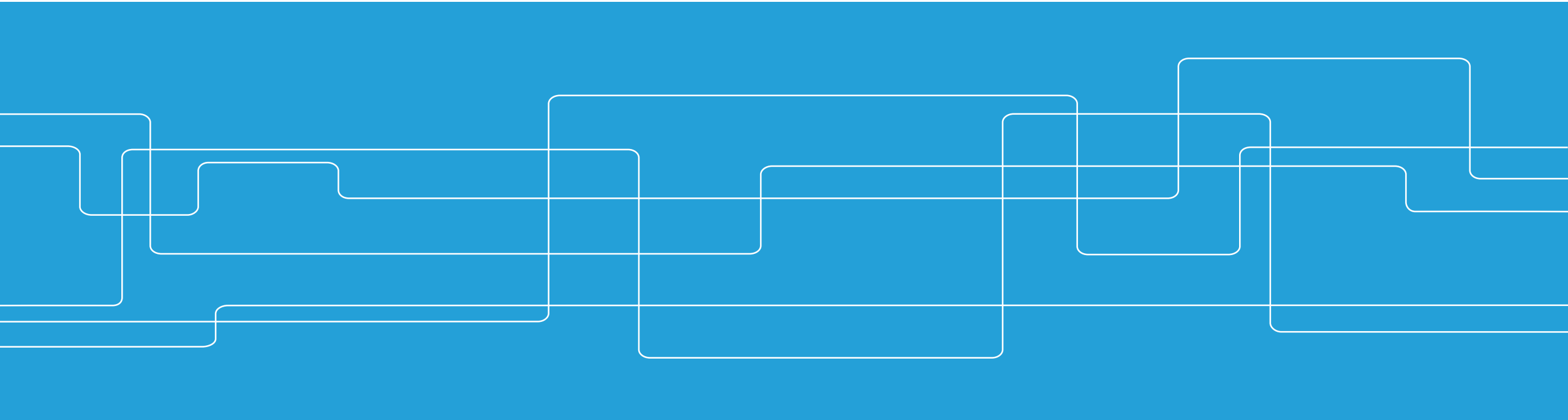# Prototyping Smart Manufacturing

A testbed project

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Introduction

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The DigIn Project is part of Produktion 2030, and is running between 2017-2020.
Six actors are involved: KTH, Eurostep, Scania, PMH, RISE/IVF, Solme.
A research project funded by the Swedish Strategic Innovation Program
Produktion2030, a joint venture of VINNOVA, Formas and the Swedish Energy
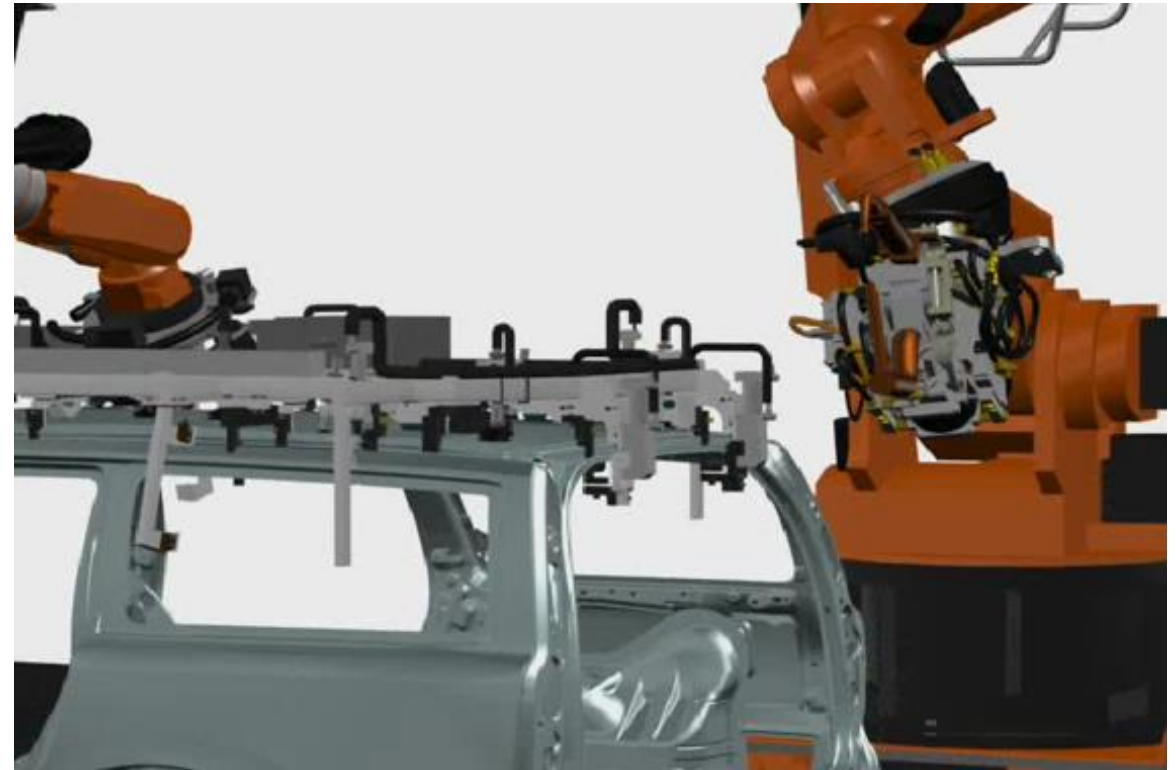Agency.

