



Forecasted Smart Manufacturing Applications

Oregon Dairy Industries

Presented by: Eva Kuhn, Cheese Technologist – Tetra Pak

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About me

- ▶ Oregon native
- ▶ Cheesemaker 12+ years
- ▶ Oregon State University, Food Science and Technology – M.S. 2017
- ▶ ODI – attending since 2013 as Bodyfelt Scholarship recipient, currently ODI board member
- ▶ Darigold – Quality Assurance
- ▶ Tillamook – Technical Services
- ▶ Tetra Pak – Cheese Technologist

Wide range of cheesemaking experience, working with cheese plants producing anywhere from 30 lb/day to 30,000+ pounds/hr.

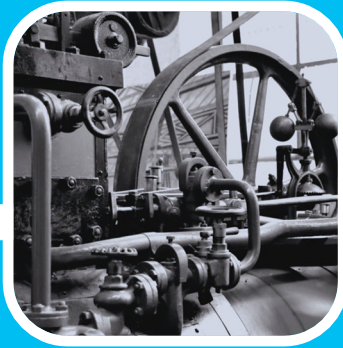


Background

Understanding the journey through industrial revolutions and today's trends in food and beverage manufacturing



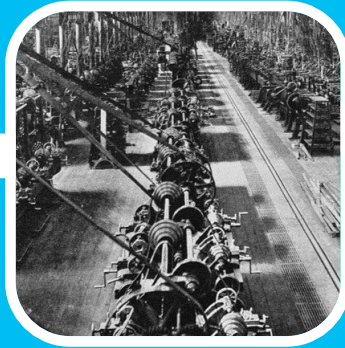
Industrial Revolutions – where are we today?



1st

Mechanisation
Steam power

Single machines
for many users



2nd

Mass production
Assembly line
Electricity

Many machines
and many users



3rd

Computers
Automation

Many machines
for each user



4th

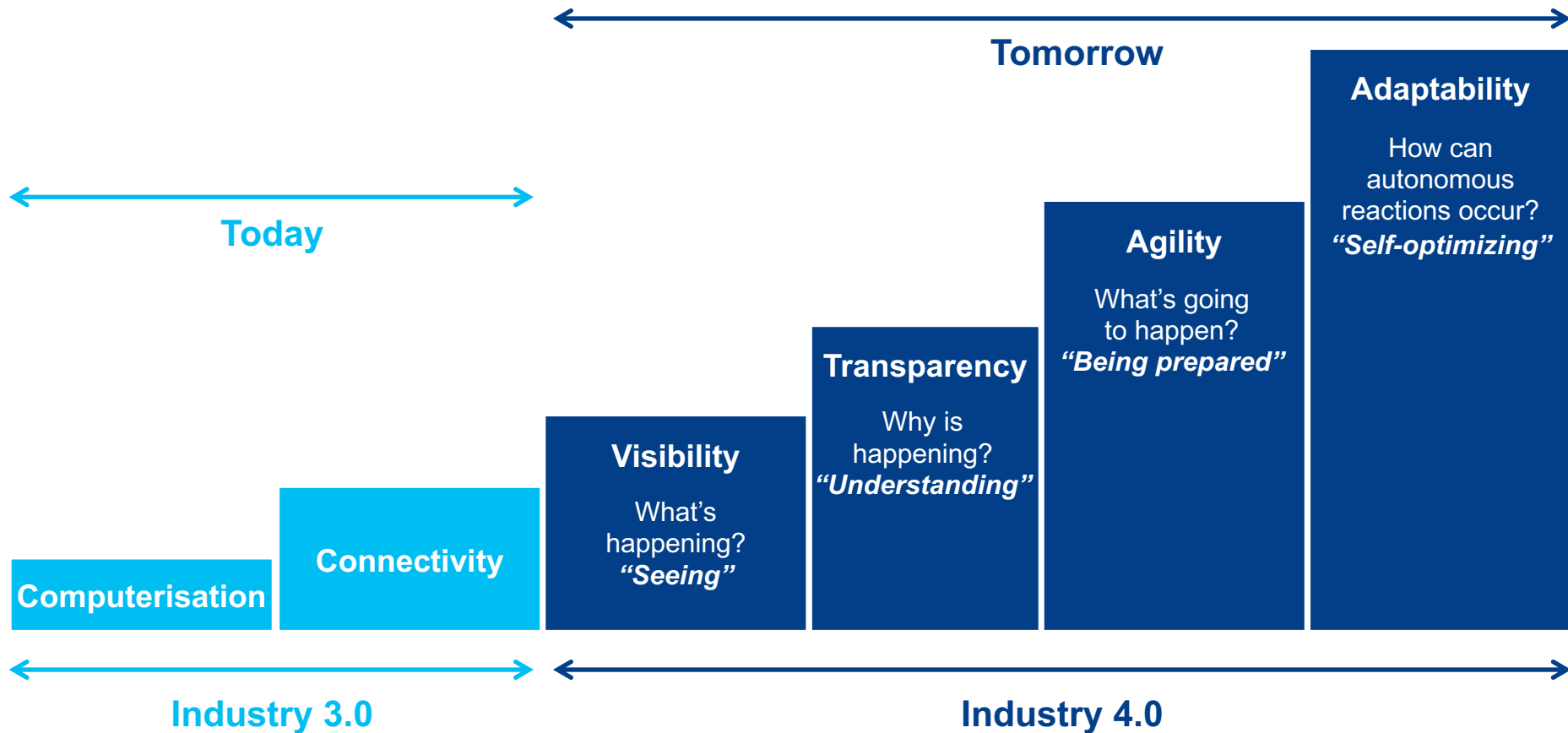
Cyber physical systems
AI, IoT, Big data, Blended
EdTech, 3D printing

