Electronics Manufacturing Break-out Session – Closed Loop Manufacturing

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Realize innovation.

Presenters

Frank Bleisteiner

Siemens DI FA MF

Senior Director Production Engineering

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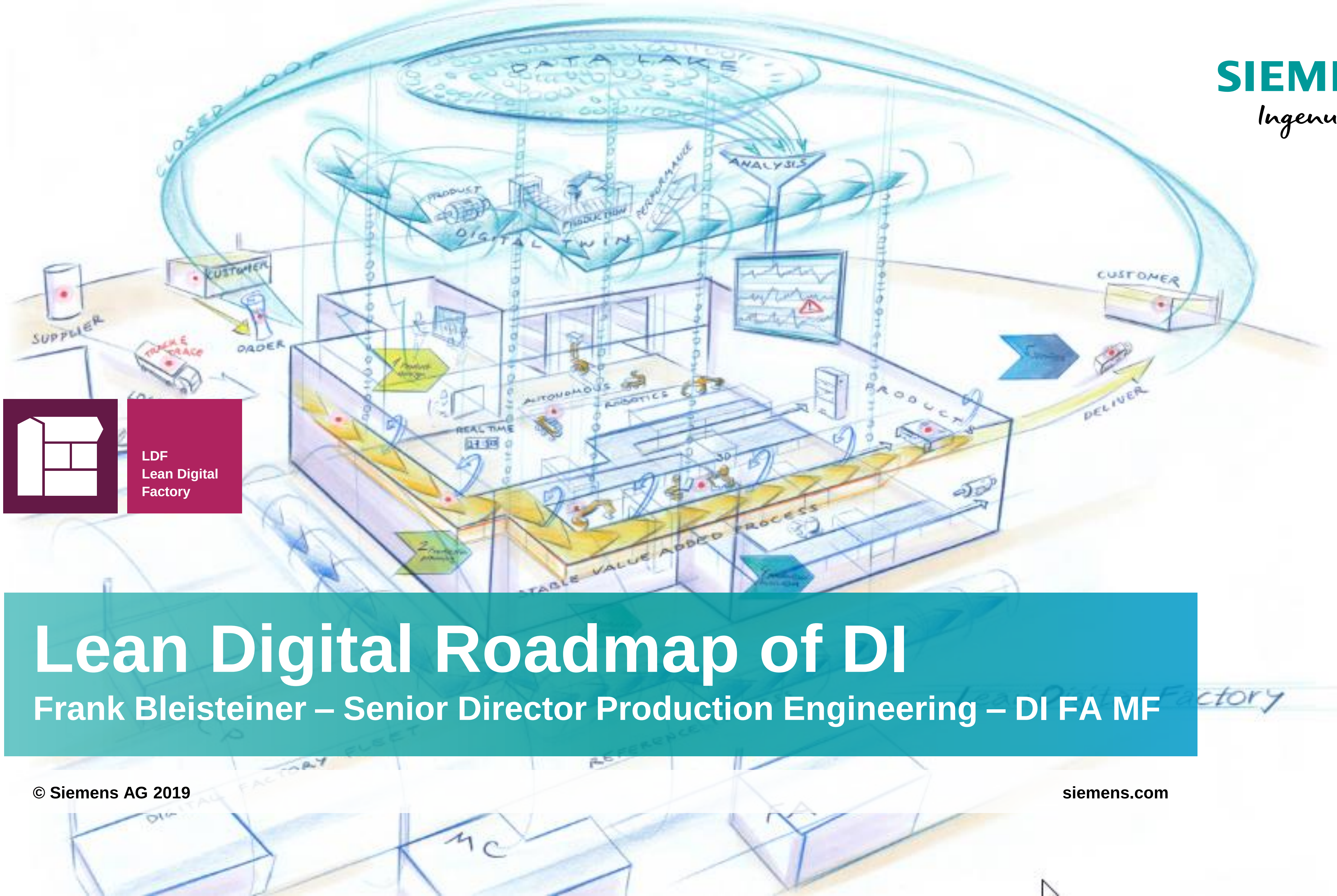
Mentor – Siemens DISW

Business Development

Valor | MOM | Electronics



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LDF
Lean Digital Factory

Lean Digital Roadmap of DI

Frank Bleisteiner – Senior Director Production Engineering – DI FA MF

Siemens DI factories strengthen the focus on automation & digitalization hand in hand with lean productivity

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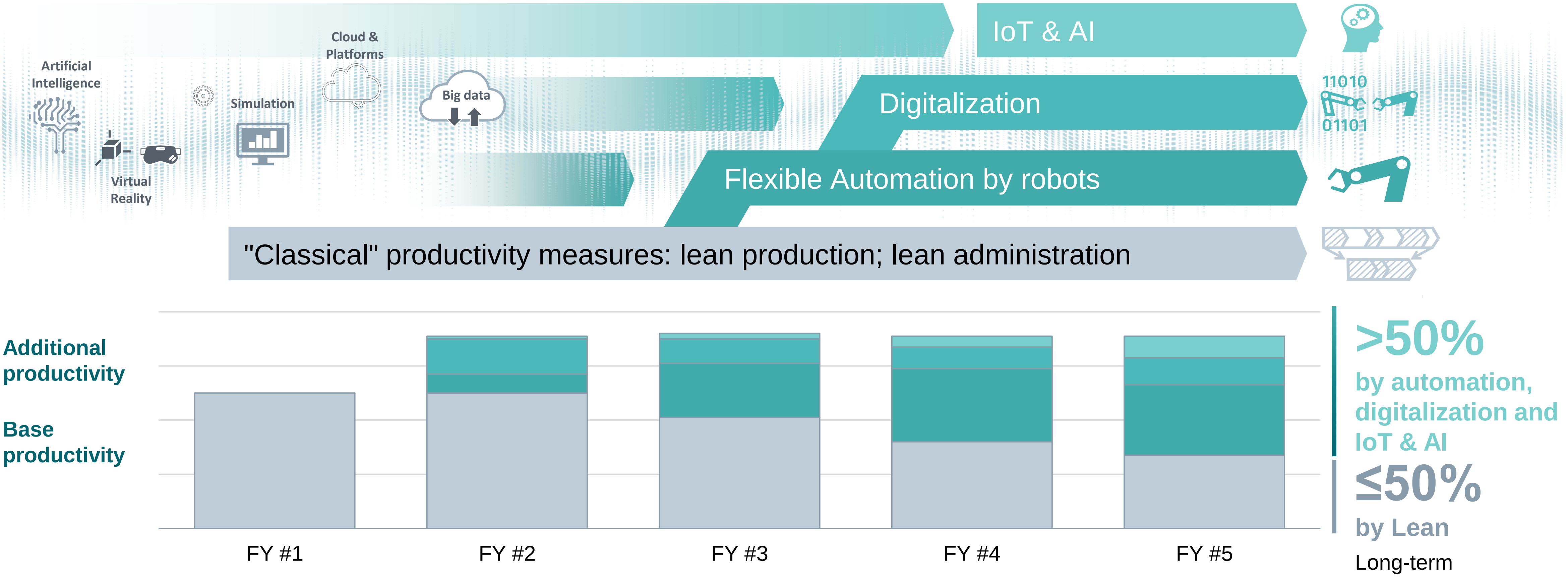

LDF guides the way to Digital Transformation

Pilots should be fresh topics using new technology, which are easily scalable and bring measurable value to the organization

Digitalization pilot criteria, working principles

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What? Digitalization pilot criteria

New Technology
Introduce / leverages a **new interesting technology** / solution

"Make things easy"
Makes a process / job **more convenient** for employees

Clear benefits
Value-add clear and easy to understand

Competences
Implementable with **available resources** / know how

Fresh topic
No **negative connotation** from previous experiences

Scalability
Scalable to **larger parts of organization** after small scale pilot

Timely
Creates **impact within 3-6 months** (1st wave pilots)

How? Principles of set-up

Dedicated Teams
Lean dedicated teams **working** on the project

Design thinking
Agile, building up ideas, user-centric, learn & iterate

Source: Siemens Consulting

Industry 4.0 - How we Transform a Buzz-word into Manufacturing Excellence in Electronics

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Change is Inevitable

“More than 50% of companies that attempt to move to a digital model will fail.”

Source: John Chambers, McKinsey & Company Report
March 2016

Trends and challenges driving MES implementation in Electronics industry

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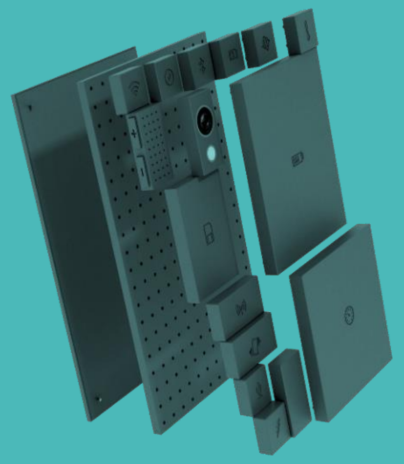
DELIVERING LOT SIZE ONE



↓ Product Lifecycle

↑ Number of NPIs

OPTIMIZING MATERIAL USAGE

COST OF SELECTED PARTS	
Display	$45
Memory	15
Communications	37.50
Cameras	11
Processor	20
Mechanical	30
Other	37.60
TOTAL PARTS	$196.10
Labor	4
TOTAL	$200.10

↑ Lead Time & Cost

↑ Number of Variants

PERSONLIZED PRODUCTS

↓ Time to Market

↑ Agility

COMPLIANCE

ISO/TS 16949

IATF 16949

Medical

↑ Customer Requirements

↑ Regulation

Technological Forces Transforming Industry

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Changing the way products come to life

