Predictive Maintenance use case report

Describing the value potential and design of this use case

NL AI Coalition

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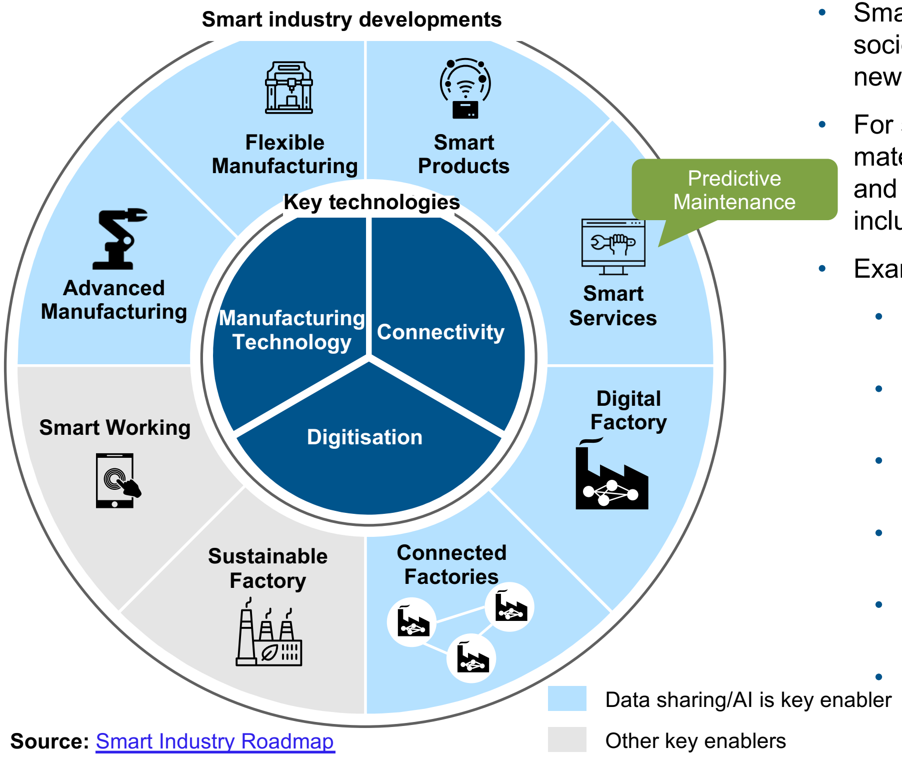
Data Sharing and AI are key to realise economic and societal benefits of Smart Industry

Data sharing and AI are key enablers in Smart Industry…



Source: Smart Industry Roadmap

… and realise both economic and societal benefits

- Smart Industry, also known as Industry 4.0, is essential for society to tackle societal challenges and for industry to remain competitive. It is is driven by new technological developments
- For society, the impact of a Smart Industry is e.g. reducing use of raw materials and energy, producing required materials for sustainable energy and affordable medical equipment. The economic benefits are also numerous, including increased productivity and GDP and more resilient supply chains
- Examples of data sharing and AI per smart industry development include:
  - Advanced Manufacturing: In zero defect manufacturing data is shared throughout the process on customer requirements
  - Flexible manufacturing: Data sharing enables shorter delivery times by digitising communication in the procure to pay process
  - Smart Products: Products are connected (IoT) and contain (embedded) intelligence
  - Smart Services: Predictive (condition based) maintenance by combining data from different sensors for use in AI models
  - Digital Factory: Using digital twins for products, equipment and processes
  - Connected Factories: Digital Twins are shared between factories using industry standards and without vendor lock-ins

An AI Data space for enables Predictive Maintenance by solving current challenges regarding scalability, standardisation and security

Smart Services (Servitisation) is the trend that capital goods, such as complex machines, are not just sold as a product but also offered as a physical component of a service: the availability of the equipment is what is being sold, often in a performance-based contract. Examples include Predictive Maintenance and leasing hardware products including required financing

(Predictive) Maintenance

- **Many systems are not optimally** used as they are either maintained too early or fail unexpectedly
    - Traditional maintenance concepts commonly applied in industry rely on pre-determined fixed intervals for maintenance tasks
    - However, degradation of systems is a dynamic process, governed by changes in both the system and its environment
- The ambition within Smart Industry is to achieve just-in-time maintenance or **Predictive Maintenance**
    - This will lead to a reduction of costs and an increase of system availability
    - To realise these benefits, completely monitoring the (production) system health and performance is needed. Data often already exists within the system's sensors used for process control, but is not yet shared for analysis

AI Data space challenges

Scalability of data sharing infrastructure, which is needed as many organisations are collaborating in the manufacturing industry

