Chapter

Perspective Chapter: Industry 4.0's Artificial Intelligence – A Blessing and a Nightmare for the Workforce

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Abstract

The nature of work has been changing since the invention of machine tools during the First Industrial Revolutions in the mid-1700s. In recent years, advancements in technology have accelerated the rate of change in work, particularly with the onset of the Fourth Industrial Revolution, which is also referred to as Industry 4.0. One of the notable fruits of Industry 4.0 is artificial intelligence (AI). It has come as a blessing to industry because of its tremendous contribution to improved productivity. Industry is now able to produce more for less with more precision, thanks to advancements in technology that have brought about AI. For the workforce, AI can be seen as a blessing to the extent that it is a tool that makes work light. This has the potential to lower labor costs because work that needs to be done by many people can be done by fewer people. However, artificial intelligence is also a nightmare because of its potential to threaten job security, workplace safety, and worker well-being. This chapter discusses the advantages of AI, the challenges that it poses (including ethical issues, fears of the unknown, alienation, worker safety, and job insecurity), and the pedagogical implications of AI (including reskilling, adoption of strategies for life-long learning, experiential learning, holistic learning, and multidisciplinary learning). The chapter also recommends that workforce development institutions should adopt learner-centered pedagogical approaches which foster experiential learning, prepare learners for lifelong learning, and facilitate acquisition of soft skills (such as communication, problem-solving, creativity, and critical thinking).

Keywords: Industry 4.0, Industry 5.0, alienation, environment, human-centricity, artificial intelligence, job insecurity

1. Introduction

This chapter discusses the advantages of artificial intelligence (AI), the challenges that it poses, and the pedagogical implications of AI. The chapter also heralds Industry 5.0 as a cure for some of the side effects of Industry 4.0.

The history of man-made tools can be traced back to 2.5 million years ago with the invention of stone tool technology [1]. Since the adoption of stone tool technology, to overcome innate human limitations that make work laborious, man has made and

used tools. Technological innovations of the First Industrial Revolution (also referred to as Industry 1.0), which happened around 1750–1,840 did not, therefore, mark the beginning of the use of technology in man's quest to use tools to perform tasks for which human hands alone were not sufficient. However, Industry 1.0, through the invention of the steam engine, made a huge impact on the rate of industrialization and the displacement of many workers [2] and laid a foundation for today's workplace technologies.

On the heels of Industry 1.0 in the late 1800s and early 1900s came Industry 2.0, which is remembered for the advent of electricity, electronic and mechanical devices, and cars [3]. Highlights of Industry 2.0 included a huge increase in mass production, a significant drop in costs, a rise in labor unions and social welfare programs, and workers' demand for better working conditions and better wages [4].

Industry 2.0 was followed by Industry 3.0 (starting in the1950s), which was associated with "the movement from mechanical and analogue electronic technology to digital electronics, such as green buildings, electric cars, and distributed manufacturing. It is based on energy transition and digital technologies, and the internet" [5]. Then, in the 1990s, Industry 3.0 seamlessly transitioned into Industry 4.0. Commenting on Industry 4.0, some scholars have said:

> *As industrial revolutions have moved from the mechanization of production in the first industrial revolution, to the mass production in the second, and then to the automation of production in third, the standards of living for most people around the world have greatly improved. Undoubtedly, the capability of advancing technology coming forth from the latest industrial revolution has the potential to make even bigger and greater improvements on every aspect of our lives changes than the first three industrial revolutions summed together [6].*

One of the notable fruits of Industry 4.0 is AI. Recently, much has been said about the growing application of AI to work processes and its place in the development of tomorrow's workforce [10–12]. Through the lens of workforce development (WfD) pedagogy, the storyline of this chapter will be guided by the following questions: What is AI? What benefits does AI bring to the workplace? What challenges does AI pose to the workforce? What are the WfD pedagogical implications of AI?

2. Defining artificial intelligence

The definition of AI can be elusive, probably because it is still a relatively new concept. Hashimoto et al. defined AI as "the study of algorithms that give machines the ability to reason and perform cognitive functions such as problem solving, object and word recognition, and decision-making" [13]. This definition may be contrasted with Du-Harpur et al.'s definition: ". . . the ability of a machine to communicate, reason and operate independently in both familiar and novel scenarios in a similar manner to a human" [14].

