Using Digital Twin for Validation in a Life Science Warehouse Application

Jonas Larsen (Novo Nordisk)
Poul Kristensen (ProjectBinder)

Bio

Jonas Larsen
OT Specialist
25A Novo Nordisk

Jonas has 30 years of automation experience in pharma / medical devices, with the last 3 years focusing on Test systems and digital twin setup, with the business goal of "faster time to market", Jonas works on enabling the team to work on the job with a solid joined foundation and empowerment to explore the limits for technology, interfaces, procedures at Novo Nordisk he works in material handling where he automates all material flows

Poul Kristensen
Head of Digital Twin

As an engineer, Poul has over 20 years of experience in industrial automation and digitalization. He is an expert in strategic sales, business development and thought leadership, passionate about enabling new technologies such as Digital Twins, Artificial Intelligence and Predictive Operations. Poul strongly believes in innovations pushing the borders and harvesting the benefits. At ProjectBinder, he leads a highly skilled team of engineers who develop innovative projects to meet the needs of each client.

The strategy behind using the digital twin for de-risking purposes, and to validate changes before they are implemented in a facility that's already up and running.

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Agenda

- Introduction and vision of the Digital Twin at Novo Nordisk 25A.

- Technical challenges and solutions.

- The benefit of working with partners.

- Next Step.

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ProjectBinder - Company Overview
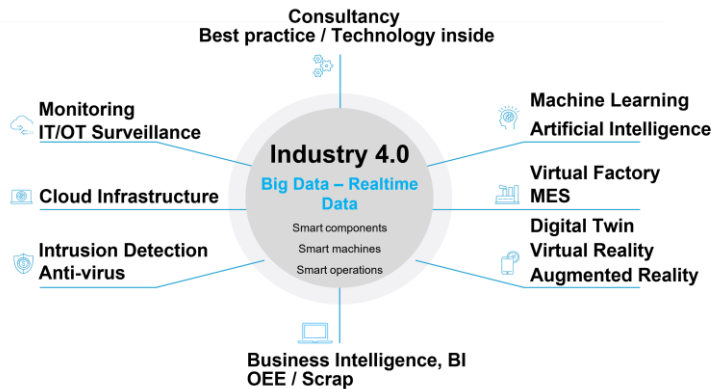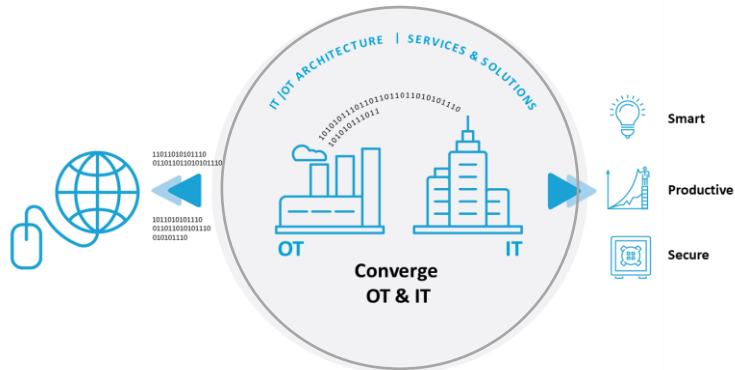
ProjectBinder is a company specialized in project management, Compliance and SME competences within all project phases as **implementation partner** for our customers. Our key focus is IT, automation, and network establishment primary within the GMP oriented industries.

In this aspect securing alignment of the OT and IT infrastructure strategy is often the cause of delays and added costs.

Here ProjectBinder provides a solution for IT & OT Convergence in the Industry 4.0

Geographical structure

Copenhagen, DK
62 Senior Architects and Project Managers

Valencia, ES
12 Specialized Engineers

Selected clients

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Novo Nordisk at a **glance**

Novo Nordisk is a leading global healthcare company founded in 1923 and headquartered in Denmark.

Our purpose is to drive change to defeat diabetes and other serious chronic diseases such as obesity and rare blood and endocrine disorders.

We do so by pioneering scientific breakthroughs, expanding access to our medicines and working to prevent and ultimately cure disease.

