



## MOBILITY & PRODUCTION

Fields of Expertise TU Graz

Source: istockphoto.com/fotolia.com



**Rudolf Pichler,**  
**Mobility & Production**

Source: Lunghammer – TU Graz

**T**he most wonderful thing this summer was being able to meet people again and to work without masks for a longer period.

There were two events worth mentioning in the FoE Mobility & Production where we had the opportunity for an intensive exchange of knowledge.

In the middle of July the Institutes of Automotive Engineering and of Thermodynamics and Sustainable Drive Systems organised a symposium with more than 40 PhD students presenting and discussing their results on vehicle and drive technology. In September, our university once again hosted a conference and showed the latest research results in the area of Mobility and Production. Our FoE participated with six speeches and three posters.

There is also good news in the area of funding. The Institute of Production Engineering, which also runs the smartfactory @tugraz together with Vienna University of Technology and the JKU University in Linz, was able to win a five-year funding programme to network their pilot factories in order to generate sustainable innovation on basis of the new European Platform Gaia-X. This funding programme goes hand in hand with the article that follows, which gives deeper insights into the new era of industry 5.0. It shows that TU Graz is again proactive in this new dimension of using highly up-to-date technology in order to create competitive worlds of production. ●

**Matthias Wolf, Rudolf Pichler**

## Smart Production: The Jump-Off Base for Industry 5.0

One could discuss whether the latest industrial revolution (Industry 5.0) launched by the EU commission already deserves a full digit rise, but one thing is evident: It is the smart world of digitalization (Industry 4.0) which is the powerful enabler of these new 5.0 topics, comprising resilience, human-centric work and sustainability. What TU Graz is doing exemplarily in these new fields of research will be introduced here in the following.

### SMART PRODUCTION ON ITS WAY TOWARDS INDUSTRY 5.0

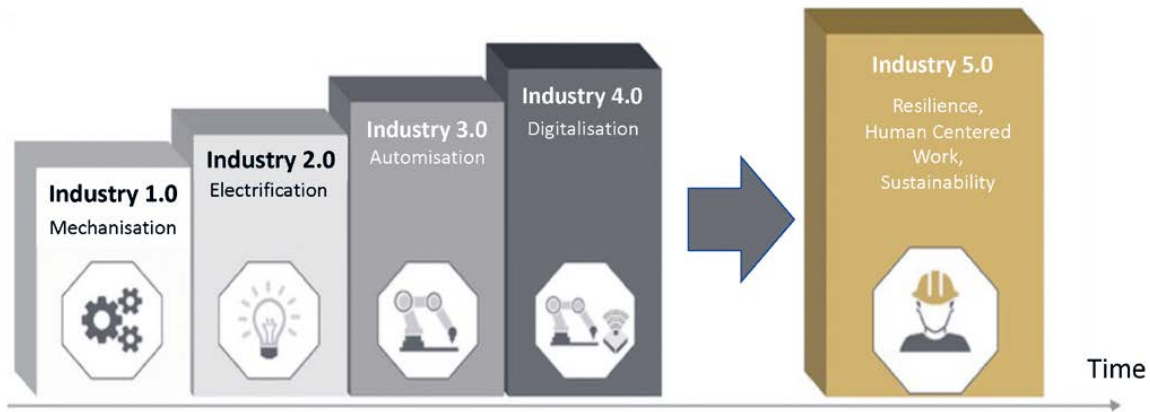
More and more companies have arrived in the world of smart production with its borderless benefits of communication and interaction. There seems to be no limit when leaving the former strict hierarchy of the automation pyramid and using the new forms of collaboration and ICT

based interconnection of facilities either within an independent company or even better across the value chain of a series of companies.

All the advantages of this networked operations (global CPPS) aside, there has been a missing something that is at least of the same importance and necessity for



Source: Shutterstock/asharkyu



**Figure 1:**  
**The step forward to industry 5.0.**

Source: Own representation.

sustainable smart operation in the actual situation of companies. The European Commission found out that there is a strong need to focus the aspects of Resilience, human-centric Work and Sustainability in order to reinforce the Smart Production Initiative and the economy of European production as a whole. Thus, Industry 5.0 [1] was launched. What TU Graz is contributing in these matters and which research fields it has put onto its agenda will be introduced here.

### THE MAKERS OF RESILIENCE

It is the new way of engineering (simulation, virtual reality, etc.), the use of disruptive technologies (IoT, Artificial Intelligence, CPPS) and the design of top competitive working environments (collaborative robotics, wearables, agile infrastructure) which enable the future of human work to be mastered. All these new means build the important tool kit for achieving the status of resilience and the condition of remaining robust and successful in always faster and furiously volatile markets.