- Generative design
- Intelligent models
- System of systems

Changing the way products are realized

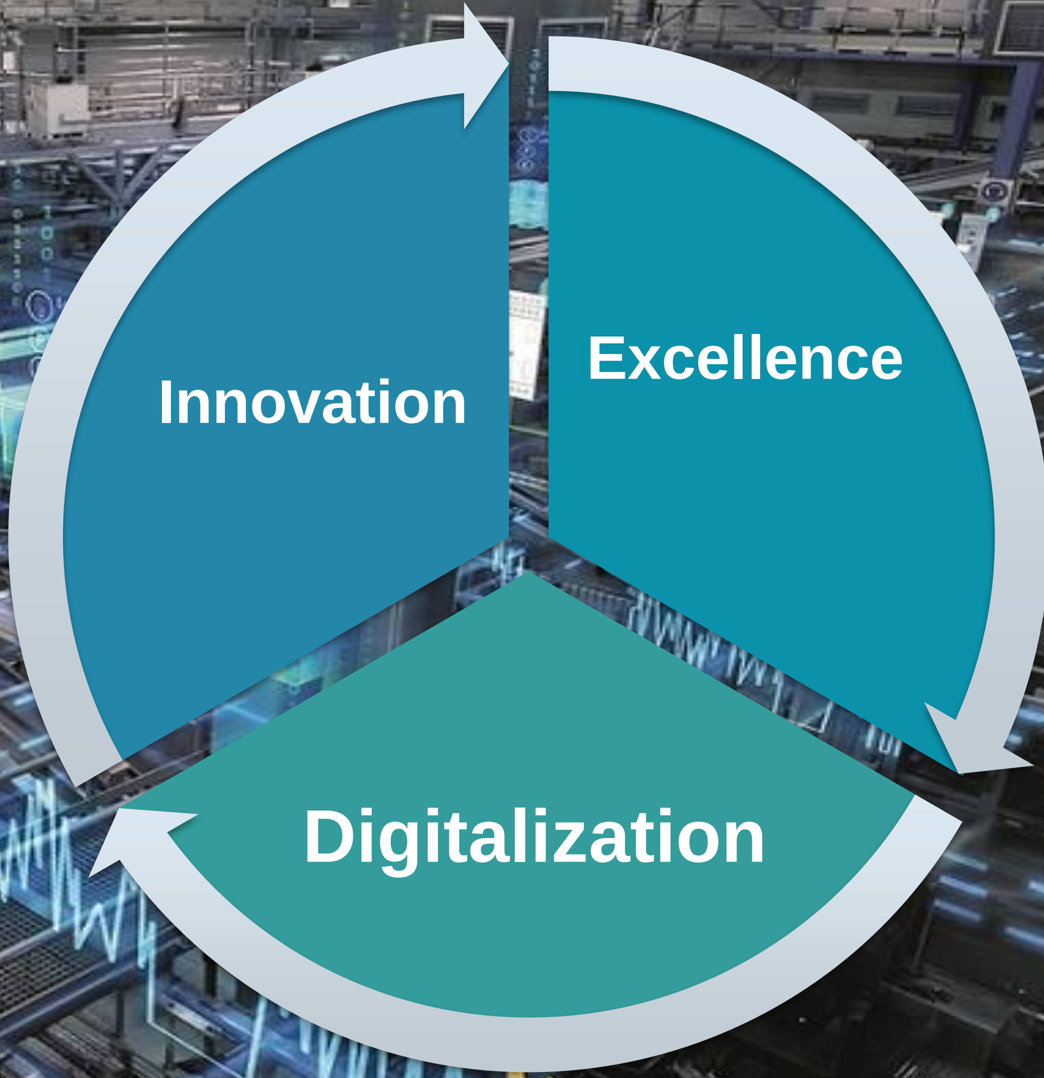
- Intelligent automation
- Additive manufacturing
- Advanced robotics

Changing the way products evolve

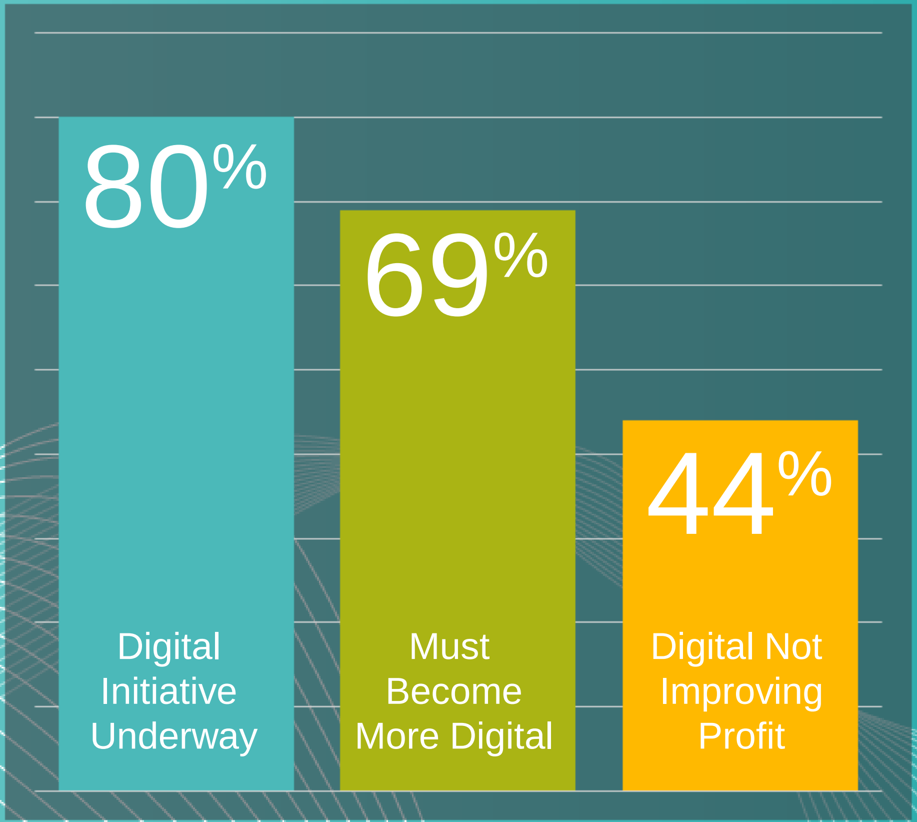
- Closed loop feedbacks
- Knowledge automation
- Big data analytics

Trends like
Industry 4.0
Provide a Framework
for Addressing the
Challenges of Modern
Manufacturing.

But how do you
implement them?



SENIOR EXECUTIVE VIEWS ON DIGITALIZATION



"Digitalization success depends less on having the most advanced technologies and more on having the right operating systems."

CEB GLOBAL, 2017

Digitalization Delivers Value & Excellence

PRODUCT	PROCESS	ASSETS AND MATERIALS	QUALITY
Time to market Quality	Setup time Work instructions	Equipment utilization OEE, ROA, inventory turnover, waste	Online Process Interlocking
Chinese Telecom Factory **+25%** **Units shipped**	Japanese Automotive Company **+$1.4M** **Annual savings**	Chinese Telecom Factory **+100%** **Operator efficiency**	German OEM **Invaluable data for** **ZERO** **Defect initiative**

Digitalization Delivers Value & Excellence

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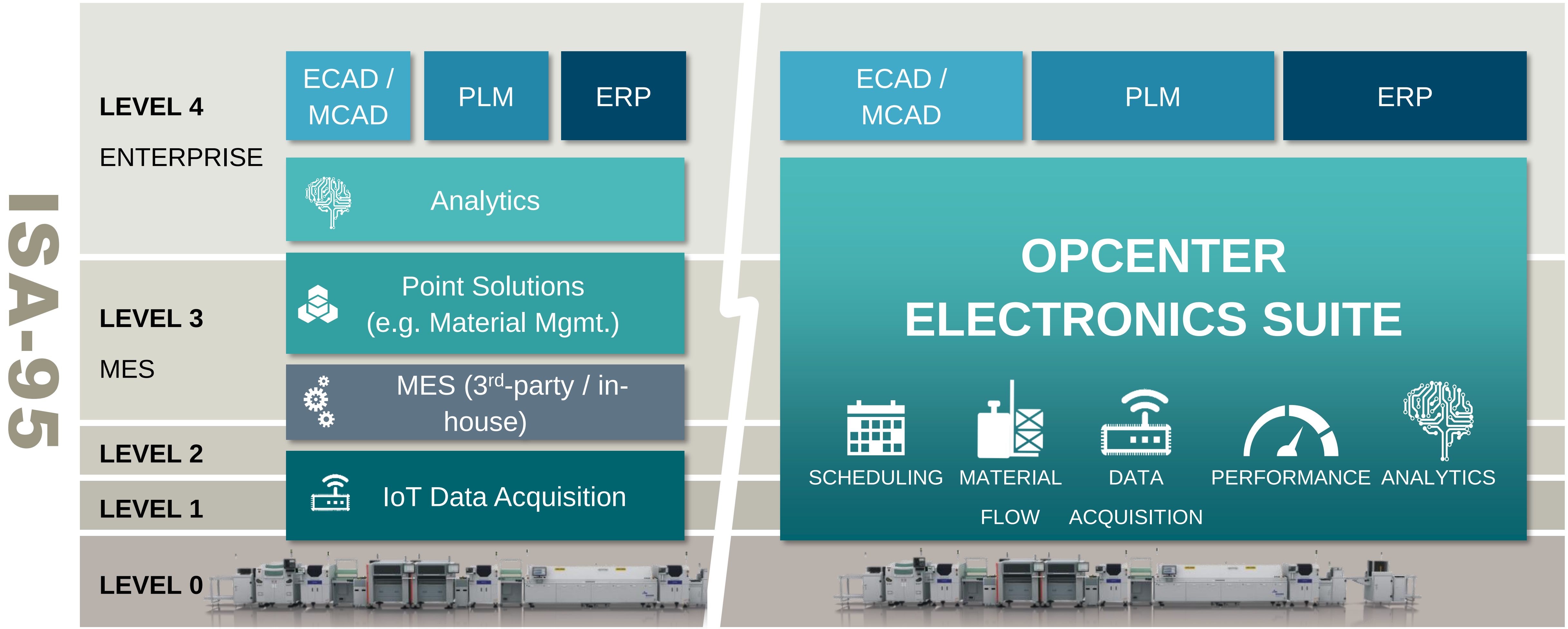
PERFORMANCE	PROCESS MONITORING	FINDING BOTTLENECKS	BOXBUILD
Global Decision Making	Changeover Optimization Guided Shop floor Operations	Drill Down to the Details	Manage Guided Assembly & Test
Automotive FTS **80% → 52%** OEE → LIVE OEE	Top 50 Global EMS **29k Components** ↓ **37k Components** ↓ **42k Components** ↓ **50k is the max!**	Top 50 Global EMS **Waiting 60 hours monthly for the reflow oven!** **60 Hrs** **Added another oven instead of another line**	European EMS **1,410 DPMO** ↓ **568 DPMO** **Saving/Yr $170k**