Internet of Things
Smart factory



The digital transformation journey

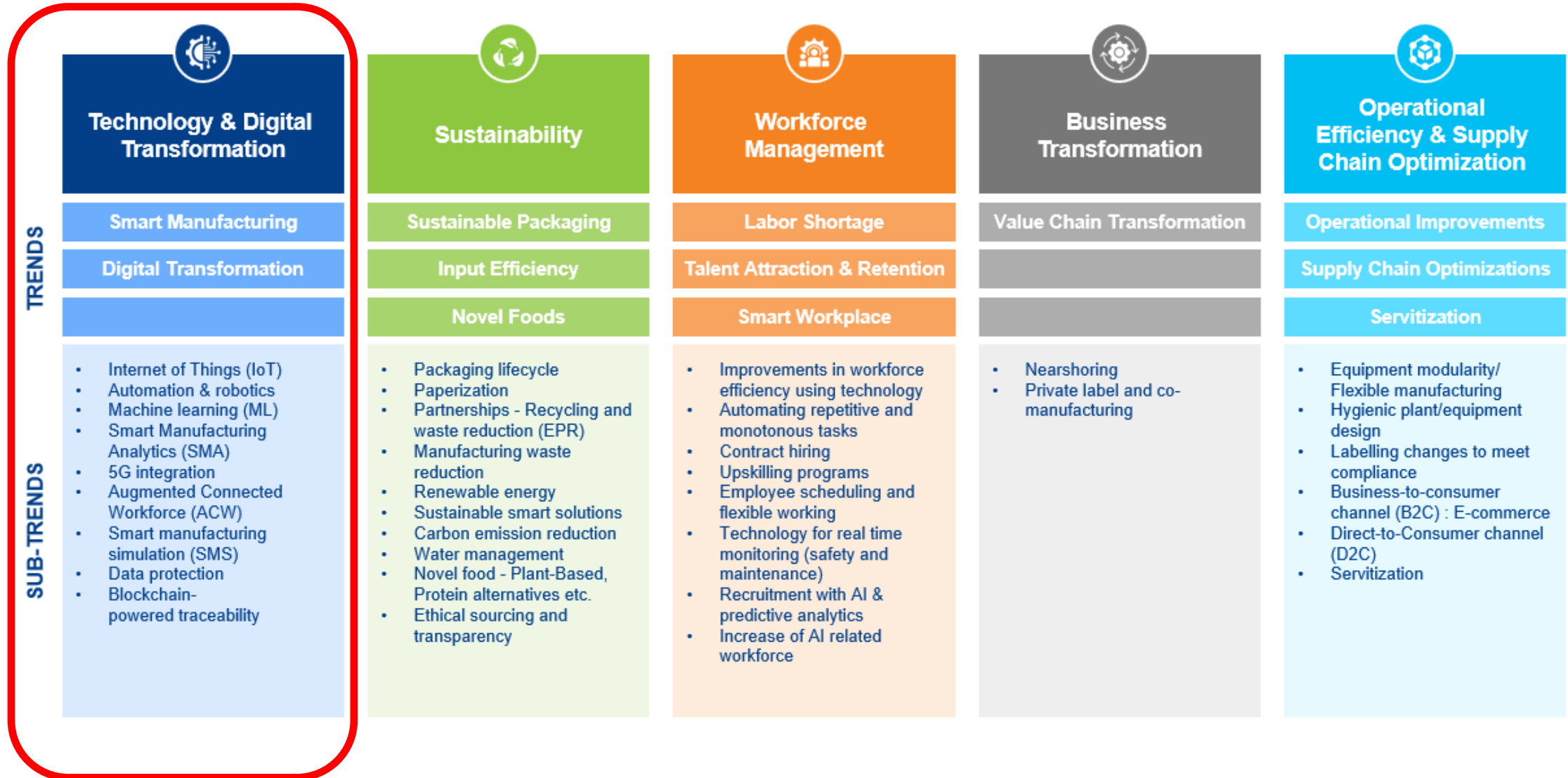
Value-based approach





Food and Beverage Manufacturing Trends

Developed from top-down analysis





Prioritization of identified sub-trends

Ranking by significance, potential impact, and market feedback

	Technology & Digital Transformation	Sustainability	Workforce Management	Business Transformation	Operational Efficiency & Supply Chain Optimization
TRENDS	Smart Manufacturing	Sustainable Packaging	Labor Shortage	Value Chain Transformation	Operational Improvements
	Digital Transformation	Input Efficiency	Talent Attraction & Retention		Supply Chain Optimizations
SUB-TRENDS		Novel Foods	Smart Workplace		Servitization
	<ul style="list-style-type: none"> Internet of Things (IoT) Automation & robotics Machine learning (ML) Smart Manufacturing Analytics (SMA) 5G integration Augmented Connected Workforce (ACW) Smart manufacturing simulation (SMS) Data protection Blockchain-powered traceability 	<ul style="list-style-type: none"> Packaging lifecycle Paperization Partnerships - Recycling and waste reduction (EPR) Manufacturing waste reduction Renewable energy Sustainable smart solutions Carbon emission reduction Water management Novel food - Plant-Based, Protein alternatives etc. Ethical sourcing and transparency 	<ul style="list-style-type: none"> Improvements in workforce efficiency using technology Automating repetitive and monotonous tasks Contract hiring Upskilling programs Employee scheduling and flexible working Technology for real time monitoring (safety and maintenance) Recruitment with AI & predictive analytics Increase of AI related workforce 	<ul style="list-style-type: none"> Nearshoring Private label and co-manufacturing 	<ul style="list-style-type: none"> Equipment modularity/ Flexible manufacturing Hygienic plant/equipment design Labelling changes to meet compliance Business-to-consumer channel (B2C) : E-commerce Direct-to-Consumer channel (D2C) Servitization



