Process Automation for Discrete Manufacturing Excellence PADME

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HUVUDMAN: Teknikföretagen
GRUNDARE: swerea swedish research, KTH, The Swedish Production Academy, CHALMERS
Med stöd från: VINNOVA, Energimyndigheten, FORMAS, STRATEGISKA INNOVATIONS-PROGRAM
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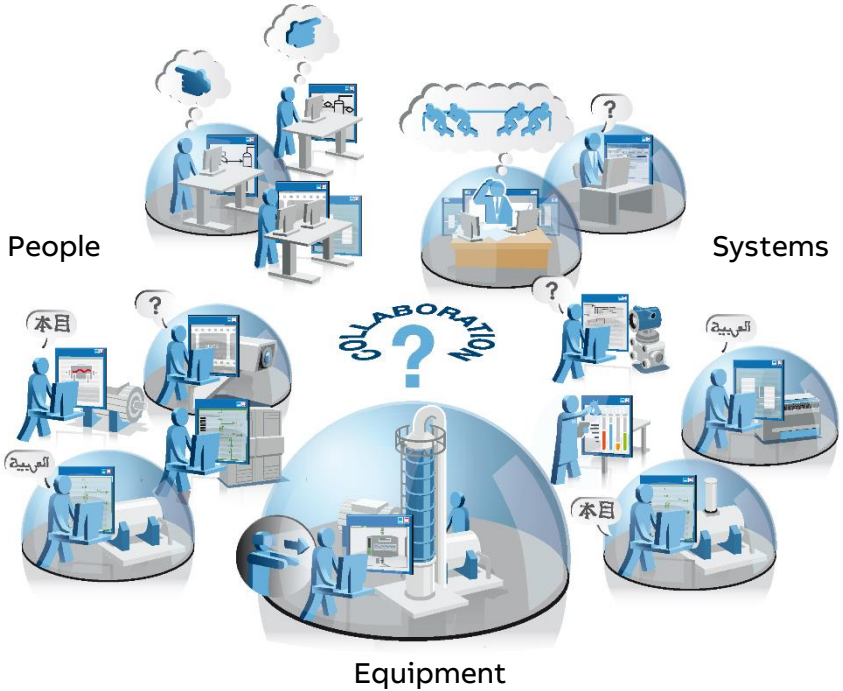
Content

- Industry problem
  - General
  - Interview results
  - Specific to robotic factory
- Available system solutions
  - System for collaboration support
- Solution
  - Description
  - Results (800xA integrations, visualization)

Industry Challenges



Industry 3.0

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People, Systems and Equipment Collaboration

Industry 4.0

Questionaire to measure digital maturity

System to System

Questions about how well systems are connected /integrated.