PRODUKTION2030

Industrial opportunities

Digital modeling and simulation

Automation

IoT with sensors and information on demand

Distributed control and communication standards

Industrial challenges

1. Products and manufacturing systems are complex, interdependent, systems.

2. The business is order based, creating customized products on order.

3. Both product, manufacturing systems and orders change and require up-to-date information.

1. Data in manufacturing is often unstructured, hidden and plentiful.

2. Manufacturing data needs to be elicited and transformed into information.

3. Challenge to combine the rich information from design with data from manufacturing to update models and make smart decisions.

Business

Manufacturing

Product lifecycle

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
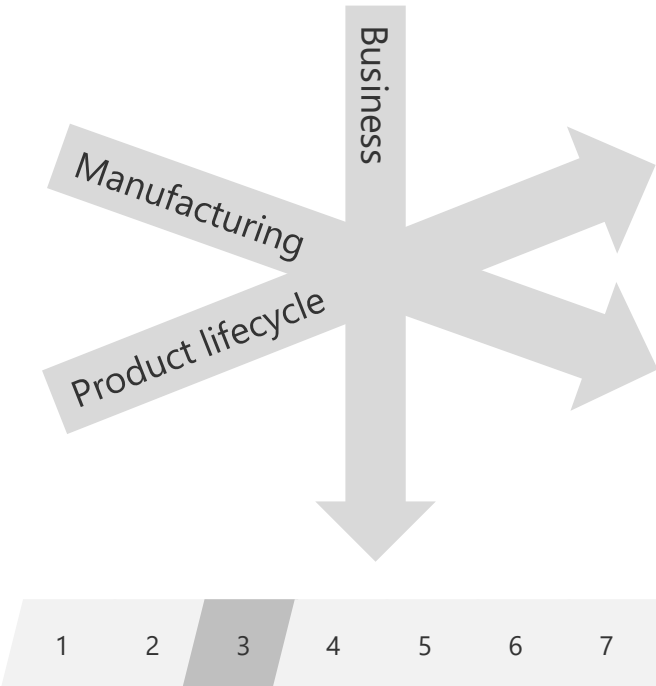
The targets of DigIn – an infrastructure for Smart manufacturing

Testbed for smart manufacturing
- Try out new technologies in line with Industrie 4.0

Create digital twins based on integrating engineering and production IT-systems
- Closing the gap between unstructured data, design structure and business process using standards – ISO 10303-239 PLCS

Updated Digital twins
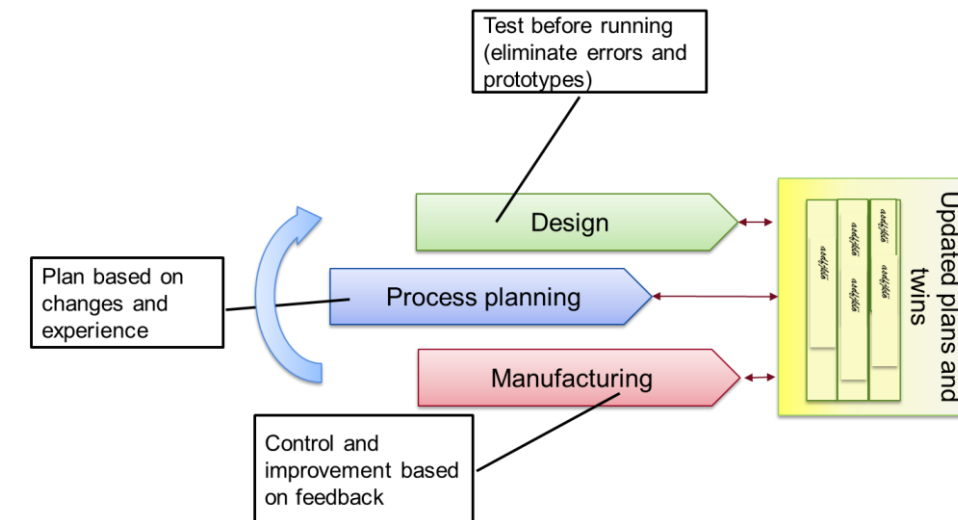- Digital twin kept up-to-date based on feedback, creating knowledge for next round