Trend #1 – Smart Manufacturing

- Sub-trend #1: Machine Learning
- Sub-trend #2: Smart Manufacturing Simulation
- Sub-trend #3: Smart Manufacturing Analytics

Trend #2 – Digital Transformation

- Sub-trend #4: Augmented Connected Workforce

Trend #3 – Input Efficiency

- Sub-trend #5: Water Management
- Sub-trend #6: Sustainable Smart Solutions

Trend #4 – Servitization

- Sub-trend #7: Servitization

Trend #5 – Operational Improvements

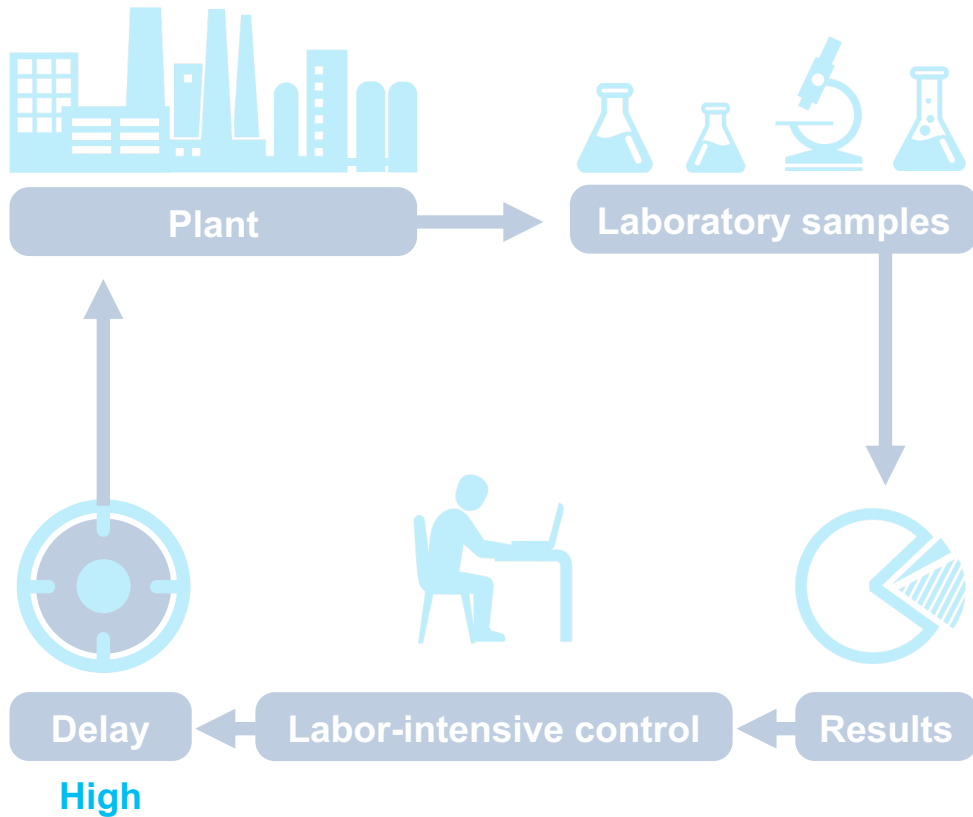
- Sub-trend #8: Equipment modularity/Flexible manufacturing

