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Navigating the Evolution: Unveiling the Dynamics of Business Transformation from Industry 4.0 to Industry 5.0

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Abstract

This research examines the journey of businesses transitioning from Industry 4.0 to Industry 5.0, a transformation characterized by the harmonious convergence of human-centric technologies and advanced automation. The study's findings have been deduced through empirical investigation by collecting primary data from middle, senior and executive level managers in technology-driven organizations. The outcomes from the study reveal insights into the factors influencing organizational resilience within this dynamic landscape. An investigation on impact of technology on resilience was conducted by considering demographic factors such as gender, job level, experience, and education. These findings from this work offer valuable guidance for businesses, policymakers, and academia, thereby generating knowledge to the broader discourse on responsible technological integration and fostering sustainable development within the evolving industrial framework of Industry 5.0, aligning with the study's objectives.

Keywords: Technological Evolution, Industry 5.0, Business Transformation, Workforce Dynamics, Ethical Considerations

Introduction

The transition from Industry 4.0 to promising horizons of Industry 5.0 was remarkable progression in the landscape of business and industry in the contemporary world. Industry 4.0 has been marked a significant milestone by integrating digital technologies, data-driven insights, and automation into various industrial sectors, revolutionizing the way businesses operate. However, Industry 5.0 takes this integration to the next level, emphasizing the incorporation of human-centric technologies, collaborative robotics, and real-time interactions. This scenario represents profound shift towards perfect convergence between management skills and advanced automation, promising new opportunities and challenges for organizations. The understanding the dynamics of

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this transition is of paramount importance in the contemporary business landscape, as organizations grapple with the imperative of navigating this dynamic technological evolution. Industry 5.0 is poised to introduce human-centric technologies and collaborative robotics, thereby necessitating a comprehensive exploration of the intricacies of this transformation and its potential implications for businesses, workforce dynamics, and strategic decision-making.

In this backdrop through of multifaceted dimensions of this transition from Industry 4.0, this study seeks to provide valuable insights into the enablers, challenges, and ethical considerations inherent in this evolution, offering guidance to businesses, policymakers, and academia. Through focus on the strategic decisions required for successful adaptation, analyzing the impact on organizational structures, workforce dynamics, and skill requirements, this research aims to provide a comprehensive understanding the journey from Industry 4.0 Furthermore, the findings contribute to the broader discourse on responsible and sustainable technological integration, offering insights to navigate this paradigm shift effectively, foster innovation, and ensure long-term growth in backdrop of Industry 5.0.

Need and Scope of this Study

The need and scope of this study is linked with the transformative nature of the transition of Industry 4.0 toward Industry 5.0. This research study need arises from the imperative facing organizations in understanding and adapting to this dynamic technological evolution. As Industry 5.0 introduces human-centric technologies, collaborative robotics, and real-time interactions, there is a pressing need to unravel the intricacies of this shift and its implications for businesses, workforce dynamics, and strategic decision-making. This study's scope encompasses a comprehensive exploration of the enablers, challenges, and ethical considerations inherent in the transition, offering valuable insights to guide businesses, inform policymakers, and contribute to academic discourse. It further covers the analysis on impact on organizational structures, workforce skill requirements, and the broader landscape of responsible and sustainable technological integration. In essence, this research endeavors to address the need for informed choices and innovation while navigating the evolving industrial framework of Industry 5.0.

Research Questions

1. What are the primary enablers and challenges during the transition from Industry 4.0 towards Industry 5.0 for businesses?

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2. How does the integration of human-centric technologies and collaborative robotics in Industry 5.0 affect organizational structures and workforce dynamics?

Research Objectives

- Investigate the key enablers and challenges faced by businesses during the transition from Industry 4.0 towards Industry 5.0.
- To investigate the impact of the Industry 5.0 paradigm on organizational structures, workforce dynamics, and skill requirements.
- Analyze the ethical considerations and potential disruptions arising from the integration of human-centric technologies and collaborative robotics in Industry 5.0.

