C/2025/108

10.1.2025

Opinion of the European Economic and Social Committee

Industry 5.0 – how to make it happen

(own-initiative opinion)

(C/2025/108)

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Plenary Assembly decision	18.1.2024
Legal basis	Rule 52(2) of the Rules of Procedure
Section responsible	Consultative Commission on Industrial Change (CCMI)
Adopted in section	24.9.2024
Adopted at plenary session	23.10.2024
Plenary session No	591
Outcome of vote (for/against/ abstentions)	248/1/4

1. Conclusions and recommendations

1.1. Industry 5.0 involves a further step towards a deeper impact of digital technologies in manufacturing to a new level, as it also embraces human-centrism, economic resilience and sustainability. It should be regarded as a continuation of the existing digital industrial revolution, while addressing the shortcomings of Industry 4.0 in empowering societal and ecological values that are now priorities. Industry 5.0 allows businesses and industry to embrace a broader perspective, and deliver solutions for emerging societal challenges.

1.2. EU institutions should encourage the creation of a favourable European industrial ecosystem, which has to be future-proof and enhance competitiveness as the world's first human-centric economy.

1.3. The EESC believes that the concept of Industry 5.0 needs further elaboration in order to better define its economic, social, political, legal and technological consequences, while separating facts from sales propositions. First and foremost, it is important to assess the results of Industry 4.0, which is still unfolding and is still far from a wide-scale implementation.

1.4. The EESC supports authorities and social partners in developing a clearer conceptual, economic and regulatory framework and action plans for the widespread adoption of the principles of Industry 5.0, while considering the potential social costs. This means investing in workplace innovation to foster the competitiveness of European companies, while maintaining high occupational levels and improving the quality of jobs. Ensuring an orderly technological transition requires intensified worker participation and a well-established social dialogue that includes all relevant stakeholders and organised civil society.

1.5. The roll-out of Industry 5.0 should also be supported by decentralised stakeholder platforms and public-private partnerships that will have to develop learning tools, establish programmes/business cases, promote the take-up and exchange/scale up good practices. Broad access to these programmes (including SMEs, entrepreneurs, employees at all levels, as well as remote regions) should be guaranteed and supported as essential policies for innovation and development.

1.6. Industry 5.0 should also become a tool to make manufacturing more attractive to young and older people, thus addressing the growing issue of the lack of skilled human capital, retaining expertise, keeping workers engaged throughout challenges, harnessing the potential of young generations for innovation.

1.7. From an industrial policy perspective, the EESC finds it important to:

— ground the Industry 5.0 vision on existing European policies, such as the Green Deal, the Industrial Strategy, the AI Act, the Digital Decade, the European Pillar of Social Rights and the Skills Agenda. At the same time, these policies should be updated in order to also integrate the Industry 5.0 principles;

— integrate the Industry 5.0 principles in the design of the transformation pathways for the industrial ecosystems and existing programmes, such as the 'Made in Europe' partnership;

— increase the knowledge of the potential of digital technologies among manufacturing companies, especially SMEs. This requires adequate support for companies to understand the potential of innovation for their business, defining their digital, green and resilience objectives, developing and implementing transformative strategic plans;

— provide continuous and sufficient support to expensive 360° investments needed for upgrading companies to Industry 5.0;

— focus on entire value chains and ecosystems and circular production processes, thus achieving the integration of societal objectives into economic development;

— invest in R&D and innovation programmes, both public and private, for developing new sustainable/resilient/human-centred economic models/production systems/markets;

— use Industry 5.0 as a lever for regional transformation strategies, combining economic redevelopment with just transition policies and circular, resilient and sustainable value chains.

1.8. The EESC wants to draw the attention of decision makers to the need to develop a thorough approach to the digital innovation of our productive systems and societies, in an era of abrupt changes, aimed at enhancing regulatory profiles that are ethically oriented by democratic values, social equity, fair competition and inclusive competitiveness.

1.9. The EESC thinks that integrating digital technologies in a human-centred way and turning companies into 'permanently learning organisations' will enhance EU competitiveness.

2. **Context of the proposal**

2.1. This opinion addresses the emerging concept of Industry 5.0, which aims to tackle the societal concerns associated with the ongoing digital transformation of industry, considering both manufacturing and service sectors, whilst ensuring that the EU's industry will continue to be productive and competitive.

