CEUP2030

Interreg
CENTRAL EUROPE
European Union
European Regional Development Fund
CEUP 2030

INTELLIGENT PRODUCTION SYSTEMS

Project co-funded by European Regional Development Fund.

CONTENT

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INTRODUCTION

The manufacturing industry has a strong influence on the national economies of European countries. The European Union is the largest exporter of high-quality products. In recent years, European countries have faced many challenges such as an aging population, and competition from China, the USA, and developing countries [1].

The countries of Central Europe are an important factor in keeping the EU as a global leader in the production of high-quality products. However, the manufacturing sector of many Central European countries is at risk due to possible relocations of manufacturing companies caused by the rising costs of production resources [2]. For the EU to maintain its status, innovations in manufacturing are necessary, which will result in increased efficiency of manufacturing processes and the supply chain.

To increase the efficiency of manufacturing processes, it is necessary to use the available resources optimally. Traditional manufacturing systems have difficulties coping with this challenge due to the limitations of the human operators in making decisions in conditions of high uncertainties and complexities of manufacturing processes [3].

Industry 4.0 is a business and manufacturing paradigm based on the integration of machines and people within complex manufacturing and logistics processes through the application of a cyber-physical system (CPS) [4]. The CPS is powered by a large amount of data collected through a network of sensors, which opens the possibility of creating intelligent production systems that can optimize manufacturing processes through data processing and analysis. Important features of an intelligent production system are sustainability, the use of big data, the use of additive manufacturing technologies, scalability, and flexibility.

Energy management and sustainability of manufacturing are some of the key topics when it comes to intelligent production systems.

The application of Industry 4.0 technologies is expected to have a positive impact on waste reduction through increased productivity, flexibility, and resource efficiency [5,6]. Optimized processes will lead to products being made only to customer orders which will, in turn, result in reduced energy consumption. Critics of Industry 4.0 argue that an increase in energy consumption is also possible due to a large number of sensors and data centers for manufacturing operations [7].

The manufacturing sector generates and stores large amounts of data, and there is a need for solutions and algorithms that will allow the automated extraction of knowledge from this data [8]. Solutions based on machine learning have a high potential to help reduce production downtime, increase quality and productivity through the exploitation of collected data.

Additive manufacturing technologies enable personalized production in small batches with lower development costs, shorter lead times, lower logistics and warehousing costs, and lower energy consumption [9]. Unlike technologies that remove material such as cutting and turning, technologies such as 3D printing generate significantly less waste [10].

The scalability and flexibility of manufacturing systems can be achieved through the use of additive technologies that increase the resistance of the supply chain to changes in demand. The flexibility of the manufacturing system can also be achieved through the application of smart scheduling systems that can adapt to dynamic and global market needs [11].

Digital Twins are Taking Over

Digital twins provide a virtual counterpart to physical components used in industrial sectors. The arm of a robot used in automobile manufacturing, for example, can be monitored using a digital twin, which collects data about the arm's operation and provides information about components that need periodic maintenance or replacement. Digital twins make predictive maintenance easier, and they offer valuable visualization capabilities to improve efficiency. There are plenty of ways to harvest and manage IoT information, but digital twins deliver an intuitive and powerful approach.

Innovative Human-Machine Interfaces

Computer screens and more primitive displays still dominate in industrial areas, but this is changing. Augmented reality applications offer valuable feedback when looking at physical components, and providing employees with IoT-derived information about manufacturing equipment lets companies make better use of their investments. Virtual reality can also play a role, giving workers powerful visualization capabilities impossible with more traditional technologies. VR and AR are typically tailored to specific tasks, but the popularity and dropping prices of headsets and smart glasses are making these technologies more popular, particularly in industrial environments.

Better Predictive Maintenance

Predictive maintenance has been playing a larger role in industrial environments for years, but the continuing rise of IoT components is providing more information than even before. When combined with machine learning and other artificial intelligence tools, modern industrial software is better than even at determining when parts need to be replaced. Unlike other technologies, the benefits of predictive maintenance are easy to calculate, making it a technology that's sure to be at the top of C-level executives' priority lists going forward.

Increased Emphasis on Security

The early days of the IoT were somewhat haphazard in execution, and securing devices was not seen as a top priority for many companies. This is no longer the case, and companies looking to invest in the IoT are increasingly taking steps to ensure their new investments can be protected from cyberattacks. Part of this change is due to the increasingly lucrative nature of cyberattacks, and compromised industrial equipment can be especially tempting. One of the challenges companies will face going forward will be ensuring they're using the right security paradigms and ensuring compliance, as there's no one-step solution to keeping devices safe from attackers.

Greater Flexibility

Industrial organizations sometimes move slowly, as the high cost of downtime means it's often better to avoid hardware and software changes whenever possible. Increasing efficiency across the board, however, will compel companies to adopt a more nimble approach to operations. IoT analysis can lead to surprising results at times, as artificial intelligence is great at finding correlations that humans might never explore. A long-term shift for industrial entities will be finding ways to adjust to information more quickly, and this move will only continue to increase in the coming years.

Automation

Automation has always been a centerpiece in industry, and digital technology is extending this trend. Instead of investing in expensive heavy equipment, however, companies can now rely on low-cost devices that complement a broader range of manufacturing components. As automation systems continue to prove their worth, companies will invest more heavily and see significant efficiency gains and lower labor costs. However, hiring will still remain strong, as even the most heavily automated systems need people to monitor progress and look for ways to maximize efficiency.