Products marketed in
168
countries

Total net sales
140.8
billion DKK

Affiliates in
80
countries

Supplier of nearly
50%
of the world's insulin

More than
34
million people use our diabetes care products

R&D centres in China, Denmark, India, UK and US

Strategic production sites in Denmark, Brazil, China, France and US
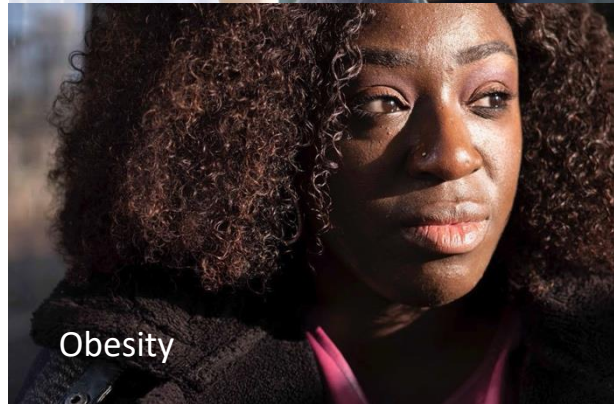
Around
48,000
employees

Growth disorders
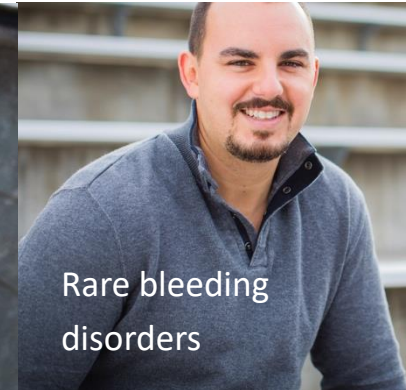
Rare bleeding disorders

Diabetes

Obesity

Among the world's
10
largest pharma companies measured by market value[1]

Introduction – Vision and Objectives on Digital Twin

The journey started in 2020, exploring and building the existing warehouse digitally.
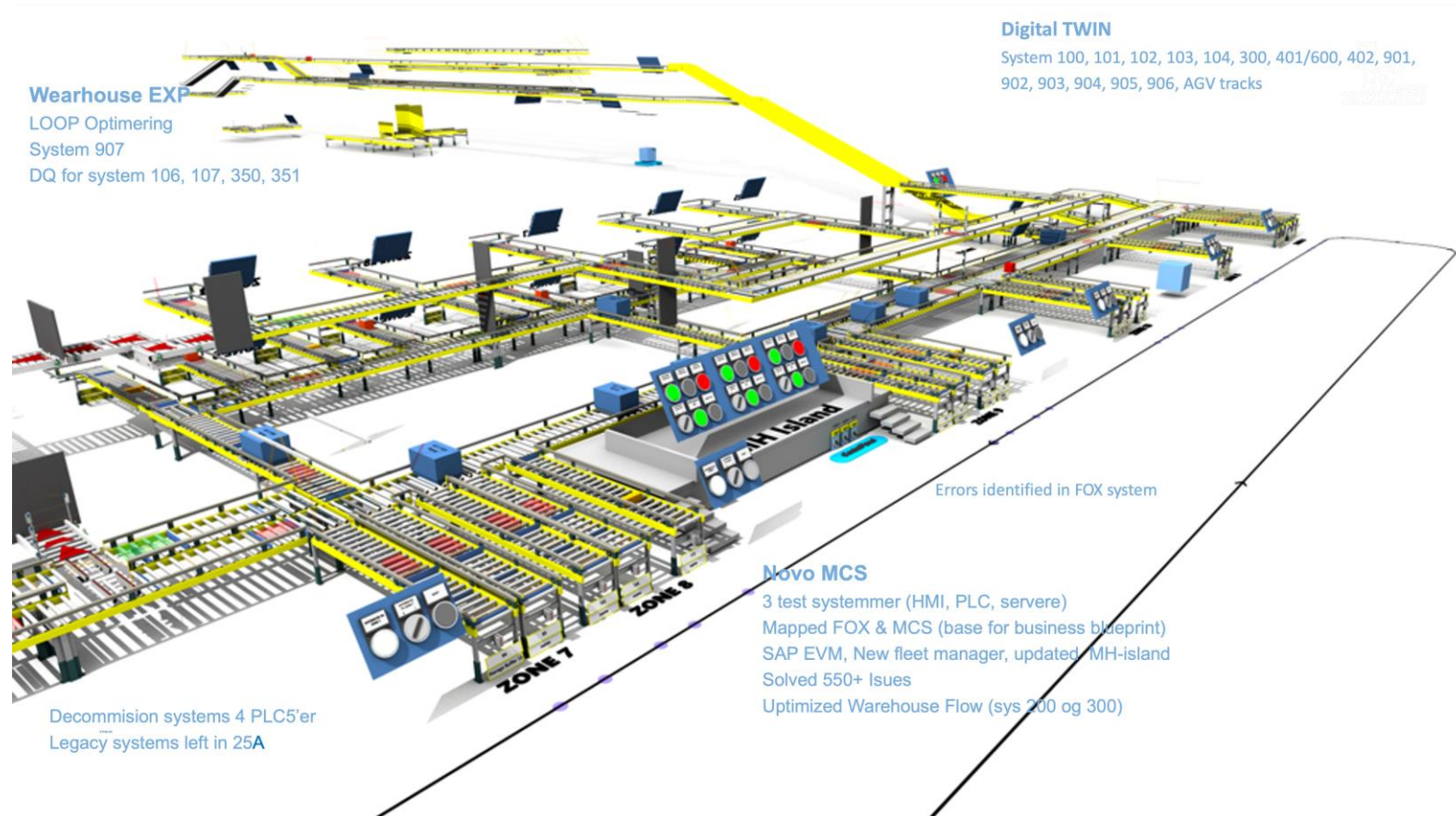
The Vision

