CHEMICAL INDUSTRY

CHEMICAL ENGINEERING

# Transforming Batch Production

The Power of Digital Twins in the Chemical Industry

Tuesday, January 14, 2025 – 1:00 p.m.

(GMT-06:00) Central Time (US and Canada)



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# Introductions

**Iiro Esko**
Siemens Chemical Engineering Expert

Iiro is a chemical engineer with 15+ years of experience in process industries working with digitalization and the application of Digital Twins across chemical industry value chains



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# Agenda

1. Introductions
2. Current industry trends and challenges
3. What is Digital Twin and why do chemical businesses need it?
4. Use Case discussion
5. Key takeaways
6. Q&A



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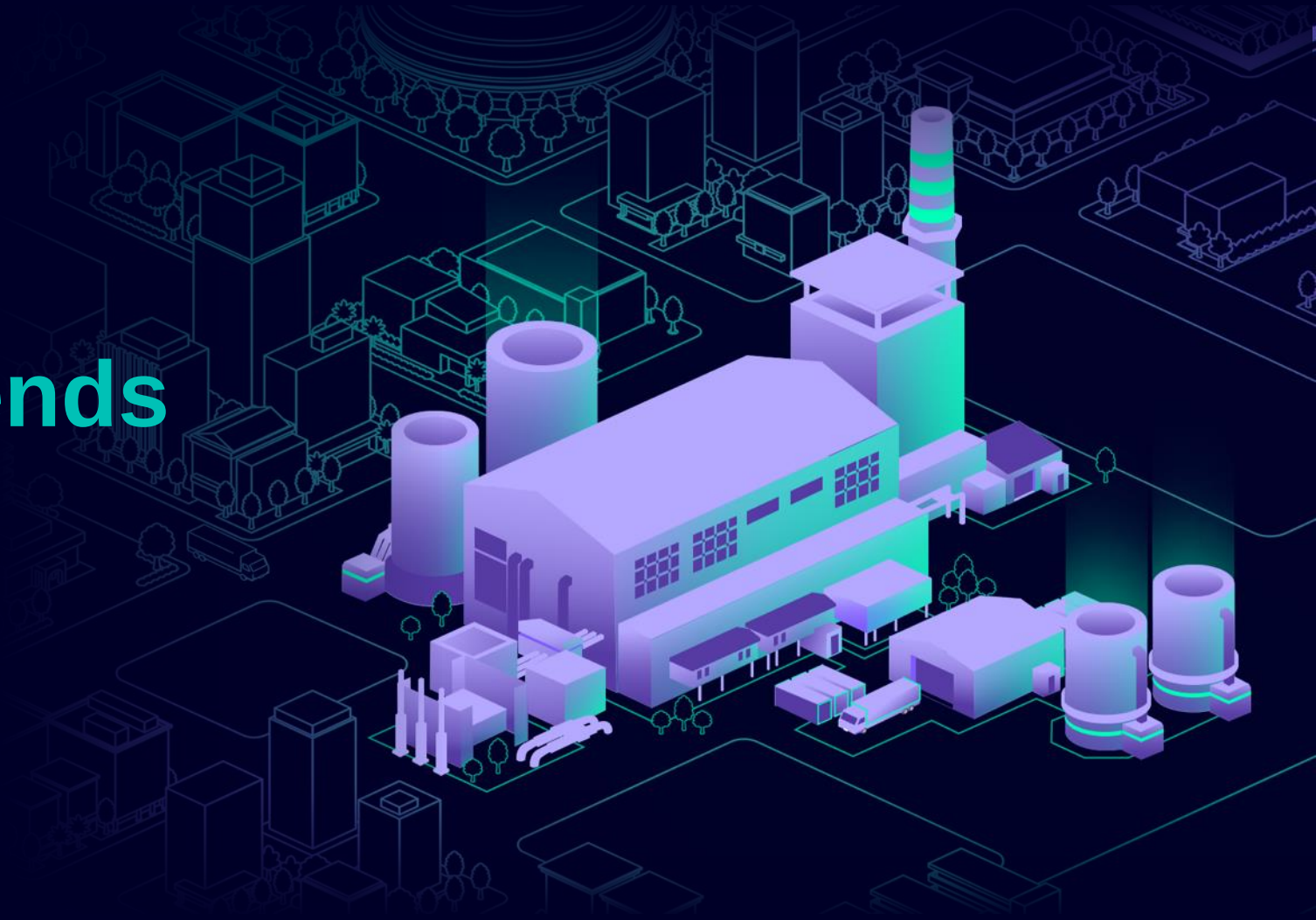
# Current **industry trends and challenges**





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# Megatrends impacting the industrial landscape

**Digital Transformation and Big Data**

**Sustainability and Decarbonization**

**Skills Gap and Workforce Transformation**

**Geopolitical Changes and Instabilities**

On top of these four megatrends, increased competition due to **Globalization** is driving higher automation levels, lower frontline worker counts, and even autonomous lights-out production reshaping **production methods**, lifestyles, and work dynamics to answer new requirements.



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# The reality that chemical batch production is facing today

Missing standardization leading to dependencies

Resistance to change and fear of “the new”

Poor and outdated knowledge transfer

Missing expertise to work the right technologies

An **inability to react** to change will dull the competitive edge of any organization!

**Inaction** today leads to lower investments in manufacturing operations making US facilities **less profitable** and **less attractive!**



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# Why do chemical businesses need to **prioritize a Digital Twin?**



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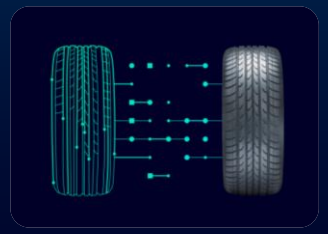

## Introduction to a Digital Twin

A Digital Twin is a virtual representation of a batch plant that provides plant managers and executives a powerful tool to synchronize production planning, execution, engineering, and quality assurance.

## A Digital Twin can provide value at every level

The Digital Twin enhances efficiency and management capabilities across all levels, from overarching business drivers to enterprise operations, manufacturing processes, and individual batch production activities

## The Power of a Connected Digital Ecosystem

By connecting all plant functions within a single unified digital ecosystem, the Digital Twin enables collaboration not only across internal teams but also with feedstock suppliers, OEMs, and sister plants

## Key Benefits for Batch Plants

- Optimized process yield, improved uptime, and minimized downtime.
- Increase speed from bench to pilot to commercialize – Scale at the speed of software
- Optimized plant design for enhanced sustainability and emissions reduction
- Secure, standardized insights from enterprise to site-specific recipes, ensuring accuracy across all levels



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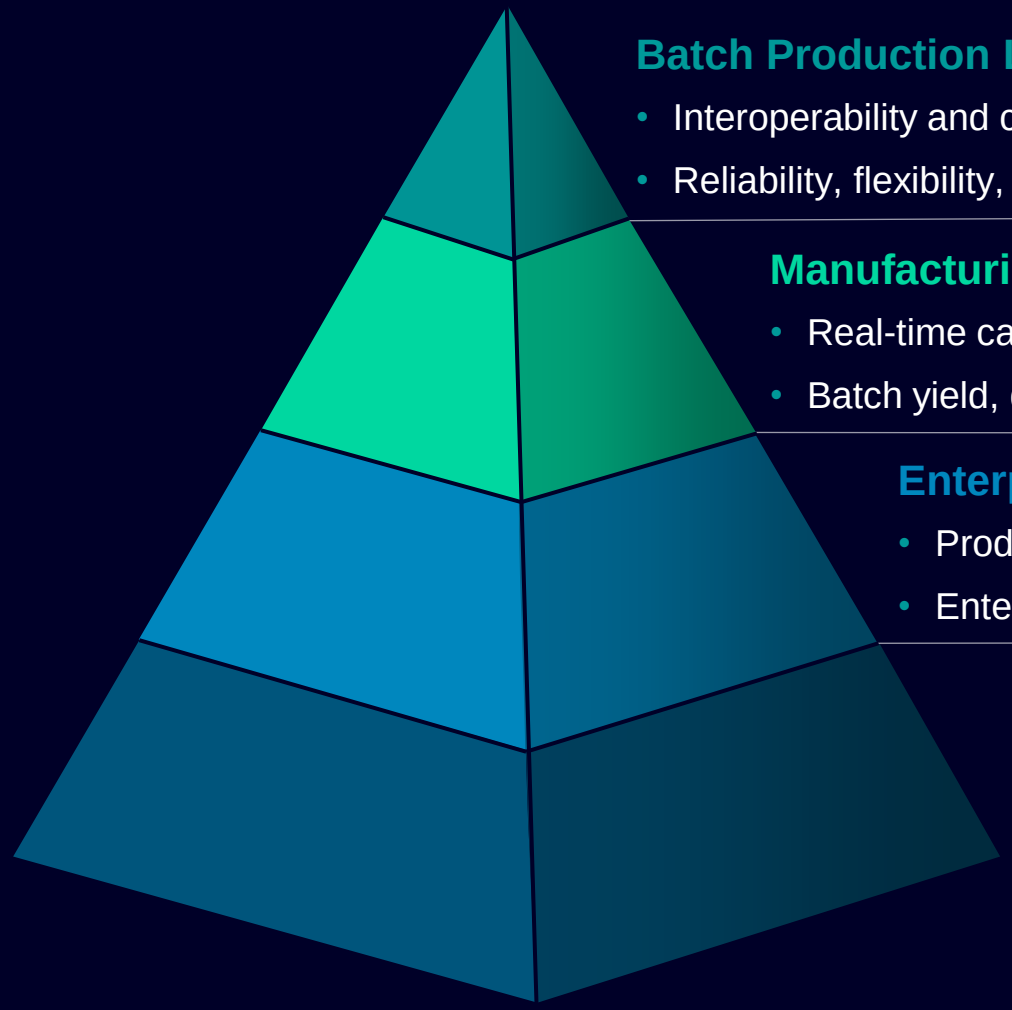
# The case for the Digital Twin, the Digital Thread, and the Digital Enterprise

POLL



**Batch Production Level:**

- Interoperability and connectivity
- Reliability, flexibility, and profitability

**Manufacturing Level:**

- Real-time capabilities for safe operations
- Batch yield, quality, energy, and feedstock

**Enterprise Level:**

- Product Lifecycle Management
- Enterprise Recipe Management

**Business Drivers:**

- Customer Relationship Management
- Enterprise Resource Planning



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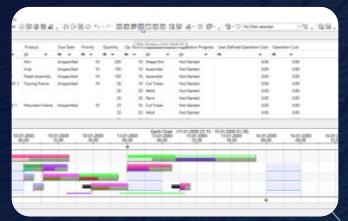
# The case for the Digital Twin, the Digital Thread, and the Digital Enterprise

## A Digital Twin connects…

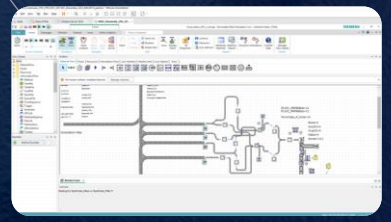


Management

R&D

Operations

Engineering



OEM’s and EPC’s

Maintenance



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# The chemical batch production Digital Twin journey

## Purchase Order and Planning

**Digital Twin Value:**

Simulates production capacity and schedules resources to meet demand efficiently, reducing lead times

## Raw Material Procurement

**Digital Twin Value:**

Provides predictive insights on supplier performance and quality, optimizing material usage and reducing delays

## Production Scheduling

**Digital Twin Value:**

Simulates production capacity and schedules resources to meet demand efficiently, reducing lead times

## Batch Production Execution

**Digital Twin Value:**

Monitors and optimizes real-time production processes, ensuring quality and consistency while identifying potential deviations early

## Quality Control and Testing

**Digital Twin Value:**

Predicts quality outcomes based on process parameters and historical data, reducing the need for extensive testing and ensuring compliance

## Packaging and Storage

**Digital Twin Value:**

Optimizes packaging processes and storage conditions to maintain product integrity and reduce costs

## Distribution and Logistics

**Digital Twin Value:**

Enhances logistics planning and tracking, reducing transportation costs and ensuring timely delivery

## Customer Utilization

**Digital Twin Value:**

Provides traceability and performance data to customers, ensuring confidence in the product and its sustainability

## Feedback Loop

**Digital Twin Value:**

Analyzes customer usage data to inform product improvements and optimize future production cycles