Equipment to Equipment

Questions about how well equipment is connected other equipment

System to Equipment

Questions about how well systems are connected/integrated to the equipment

Equipment to People

Questions about how well equipment are collaborating with people

System to People

Questions about how well systems collaborate with people

People to People

Questions about how well people collaborate with other people

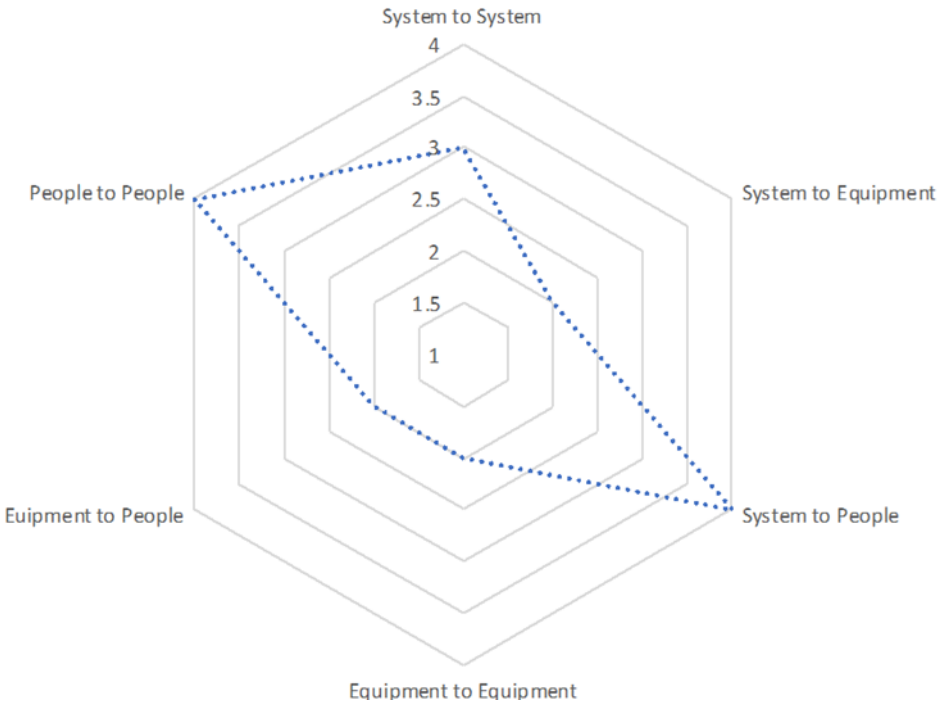
Plot of Digital maturity

Each question can be answered with a rating from 1 - 4

1 = not implemented

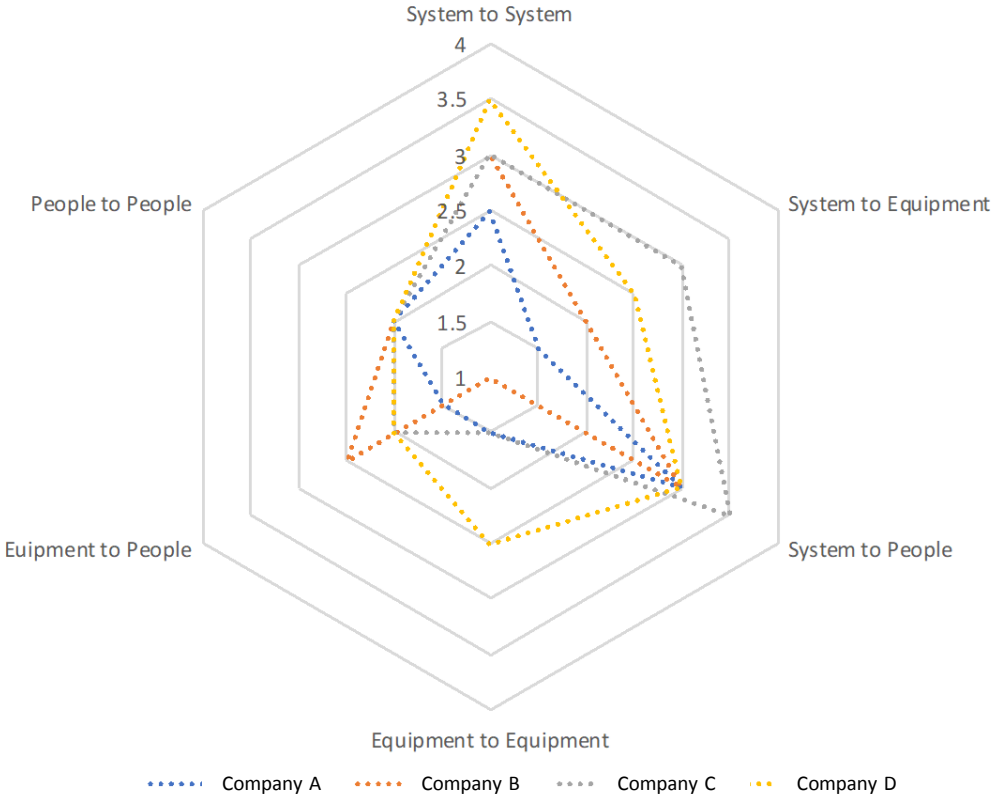
4 = fully implemented

The average in each dimension leads to a diagram to visualize the results.



Note: For the background interviews the interviewer made the rating based on the answers received. Within the report the information gained from the interviews were summarised according the dimensions to fulfil the need to gain background knowledge and identify potential use-cases.