Validation of production equipment

Produce in the future by fast-forwarding the production.

The objectives

- Test advanced scenarios.
- Test new functionalities of mechanical end automation.

- Test interface to key systems like SAP EWM, PasX etc,.
- Mitigate and remove people's stress during a planned shutdown.

Wearhouse EXP
LOOP Optimering
System 907
DQ for system 106, 107, 350, 351

Digital TWIN
System 100, 101, 102, 103, 104, 300, 401/600, 402, 901, 902, 903, 904, 905, 906, AGV tracks

Errors identified in FOX system

Novo MCS
3 test systemmer (HMI, PLC, servere)
Mapped FOX & MCS (base for business blueprint)
SAP EVM, New fleet manager, updated MH-island
Solved 550+ Isues
Uptimized Warehouse Flow (sys 200 og 300)

Decommision systems 4 PLC5'er
Legacy systems left in 25A

ZONE 7   ZONE 8

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Introduction – building the twin
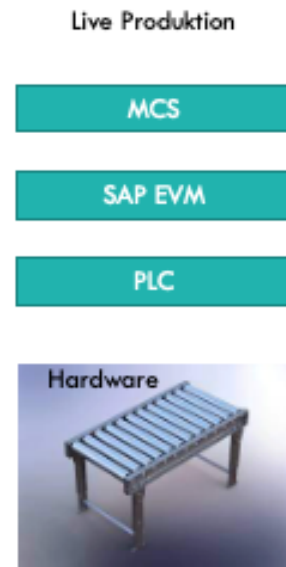
No CAD drawings were available

Warehouse consists of many individual systems

OT architecture a mix between legacy systems and current systems

IT architecture based on legacy and current systems

Based on a 24/7 producing equipment where no breakdown is allowed

Manually measuring equipment and then reproducing it virtually

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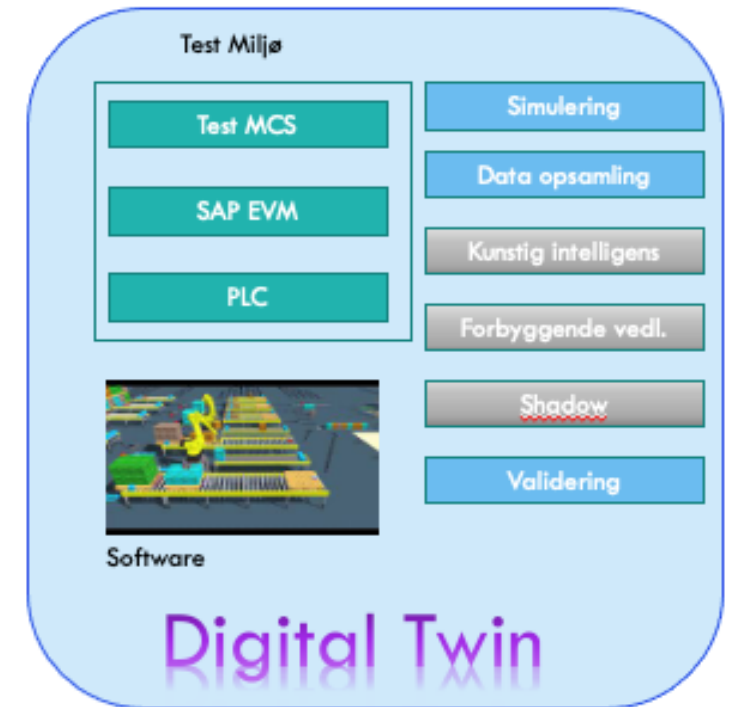
Technical challenges & current status