Providing both Data solutions and Enterprise MES



Streamline PLM

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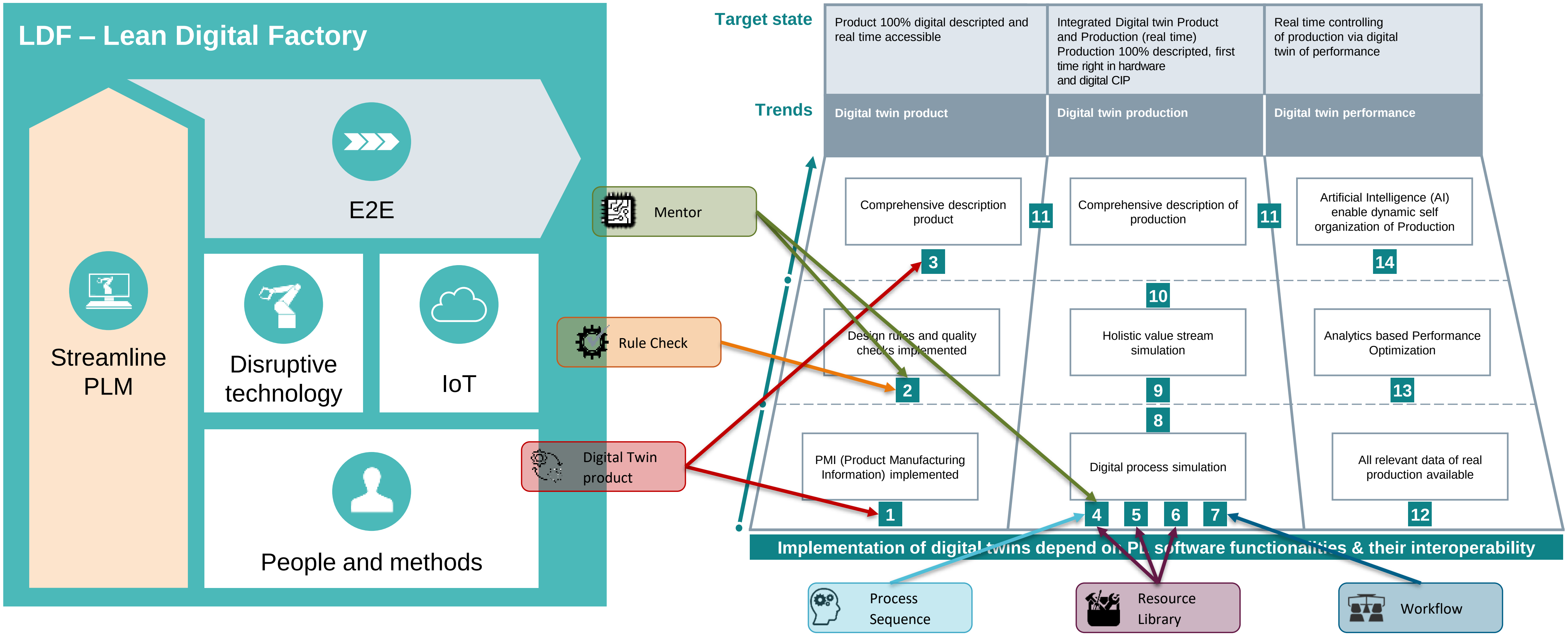
Lean Digital Factory (LDF) modules



SPLM Mapping of PoCs to Digital Twin Approach

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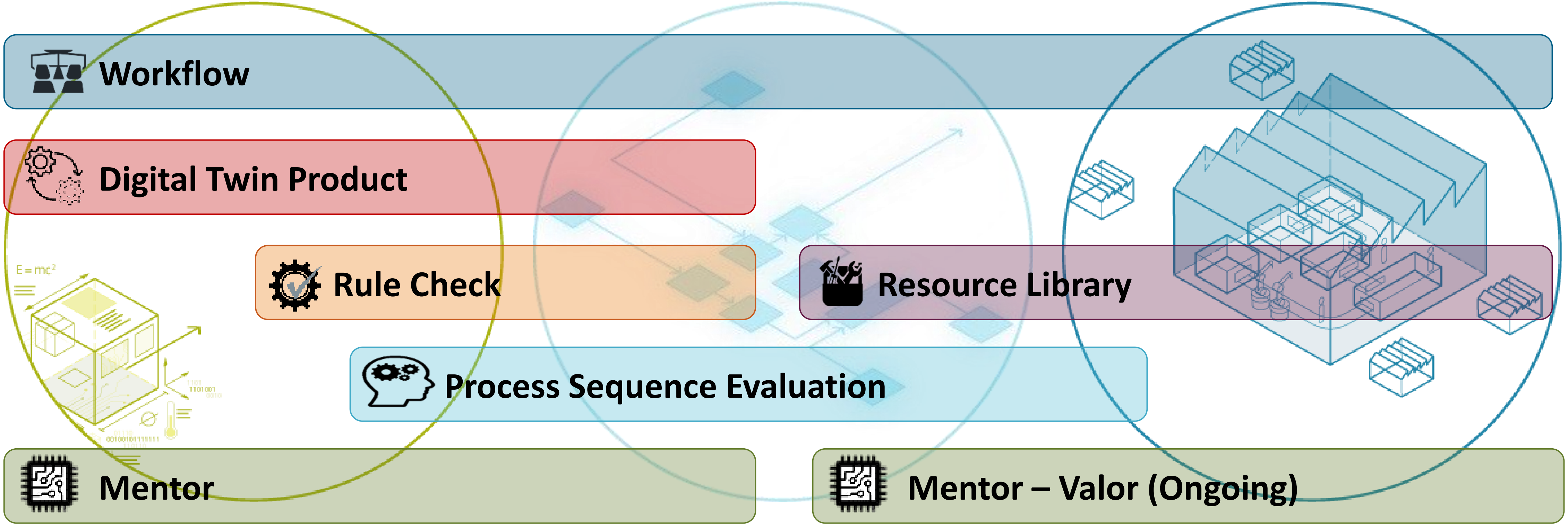
Digital Twin Product | Digital Twin Production | Digital Twin Performance



PoC Workflow Engine

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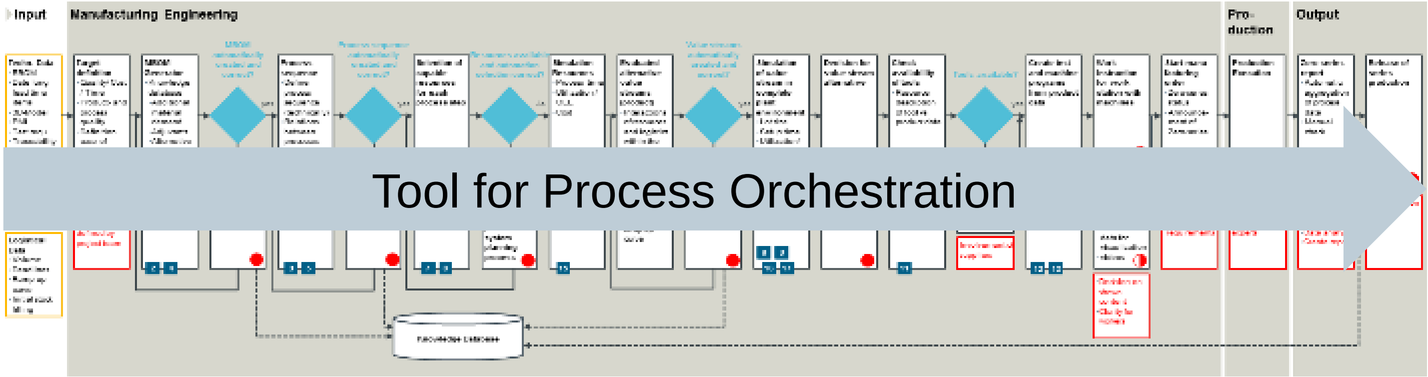
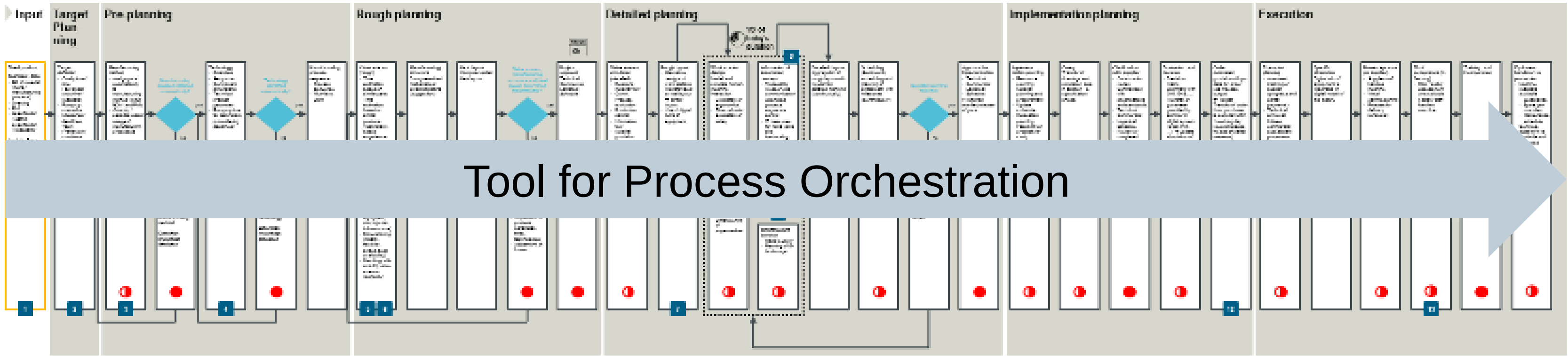
Workflow

Ref Process: NPI = New Product Introduction



Ref Process: NMI = New Machine Introduction



Workflow PoC supports the NPI[1)]/NMI[2)] reference processes (NPI: 2000/year @ EWA; 600/month @ WKC)

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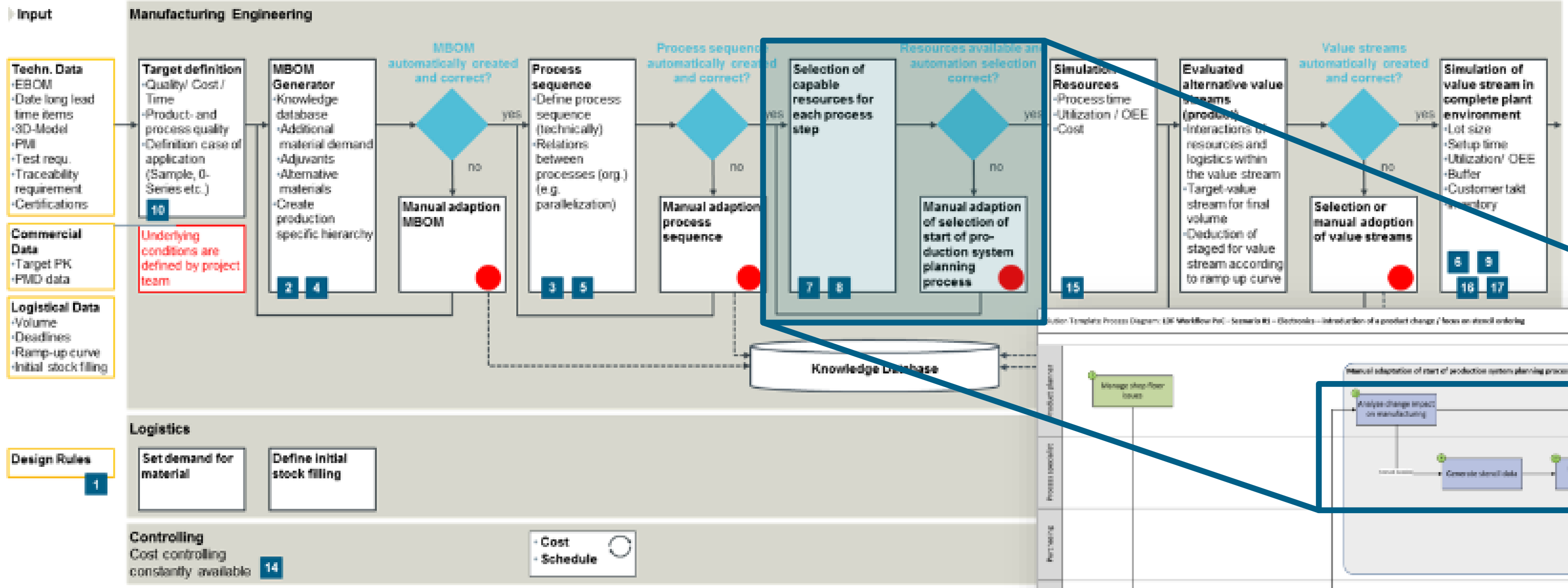
Workflow