2.2. Industry 5.0's ambition is to integrate social and environmental issues in business processes, as these were inadequately addressed by Industry 4.0, which was mainly oriented towards digitalisation and automation. The swift emergence in recent years of new issues and concerns is also having a profound impact on business strategies, with growing concerns regarding a broad concept of the social and environmental responsibilities of enterprises.

2.3. Industry 5.0 updates and broadens the concepts of Industry 4.0, focusing on what has been termed the 'three P's': people, planet and prosperity. The update is due to three main factors: the technological changes that have occurred; the growing societal and political issues that have intervened since the development of the vision; and the shifting geopolitical paradigm, which is deeply affecting the way manufacturing is spatially organised.

2.4. By integrating technologies aimed at better dealing with new global challenges such as climate change, resource scarcity, energy efficiency, new and complex geoeconomics and the need for more socially just development, Industry 5.0 offers the opportunity to develop an industrial paradigm that goes beyond a merely technology-centred and growth-oriented approach.

3. **From Industry 4.0 to Industry 5.0: revolution or evolution?**

3.1. Industry 4.0 was initially developed as a national strategy to bring the German manufacturing industry into the digital age, it went on to become a new paradigm for digital innovation in industry. It was characterised by the widespread adoption of multiple automation technologies, such as cloud computing, big data, machine learning, automation technologies, robots and the Internet of Things, which allowed unmanned communication between devices. Through ever-increasing computer power and faster networks, manufacturing systems can be managed in real time and prepared for data-driven decisions, thus dramatically increasing flexibility and efficiency and allowing a high degree of customisation even in mass production. The resulting 'smart factories' should make industry 'fit for the future', linking machines, products, systems and people, merging the physical and virtual worlds through cyber-physical systems.

3.2. Industry 4.0 has been implemented in several different productive contexts, including SMEs. Its development, in a turbulent geopolitical and economic era, has nonetheless raised some concerns in terms of the social fallout (job security, skills obsolescence) of such massive automation of productive processes, while new challenges were climbing to the top of world leaders' agendas. Industry 4.0's goal was to digitalise manufacturing as it was in 2011: organised in apparently seamless global value chains, and with much less concern about its environmental and social consequences.

3.3. After years of worldwide development and experimentation, it is now clear that Industry 4.0's focus on automation has overlooked its consequences on human capital, from the lack of necessary skills to deal with the growing complexity of digital technologies, to the risk of intensification of work, to the growing issue of integrating elderly workers into an ever-changing environment.

3.4. More attention should also be paid to 'datafication', namely the tendency towards total reliance on data and algorithmic control of production processes, which, while it has the merit of making production processes increasingly more accurate, can also impoverish the creative contribution of human competences.

3.5. Industry 4.0 has underestimated the human factor as the main contributor to the success of the production process, especially in democratic and open societies. It has also paid less attention to some key dimensions of industrial production that go beyond productivity and have since become top policy priorities, such as the need to ensure that industry has a much lighter footprint on the environment by cutting waste, fostering circularity and economic resilience and using less and greener energy.

3.6. Hence, the need for a thorough revision of Industry 4.0's vision and goals, which has been labelled 'Industry 5.0'. In this respect, the EESC supports the vision of DG Research and Innovation ([1]) which aims to bring the deepening of digital technologies in industry to a new level by integrating the dimensions of sustainability, human-centrism and resilience. Industry 5.0 cannot be considered a new industrial revolution, but rather a continuation of the existing digital industrial transition, with a new and necessary emphasis on empowering societal and ecological values. Moreover, its large-scale implementation still has yet to start.

([1]) European Commission, DG Research and Innovation, Breque M., De Nul L., Petridis A, *Industry 5.0 – Towards a sustainable, human-centric and resilient European industry*, Publications Office of the European Union, 2021, https://op.europa.eu/en/publication-detail/-/publication/468a892a-5097-11eb-b59f-01aa75ed71a1.