Standardised digital twin, as in analysis data is combined from equipment, products, etc

Security/Data sovereignty (control over one's data) as data often concerns commercially sensitive information

Source: Smart Industry Roadmap

In this use case, TATA Steel and IJssel technologies apply AI-based Predictive Maintenance using NLAIC data sharing building blocks

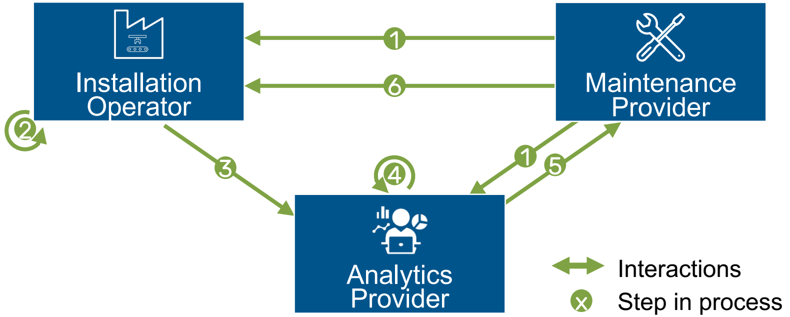
Use case introduction

- Tata Steel has developed a data strategy for reducing costs and climate footprint of steel for European car manufactures
- The continuous casting process is essential for producing steel coils according to the strict quality norms for cars, where parameters like temperature, pressure and speed determine the quality of the coils
- IJssel technology is responsible for maintenance of rolls used in the continuous casting process. Currently, this maintenance is done on pre-determined fixed intervals
- The challenge for realising predictive maintenance is organising trust for data sharing and for applying AI models on the shared data

Goal of this use case

- The goal of this use case is to show that AI based predictive maintenance can be realised based on data sharing in a data space, where data is only shared in a controlled manor
- Three main research questions will be covered:
  - What value is generated in this use case for Tata/IJssel?
  - How can existing (NLAIC) building blocks be re-used for predictive maintenance
  - What additional building blocks are needed to realise this use case?

Data sharing interaction model



Steps in process (simplified)

1. The Maintenance Provider (MP) requests development of a specific AI model at the Analytics Provider (AP) and shares a digital twin of the installation equipment with the Installation Operator (IO)
2. The IO loads the digital twin with usage data from the equipment
3. The IO shares the digital twin with usage data with the AP
4. The AP creates the AI model and executes it on received data
5. The AP shares the insights from the AI model with the MP
6. The MP provides predictive maintenance based on the insights from the AP

TATA STEEL IJSSEL The NLAIC Data Sharing working group has supported TATA Steel and IJssel in this use case

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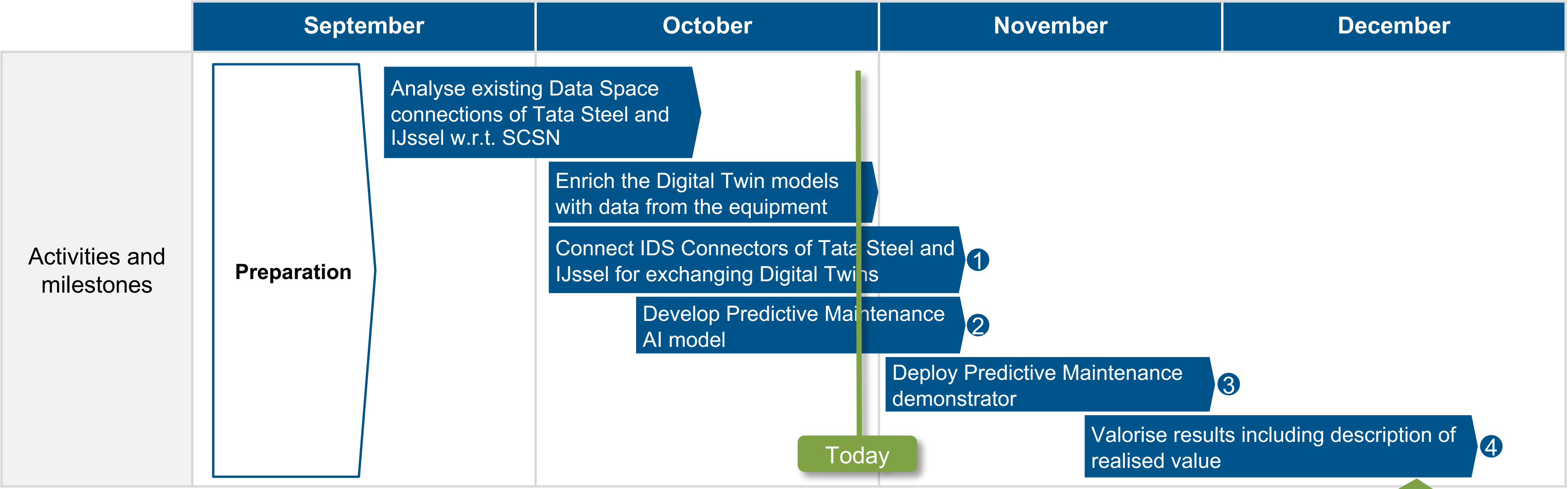
Plan of approach for the use case realisation

