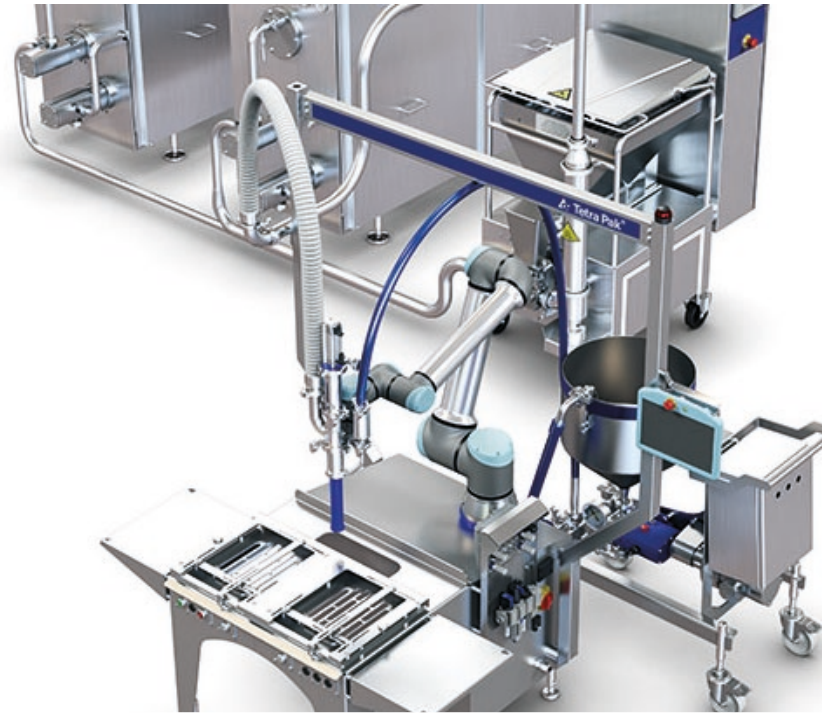► What is the best destination for my raw material based on parameters?

$1M USD
Potential increase yield in a year

**Cobots
Robots
and AGVs**

1 **Increased throughput**

2 **Improved quality and repeatability**

3 **Cost savings with risk reduction**

Enhancing the automation foundation

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Questions and Answers

Q&A

How do you see AI's application distinct to dairy processors vs. other agricultural industries or industries in different verticals?

Q&A

How will AI change the business processes at a manufacturing plant?

Q&A

Have you reached any AI or Energy optimization programs for Spray Drying or Evaporation/Concentration? Would you be open to a local engineering office to provide this service?