Reflecting industrial complexity
- Changes in interdependent products, production systems and orders

Open and cloud based
- Using Microsoft Azure makes it possible to use the cloud

Test before running (eliminate errors and prototypes)

Plan based on changes and experience

Design

Process planning

Manufacturing

Updated plans and twins

Control and improvement based on feedback

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Digital twins
Product (pedal car) – process (assembly) – resource (handheld torque tool)

The Digital Twin – A replica of the physical product and production system with all the information needed

Consolidating lifecycle stages and PPR-context
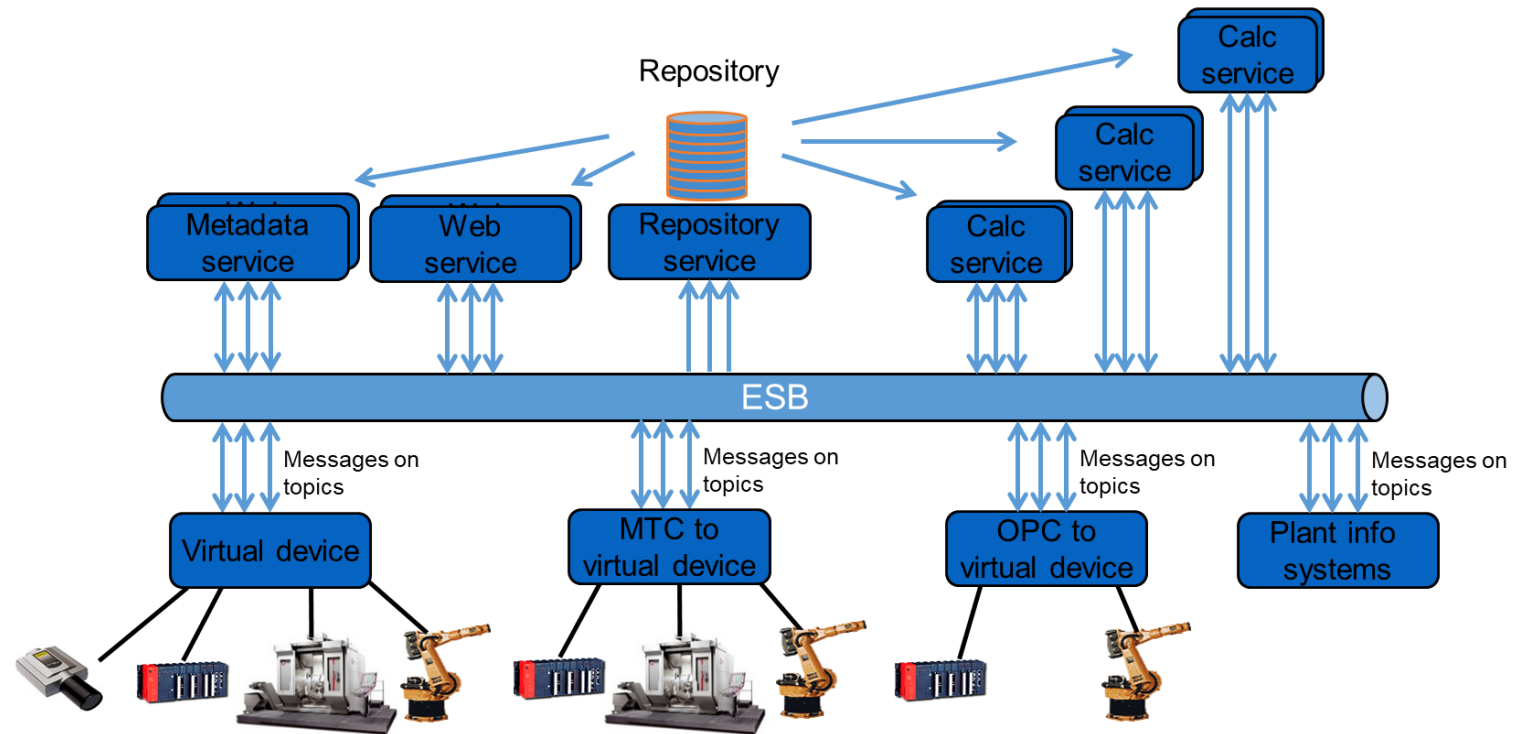
Key concept in the smart factory