Trend: Technology and Digital Transformation

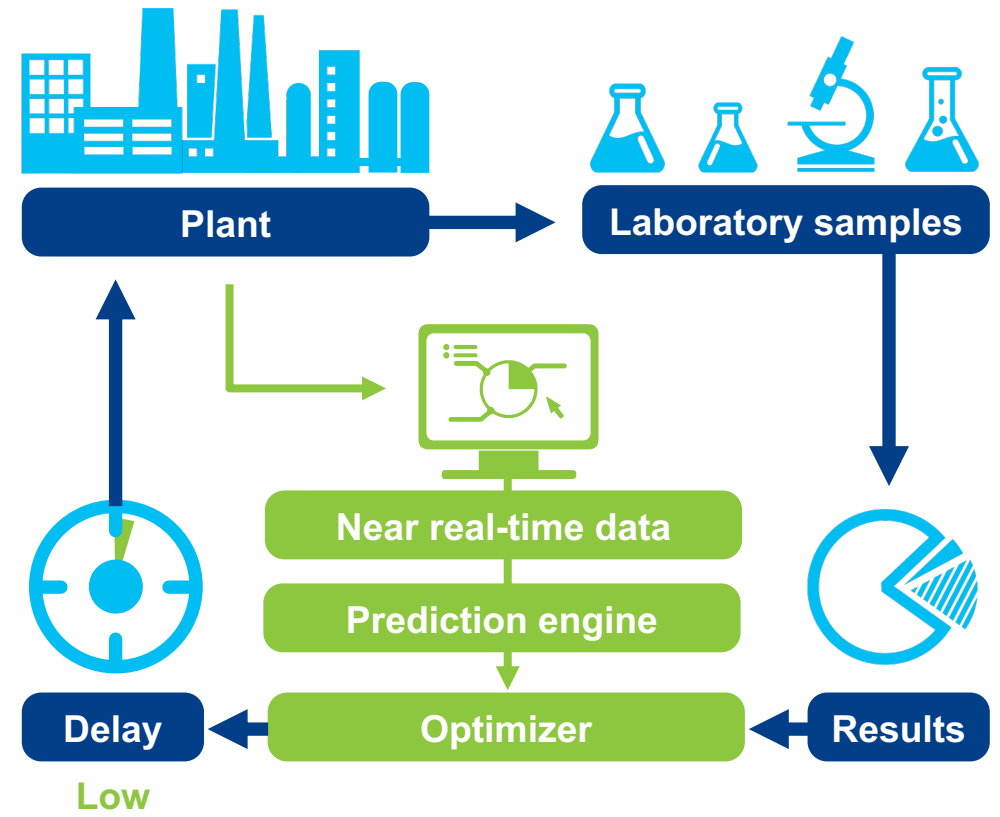
Smart manufacturing



Today's and Tomorrow's Operations



Current plant state



Future, desired plant state

“Smart Manufacturing,

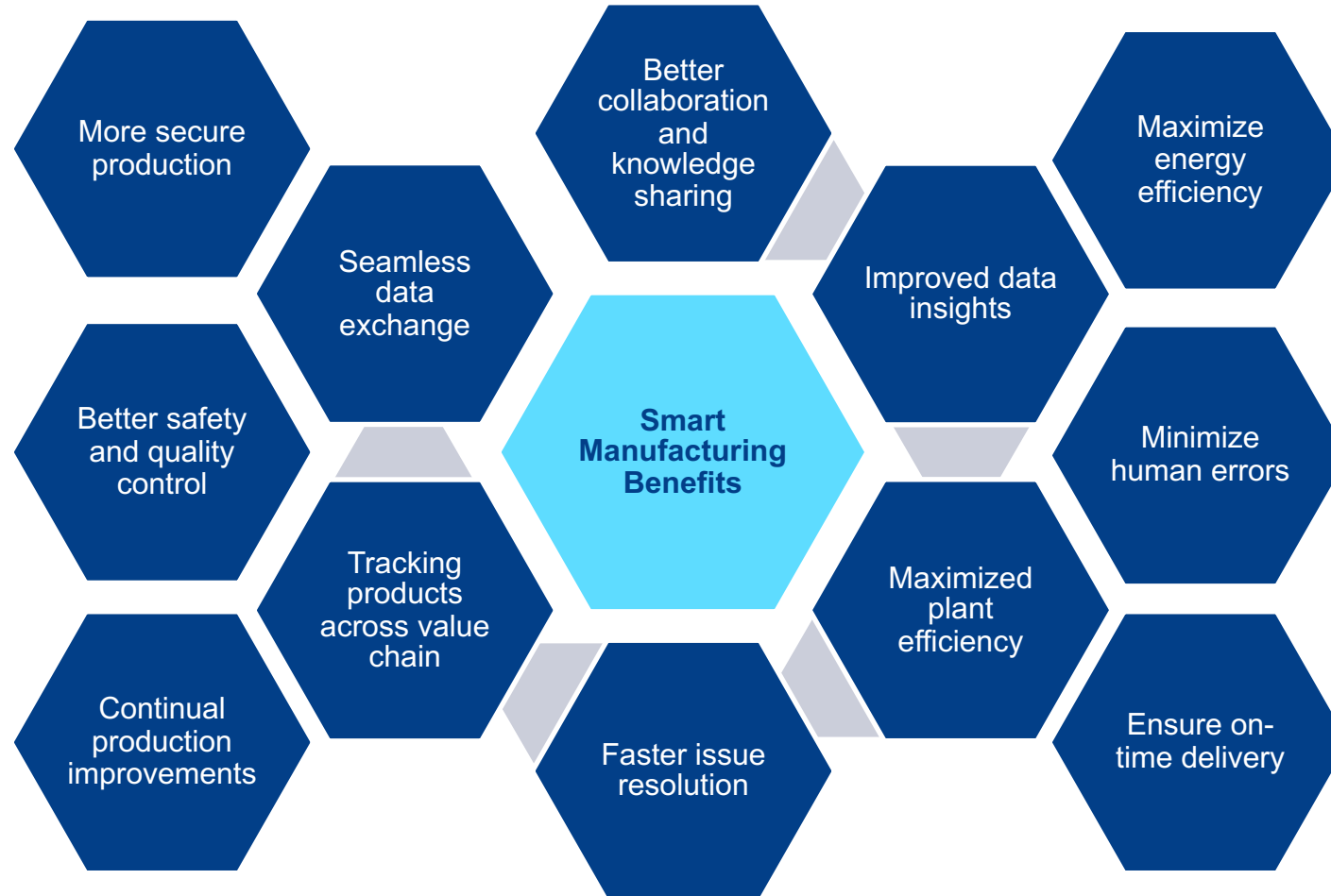
The processes and technology are customizable, empowering every brand to create a roadmap for achieving its business goals.

relies on digital technologies to create efficiencies and flexibilities in machinery, data, supply chain, personnel and more, a brand can focus on solving any one of many pain points.”



