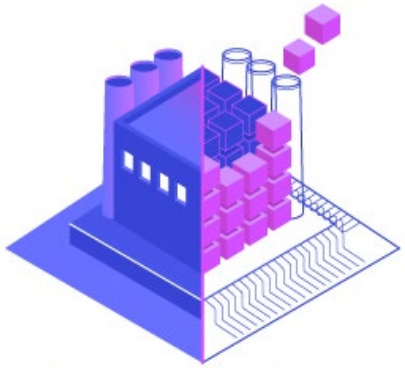


Towards AI powered manufacturing services, processes, and products in an edge-to-cloud-knowlEdge continuum for humans

Redefining Manufacturing:

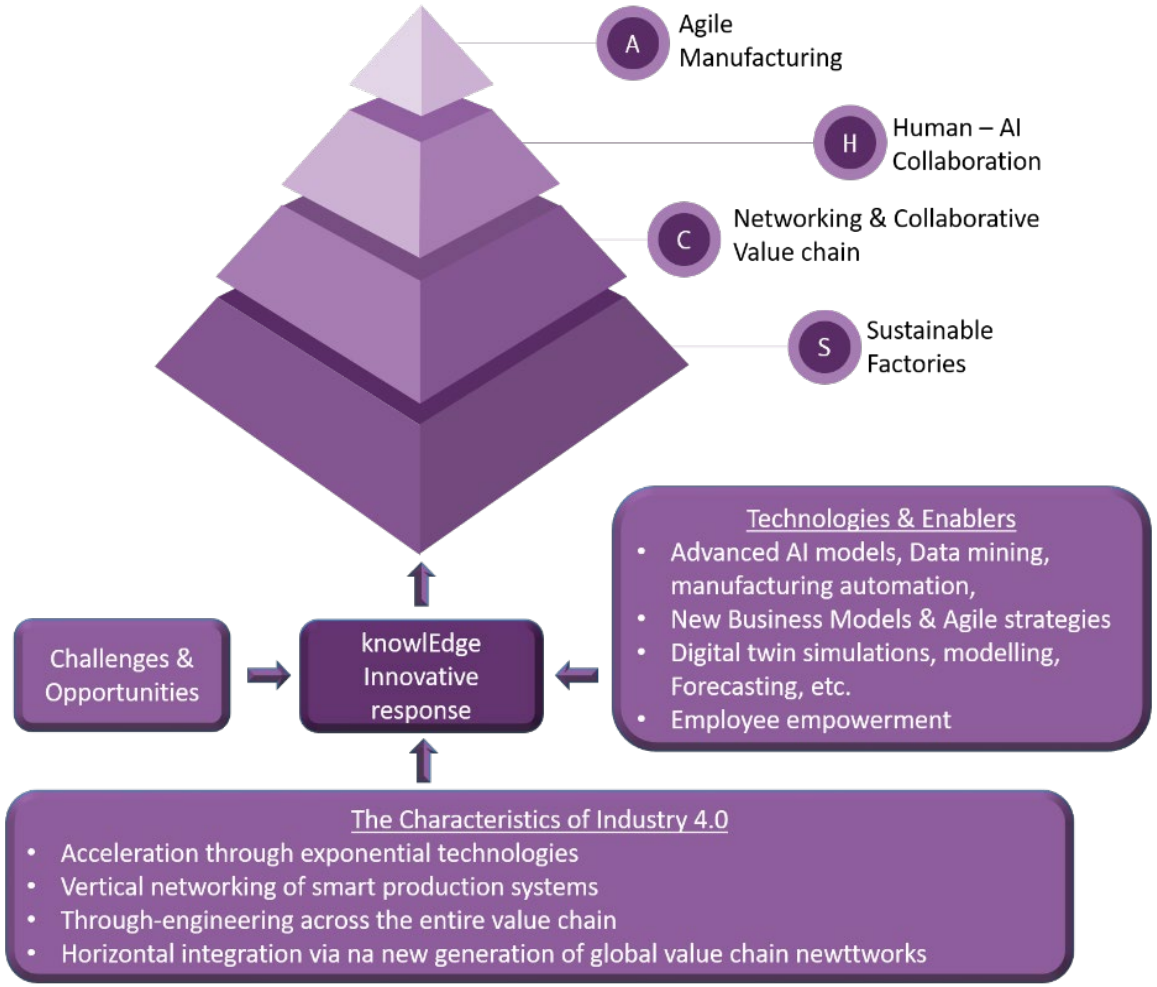
Empowering Humans with AI-Driven Solutions from Edge-to-Cloud