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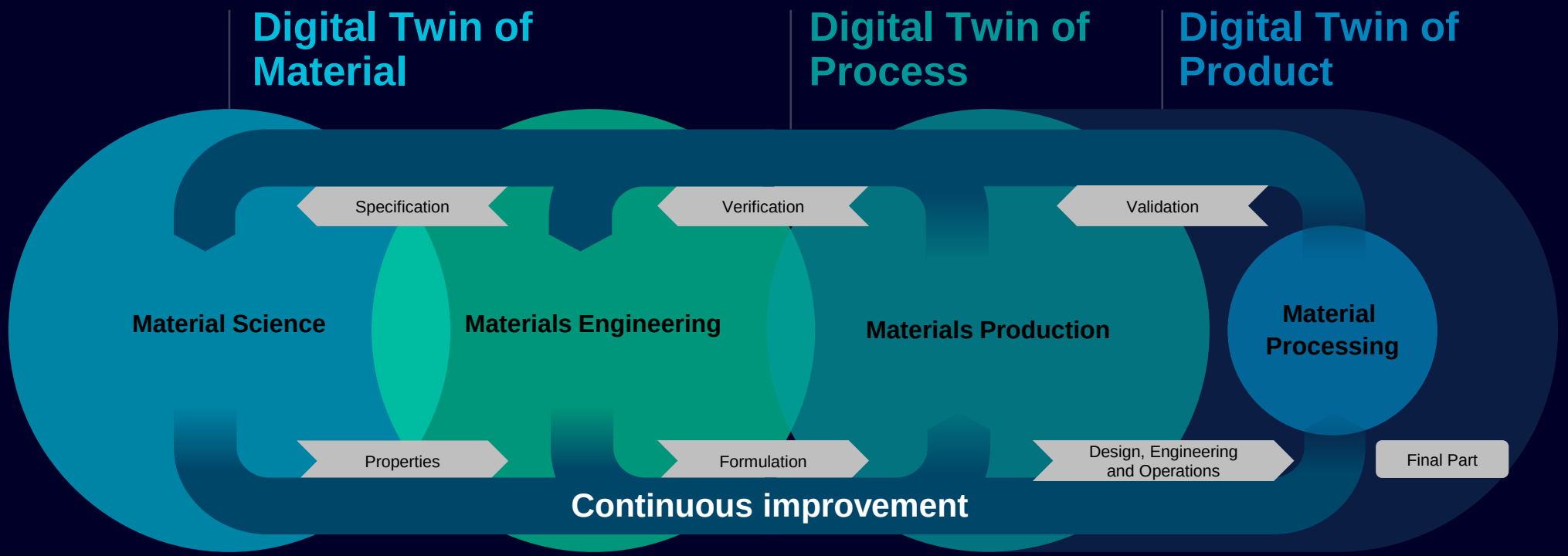
# Digital approach to material innovation, engineering, production and processing




| How do I discover / invent materials with desired properties? | How will the material perform in product of end-customer ? | How do I produce the chemicals / materials in plants? | Once produced, how is material processed to make products? |
|---|---|---|---|



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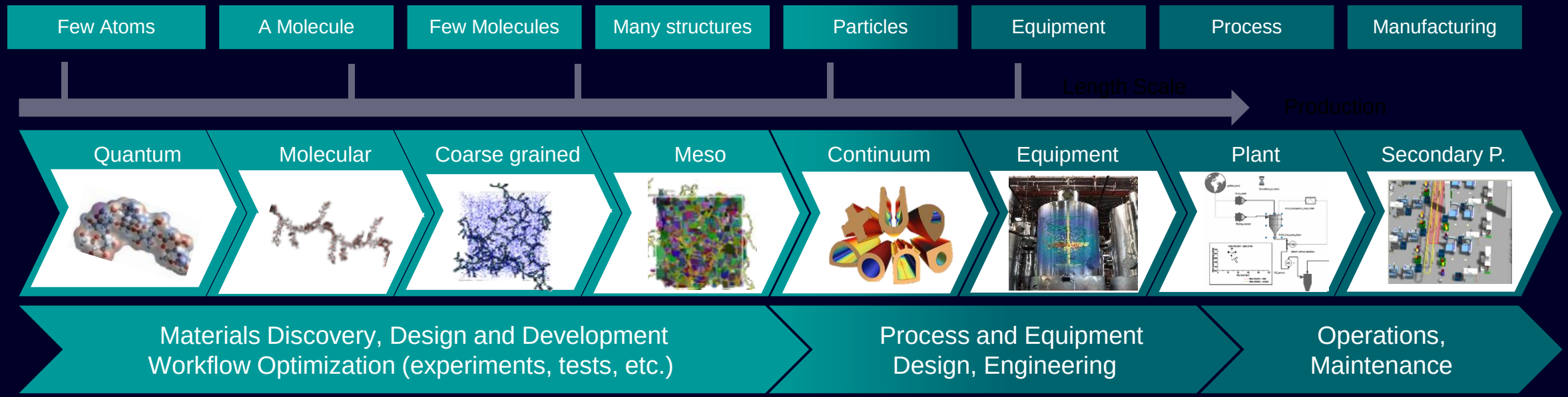
# A Digital Twin can be supported by modeling and simulation across all length scales and multi-physical and chemical phenomena relevant to a batch process




Siemens offers a comprehensive simulation portfolio to address the challenges across the complete lifecycle and domains enabled by a holistic physics-based digital twin approach



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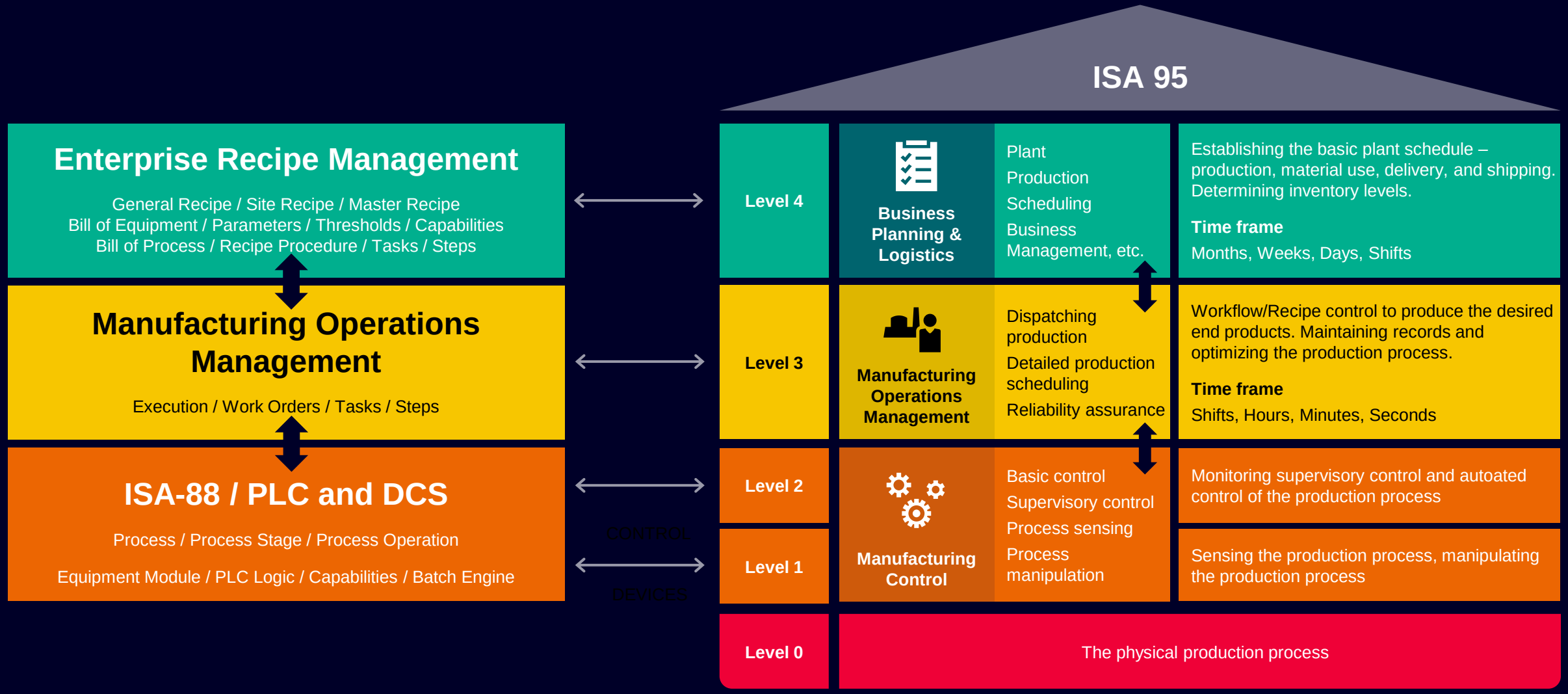
# Siemens and ISA95 / ISA88 Standard Mapping



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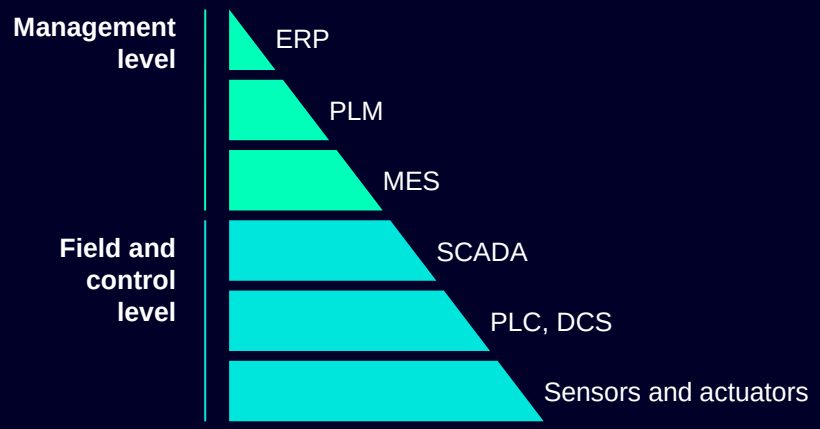
# IT and OT technologies and discipline are converging

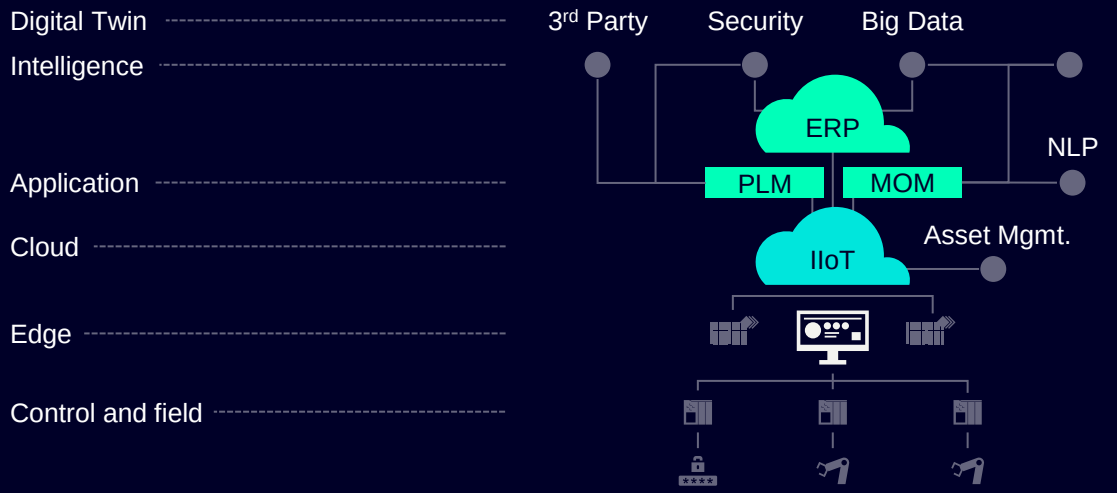
## Yesterday/“often” today

Monolithic pyramid




## Available and ready today

The two worlds of IT and OT are converging




**With the technology convergence data can now be leveraged where necessary**

This means opportunities and challenges to our customers that we – as Siemens – can help.



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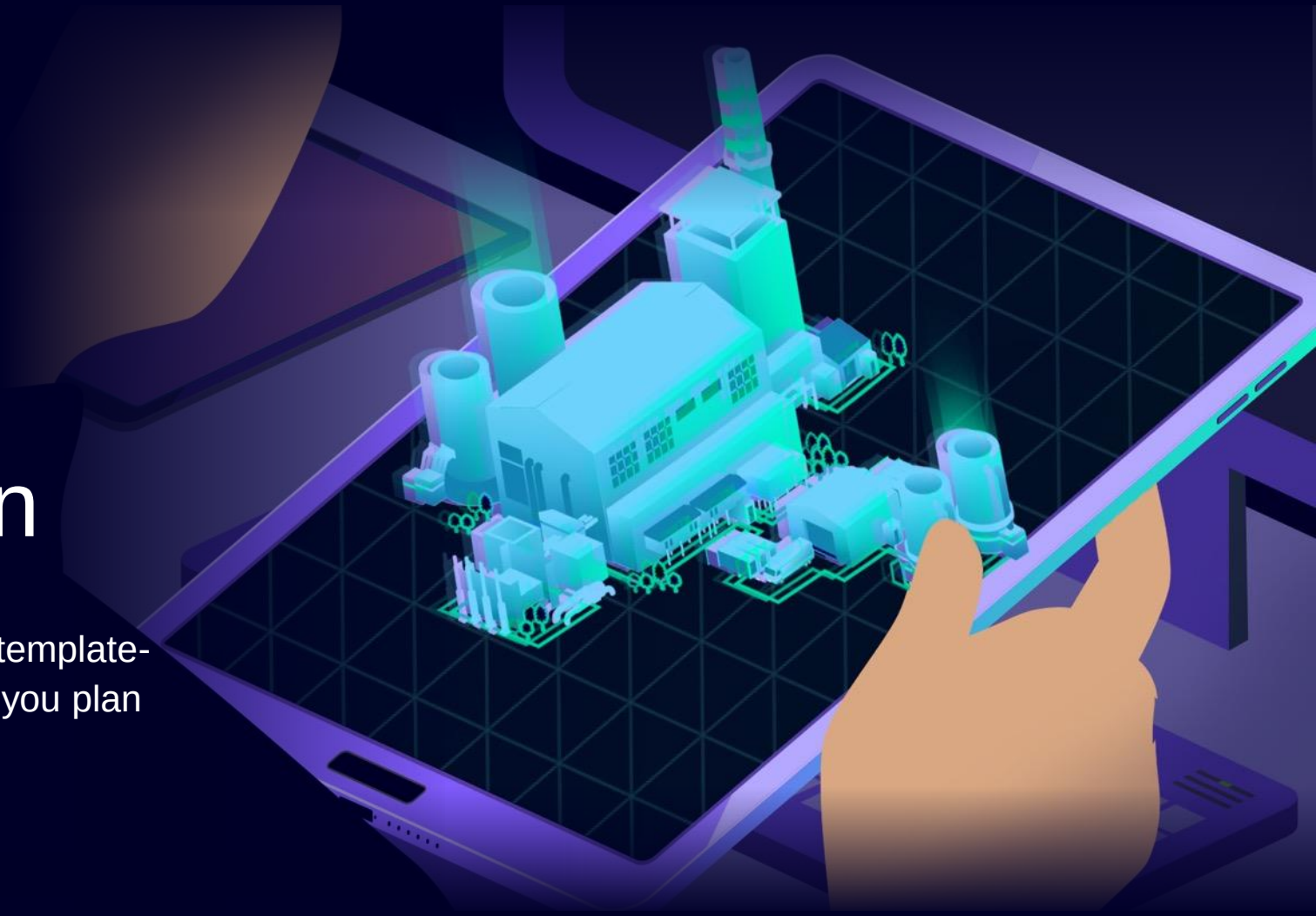
# **Use Case** discussion

Careful planning, Enterprise Recipe Management, template-based approach, now you have your plant how will you plan for the future and scale up?





