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Reimagining Industry 5.0: Centering People in a Digital World and Bridging Techno-Economic and Socio-Technical Futures

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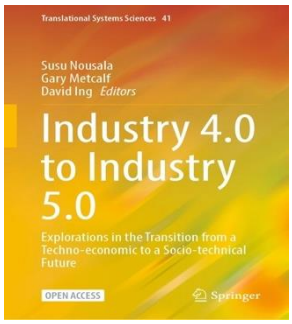

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Introduction

In the past decade, the discourse on global industrial transformation has been dominated by debates about the shift from the Industry 4.0 paradigm to Industry 5.0, in which automation, artificial intelligence, and cyber-physical systems are no longer seen solely as engines of economic growth, but also as negotiating fields for social, ethical, and sustainability values. Studies have confirmed that Industry 4.0 has succeeded in driving efficiency, supply chain integration, and new business models, but at the same time raises questions about its impact on inequality, work quality, and environmental sustainability. It is in this context that Industry 5.0 comes with a stronger emphasis on the human dimension, resilience, and sustainability as a

correction to the overly techno-centric orientation (Adel, 2022; Barata & Kayser, 2023; Beier et al., 2020; European Commission, 2021; Islam et al., 2025; Rame et al., 2024).

The literature on Industry 4.0 shows that this phase of the industrial revolution is generally framed in a techno-economic logic that emphasizes productivity, data integration, and large-scale automation, but often ignores the social complexity and human needs in the workplace and in the wider society. The socio-technical perspective criticizes this tendency because it views organizations and technology as a single system that cannot be separated from the practices, values, and power relations that exist in them, so that the success of digital transformation cannot be measured only by indicators of technical efficiency. A number of systematic reviews show that without a mature socio-technical design, the implementation of Industry 4.0 risks perpetuating inequality, exacerbating mental workloads, and generating resistance at the organizational and public policy levels (Abdullah, Jayus, et al., 2024; Beier et al., 2020; Davies et al., 2017; Islam et al., 2025; Margherita & Braccini, 2021; Rame et al., 2024).

The emergence of the Industry 5.0 discourse popularized by the European Union policy document is marked by a shift in focus from simply "digital and automated" to "human-centric, sustainable, and resilient", so that technology is placed as a means to improve the well-being of people and the planet, not an end in itself. This approach drives a paradigm reorientation from machines that replace humans to human–machine collaboration that values human creativity, empathy, and reflective capacity in industrial ecosystems. Recent reviews confirm that Industry 5.0 does not replace the achievements of Industry 4.0, but rather bridges technological achievements with a broader social and environmental agenda, including the green transition and circular economy (Adel, 2022; Barata & Kayser, 2023; European Commission, 2021; Islam et al., 2025; Nahavandi, 2019).

From a socio-technical point of view, the transition from Industry 4.0 to Industry 5.0 can be understood as an effort to bridge the techno-economic logic that focuses on economic efficiency and value with the socio-technical logic that takes into account the complex interactions between technology, people, organizations, and the social environment. Recent socio-technical studies emphasize the importance of system design that explicitly includes stakeholder participation, knowledge distribution, and fair work arrangements so that technology not only optimizes processes, but also strengthens the collective capacity to adapt and innovate. In this context, the human-centric industry 5.0 collaboration model maps out how collaborative architecture, data governance, and AI-based decision-making should be

calibrated against social, ethical, and long-term public policy goals (Ali & Johl, 2024; Beier et al., 2020; European Commission, 2021; Islam et al., 2025; Tóth et al., 2023).

The literature on Industry 5.0 also emphasizes that the center of transformation is no longer just smart factories, but human-centric manufacturing that positions workers, designers, and consumers as active subjects in the entire production life cycle. Studies on human-centric manufacturing show that the integration of AI-based manufacturing execution systems, human digital twins, collaborative robots, and immersive training environments not only improves technical performance, but also opens up opportunities to design more meaningful, safe, and inclusive work. The multi-level framework developed for Industry 5.0 links the process, system, and management levels with the principles of sustainability and social justice, so that aspects of ergonomics, organizational culture, and consumer participation are read as integral parts of the socio-technical architecture (Abdullah, 2020; Adel, 2022; Ali & Johl, 2024; Islam et al., 2025; Rame et al., 2024; Tóth et al., 2023, 2023; Yanytska, 2025). The policy and governance dimension in Industry 5.0 expands the discussion from just the adoption of technology to the question of how the state, industry, academia, and civil society together formulate a just and sustainable socio-technical future. Recent bibliometric analyses show a significant increase in research linking Industry 5.0 to the sustainability, ESG, and social transformation agendas, including the need to develop new indicators capable of capturing human well-being and systemic resilience. On the other hand, theoretical works in the realm of Industry 5.0 highlight that the success of the transition depends heavily on the collective capacity to practice systemic innovation, manage long-term risks, and strengthen cross-stakeholder communication in designing a desired future, not just one that is "possible" by technology (Ali & Johl, 2024; European Commission, 2021; Islam et al., 2025; Metcalf, 2024; Nabillah, 2026; Nousala et al., 2024; Rame et al., 2024)

In this knowledge landscape, the book Industry 4.0 to Industry 5.0: Explorations in the Transition from a Techno-economic to a Socio-technical Future occupies an important position because it explicitly examines the transition from a techno-economic framework to a socio-technical horizon with an interdisciplinary and reflective approach. Edited by Susu Nousala, Gary Metcalf, and David Ing, this book brings together a variety of contributions that review the history, foundations, and possible future of Industry 5.0, including issues of artificial intelligence, sustainability, soft skills, and changes in social and economic structures. Published book reviews confirm that this work not only provides a theoretical synthesis, but also offers a critical lens to re-read the impact of the industrial revolution on society, as well

as inviting readers to rethink the relationship between technology, people, and the planet (Huang et al., 2022; Passalacqua et al., 2025; Rožanec et al., 2023; European Commission, 2021)

Based on this context, the book review entitled "Reimagining Industry 5.0: Centering People in a Digital World and Bridging Techno-Economic and Socio-Technical Futures" aims to critically examine how this book helps us reimagine Industry 5.0 as a social communication and negotiation project that goes beyond mere technical discourse. Placing humans at the center of the digital world, this review will examine the extent to which the book's contribution is able to bridge the gap between techno-economic narratives (which emphasize efficiency, productivity, and market competition) and socio-technical narratives (which prioritize participation, justice, and the meaning of work) and their implications for communication studies, public policy, and industrial practices in the era of digital transformation. Thus, this book review is expected not only to summarize the content of the book, but also to open up new spaces for dialogue on how we communicate, design, and manage a more humane socio-technical future in the midst of global digitalization (Jayus et al., 2025; Deguchi, 2020; Schröder et al., 2024).