Literature Review

Ghobakhloo et al. (2023) have explained about actions and approaches for enabling Industry 5.0-driven sustainable industrial transformation, emphasizing stakeholder integration, proactive governmental support, eco-innovation, and sustainable value network reformation as key enablers. Their study provides a strategy roadmap for Industry 5.0 transformation and offers implications for policymakers and practitioners, aligning with the study's focus on sustainability and transformation (Ghobakhloo et al., 2023). Carayannis and Morawska-Jancelewicz (2022) discussed the context of Society 5.0 and Industry 5.0, emphasizing their association with sustainable development goals and their implications for universities. They have argued for incorporating these concepts into university practices and policies, highlighting the role of digitalization in driving change and sustainability (Carayannis & Morawska-Jancelewicz, 2022).

Atif (2023) investigated the relationship between circular economy (CE), Industry 4.0 (I4.0), and Industry 5.0 (I5.0), highlighting the shift towards a more value-driven and human-centric approach in I5.0. Thire study's results emphasize the comprehensive nature of I5.0, aligning with the study's objectives of exploring enablers and sustainability within the transition (Atif, 2023). Kasinathan et al. (2022) discussed the role of disruptive technologies, including Industry 5.0, for achieving Sustainable Development Goals (SDGs). They proposed an integrated framework involving Industry 5.0 along with Society 5.0 to support SDGs, which resonates with the study's objectives related to sustainability and responsible technological integration (Kasinathan et al., 2022).

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Narkhede, Pasi, Rajhans, and Kulkarni (2023) explored the emerging concept of Industry 5.0 (I5.0) while Industry 4.0 (I4.0) is still evolving. They study has an aim to understand I5.0, identify its benefits and drawbacks, and investigate its effects on economic, environmental, and social sustainability pillars. The review revealed that I5.0 represents a paradigm shift that integrates advanced technologies with human-centric approaches, offering potential to enhance sustainability in manufacturing. Their proposed I5.0 outline provides important insights for policymakers, industry leaders, and technology providers, setting the stage for further research on its application in various sectors. The presence of robots and AI in various aspects of life and work and addresses the need for future research to delve into the organizational challenges and implications of this evolving human-robot collaboration. This forward-looking perspective underscores the importance of understanding the organizational dynamics of this emerging trend in the field of robotics (Demir et al., 2019).

Enang, Bashiri, and Jarvis (2023) conducted literature review in a systematic way that explores the transition from technocentric Industry 4.0 (IN 4.0) to value-centric Industry 5.0 (IN 5.0) using the multiple level perspective (MLP). They have identify key contextual factors such as the Covid-19 pandemic and Climate change, regime factors including Trust and Mass personalization, and niche innovations like Advanced Extended reality technologies and Advanced AI. The study underscores the reconfiguration pattern in the transition and provides insights for practitioners and academics (Enang et al., 2023). Jafari, Azarian, and Yu (2022) investigate the implications of Industry 5.0 on smart logistics, highlighting the shift from technology-focused Industry 4.0 to a socio-economic transition driven by humans and technologies. Their research emphasized the association between manpower and technology in Industry 5.0 along with discussion on smart logistics areas such as human-machine systems and human-robot collaboration, aligning with the study's objectives (Jafari et al., 2022).

Aheleroff et al. (2022) highlighted the significance of mass personalization in the circumstance of Industry 4.0, highlighting the requirement for sustainable collaboration between humans, machines, and technologies. Their research proposed a Reference Architecture Model for achieving mass personalization and emphasizes the role of Human Capital 5.0 in enhancing collaboration, aligning with objectives of their study (Aheleroff et al., 2022). Akundi et al. (2022) described about evolution of Industry 5.0 which has been response to drawbacks of Industry 4.0

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in addressing personalization and empowering humans in manufacturing processes. They have identified key enablers such as IoT, blockchain, artificial intelligence (AI), big data analytics, and machine learning, which align with the research objectives associated with impact of technology on organizational resilience and between human and machine interaction (Akundi et al., 2022).

Ben Youssef and Mejri (2023) conducted a standardized literature analysis of research on Industry 5.0, revealing key themes and concepts, including human-centricity and smart manufacturing. Their findings support the focus on human-machine connectivity and Industry 5.0's contribution to sustainability, echoing the study's objectives and discussions (Ben Youssef & Mejri, 2023). Pizoń and Gola (2023) inspected the evolving human-machine relationship within the backdrop of Industry 5.0, emphasizing the importance of restoring the human aspect in production. Their findings line up with the study's objectives of exploring the perspective and future roadmap of Industry 5.0 solutions, particularly in terms of human-robot co-working (Pizoń & Gola, 2023).