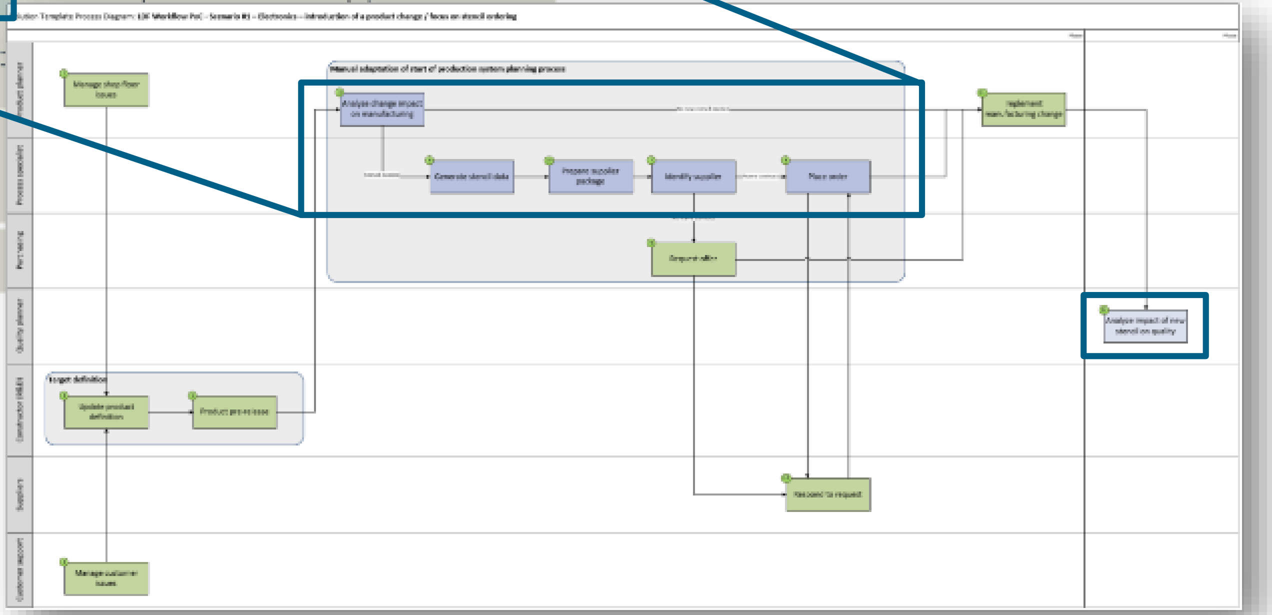
Evaluation of a workflow engine	
PoC completed	PoC extension requested

Detail view: Reference process product introduction – Part 1/2



Stencil ordering is chosen for PoC

The example is just one out of 30+ sub-processes!



Flexible Microservice Apps
powered by Mendix

The PoCs digital twin product and DI-wide resource library resulted in a standard definition and thus reusability for DI

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Resource Library

Levels of detail fulfilled by digital twin

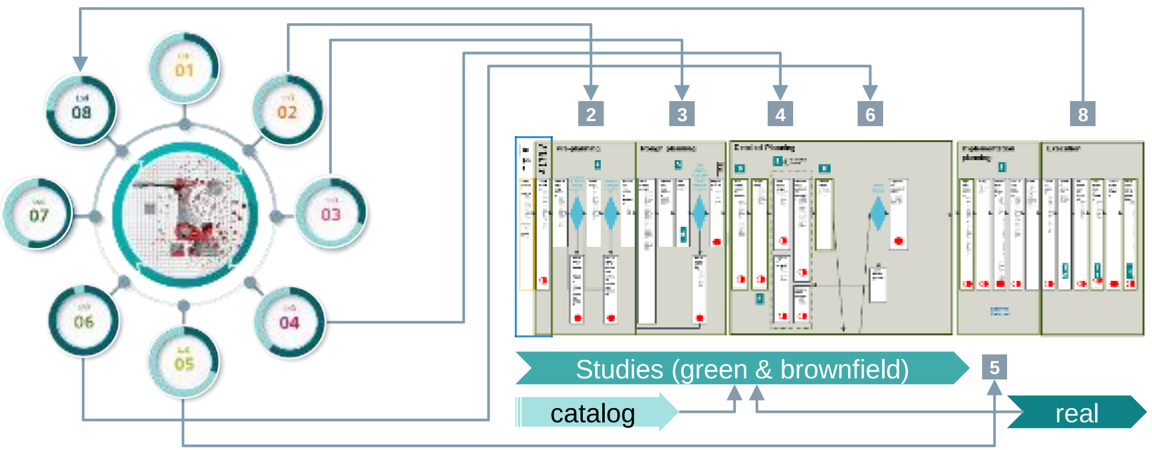
Workflow (How to)

Basic Info Name and type of an asset classified according to potential use cases (e.g., production, assembly, logistic, ...)	LoD 01
Supporting Pre-Planning phase as well as implementation and executing of SPLM Descr. of essential asset capabilities (PMI), all relevant data for factory planning & execution process	LoD 02
Basis for 2D-Layout planning and material flow analytics Factory planning, sensible 2D layout incl. all functional areas and relevant operation pages (operating page, material delivery/flow, maintenance access, ...)	LoD 03
Enabling for realistic rough layout planning Simplified 3D model (boundary view) with enveloping contours and provision in typ. exchange and planning file formats (e.g., JT)	LoD 04
Supporting workstation or work-cell design and detail layout of the factory 3D model based on NX incl. kinematic axes (if relevant for subsequent use in corresponding planning tools); NX assembly of complex parts (single resources) for integr. into combined plant project planning	LoD 05
Implementation planning and physical simulation evaluation (if needed) Native 3D design model incl. all material types and surface properties for simulation of physical, electrical and so on properties (e.g., FEM, thermo, …)	LoD 06
Execution phase based on specific simulation and virtual commissioning Mechatronic System/Cyber-physical model including all electrical capabilities for virtual commissioning, programming and simulation	LoD 07
Closed loop with life cycle data from operating phase Aggregated process and event data from MindSphere applications and microservices for reuse in next planning phase or scenario validation/simulation	LoD 08

eCl@ss

Linked to standard

Linked to the reference process



Level of Detail (LoD)

Frame Specification for Supplier

IN0692 – SITEMA

Purchase order

PI0674 – Introduction of systems

Linked to supplier

Digital twin of product		DF wide production resource library	
PoC completed	PoC: Evaluate defined concept	PoC completed	Pilot: Pre-filling of library

Work Based Interaction with Robotics

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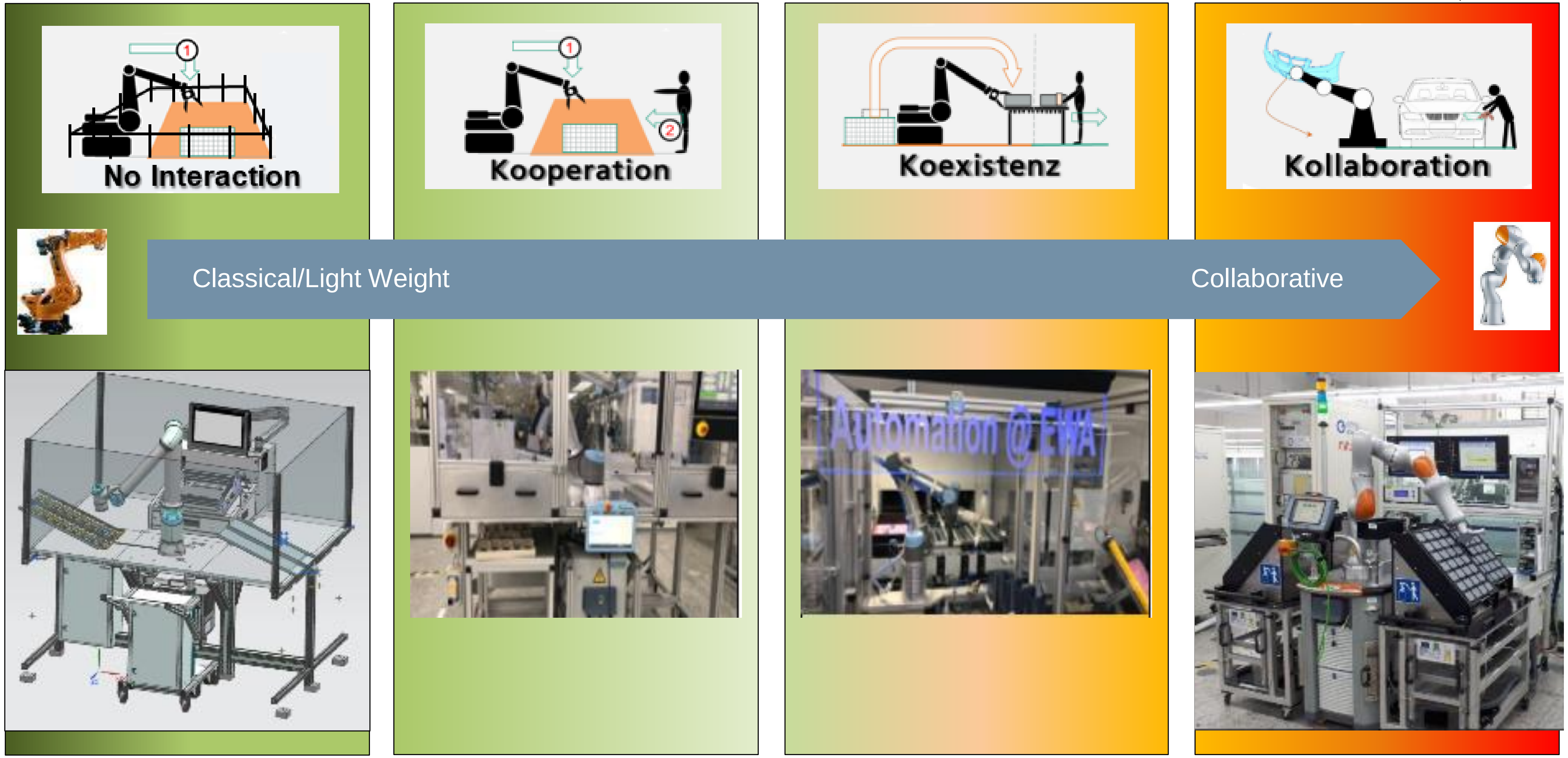
Classical/ LWR versus Collaborative

- Standard robot carrier system
- Increase efficiency
- Improve ergonomic
- High flexible
- High tact time
- ROI < 2a