The Many Benefits of Smart Manufacturing

Smart manufacturing touches on all aspects of the business



“Artificial intelligence,

*the simulation of human intelligence by machines,
particularly computer systems,*

*aiming to perform tasks that typically require human
intelligence,*

such as learning, reasoning, and problem-solving.”

Raise your hand if you think you benefit from AI in your daily life?

“AI platform usage is believed to be at **33% by consumers**, whereas the **actual usage is 77%.**”

Types of AI encountered in daily life

Machine Learning



Natural Language Processing



ChatGPT

Computer Vision



TESLA

Robotics



Expert Systems



Neural Networks



“Machine learning,

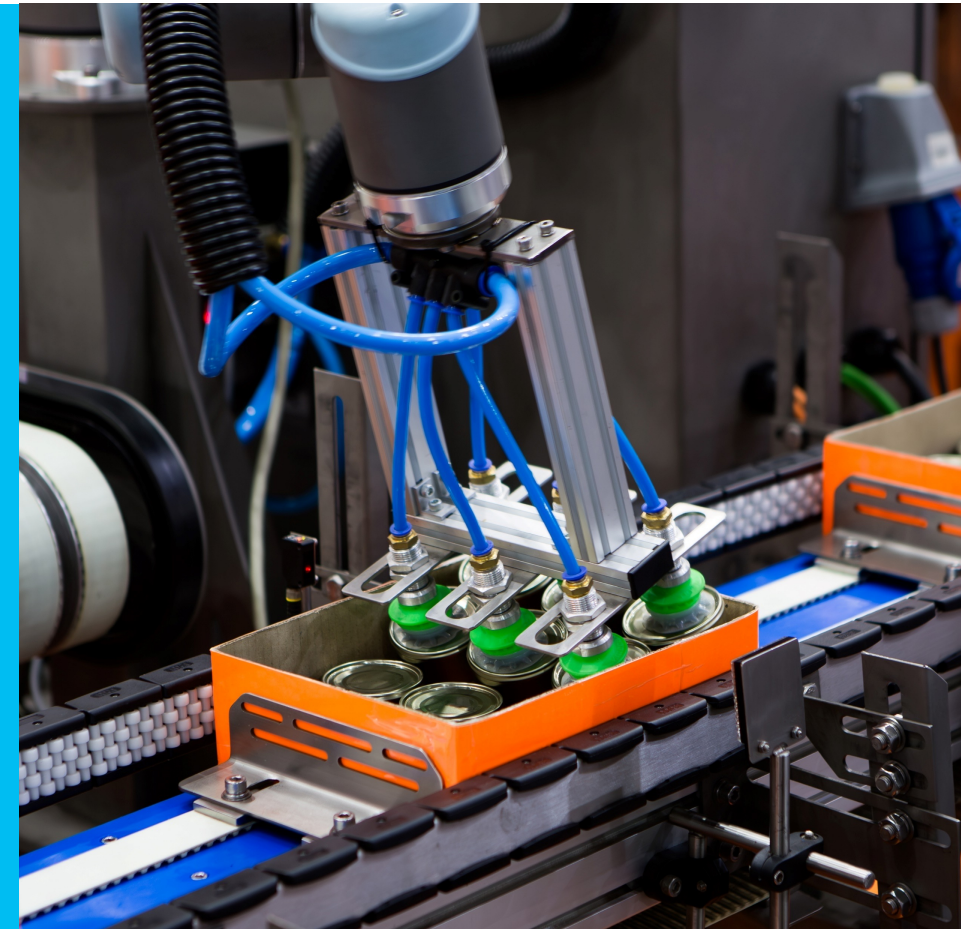
is a subset of artificial intelligence that allows for optimization.

When set up correctly, it helps you make predictions that minimize the errors that arise from merely guessing.”



Machine learning is transforming Food & Beverage production

- ▶ In F&B manufacturing, machine learning **analyzes data through recognizing patterns and making predictions**
- ▶ Machine learning is transforming the F&B industry by **enhancing quality, supply chains, efficiency, product development, food safety, and sustainability**
- ▶ Machine learning is **driving innovation and competitiveness** across various aspects of the F&B industry





Machine Learning

General Overview

A way to process large amounts of data in an intelligent manner to get predictions and optimizations.

Computer vs. Human

Larger **processing power**

Faster **processing speed**

Larger **storage capability**

Faster **pattern recognition**

Strict **continuous learning**

Infinite **availability**



Machine Learning

General Overview

A way to process large amounts of data in an intelligent manner to get predictions and optimizations.