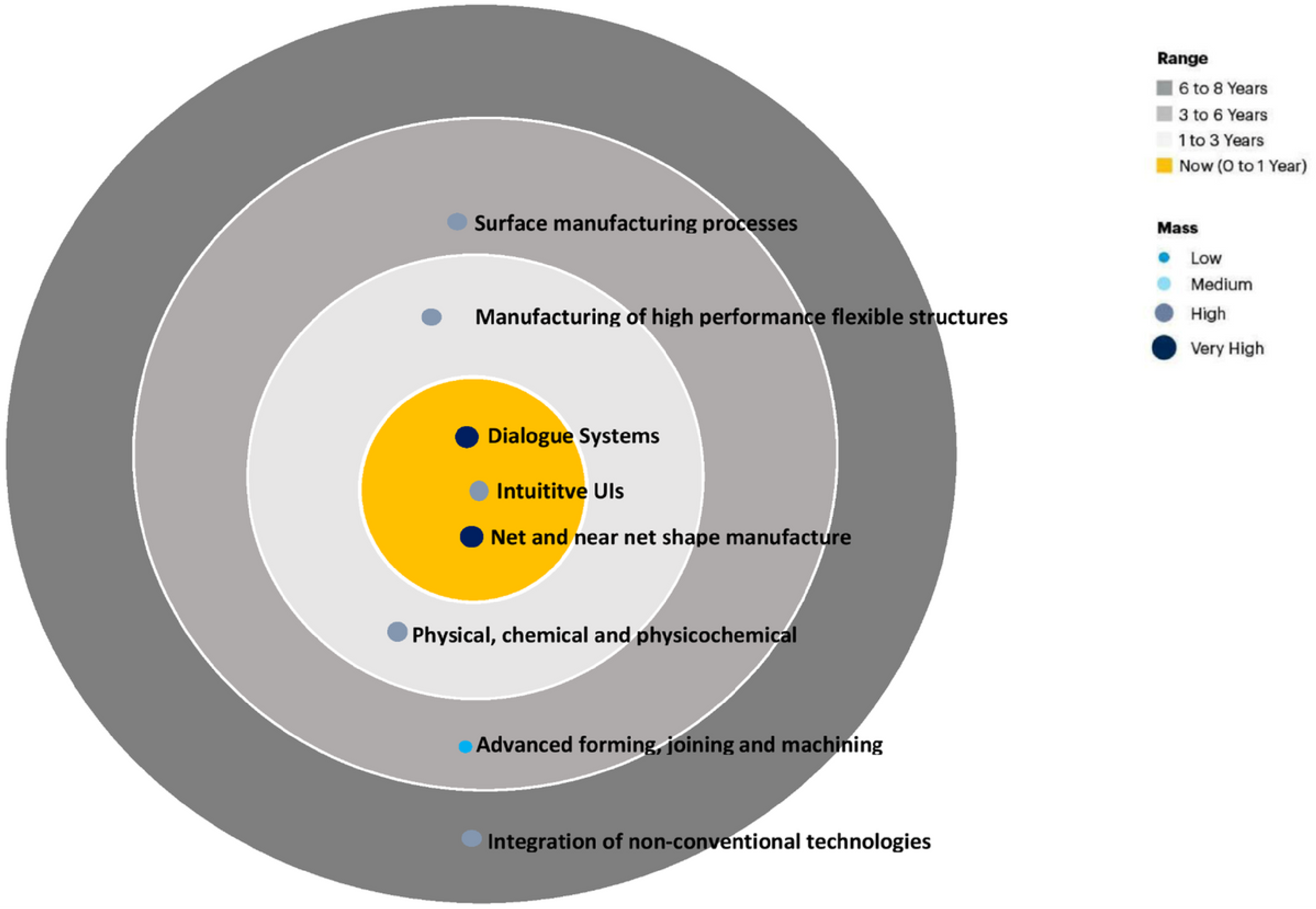
Moving to the Edge

The sheer volume of data collected by IoT components can be staggering, and one of the bottlenecks in IIoT applications is making sure systems are capable of monitoring necessary information. A powerful components of IoT operations is relying on edge computing devices that collect, process, and even analyze data before it's sent to more centralized servers. Although investment in servers or off-site cloud solutions will continue to rise going forward, edge devices will see significant investment in the future and relieve some of the processing stress common to today's industrial environments.

IoT devices are a natural fit in industrial environment, as sensors have long been a core components of successful operations since well before the IoT concept arose. However, the benefits of general-purpose IoT devices are transforming industrial operations, and industry-specific IoT devices have become far more powerful over the years. Despite the conservative nature of industry, IoT adoption is rising at a rapid pace, and there's no doubt this trend will only continue to ramp up for the foreseeable future.

IMPACT RADAR

Impact Radar for Emerging Technologies and Trends: Intelligent Production Systems



POLICY INTELLIGENT DASHBOARD

The CEUP 2030 Partnership would like to invite all interested stakeholders to explore Policy Intelligence Dashboard - policy tool to streamline, process and manage the knowledge for improved policy decision making, in a practicable and sustainable manner.

Policy Intelligent Dashboard is the most complete one-stop-shop for policy makers and policy influencing stakeholders as research technology organizations and enterprises operating around Advanced Manufacturing and Industry 4.0 topics.

PID gathers in one place practical and streamlined knowledge and insight on technology trends and potential industry impact for the entire innovation eco-system. Each CAMI4.0 area: Intelligent Production Systems, Automation and Robotics, Smart Materials and Artificial Intelligence represents a Tech Radar, where policy-relevant data sources as use cases, financial instruments, flagships and organizations are presented with a goal to support, transfer and enrich policy decision making processes in the area of key technologies.

PID is located on the http://ceup2030pid.eu/ -website and integrate knowledge and insight developed from dialogue occurring within the Partnership's workshop series includes the following elements for each CAMI4.0 topics :

1

INTERESTING USE-CASES

Each project partner provided contributions of thematic use cases/developments from regional companies/DIHs in connection with every thematic topic identified in the CEUP project.

2

SUMMARY OF THE FLAGSHIPS

Flagships are significant initiatives which clearly add value or deliver enhanced competitive advantage to the innovation eco-system surrounding advanced manufacturing and industry 4.0

3

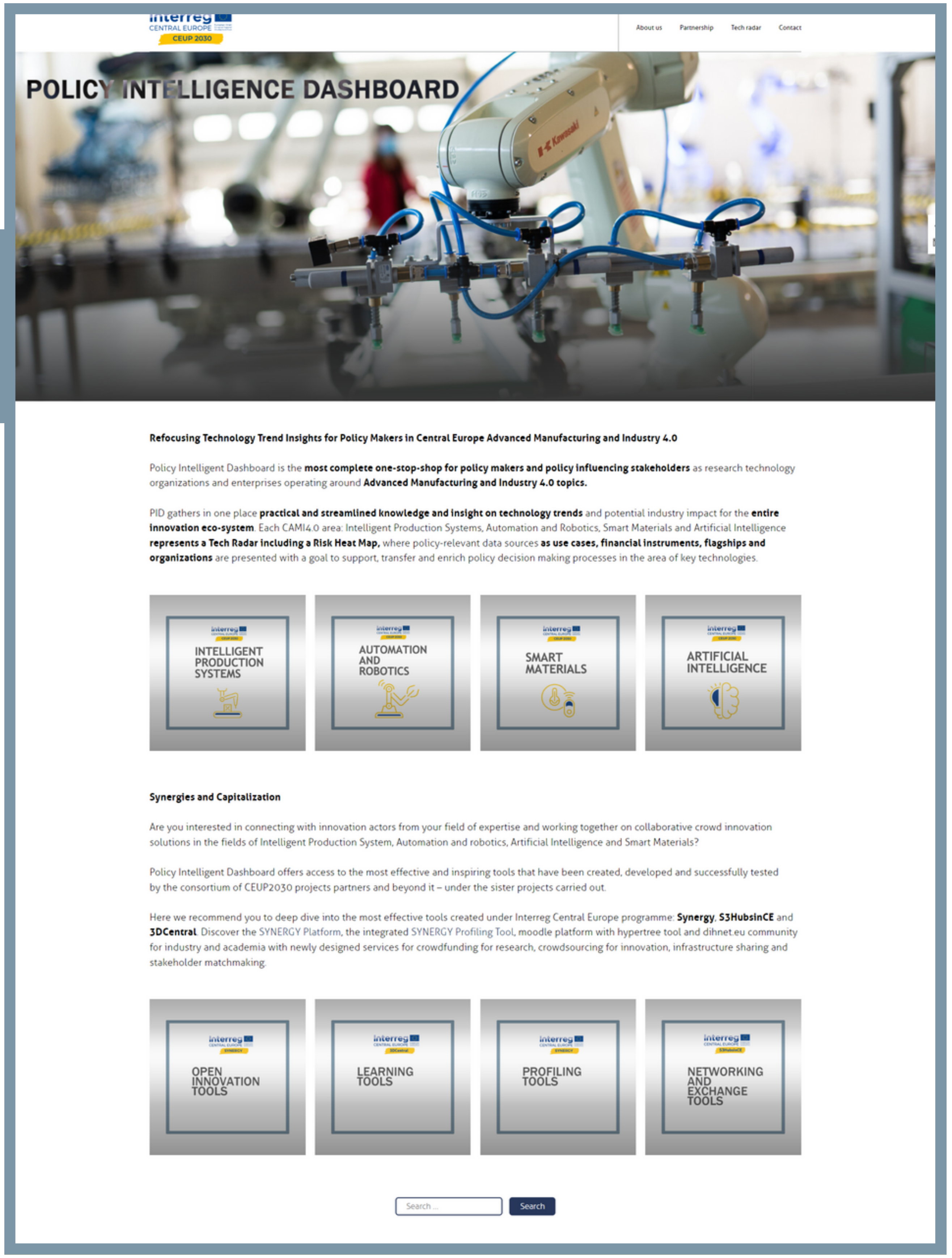
POLICY INSTRUMENTS

One of CEUP 2030's main goals is to exchange information and good practice examples regarding policy instruments that are being used and deployed in Central Europe.