Fraunhofer IWU, Chemnitz ©



SIMOVE is evaluated as Master Controller for Autonomous Mobile Robots (AMR) and forklifts

A unified control system for transport order assignment is needed

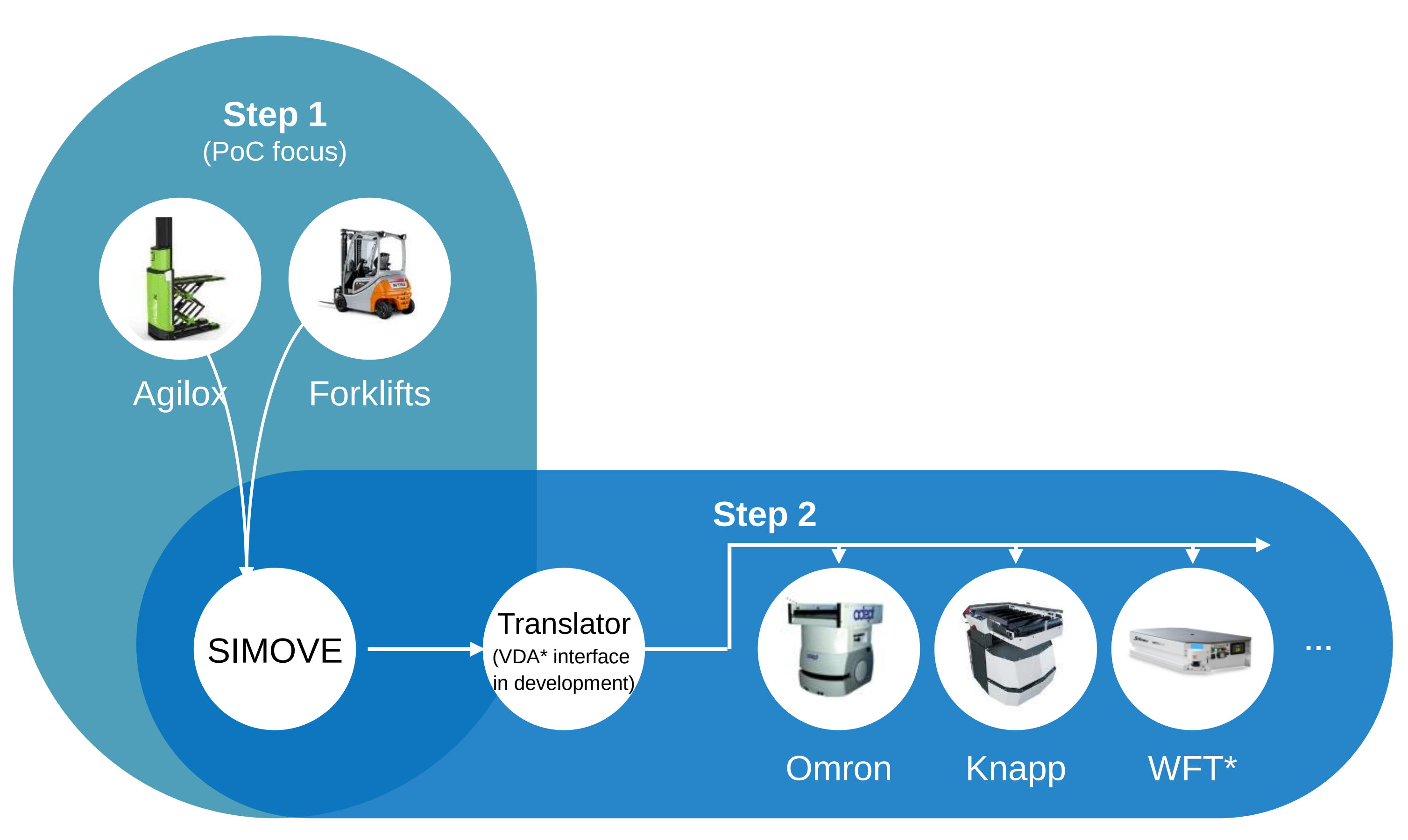
From separated control systems to one Master controller

Step 1 (PoC Focus)**:**
Control forklifts & Agilox with one system

➢ Transfer forklift control system functionalities to SIMOVE

➢ Realize interface to Agilox

Step 2 :
Control forklifts & different AMR types with one system



* Verband der Automobilindustrie | ** STÄUBLI WFT GmbH

Closed-Loop Manufacturing – OpCenter Execution Electronics

The most frequent use cases for CLM

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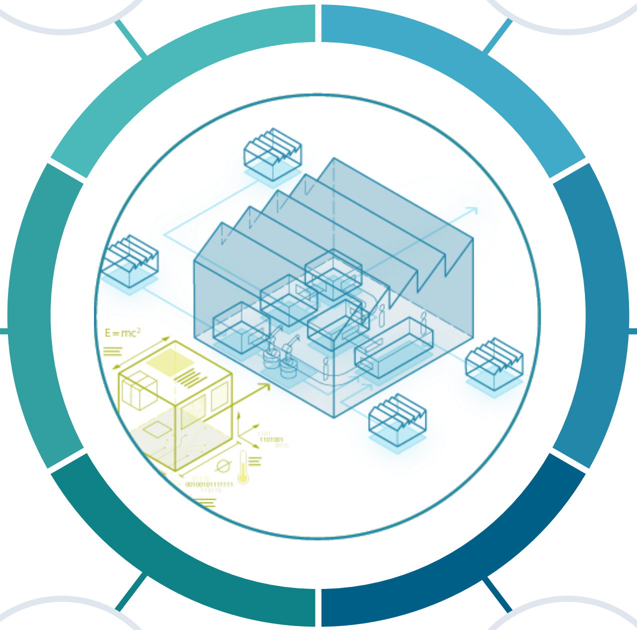
Work instructions and 3D visualization

Improved operator experience to access the right work instructions, 2-D & 3-D models

Design for Manufacturability

Collaborative (BOP) approach between engineering and manufacturing to design a process for manufacturability



Electronic Work Instructions (EWI) harmonization

Provide necessary tools to author manufacturing work instructions consistent with design requirements

Cross-domain change management

Global change and configuration management

Shop floor issue closed-loop

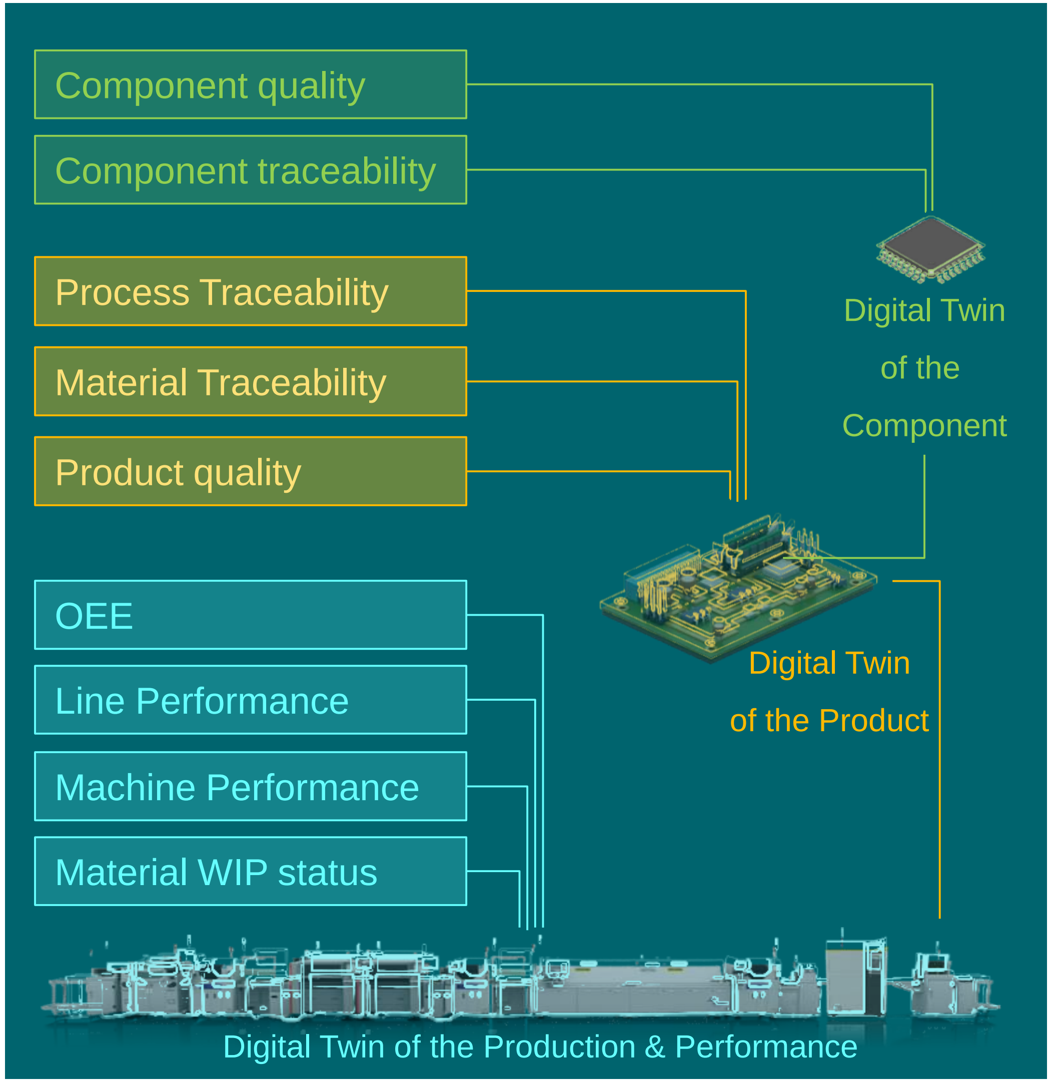
Ability to take containment actions in the Shop Floor & escalate systemic problems to Engineering for corrective actions

Options & variants

Ability to configure manufacturing process for the product family and dynamically apply the configured process requirements for appropriate orders