3.7. Industry 5.0 finds its inspiration in 'Society 5.0', a concept developed in Japan in 2017, with a vision to digitally transform society, thus reaching far beyond manufacturing. The Japanese origin of Industry 5.0 is no coincidence, as Japan has been the first developed country to experience the societal and productivity issues that have forced a more forward looking and comprehensive approach to technology: not a tool for those already at an advantage, but a necessary means to overcome growing challenges, as an aging society and a less productive and competitive economy. Applied to industry, it means combining the technological innovation of Industry 4.0 with concerns for the general welfare of society and for the environment by integrating three new dimensions: human-centrism, sustainability and resilience.

Human-centrism and human capital

3.8. Industry 5.0's vision invites companies to embrace a wider values-driven perspective and to consider the impact of production in general, as well as to undertake a much broader definition of value creation. Companies must assign new priorities to societal goals going beyond growth to become resilient providers of prosperity. As a result of such commitment, they must adopt responsible production and innovation models, respect and empower their human capital, reconsider their environmental and societal goals and move beyond a focus on short-term profits, while actively pursuing the twin transition.

3.9. Industry 5.0 places humans back at the centre of production, considering their experience, knowledge and skills as fundamental resources for long-lasting competitive advantages. It balances the advantages of automation in terms of productivity with the creativity and craftsmanship that are considered solely human, also encompassing the cases where worker participation is intrinsic to the very nature of the enterprise, as is the case for cooperatives.

3.10. Being centred on fostering digital manufacturing as a major goal per se, Industry 4.0 somehow ignored the impact of thorough automation on human capital and societies, threatening employment levels and undervaluing the unique contribution humans can give to quality production. While machines can only deliver what they have been programmed to do, people bring innovation and creativity to the production process. Therefore, it is important to build bridges between humans and machines across all plant activities, with smart machines supporting and augmenting human work (e.g. 'cobots' that automate the repetitive, strenuous and dangerous parts of production), allowing workers to focus on designing processes and products, problem-solving, organising, planning and customer services. Finally, human-centricity also means increased attention to workers' safety and occupational health in general, even including a much bigger concern for workers who, no matter what precautions are taken, are being or will be displaced by automation.

Sustainability

3.11. Industry 5.0 aims to contribute to reaching Europe's climate targets. It aims to break the linear take-make-waste economic model by replacing it with a circular, regenerative economy based on re-use, re-manufacturing, a circular-by-design approach and production processes that avoid waste. Industry 5.0 makes a core priority of leveraging digital technologies to monitor energy consumption, optimise resource efficiency, develop circular processes or to reduce waste flows by digital tracking (a digitalised circular economy).

Resilience

3.12. Growing geo-economic tensions have resulted in a necessary increase in attention to risk management, as uncertainties of any kind have become a constant element of business. Industry 5.0 aims to develop resilience strategies based on diversification of supply chains, a more adaptable/modular and decentralised production capacity and flexible production systems. This is in order to overcome an array of different threats to production, from geopolitical tensions to energy and raw materials crises, to climate-related disasters, to pandemics. Resilience also means greater attention to cyber security as large-scale automation systems could completely collapse due to cyberattacks. In this respect, Industry 5.0 can contribute not only to supporting the competitiveness of European companies, but also to consolidating the strategic autonomy of the EU.

4. **Key enablers for the transition to Industry 5.0**

4.1. The main building blocks of Industry 5.0 are manufacturing processes based on the industrial IoT, high-speed wireless communication, advanced robotics, big data analytics, artificial intelligence and cloud computing. The core of such technologies was already present in Industry 4.0, while in the years following 2011 there has been considerable expansion in their fields of application, and they have also become cheaper and more accessible. More notably, some technologies, such as generative AI, have since then acquired more and more relevance.

4.2. According to the aforementioned goals, Industry 5.0 is shifting attention to technologies aimed at fostering collaboration between humans and software/machines, such as 'cobots' (collaborative robots) interacting with humans and improving the management of energy and the lifecycle of products. This hyper-connected industrial ecosystem vision is aimed at developing smart products targeted at smart customers and consumers through smart supply chains, while closing the ecological loop by managing the lifecycle of products.

