

INDUSTRY 5.0 AND THE SKILLS GAP: STRATEGIES FOR DEVELOPING A FUTURE-READY WORKFORCE

Milica Brkovic ¹ [ORCID 0009-0003-1925-3374], Jelena Culibrk ² [ORCID 0000-0002-0630-4051], Aleksandar Rikalovic ^{2,1} [ORCID 0000-0003-2777-5706], Nemanja Tasic ² [ORCID 0000-0003-0695-6671], Bojana Bajic ^{2,1} [ORCID 0000-0001-7843-7091]

¹ University of Novi Sad, Institute for Artificial Intelligence Research and Developments of Serbia, Serbia

² University of Novi Sad, Faculty of Technical Sciences, Department for Industrial Engineering and Management, Serbia

Abstract: Industry 5.0 represents the integration of advanced technologies, such as artificial intelligence, robotics, and the Internet of Things, with human capabilities. However, this paradigm shift poses challenges in terms of the skills required by the workforce. The main aim of this paper is to examine the concept of Industry 5.0 and its implications for the skills gap. It also focuses on identifying key aspects of the skills gap and analyzing current strategies at reducing this gap and developing a future-ready workforce. By implementing these strategies, businesses and societies may actively bridge the skills gap and provide their workforce with the talents required to succeed in the changing world of Industry 5.0. Additionally, this paper aims to provide significant insights for stakeholders to establish a resilient and flexible workforce ready to embrace the opportunities given by Industry 5.0. It can also serve as a basis for further research in the field of skill development and workforce transformation in the face of rapid technological changes.

Keywords: Industry 5.0, Skills Gap, Workforce, Strategies, Reskilling

1. INTRODUCTION

The industrial revolution's progress has caused transformational innovations in all aspects of society. However, as new social development ideas such as human-centricity, sustainability, and carbon emissions have been introduced, the manufacturing system/paradigm has faced challenges in adjusting to the requirements of an inventive community (Leng et al., 2022). With its innovative perspective, Industry 5.0 will contribute to resolving the issue of the imbalance between industrial and societal requirements. In contrast to previous industrial revolutions, which focused on the economic aspects of sustainability, the Industry 5.0 prioritizes human well-being and societal concerns (Ghobakhloo et al., 2022).

This paper focuses on important features of Industry 5.0, with a particular emphasis on the skills gap and strategies for developing a future-ready workforce. It also provides valuable insights into the ongoing evolution of manufacturing, the challenges faced and potential future directions and emerging trends in workforce development.

2. INDUSTRY 5.0: A PARADIGM SHIFT IN MANUFACTURING

We have witnessed shifts inside manufacturing systems, particularly in the field of digitization, throughout the previous decade (Aslam et al., 2020). Information and communication technologies are used at every stage of manufacturing and this results in a variety of complications in multiple areas, including technical, logistical, organizational, and environmental (Crnjac Zizic et al., 2022). A difficult transition process is underway, which must be successfully managed. Industry 5.0 acknowledges industry's ability to achieve societal purposes beyond just employment and economic growth, to become a sustainable source of development (Alves et al., 2023). It strives to build a sustainable type of development by guaranteeing that manufacturing takes into consideration our planet's constraints and emphasizes employee well-being (Huang et al., 2022). It aspires to become a trustworthy system that provides individuals with a fulfilling and healthy profession by embracing required technical improvements (Akundi et al., 2022). While being conscious of the planet's limitations, this paradigm utilizes novel technologies to create wealth beyond conventional job opportunities and economic growth (Xu et al., 2021). It empowers workers while also

meeting their evolving skill and training needs, increases industrial competitiveness and recruits top talent (Akundi et al., 2022). Last year, the European Commission presented a new and ambitious vision for Industry 5.0. This strategy plan provides the necessary direction to promote scale innovation that generates new forms of economic and social value that successfully balance people, planet, and wealth (Renda et al., 2022).

In implementing Industry 5.0, the European Commission focused on three goals: "Europe fit for the digital age", "A European Green Deal" and "An economy that works for people" (Renda et al., 2022). Thus, Industry 5.0 is not solely built on technology but is grounded in principles such as human-centricity, societal benefits, and environmental responsibility (Akundi et al., 2022). This shift is based on the idea that technology may be designed to foster values and that ethical goals should lead to technical advancement instead of the reverse (Müller, 2020).

3. THE SKILLS GAP IN INDUSTRY 5.0

Industry 5.0 emerges as the response to the demand for a revitalized human-centric industrial paradigm and includes reorganizing production processes in structural, organizational, managerial, knowledge-based, philosophical, and cultural aspects (Carayannis & Morawska-Jancelewicz, 2022). The goal is to provide positive results that enhance not just commercial perspectives but also all parts of the innovation ecosystem (Carayannis et al., 2021). Human-centricity, resilience, and sustainability are the three pillars of Industry 5.0 (Breque et al., 2021). Taking into consideration the aforementioned aspect, it is essential for the workforce to learn a set of new professional and cross-cutting capabilities in order to achieve a sustainable, inclusive, and resilient transition to Industry 5.0 and to produce long-term good consequences (Suciu et al., 2023). In the workforce of the future, soft skills appear to be increasingly crucial, primarily because they differentiate humans from machines (Kolade & Owoseni, 2022). The reality of lifelong learning for everyone is taking shape, as new skills and technologies are being introduced at a much faster pace compared to a decade ago (Li, 2022).

