

The 22nd World Congress of the International Federation of Automatic Control
July 9 – 14, 2023, Yokohama, Japan

The ‘Rocky Road’ towards Industry 5.0: Achieving Human-centricity in AI-enabled Industrial Manufacturing Work Environments and Systems

Invited Track Code: v66fr

This proposal is put forward by
TC5.1 Manufacturing Plant Control

and is endorsed by TC5.3 on Integration and Interoperability of Enterprise Systems

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Abstract

To overcome the overly “techno-centric” transformations towards Smart Manufacturing Systems, the Fourth Industrial Revolution was recently upgraded to a new version: *Industry 5.0*, explicitly promoting a focus on human-centricity, resilience, and sustainability. *Human-centricity* places humans and their needs and interests at the centre of manufacturing systems, facilitating a human-technology symbiosis where the interaction is designed to enhance the capabilities of all system actors involved (i.e., technical and human) and to enable new cooperation models. Achieving *human-centricity* is therefore critical for AI-driven systems. This is even further growing in importance and criticality, given the increasing incorporation of AI-driven systems within Digital Twin solutions such as Digital Twins of Systems and Humans. Integration between humans and AI-driven systems in different manufacturing domains, including quality control, maintenance, production planning and control, is expected to change the nature of both blue- and white-collar work and even blur the boundaries among them. Indeed, as opposed to designing a system with as little human input as possible, there is a consensus that humans will continue to play a vital role in designing, training, operating, and controlling AI-supported manufacturing operations. As a result, especially for workers traditionally in charge of control, planning, and supervision tasks, humans may have to conduct more mentally demanding tasks in cooperation with an AI actor (e.g., an AI-based chatbot), and consequently may experience changes in perceived autonomy, competence, or interrelatedness. Similarly, workers involved in physical tasks may also have to engage with more cognitive demanding and less routine activities, which may be further undertaken by automation, including human-robot collaboration. Overall, while the adoption of AI in manufacturing systems is growing, and the application of

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human-centricity becomes a major prerequisite, there is still a growing need to address the many evolving research avenues. For example, until now, there has been little discussion of the requirements of *human-centric designs* in AI-enabled environments, including the different technical and social choices that enable that design, and the consideration of possible ethical and legal implications. Introduction of AI in shopfloor and working spaces is driving the creation of new human-machine interaction modalities with possible shifts of responsibilities and revision of roles. Linked to this are new risks, for example, reduced sense of responsibility by human operators, new social dynamics among colleagues and also incorrect perception of AI cognitive limits and possibilities of failures. Such knowledge would enable us to develop methods and tools to overcome the techno-centric implementations that still seem to be common practice today in Industry 4.0 environments and also reduce risks of biases and ethically incorrect usage of AI. Moreover, while *human-centricity* is often addressed from the viewpoint of the human-technology interaction itself and focuses on relevant but often singular work design criteria, it can also be viewed from the perspective of the overall work system of humans, extending the unit of analysis from the technology to the overall work design. Such a complex (re-)design process often includes different decision-makers and functions across the organisational context with different backgrounds, expertise, and mindsets that need to cooperate. Hence, despite the design of the technological solutions, there are also many organisational issues that need to be explored in future multi-disciplinary research. Finally, new methods and frameworks are needed to identify relevant design criteria based on sound empirical studies addressing different use-case scenarios and the implications for human work, addressing both blue- and white-collar work.

Despite the increasing interest in this topic, there is ambiguity around the conceptualization and application of human-centricity in AI-enabled manufacturing environments, hindering its achievement and implementation in practice. This session is inviting researchers in the field to contribute conceptual and empirical papers including reviews, case studies, and design-oriented papers including frameworks or methods and simulations, addressing the following topics:

- Enabling human-centricity in the design and/or implementation process of the technology and specifying emerging socio-technical choices for different users.
- Showcasing through demonstrators and empirical studies of human-centric AI applications in different manufacturing domains including the implications for humans.
- Specifying and demonstrating the organisational, and contextual influences or factors that facilitate a human-centric work system.
- Discussing the role of the system designer and their characteristics, including the decision-making processes and their organisation.
- Presenting specific human-centric system architectures in the context of specific technological applications.
- Development of design criteria for human-centricity, e.g., specifying the human factor/work design implications of human-centric systems.
- Evaluation and assessment of human-centric AI-enabled systems in manufacturing domains.
- Frameworks and methods to achieve/adopt human-centricity in the design or

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implementation process of AI-enabled industrial systems.

- Technology enablers for human-centric AI-enabled systems in manufacturing, including enablers for human-AI interaction.
- Regulations, guidelines, and standards pertaining the adoption of AI and mitigation of risks linked to poor alignment of designs and solutions with ethical and legal requirements, and examples of their adoption for human-centric AI systems

Tentative schedule

- October 31, 2022 Deadline for paper submission
- February 01, 2023 Notification of acceptance/rejection
- March 31, 2023 Final paper submission
- 09-14 July 2023 22nd IFAC World Congress: Yokohama, Japan

Manuscript preparation

Papers for the open invited track will follow the guidelines of the conference, available at:
<https://www.ifac2023.org/submission/submit-contribution>

and specifically:

<http://www.ifac.papercept.net/conferences/support/support.php>

Upon preparing the manuscript, please follow the submission guidelines:

<https://ifac.papercept.net/conferences/scripts/start.pl>

When submitting your paper, make sure to select Open invited track code: v66fr

For any queries, please do not hesitate to contact the organisers

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