4.3. Worker participation and social dialogue are key to seizing the opportunities offered by the introduction of Industry 5.0, as this requires the commitment of all employees, at every level. Therefore, information and consultation should take place at an early stage with a view to: i) ensuring that digital solutions support and empower human labour rather than replace it; ii) mitigating the potential social costs and establishing safety nets for workers between jobs, including tailor-made solutions for workers who cannot be retrained; iii) ensuring a fair re-distribution of the underlying benefits; and iv) opening social dialogue at different levels and in different sectors, leading to greater involvement of organised civil society.

5. **Work organisation**

5.1. Focusing on reaffirming the role of human capital in highly automated productive environments, Industry 5.0 envisions a more rewarding and attractive work environment, based on sound, creative and meaningful interaction between humans and machines. This should be made possible through an understanding that technology complements the human, and that the collaboration between human and machine should be designed from a learning perspective. The human should learn from how to improve technology through using it.

5.2. Technological innovation is profoundly rewriting the actual labour landscape, calling for new skillsets. This will raise the need to redefine jobs, and consequently adapt training programmes, while raising concerns about the workers who will turn out to be more vulnerable to skills obsolescence and substitution through automation of their tasks. In order to unleash the full potential of Industry 5.0, a broad range of either new or updated skillsets are required. Besides digital and technical process-related skills, soft skills will also be much needed. Such massive up- and re-skilling will be of the utmost importance, not just for the present, but even more for the future.

5.3. As industry 5.0 enables more accurate production planning and more efficient workflows, it may also reduce the autonomy of workers, as their role may be reconfigured and diminished, i.e. requiring them to follow instructions from digitised systems, as is already happening in highly automated logistics, or limiting their tasks to monitoring the results of technologies that are being perfected, as it is for AI-generated texts and translations.

5.4. A more efficient and digitised work organisation could also mean higher work intensity, with technologies setting the pace and humans trying to keep up, as well as increasing inequalities. On one end, high-skilled, extremely in-demand and well-paid workers designing, implementing and maintaining digital technologies; on the other end, low-skilled workers, doing monotonous tasks for which technological substitution would be too expensive or just overseeing machines that do the work, or bogus self-employed workers in the gig economy on digital platforms. This area is likely to expand to intellectual jobs previously considered to be part of an elite immune from technological substitution, whose tasks are set to be replaced, or marginalised, by technologies such as AI.

6. **Skills**

6.1. Digital skills are becoming ever more important, therefore access to digital education and training must be guaranteed at all levels, and digital exclusion (access to computer hardware, to fast internet connectivity and basic digital skills for all) should be addressed. Within the Industry 5.0 paradigm, digital skills must also be accompanied by widespread and connected green skills, as the demand for skills relating to waste reduction, waste and energy management, recovery and recycling of secondary materials, and more efficient life cycles is only growing.

6.2. Digitalisation of education and training needs to be promoted. The widespread adoption of digital technologies in education and training will widen access to learning opportunities that put humans at the forefront of decision-making.

6.3. In all enterprises, training pathways need to be established for all workers, including older and lower-educated workers. Especially in SMEs, such pathways must also include entrepreneurs, as they lead the investment decisions, and they must be made aware of the need to pursue the digital and green transition.

6.4. As it is important to make the most of workers' experience, companies must develop a collective knowledge base to allow employees to exchange experiences, work better together, solve issues more effectively and drive responsible and resilient decision-making.

6.5. Social economy enterprises, and in particular cooperatives, have demonstrated, even in industrial sectors, that they know how to effectively combine democracy in the workplace, workers' participation and involvement of local communities, creating economic proximity ecosystems, capable of promoting sustainable development. This is why it is important to include the ability to cooperate among the soft skills necessary for the industry of the future.

6.6. To be able to integrate digital technologies in a human-centred way, companies must become 'learning organisations', creating a learning culture that makes the most of the capabilities of workers in the use of technology.

6.7. It is essential to organise continuous up- and re-skilling for existing workers, to reduce the gender and age-related digital divide, and the polarisation of labour markets, as well as to guarantee a high quality of existing jobs.

6.8. Attention should be paid to the prevention of new occupational risks, be they regarding safety and ergonomics resulting from human-robot interaction, or the lack of privacy and self-determination of work as a result of digitised surveillance and monitoring practices.

Brussels, 23 October 2024.

The President
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