In order to demonstrate how such resilient or agile concepts could look like in the field of production there are two specific labora-



**Figure 2:**  
**Simulation-based factory planning as a tool for resilience.**

Source: Own representation.

tories established at TU Graz. On the one hand there is the “LEAD-Factory” and on the other the “smartfactory@tugraz” where Virtual Plant Design, Virtual Commissioning, Mobile Working Stations for Agility, Process Simulation, Digital Twin and similar tools are installed and researched. These environments build an attractive offer for joint research and introduce many living solutions to students and industrial companies.

### PEOPLE AT THE CENTER OF VALUE CREATION

Increasing competition and growing efficiency requirements lead to a higher intensity of work. Going into a higher degree of automation can only counteract this to a limited extent because of technical >



**Figure 3:**  
**LEAD Factory and**  
**digital workplace design.**

Source: Own representation.

### MINIMIZING THE ECOLOGICAL FOOTPRINT

Due to the EU's goal of ensuring CO<sub>2</sub>-neutral production in Europe by 2050 [2], the reduction of environmental footprints will be a central target especially for manufacturing companies. Regarding this, smart production concepts are predestined to provide the relevant data as a "by-product".

The relevant emission data, the product footprint (CPF) and other sustainability targets can be computed and monitored quite easily even with high temporal and spatial resolution via smart data acquisition directly at the machines and with the use of networked libraries. This is the basis for controlling the actual situation and finding new potentials of reduction.

At TU Graz research is being done on transparent procedures for determining the relevant emissions (the Transform. Industry project) as well as knowledge transfer for their targeted reduction (energy efficiency LEAD factory training). Additionally, this is part of two generously funded projects (PilotLin-X and ResearchLin-X) for sustainable innovation networks (Fig. 4). Together with the corresponding universities in Vienna and Linz and 20 companies, a modern network architecture (Gaia-X) and its Data Spaces are going to be designed for complex and sustainable innovations. As a basis and for a better understanding, this process is being carried out using the example of sustainable co-design and co-production of an industrial product.

and economic limits. Even more so, the goal of a "smart factory" has never been to create a factory without people. Rather, it is about flexible automation and collaborative working environments in which humans and machines complement each other's capabilities. So, the focus remains or has to be reinforced again on the working people.

Regarding this, researchers at TU Graz are actually working on the simulation-based ergonomic design of workplaces (Fig. 3) or RTLS systems for linking humans and technical systems. For example, research is being conducted on how and when systems for physical sup-

port (e.g. CoBots, exoskeletons) are useful in order to avoid overload and absenteeism (e.g. research project ExoFitStyria).

As for the growing amount of information to be processed, worker-guidance systems and "extended reality" applications are becoming more and more important. To put working people at the center of production processes, the task of research is to offer efficiently designed devices.

Last but not least, the necessary raising and transfer of skill levels is also part of the research at TU Graz (actually conducted in the research projects LeNuWas and VolaDigital).



**SUMMARY AND OUTLOOK**

The digital possibilities of an existing smart production concept offer the appropriate mindset and the right tools for creating a successful world of industry 5.0. So, the new topics of Resilience, HumanCentric Work and Sustainability find their ground to develop properly. TU Graz has already started to step into these new dimensions of the future working style in production environments. It has been running various related projects and wants to be one of the industry 5.0 frontrunners. ●



**PilotLin-X / ResearchLin-X**



- ➔ Structural Research in Sustainable Innovation
- ➔ Creation of Data Space AMIDS
- ➔ Vivid Innovation Networks

**Figure 4: Funded research projects on sustainability.**

Source: Source: Own representation.

**REFERENCES**

- [1] European Commission, Directorate-General for Research and Innovation, Renda, A., Schwaag Serger, S., Tataj, D., et al, Industry 5.0, a transformative vision for Europe: governing systemic transformations towards a sustainable industry, Publications Office of the European Union, 2022, <https://data.europa.eu/doi/10.2777/17322>.
- [2] European Commission, A European Green Deal - Striving to be the first climate-neutral continent; [https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal\\_en](https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en), 2022.



**Matthias Wolf**

Is assistant professor at the Institute of Innovation and Industrial Management. His research focuses on the topics of industrial management, human-centred work system design, green production and engineering education with a focus on learning factories.

Source: Privat



**Rudolf Pichler**

is senior researcher at the Institute of Production Engineering and leads the research and learning factory smartfactory@tugraz. His major research field is the digitalization of manufacturing environments with emphasis on sustainable systems.

Source: Privat