Comparison -> Digital Collaboration Profiles



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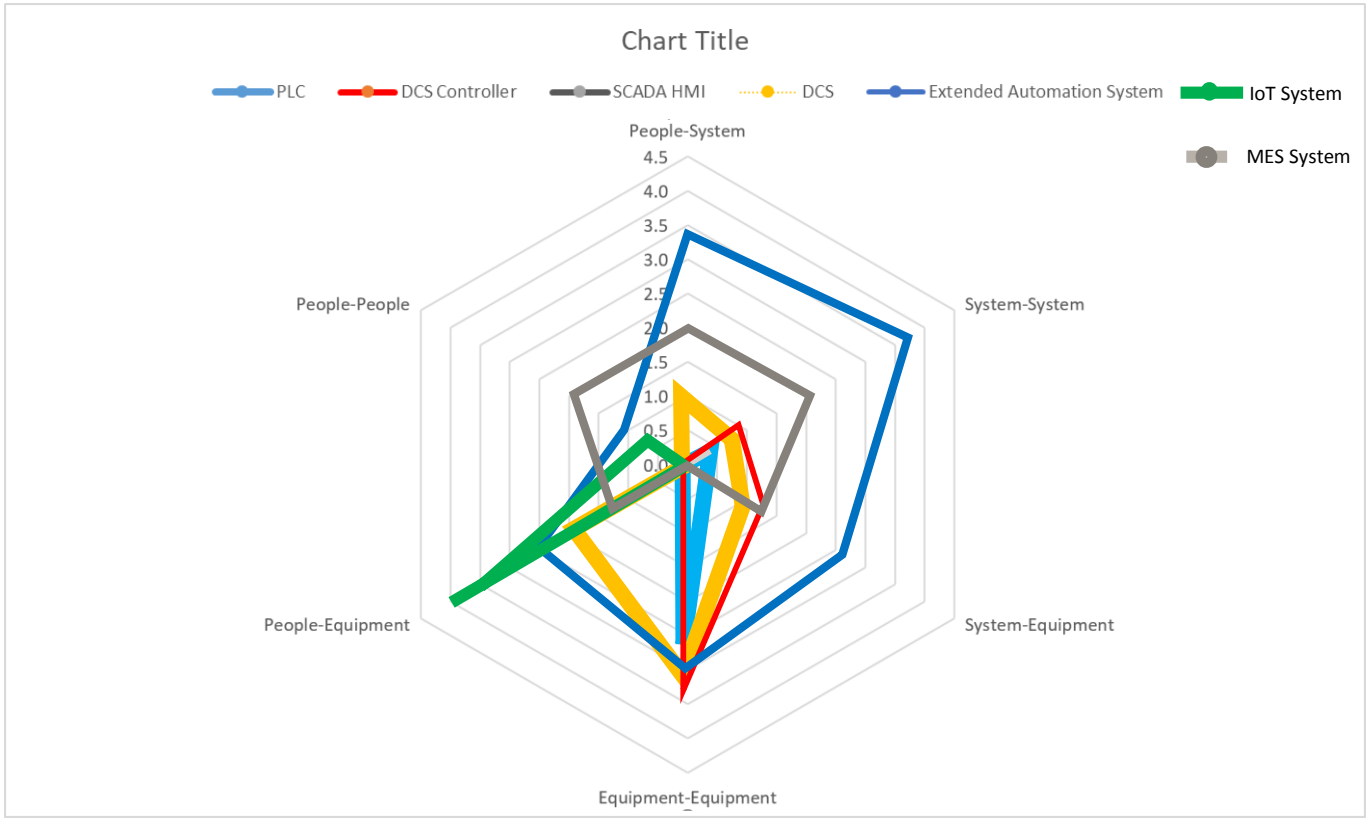
Collaboration values of Automation Systems



PLC: Programmable Logic Controller

DCS: Distributed Control System

SCADA: Supervisory Control And Data Acquisition

IoT: Internet of Things

MES: Manufacturing Execution System

PADME – Test Bed Objectives - Test Bed for the Smart Digital Factory

- Arena
  - The Production Line for the assembly of medium and large size Robots at ABB Robotics in Västerås
- Target
  - Decrease throughput times by 50% and level production through increased automation and digitalization
- Technical Solution
  - Create a digital twin of the processes (model the factory in 800xA system) with real-time information from the process
  - Implement applications to optimize operations