Computer + Human vs. Problem at Hand

Larger **processing power**

Faster **processing speed**

Larger **storage capability**

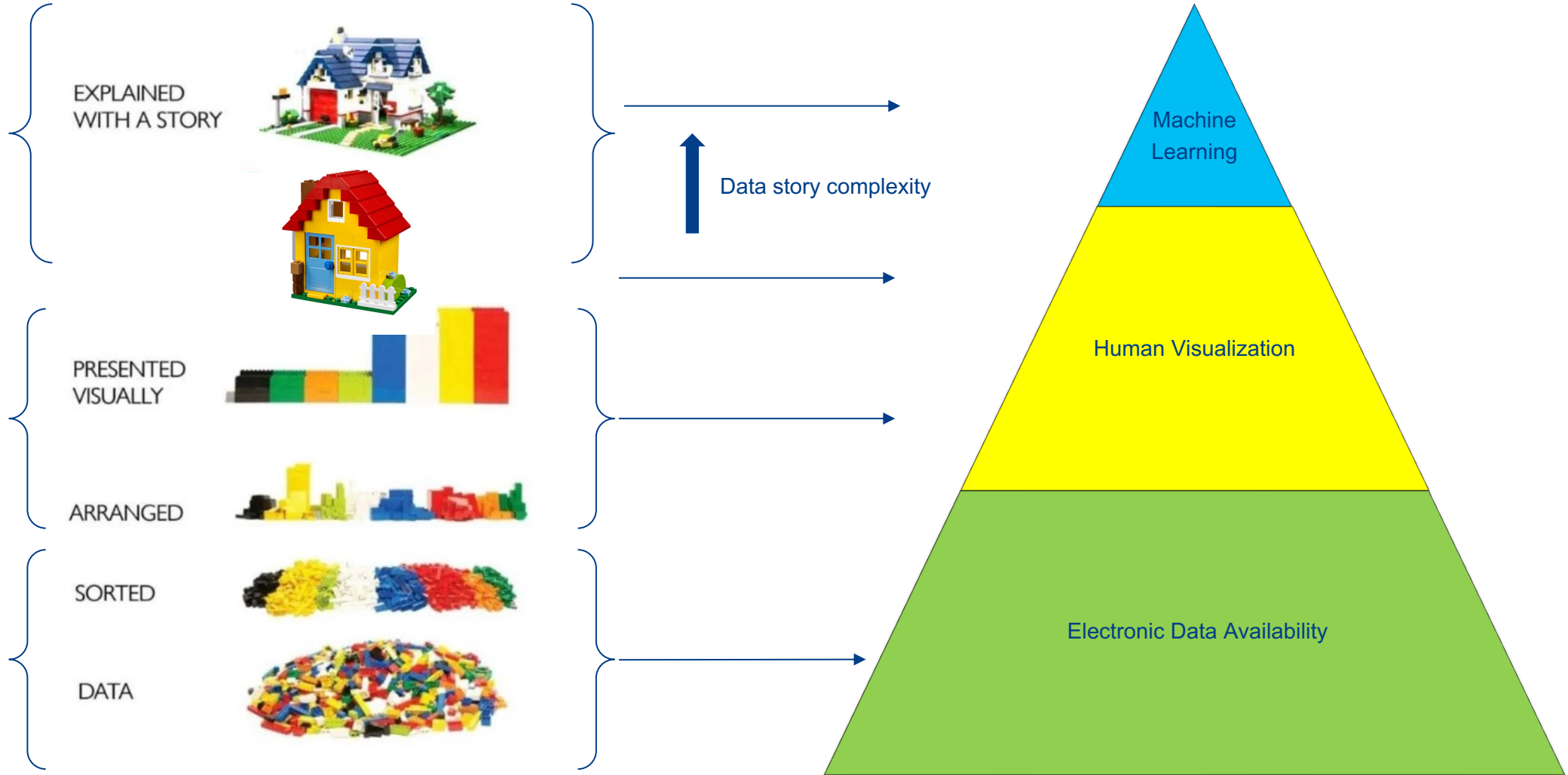
Faster **pattern recognition**

Strict **continuous learning**



Data is the Backbone of Smart Manufacturing

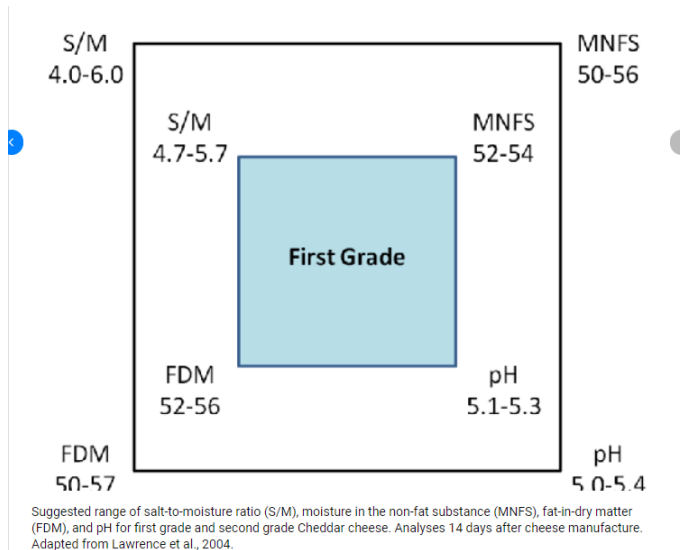