The two definitions cited above may also be contrasted with the following definition by the University of Notre Dame: "*Artificial intelligence (AI), in its simplest definition, is any technology/machine that can perform complex tasks that are typically associated with human intelligence.* These tasks can include problem-solving, planning, reasoning, and decision-making" [15].

The three randomly selected definitions mentioned above vary slightly. What they have in common is that they all use human ability to reason and solve problems as the yardstick for determining whether a machine's capability qualifies it to be considered as possessing AI. Any technology or machine can be classified as AI if it can perform tasks that would ordinarily require human cognitive abilities, such as reasoning, problem-solving, and decision-making.

Defining AI by making comparisons to human cognitive abilities adds to the challenges of adopting a generally agreed-upon definition of AI, which bases its definiens on human intelligence. As some scholars have pointed out, to define AI by referring to human intelligence calls for a close look at the meaning of intelligence and drawing boundaries between AI and real intelligence [16, 17].

It is, therefore, for reasons of simplicity rather than completeness of the definition, that in this chapter we shall adopt a definition of AI that describes it as the ability of technology or a machine to perform tasks that ordinarily require some human cognitive abilities.

3. Benefits of artificial intelligence to the workforce

The application of AI to work processes is a blessing to the industry because of the several benefits it brings, including enhanced accuracy and efficiency, high productivity, reduction in costs, improved decision-making, and minimal concerns about safety.

3.1 Accuracy and efficiency

AI has made tremendous improvements to accuracy and efficiency in several business sectors, such as healthcare, finance, e-commerce, manufacturing, and marketing [18]. Taking healthcare as an example, AI enhances accuracy and efficiency through its:

> *exceptional ability to detect intricate patterns in medical images, often surpassing human capabilities, which is crucial for diagnosing complex diseases such as cancer and neurological disorders. AI's role in reducing human error, coupled with its rapid processing abilities, not only accelerates diagnostic procedures but also contributes to operational efficiency and cost-effectiveness by minimizing unnecessary repeat scans and the likelihood of misdiagnoses [19].*

3.2 Productivity

Recent research has demonstrated how AI is revolutionizing production processes to enhance productivity. For instance, a study by Gao and Feng [20] concluded that "AI enables firms to improve their productivity, leading to increased main business income and higher added value of products. This results in higher output from all factors of production in the current period compared to the previous period, leading to a significant increase in TFP." This is not surprising because, although human labor has its strengths, it has weaknesses that can affect productivity. For example, human beings can impact productivity through industrial disputes, fatigue, human error, sickness, or resignations. AI is free from these weaknesses. Furthermore, AI is better suited than human workers for repetitive tasks that are characteristic of mass production processes.

3.3 Costs

One of the central motives of business enterprises is to make profits from business operations by minimizing costs. AI comes in handy in this regard. Examples of the contribution of AI to cost reduction include the use of robotics process automation (RPA) to minimize production costs associated with human labor, enhancing predictive analytics through the deployment of machine learning (ML), and applying natural language processing (NLP) technologies to customer services and communication processes [21].

3.4 Decision-making

Effective decision-making is a function of the utilization of data in problem analysis and the selection of problem solution options. AI contributes to the decision-making process by generating and providing the data needed to guide the process. Jarrahi [22] illustrates how AI helps decision-makers when navigating three challenges of decision-making, namely *uncertainty, complexity, and equivocality*. **Table 1** paraphrases Jarrahi's decision-making model.

As **Table 1** shows, AI aids the decision-making process by the speedy provision of necessary information, facilitating quick analysis of data, and analyzing divergent interpretations of a decision domain.

3.5 Safety

The subject of workplace safety and occupational health is critically important. It affects productivity through the loss of man-hours caused by injuries, fatalities, occupational diseases, and accidents [23–25]. The rate of occupational casualties is very high. It is estimated that annually, two million workers worldwide lose their lives due to work-related causes [23], not to mention the number of workers who cannot contribute effectively to productivity because of occupational sickness and injury.