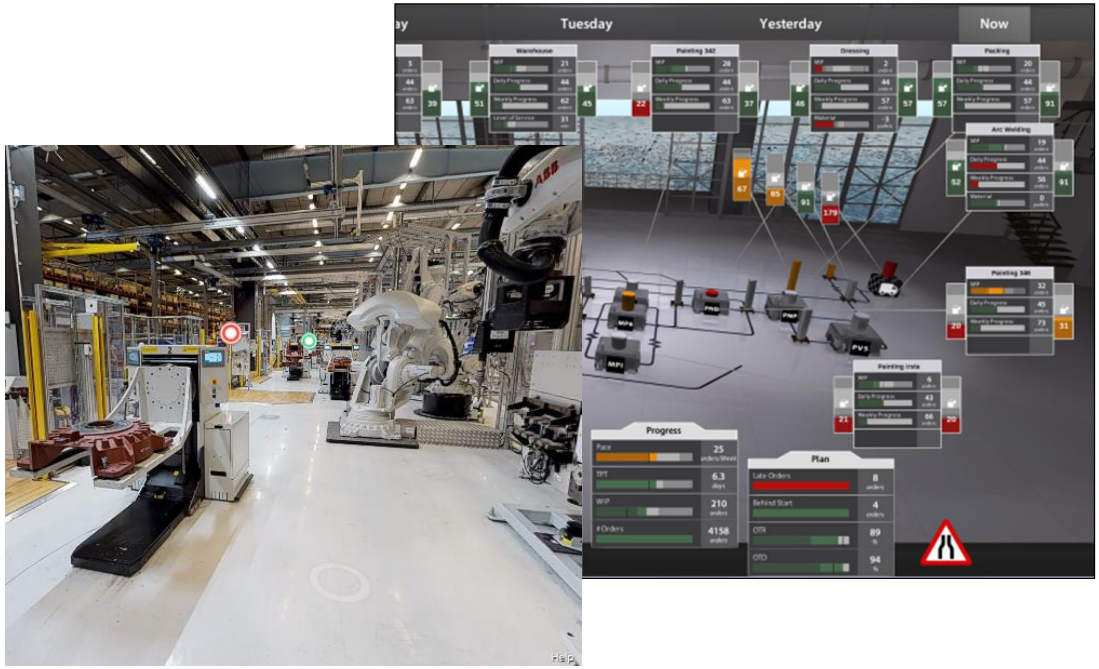


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ABB Robotics - Manufacturing of a Robot

Discrete manufacturing comprises of separate production units where each unit delivers part of the final product

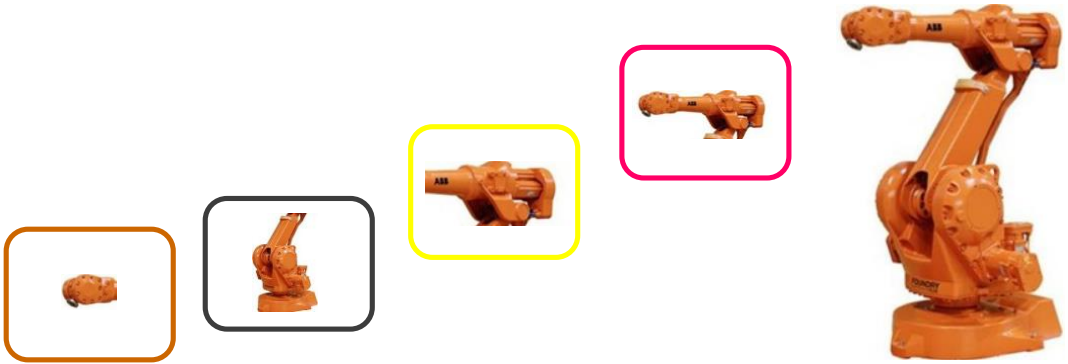
The manufacturing process is often divided in smaller steps called sequences

Each production unit is often a combination of manual and automatic sequences

Each production unit follows a production recipe, which is a set of sequences in a specific order mandated by design

Process controller within production unit:

- Often a controller exists within a production unit to control the execution of sequences
- There may exist production units that are fully manual and there is no controller within those sections