As_designed

- Up to date versions of components
- Operations needed to assemble the product
- Operation sequence

As_prepared

- Details of how to assemble (How)
- Possible failures (Why)
- Types of tools
- Balanced tasks

Digital twins

As_realized

- Real-time data from resources
- Status of smart products

As_ordered

- Product variant
- Time & Place of production
- Correct versions
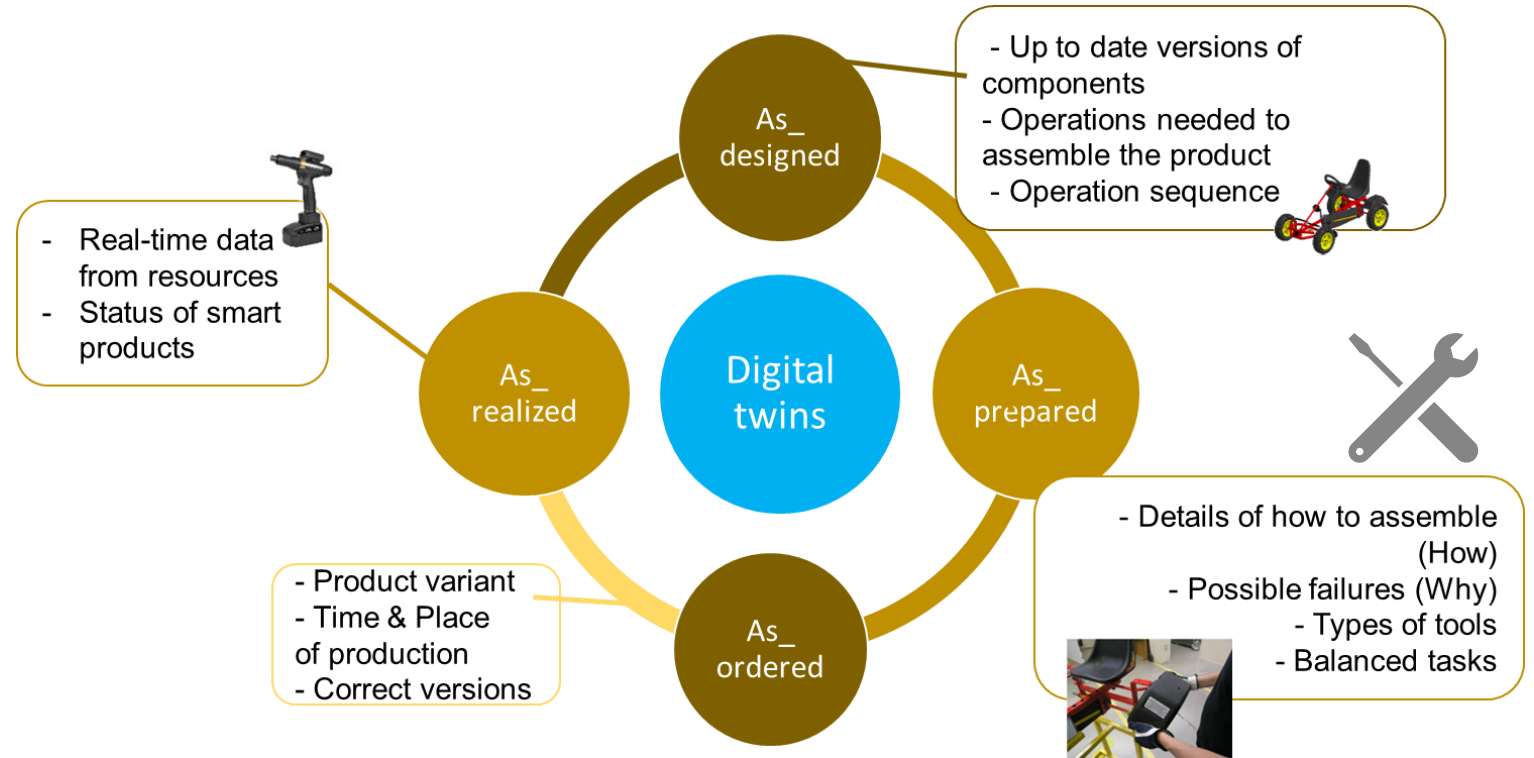
Infrastructure based on enterprise service bus