Challenge

- How can decisions be based on a virtual environment?
- What is a Digital Twin?

Proof of Concept

- A small PoC was made and demonstrated for all interested employees.
- The PoC was a testing interface between MCS -> FOX -> PLC.

Solution

- Novo Nordisk demonstrated that testing different protocols and connections between systems was possible.
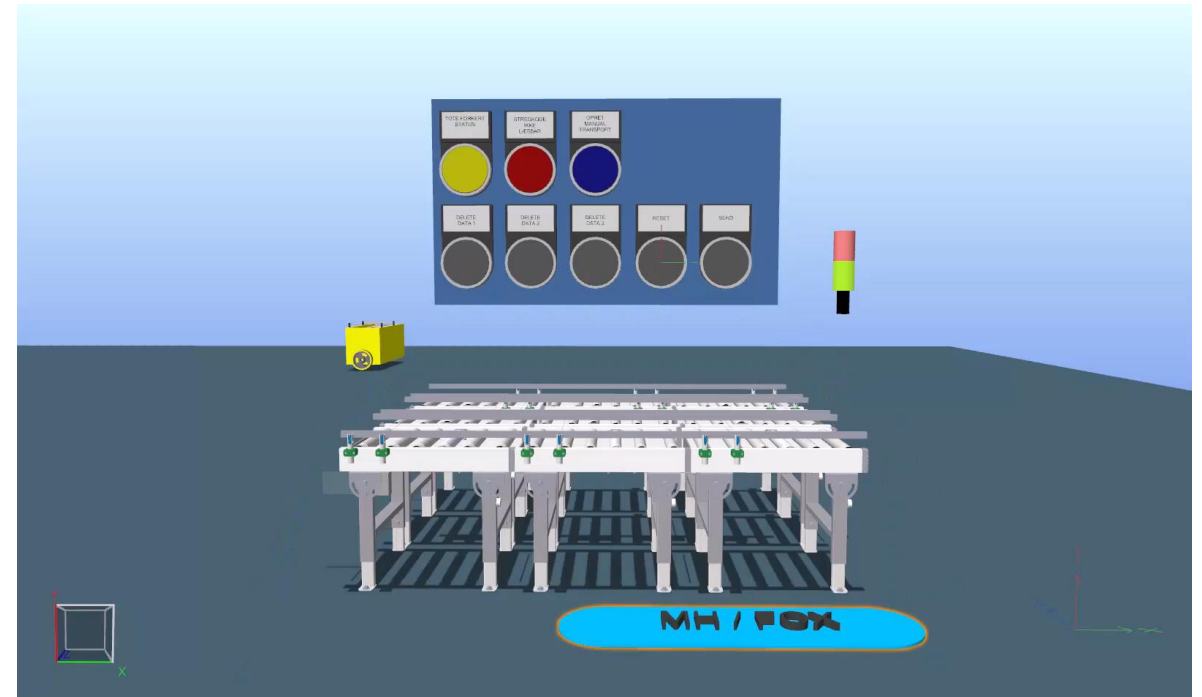
Technical challenges & current status

Challenge

In real life, all routes and decisions are made by a unique barcode on all Totes. Barcode reader did not exist in Emulate3D.

Communications:

SAP/MCS -> PLC -> Barcode string -> Tote
Tote -> Sensor -> PLC -> SAP/MCS.

Solution

Develop a custom Barcode reader to read Barcodes across systems.