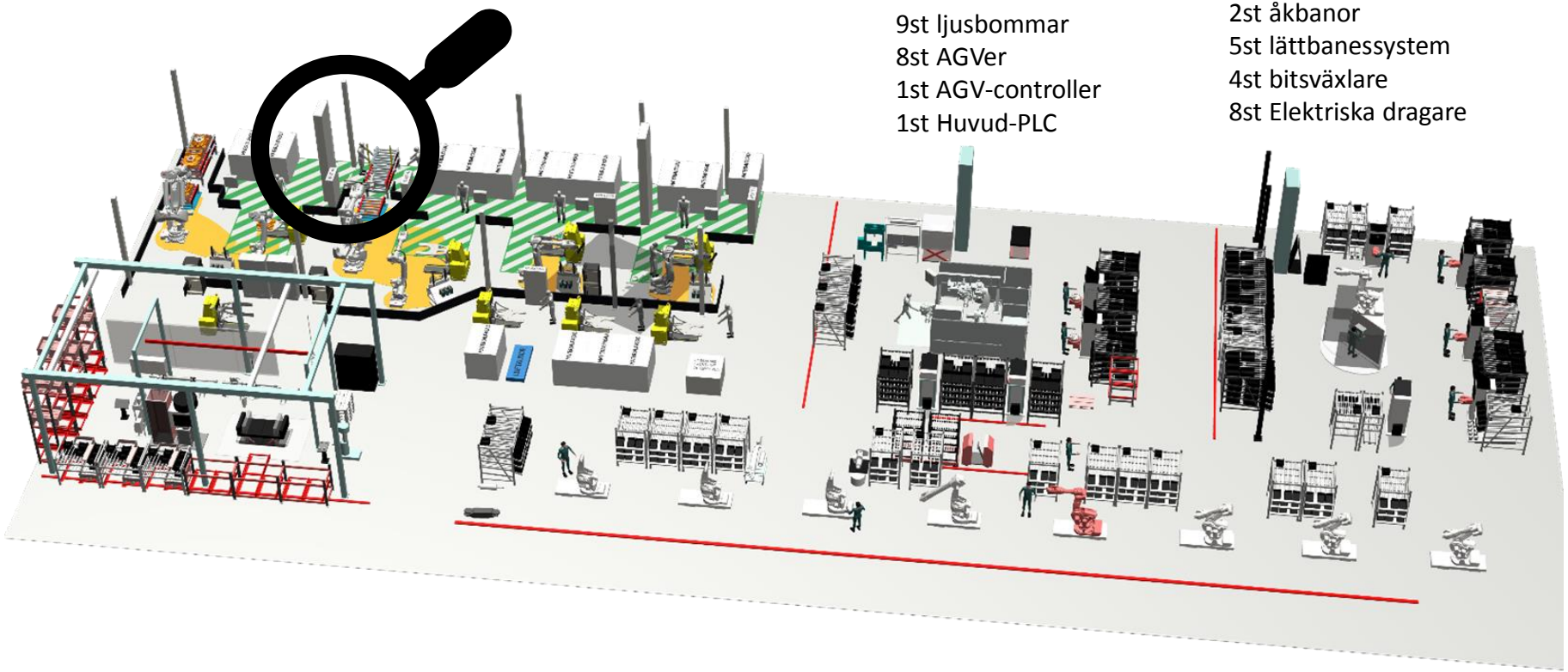


PADME

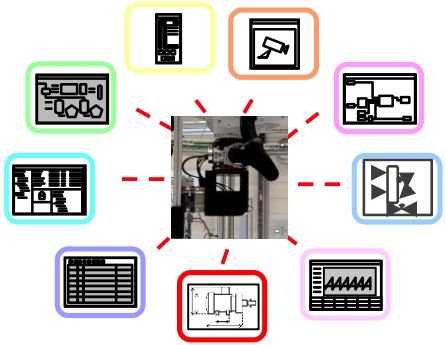
60+ collaborating systems

6st IRB
22st Säkerthetscannrar
9st ljusbommar
8st AGVer
1st AGV-controller
1st Huvud-PLC

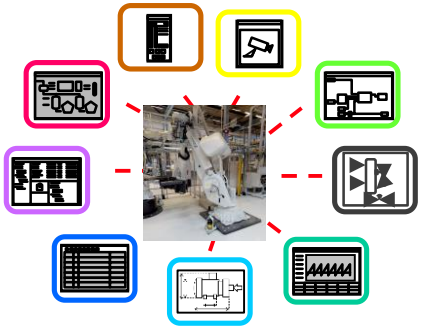
1st säkerhets-PLC
2st åkbanor
5st lättbanessystem
4st bitsväxlare
8st Elektriska dragare



