Science and Industry

SCIENCE AND INDUSTRY

Our working groups have researchers and representatives from our member companies working together to develop new concepts and systems. Results feed into our ecosystem, where they are tested and improved.

Currently, three working groups are addressing practical issues in manufacturing, while focusing on the following characteristics of subsidiarity:

- A self-explanatory capability
- Fault tolerance and resilience
- Resource adaption
- A cooperative ability
- A decision making ability

WG 1:
CYBER-PHYSICAL PRODUCTION MODULES (STATIONS)

Vision
To design and control cyber-physical production stations and the production infrastructure for sustainable factory floors in the future.

Goals
- Develop innovative PL4 modules and hardware.
- Prepare the design and definition of production infrastructure.
- Develop new power supply infrastructure based on overall concept, topology & power media (DC, AC, Ethernet, etc.).
- Integrate industrial edge architecture (edge devices, edge nodes, etc.).

WG 2:
CONNECT & CONTROL

Vision
To build a manufacturer-independent system for autonomous control of the production process

Goals
- Build a manufacturer-independent and robust information infrastructure and middleware.
- Implement data and capability models in the administrative shell.
- Develop a matching approach for autonomous and flexible process control in production.
- Design negotiation strategies for optimal and sustainable resource use.
- Perform advance development of operational safety intelligence.
- Enable visualization of module states and production decision processes.

WG 3:
THE COGNITIVE FACTORY

Vision
To set up a cognitive factory able to actively make decisions to improve production.

Goals
- Assist users through automated data processing and the resulting recommendations for action.
- Optimize and control production processes using agent systems.
- Enable early detection of faults and malfunctions through modern sensor technology.
- Minimize and optimize retooling through automated parameterization.
- Integrate IT and OT: Link shop floor and cloud on the basis of machine learning methods.
- Link all stations with the dashboard (digital twin).

The administrative shell – a key enabling technology

THE ADMINISTRATIVE SHELL – A KEY ENABLING TECHNOLOGY

In the future, each asset will be described by its asset administration shell (AAS). The shell contains both static and dynamic data such as material composition, production history, CO_2 footprint, manufacturing instructions, etc. It can also be expanded with the addition of sub-modules such as the Digital Product Pass. The shell enables communication between all services in the data space.

Four modular production cells perform the various work and services at three locations in Kaiserslautern: there is a transport system, a manual work station, assembly, AI operations, 3D printing, quality control, etc. The communication involved in shared production is Gaia-X compliant and operates skill-based via the AAS.

In the *Production Level 4* demonstrator ecosystem, we manufacture a model truck as the example product. The customer can individually configure the truck to be manufactured and each production cell takes over certain tasks in the production process of the end product. Depending on the configuration, certain modules at the production cells will be tasked to manufacture the necessary parts. The services (capabilities) are offered, selected, and individual work steps coordinated via the administrative shell: for example, milling, quality controls, transport, assembly, etc.

Currently, it is possible to balance and transparently display the CO_2 footprint of each model truck. In addition, the software generates a Product Carbon Footprint (PCF) certificate.

SmartFactory^{KL}

The future starts today
We are developing the production of tomorrow

smartFactory^{KL}®

Prof. Dr. Martin Ruskowski, Vorstandsvorsitzender der Technologie-Initiative SmartFactory KL e.V

Dear Reader,

more and more companies are asking how they can bring sustainability and resilience to their production operations. ***Production Level 4*** is our vision in answer to their questions. Moreover, we want to show that our ideas are technically feasible and can actually create added value on the shop floor. To accomplish this, we have recently established a shared production environment in Kaiserslautern in which we demonstrate the production of the future using a model truck. This interoperable ecosystem with dynamic supply chains serves as a testbed for the latest key enabling technologies, such as the administrative shell, 5G, industrial edge cloud, operational safety intelligence, matching-platforms, digital carbon footprint capture, and Gaia-X.

Our mission is to implement the solutions to tomorrow's challenges today.

You are invited and always welcome to join us.

Sincerely,

Prof. Dr. Martin Ruskowski,
CEO of ***SmartFactory***^{KL}

PRODUCTION LEVEL 4

Manufacturers want to have effective production and any external disruption slows down value creation. Our ***Production Level 4*** (PL4) vision includes a resilient and sustainable production infrastructure in concert with the concept of subsidiarity. PL4 is a dynamic upgrade of Industrie 4.0 (I4.0). The future of manufacturing lies with distributed networks that collaborate on the basis of capabilities (skill-based) in secure data spaces. Digital matching platforms configure individual, needs-based, supply chains. Software agents take over the tasks of coordination, execution, and organization.

It all starts with the product to be produced. The required workflow (manufacturing steps) is arranged autonomously, depending on the product attributes. The necessary prerequisites for implementation are the new technologies such as 5G, artificial intelligence, operational safety intelligence, industrial edge clouds, data platforms, etc.

People are considered the decisive factor here: many human capabilities are unique and cannot be implemented by machines or software. In our vision, rather than replacing them, future production assists people as they work. Optimally, the strengths of all participants should be used in concert.

THE PRODUCTION LEVEL 4 ECOSYSTEM

Shared production in Kaiserslautern is gradually advancing with the implementation of our ***Production Level 4*** vision: resilient, sustainable, and value adding manufacturing.

Data ecosystems are of critical importance to this effort. The Federal Ministry for Economic Affairs and Climate Action (BMWK) supports the Gaia-X Initiative to develop the next generation of infrastructure for European data ecosystems. The aim is to build a secure and networked data infrastructure that meets the highest standards of digital sovereignty and promotes innovation. In such a network, data and services are collated and shared in a dynamic supply chain architecture based on the values of openness, transparency, and trust. ***SmartFactory***^{KL} is participating in the Gaia-X project with its own sponsored project called smartMA-X. The PL4 ecosystem at ***SmartFactory***^{KL} is the testbed and central reference for industrial applications.

SHARED PRODUCTION Kaiserslautern

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