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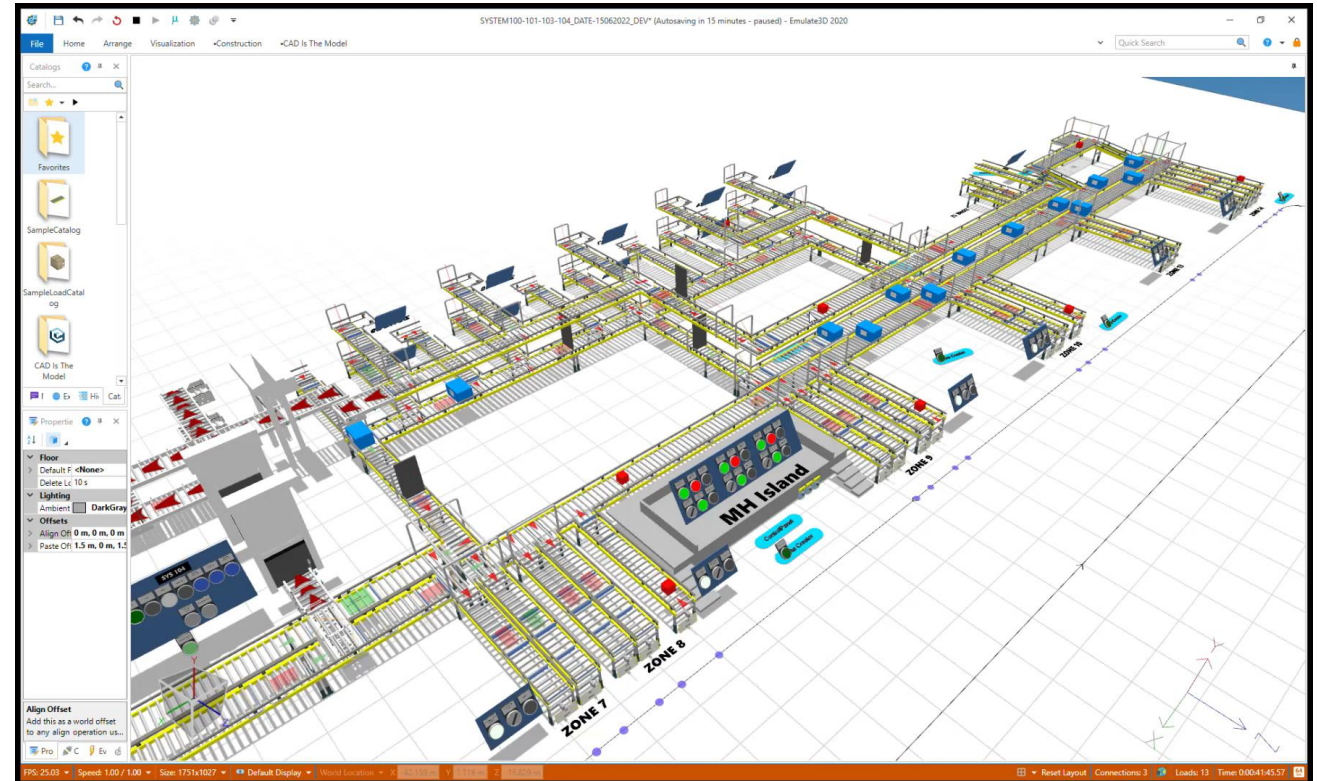
Technical challenges & current status

Challenge

All systems are connected, and totes need to float between each other when not all systems are built from the beginning
Some systems are legacy systems and some more current.

When emulating systems, a different resource profile is required to archive the digital twin.

Solution

Partnering up with SMEs from internal and external organizations.
Build in a system approach and start.

System 100	✓	System 401/600	✓
System 101	✓	System 901	✓
System 102	✓	System 902	✓
System 103	✓	System 903	✓
System 104	✓	System 904	✓
System 300	✓	System 905	✓
System 401/600	✓	System 906	✓
System 402	✓	System 907	
Area 51		AGV tracks	✓