Manufacturing Partnership Day, Brussels, 26.09.2023

Dr. Stefan Walter

stefan.walter@vtt.fi

The manufacturing evolution



- Companies must address their transition with digital technologies to **reinvent their products, processes and services from a variety of perspectives**, including design, engineering and support services.
- The solution to realise the potential of digitalisation and the progress in the manufacturing industry lies in a **meaningful combination of smart and connected technologies.**
- The outcome of this effort is the **enabler** of Industry X.0.

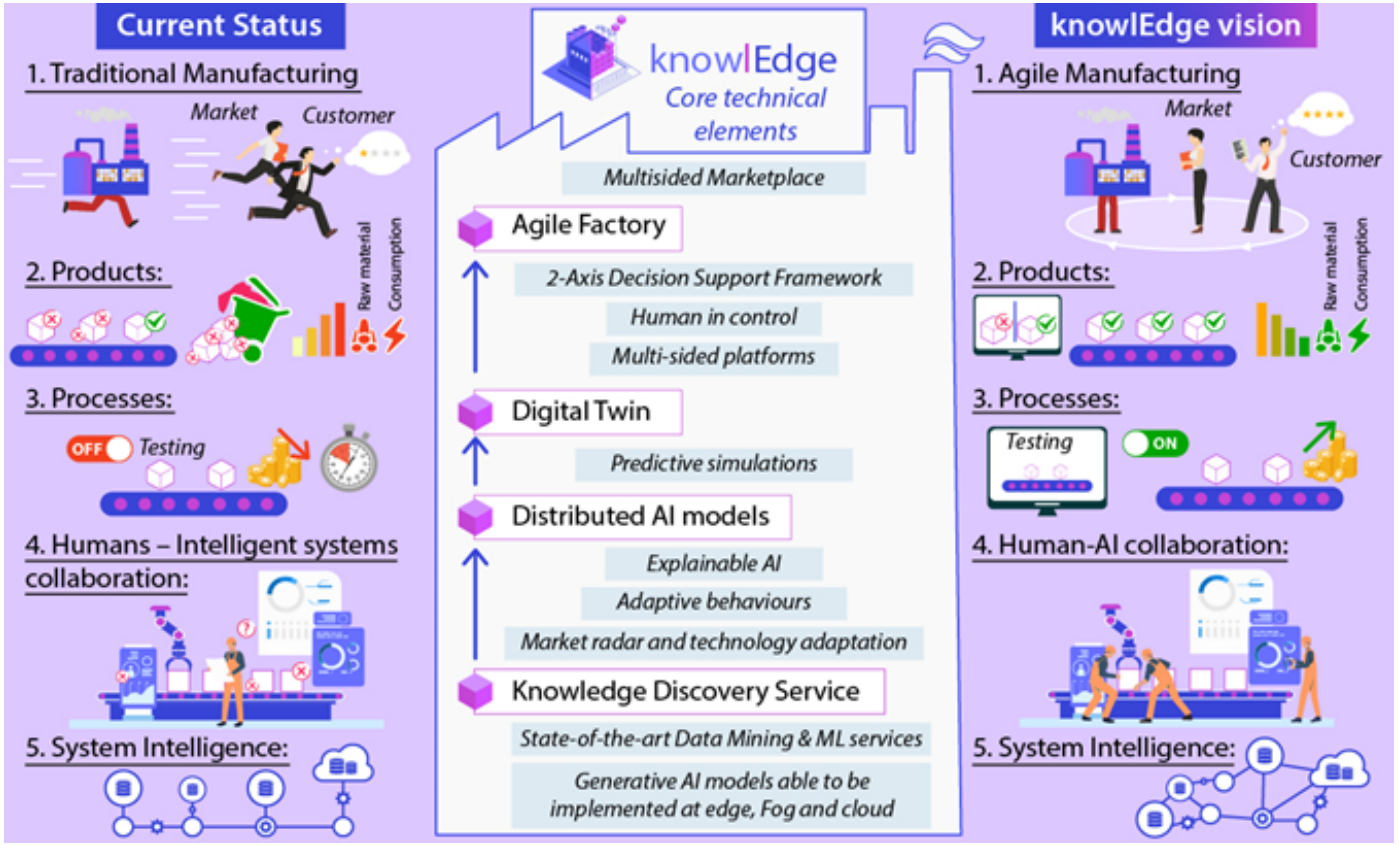
knowlEdge partners and objectives

knowlEdge consortium