Messages sent on topics in Kafka service bus

Communication like Twitter

Result from previous research projects in manufacturing

Extended to engineering applications in assembly

Repository

Metadata service

Web service

Repository service

Calc service

Calc service

Calc service

ESB

Messages on topics

Virtual device

MTC to virtual device

OPC to virtual device

Plant info systems

Digital factory

Design & Engineering applications

Manufacturing applications

Information

Structured data storage

Unstructured data storage

Data analysis applications

Digital factory
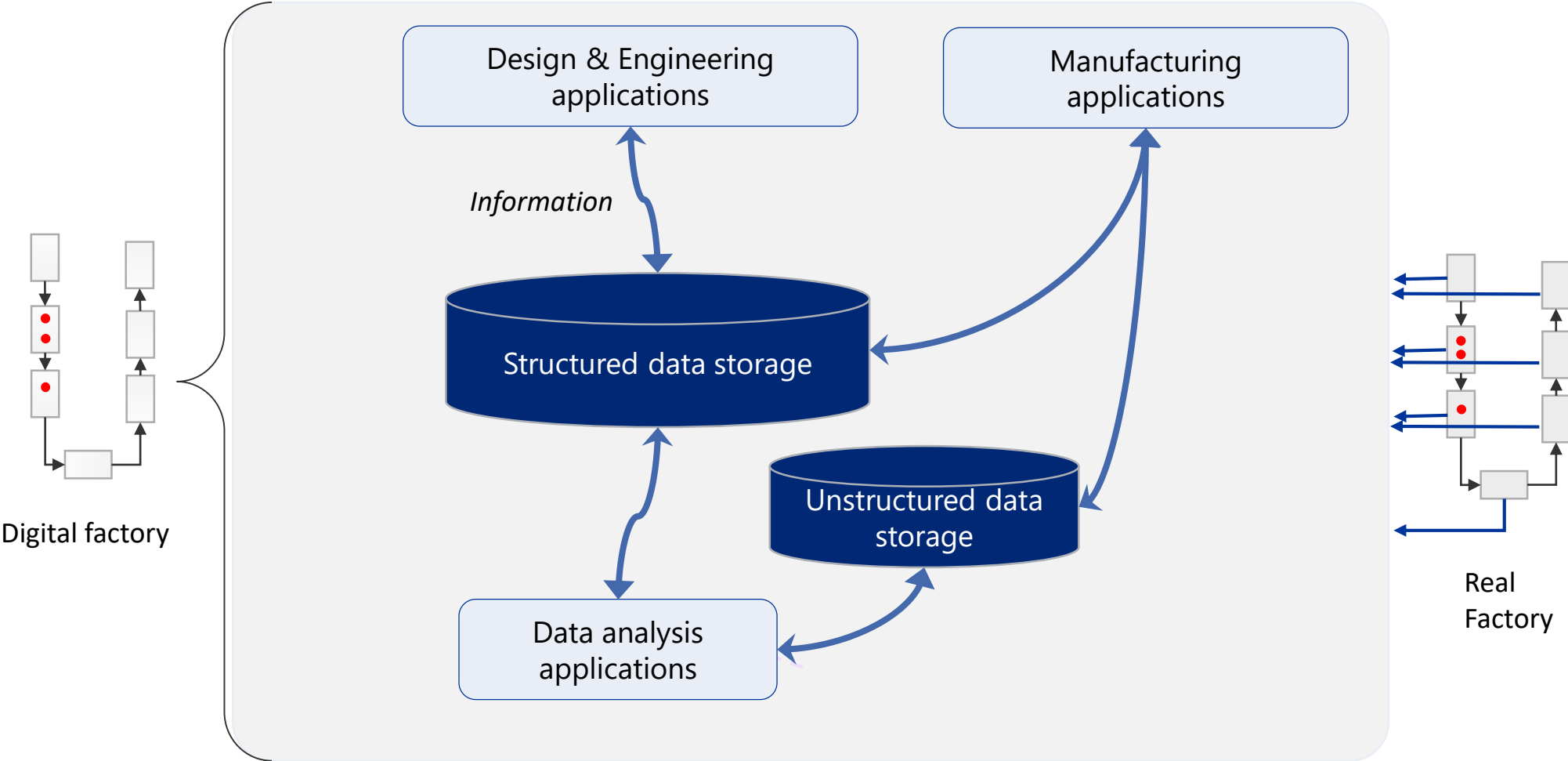
Real Factory

Digital factory – a combination of applications and models
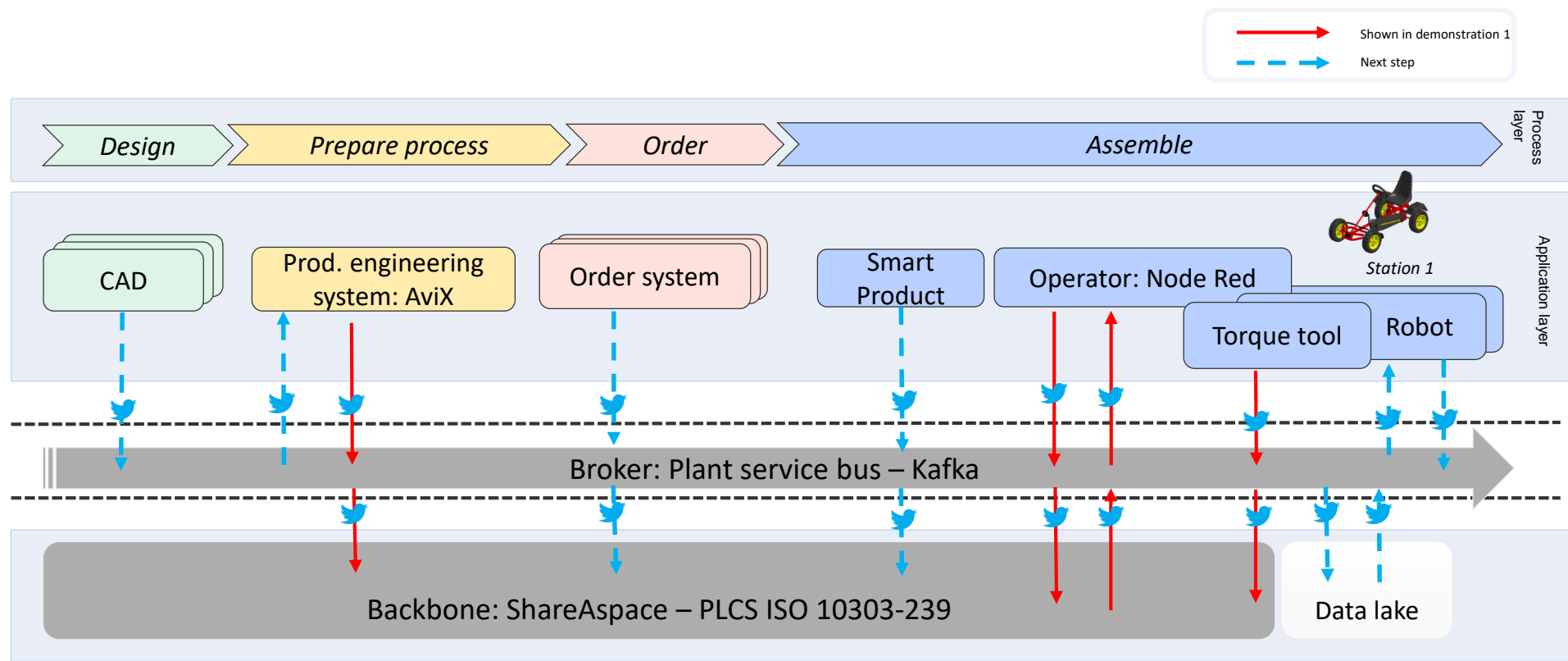
Communication of information is happening *non-sequencially*