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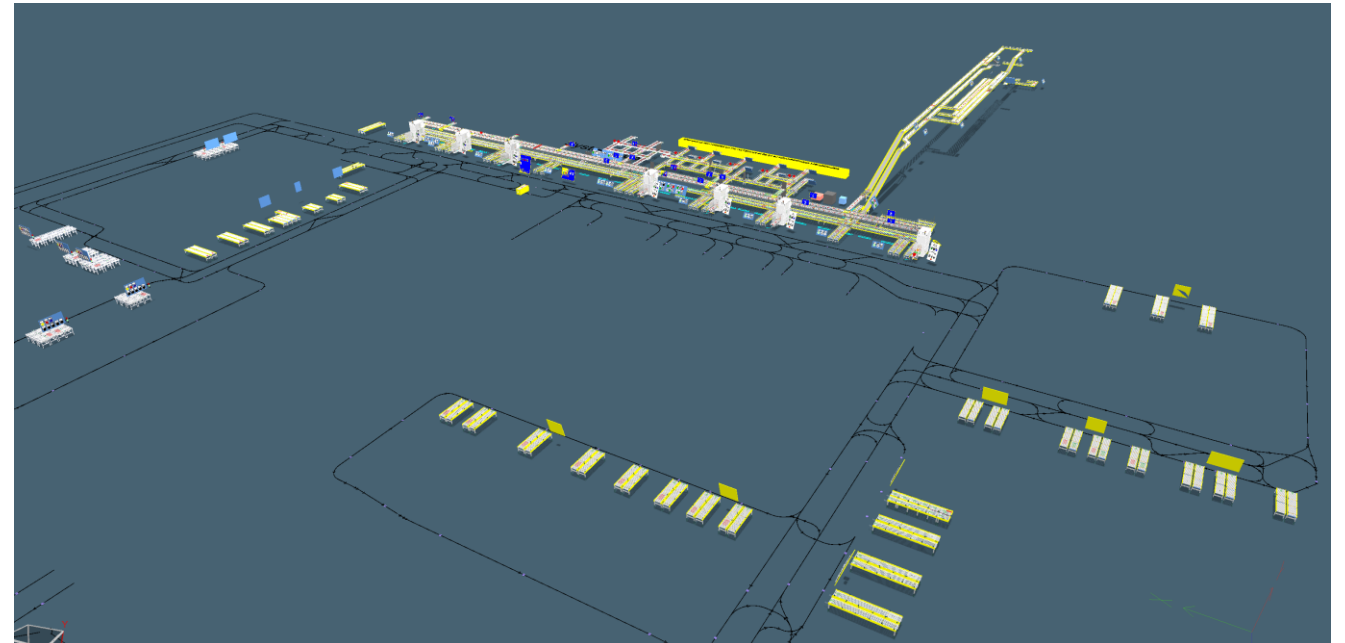
Mitigating risks – working with partners

Challenge
Novo Nordisk 25A is expanding with upgrades and new systems.
Time to market is critical, but the risk is high when working with different sub-suppliers.

Solution
Working with OEMs to provide a Digital Twin of their system as a part of their scope.
Working with Partners to integrate systems and deliver needed infrastructure