Horizon 2020, ICT-38 AI for manufacturing, 2021 – 2023

- AI centric **software architecture to support agile manufacturing scenarios.**
- Deployment model capable of **distributing data mining and analytic services across the compute continuum (edge-to-cloud).**
- Interactive and multi-sided **knowledge marketplace** to enable the provisioning and utilisation of AI – **simplify uptake and diffusion.**
- Efficient and secure communication, **data management and governance infrastructure.**
- Advanced **user-facing applications** and services.

Unique knowlEdge



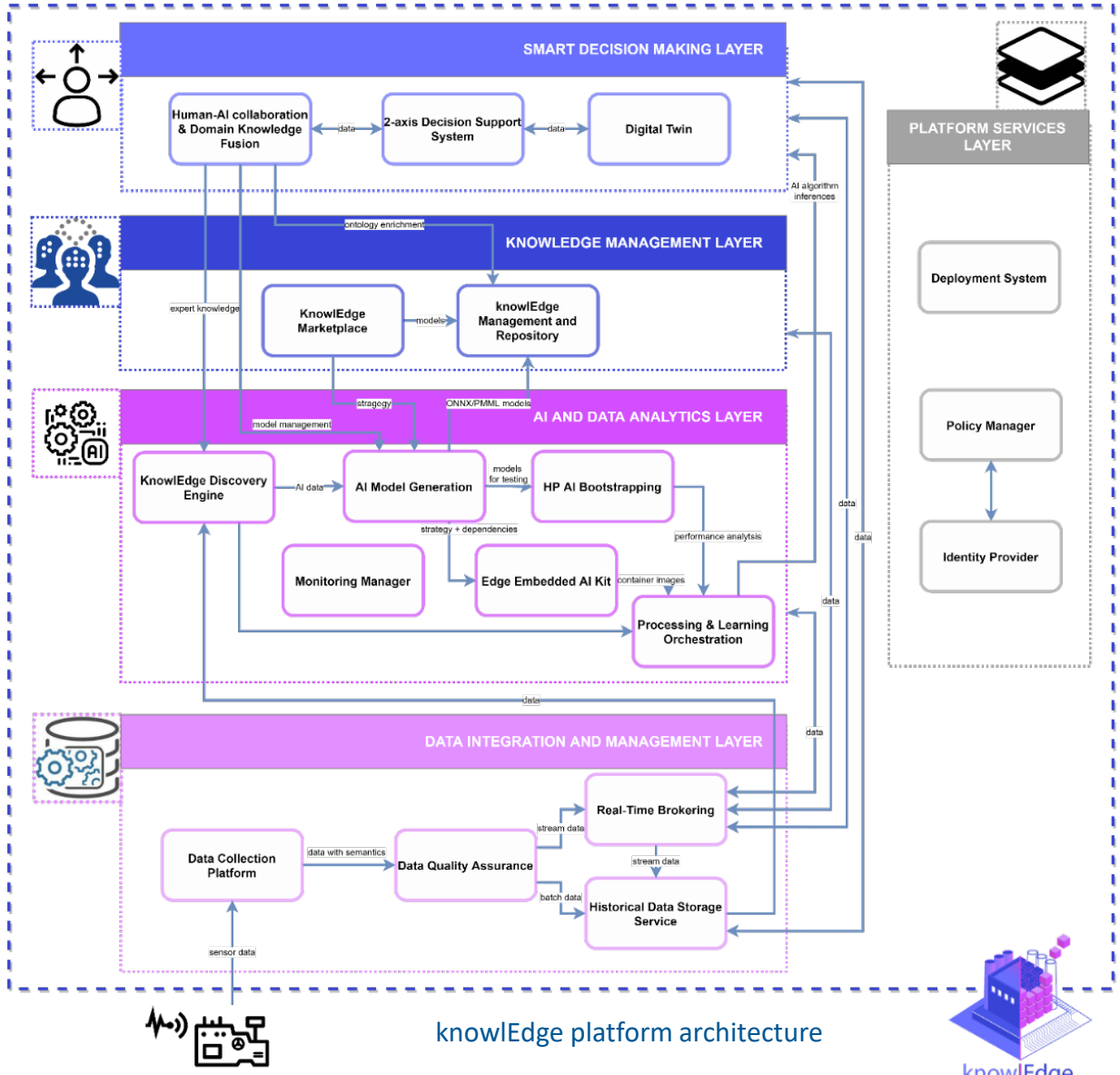
Current practices and envisioned future through the knowlEdge prism