Against this background, the advent of AI-based solutions to occupational health and safety issues is a huge blessing. Examples of solutions include "smart sensors,

Challenge	Uncertainty	Complexity	Equivocality
	(characterized as a lack of information about all the alternatives or their consequences, which makes interpreting a situation and deciding more difficult)	(characterized by an abundance of elements or variables; they demand the processing of masses of information at a speed beyond cognitive capabilities)	(the presence of several simultaneous but divergent interpretations of a decision domain, often due to the conflicting interests of stakeholders, customers, and policymakers.)
Role of human decision-maker	Make swift, intuitive decisions in the face of the unknown	Decide where to seek and gather data, and choose among options with equal data support	Negotiate, build consensus, and rally support
Role of AI	Provide access to "real time" information	Collect, curate, process, and analyze data	Analyze sentiments, and represent diverse interpretations

Table 1.
Use of AI in the navigation of uncertainty, complexity, and equivocality.

drones, and predictive systems" that have proven to significantly reduce accidents and strengthen decision-making capacity in terms of prevention. For example, companies such as Siemens and Bechtel have reported decreases of up to 40% in workplace incidents following the adoption of smart technologies [26]. Prevention is better than cure. Therefore, the greatest contribution of AI-enabled systems to occupational safety is prevention through advanced sensor technologies and other AI-enabled technologies that help in processing huge datasets to identify and warn about health risks and other hazardous situations, and suggest preventative measures in good time [27].

4. Challenges of artificial intelligence

AI poses several challenges, such as ethical issues, fears of the unknown, alienation, worker safety, and job insecurity. As some scholars have perceptively observed, AI in the workplace indeed tends to function as a double-edged sword [28–30].

4.1 Ethical issues

One of the greatest challenges posed by AI is the issue of ethics. Ethics may be defined as "the discipline dealing with right versus wrong, and the moral obligations and duties of entities (e.g., humans, intelligent robots, etc.)" [31]. Concerns that have driven the issue of ethics to prominence include:

> *an increasing number of high-profile cases of harm that has resulted either because of the misuse of the technology (e.g., psychometric voter manipulation, facial recognition surveillance, mass data collection without consent, etc.), or as a result of the technology having design flaws (e.g., bias in cases of recidivism, loan rejection, and medical misdiagnosis, etc.) [32].*

According to Kazim and Koshiyama [32], the major themes in AI ethics are human well-being, safety, privacy, transparency, fairness, and accountability. **Table 2** summarizes the descriptors of these six themes.

4.2 Fear of the unknown

AI is a relatively new phenomenon. Its limits and potential harm are not yet fully understood. The general workforce is not quite sure yet of the possible harm of AI in

Themes	Descriptors	Examples of risks
Human well-being	This theme is grounded in the ethical principle of respect for human dignity and includes psychological, social, and environmental well-being.	Possibility of a system diminishing the deliberative/rational capacity of humans; mental and physical ill-health caused by job stress and anxiety; undesired impact on society and the environment, for example, through pollution caused by poor industrial waste management.
Safety	This theme is based on the ethical principle of preventing harm, where harm is defined in terms of adverse effects on human well-being, that is, the psychological, social, and environmental human well-being.	Data poisoning, model leakage, weaponization of delivery drones; a warehouse robot that causes new safety risks; a malfunction of an AI-powered tool can cause injuries to workers.

Themes	Descriptors	Examples of risks
Privacy	This theme is based on the public and political demand to respect a human's personal information. It relies on a distinction between the private-personal and the public-political/communal sphere, where the former is seen as demanding a higher level of respect for privacy than the latter.	Mass surveillance and personal data are being used to target and engage in recommendation and manipulation (for both political and economic ends); identity theft caused by data breaches or leakages of confidential information.
Transparency	This theme is based on the public and political demand to respect a human's personal information. This relies on a distinction between the private-personal and the public-political/communal sphere, where the former is seen as demanding a higher level of respect for privacy than the latter.	Failure to explain how a system has come to a decision and to make that decision explicable to workers and other stakeholders leads to a loss of trust.
Fairness	This theme is based on the ethical principle of human equality. Fairness falls under debates about justice and is hotly contested. A central question is what definition(s) of fairness/justice to commit to, that is, there are mutually exclusive theories of fairness, such as corrective, distributive, procedural, substantive, comparative, etc.	Bias in datasets, intentional exploitation of people (e.g., customers/regional pricing), unfair competition, and a hiring tool that ignores qualified female applicants.
Accountability	Ethical AI is a branch of applied ethics and, as such, is inherently concerned with how AI systems impact human beings: how the systems are developed, the processes and logic of decision-making, the allocation of duties with respect to who makes decisions and how, to what extent impacts, risks, and harms are gauged and measured. All this falls under the remit of accountability, and, as the previous sentence indicates, accountability relates to knowing who made decisions, how those decisions were made, and what systems or tools were put in place to measure and track – that is, governance.	Not communicating the capabilities and purposes of the system to those both directly and indirectly impacted; misleading a person to believe that he/she is communicating with a human being by not making it known that they are interacting with a system. A system may be mimicking human subjectivity (e.g., a chatbot).