Review Point

Through an in-depth reading of this book, readers will be confronted with the idea that we are currently in an era of transformation marked by rapid advances in digital technology. The book entitled "*Industry 4.0 to Industry 5.0: Explorations in the Transition from a Techno-economic to a Socio-technical Future*" published by Springer (2024) will take us to surf how technology works and how the pace of industrial development will certainly be a double-edged sword; One side has a positive impact and the other side will give birth to a negative impact.

Industry 5.0 is an important initiative of the European Union (EU) that not only reflects the economic transition, but also an effort to shift the focus of the industrial, research, and economic worlds from an industrial paradigm that almost entirely prioritizes shareholder value and return on investment to values that are human-centered, respectful of individual rights, and sustainability for the environment. ecology, society, labor, and even for the survival of the company itself. This term has been widely adopted and is closely related to the previous concept, namely Fifth-Generation Industry. Online searches on Industry 5.0 show that the concept is increasingly being seriously considered in industrialized countries and is even connected to various social and environmental initiatives around the world (Nabillah, 2026).

When we turn the pages of history again, most observers agree that Industry 1.0 began in the 18th century in England, marked by the transition from home crafts to factories, the emergence of mechanization, the standardization of work patterns, and the formation of early industrial networks. Industry 2.0 is generally associated with the emergence of steam, railways, telegraph power, and the integration of transportation and communication systems. After that, there was a difference of opinion. One of the approaches defining Industry 3.0 occurred between the late 19th century and the early 20th century, marked by the emergence of steel, electricity, automobiles, petroleum, and mass production. Meanwhile, Industry 4.0 is identified with the era of computers and digital technology. Another approach puts Industry 3.0 only starting around 1965 when computers began to be widely used, followed by Industry 4.0 in the early 21st century, as e-commerce, cyber-physical systems, the Internet of Things (IoT), and cognitive computing developed rapidly. Finally, Industry 5.0 is referred to as the era of consumer industrialization where individuals are no longer just passive recipients of products, but also part of the industrial system through data, digital interactions, and online behavior.

Industry 5.0 emerged as a critical response to the excesses observed during the implementation of Industry 4.0, particularly its strong emphasis on technological efficiency and economic growth. One of the major criticisms of Industry 4.0 lies in its overly economy-centered orientation, where the interests of short-term investors often take precedence over broader social considerations. This paradigm has reinforced the dominance of top management in decision-making processes, while marginalizing the voices of other key stakeholders. As a consequence, the interests of workers, environmental sustainability, and societal well-being have frequently been overlooked. Industry 5.0 seeks to address these imbalances by re-centering industrial development on human values, inclusivity, and long-term social responsibility, thereby promoting a more holistic and sustainable industrial ecosystem.

Industry 5.0 has emerged not only as a technological paradigm shift but also as a strategic response to major global challenges, including climate change and the ongoing Sixth Mass Extinction. These crises highlight the unsustainable consequences of industrial practices that prioritize efficiency and growth over environmental balance and ecological preservation. In addition, the rapid development of advanced technologies such as generative artificial intelligence, cyber-physical systems, and large-scale automation introduces new social, ethical, and economic risks. Without adequate governance, these technologies may exacerbate job displacement, deepen social inequality, and reduce human agency in decision-making processes. Therefore, Industry 5.0 emphasizes the urgency of adopting a more humane,

responsible, and sustainable industrial approach that integrates technological innovation with environmental stewardship and social well-being.

In addition, Industry 5.0 also tries to answer the issues of diversity, equity, and inclusion (DEI) related to economic and social colonialism, as well as conditions that can now be addressed with medical approaches or social interventions. Therefore, Industry 5.0 is closely related to ESG (environmental, social, and governance) and DEI initiatives, both in corporations and governments. This book is a book in the "Translational Systems Sciences 41" series edited by Susu Nousala (Kaunas University of Technology, USA Kaunas, Lithuania), Gary Metcalf (InterConnections, LLC, Ashland, KY), and David Ing (Creative Systemic Research Platform (CSRP) Institute, Toronto, ON, Canada). The forerunner of this 184-page book was born from an internal discussion by the Kaunas University of Technology (KTU) research team and then led to the IN4ACT Research project funded by the Horizon 2020 program from the European Union. The project is centered at the Kauno Technologijos Universitetas (KTU) or Kaunas University of Technology, specifically at the Faculty of Economics and Business, Lithuania. With a period of four years from 2020, the research team was tasked with examining the impact of Industry 4.0, in line with the redefinition of the industrial sector in Europe due to the adoption of new digital technologies, new materials, and cutting-edge production processes.

However, as the definition of Industry 5.0 evolves, the focus of research has shifted towards broader issues such as ecological sustainability, human-centricity, and resilience, especially after the world experiences the COVID-19 pandemic (Sumaiyah et al., 2024). Towards the end of the study in 2023, the sudden and rapid emergence of Generative Artificial Intelligence (Generative AI) technology brings a new dimension that goes beyond the research mandate of the beginning of 2020.

With an open attitude and a far-sighted vision, the authors welcome interaction and contributions from all over the world. This approach gives the book a strong international feel as well as a truly cross-disciplinary perspective. Interestingly, this team consists not only of academics, but also practitioners. They consciously choose to present a picture that is not so theoretical, but closer to the reality of the present. Nevertheless, the concept of Industry 5.0 combined with a systems science approach and a cybernetic view remains the foundation in the development of the content of this book. Cross-disciplinary and multi-perspectived, the chapter's editors and authors come from very diverse backgrounds. Many of them are academics who actively publish scientific papers in various fields. Their collective expertise

includes: technology and computer science, engineering, ethics, philosophy of science, sustainability studies, interdisciplinary studies, education and pedagogy, social sciences, linguistics, art, and so on. The editors and writers on this team have established a long cooperation and intellectual relationship. They regularly hold formal and informal meetings, joint workshops, collaborative presentations, write together, sit on thesis committees, and help each other's students.

Before going deeper into this book, the author would like to explain chapter by chapter as the opening part of this book review. Each chapter stands autonomously, written by authors who come from diverse disciplinary backgrounds, cultures, and experiences. However, the common thread that unites the whole is concern for a human-centricity approach, along with the ongoing industrial and social transitions. In the subtle differences raised by each researcher, the observant reader will feel as if they are entering into an ongoing and unfinished dialogue.

Chapter 1 is written by a senior researcher in the field of systems science, presenting the historical and theoretical context of technological developments from the first Industrial Revolution in the 18th century to the modern era. The historical path from steam engines to artificial intelligence (AI) is not linear, but AI is not the result of mere coincidence. Cultural factors such as the drive for efficiency and productivity in the industry, as well as the influence of corporate-funded media, continue to shape the direction of the technology and its applications. The question now is, will these factors remain the main drivers for future technology?

Chapter 2 was co-authored by the three principal investigators of the IN4ACT team. Based on the results of four years of study and publication, they explored the stages and layers of transition from Industry 4.0 to 5.0. On a diverse scale, they analyze the benefits and impacts from economic, environmental, technological, and social aspects. Using the typology of the Circular Economy discourse, they raise the risk of maintaining stability during complex socio-ecological and socio-economic transitions. Two industrial case studies in Europe were used as "living laboratories" to test innovations.