4

ANALYSIS OF THE TECH RADAR

The Tech Radar and Risk Heat Map offer open access to policy-relevant data sources as use cases, policy instruments, organisations and networks, technology trends in the most convenient, practicable and efficient way.



Policy Intelligent Dashboard offers access to the most effective and inspiring tools that have been created, developed and successfully tested by the consortium of CEUP2030 projects partners and beyond it – under the sister projects carried out.

We recommend you to deep dive into the most effective tools created under Interreg Central Europe programme: Synergy, S3HubsinCE and 3DCentral. Discover the SYNERGY Platform, the integrated SYNERGY Profiling Tool, moodle platform with hypertree tool and dihnet.eu community for industry and academia with newly designed services for crowdfunding for research, crowdsourcing for innovation, infrastructure sharing and stakeholder matchmaking.

Check the Policy Intelligent Dashboard now!

http://ceup2030pid.eu/

FLAGSHIPS

Karlsruhe Institute of Technology

KARLSRUHE INSTITUTE OF TECHNOLOGY

The research project will use bioinspired process and product design for manufacturing as a promising enabling strategy towards sustainable, value-added manufacturing that meet increasing consumer demands.

Fraunhofer IWU

IWU FRAUNHOFER

Smart Circuit project proposed by IWU: Fraunhofer tries to establish service corridors to promote sustainable transition in industrial production facilitated through digitally enabled technologies and to reduce implementation barriers and upgrade the production of sustainable products.

PBN advanced management

PANNON BUSINESS NETWORK ASSOCIATION

To provide a holistic set of tools covering the entire production process, in addition to the formerly isolated digitalization development solutions, suitable for both educational and demonstration purposes and for the implementation of specific R&D projects.

INDUSTRIE 4.0 AUSTRIA

ASSOCIATION INDUSTRY 4.0 AUSTRIA

Creation of a solid framework that standardizes the view of Industry 4.0 and thus leads to a more concrete understanding of Industry 4.0 among the general public.

PROFACTOR®

PROFACTOR GMBH

The project addresses the topic of vertical process optimization to increase productivity and sustainability, taking production data and human-centered assistance into account.

Pomurje TECHNOLOGY PARK

POMURJE TECHNOLOGY PARK

The overall flagship objective is improving competences and skills in less developed rural regions which are characterized by lack of development capacities, high unemployment, brain drain and emigration.

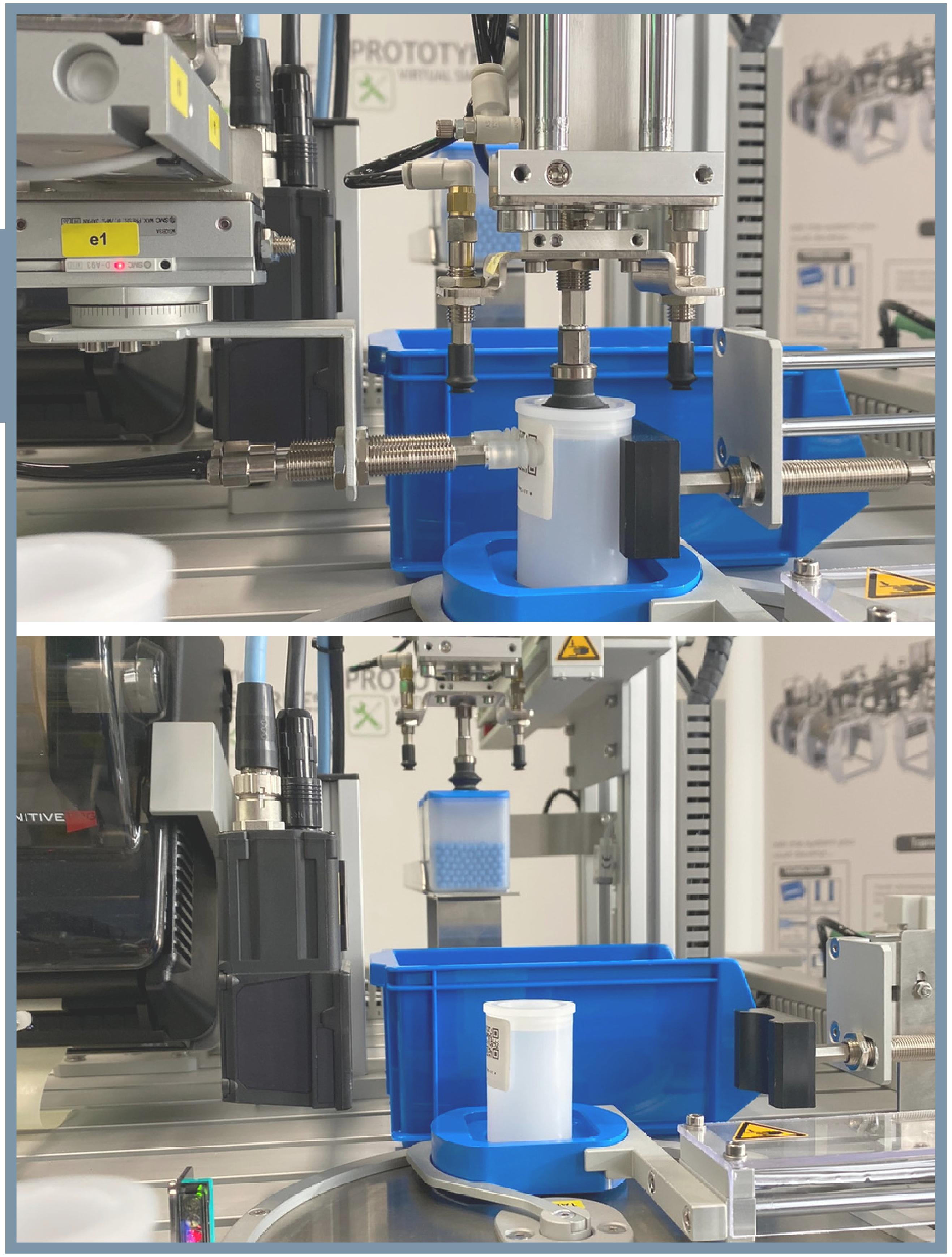
Karlsruhe Institute of Technology

Karlsruhe Institute of Technology

BIOSAM (Biologicalisation for Sustainable Advanced Manufacturing) project proposed by Karlsruhe Institute of Technology aims to develop the biologicalisation in design for manufacturing. The research project will use bioinspired process and product design for manufacturing as a promising enabling strategy towards sustainable, value-added manufacturing that meet increasing consumer demands. Bio inspired solutions to manufacturing problems can give more capacity for manufacturing systems to handle problems in a greater systematic and automated manner. The implementation of the program is focussed on the demonstration of the complete approach through concrete use cases and applications developed within the project consortium. The focus is also on commercialisation of the applications and the holistic development of the ESRs involved within the project. This project will enrol 10 doctoral candidates (DCs), developing individual research projects within the doctoral network program. One of the many challenges being addressed by this project include the unavailability of trained R&D personnel in this field within Europe. By training DCs this project achieves this along with all the technological developments outlined. Target groups of the project are large enterprises, SMEs, and higher education and research organisations. The network of project partners is composed of 4 universities, 2 research and technology development organizations and 1 industrial partner from 4 different countries. The project will be funded by Horizon Europe MSCA DN funding program.