Table 2.
Descriptors of AI ethical themes based on Kazim and Koshiyama's analysis.

the workplace, which raises fear and anxiety. According to a study by Wang and Xiao [33], "Anxieties induced by AI, such as privacy violation, bias behavior, job replacement, and learning anxiety, are not limited to the field of AI-generated art but are prevalent across various domains. Such concerns may also trigger multifaceted anxieties among individuals and with society at large."

4.3 Alienation

The history of the concept of alienation can be traced to the writings of Karl Marx during the epoch of Industry 1.0 [34]. Work alienation may be defined as "a feeling of the loss of meaningfulness towards the job; this means that an employee will only perceive his job as a way of survival, overlooking factors such as self-fulfillment and satisfaction, which limits the full use of his skills, experiences, and knowledge"

[35]. Apart from the sense of detachment from the job, a worker may also feel detached from himself and other people [36].

Research has shown that workers can easily feel alienated when AI seems to take away their jobs and their sense of ownership of the expertise needed to perform their tasks, creating anxiety and an identity crisis [37]. The consequences of work alienation can be dire:

> *An alienated employee suffers several adverse ramifications. An alienated employee particularly suffers from low quality of work, production, cooperation, motivation, and organizational commitment. He/she would suffer deficiencies in organizational identification and job involvement. He/she would be liable to excessive absenteeism, feeling of purposelessness, disruption of work activities, changes in job designation, more indulgence in immoral activities. He/she would suffer a sense of fatigue along with other health issues; they would feel distant from colleagues, they would have lack of interest in achieving organizational targets and unable to shoulder their responsibilities [38].*

5. Pedagogical implications of artificial intelligence

The increased use of AI in the workplace has some pedagogical implications. Workers need education and reskilling to enable them to maximize the benefits of the ever-changing AI-enabled tools and to minimize, cope with, and survive the impact of the negative effects of AI.

5.1 Knowledge and skills for maximizing the benefits of artificial intelligence

To operate AI-powered machines and to interact well with non-human "workers" (e.g., robots), employees need to acquire appropriate technical as well as soft skills. The term "technical skills," also known as hard skills, refers to skills that enable "employees to compete in tasks, including skills related to scientific knowledge, professional abilities, and technical expertise" [39]. According to a study by Babashahi et al. [40], the technical skills include:

> *proficiency in language processing, machine learning, machine vision, big data analysis, IoT-related technologies, programming, data analytics, cybersecurity, messaging platforms, chatbot development, natural language processing, intent recognition, robotic process automation, assistive robotics skills, human–robot cooperation, exoskeleton robotics, and various scientific and technological proficiency. These technical skills form the backbone of AI integration and technological advancement across industries, driving innovation and efficiency.*

In addition to the technical skills mentioned above, today's workers are expected to have soft skills. There is no commonly agreed-upon definition of soft skills yet. However, the term "soft skills" generally encompasses:

> *personal, social, communication, and self-management behaviors. They cover a wide spectrum of abilities and traits: being self-aware, trustworthiness, conscientiousness, adaptability, critical thinking, attitude, initiative, empathy,*

> *confidence, integrity, self-control, organizational awareness, likability, influence, risk taking, problem solving, leadership, time management, and then some [41].*

5.2 Knowledge and skills for minimizing the impact of the negative effects of artificial intelligence

Not all workplace-related stressors and traumatic situations arising from the unintended consequences of AI-powered technologies can be resolved by education and training. Some responses to psychosocial problems will need non-training-related interventions, such as the formulation of policies for the prevention, detection, and treatment of workplace mental health issues caused by the negative side of Industry 4.0. Other non-training-related interventions include medication or counseling, communication about one's condition, accepting one's condition, and allowing oneself to take time off when needed [42].