Chapter 3 was written by two researchers who focus on organizational development and performance management. They highlight that the transition to Industry 5.0 at least requires the development of technical skills (hard skills) to operate new technologies. However, behind that there is a need for soft skills that are still not fully understood. Both experienced workers and new generations face psychological, structural, and managerial challenges. A deeper understanding of soft skills opens up questions about the complexity of human organizations,

transferability between contexts, and how to evaluate behavior. The experience of teaching emotion regulation to laboratory scientists and economists is an important illustration in the context of this transition.

Chapter 4 comes from a figure in the service science movement and a former IBM research executive. He expands the focus of this book by highlighting the service side of the industrial ecosystem. If so far Industry 4.0 and 5.0 have been discussing manufacturing more, now stakeholders from various service sectors need to be involved. Entities in service systems are encouraged to look beyond local efficiencies, towards investments in the ecology of global actors. AI training to increase productivity at the national level brings concerns about the ethics and awareness of actors in its use. Digital twins, which are easier to understand for machines, are still not developed enough to comprehensively describe humans, organizations, and other service systems. Service science is positioned as a promising transdisciplinary discipline.

Chapter 5 was written by a sustainable economics researcher from the IN4ACT team who completed his doctoral program during the project. He examines changes in job advertisements as a reflection of the shift towards a more human-centric approach for workers and companies. The development of machine intelligence is described as three levels: (a) Artificial Narrow Intelligence (ANI), (b) Artificial Semi-General Intelligence (ASGI), and (c) Artificial General Intelligence (AGI). In addition to routine task automation, Industry 5.0 has the potential to see ASGI's penetration into the creative sector. As a bold experiment, ChatGPT's Generative AI technology was used to compile the initial draft of this chapter, although it still required refinement from the authors due to ChatGPT's limitations in including scientific references.

Chapter 6 is written by a digital technology executive who explores the merging between Human Intelligence and Artificial Intelligence. This combination is referred to as Hyper-Selfish Intelligence, where the impulse of human biological evolution can lead to AGI developing into Super Intelligence. In this chapter, the argument is made for the need for strong global regulation of AI to prevent extreme risks to human civilization. Industry 5.0 is considered an opportunity to steer social and technological developments in a positive direction. Chapter 7 is written by a systems researcher with a background as a consultant and market developer at IBM. He examines the numbering of versions such as 4.0 and 5.0 as a reflection of various generational leaps in the history of innovation, from Schumpeterian innovation, the Japan Science and Technology Basic Plan, to the European Union's Industrial Research and Innovation Commission, and the World Economic Forum. He compares the era

of exploration around 1492 as the transition from Era 0 to Era 1, using two synthetic perspectives: Socio-Technical Systems (STS) and Socio-Ecological Systems (SES). The current era is seen as a change in SES along with the emergence of the service economy, and the change of STS as a knowledge society. Meanwhile, the next era is predicted to be marked by a polycrisis in the SES before STS experiences a next-generation leap.

Chapter One, An Introduction to Industry 5.0: History, Foundations, and Futures

Chapter 1 works like a "big map" that prepares the reader to understand the transition from Industry 4.0 to Industry 5.0 not as just a technology leap, but as a change in perspective on the human–technology relationship. The narrative starts from the evolution of the most ancient tools to computers and algorithms, and then moves to the idea that the real revolution (agriculture/industry) is an accumulation of small changes that eventually shift the way of life. The strength of this chapter lies in its gradual, flowing, and "inviting" writing style, so that even ordinary readers can follow its grand logic without having to immediately immerse themselves in technical jargon (Metcalf, 2024; Nabillah, 2026; Nousala et al., 2024).

Argumentatively, the author asserts a shift in the center of gravity: before the Industrial Revolution, tools were an extension of man; After that, humans are often positioned as the "stewards" of machines and it is at this point that the fear of being replaced by technology begins to become a recurring theme. The division of the Industrial Revolution into phases 1.0 to 4.0 is used as a concise framework to show that each phase has a dominant technology and a distinctive economic logic. This chapter does not stop at chronology, but instills a "common thread" that technological change is always accompanied by social change, sometimes it feels slow, sometimes it explodes, but always brings consequences to work, culture, and power.

When it comes to Industry 4.0 and 5.0, this chapter quite effectively distinguishes the two: Industry 4.0 is described as a manufacturing competitiveness project based on cyber-physical systems, connectivity, IoT, and AI; while Industry 5.0 is positioned as a normative correction so that technology does not focus on efficiency alone. The three pillars (human-centric, sustainability, resilience) are used as a "compass" that provides ethical and policy direction, not just an innovation roadmap. Here, readers get a powerful message: Industry 5.0 is not the "latest version of the machine," but the "latest version of value" that is supposed to guide the design and implementation of the technology. The interesting (and relevant to communication studies) section is when the author relates the evolution of industrial digitalization to the history of media: radio, television, and internet social media as an

infrastructure for attention-forming, manipulation, and consumption. References to advertising, propaganda, and the birth of "social currency" such as likes make this chapter feel sharp to read in the attention economy (Abdullah et al., 2023; Abdullah & Mustafa, 2021; Abdullah, 2020; Jayus et al., 2024). The internet's transformation from a peer-to-peer ideal to a commercial overlay is also written in a critical tone: "free" platforms are paid for with data, and algorithms direct behavior. This enriches the chapter because the Industry 5.0 transition is not only addressed from factories and robots, but also from the digital culture that shapes citizens, consumers, as well as "products."(Sumaiyah et al., 2025)

The exposure to AI is quite historically structured from cybernetics, the Macy's Conference, the Ratio Club, Dartmouth, to the Turing Test and Shannon's communication theory and then passed on to modern architectures such as deep learning, transformers, and context extension. This chapter is clever in balancing "admiration" with "suspicion" that AI can process giant-scale data and mimic many language-based tasks, but questions about intelligence, meaning, awareness, and design goals remain. The section that touches on computing costs, investors, copyrighted data, and annotator work including the psychological impact of content moderation workers gives moral weight to discussions that are often cleaned up as mere technological innovations (Abdullah, Jayus, et al., 2025).

On the theme of human-centered, resilience, and sustainability, this chapter expands the horizon to socio-technical systems: not just "safe tools," but how work policies, retraining, data protection, and organizational design need to change. The authors also remind of the paradox of efficiency vs resilience: over-optimized systems are fragile when a crisis or cyberattack occurs. In the realm of sustainability, this chapter is quite ambitious to link Industry 5.0 with the circular economy transition and the SDGs, and places climate change as a "real test" of whether technology really serves the future of humanity, not just growth.