GETTING VALUE FROM DATA



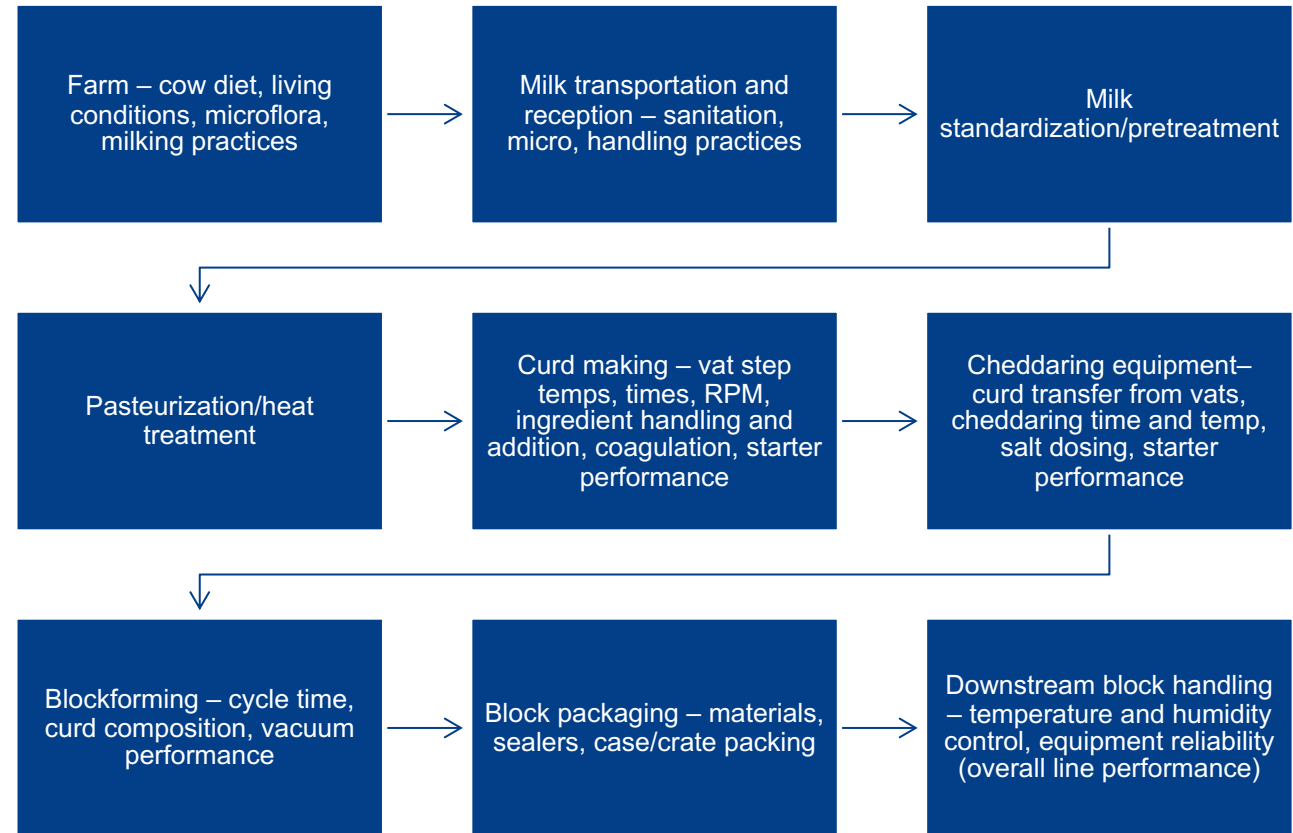


Example - The “perfect” cheddar every vat, every time

Suggested cheddar analytic targets for first grade (best grade) cheddar – easy enough right? Follow the recipe and it makes perfect cheese every vat, what could go wrong?