Timeline for use case realisation



Deliverables:

1. IDS based Data space connection suitable for exchange of Digital Twins
2. Predictive Maintenance AI model
3. Predictive Maintenance demonstrator
4. Use case report including main findings and lessons learned

Activities

Results will be presented in various relevant stakeholder groups within and outside NLAIC

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Collaborative Condition Monitoring (CCM) using predictive maintenance case (business case)

- CCM will demonstrate data-driven distributed environments up to TRL 7/8 in one manufacturing application (industrial machinery and Steel Coils for automotive applications) by bringing together its value chains stakeholders - an OEMS and IJssel as an industrial suppliers/technology provider. CCM brings organisations fostering standardisation approaches and adopting the current open-source toolkits from IDSA to widen availability of the proposed solutions.

- The main goal of the current experiment is to realize a paradigm shift to provide the European Industry a Resilient and Sustainable Manufacturing drive by Open and standardized Manufacturing Data Spaces framework supporting the digital and green transition of production systems, prioritized in SMEs. CCM will leverage Industrial Internet Standards strategies (RAMI 4.0, Asset Administration Shell, IDS) for data-driven manufacturing setting up digital and standardized value chains.

Smart Industry specific challenges

Data is becoming the core engine of businesses. Data allows extracting, exchanging and sharing value out of the myriad of production and service chains that are no longer under a centralised distribution. As a result, a trust reliable Data Space will transform market dynamics by:

- Better management of individual equipment and the entire ecosystems;
- Improved uptime by constantly monitoring the condition and performance of systems and equipment;
- Cross-fertilization business opportunities through the A.I. analysis of processes and services; and
- Control to data owners control on who is using their data and for which purpose.

- Our real-world experiment

to set up predictive maintenance would help a lot in becoming more sustainable. Much CO2 could saved by doing maintenance on-time instead of on a fixed regular base. This experiment can be part of the exploitation pathway to scale up, replicate, and extend our value proposition to other Europe manufacturing stakeholders.

Interoperability of data and formats (Industry 4.0 standards)

- Together with the deployment of frameworks for data governance, is another technical challenge directly linked to the deployment of sectorial and cross-sectorial European Data Spaces and data sharing . To cope with this issue, the concept of cyber-physical systems (CPS) and Digital Twins
- Digital Twins (DT) were introduced to create a uniform digital representation of assets in the production value chain and solve the issue of the massive heterogeneity of technologies and information models in the industrial environment. will use of the Asset Administration Shell (AAS), the implementation of the DT within the Reference Architecture Model for Industry 4.0 (RAMI4.0), to transform, organize, and standardize industrial data so that it satisfies FAIR principles.

- The experiment:

Currently, limited universally useable AAS submodels are defined and very few free submodels to support AI-based industrial applications. As an SME we would like to pioneer the use of practical AAS Models on top of the IDS Data Space.

Data Sovereignty

- Data sovereignty has become a priority for companies willing to keep the control over their data. As the data being shared has turned out to be more sensitive, an extended control is necessary to developed highly rewarding scenarios envisioned by the thinkers of the data economy. The IDS framework was created for that specific purpose. Based on trust and data sovereignty, it provides companies with a secure ecosystem where they could share data while retaining the control over it and especially on its use. Indeed, the framework does not only offer access control but broaden it to usage control.

- The experiment:

We adopt IDS and would like to learn if we can address the challenges of data sovereignty as mentioned above. Trustworthiness requires the ability to securely identify communication partners, to make sure that communication is private when required, and to make sure that data is not modified.

[Placeholder for describing building blocks / results and how they can be re-used in other use cases]

@all, kunnen we hier nog iets toevoegen wb resultaten die breed gedeeld kunnen worden achteraf? Naar mijn inziens:
1) IDS connector (https://tno-tsg.gitlab.io/)
2) SCSN netwerk (https://smart-connected.nl/nl)
3) Asset Administration Shells (source?)
4) Gebruikt AI Model (specifics kunnen we achterwegen laten, maar misschien is er toch iets wat we kunnen delen?)