

Artificial Intelligence beyond Efficiency

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Use only Industry 5.0 provides a vision of industry that aims beyond efficiency and productivity as the sole goals and reinforces the role and the contribution of industry to society. The workshop presentations were related to drivers, barriers and implications of leveraging the technological solutions developed in Industry 4.0 taking into account the interoperability to address relevant societal impacts moving to Industry 5.0 having the human at the center.

Maria José Nuñez introduced the overall agenda and gave the floor to Dr. Francesco Lelli who introduced the workshop. Afterwards we listen our invited keynote speaker Alessandro Piscioneri from COMAU explaining his experience about evolution of I4.0 in Industry 5.0, related challenges, and explanation of some industrial examples/use cases COMAU is developing or already developed.

Before the paper's presentations the project coordinator of the EFPF project (Workshop sponsor) speaks about the federated Smart Factory ecosystem with the different pilots scenarios with the specific solutions addressing interoperability.

Eleven papers have been presented at the workshop:

- “Introducing Building Blocks for Industry 4.0, an analytics application for the federated EFPF platform”: This paper presents an application that leverage analytic modules for the manufacturing industry developed as part of the EFPF ecosystem. This approach will allow the use of data analytics and predictive maintenance methodologies for SMEs.
- “AI Ethics for Industry 5.0 – from principles to practice”: it discusses the new challenges that Industry 5.0 brings to the way humans are organizing themselves in groups. It also suggests an ethical framework for AI that can enable the creation of a sustainable society from an economical and environmental point of view.
- “A practical experience of AI Solution used to improve varnishing process efficiency in furniture manufacturing”: This paper introduces opportunities and barriers related to the interoperability of systems where AI techniques are applied. It presents a use case for improving the efficiency of a varnishing process for flat parts in the furniture-manufacturing sector. Finding includes the fact that the installation of sensors must be planned with the target company involving decision makers from innovation, production, and maintenance. In addition, we need to avoid situations where the maintenance personnel remove these sensors due to difficulties in opening the machine to perform some routine operation or repair.
- “Industry 5.0 and Sociotechnical Theory: theoretical underpinnings”: This paper discussed why the Sociotechnical Theory should not be neglected in addressing I5.0. It presents a framework of reference for manufacturers looking to implement I5.0. In particular, it highlights the interdependencies between people and technologies and how the EC should apply it to I5.0 driving towards human-centric, resilient, and sustainable manufacturing.
- “Relevance of Visualization and Interaction technologies for Industry 5.0”: it investigates bidirectional communication channels between humans and machines as key aspects for generating collaborators instead of competitors. This approach strength the human role of Industry 5.0 in manufacturing environments.

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- “Teaming.AI: Enabling Human-AI Teaming Intelligence in Manufacturing”: it presents a teaming framework that structures the interactions between humans and AI systems to overcome the lack of flexibility as a limiting factor of human-centered AI collaboration. It also outlines the need of a balance between the practical and the academic work.
- “On Exploring the Possibilities and the Limits of AI for an Interoperable and Empowering Industry 4.0”: This paper proposes to raise awareness on certain interoperability issues shaping industry 5.0 to enable a human-centric resilient society. It presents a case study where machine intelligence perform better than human intelligence and investigate the minimum amount of data that are needed for implementing such solutions.
- “Artificial Intelligence from Industry 5.0 perspective. Is the technology ready to meet the challenge?”: Authors introduce the underpinning technologies that Industry 5.0 will require. In particular they propose the emerging concept of augmented intelligence as the key technology to transition Industry 4.0 to the fifth industrial revolution.
- “Towards Zero-Defect Manufacturing: Machine Selection through Unsupervised Learning in the Printing Industry”: This paper addresses Zero Defect Manufacturing as one of the key concepts of Industry 4.0. This approach is critical in the offset printing industry as a specific example to reduce the printing defects.
- “Towards Industry 5.0 – A Trustworthy AI Framework for Digital Manufacturing with Humans in Control”: This paper presents a digital manufacturing platform architecture that extends Industry 4.0 paradigms as the next ‘revolution’ in industrial domain characterized by three main elements, human-centricity, sustainability, and resilience – as desired in Industry5.0.
- “On Developing Human Centric Digital Tweens”. This paper present how humans use smart devices for addressing several different needs. It focusses on the needs of been connected and advocate that such need is present in every human machine interaction and industry 5.0 is not an exception.

The workshop concluded with an open discussion on the topic raised by these presentations. The participants agreed that industry 5.0 is a nice and catchy name for what is the fact an evolution (and not a revolution) of I4.0. Here we report some of the key point that have been discussed:

- Industrial companies when investing in technological solutions are interested in supporting solutions that offer a clear investment path. In addition, it is necessary to keep workers in the loop in order to avoid any resistance to change. With particular focus on “been replaced by machines” or monitored.
- The need to be concerned not only with Return on Investment (RoI), but with a wider Prosperity agenda. In particular we should also focus on industry-pull, education skills, and impact in society.
- For I5.0 to be effective, we should avoid to separate the technological from the social. In other words, a narrow focus on technological innovation to improve productivity and increase financial returns fails to adequately account for the wider contexts within which manufacturers (and all businesses) are embedded. Using Prosperity as a measure of success rather than RoI provides a more accurate basis on which to make business decisions.
- Industry 5.0, should offer solutions that improve the reliability towards future by offer something that is tangible and quantifiable by stakeholders.
- Developed solutions should be also analyzed from the point of view of how the proposed approach impacts in how the tools can affect the human well being.
- In some specific use cases we can register up to 30% absenteeism due to the working environment. Encourage workers using technologies to help them in repetitive tasks, the worker must trust more in the technologies and make them aware that there is no danger when they are monitored, on the contrary, they must trust and be aware that their work can improve and not be replaced by machines.

As a concluding remark the participants agreed that for the future development of industry 4.0 towards I5.0 industry, academia and society in general should pay more attention to humans when addressing the future in the manufacturing domain.