As a critical review, this chapter is powerful as a broad, interdisciplinary, and provocative introduction; but the consequence is that depth at some points still feels like a "helicopter" across many topics without always providing detailed case examples (e.g. a particular industry study, a Global South country, or concrete policy practices on the ground). Some of the big claims about internet culture, self-commodification, and the direction of AI investment would be stronger if they were supplemented with cross-regional comparative data (outside of Europe/US) or a brief empirical vignette. Even so, for Chapter 1 to serve as a foundation, it manages to instill the right key question: not "what technology next?", but "technology for whom, with what incentives, and with what social impact?", a powerful

gateway for academic readers, practitioners, and policymakers who want to understand the socio-technical future of Industry 5.0.

Chapter Two, The Complexity of Sustainable Innovation, Transitional Impacts of Industry 4.0 to 5.0 for Our Societies: Circular Society Exploring the Systemic Nexus of Socioeconomic Transitions

Chapter II is already powerful because it recognizes from the outset the main problems of the transition from Industry 4.0 to Industry 5.0: the definition is still loose, the goals are multi-layered, and often contradictory among economic–technological–social–environmental interests. The argument that "human-centered relationships" often misses the reading of transition is also relevant and makes this chapter have a clear common thread: Industry 5.0 is not enough to be read as a technological leap, but as a paradigm shift in governance and value in the industrial ecosystem (Morales et al., 2024).

However, this chapter will be much more "*sharp*" if from the beginning it emphasizes the limits of the working definition of Industry 5.0 that is used, then shows the analytical consequences. For example, the European Commission positions Industry 5.0 as a complement to Industry 4.0 with an emphasis on three pillars: sustainable, human-centric, and resilient (European Commission, 2021)

With an explicit and operational definition of the human-centered concept, readers are able to clearly understand the specific dimensions discussed in this chapter. The term “human-centered” does not merely refer to a normative ideal, but encompasses concrete aspects such as job welfare, human dignity, individual agency, ethical system design, and participatory governance. These aspects can be systematically observed and analyzed across different levels of analysis. At the micro level, indicators include workers’ well-being, autonomy, and skill development in technology-mediated environments. At the meso level, attention is given to organizational practices, institutional policies, and inclusive system design, while at the macro level, human-centeredness is reflected in regulatory frameworks, labor protections, and societal participation in technological governance.

The use of Complex Adaptive Systems/Social Complex Adaptive Systems (CAS/SCAS) lenses is the theoretical strength of this chapter because it is suitable for explaining the dynamics of transition that are non-linear, emergent, and full of feedback. However, the explanation of CAS/SCAS still feels like a "conceptual label" that has not been fully operationalized: what are the characteristics of CAS/SCAS used (e.g., emergence,

adaptation, self-organization, feedback loops), and how these characteristics translate into an analytical framework for the transition of Industry 4.0 to 5.0. You can reinforce this section by linking the concepts of resilience and system stability as the logic of why "controlling all aspects at once" is unrealistic in complex systems (Holling, 1973)

The "Value Paradox" section explains the normative reasons why Industry 5.0 emerged: Industry 4.0's productivity and automation often give rise to social-environmental externalities (worker privacy, work polarization, skills gaps, AI ethical dilemmas, energy consumption, and waste). To avoid generalizing arguments, this chapter should add markers: which are the findings of the literature, which are general patterns (tendencies), and which are context-dependent conditions (e.g. different sectors, different countries, different levels of adoption). That way, the narrative "Industry 4.0 is problematic Industry 5.0 fixes" does not fall into a dichotomy, but rather becomes an explanation for a more proportionate policy transition and system design.

The micro–meso–macro level framework in this chapter helps readers see that the impact of Industry 4.0/5.0 is not only a corporate issue, but also a broader supply chain and social structure. My suggestion: add a single concise diagram/framework that shows the causal flow (e.g., automation, work design changes, dignity/agency impacts, regulatory/standard responses, changes in supply chain practices). To clarify the logic of transition, the multi-level perspective framework in socio-technical transition studies can be used as a conceptual reference so that cross-level discussions are not only descriptive, but also explain the mechanism of change (Geels & Schot, 2007)

The integration of the circular economy through the “four visions” typology, as adopted from Friant et al., represents one of the most concrete analytical components of this chapter. This typology provides an ideological map that systematically distinguishes between technocentric, reformist, transformative, and holistic-skeptical discourses on sustainability. Each vision offers a distinct perspective on the role of capitalism, the meaning of innovation, and the perceived risks of ecological collapse. By doing so, the framework allows readers to understand how different circular economy narratives either reinforce existing economic structures or challenge them more fundamentally. Consequently, the use of this typology strengthens the analytical clarity of the chapter by linking industrial discourse to broader ideological positions regarding socio-ecological transformation (Calisto Friant et al., 2020). To be stronger, this section should clarify the "position of the chapter": whether Industry 5.0 is considered compatible with all circular economy visions, or only compatible with certain

visions (e.g. Circular Society which emphasizes slowing/longer lifetimes). Position affirmation is important because it will determine the direction of policy recommendations and success indicators that you are pushing.

The two case studies (French biorefinery and Digital Product Passport) make the chapter more applicable, but the methodology needs to be "framed" a bit: why these two cases were chosen (typical, extreme, best practice, or pilot), what are the units of analysis (innovation ecosystem, territorial governance, data traceability), and what evidence is used to conclude their success/risk. Since you emphasize data transparency and governance, this section is more convincing when it links data practices to the principles of FAIR (findable, accessible, interoperable, reusable) as a conceptual standard for cross-stakeholder data management (Wilkinson et al., 2016)

Overall, Chapter II is rich in literature and has a clear normative direction, but it still needs to be "condensed" through: (1) a firm definition of Industry 5.0 work and a potentially ambiguous distinction of terms, (2) the operationalization of CAS/SCAS as a component of the analysis framework, (3) an explicit micro-meso–macro causal framework, and (4) an affirmation of normative positions related to the circular economy (which vision is adopted). If these four things are strengthened, Chapter II will be better equipped to become the foundation of Chapter III (method/conceptual framework) and make the research contribution apparent: not just "reviewing the transition", but explaining the mechanisms and consequences of the Industrial 4.0 to 5.0 transition in human-centered logic and sustainability.

Chapter Three, Coping with Industry 5.0: An Assessment of Evolving Soft Skills for the Workplace

Chapter III proposes a clear thesis: the transition from the profit-driven logic of Industry 4.0 to the human-centric Industry 5.0 makes soft skills upgrade not just a complement, but a moderation factor that determines whether new technologies really produce the well-being of humans, organizations, and society (Armstrong & Vergara, 2024). The strength of this chapter lies in the organized flow of argumentation: starting from a problematic introduction, formulating three research questions (drivers, challenges, and the future of soft skills), then moving to a multi-level discussion (micro-meso–macro) before moving into the problem of definition and evaluation.