Hein-Pensel et al. (2023) reviewed the maturity models (MMs) for Industry 4.0 and assess their suitability for Industry 5.0, focusing on a human-centered approach and readiness for disruptive technologies. Their findings highlighted the increasing complexity in Industry 5.0, which emphasizes holistic, sustainable, and human-centered value creation. Their study contributes to understanding the challenges experienced by micro, small and average middle sized organizations during digitalization (Hein-Pensel et al., 2023). Mourtzis, Angelopoulos, and Panopoulos (2022) conduct a literature review on the challenges and opportunities of transitioning from Industry 4.0 to Society 5.0. They emphasized the shift toward human-oriented technologies and services in Industry 5.0, focusing on sustainability and human well-being. Their research provided basis for the coexistence of industry and societal trends, in line with study's objectives (Mourtzis et al., 2022).

Aheleroff, Huang, Xu, and Zhong (2022), has opined for the need for customization for sustainability and resilience in backdrop of Industry 4.0 towards Industry 5.0. They have proposed a Reference Architecture Model for achieving mass personalization, highlighting how Industry 5.0 enhances Industry 4.0 through a human-centric approach, particularly emphasizing the role of Human Capital 5.0 in collaboration by means of machines and technologies to create sustainable and value-added products. Saniuk, Grabowska, and Straka (2022) stressed the socioeconomic

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expectations with regard to advancement of Industry 4.0 in backdrop of sustainability, humanization, and resilience. Their research identified key social expectations and recommends industry development in three areas: human-centric, sustainable, and resilient. Their study outcome important insights for investment strategies and government policies to support industry development based on human-centric digitization.

Akundi, Euresti, Luna, Ankobiah, Lopes, and Edinbarough (2022) explored the progression from Industry 4.0 in the direction of Industry 5.0, highlighting the shift from automation in Industry 4.0 to customized manufacturing and the empowerment of in manufacturing processes in Industry 5.0. They have conducted content analysis of research trends and identify key themes in Industry 5.0 research, encompass AI, data analytics, supply chain management, digitalization, transformation, machine learning, and human-machine connectivity, indicating the growing interest in the role of human-machine interaction. Raja Santhi and Muthuswamy (2023) provide broader perspective of the enabling knowledge of Industry 4.0 and their potential as the foundation for Industry 5.0. They have discussed socio-economic challenges and propose the term "Industry 4.0S" to describe this transition, emphasizing the requisite for sustainability and addressing the "sustainability trilemma."

Zizic, Mladineo, Gjeldum, and Celent (2022) have conducted a literature-based analysis to compare Industry 4.0 towards the direction of Industry 5.0 from the perspectives of people, organization, and technology. They highlight the shift toward human-centricity in Industry 5.0 along with note for change in research aims from sustainability to human-centricity. Their analysis of maturity models evaluated about the enterprises' readiness for the features of these paradigms. Golovianko, Terziyan, Branytskyi, and Malyk (2023) argued for the creation of an Industry 4.0 along with Industry 5.0 hybrid, combining efficiency from Industry 4.0 with sustainability starting Industry 5.0. They proposed digital cognitive clones as an enabling technology for this hybrid, emphasizing requirement for balance between automation and human-driven processes to achieve sustainable and resilient smart manufacturing. Xu, Lu, Vogel-Heuser, and Wang (2021) discussed the inception, conception, and perception of Industry 4.0 along with Industry 5.0. They highlighted the technology-driven nature of Industry 4.0 and the value-driven approach of Industry 5.0. The co-existence of these two industrial revolutions raises questions and calls for continued debate and discussion to clarify their roles and implications.

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Research Methodology

The research methodology encompasses a well-structured approach to gather and analyze data pertaining to the changeover of Industry 4.0 to Industry 5.0. The sample size of this study has 50 respondents (N = 50), selected through purposive sampling. Such sampling method deliberately ensures that participants possess the requisite experience and qualifications to provide valuable insights into the topic. Specifically, respondents are required minimum at the level of middle-level managers working in modern organizations where technology has crucial role in daily business processes. This criterion ensures that the participants have a meaningful perspective on the industry's technological evolution. The data collection process involves the administration of a survey, which includes demographic variables like gender, job level, experience, and education.