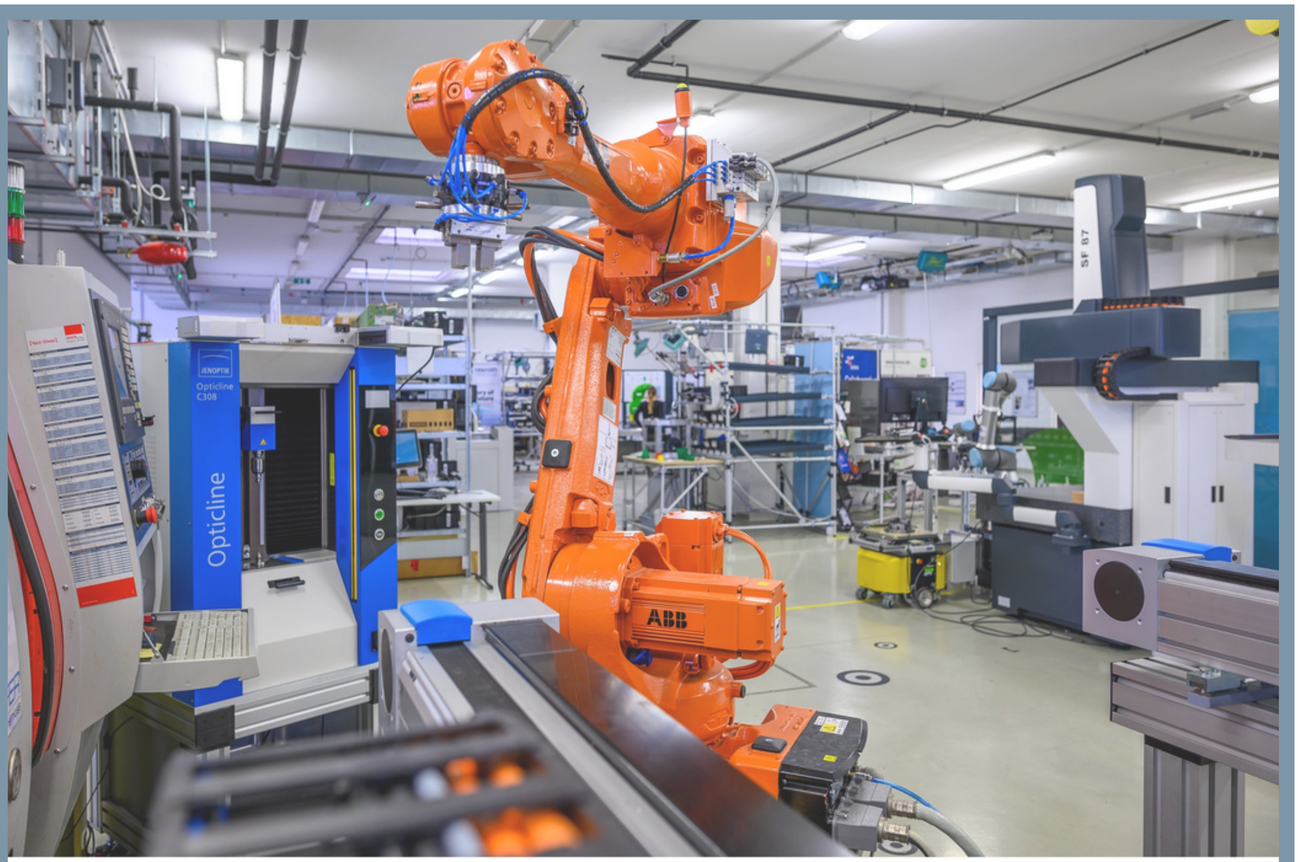
IWU Fraunhofer

Smart Circuit project proposed by IWU: Fraunhofer tries to establish service corridors to promote sustainable transition in industrial production facilitated through digitally enabled technologies and to reduce implementation barriers and upgrade the production of sustainable products. The project consists of three key goals. First goal is improving capacities of and cooperation among innovation stakeholders by strengthening transnational innovation networks among digital innovation hubs. Second goal is exchanging good practice on digital circular economy in manufacturing and gaining insights from successes. Third and final goal is implementation of pilot actions to improve SMEs access to the research and technological innovation required to take up and support the roll out of innovative solutions to promote digitally enabled circularity. Target groups of this project are large enterprises, SMEs, higher education and research organisations, business support organisations, schools, and training institutes. The project will be implemented with the help of 7 business support organizations, 3 higher education and research organizations, 1 national public authority organization, other regional stakeholder ecosystem and associated partners. The financial resources required for the implementation of the project are provided from Interreg CE.



Pannon Business NetworkAssociation

Project proposed by Pannon Business Network Association called Purchase of autonomous production line (Teaching and Learning Factory) and smart material board and further developments aims to provide a holistic set of tools covering the entire production process, in addition to the former isolated digitalisation development solutions, suitable for both educational and demonstration purposes and for the implementation of specific R&D projects. Project goals are going to be met by development and procurement of a Teaching and Learning Factory which is a manufacturing unit with online, remote access to broaden cross-border services directly related to digitization competencies of the partners. The topics data science, autonomous robotics and 3D printing are integrated, enabling stakeholders to provide internationally competitive research and training infrastructure. With future actions, connectivity will be ensured, contributing to its sustainability for the 2021-2027 period. In parallel with the TLF procurement and development, PBN will also procured a smart material board, which can be considered as a complementary element of the TLF. Target groups of this project are large enterprises, SMEs, higher education and research organisations, business support organisations, schools, and training institutes. The implementation of the project is carried out with the help of 5 partners consisting of 3 business support organizations, 1 higher education and research organizations, and 1 large enterprise. The financial resources required for the implementation of the project are provided from Interreg V-A Austria-Hungary Cooperation Programme 2014-2020 and Interreg Central Europe Programme.



INDUSTRIE 4.0 AUSTRIA

Association Industry 4.0 Austria

Austrian Industry 4.0 Association (PIA) wants to create a solid framework that standardizes the view of Industry 4.0 and thus leads to a more concrete understanding of Industry 4.0 among the general public. For this purpose, they proposed a project called Testbed Exchange. The leading players in Industry 4.0 are currently in many cases universities and specialized departments of top companies. At academic institutions, so-called testbeds (in Austria called pilot factories) have emerged in recent years, which have both in-depth expertise and modern infrastructures. The aim of this project is to survey these testbeds and to create a sustainable network in which intensive communication, mutual learning and exchange of experience takes place. The project will be implemented by meeting two key goals. One goal is to create and implement a strategic plan to identify key areas of interest and plan concrete collaborations among the cooperating pilot factories. The second goal concerns the transfer and publication of expertise, which will be done through three seminars. These seminars are designed for cooperating testbeds, SMEs, students, and partner universities, as well as the general public, which are actually the target groups of the project. The project is implemented together with one higher education and research organization and is funded by INTERREG V-A Austria-Czech Republic funding program.