Some of the core competencies that are crucial include:

- Competence in using, controlling, and monitoring technological devices;
- Technological and programming solutions development;
- Lifelong learning;
- Originality, initiative, and creativity;
- Innovative, creative, and analytical thinking;
- Ability to tackle difficult situations and solve complex problems;
- Emotional intelligence;
- Leadership (Suciu et al., 2023).

"The Future of Jobs Report 2023" by the World Economic Forum highlighted that analytical thinking and creative thinking will continue to be the most important skills for workers in 2023. Employers predict that in the next five years, 44% of employee skills will be disrupted and cognitive skills are the most important, indicating the rising relevance of complex problem-solving in the workplace (World Economic Forum, 2023). According to "The Future of Jobs Report 2023", the third-fastest growing core competency is technology literacy. Individuals who develop these types of skills and essential abilities will be better prepared to work as a researcher, artificial intelligence (AI) specialists, Internet of Things (IoT) specialists, software developers, information security analysts, robotics engineers, database and networking specialists, process automation specialists, materials engineers, renewable energy engineer or digital marketing specialist (Suciu et al., 2023). From entry-level personnel to boards of directors, the Industry 5.0 paradigm entails cultivating mindsets, competencies, and skills, through comprehensive training aimed at adopting a systemic approach and comprehending complexity (Renda et al., 2022). Recognizing difficulty, as well as designing complexity-friendly tools and processes, thinking in systems, experiential learning, design principles, iterations and action and reflection cycles involves this training (Suciu et al., 2023). Additionally, Industry 5.0 is characterized as a green and digital technology transition aimed at creating a more sustainable industry (Alves et al., 2023). It has also been envisioned as a greener and more human-centered iteration of Industry 4.0 (Güçerçin, S. & Güçerçin, U., 2021).

Looking back at the previous concept, Industry 4.0's ultimate objective is to increase digitalization and automation and one of the key concerns of the paradigm is smart factories (Güçerçin, S. & Güçerçin, U., 2021). These factories are high-efficiency manufacturing facilities that operate with exceptional efficiency using smart technologies, eliminating the requirement for human involvement in the production process (Phuyal, Bista & Bista, 2020). Transformative technologies such as AI, IoT, robots, digital twins, 3D printing, and blockchain have been the key

concepts in constructing efficient and competitive production processes in the Industry 4.0 era. These advantages, however, were not without drawbacks, particularly in encounters involving human-machine disputes (Battini et al., 2022). Researchers identify health issues, worker satisfaction, and worker welfare as important considerations in this respect (Pizoń & Gola, 2023).

Looking at the larger picture, Industry 5.0 has two main goals. The first entails providing personalized services and manufacturing by collaborating with people, algorithms, and robots (Marinelli, 2023). The second purpose is to create an economy that encourages sustainability (Marinelli, 2023). To summarize, Industry 5.0 intends to change the working system by merging humans, algorithms, and robots, while simultaneously fostering a global bio-economy based on sustainable principles (Alves et al., 2023). Moreover, human involvement in the manufacturing process blends industrial automation's speed with cognitive abilities and critical thinking (Ivanov, 2022). Mechanical and repetitive tasks will be taken over by automated machines, while humans will contribute with their skills to creative projects (Marinelli, 2023). As a result, in the framework of Industry 5.0, employees are expected to increase their value by learning new skills and adjusting to changes through reskilling and upskilling programs (Fitsilis, Tsoutsas & Gerogiannis, 2018).

4. STRATEGIES FOR DEVELOPING A FUTURE-READY WORKFORCE

Much of the recent debate on the global economy's future has concentrated on the influence of digital transformation on corporations, governments, and industries during the last decade (Battini et al., 2022). In accordance with this, researchers and professionals have claimed that the global economic growth trajectory has shifted from a market economy to a knowledge economy (Mohamed, Liu & Nie, 2022). In this context, the Industry 5.0 paradigm requires a proactive approach to education and training to ensure employees have the necessary skills and knowledge to succeed in this new industrial paradigm (Pacher et al., 2023). The reform of vocational educational institutions, particularly business schools, is a pressing issue that necessitates a full overhaul of present academic curricula (Renda et al., 2022). Collaboration with an industry-led vanguard focused on circularity, regeneration and resilience could help universities reduce the time it takes to distribute and disseminate new knowledge, promote strategic innovation portfolios, and reform education (Siciu et al., 2023). A strengthening of public-private partnerships aimed at accelerating industrial transformation and collaboration along sustainable lines could encourage universities, primarily European universities, to become better incubators of innovation, not just through commercialization of research (licensing offices and tech transfer), but also through education renewal (content/reach/form), industrial clusters, co-creation and new forms of collaboration with SMEs and by being 'living labs' (Renda et al., 2022).