The survey comprises four constructs - technology, adaptation, organizational resilience, and ethics - each measured using a 5-point Likert-type scale, where 5 represents "strongly agree" and 1 represents "strongly disagree." The items, constructs and reliability are presented in appendix section of this report. To gain a comprehensive understanding procured data, the research employed combination of statistical tools. The frequency analysis was implemented to explore the demographic profile of the respondents, providing valuable insights into the features of the sample. The descriptive statistics is conducted to report the means and standard deviations for 4 constructs, offering an initial overview of participants' perceptions. Furthermore, one-way ANOVA is employed to examine the variation in organizational resilience across different job levels, while regression analysis is utilized to know about relationships between technology, adaptation, and organizational resilience. The software chosen for data analysis is SPSS version 26.0, providing a robust platform for conducting the statistical analyses required to uncover meaningful insights into this dynamic industrial transition.

Data Analysis

The frequency analysis tool was implemented to describe demographic profile of respondents. The measurement scale in the first part has collected demographic profile for four variable variables namely gender, job level, experience and education. The majority of participants were male (76.0%), while females constituted a smaller portion (24.0%) of the sample. In terms of job level, the distribution shows that a significant proportion of participants held senior positions

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(74.0%), followed by middle-level positions (20.0%), and executives (6.0%). Considering the participants' years of experience, the data represents a substantial count of respondents with above 10 years of experience (84.0%), while a smaller portion reported having less than 10 years of work experience (16.0%). Lastly, regarding education, the greater portion of participants had completed post-graduation (66.0%), while 22.0% had graduated, and 12.0% held other qualifications.

The means and standard deviations of 4 constructs: Technology (M = 4.14, SD = 0.95), Adaptation (M = 4.41, SD = 0.55), Organizational Resilience (M = 4.84, SD = 0.34), and Ethics (M = 4.22, SD = 0.49), are reported. These statistics provide an initial overview of participants' perceptions of these constructs within backdrop of transition. The comparatively high mean scores depicts a generally positive outlook regarding technology, adaptation, organizational resilience, and ethics, indicating that participants may view these aspects favorably in the circumstance of the industry's evolution. The relatively low standard deviations depict relatively high level of consensus among participants regarding these constructs.

H1: The mean value of organizational resilience varies across the job levels.

Table 1: One-way ANOVA

Groups	*N*	*Mean*	*SD*	*95% CI of Mean*		*ANOVA*	
				LB	*UB*	*F(d f)*	*p-value*
Middle level	10	4.80	0.42	4.50	5.10		
Senior level	36	4.78	0.39	4.65	4.91	0.02	0.97
Executive level	4	4.75	0.50	3.95	5.55		

Notes: Dependent variable = Organizational resilience, SD = Standard deviation, F = F-statistic, LB = Lower Bound, UB = Upper Bound
Source: Output from SPSS

The results from one-way ANOVA test are presented in Table 1 which depicts a statistically significant difference in the mean value of organizational resilience across job levels, F(2, 47) = 0.02, p = 0.97. The mean organizational resilience score for middle-level employees is 4.80 (SD = 0.42, 95% CI [4.50, 5.10]), for senior-level employees is 4.78 (SD = 0.39, 95% CI [4.65, 4.91]), and for executive-level employees is 4.75 (SD = 0.50, 95% CI [3.95, 5.55]). However, the p-value is well above the conventional significance level of 0.05, suggesting that of no statistically significant variation in organizational resilience means across job levels. Therefore, hypothesis (H1), which posited significant variation in organizational resilience means, is not

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supported. These findings imply that, in this sample, job level does not found as a significant factor influencing organizational resilience perceptions among participants.

H2: The technology has significant association with organizational resilience.

H3: The adaptation has significant association with organizational resilience.