PROFACTOR®

PROFACTOR GmbH

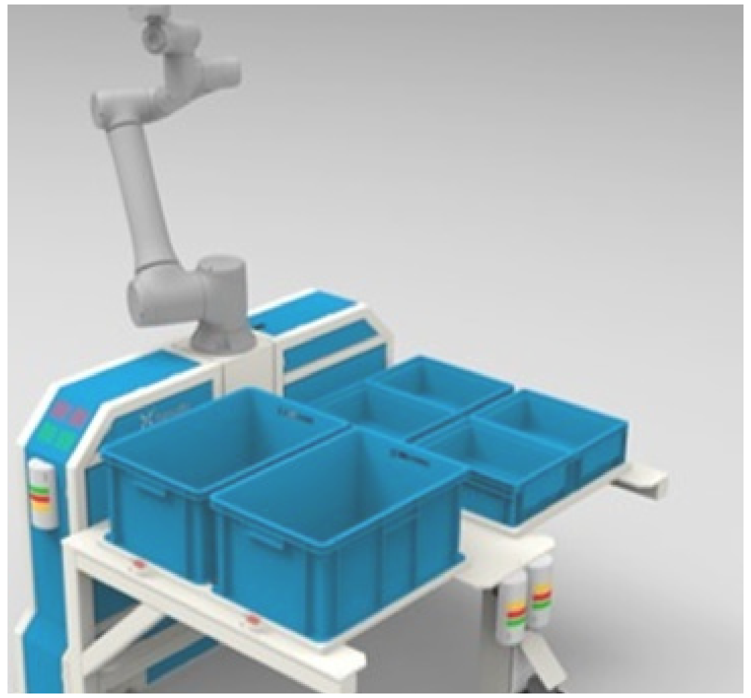
Human Centered AI Based Production Optimization (HAIPrO) is a project proposed by PROFACTOR GmbH. The project addresses the topic of vertical process optimization to increase productivity and sustainability, taking production data and human-centered assistance into account. The use of assistance systems is intended to make production more flexible (e.g. by supporting low volume, high mix production, greater transparency of both machine operation and process management). An inter-company quality data exchange or inter-company available evaluation and visualization services enable a cross-company increase in product quality (e.g. by integrating the Gaia-X platform). Tools are created to guarantee high interoperability of the quality data to be exchanged. Furthermore, the project aims to increase worker satisfaction, productivity, and the sustainability of human-centered manufacturing processes through an improvement in the safety and stability of manufacturing processes and through optimized, employee-centered production planning. This is made possible by processes such as transfer learning, data augmentation and data fabrication. This data is to be enriched by individual operating and handling data at operator and team level. An innovative platform for privacy-preserving-transform-learning and the integration of the open platform Gaia-X guarantee a high level of data security and data sovereignty even when using data sources with differing statistical characteristics. The target groups of the project are large enterprises, SMEs and higher education and research organisations and it is implemented with the help of 8 SMEs, 1 large enterprise and 1 higher education and research organization. This project is financed by Austrian Research Promotion Agency (FFG) and German Federal Ministry for Economic Affairs and Climate Action (BMWi/DLR-PT).

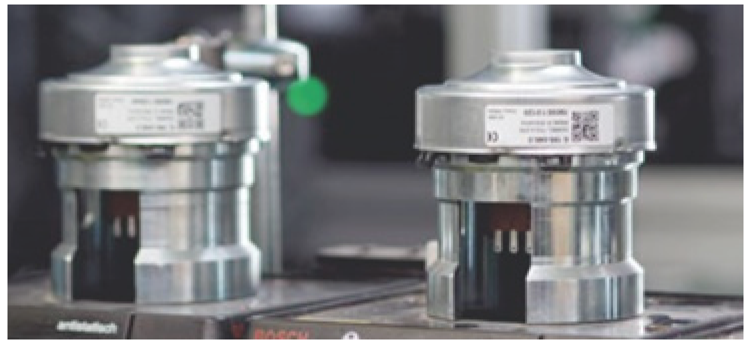
Pomurje
TECHNOLOGY PARK

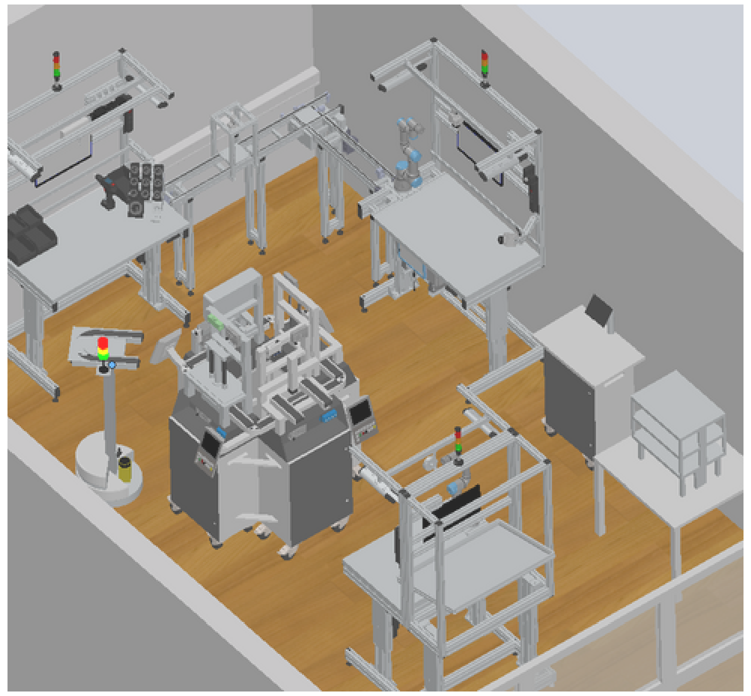
Pomurje Technology Park

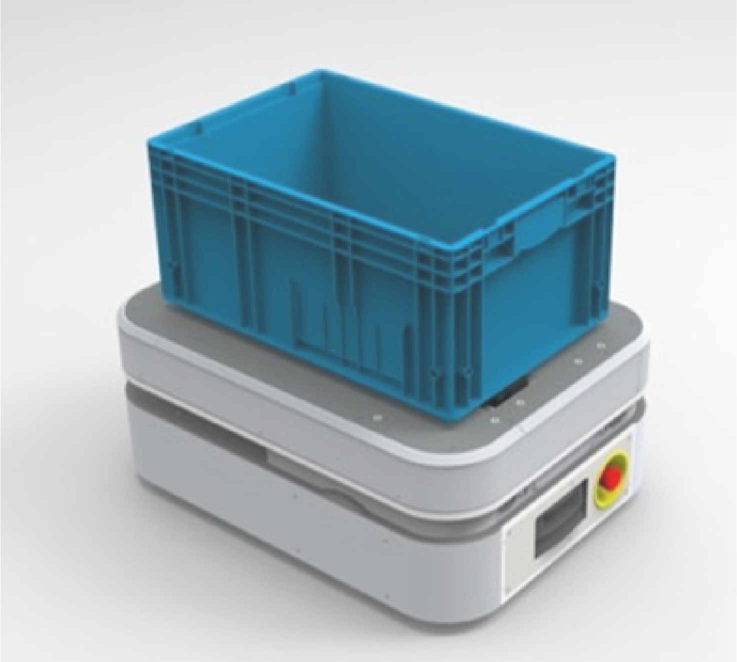
Rising competences in less developed regions focused on small scale food product & service providers through new transnational mentoring services is a project proposed by Pomurje Technology Park (PTP). The overall flagship objective is improving competences and skills in less developed rural regions which are characterized by lack of development capacities, high unemployment, brain drain and emigration. The Flagship is therefore focused on improving regional support ecosystems and their involvement into developed joint transnational mentoring services to transform small scale rural food and drink products and services into digital and circular attractive. Innovativeness is shown by developed transnational mentor services jointly offered to small scale food product & service providers, where regional support ecosystem and their mentors will have access to wide range of specialized digital & circular toolkits and access to pool of international experts to support digital & circular transition. Target groups of this project are large enterprises, SMEs, higher education and research organisations, business support organisations, schools, and training institutes. The implementation of the project is carried out with the help of 7 partners consisting of 5 business support organizations and 2 sectoral agencies. The financial resources required for the implementation of the project are going to be provided from Interreg Central Europe Programme.