- Human-AI collaboration: **humans at the core of the AI pipeline**, from development to deployment
- Data Exploration and Management: **making data meaningful**
- Human-AI Feedback Loop: **Xplainable AI**
- AI **Monitoring and Maintenance**: detecting performance degradation, re-training techniques
- Digital Twin Framework for **realistic simulations** before bringing AI models into production
- Integrated **edge-to-cloud** orchestration
- Incorporates **marketplace** for AI models, allows trading pre-learned models (new business models)
- Foundation for enhanced system intelligence & **decentralisation**

Progress so far: platform components developed

Functional layers:

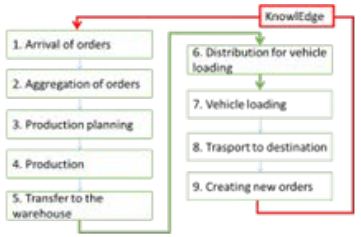
Smart decision-making	• Provides user interfaces and offers the human-in-the-loop aspects
knowlEdge management	• Represents and stores knowledge used throughout the architecture
AI and data analytics	• Covers the AI lifecycle, from model training to deployment and maintenance
Data integration and management	• Enables interoperability and incorporates data from various sources, such as supply chain nodes
Platform services	• Governs the deployment of models in the cloud, fog and edge computing continuum

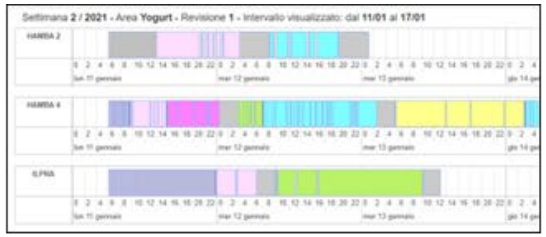


knowlEdge platform architecture

In the process: pilot deployment

Pilot: dairy food production

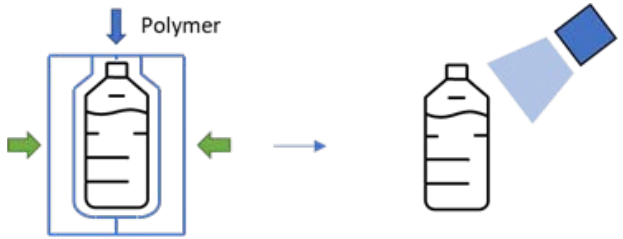




Use cases	Manufacturing scenarios
1. Optimising **production scheduling**, based on incoming order data (finite capacity: optimizing production while meeting constraints) 2. Enhanced **process efficiency**, based on interconnected data of production and distribution chains (allocate resources to production while forecasting demand)	**Scheduling the production plan:** Advanced analytics, constraints, priorities, forecasts **Monitoring of production:** Real time data collection, decision-support **Real-time adjustments of the production process:** Managing deviations, suggestions for decision-making, documentation