To promote the concepts of circularity, resilience, and successful regeneration within sustainable business models and value chains, it will be necessary to establish innovative collaborative industrial networks (Crnjac Zizic et al., 2022). These networks should encourage the exchange of ideas, expertise, and resources across different sectors (Crnjac Zizic et al., 2022). Furthermore, the establishment of integrated multidisciplinary teams is crucial to achieve multidimensional business models that produce many types of value (Battini et al., 2022).

5. CHALLENGES AND FUTURE DIRECTIONS

In Industry 5.0, there is a focus on improving worker well-being by developing techniques to track and incorporate more precise individual worker characteristics into work planning decisions (Lu et al., 2022). Individual talents, technological acceptance level, physical capabilities, age, gender and other factors all contribute to workforce diversity (Battini et al., 2022). Actively recognizing, assessing, and taking diversity into account in workplace policies becomes a critical strategic requirement in order to increase performance by practice decisions with the diverse qualities and attributes of individual workers and better aligning work policy (Katirae et al., 2021). There is also a requirement to improve workforce well-being and employee satisfaction (Battini et al., 2022).

In addition to the previously mentioned systems thinking and complexity skills, Industry 5.0 will need to attract and invest in mind-sets, skills, and abilities capable of radical cross-border collaborations and governance and sustaining long-term partnerships and including cross-disciplinary co-creation (Renda et al., 2022). Currently, these skills are not emphasized in secondary and postsecondary education core curriculum (Kolade & Owoseni, 2022). Individuals often develop these talents later in life as they mature and participate in lifelong learning (Pacher et al., 2023). However,

these talents must be developed at a young age, which would entail a major overhaul of educational and training institutions' structures and methods (Kolade & Owoseni, 2022).

Furthermore, it is crucial to highlight the importance of imparting these skills to decision-makers, boards of directors, and middle management within European enterprises and the public sector (Renda et al., 2022). This is essential to facilitating one of the most important intersectoral collaborations, namely the intersection of the public and private sectors, as well as the collaboration between industry and government in managing shared resources and working toward collective welfare (Kolade & Owoseni, 2022). Currently, the competencies required to assume such roles are not widely distributed among individuals. In this context, universities are emphasized for their role in building and nurturing these abilities, as well as matching university curricula with labor market demands (Siciu et al., 2023). On the other hand, the focus is on the importance of training and lifelong learning in light of new innovative and technological developments (Kolade & Owoseni, 2022). It is becoming increasingly clear that not all persons are capable of continually improving their skills and core competencies in response to technology innovation, but the Industry 5.0 paradigm also provides feasible alternate solutions to these types of circumstances (Battini et al., 2022). The Industry 5.0 model's perspective does not develop integrated solutions only for human resources with the ability to acquire such core skills and competencies (Pizoń & Gola, 2023).

AI and virtual and augmented reality may be used to construct tools that assist and guide less specialized or less competent humans in performing more difficult jobs that need advanced and high skills and competencies (Siciu et al., 2023). Furthermore, there is a potential for the development of technologies that are more intuitive and user-friendly, allowing for enhanced interactivity and effectiveness in their usage (Crnjac Zizic et al., 2022).

6. CONCLUSION

In this rapidly evolving world, fostering collaboration between automated systems and human workers is crucial. The successful implementation of the Industry 5.0 model is highly dependent on employees being involved in the development and use of new digital and industrial technologies like artificial intelligence and robots (Breque et al., 2021). By establishing seamless integration and cooperation, organizations can create synergistic workflows where humans and machines complement each other's strengths (Renda et al., 2022). This collaboration enables tasks to be performed more effectively and efficiently, leveraging the unique capabilities of both humans and digital technologies. As we transition to Industry 5.0, it is essential for employees to cultivate a proactive attitude toward learning and upskilling (Li, 2022). This proactive mindset enables individuals to adapt and thrive in this new era of constant transformation by consistently updating their knowledge and acquiring new skills that align with the evolving technological advancements and industrial practices (Crnjac Zizic et al., 2022). This approach empowers workers to manage the shifting needs of the industrial sector efficiently, contributing to the overall sustainability, competitiveness, and resilience of both companies and the broader economy (Kolade & Owoseni, 2022). By developing their core competencies and skills, individuals become better equipped to tackle new challenges and transform them into opportunities.

Additionally, the collaboration between academia, industry, and government is vital for skill development and lifelong learning initiatives (Renda et al., 2022). By leveraging the potential of emerging technologies and promoting collaborative efforts, it is possible to efficiently bridge the skill gap, equip the workforce with essential capabilities, and ensure that employees are prepared for the demands of the future (Siciu et al., 2023).

Furthermore, fostering an organizational culture of creativity, flexibility, and diversity is important for developing a future-ready workforce capable of embracing technology breakthroughs and driving innovation (Battini et al., 2022). However, challenges such as the rapid pace of technological advancements and the need for a comprehensive understanding of evolving job roles require continuous research, evaluation, and improvement of skill development strategies.

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