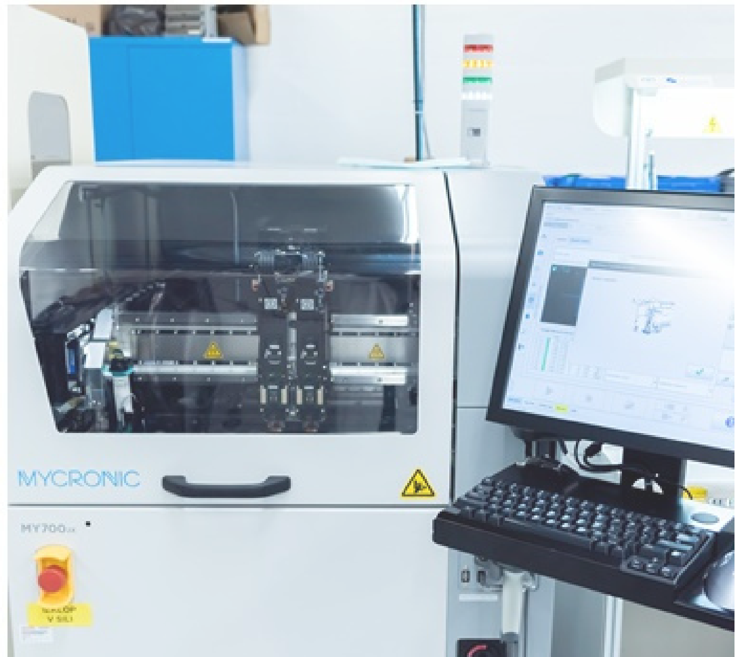
USE CASES











1.Learning Factory at Faculty of Mechanical Engineering and Naval Architecture

Learning factory was established at the beginning of 2022 at the Department of Industrial Engineering within the Faculty of Mechanical Engineering and Naval Architecture in Zagreb. By researching the existing solutions and needs of manufacturing companies, it was decided that the learning factory will simulate discrete manufacturing processes. The system consists of five workstations that accurately simulate real-world manufacturing processes. Workstations that simulate the change of properties (pressing), particle separation (drilling), storage and input/output of the production line are connected by a belt conveyor to achieve the possibility of a circular process. Manual workstation is separated from the others and a mobile robot was acquired to connect them. Each workstation can work on its own or be connected to other workstations, allowing system modularity and production flexibility. In addition to these modules, the learning factory also consists of smart maintenance and energy monitoring systems that greatly contribute to increasing the sustainability of the system and production. Each learning factory module is equipped with many sensors connected to programmable logic controllers (PLCs) that enable system operation. All modules are connected using a manufacturing execution system (MES) that manages all processes by collecting and analyzing big data from sensors. The learning factory was established with the aim of facilitating the education of students and workers on discrete production systems within Industry 4.0. In the future, it is planned to expand the established learning factory with additional workstations and systems for machine learning and artificial intelligence.

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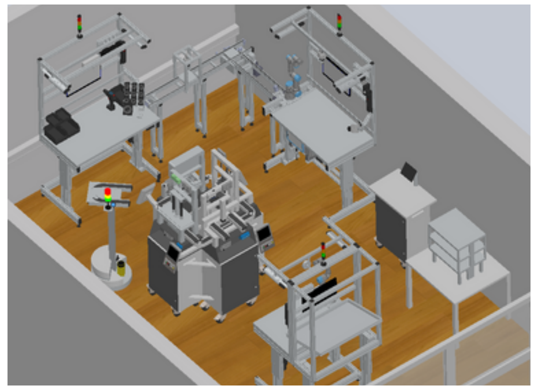


2.ISKRA d.o.o. eSTEP Solution

The eStep is digital interface that enables masters and workers paperless information exchange about work in progress or finished work. Master or lead worker can see most of the necessary information such as what should be producing, operations, planned workspace, planned start time, the state of stocks required for the operation. In addition to the list of tasks/operations, master will also have a list of employees, who are distribute to him. Then the master can simply assign the worker to a specific operation/job. When this is completed, supposedly before the start of the shift, the master has a plan in front of him, so that 'his' employees can work in this shift. This plan is also displayed on the monitors at the entrance to the production, so that every worker entering the production facilities can see what the master has assigned him for the current shift. The worker can therefore go to the job assigned to him and log in to the user interface with his username. Upon registration, he is immediately shown the tasks/operations assigned to him by master. The following information is available to the employee: work order/operation to be performed, total quantity ordered, information on the quantity already made, information on the quantity still to be produced, instructions for manufacture/operation, stock status required for the application. The start and end of the work are recorded within the ERP system.

3.Metal ADditivE for LOmbardy (MADE4LO)

Concerning Additive Manufacturing for metals, a "widespread" factory for the development of metal 3D printing technology was the objective of the project Metal ADditivE for LOmbardy (MADE4LO), with the involvement of two Universities (Politecnico di Milano and Università di Pavia), three Big Industries (Tenova, BLM, and GF Machining Solutions), and six SMEs (TTM Laser, 3D-NT, GFM, Fubri, Co. Stamp, and Officine Meccaniche G. Lafranconi). The project has addressed and proposed innovative solutions to the main technological challenges of additive manufacturing, such as: production of new metal powders, printing of complex materials, large and multi-material and the adoption of hybrid processes that include both additive and subtractive aspects. It also contributed to the creation of two regional and national competence centres dedicated to AM; GFM has founded, in collaboration with other industrial realities, the Additive Technology Centre – ATC, while GF Machining Solution has established a competence centre where additive printing is combined with traditional technologies. Several innovative applications such as:

- printing of pure copper components,
- difficult materials with high performance in terms of hardness,
- production of large, multi-material, geometrically complex components with a hybrid machining component,
- realization of a large and multi-material recuperator,
- creation of a mould with additive and subtractive hybrid process,
- realization of an Axial Vorticator for Gas Turbines

4.Končar Power Transformers Ltd. A Joint Venture of Siemens Energy and Končar - Smart Digital Assistance