Implementation as of now
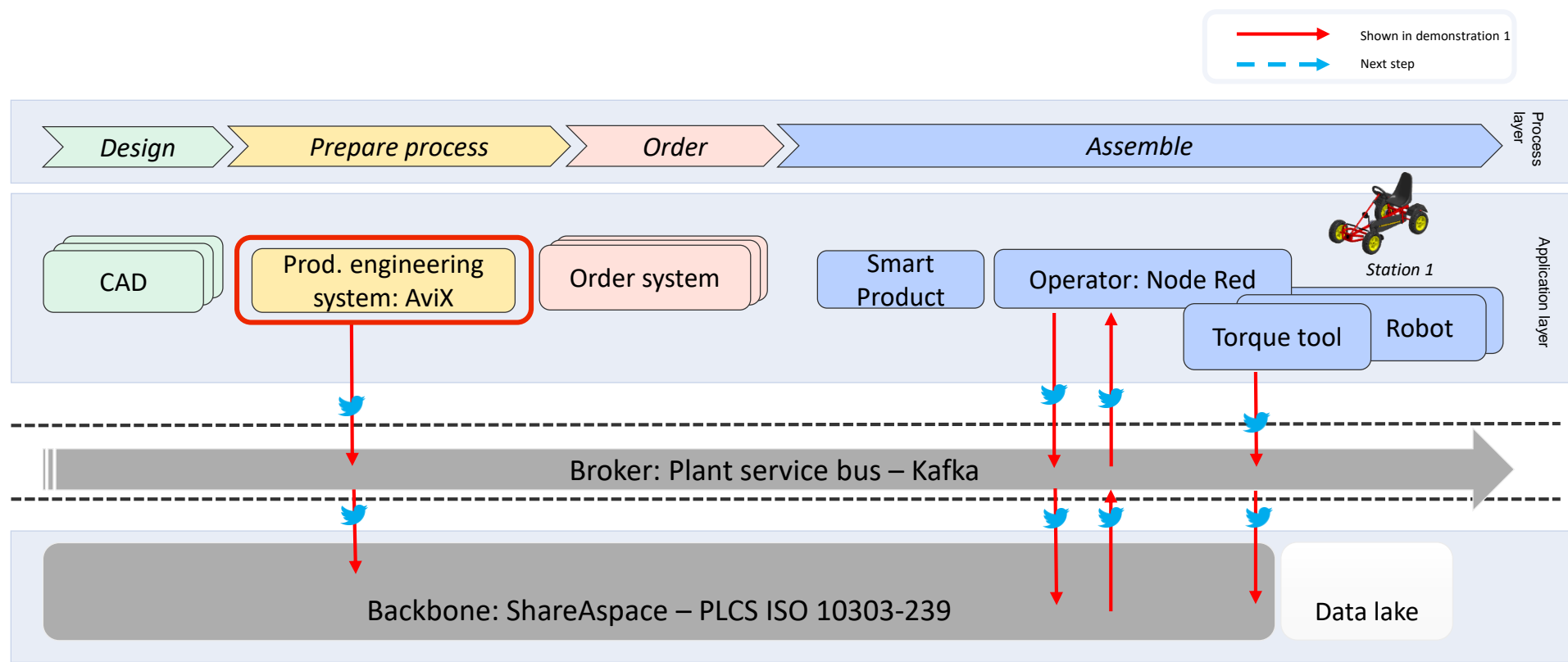
AviX

Production Engineering System

Implementation as of now

- Shown in demonstration 1
- Next step

Process layer

Design → Prepare process → Order → Assemble

Application layer

CAD | Prod. engineering system: AviX | Order system | Smart Product | Operator: Node Red

Station 1

Torque tool | Robot

Broker: Plant service bus – Kafka

Backbone: ShareAspace – PLCS ISO 10303-239 | Data lake

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

ShareAspace

Information Backbone and Information Hub

Implementation as of now

Shown in demonstration 1

Next step

Process layer

| Design | Prepare process | Order | Assemble |

Application layer

- CAD
- Prod. engineering system: AviX
- Order system
- Smart Product
- Operator: Node Red
- Torque tool
- Robot

Station 1

Broker: Plant service bus – Kafka

Backbone: ShareAspace – PLCS ISO 10303-239

Data lake

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Node Red

Operator information – connects hardware devices, APIs and different services

Station 1 - Task by Task

Please select desired task:
9

SCANIA

Task Nr.	Instruction	Time [sec]	Component	Tool	Required Torque	Consumable	Qty.
Station 1 Task 9	Momentdra vänster skärm	1.44		ETV STB-30-10-B	2 Nm		