Data Acquisition → Analysis → Insights → Action

Data Acquisition → **Analysis → Insights** → Action



Data Acquisition → Analysis → Insights → Action

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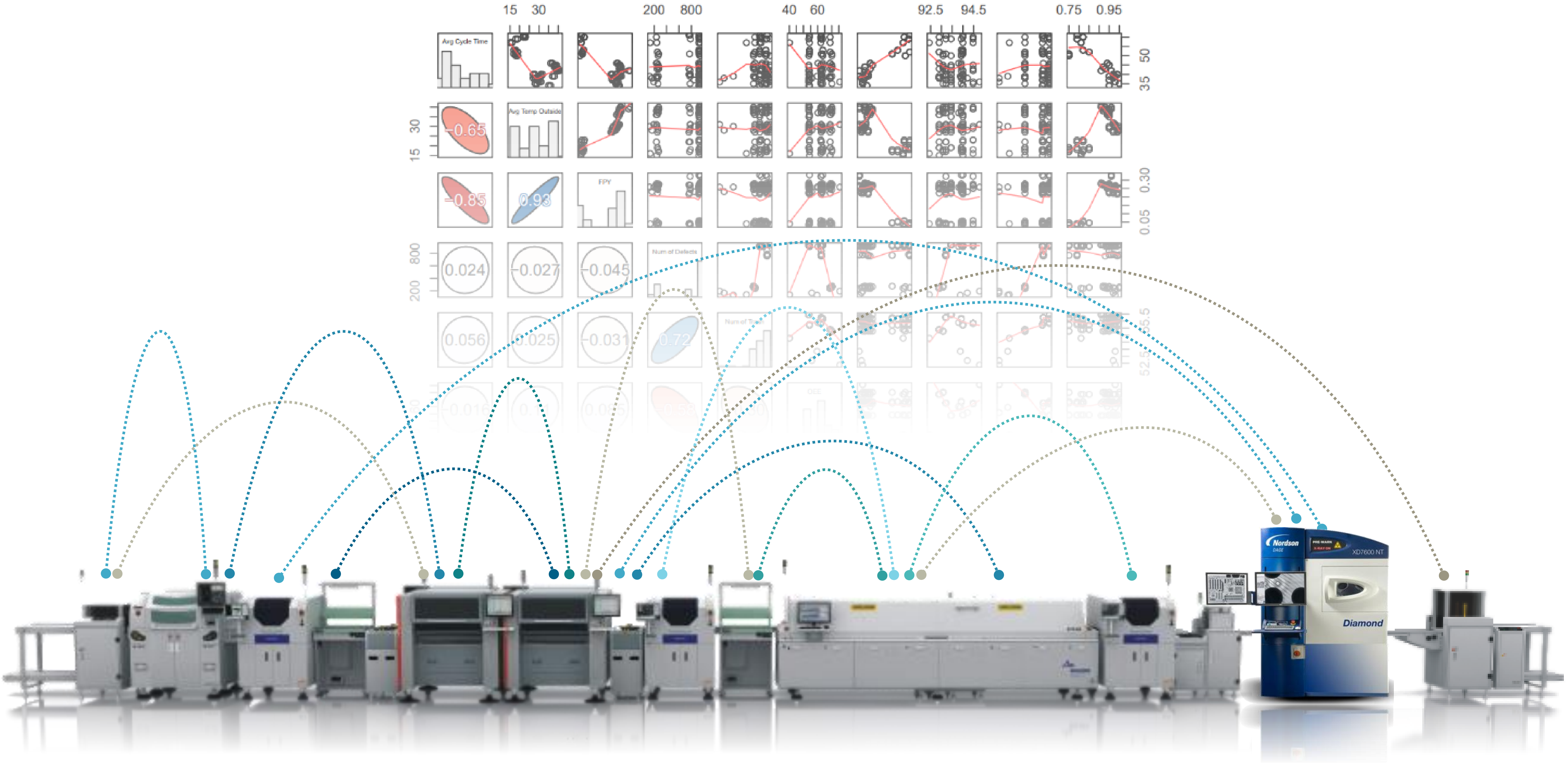


"In the product, the value of the raw material is 80%, but then you have scrap and inventory failure, and that can kill your profit! The material must be under control"

Franco Oliaro

ROJ CEO

Challenge

Material Overspend

Inefficient flow of materials and missing real-time visibility of material quantity across the factory leads to inflated inventory spend, material obsolescence, poor production efficiency and waste of shop-floor space

SOLUTION

Aggregate data from manufacturing lines, kitting stations and warehouse, to generate prescriptive model of material flow

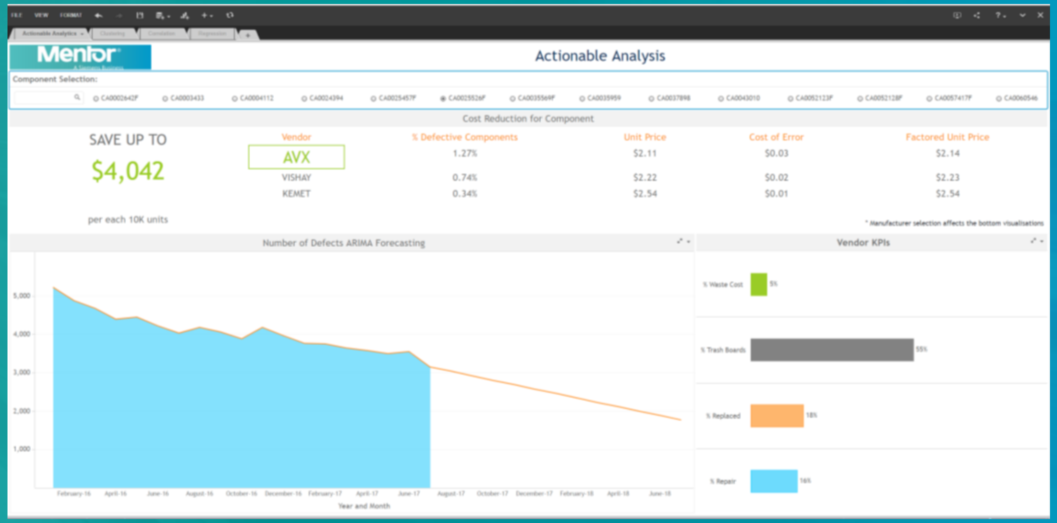
1 Data Acquisition	2 Analysis & Insights	3 Action
Machine performance	Predict material run-out	Proactive picklist generation – deliver the right material, at the right time
Warehouse inventory	Prioritize material selection	
Work-order Bill of Material	Minimize change-over effort	Change-over instructions (change / keep / remove)

RESULTS

€150K – €2M Excess inventory reduction

20% Reduction in obsolescence

20% Production efficiency increase



Closed-Loop Feedback from Manufacturing to Design via Manufacturing Execution System (Available Today)

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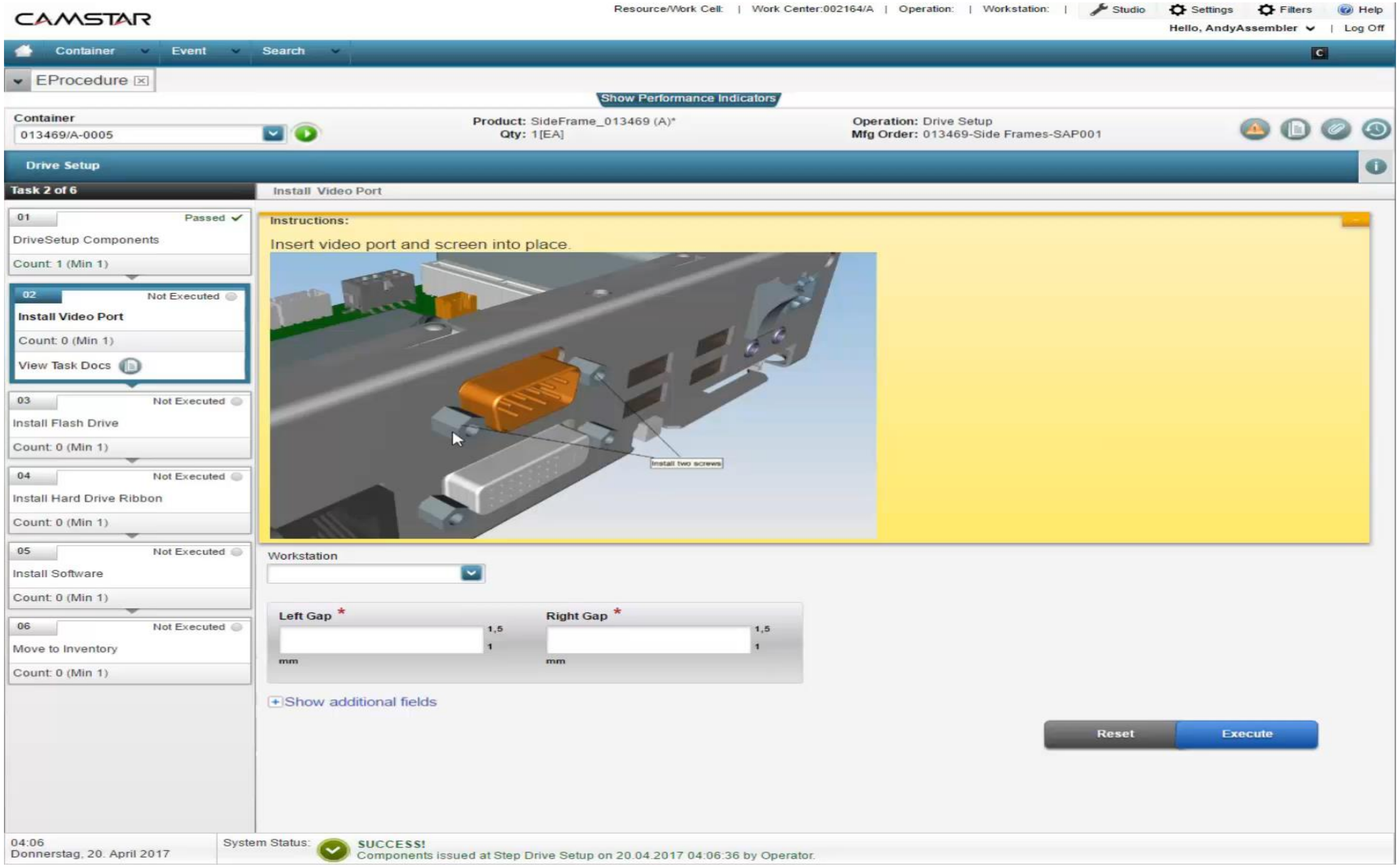
Collaborative interaction among Design, Engineering and Execution domains based on seamless integration



Machine-to-Machine Closed-Loop Feedback (POC)