Končar Power Transformers Ltd., A Joint Venture of Siemens Energy and Končar is a Croatian company engaged in the development, design, production, testing, sale, and servicing of power transformers and shunt reactors. They specialize in the production of large power transformers of voltages up to 550 kV and up to 1000 MVA, which are currently exported to more than 90 countries around the world. Transformers are designed to provide maximum grid availability through long lifecycle, maximum efficiency, connectivity, and optimized operation. Each transformer is adjusted to the customer's needs and on average two products are produced in series. Due to different customer needs, there are no standard parts. To increase sustainability and facilitate the flexibility of production, systems for smart digital assistance, tracking of metal parts and measurements in production have been implemented in production processes. Prior to the implementation of these systems, the necessary digitization and optimization of production processes and infrastructure was carried out. Smart Digital Assistance is a system consisting of a mobile stand and a large touch screen that allows employees easier access to the necessary documents and information in the workplace. The Smart Digital Assistance system currently provides digital information on work orders, technical documentation (drawings, BOMs) and work instructions. New parts of the system are being developed that will enable digital management of checklists, maintenance, and registration of working hours. The Metal Part Tracking system provides current information on the status of deliveries from the supplier and the location of the product in the warehouse. This information is very useful due to the large number of metal parts that make up each product. The system is based on RFID technology, and implemented using fixed antennas, forklifts with RFID and GPS antennas, mobile portals with antennas and handheld readers. Information on the status and location of the product obtained by reading RFID tags is stored directly in the ERP system. The Measurements in production system processes a large amount of data collected from various sensors and thus provides various information from the production process itself such as air quality inside the plant and the condition of machines. Additionally, it enables inspection of input material dimensions and product quality control. In development is the control of dimensions of input materials and semi-finished products performed by 3D scanning and automatic comparison with CAD models. Additional sensors are also in development for the product quality control to be performed during the production process using sensors that automatically measure the dimensions of product components. After checking each dimension, the system will automatically enter its status in the checklist.

5.AGENT-3D: Additiv generative Fertigung

The AGENT-3D project aims to develop additive-generative manufacturing into the key technology of Industry 4.0 and enable its industrial breakthrough. The core of the work is the development of Additive Manufacturing technologies based on inks and pastes. The consortium considers the entire process chain starting from the preparation of raw materials, substrate pre-treatment, aerosol and dispenser printing, drying, curing, laser and plasma sintering and characterization of the final components. Materials include metals, polymers, ceramics, and composites. Important applications are flexible or conformal thermoelectric generators. Further technologies applied are for example powder bed processes, generative laser powder build-up welding, generative laser wire build-up welding and process monitoring. The second core field “materials” focuses on the development and characterization of innovative materials, material combinations and technology-specific material adaptations primarily in metal as well as ceramics, polymers, composites, and nanomaterials. The aim is to secure desired product characteristics as well as the integration of additional functionalities into components. In parallel, the characteristics of already used materials can be improved, especially regarding the reproducibility of mechanical material characteristics, the aging process, electrical and other specific properties. Material production must reflect the increased usage of additive production processes and has to offer tailored material solutions.

6.For innovative, versatile production of the future

The Wertstromkinematik concept (WSK) is based on the vision of setting up a production completely with universally applicable robot kinematics of identical design, which can be placed on patterned shop floor to form specialized production cells. Their tasks not only include the handling tasks common in industrial robotics, but also manufacturing and assembly processes as well as quality assurance. The resulting elimination of expensive, less flexible special machines within a value stream greatly increases the flexibility of the production chain and makes it much easier for the user to switch to other end products. An essential research task for the implementation of Wertstromkinematik is to enable the kinematics to perform tasks with high accuracy or force requirements. Compared to expensive specialized machines (e.g., machining centers), classical industrial robots usually lack sufficient stiffness for this purpose. Wertstromkinematik solves this problem with an innovative coupling function. Several kinematics are mechanically connected with a coupling module to enable a joint production process with the aid of the associated increased overall rigidity. The vision of Wertstromkinematik also includes a digital process chain that guides engineers in planning future productions and monitoring current ones. With the digital platform, a significant part of the planning and commissioning can be carried out on a purely virtual basis and, in the future, also autonomously.

7.Autonomous and Intelligent Robotics Laboratory in Győr, West-Hungary

Students are introduced to a wide range of modern robotics at the Autonomous and Intelligent Robotics Laboratory (AIR-Lab). In addition to industrial robots, autonomous vehicles, service robots, and anthropomorphic systems are available in the lab. The main profile of the AIR laboratory, in addition to education, is research and development. The main research directions in the laboratory cover the topics of intelligent control of robots, human-machine cooperation tasks, sensor fusion and machine vision. The laboratory is well-equipped to carry out research and development tasks in both hardware and software, with modern instruments, tools and the basic elements and software required for robotics.

8.Enabling the smart and sovereign use of data in manufacturing Hungary

The Austrian-German lighthouse project EuProGigant (“European Production Giganet for calamity avoiding self-orchestration of value chain and learning ecosystems“) aims at building a multi-location, digitally networked production ecosystem with the goal of advancing a resilient, data-driven and sustainable industry in Europe.

The project was started in 2021 and will continue until 2025. In alignment with the principles of Gaia-X, EuProGigant addresses three central research questions: How can…

·…value chains be made resilient to market changes and capable of a large number of variants?

·…interdependencies between stages in the value creation process be recognised and used to increase economic efficiency?

·…we design platforms for production systems that are both responsive and universal?

The project wants to combine existing technologies and build a Gaia-X demonstrator in manufacturing with concrete use cases. For these use cases, the project will develop innovative, data-driven business models according to Gaia-X as a best practice example for Europe. The economic application of the business models will be pursued during the duration of the project.

16 Austrian and German project partners are involved with the execution, development, and implementation of the project. The leading project partners are the Technical University of Darmstadt in Germany and the Pilot Factory Industry 4.0 of the Technical University of Vienna in Austria.

9.ShowMe - Integrated Installation Assistant in Engine Production

The “ShowMe” develops the future assembly workplace. The goal of ShowMe is to help the workers as efficiently as possible at what they are doing. To achieve this, ShowMe combines sensors, object recognition algorithms and metaheuristic optimization to allow a realtime-detection of the workpiece’s assembly state.

This automatic recognition allows for a variety of innovation, which are part of ShowMe:

·An inline-quality assurance continuously checks if there are deviations between the target/actual state of the parts and shows the difference immediately. (“Zero-defect” production).

·The automatic state recognition enables a visualization of the next possible assembly tasks. This help leads to less mental stress which in turn leads to a lower number of mistakes.

·ShowMe can observe and analyze chosen assembly sequences, and can calculate new, optimized sequences and provide these calculations to the workers: the system learns from the workers, which leads to a continual improvement.

·Recognized assembly states are visualized in real time via Augmented Reality, which leads to an immediate quality feedback loop. The workers can immediately repair the problem.

By using ShowMe, the error rate for assembly rate drops, which leads to savings in follow-up processes. Simultaneously, the assembly process optimizes itself: the worker’s knowledge is aggregated and efficiently distributed, which leads to continuously improvements in efficiency and error reduction.

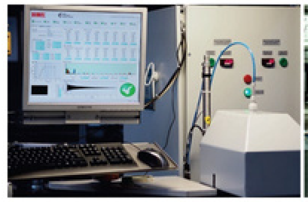
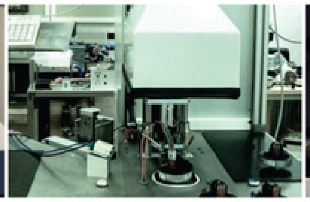
10. Digital system for smart injection molding production line

The goal of the experiment is to establish fully functional smart production line for production of injection moulded parts. The existing production line in the manufacturing company will be improved and equipped with the sensors, vision system and supported with the robots, cobots and SDV trough the NGSI agent's and open source FIWARE context broker to the company's MES and ERP system. The system will use the NGSI interface to collect and store the data from the production line, compare it with the MES system and send back the optimized information's and tasks to the production line. The state of the art of the proposed production line is mobile collaborative robot which can be moved with SDV vehicle from one production line to the other for the pick and place operations (self-adjustable cobot – recognition of parts with vision system). The novel approach will be presented in the concept of vertical storage unit which will be fully monitored with the vision system installed above the storage unit and controlled on the data gathered from the vision system. The production line operations and capabilities will be increased with fully automated optimization system which will send the execution orders to production line based on data collected from the real-time environment.