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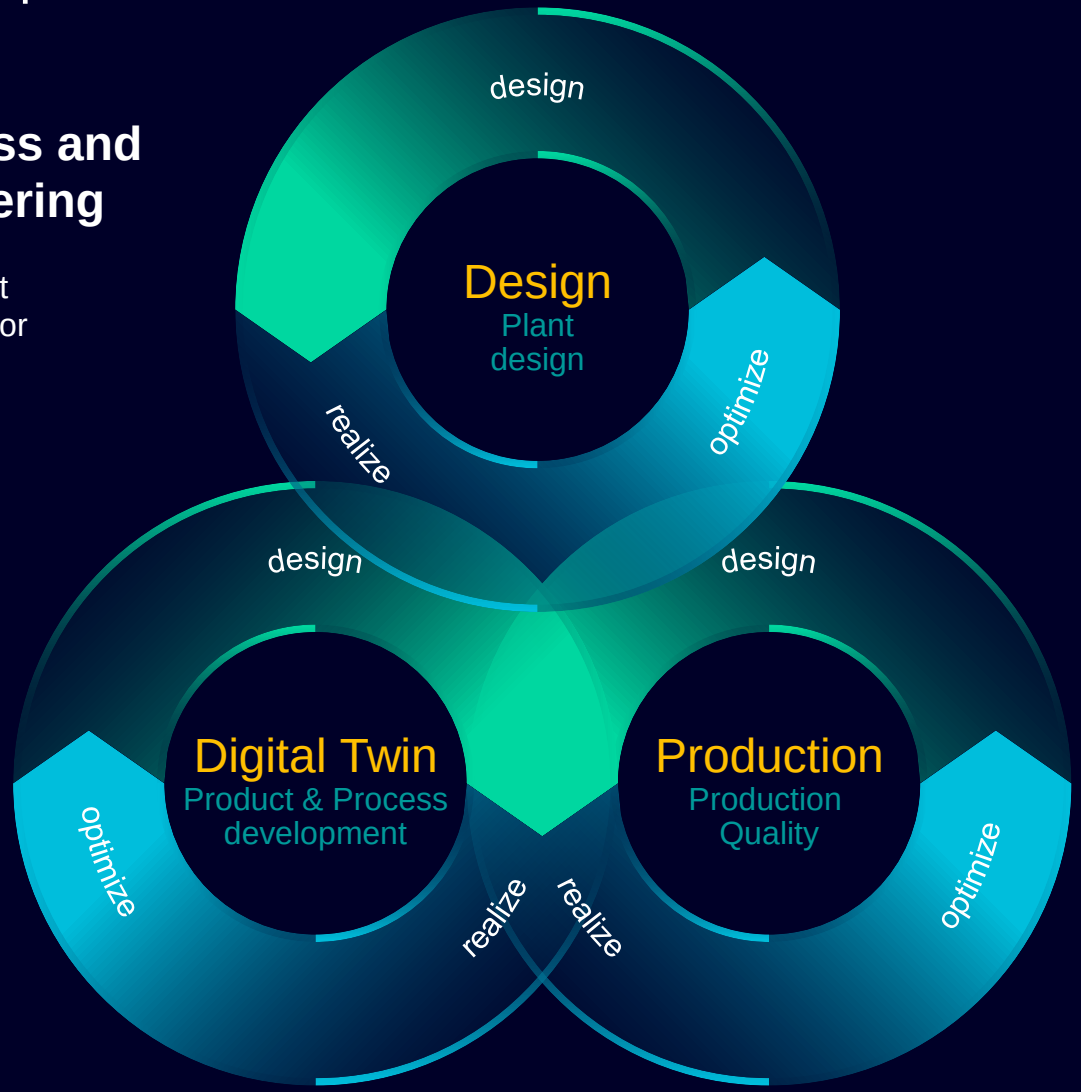
# **Digital Twin of batch plant in specialty chemicals**
based on a paint production process

## **Digital Process and Plant Engineering**

SIMATIC PCS 7 Plant Automation Accelerator




**Lifecycle**



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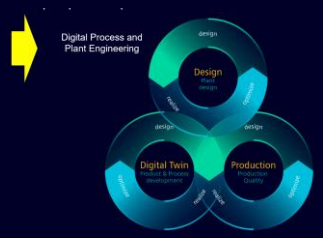
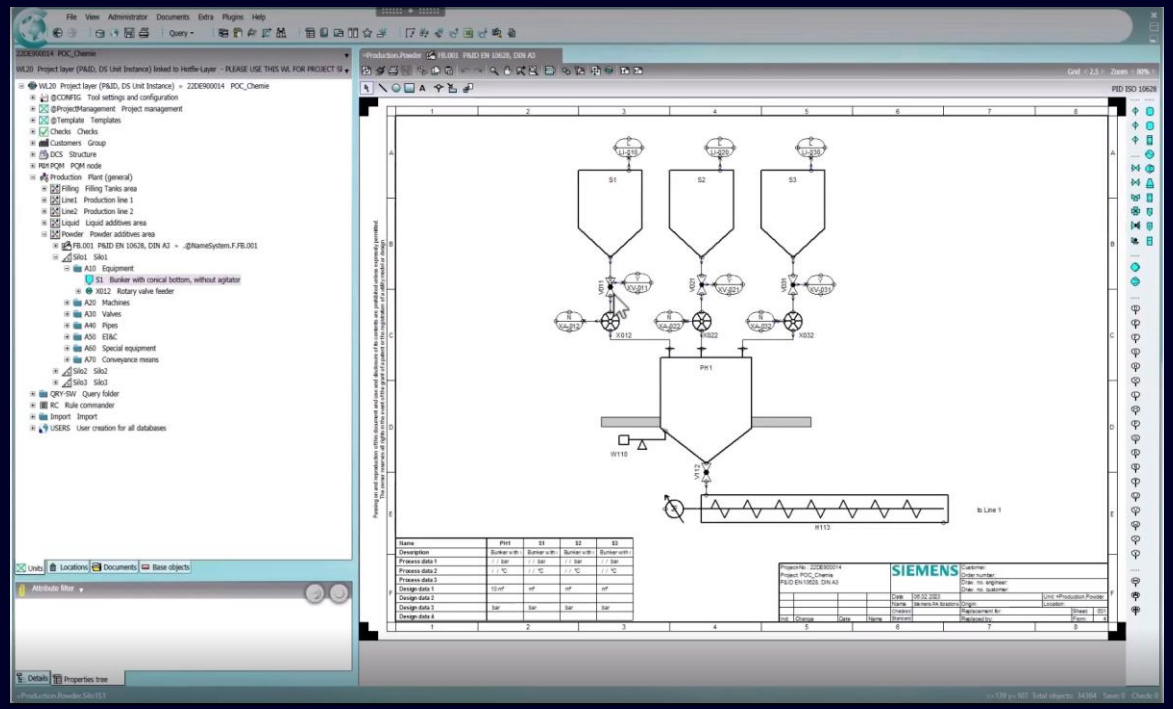
# Create and keep Digital Twin evergreen

Digital Twin of batch plant



## Digital Process and Plant engineering

### Solution

Our concept begins with the digital process design and engineering of the plant, including the constantly updated documentation. This enables automation planning without system breaks and offers consistent engineering up to the control system. The template-based system and automation design is created according to ISA-88. This standardized architecture makes the system future-proof.
Automation changes are updated via type/instance synchronization between the library and automation software, so that consistent as-is documentation of the software and hardware is achieved.

### Value

- Integrated Digital Twin for design, simulation, documentation and operations
- Reduces engineering effort and enables to easily create and maintain the application.
- Standardized and real-time digital documentation and simple implementation of modifications and changes
- Cost advantages, time savings and increase of quality of the documentation.

### Products and Services

- SIMATIC PCS 7 PA Accelerator



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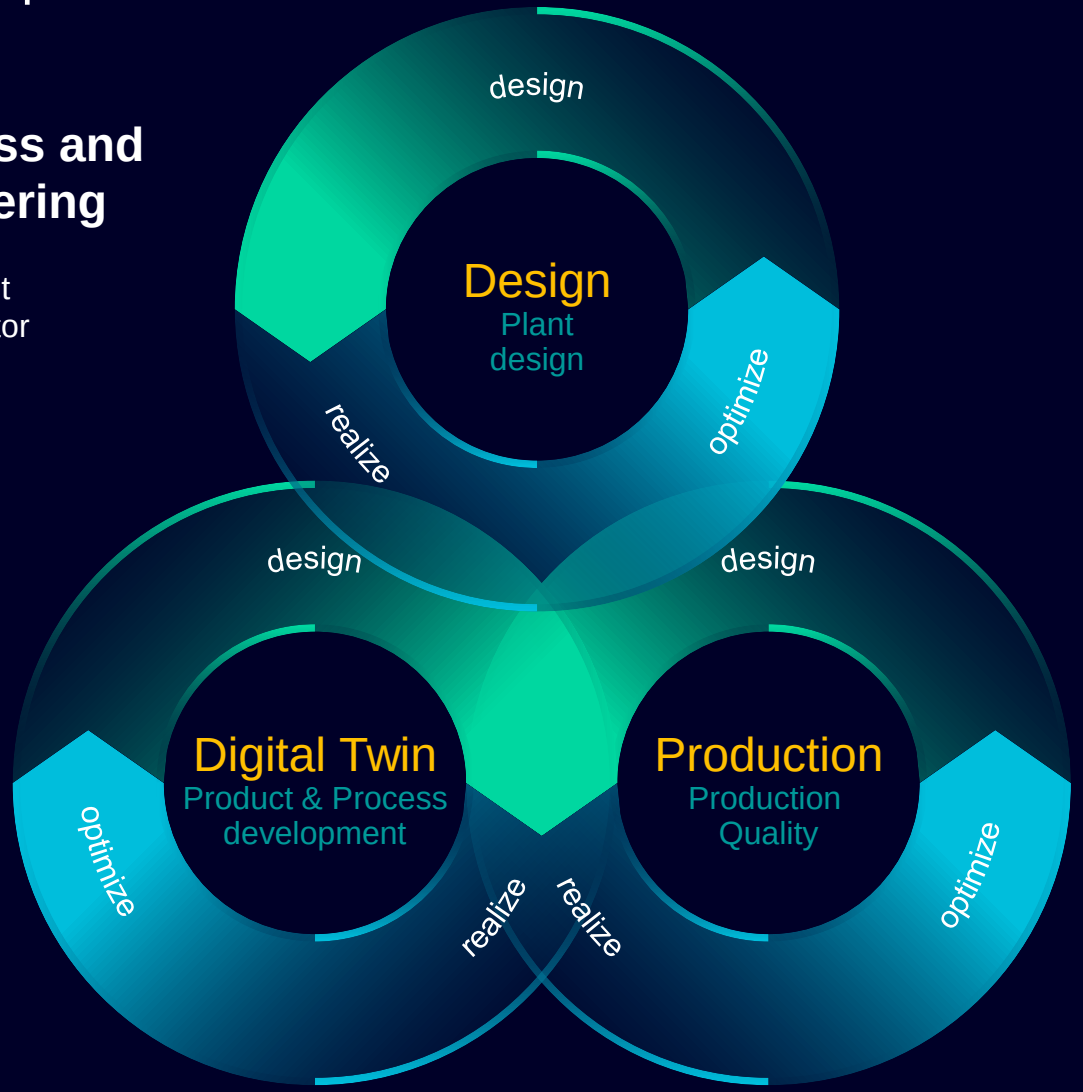
# **Digital Twin of batch plant in specialty chemicals**
based on a paint production process