The use of Future Shock as an "entrance" is also both rhetorically and conceptually effective, as it links the theme of "storm of change" to the psychological and social

consequences of technological acceleration (Armstrong & Vergara, 2024; Toffler, 1990). This strategy helps readers understand that the key issue is not just the adoption of technology, but the capacity of humans to behave differently in the midst of rapid change a relevant framing for the Industry 5.0 discourse that demands a more reflective and human-centered way of working

In terms of policy footing, this chapter is strong because it links Industry 5.0 to the European agenda of sustainability, resilience, and human-centricity, so that the argument does not stand in an academic vacuum (European Commission, 2021). The affirmation that the goals of production must include welfare workers' rights, mental/physical health, equality, and the meaning of work makes this chapter have a firm "normative compass," while also opening up space for criticism of innovation models that sacrifice the social dimension (Armstrong & Vergara, 2024).

The most interesting conceptual contribution is the idea of soft skills as a moderator between technology-based production and human-centered output. By mapping psychological, business/managerial, and structural pressures, this chapter shows that the challenges of Industry 5.0 are not only technical "skills gaps", but also human "coping gaps" e.g., the ability to set boundaries, emotion regulation, communication, and ambiguity tolerance(Armstrong & Vergara, 2024)). For me, this reinforces the message that digital transformation without behavioral transformation will easily result in a paradox: efficiency goes up, but quality of life goes down (Abdullah, Yazid, et al., 2025).

In the section on psychological challenges, this chapter is convincing because it connects phenomena such as technostress and overload with concrete soft skill needs (e.g. boundary setting, delegation, and emotion regulation), so that the reader does not stop at the slogan "soft skills are important" (Armstrong & Vergara, 2024).. However, to reinforce the scientific weight, this chapter would be stronger if it added more operational markers: which soft skills are "key" in a particular work context (e.g., remote work, human–AI collaborative work, or high-risk work), as well as indicators of change that can be observed at the individual/group level.

Section 3.3 on "misuse of terms" is a sharp and important critique: when the definition of soft skills is loose, then research is difficult to compare, and practice is easily turned into mere HR rhetoric (Armstrong & Vergara, 2024). An approach that emphasizes "skills as effective behavior in context" is helpful to contain term inflation and prevent category errors (e.g. equating traits with skills) (Armstrong & Vergara, 2024; Rousseau, 2006). This is where

this chapter feels "educational": it not only describes trends, but also rebukes epistemic weaknesses that make them difficult to evaluate.

At the same time, the choice of the lens of behaviorism (skills as behaviors that can be learned, trained, and "blunt" if not trained) provides a powerful bridge to intervention design similar to the logic of deliberate practice that emphasizes directed training and repetition to achieve competence (Armstrong & Vergara, 2024; Ericsson et al., 1993). A critical note: the more the chapter emphasizes contextual dependency and complexity, the more the reader needs examples of "minimum standards" (e.g., rubrics, indicator behavior, or assessment design) so that the evidence-based approach does not stop at problem diagnosis alone.

Discussions about complexity, contextuality, and evaluation difficulty are one of the most realistic and "grounded" parts, as it rejects the instant promise that automated soft skill training produces uniform positive impacts. The point that short-term outcomes can reinforce long-term detrimental behaviors, or that one behavior can lead to both positive and negative effects, is important to remind practitioners to be wary of narrow KPIs. At this point, this chapter is already very good as a problem map; What can be added in the future is a gradual evaluation framework (e.g. baseline–follow up–triangulation) so that the evaluation challenge does not feel "deadlocked".

The illustration of emotion regulation training in two groups of researchers (laboratory scientists vs. economists) is of added value because it shows how the "same skills" demand different training designs according to the rhythms of stress, interaction patterns, and available practice opportunities. This chapter also honestly acknowledges the limitations: evaluation relies heavily on self-reports, and the impact on the organization can be ambiguous (even the trade-off between individual well-being and organizational interests). Going forward, this example will be stronger when paired with more diverse measures (e.g., validated psychological health indicators, or non-invasive work behavior data), given that emotion regulation itself has a well-established tradition of evidence in the intervention literature (Grossman et al., 2004).

Overall, Chapter III succeeds in bringing together three things: (1) Industry 5.0's normative arguments, (2) cross-level challenge maps, and (3) conceptual critiques of the vagueness of the term soft skill so that the reader gets "why it matters", "where the pressure", and "why it's hard to execute" in a single sequence. If this chapter is to be improved further, the most strategic suggestion is to thicken the "implementation bridge": the sorting of priority soft skills per work context, examples of assessment instruments compatible with human-

centered principles, and a cross-cultural longitudinal research agenda so that the "growing need" claim is not only based on global reports, but also evidenced on local organizational dynamics (WEF, 2020).

***Chapter Four,* AI Upskilling and Digital Twins: A Service Science Perspective on the Industry 4.0 to Industry 5.0 Shift**

In this Fourth Chapter, the author is strong in positioning the shift from Industry 4.0 to Industry 5.0 as a *sustainable development problem* that is "not solved" if only the pursuit of efficiency and productivity, because social impacts (privacy, job dignity, skills gap, income polarization) arise across micro-meso-macro scales. The argument about stakeholder integration (STI) is relevant because this chapter emphasizes that technological change is always mediated by power relations, conflicts of interest, and social network dynamics, not just the adoption of devices. Conceptually, this chapter is convincing; however, it would be sharper if STI was given operational parameters from the beginning (e.g. indicators of alignment of interests, accountability mechanisms, and "win-win" measures that can be tested), so that the reader can distinguish STI as a normative concept vs. a measurable research agenda.

The AI upskilling section presents the definition and urgency quite comprehensively, and is smart because it not only "celebrates" generative AI, but also acknowledges its limitations (misinformation/hallucinations, restrictions on use, legal/ethical risks) (OpenAI, 2025). I think the main strength is the emphasis that AI competence is not just the ability to use tools, but includes verification, risk assessment, and responsibility for use. To be more applicable, this chapter could link upskilling to competency maps and job needs trends more explicitly for example, by referring to the "skills shifting" framework discussed in global labor market reports (WEF, 2023b).

The digital twins section succeeded in explaining digital twins as a synchronized model that is historical-real-time-predictive, then extended it to the idea of personal/stakeholder digital twins. This is interesting because it provides a "bridge" between computational capabilities and social coordination problems: if each stakeholder can model the consequences of decisions (including externalities), then negotiation and change engineering are potentially more rational. However, this chapter will be more solid if it makes a clear distinction between digital twins (system/entity models with data attachments and simulation objectives) vs data profiles (behavioral tracking for recommendations/targeting). The literature also shows that digital twins evolved from the systems engineering paradigm and has been

widely used in the aerospace/manufacturing context (Glaessgen & Stargel, 2012; Kritzinger et al., 2018), so that this chapter can add an empirical example that is "grounded" before jumping into an individual digital twin scenario.