11. Diagnostic systems for end-of-line quality assessment of electric motors

In recent years, companies have been upgrading production lines with the ability to flexibly produce different electric motors and quickly switch between them. The end-of-line quality control diagnostic system must follow this trend and allow for such flexibility, both in terms of the test itself, as well as the classification of results and evaluation with specific limit values. The main function of the developed diagnostic system is to perform a 100% end-of-line quality control for several different types of electric motors. The system must detect and identify, with high reliability, the potential defects of the manufactured product, as well as any deviations from the nominal characteristics resulting from either its electronic, electrical, or mechanical components. In doing so, it should facilitate the change of the product type and shorten the time required for the change. In developing such a flexible diagnostic system, innovations are embedded in several areas. First of all, in the semi-automatic or automatic gripping of products. Furthermore, in the procedure of achieving working conditions and finally, evaluating the measured results, both based on the parameters obtained from the database or the MES system. At the same time, solutions are sought to reduce the duration of the process and increase the reproducibility of the results. The current application scope of developed diagnostic system is the production of electric motors for vacuum cleaners and household appliances.


POLICY INSTRUMENTS

WHICH MIGHT INFLUENCE THE DEVELOPMENT OF THE FLAGSHIPS

Policy instruments that will have impact on flagships are certainly national and / or regional support available from various funds and programs. In the Republic of Croatia, support for research and development is currently planned through the National Recovery and Resilience Plan 2021-2026 and the National Development Strategy of the Republic of Croatia until 2030. The strategic plans of the Republic of Croatia are financed from the national budget and from European Union funds. Within both strategic plans are planned investments in research and development with the aim of strengthening science, research, and technology. In addition to Croatia, the partners involved in the project also come from Hungary, Slovenia, Germany, Italy, Austria, and Poland. When applying for projects, each of the partners proposed national and / or regional instruments that can be used to support the projects. The policy instruments proposed by flagship partners are listed and explained below.

1.KIT: KARLSRUHE INSTITUTE OF TECHNOLOGY (GERMANY)

Funding opportunities by the German Ministry of Education and Research (BMBF):

- Research program “From materials to innovations” offers several different national funding opportunities for collaborative projects for academic and industrial partners as well as specific programs for SMEs.
- National Strategy for Artificial Intelligence “AI made in Germany”
- Microelectronics Framework Programme Germany
- Federal Agency for Disruptive Innovation SPRIND is creating spaces for innovators, where they can take risks and think radically different.
- Strategic international collaborations are fostered by specific bilateral calls (2+2 Projects), via dedicated ERA-Net programs (e.g. M.Era-Net)
- BRIDGE2ERA2021 program - for better integration of the regions of Central Eastern and South-eastern Europe

2.IWU: FRAUNHOFER (GERMANY)

- To make it easier for companies to access new technologies, the Free State of Saxony has set up a range of support measures. Companies can take advantage of these support opportunities to introduce innovative products and processes and thus increase the competitiveness. The following funding measures are available:
- R&D project funding in the form of individual company projects or joint projects in cooperation between companies and/or companies and research institutions.
- Technology transfer funding (exclusively for SMEs) can be used to promote the acquisition of technical knowledge for the realization of new products or processes or those adapted to a new state of the art.
- The innovation award (exclusively for SMEs) supports the use of external R&D service providers for the development of new or improvement of existing products, processes, and services as well as technical support in the implementation phase.
- The KETs pilot line funding serves to implement research results in a pilot line.
- The InnoTeam program supports cooperation between small and medium-sized enterprises and universities or research institutions in the formation of competence teams.
- Funding for a transfer assistant supports the recruitment and employment of persons with relevant professional experience in science or business.

3.PBN: PANNON BUSINESS NETWORKASSOCIATION (HUNGARY)

The project defined by PBN in the Intelligent Production System topic is compatible with the local strategy, called SZOMBATHELY2030 since the vision of the strategy is to contribute to the improvement of the standard of living in Szombathely and its region by focusing on education and research and development by promoting industrial transformation and specializing on complex rehabilitation within the health industry.

4.PIA: ASSOCIATION INDUSTRY 4.0 AUSTRIA (AUSTRIA)

“Production of the Future" is a national Austrian funding scheme that aims to promote cooperation between business and science, build up human resources and develop research infrastructure.
There are two opportunities for receiving funding from “Production of the Future”:
·National submission opportunities are regularly offered for funding regular R&D projects, lighthouse projects, and R&D services. Furthermore, endowed professorships and research infrastructure projects such as "Industry 4.0 pilot factories" were funded to make innovative production technology and ICT accessible to both scientists and companies.
·Transnational submission opportunities exist via the European Research Area Network M-ERA.NET "ERA-NET for research and innovation on materials and battery technologies, supporting the European Green deal". Bilateral submission opportunities have existed with China since 2014.

5.PRO: PROFACTOR GMBH (AUSTRIA)

The Austrian partners of transnational and application-oriented research and development projects can apply for funding under one of the two FFG programs: Intelligent Production or Basic Program, as part of the European Research Area Network M-ERA.NET "From materials science and engineering to innovation for Europe."

6.PTP: POMURJE TECHNOLOGY PARK (SLOVENIA)

Policy instruments which might influence the development of the flagships in Slovenia are:
Public tender for the digital transformation of large companies – used to encourage raising and growing of productivity, optimization and reduction of production costs and costs of services and operations, and greater competitiveness and a more open market, as well as greater opportunities for the commercialization of innovative solutions.
Public tender for the promotion of large investments for higher productivity and competitiveness in the Republic of Slovenia – used to encourage companies to sustainably invest by investing in more advanced technology and automation of business processes.

7.AFIL: ASSOCIAZIONE FABBRICA INTELLIGENTE LOMBARDIA (ITALY)

Policy instruments which might influence the development of the flagships in Italy and Lombardy Region:
Manifestazione di interesse Regione Lombardia e Uniocamere – regional initiative which can be used to support CEUP2030 CAMI4.0 projects in areas of sustainability and circularity, innovation and technology transfer, digitisation, research and intellectual property and training.
Piano Nazionale di Ripresa e Resilienza (PNRR) - Italian national COVID-19 recovery plan aligned with the European Next Generation EU (NGEU) program to facilitate Recovery and Resilience after pandemic.
Smart Specialization Strategy (S3) – Lombardy Region strategy with objective to identify areas of competences and innovative potential priorities in terms of industrial transformation and resilience of the Lombardy economic and productive system, as well as emerging technological areas to focus regional investment.

INTELLIGENT PRODUCTION SYSTEMS

Interreg CENTRAL EUROPE

European Union European Regional Development Fund

CEUP 2030

https://www.interreg-central.eu/Content.Node/CEUP-2030.html

https://www.facebook.com/CEUP2030

https://www.linkedin.com/in/ceup-interreg-ce-1a561b1a8/

Pomurje TECHNOLOGY PARK · PROFACTOR · AFIL Lombardia · HAMAG BICRO · Siit

PBN advanced management · Fraunhofer IWU · INDUSTRIE 4.0 AUSTRIA · KIT Karlsruhe Institute of Technology · KRAKOWSKI PARK TECHNOLOGICZNY

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