## Digital Process and Plant Engineering

SIMATIC PCS 7 Plant
Automation Accelerator




Lifecycle

## Digital Process and Plant Operation

SIMATIC PCS 7 Batch
Opcenter Execution
Process



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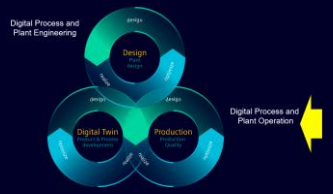
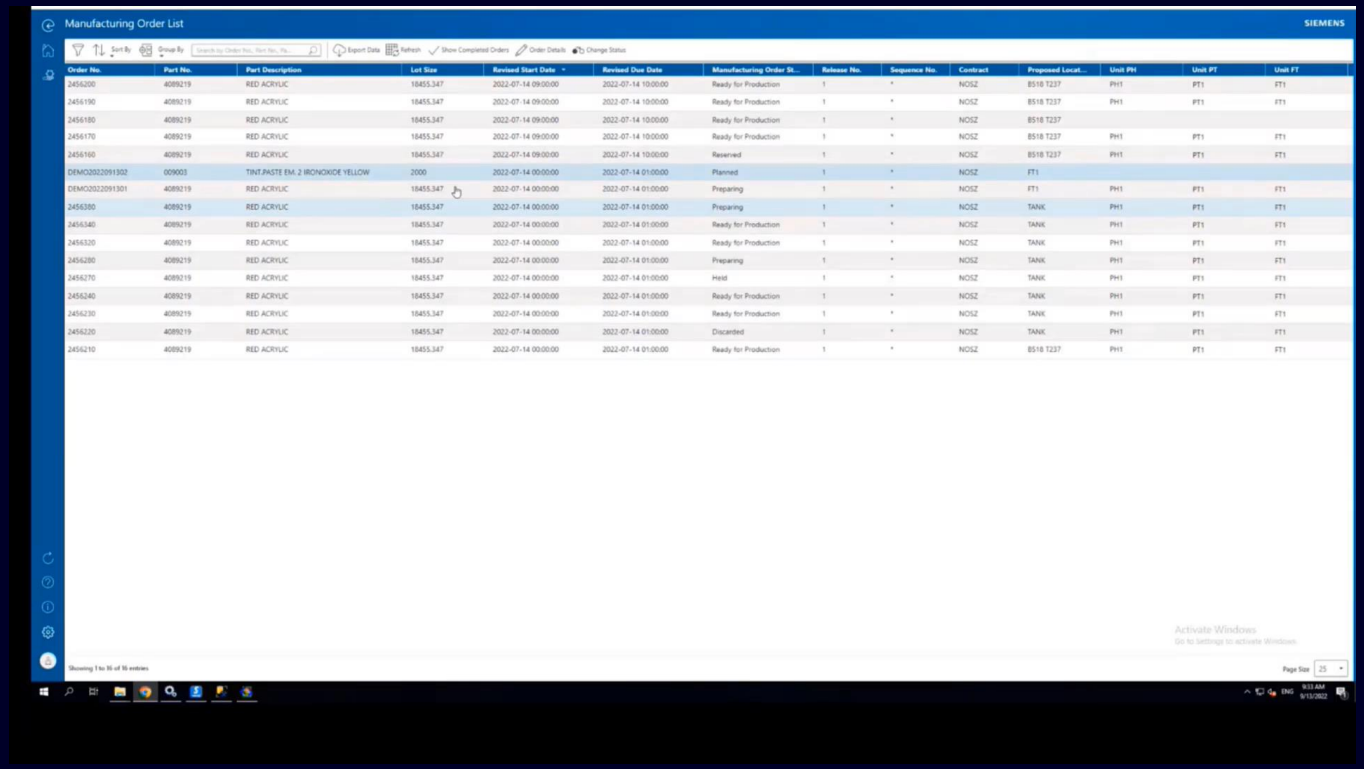
# Create and keep Digital Twin evergreen

Digital Twin of batch plant




## Digital Process and Plant operation

### Solution

A digital process and plant operation (the automation and production software). We provide a fully integrated example system based on a paint and coatings production process which represent all typical functionalities. The system supports the entire production process: From the delivery of the raw materials, material preparation, batch operation, the filling operations to final shipment of the goods. All production information from the ERP system is transferred to automation via vertical integration and all relevant data generated in production is synchronized back with the ERP. The batch-based automation solution corresponds to the S-88 philosophy. The MES offers other important additional functionalities such as the management of material data and equipment management.

### Value

- Simple implementation of modifications and changes
- Modular batch plant and production process acc. to ISA-88
- Screens in automation and operation (MES) show all relevant process and production information and parameters
- Flexible and efficient processing of the production recipes
- Full batch recording and reporting.

### Products and Services

- SIMATIC PCS 7 Batch
- Opcenter Execution Process



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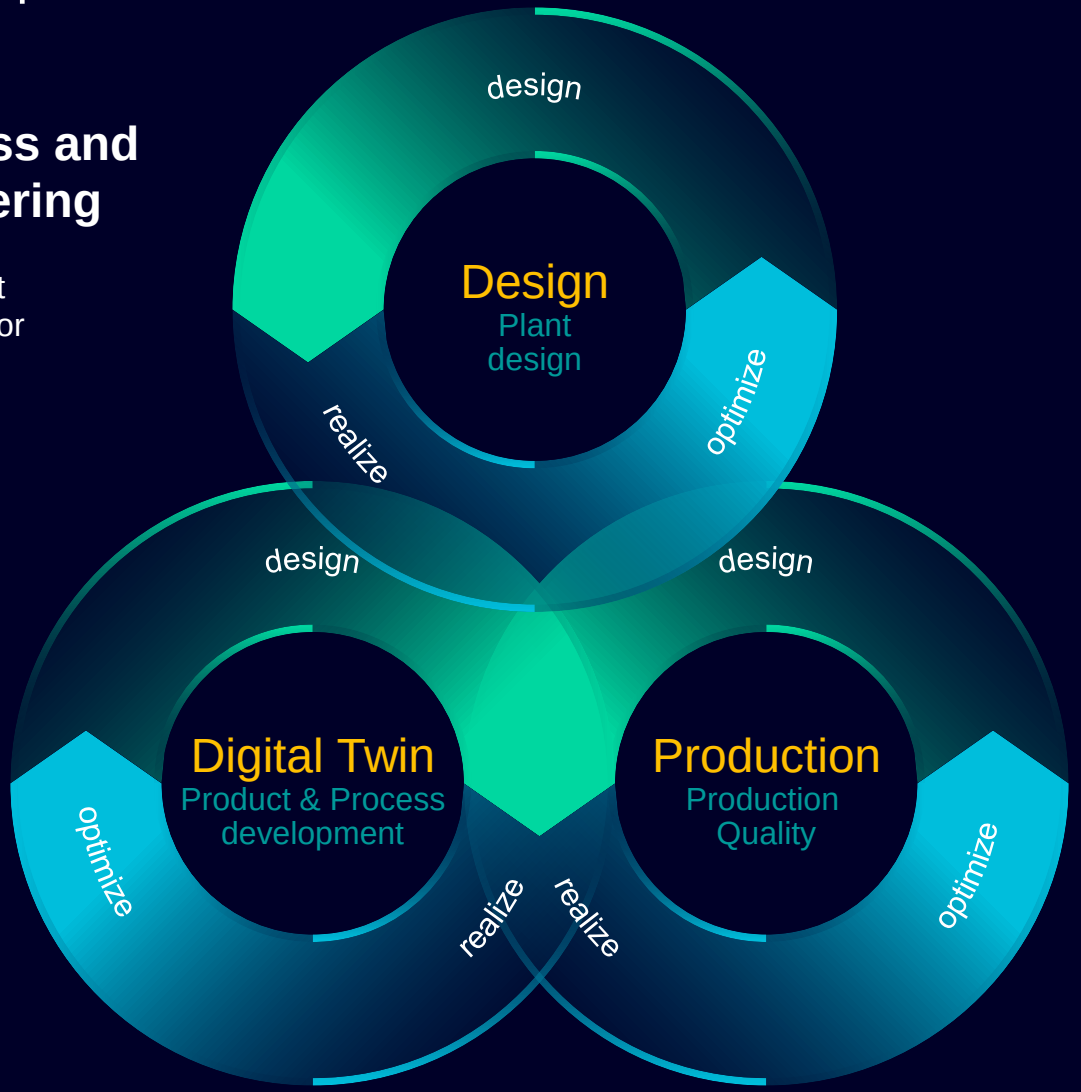
# **Digital Twin of batch plant in specialty chemicals**
based on a paint production process

## **Digital Process and Plant Engineering**

SIMATIC PCS 7 Plant
Automation Accelerator




## **Digital Recipe and Process Development** and Simulation

**SIMATIC Batch,** Batch control center and Recipe editor
**SIMIT**

## **Digital Process and Plant Operation**

SIMATIC PCS 7 Batch
Opcenter Execution
Process

**Lifecycle**



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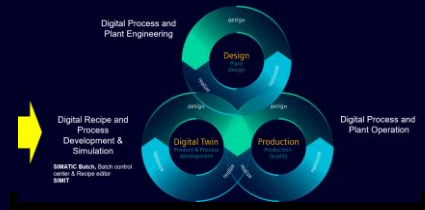
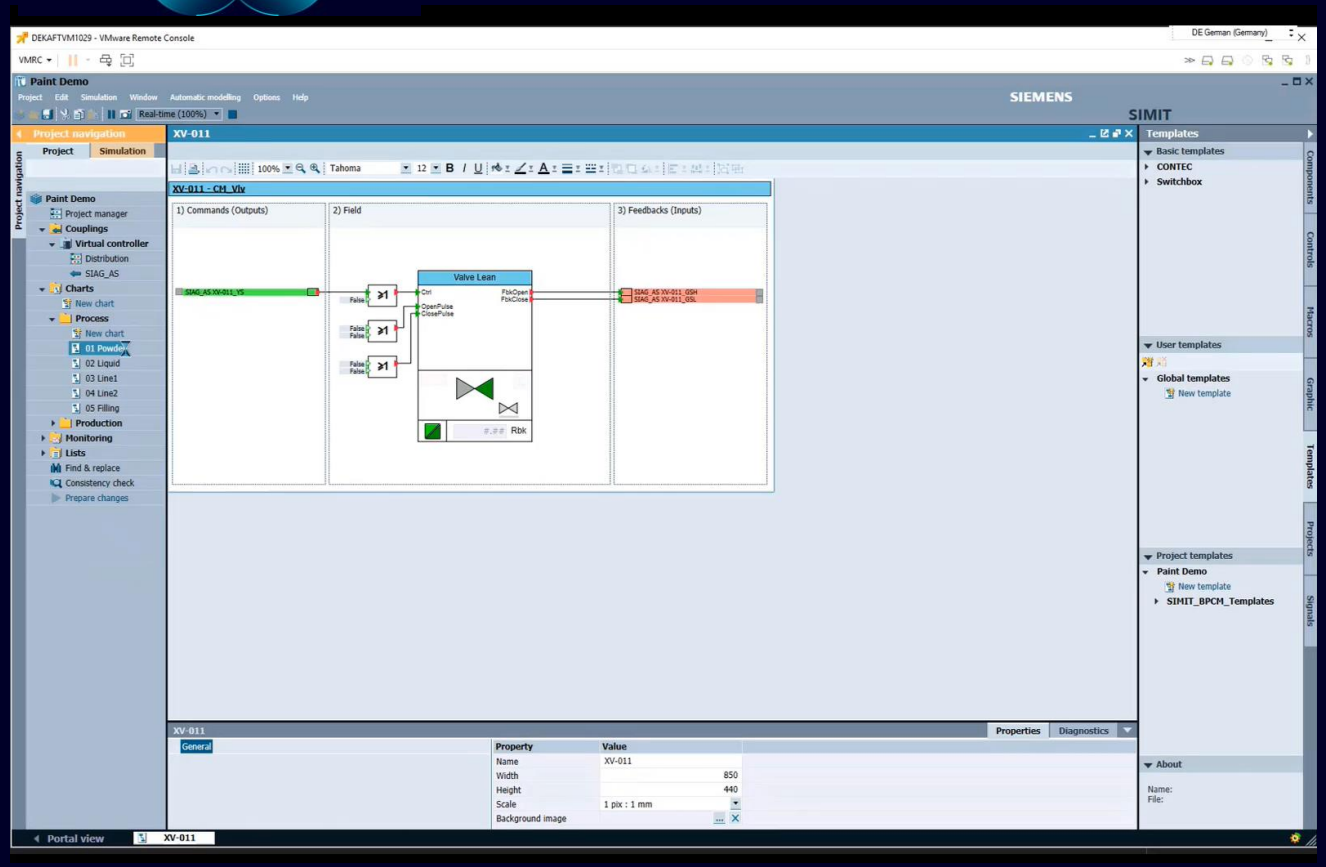
# Create and keep Digital Twin evergreen

Digital Twin of batch plant




## Digital Recipe / Process development and simulation

### Solution

Recipe and process development in the Digital Twin. We provide a fully integrated example system based on a paint and coatings production process which represent all typical functionalities. The batch plant is modular and the production process is acc. to ISA-88 standard.

### Value

- Integrated Digital Twin for design, simulation, documentation and operations
- Process level simulation of the entire production line
- Plant model as simulation, based on standard Chem -Basic SIMIT library
- The production with new recipes can be tested (simulated) in the Digital Twin before used in real plant.
- Operator training station

### Products and Services

- SIMATIC PCS 7 Batch
- SIMIT



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# Digital Twin enables:

## Batch analytics

Siemens Batch Performance Analytics
Siemens Process Analytical Technology
Executable Digital Twin Real-time optimization & monitoring

## Safety and cyber optimization

System Integrity
Network Security
Plant Security & Monitoring

## Virtual commissioning

Feasibility Studies & getting it right the first time
Batch production optimization & reusability
Measure twice and cut once

## Frontline worker training

Operator training on the system controls
Virtual reality training for field workers and contractors
Augmented Reality and electronic work instructions



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# Enterprise Recipe Management

## Ensure manufacturability for developed formulated products

### Centralize recipe authoring knowledge

Manage Recipe Life Cycles, Product Bill of Materials, Making instructions, Recipe Procedures and asset capabilities worldwide

### Validate virtually recipes in a fraction of time

Reduce trials and setup times

### Manufacture anywhere

Proactively look for the best manufacturing options, anywhere in the world



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## Virtualize a recipe?
A recipe has a lifecycle from concept to production

Formula for launch

A product formula as defined in the R&D laboratory

General Recipe

Adding a generic recipe, manufacturing process

Site Recipe

Recipe transformed for a specific production site

Master Recipe

Adding manufacturing cell information

Control Recipe

Adding Batch ID, size, operation process and system information



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# What if …

… you could **centralize all recipe authoring knowledge** and product information currently spread across the company in a digital platform?