Benefit
Pre-test in-house dependencies like SAP and current producing systems without shutdown.
OEMs can utilise the tool to increase the quality.
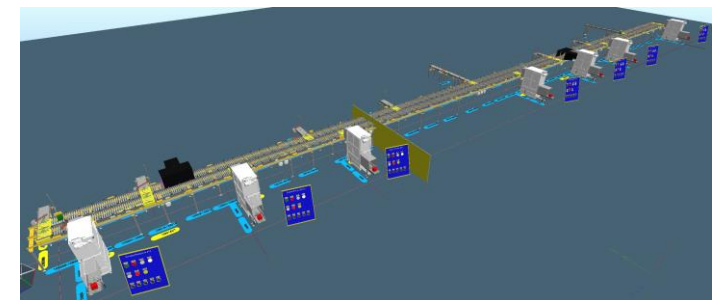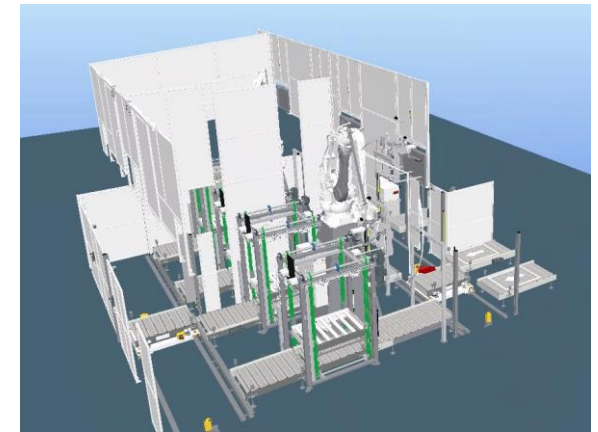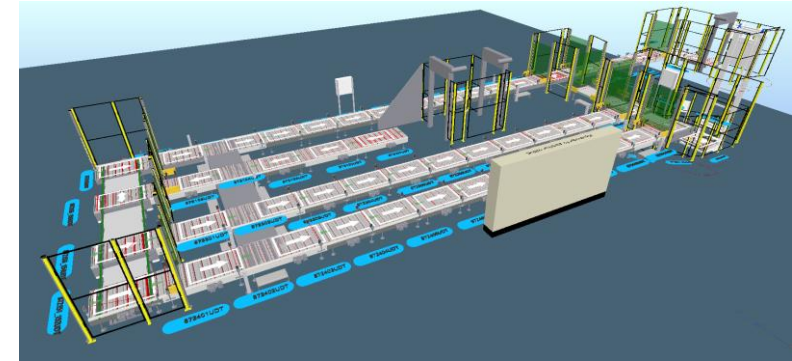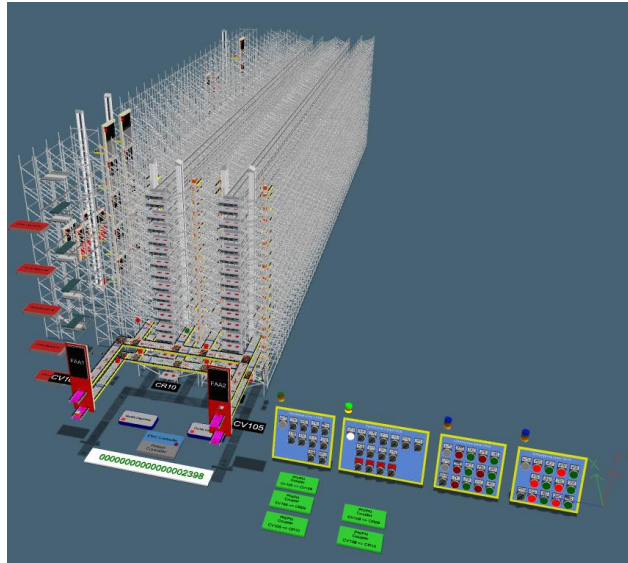
Next step - Validation

Validation

Validation is essential for compliance and ensuring the efficacy of pharmaceutical products. Regulatory agencies such as the FDA require companies to demonstrate that they can produce reliable results.

Challenges

Validation takes time and requires a lot of documentation and approval.
This has an impact on how fast the production can start after any changes have been made – planned and unplanned.

Topics to cover

Audit trail – who, what, why & when
Version Control – are we sure we use the correct system
Comparison – what has been changed and by whom?

OTnet + SCADA Env.

- ✓ Infrastructure changes
- ✓ SCADA changes
- ✓ Recovery tests
- ✓ (PLC changes)

Digital Twin – Emulate3D

- ✓ Functional tests for IT & Automation
- ✓ PLC changes
- ✓ Mechanical changes
- ✓ Process changes
- ✓ Offline training