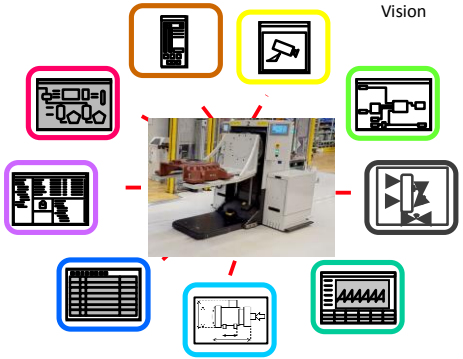
Assembly requires system collaboration



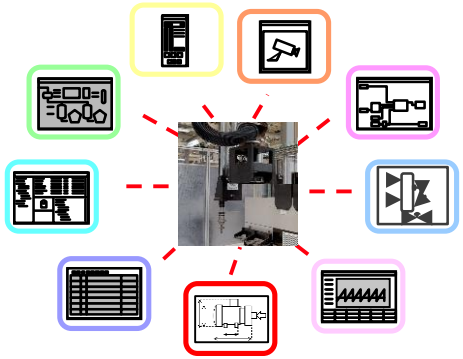
Vision



Robot



Automated Guided Vehicle (AGV)



Nut Runner

PADME use case: System Integration

Data sources

SAP

PLC

Robot Camera

Atlas Copco screw drivers

Assembly Robot

PADME

800xA

Modelling

Visualisation

Integration / correlation

Trend analysis

Solving Problems

Stop times,
Quality ,
Cycle time reduction
Throughput
etc.

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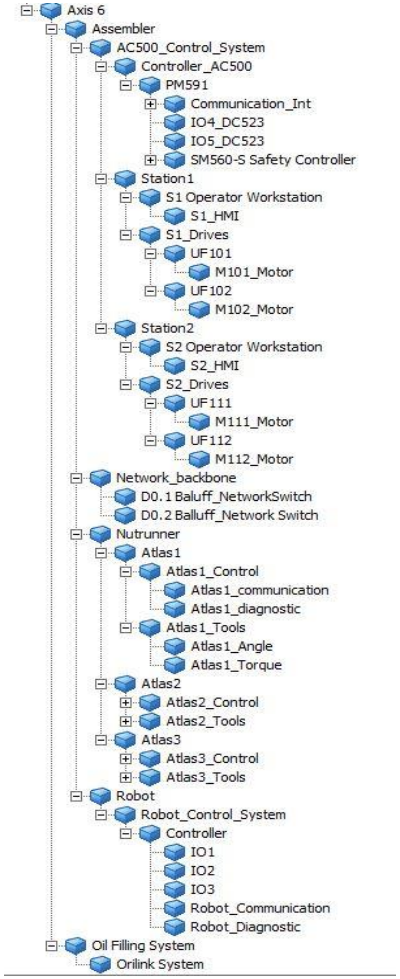
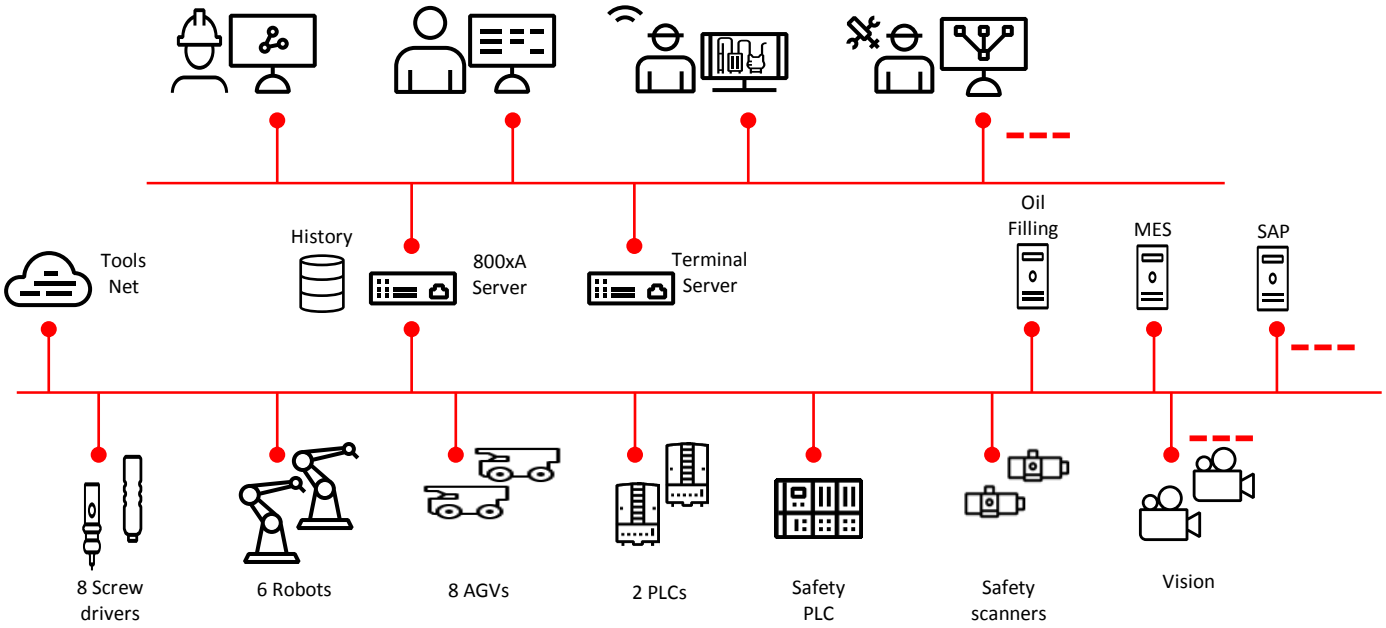
Manufacturing line Digital Twin model