Implementation as of now
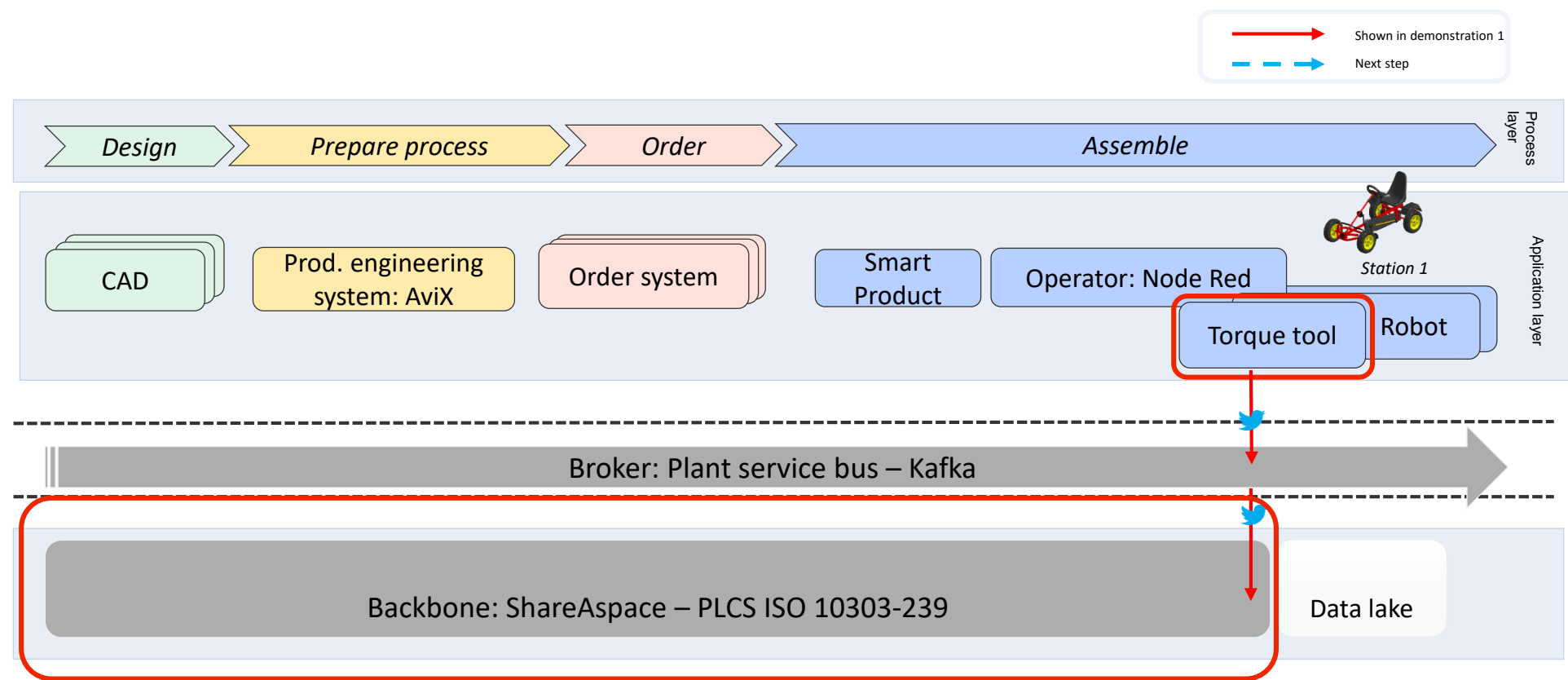
Connection to assembly line

Connected Torque Tools

To conclude

- **The digital factory is**
  - A combination of applications and models

  - Structured and unstructured data

- **Storing lifecycle data on the digital twin**
- **Information hub (ShareAspace) based on PLCS ISO 10303-239**
- **No information silos – all information exposed and available through the hub**
- **One of the defined ways of implementing administration shells**
  - Exposing standardized information about physical assets through the hub and through the twittering bus communication

What is next?
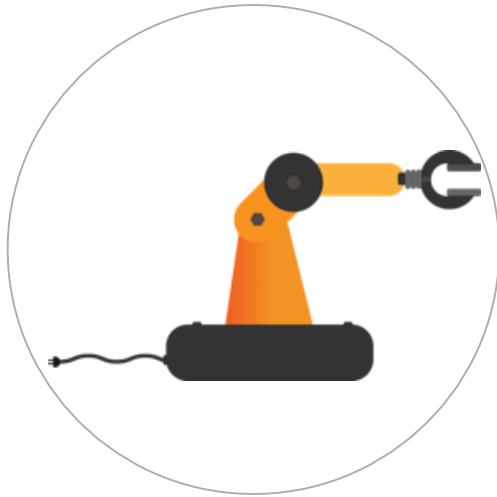
Adding IRBs
Adding a robot

Adding Smart products
Making the products contain their own information

Digital twin feedback
Knowledge source for early phases

Thank you!

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