Table 2: Regression Coefficients

Path	*Beta*	*t-value*	*p-value*
Technology--> Resilience	0.20	3.10	0.00
Adaptation-->Resilience	0.02	0.21	0.84
F(2,47)		7.62*	
R-Square		0.25	

Notes: *Significant at P< 0.001
Source: Output from SPSS

The outcome from regression test are presented in Table 2 which reveal a significant relationship between technology (M = 4.14, SD = 0.95) and organizational resilience (M = 4.84, SD = 0.34), as indicated by the beta coefficient of 0.20 (t = 3.10, p < 0.001) supporting H2. This finding suggests that as technology levels increase, there is a corresponding positive impact on organizational resilience. However, the relationship between adaptation (M = 4.41, SD = 0.55) and organizational resilience is not statistically significant, with a beta coefficient of 0.02 (t = 0.21, p = 0.84) not supporting H3. The overall regression model, which includes both technology and adaptation as predictors, is statistically significant (F (2, 47) = 7.62, p < 0.001), illustrating that selected independent variables combine and explain a substantial proportion of the variance in organizational resilience. The R-square value of 0.25 demonstrates that 25% of variation in organizational resilience can be accounted for by technology and adaptation.

Discussion

In this study, a comprehensive examination of the transition of Industry 4.0 towards Industry 5.0 and its impact on businesses was conducted. The findings revealed several noteworthy insights. The demographic analysis unveiled that the majority of participants were male, and senior-level positions were prevalent, indicating that individuals with substantial industry experience were engaged in this research. Furthermore, participants generally possessed post-graduate degrees, underlining their educational qualifications.

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In terms of the study's hypotheses, it was observed that job level does not have considerably influence perceptions of organizational resilience among participants. This means that, within this sample, organizational resilience perceptions kept as comparatively consistent across different job levels. However, a crucial finding emerged regarding the relationship amid technology and organizational resilience. The data demonstrated significant and positive association between the those two variables, illustrating that as technology levels increase, so does organizational resilience. This underscores the pivotal role of technology in bolstering an organization's capacity to navigate the transition effectively. In contrast, the hypothesis concerning the relationship among adaptation and organizational resilience was rejected, implying that adaptation processes alone may not be a significant driver of organizational resilience in this context.

These findings contribute to expand knowledge of complex dynamics at play during the transition between industry paradigms. They emphasize the magnitude of technology as a means for organizational resilience, highlighting the need for businesses to strategically leverage technological advancements in their evolution towards Industry 5.0. Additionally, the consistent perceptions of organizational resilience across various job levels suggest that fostering resilience should be an organizational goal that transcends hierarchical boundaries. While the study offers valuable insights, it also underscores the need for further research to delve deeper into the multifaceted aspects of Industry 5.0 and its implications for businesses, providing a foundation for informed decision-making in this transformative era.

Contribution to Theory

This study significantly contributes to the theory which helps in understanding transition of Industry 4.0 towards Industry 5.0 by offering insights towards factors influencing organizational resilience in this evolving landscape. The finding of positive considerable relationship between technology and organizational resilience underscores the theoretical importance of technology as a driver of organizational adaptation and capacity to withstand industry shifts. This finding extends existing resilience theory by demonstrating that technological advancements perform a pivotal role in enhancing an organization's ability to thrive amidst change. Furthermore, the study's nuanced examination of demographic factors and their limited influence on organizational resilience perceptions adds a valuable dimension to resilience theory, emphasizing that resilience-building efforts should be guided by broader organizational strategies rather than being contingent on

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individual-level characteristics. These contributions provide robust theoretical foundation for future research in the area of Industry 5.0 and its implications for organizational dynamics and strategies.

Conclusion

This research has illustrated navigation of businesses that undertake transition from Industry 4.0 to the promising horizons of Industry 5.0. The study's demographic analysis provided important insights about profile of participants engaging in this transformative discourse, revealing a predominance of experienced individuals with post-graduate qualifications. Importantly, the findings highlighted the pivotal role of technology as a significant driver of organizational resilience during this transition, with a positive and significant relationship identified. This underscores the critical importance of strategically leveraging technological advancements to enhance an organization's ability to adapt and thrive in a rapidly evolving industrial landscape. However, the study demonstrated that individual-level factors, such as job level, had limited influence on perceptions of organizational resilience, suggesting that resilience-building strategies should be approached as organizational imperatives that transcend hierarchical boundaries.

Industry 5.0 continues to shape the future of business and industry, knowledge from these study present practical implications for organizations and policymakers alike. Businesses can use this study finding to inform their strategies for embracing technology and fostering flexibility in the face of ongoing technological evolution. The policymakers and academia can draw from the study's contributions to advance discussions on responsible and sustainable technological integration, ensuring that Industry 5.0 leads to innovation and long-term growth while addressing ethical considerations. In this dynamic landscape, this research serves as a foundational resource for navigating the path from Industry 4.0 towards Industry 5.0, fostering informed choices, innovation, and sustainable development within the evolving industrial framework.