In the Service Science section, the foundation of service-dominant logic (Vargo & Lusch, 2004, 2016) It is appropriately used to shift the focus from technology as a "means of production" to the exchange of services and co-creation of value among actors who have rights, responsibilities, capabilities, and limitations. This enriches the narrative of Industry 5.0 because it places "human-centricity" as a cross-actor service ecological design, not a slogan. However, the description of the concept is dense enough that non-specialist readers can feel "far from practice". I suggest this chapter add 1–2 mini-cases (e.g. food supply chain, healthcare, or public service) that show how the combination of AI upskilling, digital twin and service design really improves stakeholder integration (not just logically, but with proof of process and outcomes).

The author also sees that the narrative of this chapter is very optimistic (e.g. the 2040/2080 projection) which is inspiring, but prone to being read as "technology definitely solves polarization". Two risks that need to be further emphasized are: (1) power asymmetry and digital twin incentives can strengthen participatory governance, but can also be a control instrument if data ownership, model transparency, and approval mechanisms are unclear; (2) the computing costs and carbon footprint of large-scale AI that can collide with the sustainability agenda these issues have long been debated in NLP/AI research, including energy consumption and policy consequences (Strubell et al., 2019).

In the end, Chapter IV offers a powerful conceptual contribution: it brings together the problem shift of Industry 4.0 towards Industry 5.0 into a single "solution path" that connects upskilling, systems modeling (digital twins), and transdisciplinary frameworks (service science). In order to be more "ready-to-use" as an academic and policy reference, this chapter will be stronger if: (a) it formulates observable STI indicators; (b) include data governance design (ownership, access, auditability); and (c) present an evaluation plan (how to assess that interactions are more mutually beneficial, not just more efficient). With this reinforcement, the optimism of this chapter will change from speculation to a research agenda that can be tested, replicated, and debated productively.

***Chapter Five,* Industry 5.0 and Artificial Semi-General Intelligence. Exploring Future Challenges and Opportunities Within Industries and Societies**

When we move on to Chapter V, it is actually powerful as a "narrative map" that bridges Industry 4.0 (efficiency-productivity) to a more normative Industry 5.0 (human welfare, resilience, and sustainability), and then tests whether the presence of Artificial Semi-General Intelligence (ASGI) will shake up the agenda. The flow is logical: starting from the history of the adoption of "Industrie 4.0", a list of key technologies, then moving on to the social criticism (inequality, displacement, skill mismatch) that triggers the need for a new framework. The main strength is that this chapter does not stop at technological optimism, but invites readers to think about the risks of the transition and the macro consequences of policy.

From a conceptual point of view, the explanation of Industry 5.0 as a response to the "productivity bias" of Industry 4.0 is in line with the European policy framework that emphasizes three pillars: human-centric, sustainability, and resilience (European Commission, 2021, p. 22). However, as a review, I see that this chapter can be sharper if it distinguishes Industry 5.0 as a governance policy/vision agenda (normative) rather than the "technology stage" (descriptive). Without that distinction, it is easy for readers to assume that Industry 5.0 automatically "happens" once certain technologies mature, even though it demands an institutional design: decent work standards, social impact measurement, accountability mechanisms, and incentives for companies to go beyond just rebranding employer branding.

The "ASGI roadmap and turning point" section is informative and helps non-technical readers understand the evolution from Narrow AI (CNN/RNN) to transformer leaps, scaling, and multimodal models (Brown, 2020; Reed et al., 2022; Vaswani et al., 2017). Even so, the term ASGI itself is still not well established in the mainstream literature; therefore, this chapter will be stronger if it provides a strict definition of operations (capability, evaluation indicators, and clear differences from "generalist"/AGI), and avoids the impression that "semi-general" is enough to be inferred from the addition of features (text-image-audio). Suggested enrichment: add an evaluation matrix (robustness, reliability, controllability, safety) and measurable failure examples so that the discussion doesn't feel "techno-deterministic".

On the issue of employment, this chapter appropriately raises the numbers of "work at risk of automation" as a spark for discussion, but methodological caution is needed. Occupation-level estimations such as Frey & Osborne are often criticized for calculating the susceptibility of work as a unit, rather than task bundles that change through job re-design (Frey & Osborne, 2017). The OECD literature emphasizes that exposure to automation/AI is not

synonymous with total job loss because adoption is influenced by cost, regulation, human-machine complementarity, and task re-allocation. Therefore, the narrative of the chapter will be more precise if it positions these numbers as "scenario ranges" and adds discussions of job redesign, industrial negotiations, and sector-based upskilling/reskilling policies rather than just aggregate alarms.

The macro scenario part (population decline, labor scarcity, and ASGI as a "productivity savior") is interesting and relevant, especially when linked to UN demographic projections that show the global population is expected to peak in the second half of this century and then decline by 2100 (UN, 2022). However, the labor market model presented is still very simple, but it does not capture the frictions of transition, regional inequality, and the different "speed of substitution" between sectors (health, education, public services). In addition, the chapter already touches on the issue of energy/computing, but it can be deepened: if ASGI is driving a computing surge, then the sustainability targets of Industry 5.0 require carbon footprint metrics and the governance of computing supply chains (chips, data centers), not just labor policies.

In closing, this chapter makes an important contribution: it forces the Industry 5.0 agenda to confront the realities of generative/multimodal AI and the possibility of cognitive automation in highly educated jobs. In order to make the policy recommendations more actionable, I suggest that this chapter links the ASGI scenario to a viable responsible AI framework (e.g. risk mapping, governance, and control) such as the NIST AI Risk Management Framework (Tabassi, 2023). That way, "human-centricity" doesn't stop at slogans, but turns into a list of obligations: transparency in the use of AI, impact audits, protection of worker privacy, bias mitigation, and measurable reskilling guarantees. Overall, Chapter V is already strong as a conceptual introduction and policy provocation; The biggest improvements needed are sharpening the definition of ASGI, strengthening the empirical basis (methods, data, and generalization limits), as well as tighter links between the vision of Industry 5.0 and AI governance instruments.

***Chapter Six*, Artificial Intelligence Capabilities and Hyper-Selfish Intelligence, the Possible Impacts, and Why Humans Need Industry 5.0**

Chapter VI has big ambitions: it links the leap in AI capabilities, the potential of "hyperselfish intelligence" (HYPERINT), and the urgency of the transition to Industry 5.0 as a human-centered "positive path." Narratively, this chapter is powerful because it frames the

argument from the macro level (industrial revolution & economic systems) to the micro-technical level (computing, algorithms, and the acceleration of AI capabilities), and then back again to the policy level (global regulation). The main advantage is in the writing style that "binds" the reader: the reader is invited to understand why the AI discourse is not just about innovation, but also about governance, values, and the design of the future of humans.

Section 6.1 is effective as a conceptual foundation because it places Industry 5.0 as a complement to Industry 4.0, rather than a replacement with an emphasis on human-centricity, sustainability, and human-machine collaboration. This is in line with the European policy narrative that popularizes Industry 5.0 as a *human-centric, sustainable, and resilient* industry. Academically, however, this section would be stronger when it contained operational indicators (e.g.: how "human-centric" is measured in work governance, how the "circular economy" translates into supply chain KPIs, and how automation risks are calculated as social costs). Currently, examples (cobots, predictive maintenance, circular economy) have helped, but they are still more "illustrative" than "conceptual-operational".