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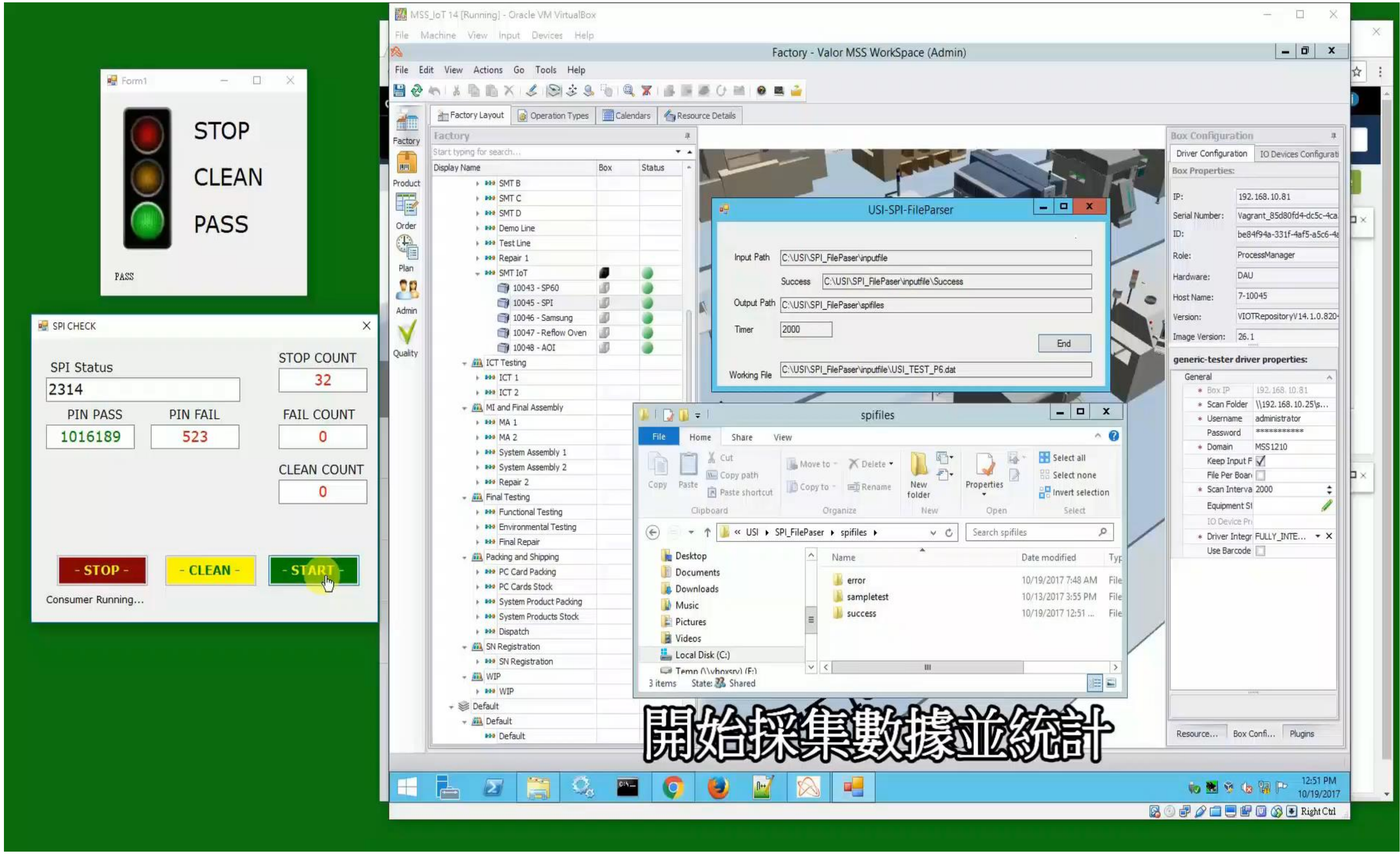
Automatically trigger equipment maintenance based on real-time quality metrics



Use Case Vacuum Gripper

Stabilization of packing machine by online monitoring of vacuum grippers

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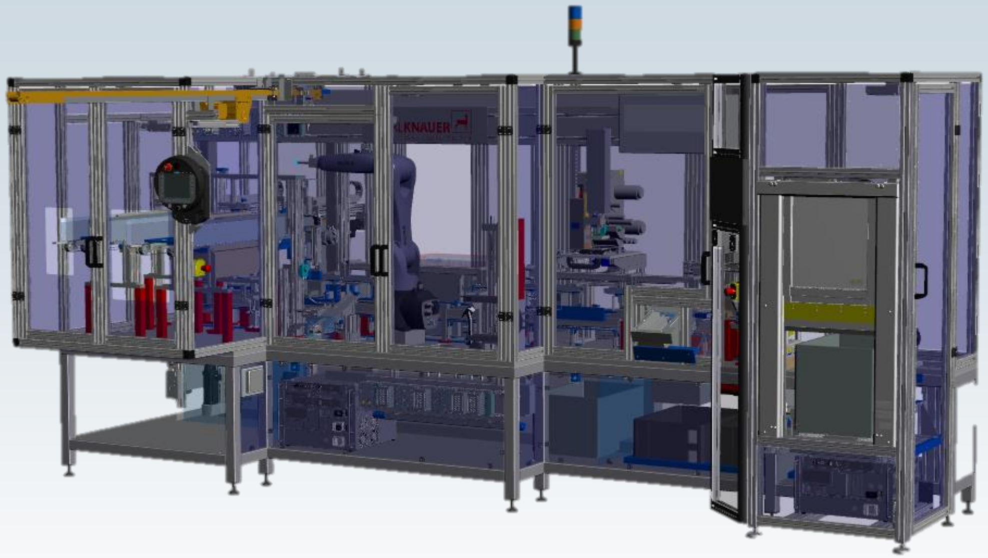
Challenge

 # Regular contamination of vacuum system due to heavy dust

 # Aggregation of process data without re-programming the PLC or intervention in the running process

In cooperation with

SCHMALZ



Splitting real time data for PLC and maintenance information for IT

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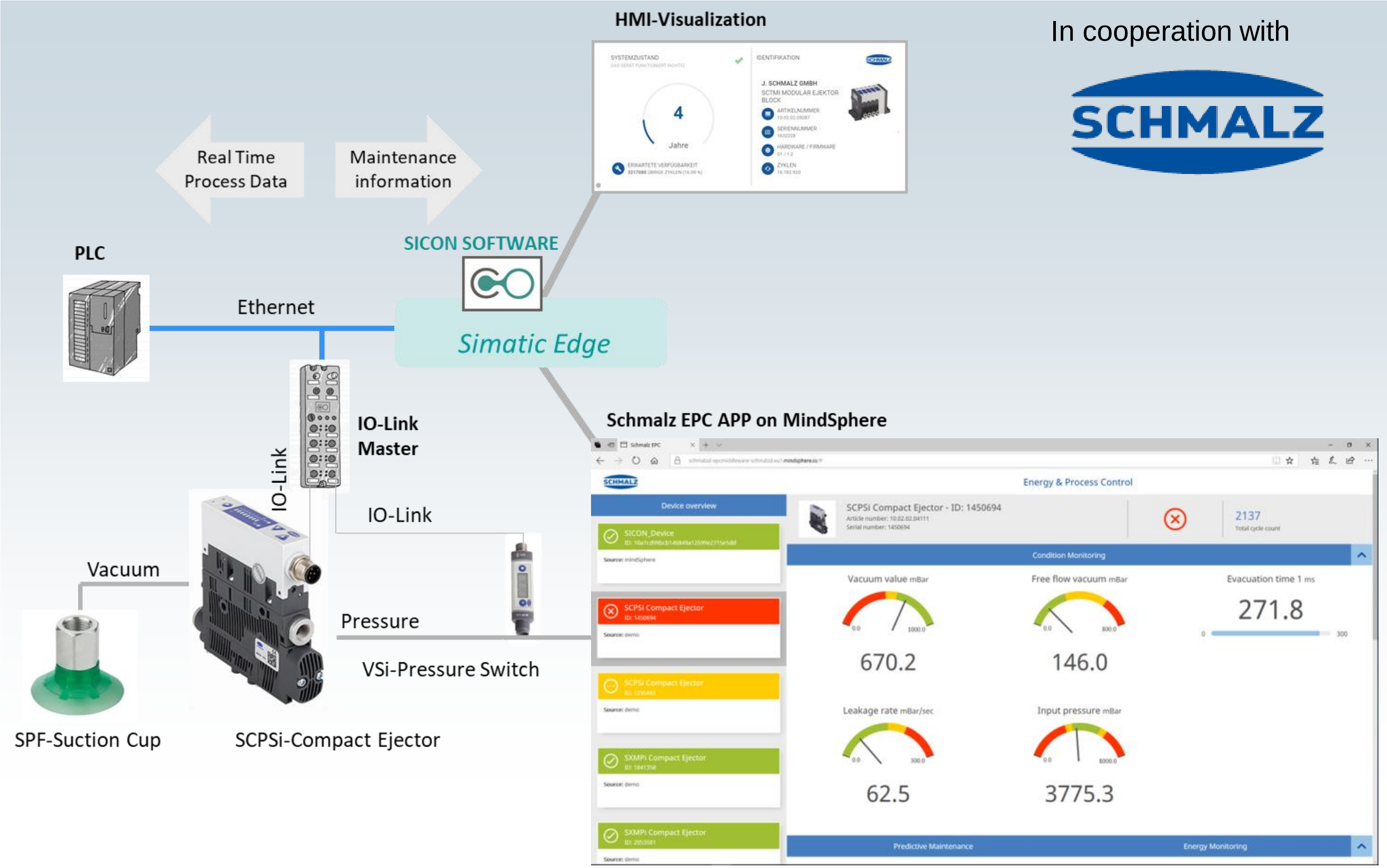
Solution

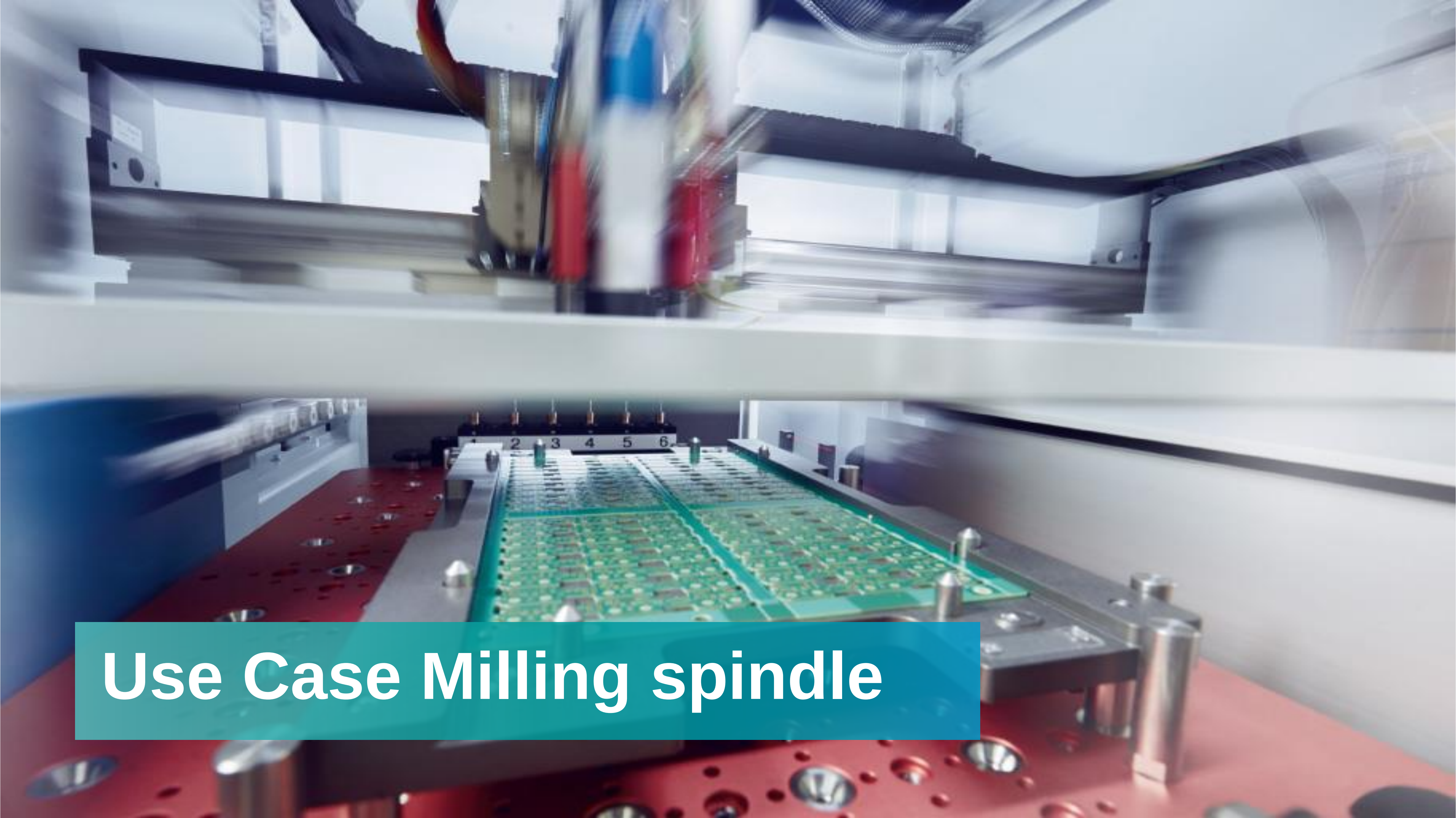
Easy integration of a Schmalz-specific condition monitoring in machine HMI and notification when to clean the filter