PADME Systems Topology



PRODUCTION OVERVIEW

Ax 1 & 2

Manufactures Axis 1 & 2

Ax 3

Ax 4

AGW
Order 123456

AGW
Order 1236895

AGW
Order 234056

AGW
Order 1234890

AGW
Order 213647

AGW
Order 201364

< Production Overview

Ax 1 & 2

Order Number
1234 5678

Product
IRB6700

Variant
HL

WS 10 >

Order Number
1234 5678

Product
IRB6700

Variant
HL

WS 20 >

Order Number
1234 5678

Product
IRB6700

Variant
HL

WS 30 >

Order Number
1234 5678

Product
IRB6700

Variant
HL

WS 40 >

Order Number
1234 5678

Product
IRB6700

Variant
HL

WS 50 >

Order Number
1234 5678

Product
IRB6700

Variant
HL

WS 60 >

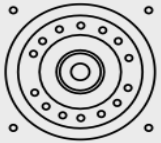
Order Number
1234 5678

Product
IRB6700

Variant
HL

WS 70

< Ax 1 & 2



Order Number
1236-14646

Product	Type	BOM	Recipe	Time Loaded
IRC5	Type A	1234-12364	1234-12364	12:55 Monday

ACTIVITY LOG

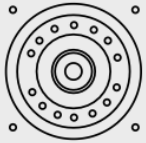
	ACTIVITY TYPE	START TIME	END TIME	DURATION	
	WS10 Bolt Axis 1 gearbox on foot	12:50:12	12:51:50	90s	›
☑	WS10 Vision system task 1	12:51:50	12:55:56	20s	›
	WS10 Bolt Axis 1 gearbox in stand	12:56:21	12:59:26	80s	›
	WS10 Vision system task 2	12:59:26	12:59:26	10s	›
	WS10 Bolt Axis 1 motor	12:59:26	12:59:26	20s	›
	WS20 Vision system	12:59:26	12:59:26	10s	›
	WS20 Bolt Axis 2 gearbox	12:59:26	12:59:26	20s	›
	WS20 Manual Ack	12:59:26	12:59:26	200s	›
	WS20 Bolt Axis 2 cover	13:55:46	N/A	Working ...	
	WS20 Vision	12:59:26			

VISION SYSTEM TASK 1 DETAILS

Image taken

Reference Image

< Ax 1 & 2



Order Number
1236-14646

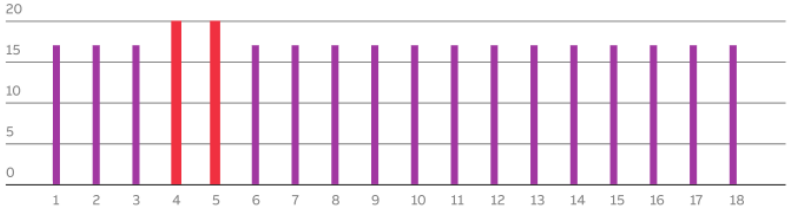
Product	Variant	BOM	Recipe	Time Loaded
IRB6700	HL	1234-12364	1234-12364	12:55 Monday