That said, there is a place for education and training for supervisors and workers. In their justification of the role of education and training in occupational stress management intervention programs, Richardson and Rothstein observed that:

> *Although it is not possible to eliminate stress entirely, people can learn to manage it. Many organizations have adopted stress management training programs to try and reduce the stress levels of their workforce. A stress management intervention (SMI) is any activity or program initiated by an organization that focuses on reducing the presence of work-related stressors or on assisting individuals to minimize the negative outcomes of exposure to these stressors [43].*

Training content for courses designed to minimize stressors includes soft skills such as communication and conflict resolution, as reported by Molek-Winiarska and Kawka [44]:

> *According to theoretical models, such as the JD–C[1] and HCM[2] presented in the introduction, improving one's skills, such as communication, conflict resolution, teamwork or self-management, is instrumental in the reduction of work-related stress, especially in the circumstances of teamwork. On the basis of the results showing a decrease in perceived stress and an increase in general health, one can support the hypotheses related to the positive influence of soft-skills training on stress reduction.*

5.3 Pedagogical approach for artificial intelligence workforce development

To equip the workforce with both hard skills and soft skills that will enable them to maximize the benefits of AI-enabled tools and minimize the impact of the negative effects of AI, institution-based and workplace-based providers of education and training need to adopt teaching-learning approaches that promote experiential learning (which enhances the acquisition of innovation, deeper learning, lifelong learning, and soft skills), holistic learning, and multidisciplinary learning.

5.3.1 Experiential learning

Experiential learning theory (ELT) is attributed to David Kolb, who defined learning as "a process, in which knowledge is created through transformation of

experience" [45]. This approach to learning shifts the burden of knowledge acquisition from the teacher to the learner [46]. Unlike the traditional didactic approach, in which the teacher is the sole provider of knowledge, experiential learning enables the learner to learn by doing and reflect on the process and outcome of learning. The teacher's role is to create a learning environment in which a student constructs knowledge from the practical experience of performing a real-world task. In this approach, learning takes place in the following four-stage cycle [47].

- Concrete experience – the student actively participates in performing a task.
- Reflexive observation – the student consciously reflects on the experience gained from performing the task.
- Abstract conceptualizing – the student tries to conceptualize a theory or model of what they have observed while performing the task.
- Active experimenting – the student tries to plan how to test the model, the theory, or the plan for the forthcoming experience.

School or college classrooms, laboratories, and workshops must be characterized by learner-centered approaches that promote experiential learning, such as project-based learning (PjBL), through which students engage in long-term, real-world projects to apply knowledge and cultivate a sense of responsibility; problem-based learning (PBL), which encourages students to actively solve real-world problems, foster collaboration, and interdisciplinary thinking; and inquiry-based learning (IBL), which fosters active learning involving questioning, exploring, and critical thinking to develop problem-solving skills [48].

Out-of-class learning environments for this approach include work-based learning (WBL) modes such as apprenticeships and internships, which allow learners to acquire AI-related skills by observing experienced workers perform tasks using AI-enabled tools, appreciating the theory behind the tasks, and then performing those tasks under the supervision of their mentors while reflecting on their experiences.

The advantages of experiential learning are many, including the promotion of innovation [49], lifelong learning [50], deeper learning [51], and soft skills [52], all of which are critical Industry 4.0 skills.

5.3.2 Holistic learning

In an AI-dominated working environment, in which workers require not only cognitive and psychomotor skills to get work done but also other skills for coping with psychosocial issues, there is a need for training providers to adopt a holistic learning approach. This approach is "characterised by focus on the 'whole person', and seeking to engage fully all aspects of the learner: cognitive; emotional; and social" [53].

5.3.3 Multidisciplinary learning

Problem-solving, collaboration, and teamwork skills rank among the in-demand Industry 4.0 workforce abilities. Workers are expected to have the ability to collaborate with colleagues specializing in different disciplines to solve real-world

production problems. To empower workers with such skills, WfD pedagogies must include multidisciplinary learning approaches. "Multidisciplinarity is understood as interaction between members from varying disciplines in academia, where the disciplinary boundaries are kept intact" [54]. According to Chi et al. [55]:

> *Multidisciplinary technological approaches in higher education are important because they foster interdisciplinary collaboration, develop critical thinking and problem-solving skills, align with the demands of the digital era, and promote innovation and creativity. These approaches aim to work across different disciplines and technologies to enhance learning outcomes, address specific problems, and develop professional skills by drawing on a range of expertise.*