Utilization of the Schmalz EPC App with additional services

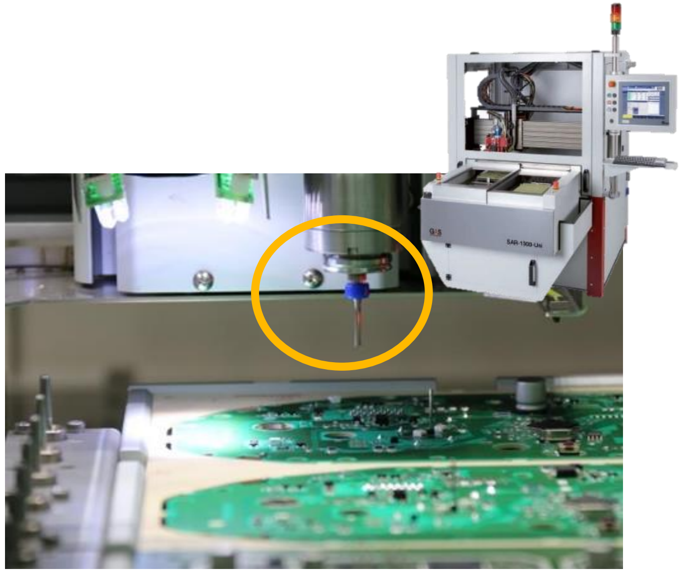
Scalable Plug&Play Connectivity

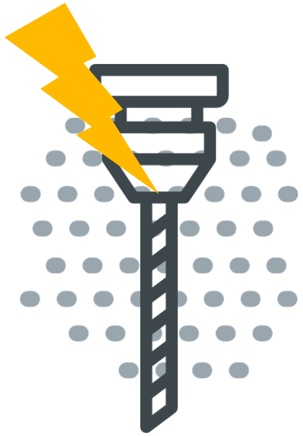


Use Case Milling spindle



Predictive Maintenance for depaneling machines





Objective:
Milling spindle in a printed circuit board depaneling machine

Problem:
Aggressive milling dust causes stiffness, which leads to machine failure

Target and approach:
Detect critical condition via current- and rpm analysis
- ✓ Edge app predicts downtime
- ✓ Cloud for alert & dashboard

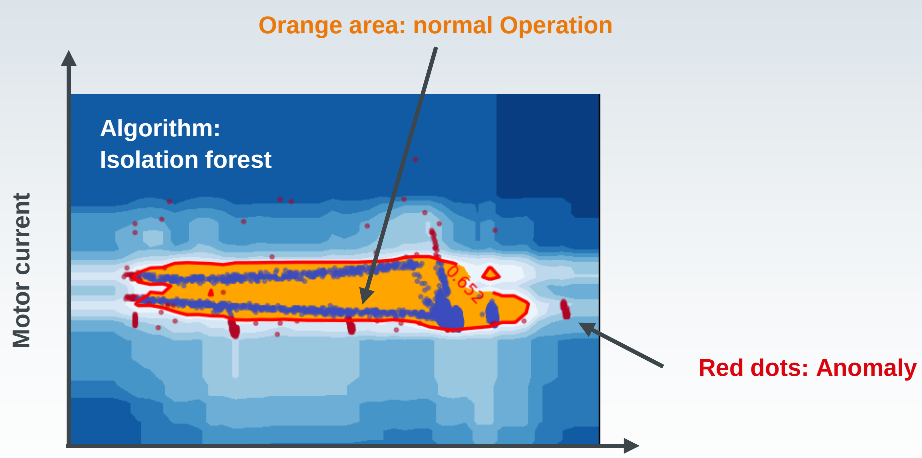
Best results by combining different analytic methods

Trend analysis

Target: Locate downtime period

Anomaly detection

Target: Set trigger for service routine



The algorithm detects downtimes up to 2 days in advance!

CHALLENGE

Using X-Ray test on every PCB is slow, expensive and reduces overall line performance

Solder paste

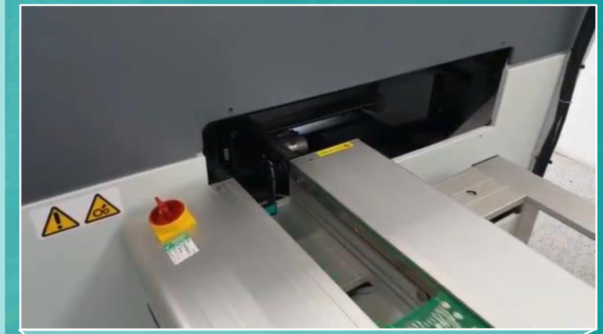
Root-cause for 60% of PCB Assembly issues

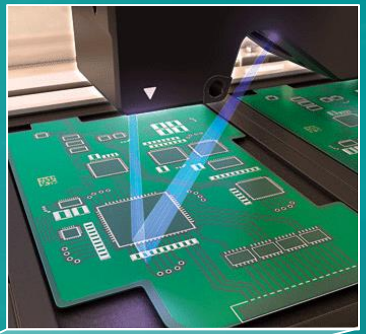
Solder Paste Inspection

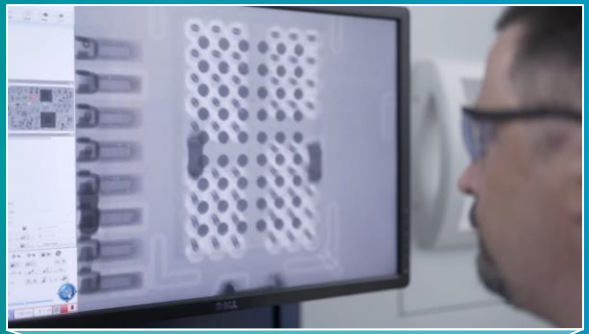
collects data about the applied solder paste

X-Ray Inspection

- Checks quality of solder joints after soldering
- Slow and expensive
- Potential process bottleneck







SOLUTION

Use solder paste inspection data to predict the need for X-Ray inspection of each PCB

RESULTS

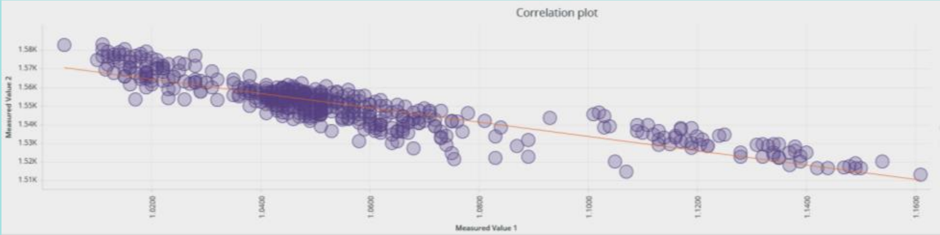
30% Reduced x-ray testing volume

10% Improved line utilization

1

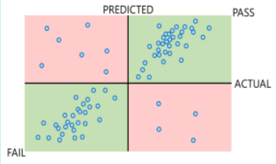
Collect solder paste and X-Ray inspection measurements and pass / fail data

2



Supervised machine learning algorithms – Determine which PCB can skip X-Ray inspection

3



Continuously re-train the machine model to increase prediction accuracy

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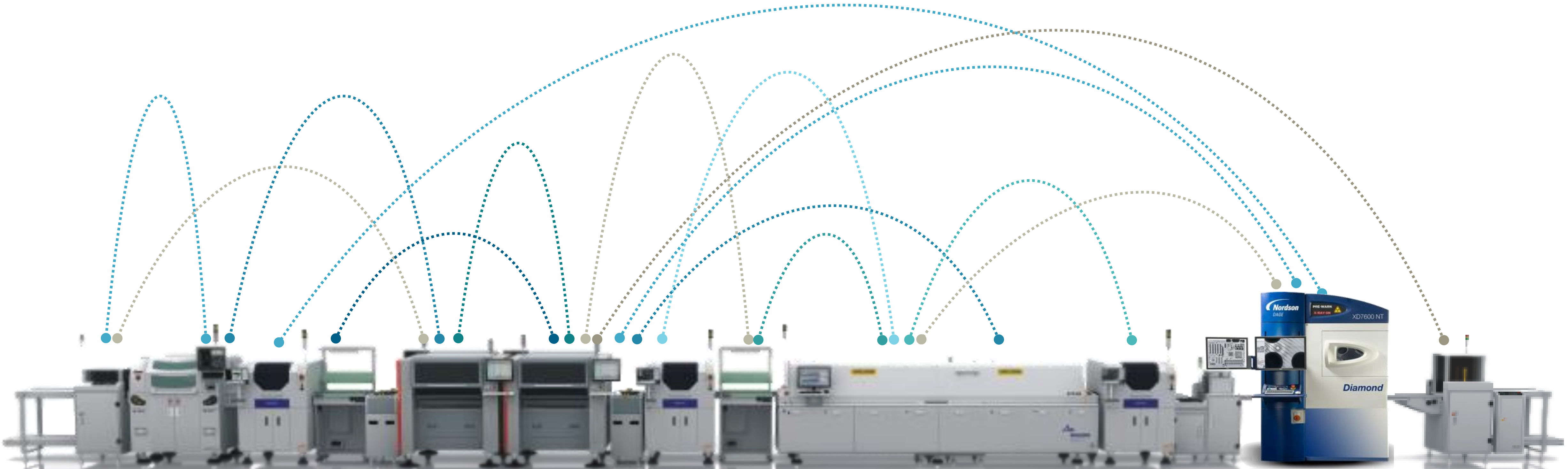
What is your vision?
We can do it together



Thanks; Tack

Frank Bleisteiner
DI FA MFG

Sagi Reuven
Valor BD