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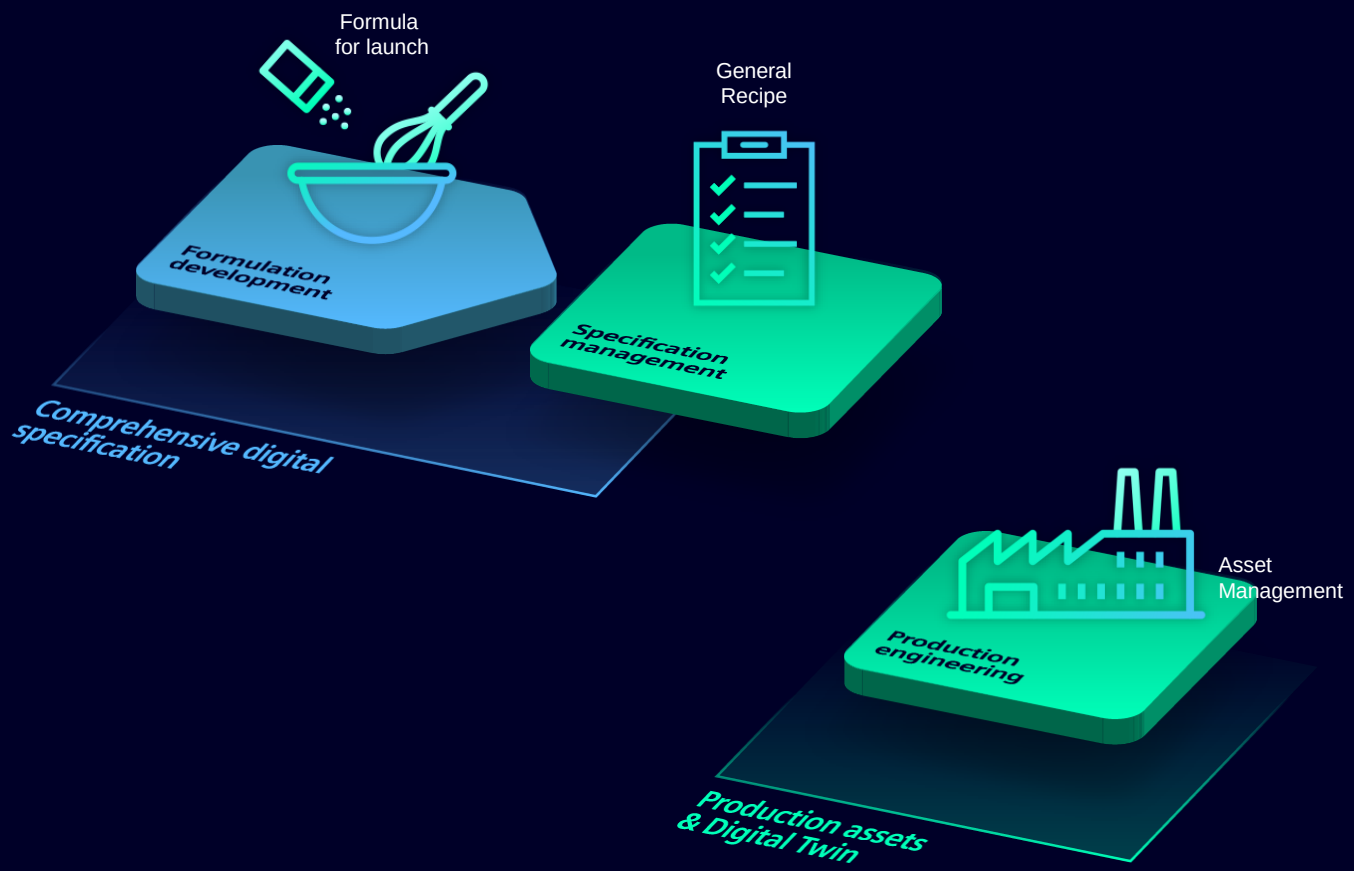
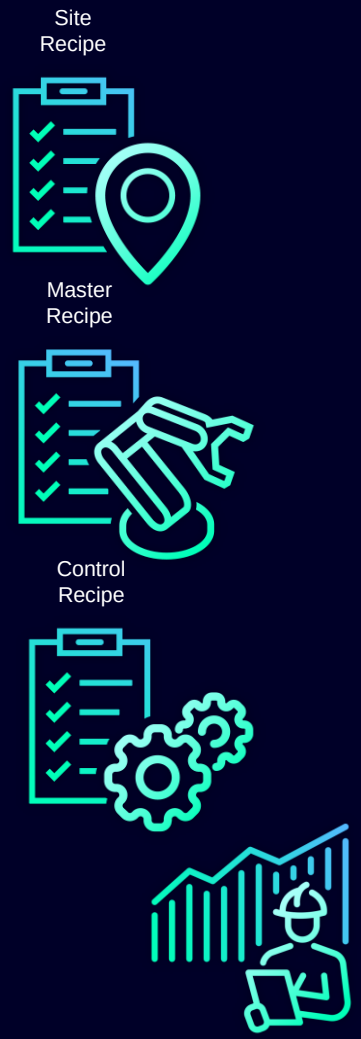
# Enterprise Recipe Management and Digital Twin Based Batch Production

A digital thread to virtualize and execute recipes digitally, anywhere, anytime



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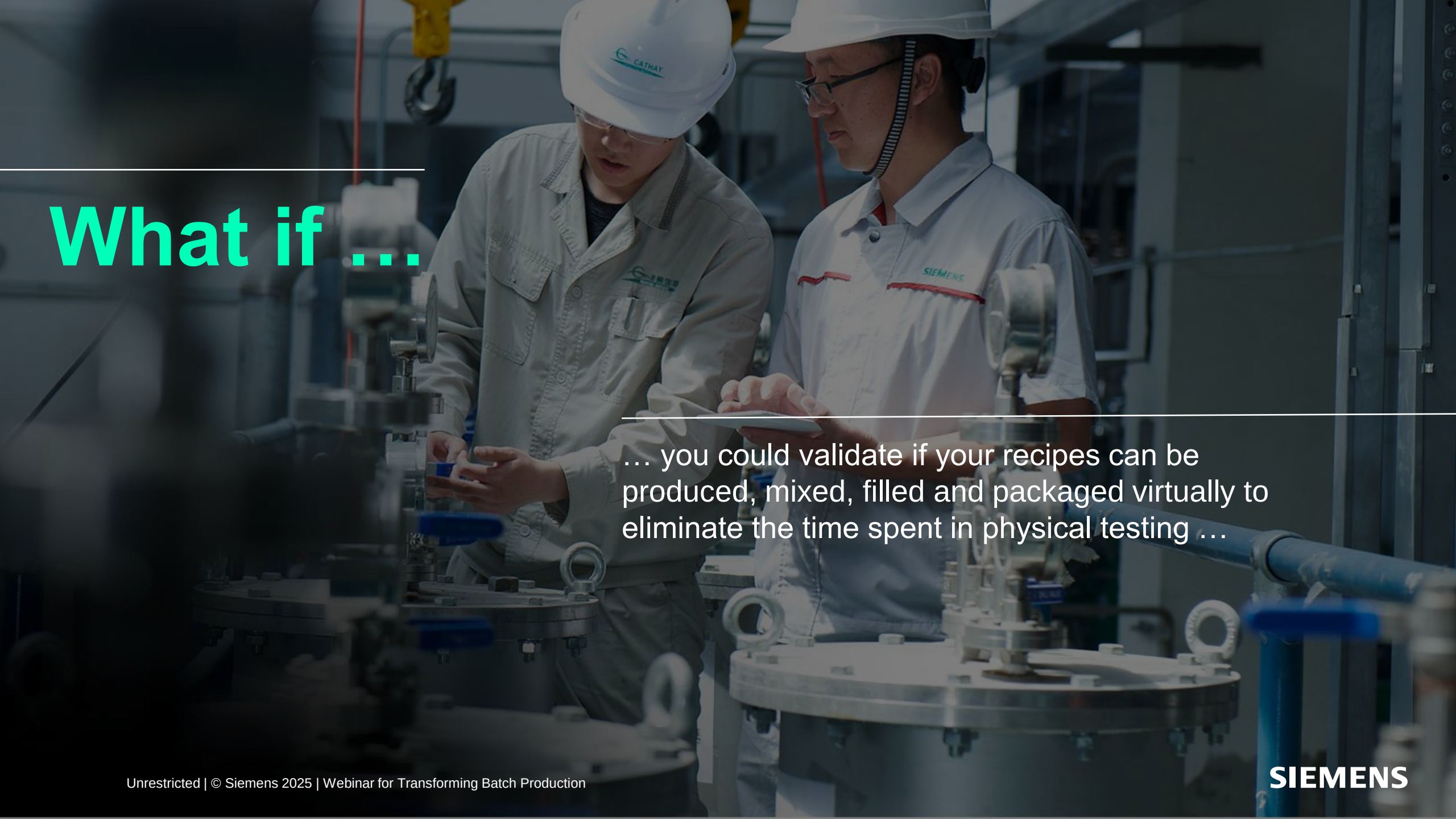
# What if …



… you could validate if your recipes can be produced, mixed, filled and packaged virtually to eliminate the time spent in physical testing …



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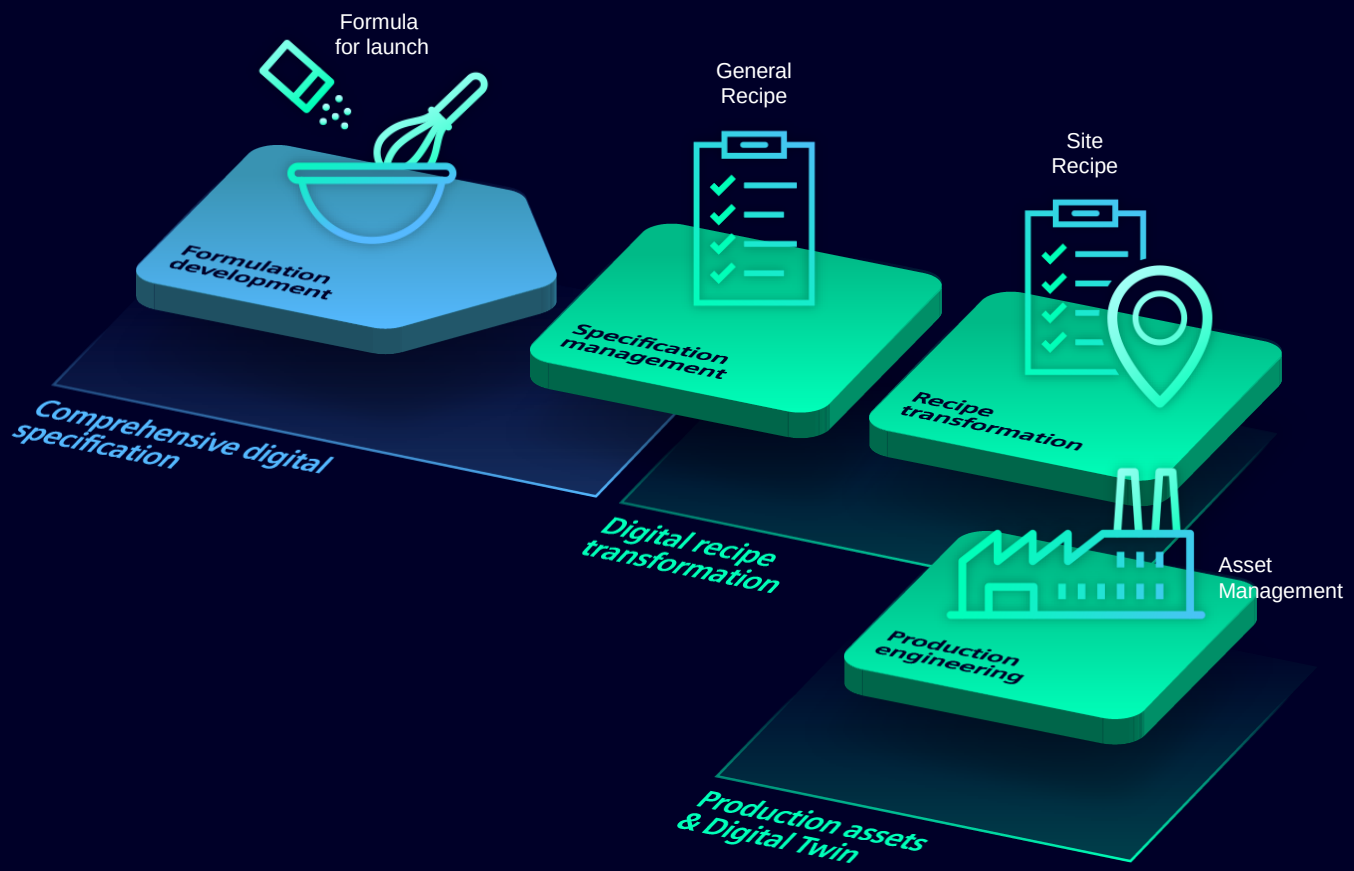
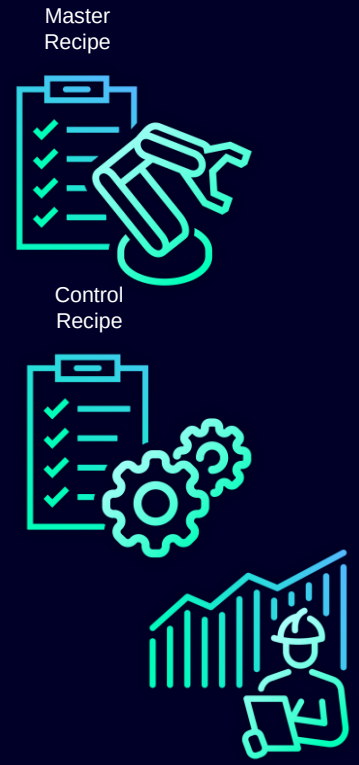
# Enterprise Recipe Management and Digital Twin Based Batch Production

A digital thread to virtualize and execute recipes digitally, anywhere, anytime



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# Imagine if …

… you could **manufacture anywhere**, look for the best manufacturing options and move production flexibly and dynamically from one existing facility to another, or to change the product mix at an existing facility to match demand?