In the process: pilot deployment

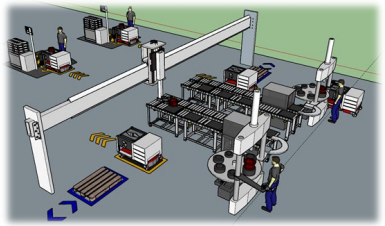
Pilot: automotive/fuel tank production

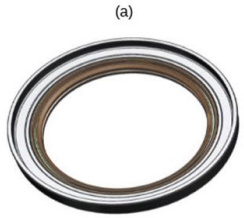


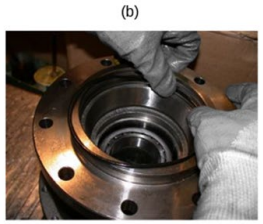
Use case	Manufacturing scenarios
3. **Production optimization for small batches** (Blow molding of fuel tanks): Based on a set of adjustable manufacturing information, ensure the final product quality, reduce faulty output and waste, reduce raw materials.	**Anomaly detection for zero defect production:** unifies and updates information (product specifications, material properties, machine data, KPI's), notifies on any deviation from the expected specifications, domain experts can take active role, AI model learns from acceptance/rejection by the domain expert, documentation of errors and solutions

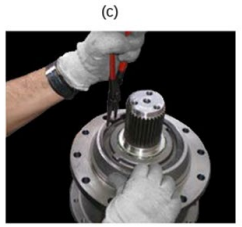
In the process: pilot deployment

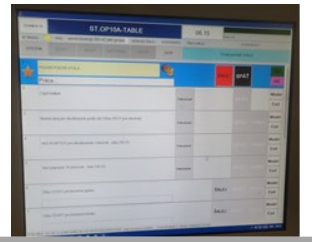
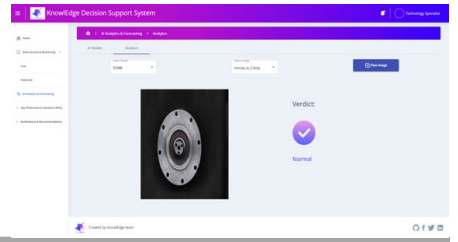
Pilot: industrial/gear box assembly









Use case	Manufacturing scenarios
4. **AI video analysis assembly supervisor:** Given a picture of an assembled product in various phases of assembly, generate solution for decision support whether or not the product is assembled correctly	**Preparing assembly:** Requirements gathering, documentation, workstation, tool availability **During assembly:** Workplace specific (contextual) information, Real-time monitoring and analysis of assembly steps, showing dependencies, prompts alert in case of errors or intolerences, troubleshooting , documentation of earlier solutions

Moving European manufacturing forward

knowlEdge addresses elements of strategic research agendas, e.g. ManuFuture SRIA 2030

ManuFuture SRIA 2030

- Real-time process supervision, control and simulation, for precise management and optimization of manufacturing operations.
- AI driven cyber-physical production systems for integrated, adaptable and efficient manufacturing.
- Zero-defect, autonomisation and (self-)adaptivity for long-term competitive, sustainable and resilient manufacturing.
- Cognitive manufacturing support, based on AI to collect historical data, scenario simulation, knowledge and best practices.
- Human-centred manufacturing, augmenting capabilities especially in terms of understanding, protecting, supporting and empowering.

Moving European manufacturing forward

Human work culture

- Human-centredness attracts new kind of workforce
- Knowledge availability allows re- and upskilling

Sustainability transition

- Reducing carbon footprint through data and AI model sharing
- Increasing energy and resource efficiency through simulations
- Transparency and accelerating innovation