Managerial Implications

The findings from research give crucial managerial implications for businesses embarking on the transition from Industry 4.0 towards the direction of Industry 5.0. A strong positive association identified between technology and organizational resilience underscores the importance of strategic technological adoption. Organizations must prioritize investments in advanced technologies and digital transformation to augment their adaptive capacity and

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resilience. This encompasses not only incorporating cutting-edge technologies but also nurturing a culture of technological innovation and continuous learning among employees.

The limited influence of individual-level factors, such as job level, on perceptions of organizational resilience suggests that resilience-building efforts could be approached holistically. Managers and leaders should promote a shared organizational commitment to resilience, encompassing all levels and departments. The strategies for enhancing resilience should be incorporated into the organizational culture, involving employees at all levels in resilience-building initiatives. Hence, by doing so, organizations position themselves to thrive in the dynamic landscape of Industry 5.0, where technological integration and adaptability are paramount.

Future Research

Future research in this domain can further deepen so that knowledge of the transition from Industry 4.0 to Industry 5.0 in several avenues. Firstly, investigating the role of specific technologies (e.g., artificial intelligence, data analytics) in determining organizational resilience inside the framework of Industry 5.0 could provide more nuanced insights. Additionally, delving into the moderating factors that influence the association between technology and resilience, such as organizational size or industry type, can offer a more tailored understanding of resilience dynamics. Furthermore, future studies need to consider about the ethical considerations related to technology adoption in Industry 5.0, examining the implications for social responsibility and sustainability. Finally, longitudinal research tracking organizations' journeys through these industrial transitions over time could give invaluable insights into the evolving strategies and challenges they face as they adapt to Industry 5.0's dynamic landscape.

References

Aheleroff, S., Huang, H., Xu, X., & Zhong, R. Y. (2022). Toward sustainability and resilience with Industry 4.0 Industry 5.0. *Frontiers in Manufacturing Technology*, *2*(October), 1–20. https://doi.org/10.3389/fmtec.2022.951643

Akundi, A., Euresti, D., Luna, S., Ankobiah, W., Lopes, A., & Edinbarough, I. (2022). State Industry 5.0—Analysis Identification Current Research Trends. *Applied System Innovation*, *5*(1), 1–14. https://doi.org/10.3390/asi5010027

ISSN 2454-9940
www.ijasem.org
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Atif, S. (2023). Analysing the alignment between circular economy industry 4.0 nexus with industry 5.0 era: An integrative systematic literature review. *Sustainable Development*, *31*, 2155–2175. https://doi.org/10.1002/sd.2542

Ben Youssef, A., & Mejri, I. (2023). Linking Digital Technologies to Sustainability through Industry 5.0: A bibliometric Analysis. *Sustainability (Switzerland)*, *15*(9), 1–20. https://doi.org/10.3390/su15097465

Carayannis, E. G., & Morawska-Jancelewicz, J. (2022). The Futures of Europe: Society 5.0 and Industry 5.0 as Driving Forces of Future Universities. *Journal Knowledge Economy*, *13*(4), 3445–3471. https://doi.org/10.1007/s13132-021-00854-2

Demir, K. A., Döven, G., & Sezen, B. (2019). Industry 5.0 and Human-Robot Co-working. *Procedia Computer Science*, *158*, 688–695. https://doi.org/10.1016/j.procs.2019.09.104

Enang, E., Bashiri, M., & Jarvis, D. (2023). Exploring the transition from techno centric industry 4.0 towards value centric industry 5.0: a systematic literature review. *Journal Production Research*, 1–37. https://doi.org/10.1080/00207543.2023.2221344

Ghobakhloo, M., Iranmanesh, M., Foroughi, B., Babaee Tirkolaee, E., Asadi, S., & Amran, A. (2023). Industry 5.0 implications for inclusive sustainable manufacturing: An evidence-knowledge-based strategic roadmap. *Journal of Cleaner Production*, *417*(July), 138023. https://doi.org/10.1016/j.jclepro.2023.138023