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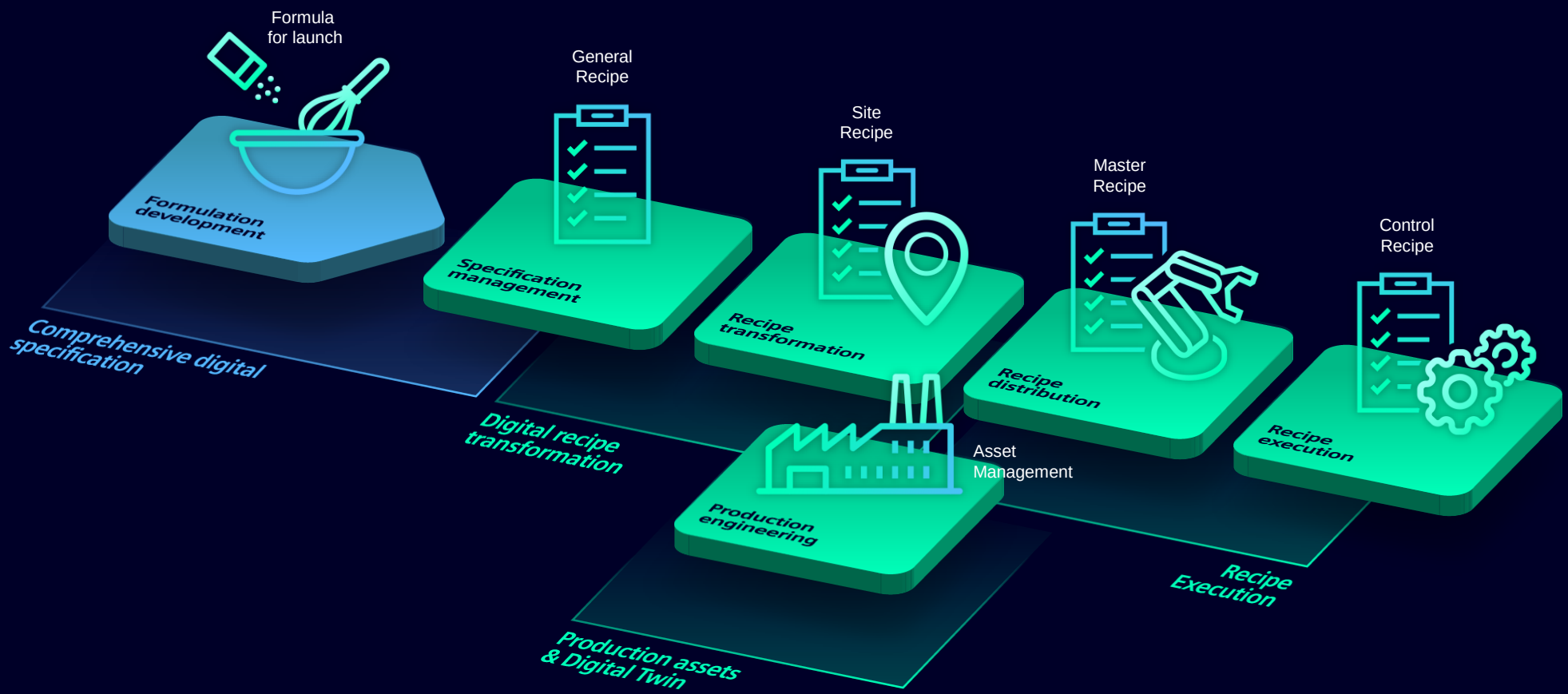
# Enterprise Recipe Management and Digital Twin Based Batch Production

A digital thread to virtualize and execute recipes digitally, anywhere, anytime



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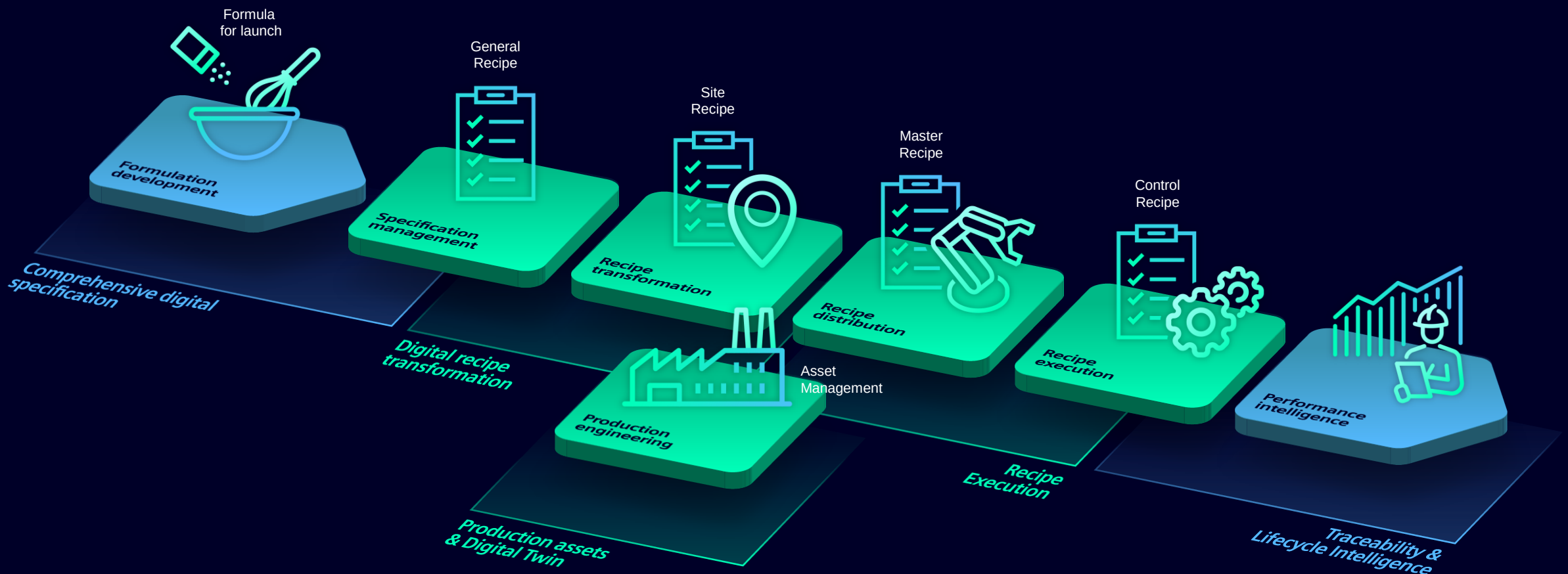
# Enterprise Recipe Management and Digital Twin Based Batch Production

A digital thread to virtualize and execute recipes digitally, anywhere, anytime



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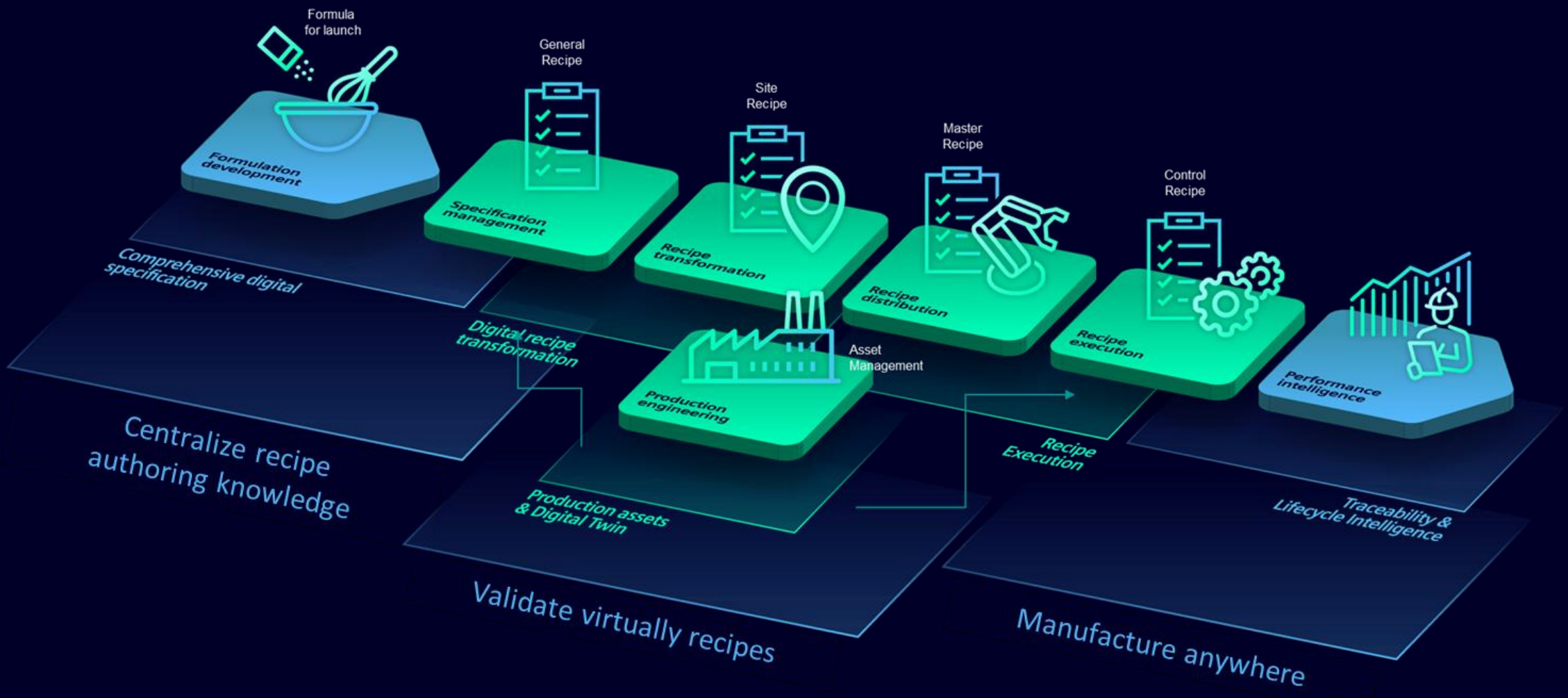
# Enterprise Recipe Management and Digital Twin Based Batch Production

A digital thread to virtualize and execute recipes digitally, anywhere, anytime



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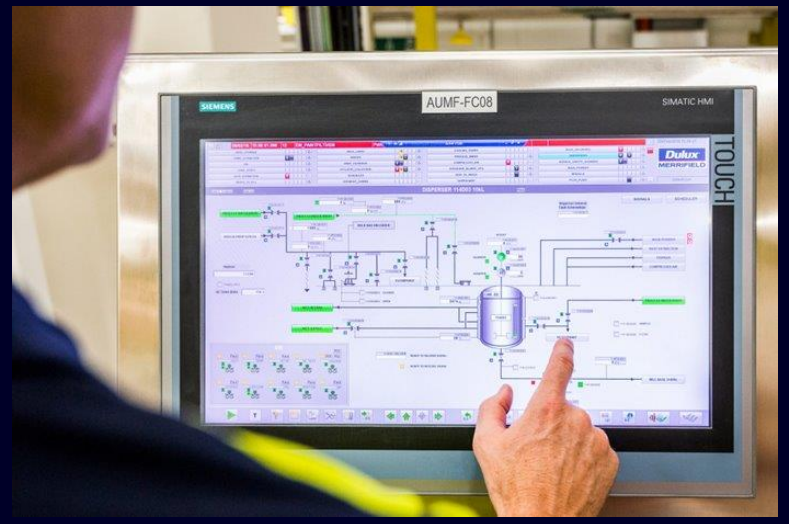
# Manufacturing Operations and Product Lifecycle Management


**16**

Hours/Week reduction in Process Planning

**98.5x**

Service Level Achieved

"We have gained 16 hours per week for the planner resource dedicated to sequencing production. Our chocolate manufacturing process maximized the quality of the final product."