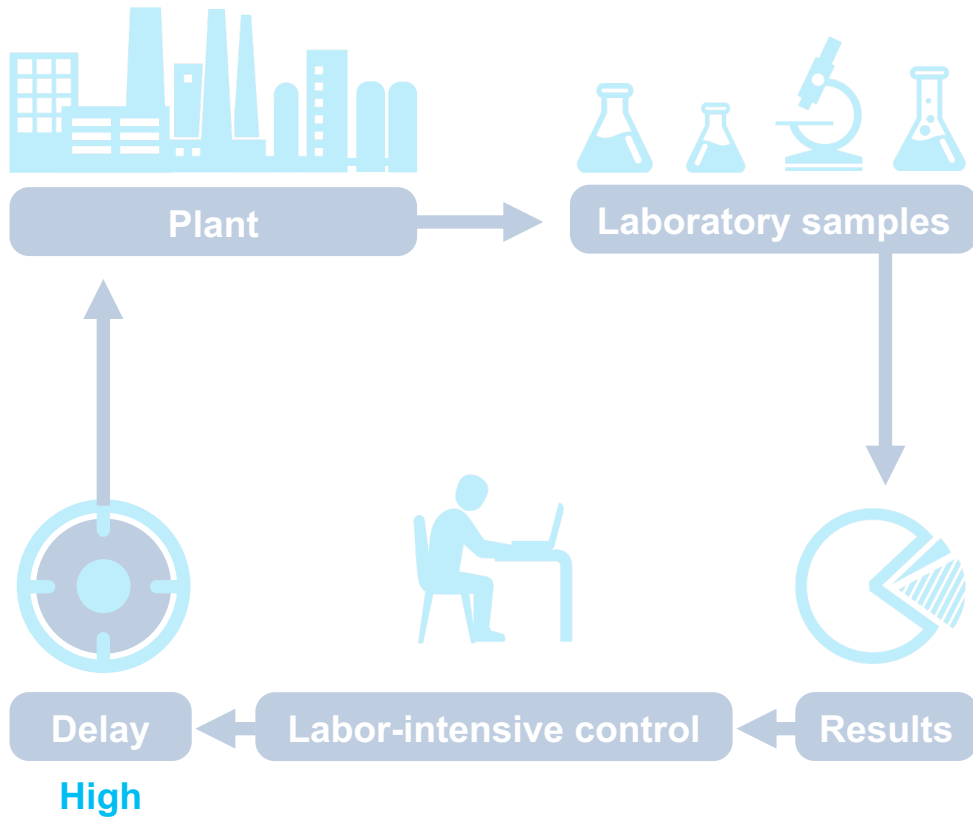
General Cheddar Process



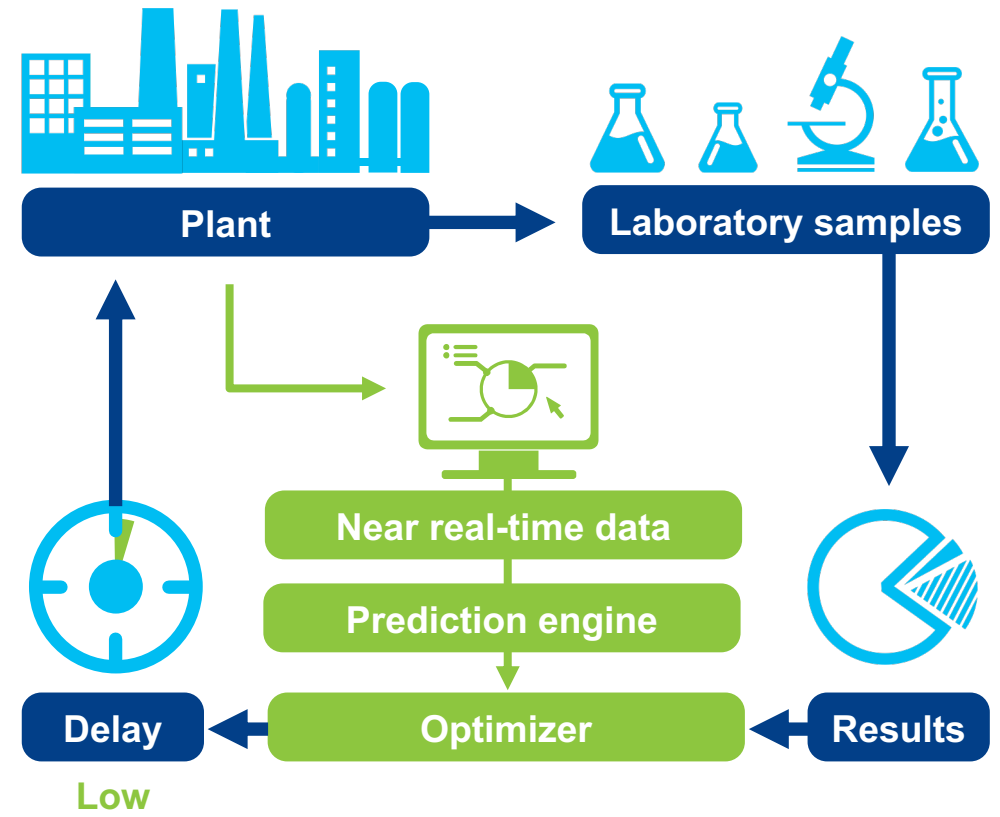
100s of variables to consider making great cheese every vat– as specialist we focus on analyzing the most important known relationships but can miss out on hidden data relationships. Using machine learning applications enhances our ability for faster, better decision making.



Operations Data Feedback Systems



Current plant state



Future, desired plant state

How can you adopt smart manufacturing in your process?



Step 1: Adopt a smart manufacturing mindset

Are you ready to challenge the process?

- ▶ Data is the backbone of smart manufacturing, but not just any data will do. Poor quality data is just as bad (sometimes worse) than no data.
- ▶ **Company culture** - we get tunnel vision to our own process, we accept things at face value, “we’ve always done it this way”, we tried that before and it didn’t work, we don’t have the resources, there’s significant quality issues and we just need to do something.
- ▶ Do you know your process as well as you think you do? Awareness of “process creep” phenomenon – unintentional process changes occur at a very slow rate, you don’t notice or think it’s a “one off” event, but overtime can change the product quality or productivity.



Tips for Understanding Your Current Process

Understanding today helps give guidance on where you want to be tomorrow.

- ▶ **Conduct a process assessment – roadmap of process with all data in/outputs**
- ▶ Data “Who, what, where, when, why, how” for each part of the process:
 - 1) Who collects the data? Machine or person?
 - 2) What type of data is it?
 - 3) Where is the data stored – paper, excel file, MES, other?
 - 4) When is the data it collected, and how frequently?
 - 5) Why is this data collected? What does it tell me/think it tells me?
 - 6) What uncertainties are there? Sampling, training, instrument calibration, etc.
 - 7) Who reviews the data and makes process decisions from it?

Strongly recommend working on this as a manufacturing team for best results, need perspective from production, quality, technical, automation, engineering teams.



Expected Outcomes of Process Assessment

- ▶ **You might find you don't know the process as well as you thought:** Identifying critical data missing, redundant or obsolete data, unreliable collection or testing, inaccurate or missing data from historical data, misunderstandings of how equipment and automation works, etc.

- ▶ Helps identify data system maturity and gives guidance on what types of smart manufacturing applications you can pursue:
 - Immature data system– lots of data is on paper or excel sheets, focus should be improving data digitalization
 - Mature data system– all data is digitalized, could focus on machine learning applications for process optimization

- ▶ Useful internal document – can use to track changes to process, and great reference and training document. “Process fingerprint”

- ▶ If you need inspiration, it's a similar approach to how we create the hazard analysis and risk assessment in food safety plans, can be as simple as an excel table matrix.



Need Help? Tetra Pak offers wide range of services