ACTIVITY LOG

	ACTIVITY TYPE	START TIME	END TIME	DURATION
WS10	Bolt Axis 1 gearbox on foot	12:50:12	12:51:50	90s
WS10	Vision system task 1	12:51:50	12:55:56	20s
WS10	Bolt Axis 1 gearbox in stand	12:56:21	12:59:26	80s
WS10	Vision system task 2	12:59:26	12:59:26	10s
WS10	Bolt Axis 1 motor	12:59:26	12:59:26	20s
WS20	Vision system	12:59:26	12:59:26	10s
WS20	Bolt Axis 2 gearbox	12:59:26	12:59:26	20s
WS20	Manual Ack	12:59:26	12:59:26	200s
WS20	Bolt Axis 2 cover	13:55:46	N/A	Working ...
WS20	Vision	12:59:26		

BOLT AXIS 1 MOTOR DETAILS

Bolt Axis 1 Torque



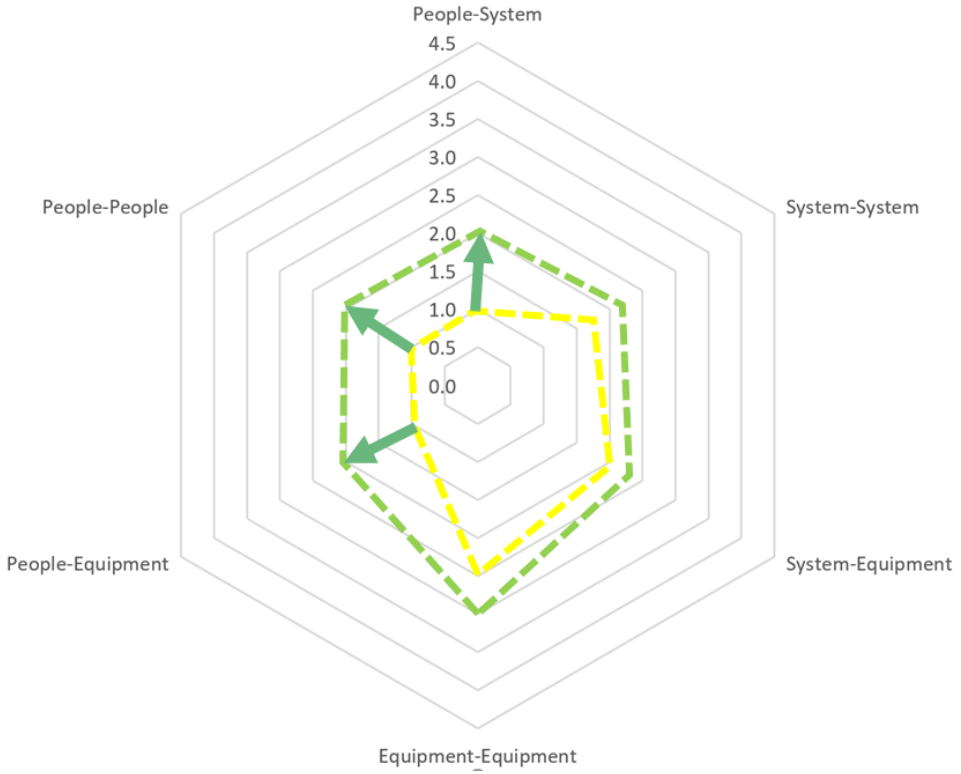
Duration for each bolt tightening

Bolt Axis 1 Error report

BOLT	FINAL TORQUE	RETRIES	Set Ok By
4	20	4	Operator
5	20	4	System

Collaboration values of PADME Solution

- Improvement areas
  - People – System
    - One environment with information from several systems
  - People – People
    - Visualization distributed to more persons
  - People – Equipment
    - More detailed information available through OPC-UA



PADME partners

Contributions per partner

LEVEL21

Level21 contributes with expertise in discrete manufacturing and ensure that selected solutions are of business value.

MDH

MDH will analyze digitalization maturity with respect to the possibility to build on CPAS logic in discrete manufacturing

RISE-SICS

SICS is responsible for the optimization models aiming at minimizing the cycle time, and monitoring and controlling the workstations' operations to ensure consistent performance.

ABB

ABB Process Industries is the main provider of technologies and expertise on IoT system architecture.
ABB Robotics provides the testbed as such and expertise in discrete manufacturing.

People, Systems and Equipment Collaboration

Besök oss gärna på produktion2030.se

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