Jordi Barbero, **Supply Chain Manager, Chocolates Valor**

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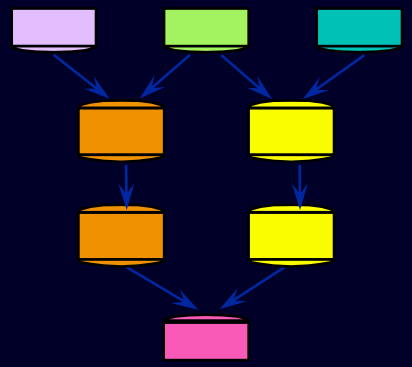
# Manufacturing Operations and Product Lifecycle Management

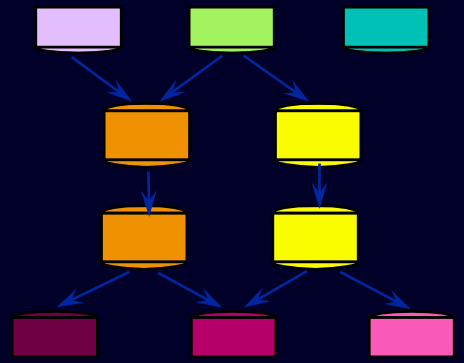




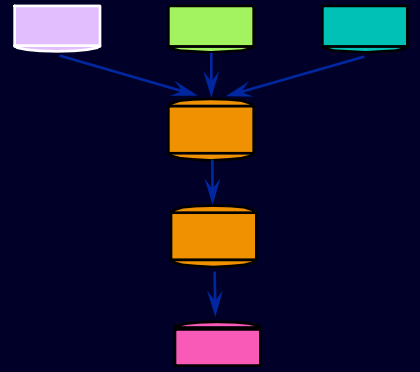
**Multi-line, one product plant**



**Multi-line, multi product plant**



**Single line, one product plant**

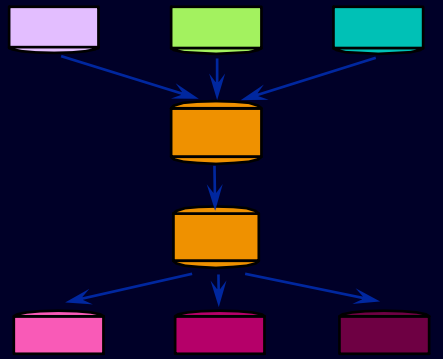


Input Materials

Lines

Products

**Single line, multi product plant**





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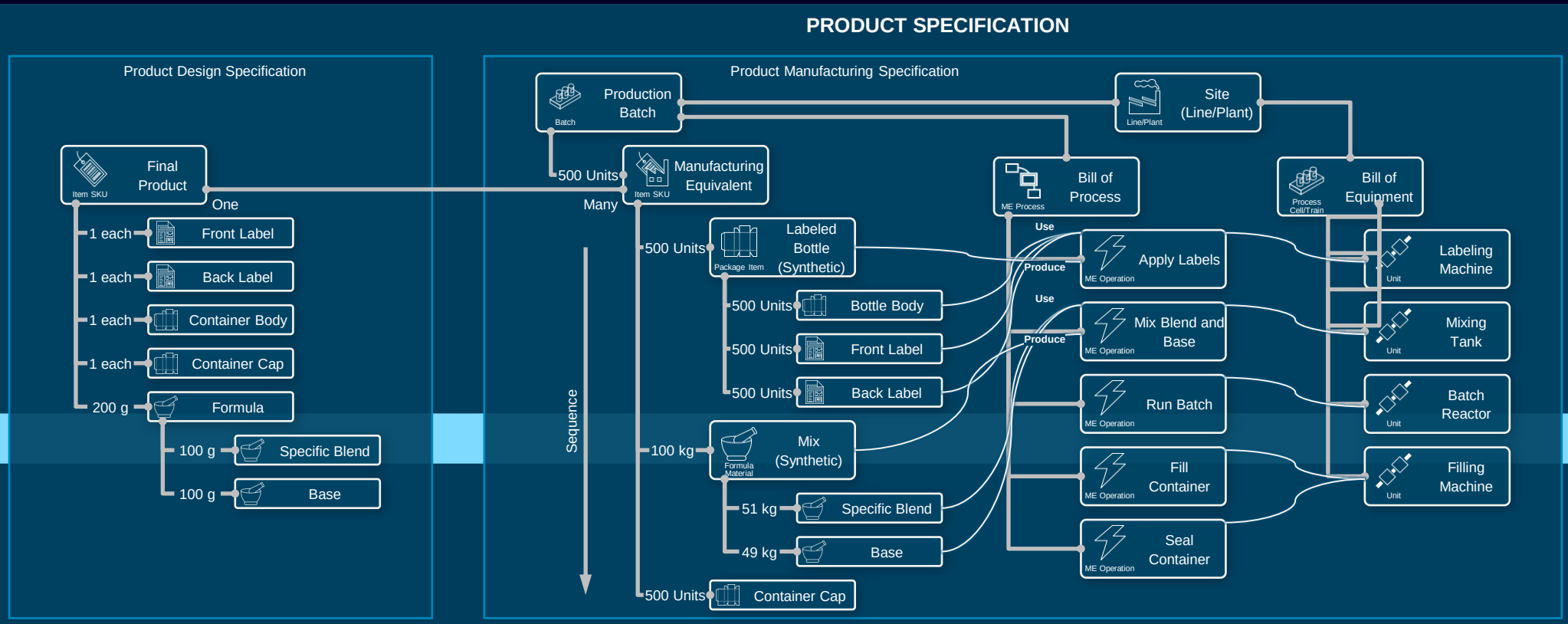
# Enterprise Recipe Management for Formulated Products




## Recipe Management

Establish Framework containing all relevant information for General and Site Recipe which may be transformed to Master and Control Recipe

**INTEGRATED EXECUTION MANAGEMENT**

Digital Thread

CAPTURE | DISCOVER | PRODUCT CONCEPT | DIGITAL CHARTER | PLAN EXECUTION | PRODUCT SPECIFICATION



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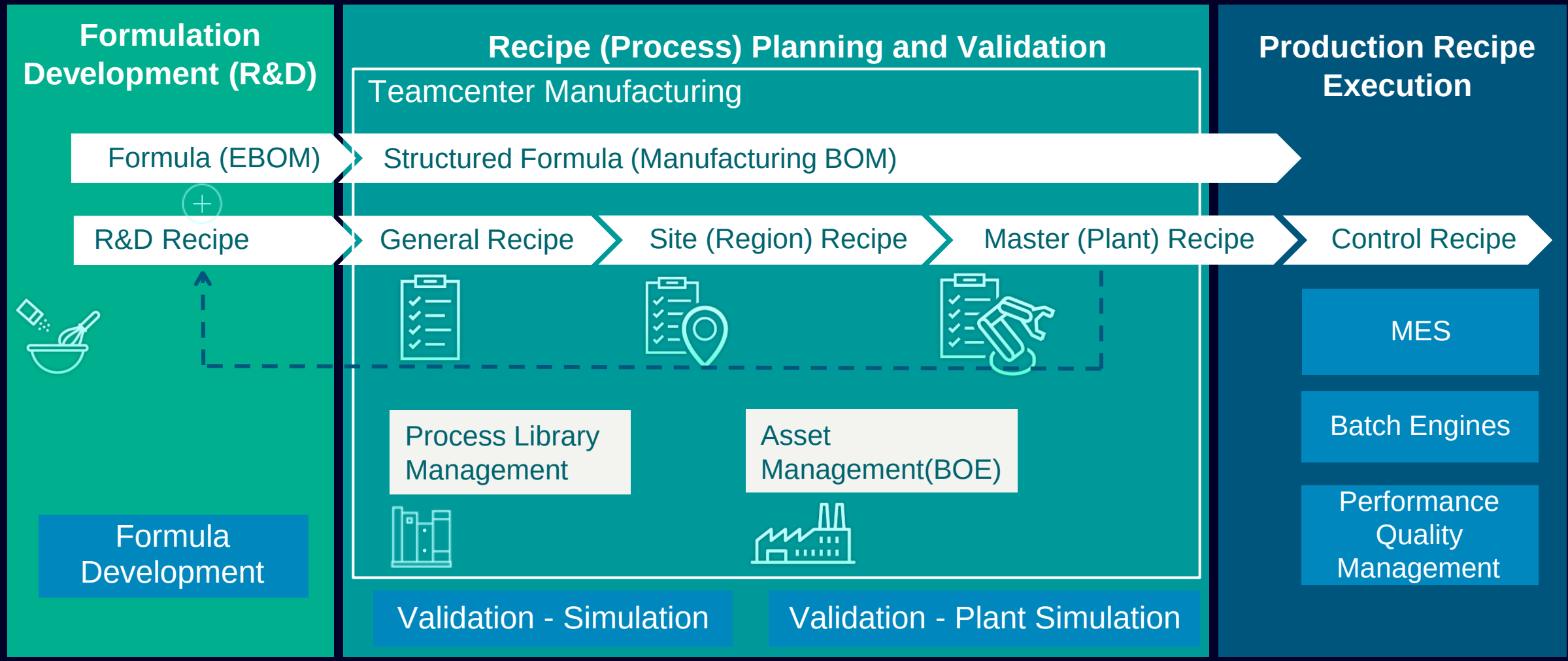
# Comprehensive manufacturing process Digital Twin with Enterprise Recipe Management

High-level workflow for Process and Hybrid Industries



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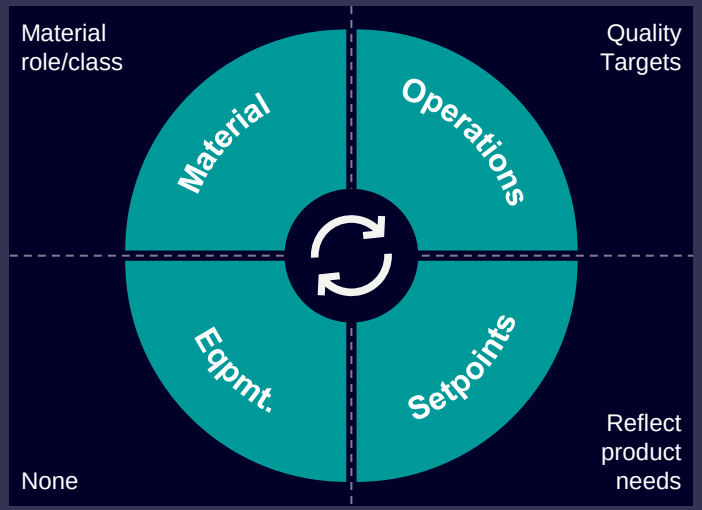
# Review of ISA-88 Recipes

## Recipe

The necessary set of information that uniquely defines the production requirements for a specific product

### General Recipe

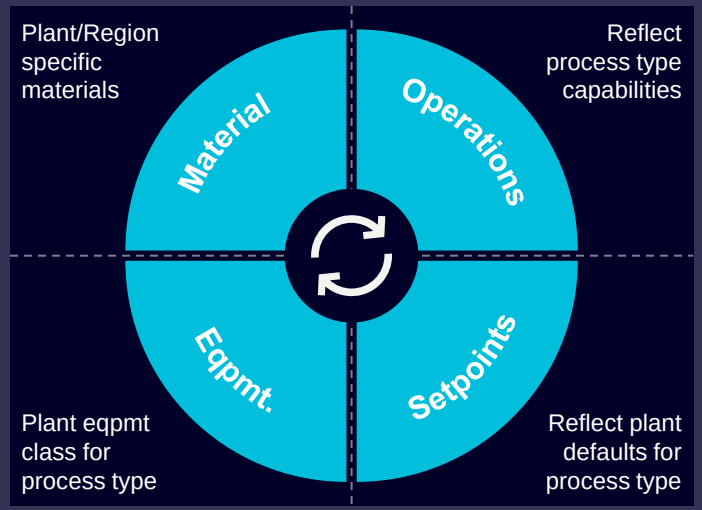
A type of recipe that expresses equipment and plant independent processing requirements




1-N

### Site Recipe

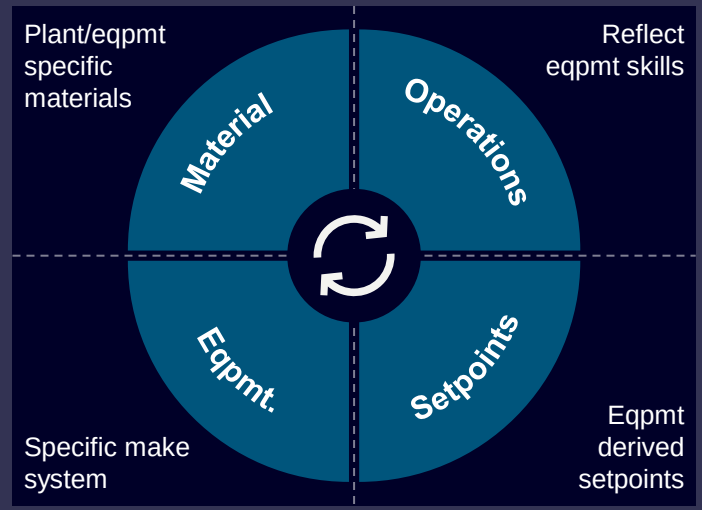
A type of recipe that is plant specific. Site recipes may be derived from general recipes recognizing local constraints, such as language and available raw materials.




1-N

### Master Recipe

A type of recipe that accounts for equipment capabilities and may include process cell-specific information.