IT&Aut.   Process   QA

| Week 1 | Week 2 | Week 3 |
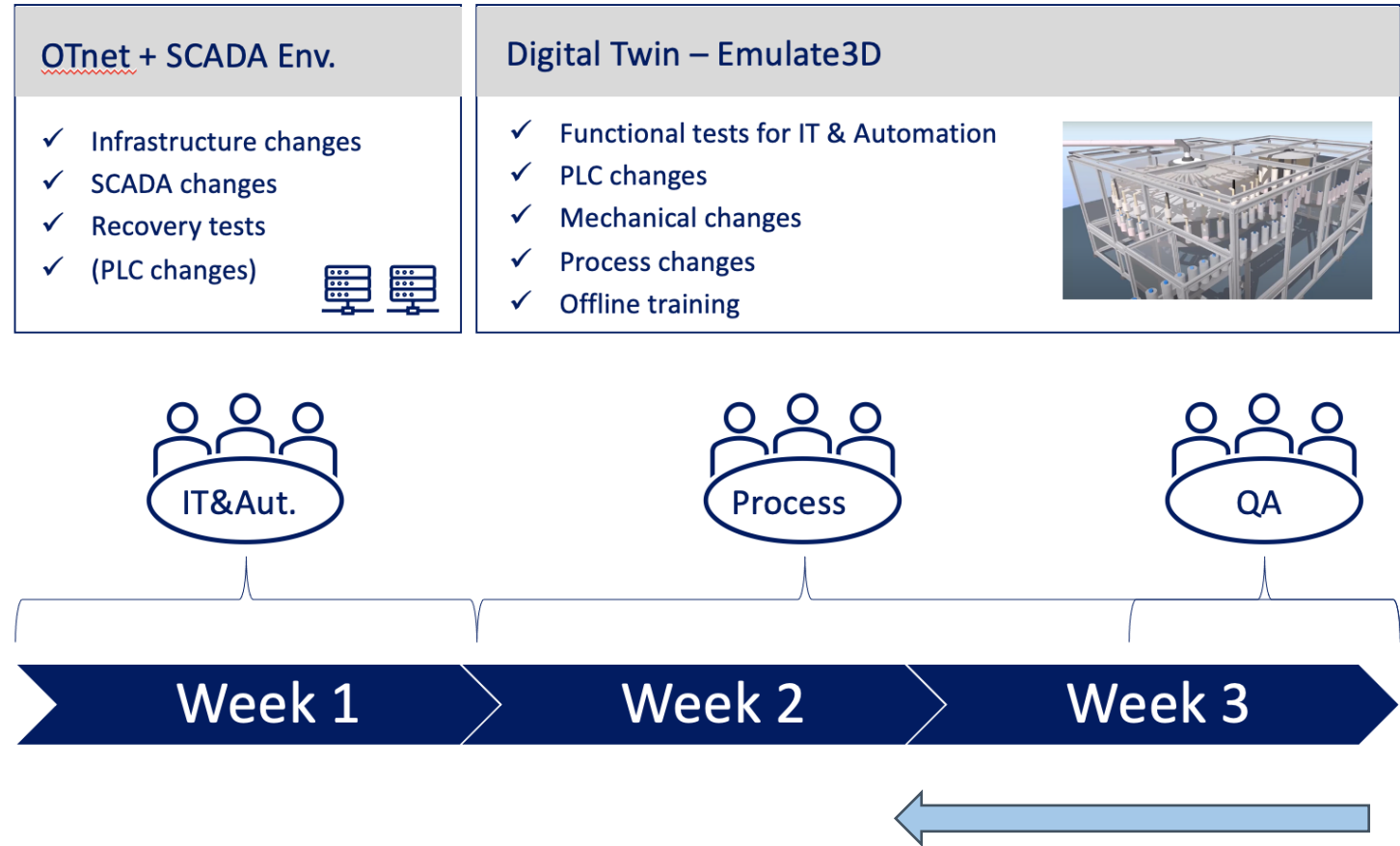
Next step - Validation

Requirements

Easy and intuitive tool embedded in the Digital Twin to cover requirements given by FDA or equivalent party.
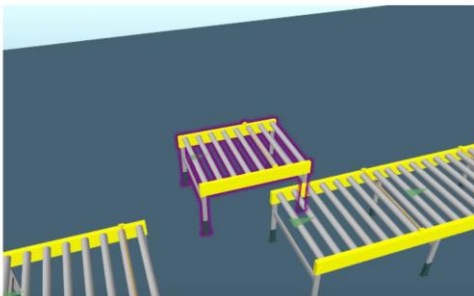
Benefits

- Engineers and QA can document and prove the model's quality and state.
- Changes can be evaluated and pre-validated before the system is available.
- The changes that are implemented on the line during shutdown have been pre-tested and verified.
- The risk of functionality is eliminated.

Gains

- Faster time 2 market.
- Less stress during breakdowns and shutdowns.
- Challenge and test SOP's and line clearance.

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Next step - anchoring

Challenges

The technology is not factory default and is commonly used in the market. Both by users and decision-makers.

The benefits are known but limited proofed.

Many sub-suppliers are still technology frightened.

Solutions

- Generate more business cases and document results.
- Make it a natural tool in both production and engineering.
- Encourage sup suppliers to utilise the technology and harvest the benefit.

Gains

- Faster time 2 market.
- Better quality in product and in the workforce.

CHANGE MANAGEMENT

GUIDANCE   SOLUTION   VISION   TEAMWORK   DIRECTION   STRATEGY   COMMUNICATION   GOAL

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