Section 6.2 is interesting because it attempts to "abstract" human intelligence as an information processing system, a move that helps bridge the HI-AI discussion. The strength of this approach is that readers can see intelligence as a *capability* (receiving information–processing–producing output) so that comparisons with AI make more sense. However, when the chapter combines the definitions of general intelligence (reasoning, planning, problem solving) with a very diverse list of dimensions (emotional, financial, political, manipulative, kinesthetic), the risk is that the concept of "intelligence" becomes too loose: a mix of *traits*, *skills*, *domains of expertise*, and *social* competenceon the same level. Methodologically, the chapter will be sharper when it distinguishes between "core capabilities" (general cognitive functions), "domain-specific derivative capabilities," and "social-affective capabilities" that work with different mechanisms.

Another strength of 6.2 is the emphasis that human capabilities are not only "computer-paralleled", but also cyber-physical (sensory, motor, real-world action). This is relevant to discussing the limits of AI today: many generative models excel at symbols and representations, but performance in the physical world, social contexts, and rapidly changing environments has its own challenges. The constructive criticism: the chapters tend to imply the "absence of innate curiosity" in AI as the main differentiator between IP vs AI. This argument is interesting, but it would be stronger if it were given a firm limit: "curiosity" can be understood as a biological-evolutionary motivation, while in AI, "curiosity" is a goal/objective

design (e.g. reward shaping). That way, the reader does not catch it as a final ontological claim, but rather as a difference in destination architecture.

The concept of HYPERINT (6.2.7) is the most original as well as the most speculative. As a "reading framework", it is useful to provoke the question: do the dynamics of evolution and competition make intelligence (biological and digital) tend towards an increasingly aggressive expansion of capabilities? This has resonances with the idea of selection and the "importance" of information-replication in the popular evolutionary tradition (e.g. the idea of "selfish genes"). However, the chapter is also right when it reminds the reader that HYPERINT should not be treated as fact without empirical evidence and the spiritual-reflective section here should be kept fenced off as *Philosophical Metaphors*, not a predictive basis of policy (Dawkins, 2016)

Section 6.3 is powerful because it carries an economic-political lens: capitalism's automation incentives can drive wealth concentration, work pressure, and potential social disruption. The argument that extreme inequality risks disrupting social stability has broad support in the inequality literature and political-economic history, so the chapter is on a relevant track (Lehmann, 2022). However, the narrative of "sociopathic / psychopathic profile of the organization" needs to be more careful: clinical terms such as psychopathy have a strict scientific definition, so when used to describe corporate culture, it can easily become a moral generalization. If the chapter wants to defend this claim, it needs to distinguish between (a) criticism of incentive structures (shareholder primacy) and (b) psychological diagnosis of individuals/organizations, so as not to seem to jump from economic phenomena to clinical labels.

The technical sections 6.4-6.5 are the most "evocative" because they provide a concrete example that AI is not only automating work, but also starting to speed up the design of computing itself. The example of Frontier as an exascale system (and its position in the TOP500) makes the reader understand the scale of modern computing. OpenAI CuLitho examples are also effective for demonstrating *Time-compression* in computational lithography (acceleration and energy efficiency) as an illustration of "AI accelerates machines that accelerate AI"(NVIDIA, 2024). OpenAI Plus, AlphaDev's research that found more efficient sorting/hashing algorithms reinforces the claim that AI can generate innovations "under the hood" of software (UK GOV, 2023; OpenAI, 2018, 2021). However, the big drawback here is the tendency to equate CPS/exaflops metrics with "intelligence" directly, and then extrapolate to very aggressive singularity predictions. Scientifically, *Compute* It is important, but

Intelligence It is also influenced by data, objective functions, architecture, and physical/economic boundaries, therefore, the "Law of AI Compression" section should be treated as an extreme scenario (stress test), rather than a "near-certain" time prediction (TOP500, 2023)

The end of chapters (6.6–6.7) is most powerful when it emphasizes the need for extreme risk evaluation and global governance as it shifts the discussion from futurism to a more concrete policy agenda. The idea of extreme risk evaluation has its footing in the literature on "model evaluation for extreme risks" and government reports on *frontier AI* which emphasizes that capabilities and risks can increase rapidly so that there is a need for mitigation, audit, and cross-border coordination mechanisms (Shevlane et al., 2023). On the other hand, the example of "AI for social control" needs to be treated with precision: the discourse of the Social Credit System in China is complex, varies across regions/actors, and is not always synonymous with a single AI system although it is true that it is often discussed in the context of data-driven governance and compliance (Kostka, 2019). Overall, this chapter is valuable as a chapter that "shakes" the reader's point of view, but it would be more mature if: (1) it limits predictive claims that are too deterministic, (2) it adds an operational Industry 5.0 framework/indicator, and (3) it strengthens the organizational psychology section with a more rigorous scientific reference than moral metaphor.

Chapter Seven, Incremental Adaptation or Generational Shift?

Chapter VII closes the book with a relatively "neat" argument: version/number labels (4.0-5.0) are often used to narrate change, but real system changes need to be distinguished between incremental adaptations (fixes that maintain continuity) and generational shifts (discontinuities that change the "way of working" and "rules of the game"). Its main strength lies in the bridge of cross-domain analogies ranging from automotive platforms to software backward compatibility that makes the reader quickly grasp that "naming" does not automatically mean "transformation", and that transitions are usually overlapping, unsynchronized, and compromised.

Conceptually, sections 7.1-7.1.2 make an important contribution because they break down numbering into "technical meaning" (generation, major/minor release, patch, backport, end-of-support) and "political-sociological meaning" (change branding, policy agenda, and legitimacy). This reading reminds us that version numbers are *a coordination artifact* helping organizations manage compatibility, user expectations, and system crash risk but they can also

be rhetoric of progress. At this point, the chapter will be stronger when it adds operational criteria (e.g. discontinuity indicators: changes in core architecture, changes in governance/incentives, changes in coordination costs) so that the "incremental vs. generational" differentiator does not rely solely on narrative interpretation. Section 7.2 is the most "teachable" theoretical contribution: the six perspectives (TS, SPS, ES, ECS, STS, SES) make the reader see system change as a combination of micro–macro and world–human lenses. This framework is in line with the tradition of socio-technical systems studies (which emphasize the co-evolution of technology and organization) and socio-ecological systems studies (which emphasize environmental resilience, governance, and limitations) (Berkes et al., 1998; Ostrom, 2009)

The advantage is that the chapter does not force a single "cause" of the Industrial Revolution, but invites the reader to understand *Configuration* Change: Technology, institutions, social psychology, ecology, and political economy move at different paces which is indeed a characteristic of complex and "wicked" problems (Abdullah et al., 2024; Rittel & Webber, 1973). However, rich historical narratives (caravel-galleon-steamship, Renaissance-Enlightenment-utilitarianism, Colombian exchange, colonization-migration) also carry risks: the reader can catch as if social change follows technology in a linear (deterministic) manner, whereas power relations, colonialism, and historical contingencies often determine the direction of the "winners" of innovation. To be more balanced, the chapter could add an explicit acknowledgment that industrial modernity is shaped by global asymmetry (e.g. the "Great Divergence" debate) and that the "diffusion" of technology is always negotiated through socio-economic conflict, not simply technical adoption (Crosby, 1973; Pomeranz, 2009).