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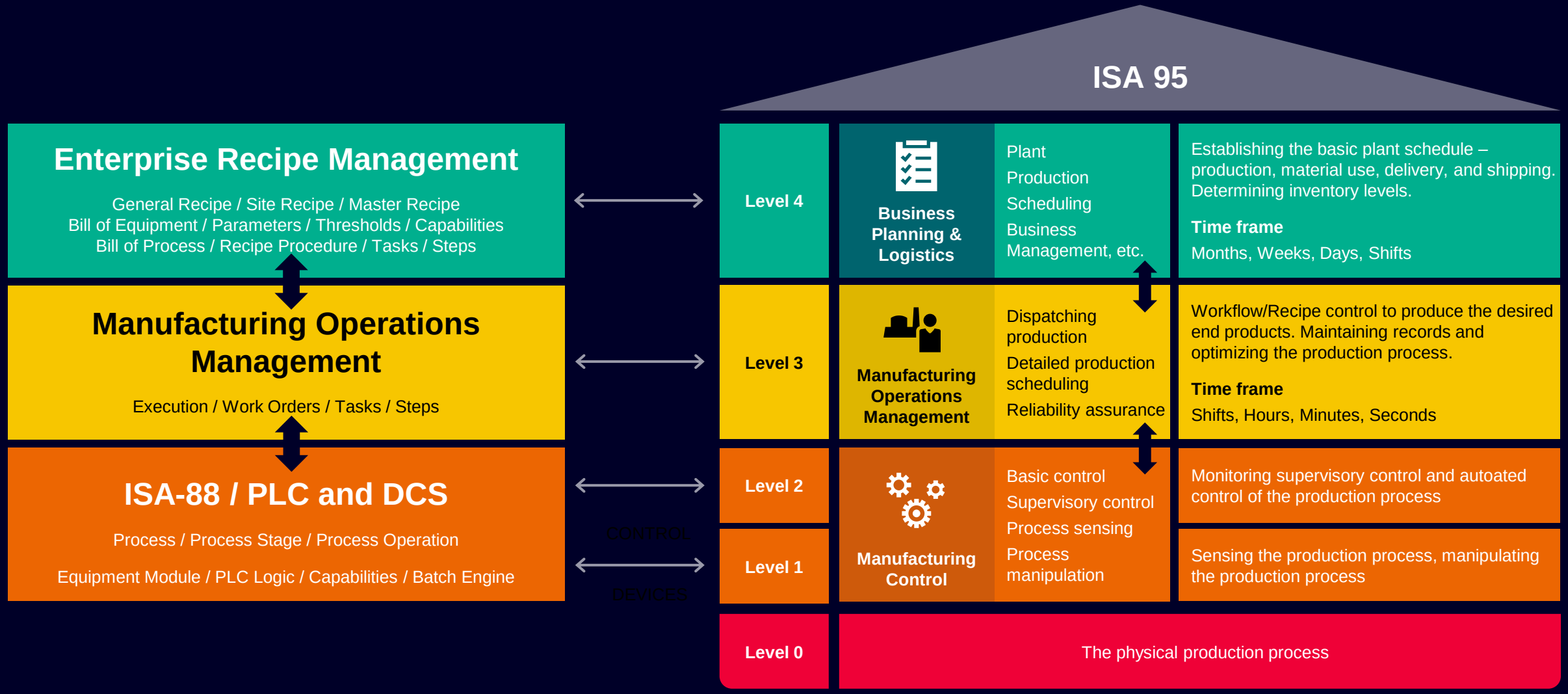
# Siemens and ISA95 / ISA88 Standard Mapping



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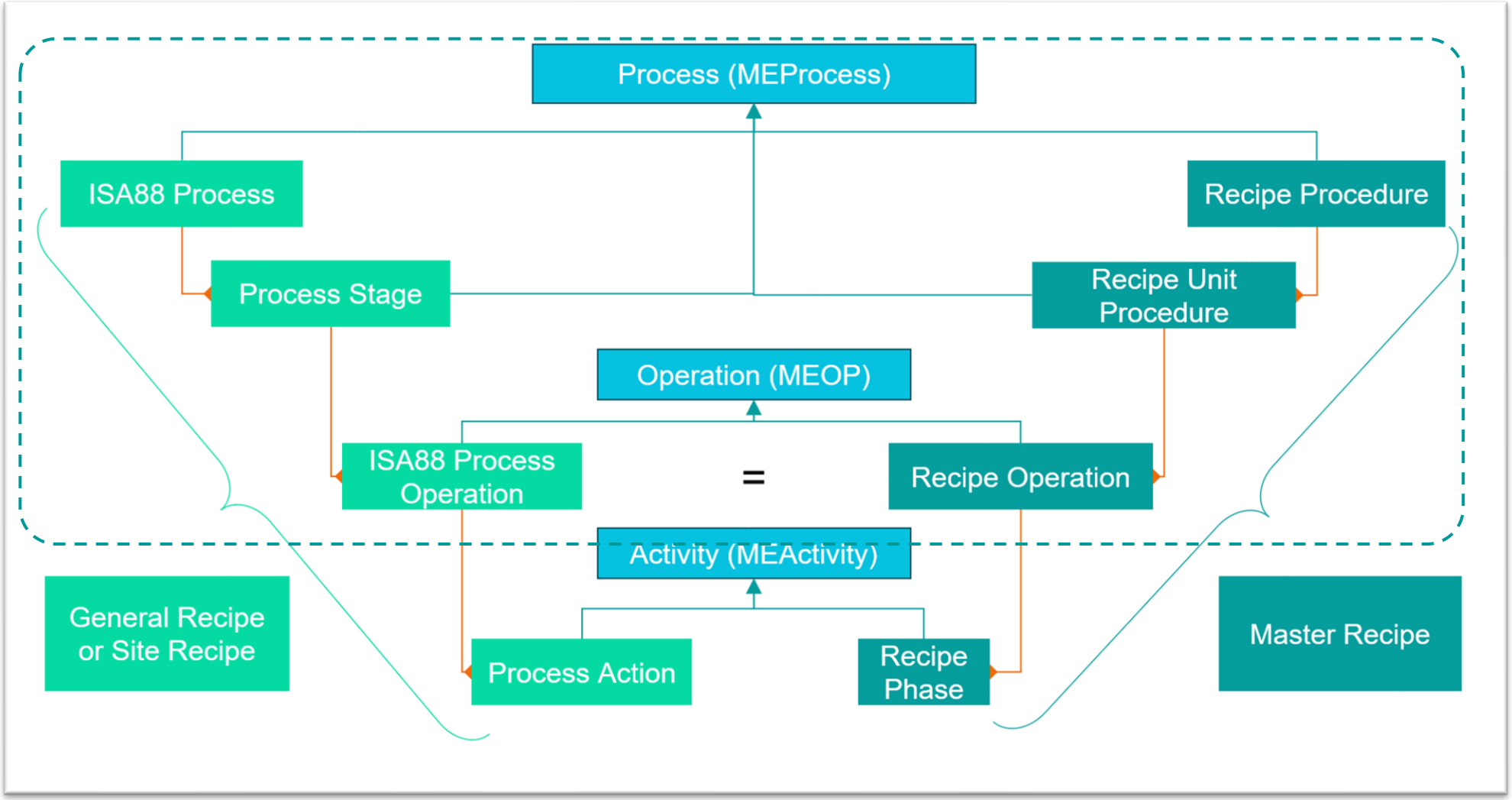
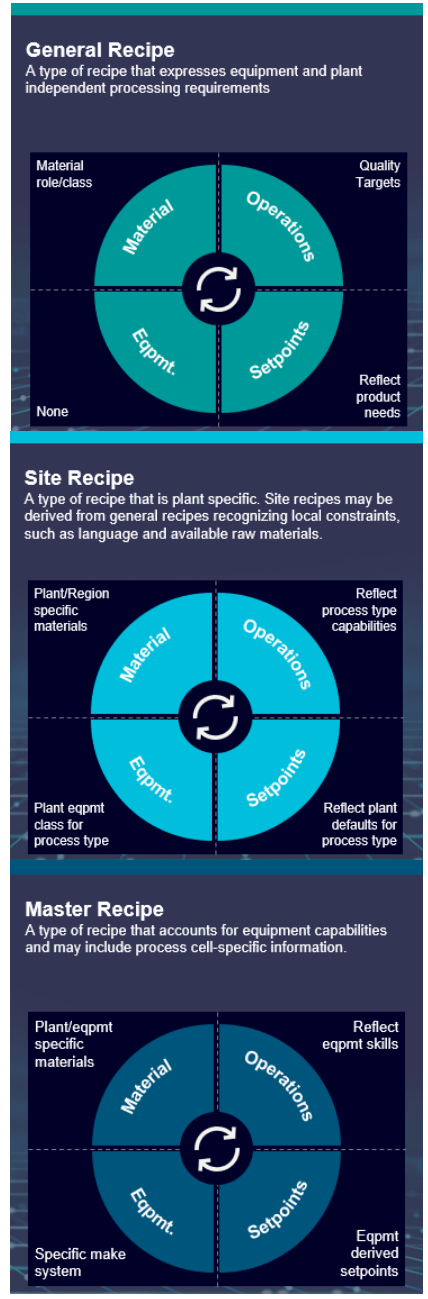
# ISA-88 Data Model Layer embedded in Easy Plan and with ready Control Recipe connectors

Adhering to industry standard language on Recipe creation and management



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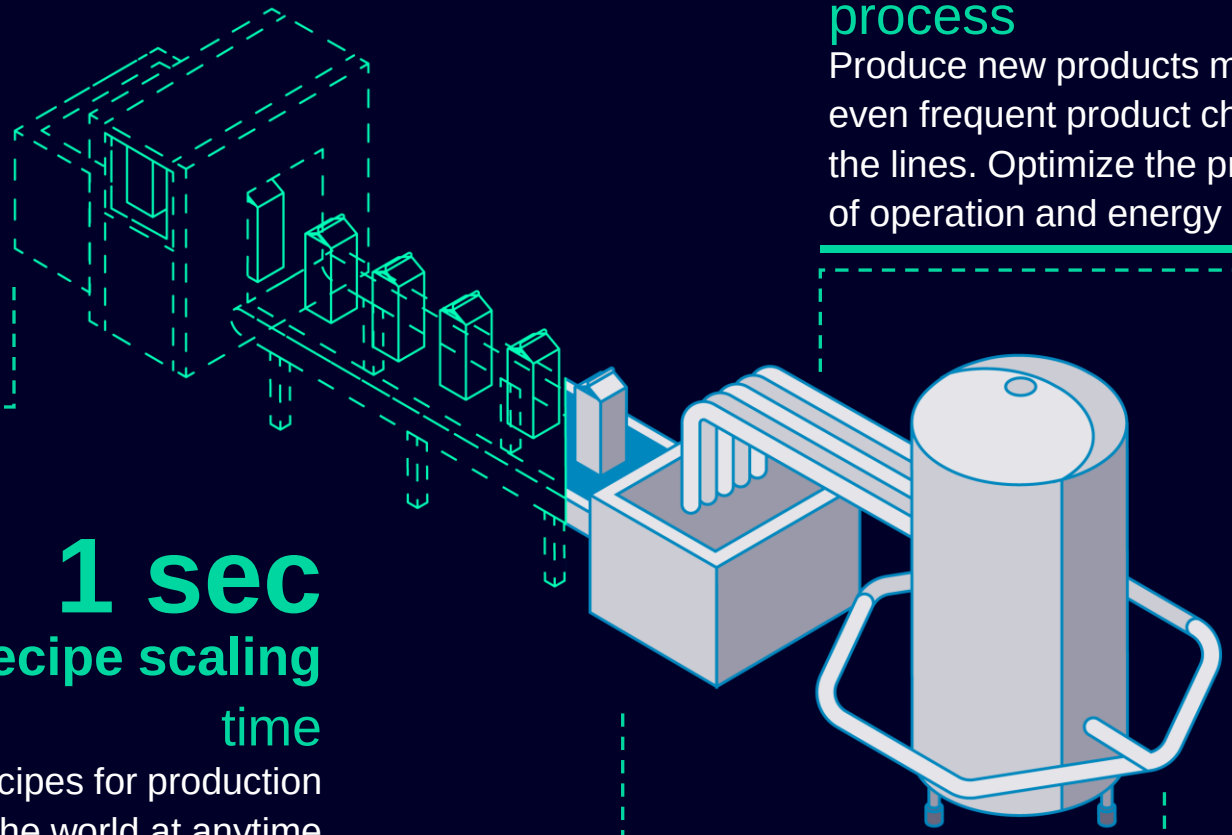
# Enterprise Recipe Management
Value creation

## 100%
**Optimized** manufacturing process

Produce new products more quickly, even frequent product changeovers on the lines. Optimize the process in terms of operation and energy

## 100%
Digital Recipes

Speed up recipe adoption in the plant



## 1 sec
**Recipe scaling** time

Scale up recipes for production anywhere in the world at anytime

## 20%
**Efficiency** increase

Best use of existing machines and flexible adjustments increase efficiency in manufacturing operations



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# Q&A and key takeaways



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# Key takeaways

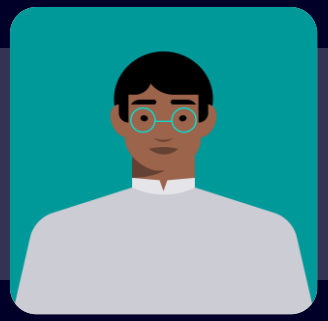
POLL

## Plant Manager

Ask for a Digital Twin of your batch operations connected to product lifecycle management

## Operations Manager

Ask for an AI/ML batch process analytics assistant app



## Production Engineer

Ask for a horizontally and vertically integrated MOM/ MES platform

## Automation Manager

Ask software-defined automation w/ edge and cloud communication-based optimization capabilities

## Decision Makers

Push digital twin requirements to your value chain through a supplier collaboration program



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# Special Offer !

As a thank you for attending our webinar we want to offer you a **30-day FREE trial of our advanced planning and scheduling tool**

**Boost Laboratory Efficiency with Optimized Scheduling - Opcenter**



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# Key Siemens Events to keep an out for

## Realize LIVE Americas 2025

Join our community of thinkers and doers in design, manufacturing, and lifecycle management to accelerate your digital transformation.

Detroit, Michigan | June 2-5, 2025

Registration opens TODAY Jan. 14, 2025

https://events.sw.siemens.com/en-US/realizelive/americas/

## AiChE Spring Meeting 2025

Attend the essential technical conference for chemical, process and process safety engineers, offering unparalleled coverage of the industry's critical needs and providing excellent networking opportunities with a diverse audience of professionals.

Dallas, Texas| April 6-10, 2025

Registration OPEN!

https://www.aiche.org/conferences/aiche-spring-meeting-and-global-congress-on-process-safety/2025/registration-info



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# Next Steps: Start your transformation today!

## Set up a 1-on-1 consultation

Meet with our Chemical experts to find your tailored solution to boost efficiency, safety, and sustainability

https://www.siemens.com/us/en/products/automation/topic-areas/process-industries/specialty-chemicals/contact.html

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