Collaborative ecosystem

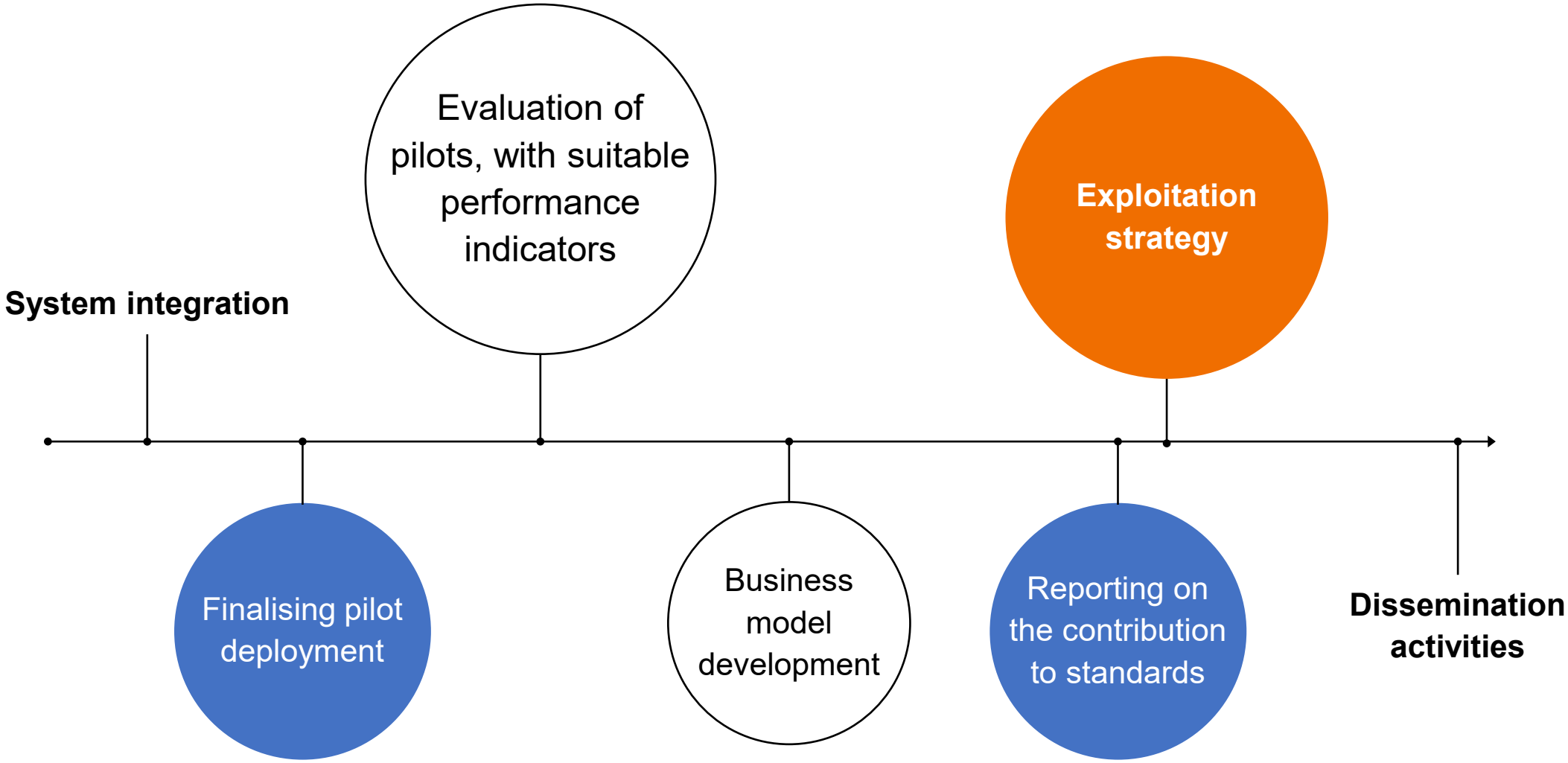
- Knowledge sharing, enabling participation and collaboration
- Untapping the potential of small businesses and reduce the gap between them and large businesses

Building the future of European manufacturing

- Collaborating while removing boundaries
- Greater resilience through decentralisation

eit Manufacturing's vision

Future plans



Upcoming book

Soon to be published:

Artificial Intelligence in Manufacturing: Enabling Intelligent, Flexible and Cost-Effective Production Through AI

edited by John Soldatos, published by Springer Nature

knowlEdge consortium contributed 6 chapters!

Thank you !

www.knowlEdge-project.eu

The research leading to these results has received funding from Horizon 2020, the European Union's Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement no 957331