Era 4 analysis (information) and the digitalization of services are also powerful because they avoid the trap of sheer "technology-centric", chapters emphasize that the economics of services, institutions, and work patterns are changing, while STS often moves faster than SES. In the generative AI section, the chapter touches on the problem of information reliability, deepfakes, and the risk of the public "lowering the filter of critical thinking" This is in line with scientific criticism that large language models can produce convincing outputs without guarantees of source traceability (Bender et al., 2021; OpenAI, 2021, 2023). However, the chapter can be sharpened by associating AI not just as a "4.3 Era feature", but as a Epistemic Infrastructure Changes (how knowledge is produced/received) that has the potential to transform media governance, education, and bureaucracy right at the heart of ΔSTS×ΔSES.

The 2030-Era 5 outlook section provides an honest conclusion, that this chapter chooses open-ended scenarios and questions instead of final conclusions, while positioning the climate crisis, pandemics, and geopolitical tensions as SES pressures that can "force" generational change. Here, the chapter's references to the global risk landscape feel relevant because the risk report emphasizes the convergence of shocks food, energy, security, technology that shaped the decade of the 2020s as a period of volatility and intertwined risks(WEF, 2023a). My critical note: the formula ΔSES or ΔSTS vs ΔSES×ΔSTS is an elegant heuristic, but the chapter would be stronger if it closes with an example *Concept test* (mini-case) and diagnostic guidance (e.g. "How to recognize generational transitions in policy, industry, or local communities") so that readers don't stop at speculation, but rather take home a wearable analytical tool.

Conclusion

This book successfully repositions Industry 5.0 not merely as the next technological phase after Industry 4.0, but as a normative and socio-technical reorientation of industrial transformation. By centering human values, sustainability, and systemic resilience, Industry 4.0 to Industry 5.0: Explorations in the Transition from a Techno-economic to a Socio-technical Future invites readers to move beyond efficiency-driven narratives and reconsider technology as a means to serve society, not dominate it. The interdisciplinary approach adopted in this volume combining systems science, organizational studies, sustainability discourse, and technological analysis offers a rich conceptual bridge between techno-economic imperatives and socio-technical futures.

However, the relevance of this book becomes even more significant when placed within the broader global context of industrial transformation, particularly in Asia and Indonesia. While the Industry 5.0 discourse is strongly institutionalized within the European Union through policy frameworks emphasizing human-centricity, sustainability, and resilience, Asian countries are experiencing industrial transformation under different structural, political, and socio-economic conditions. In East Asia (such as Japan and South Korea), the transition toward Society 5.0 and advanced manufacturing ecosystems integrates digital transformation with demographic challenges and social cohesion agendas. Meanwhile, in emerging economies such as Indonesia, industrial transformation is shaped by a combination of rapid digitalization, demographic dividend pressures, uneven infrastructure, and persistent socio-economic inequality.

In Indonesia specifically, the national roadmap Making Indonesia 4.0 illustrates that the dominant framework still leans toward techno-economic competitiveness focusing on digital manufacturing, IoT integration, smart factories, and global supply chain participation. The emphasis has largely been placed on productivity, export competitiveness, and industrial upgrading. Yet, the socio-technical dimension highlighted in Industry 5.0 such as worker well-being, inclusive digital governance, environmental accountability, and long-term systemic resilience remains unevenly institutionalized. This creates a structural tension: Indonesia is accelerating Industry 4.0 adoption while simultaneously facing Industry 5.0 challenges related to automation-driven job displacement, gig economy precarity, data governance gaps, ESG compliance pressures, and ecological vulnerability.

Moreover, Asia's industrial landscape is characterized by global production networks in which many countries function as manufacturing hubs within transnational supply chains. In this configuration, the push toward sustainability and ESG standards often driven by European regulations—directly affects Asian producers. Indonesian industries, particularly in sectors such as palm oil, mining, textiles, and manufacturing, increasingly face global demands for traceability, carbon accountability, and responsible labor practices. Thus, Industry 5.0 principles are not merely theoretical imports from Europe; they are becoming operational pressures embedded in trade regimes, certification systems, and digital transparency infrastructures. The transition toward human-centric and sustainable industry in Asia therefore unfolds through global–local negotiations rather than through purely domestic policy design.

At the same time, Indonesia presents a unique socio-technical landscape shaped by its demographic structure. With a large young population and rapidly expanding digital economy, the country is simultaneously a site of technological experimentation (AI adoption, fintech expansion, platform economy growth) and a field of vulnerability (digital literacy gaps, informal labor dominance, regional inequality). The Industry 5.0 emphasis on soft skills, participatory governance, and ethical AI is particularly relevant here. Without deliberate human-centered policy frameworks, rapid AI diffusion and automation could intensify labor polarization rather than create inclusive innovation ecosystems.

Furthermore, Indonesia's commitment to the Sustainable Development Goals (SDGs) and green transition agendas alongside its role in global climate negotiations places additional urgency on integrating Industry 5.0 principles into national development strategies. Climate vulnerability, environmental degradation, and resource-based industrial dependence require a transition not only toward digitalization but toward circular economy models and resilient

socio-ecological systems. In this sense, Industry 5.0 can serve as a conceptual bridge connecting industrial modernization with ecological transformation in Southeast Asia.

Therefore, the global context of industrial transformation does not exist uniformly; it manifests differently across regions depending on institutional capacity, political economy, and socio-cultural conditions. In Europe, Industry 5.0 emerges as a proactive normative agenda. In Asia and particularly in Indonesia it appears as a hybrid condition: partly aspirational, partly reactive to global market pressures, and partly negotiated within local development constraints. This asymmetry highlights the importance of contextualizing Industry 5.0 beyond Eurocentric frameworks and examining how socio-technical transitions are shaped by Global South realities.

In conclusion, this book offers an essential conceptual lens for rethinking industrial futures, but its greatest contribution for Asian and Indonesian readers lies in its capacity to provoke critical reflection: How can emerging economies pursue digital competitiveness without reproducing techno-centric inequalities? How can human-centric and sustainability principles be operationalized in contexts where industrial upgrading and economic growth remain urgent priorities? By opening these questions, the book becomes not only a theoretical exploration but also a strategic reference for policymakers, scholars, and practitioners in Asia who are navigating the complex intersection of digital transformation, social justice, and ecological survival.

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