6. Welcome to Industry 5.0

Like all industrial revolutions before it, Industry 4.0 will be remembered for its contribution to increased productivity. It will also be remembered for its unintended negative consequences, such as mental health issues arising from machine-human interactions; anxieties about losing jobs to machines; and social isolation of workers, with its attendant traumatic ramifications for occupational health and well-being. Anxiety about job insecurity or a reduction in wages is not without justifiable reason. It has been estimated that occupations at the highest risk of automation account for about 27% of employment, and according to OECD surveys, about 20% of workers in manufacturing and finance worry about a possible reduction in wages [56]. Technology has always had a negative impact on job security. However, AI appears to have a greater impact on employment retention rates. Studies have shown that the introduction of AI is 26.6% points more likely to be associated with job destruction compared to the introduction of other technology [57].

Industry 4.0's criticisms are not only about concerns for worker well-being; they are also about the centrality of the profit motive in the drive for technological advancements. As Ghobakhloo et al. [58] said, "Industry 4.0 aligns with the long-lasting neoliberal capitalism models that emphasize profitability and shareholder primacy, intensifying some of the prevailing socio-environmental concerns such as regional inequality, environmental degradation, of human-robot collaboration for a smart business ecosystem that promotes resource efficiency and bioeconomy."

The negative impact of Industry 4.0 on workers and the environment has led to the emergence of Industry 5.0. It might be too early for the workforce and environmentalists to sigh with relief upon hearing about the advent of Industry 5.0. However, Industry 5.0 promises to be a game-changer because, as Gamberini and Pluchino [59] have reported:

> *Industry 5.0 represents a pivotal shift from its predecessor, Industry 4.0, by integrating a broader purpose encompassing social and environmental considerations, prioritizing worker well-being, and aiming for a sustainable and resilient industry. This new industrial revolution emerged in response to the increasing automation and removal of human workers from manufacturing processes, which was a hallmark of Industry 4.0. Industry 5.0 seeks to address these shortcomings by*

> *advocating for the reintroduction of human workers for instance alongside robots and collaborative robots . . . thus combining the strengths of humans and machines . . . Industry 5.0 focuses on merging the creativity and expertise of human experts with efficient and intelligent machines.*

In addition to promising industrial practices that place worker well-being at the center of production processes, Industry 5.0 promises to promote technologies that foster environmental sustainability rather than prioritizing profits at the expense of environmental impact [60].

The learner-centered pedagogical approaches discussed in Section 5 (e.g., project-based and holistic learning) resonate with Industry 5.0's goal of placing worker well-being at the center of technological innovations. These teaching-learning approaches prepare workers for a more human-focused industry because they not only target higher-order cognitive skills such as creativity and innovation but also develop socio-cultural competencies (e.g., respect for cultural differences, empathy, and conflict resolution) and emotional intelligence (e.g., the ability to manage one's own emotions and understand the emotions of co-workers, supervisors, and clients).

7. Conclusion

Drawing on literature about Industry 4.0 in general and AI in particular, as well as learning theories associated with technology education and employability skills, this chapter has contributed to the discourse concerning the pedagogical implications of Industry 4.0's increasing use of AI-enabled tools in workplaces. Before proposing pedagogical approaches to the teaching and learning of skills associated with AI, the chapter defined AI and identified its benefits and challenges. The chapter argued that both the benefits and challenges of AI have implications for WfD, as workers need education and re-skilling to enable them to maximize the benefits of the ever-changing AI-enabled tools and minimize the impact of the negative effects of AI.

The chapter has recommended that institutions charged with the responsibility of skills development for the Industry 4.0 workforce should adopt learner-centered pedagogical approaches such as PjBL, PBL, and IBL. These approaches foster experiential learning, prepare learners for lifelong learning, and facilitate the acquisition of soft skills (such as communication, problem-solving, creativity, and critical thinking). The chapter has also recommended the adoption of pedagogical approaches that promote holistic learning (which focuses on the "whole person" – body, mind, and soul) and multidisciplinary learning, which mimics real-world Industry 4.0 environments where workers perform tasks that require multiple disciplines and different talents.

The chapter ends with a word about the advent of Industry 5.0, which is poised to reverse the unintended negative consequences of Industry 4.0, including psychosocial occupational hazards and environmental degradation, by prioritizing employee well-being and environment-friendly technologies.

Conflict of interest

The author declares no conflicts of interest.

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