Ghobakhloo, M., Iranmanesh, M., Morales, M. E., Nilashi, M., & Amran, A. (2023). Actions and approaches for enabling Industry 5.0-driven sustainable industrial transformation: A strategy roadmap. *Corporate Social Responsibility and Environmental Management*, *30*(3), 1473–1494. https://doi.org/10.1002/csr.2431

Golovianko, M., Terziyan, V., Branytskyi, V., & Malyk, D. (2023). Industry 4.0 vs. Industry 5.0: Co-existence, Transition, or a Hybrid. *Procedia Computer Science*, *217*(2022), 102–113. https://doi.org/10.1016/j.procs.2022.12.206

Hein-Pensel, F., Winkler, H., Brückner, A., Wölke, M., Jabs, I., Mayan, I. J., Kirschenbaum, A., Friedrich, J., & Zinke-Wehlmann, C. (2023). Maturity assessment for Industry 5.0: A review of existing maturity models. *Journal Manufacturing Systems*, *66*, 200–210. https://doi.org/10.1016/j.jmsy.2022.12.009

ISSN 2454-9940
www.ijasem.org
Vol 18, Issue 4, 2024

Jafari, N., Azarian, M., & Yu, H. (2022). Moving from Industry 4.0 Industry 5.0: What Implications for Smart Logistics? *Logistics*, *6*(2), 1–27. https://doi.org/10.3390/logistics6020026

Kasinathan, P., Pugazhendhi, R., Elavarasan, R. M., Ramachandaramurthy, V. K., Ramanathan, V., Subramanian, S., Kumar, S., Nandhagopal, K., Raghavan, R. R. V., Rangasamy, S., Devendiran, R., & Alsharif, M. H. (2022). Realization of Sustainable Development Goals with Disruptive Technologies by Integrating Industry 5.0, Society 5.0, Smart Cities and Villages. *Sustainability (Switzerland)*, *14*(22), 1–31. https://doi.org/10.3390/su142215258

Mourtzis, D., Angelopoulos, J., & Panopoulos, N. (2022). A Literature Review Challenges and Opportunities of the Transition from Industry 4.0 to Society 5.0. *Energies*, *15*(17), 1–29. https://doi.org/10.3390/en15176276

Narkhede, G., Pasi, B., Rajhans, N., & Kulkarni, A. (2023). Industry 5.0 and the future of sustainable manufacturing: A systematic literature review. *Business Strategy and Development*, *August*, 1–20. https://doi.org/10.1002/bsd2.272

Pizoń, J., & Gola, A. (2023). Human–Machine Relationship—Perspective and Future Roadmap for Industry 5.0 Solutions. *Machines*, *11*(2), 1–22. https://doi.org/10.3390/machines11020203

Raja Santhi, A., & Muthuswamy, P. (2023). Industry 5.0 or industry 4.0S? Introduction to industry 4.0 and a peek into the prospective industry 5.0 technologies. *International Journal on Interactive Design and Manufacturing*, *17*(2), 947–979. https://doi.org/10.1007/s12008-023-01217-8

Saniuk, S., Grabowska, S., & Straka, M. (2022). Identification of Social and Economic Expectations: Contextual Reasons for the Transformation Process Industry 4.0 into the Industry 5.0. *Sustainability (Switzerland)*, *14*(3). https://doi.org/10.3390/su14031391

Xu, X., Lu, Y., Vogel-Heuser, B., & Wang, L. (2021). Industry 4.0 Industry 5.0—Inception, conception and perception. *Journal Manufacturing Systems*, *61*(October), 530–535. https://doi.org/10.1016/j.jmsy.2021.10.006

Zizic, M. C., Mladineo, M., Gjeldum, N., & Celent, L. (2022). Review - From Industry 4.0 towards Industry 5.0: A Review and Analysis of Paradigm Shift for the People , Organization and Technology. *Energies*, *15*, 1–20. https://doi.org/https://doi.org/10.3390/en15145221

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Appendix

Table 3: Constructs and Reliability

Construct	Items	Reliability (Cronbach's Alpha)	Mean	SD
Technology	• Technology plays a significant role in our industry's transformation. • Our organization effectively integrates new technologies. • We invest in research and development to stay technologically competitive.	0.97	4.41	0.95
Adaptation	• Employees in our organization quickly adapt to technological changes. • Our workforce is skilled in using advanced technologies. • Training programs are provided to enhance employees' technical capabilities.	0.96	4.41	0.55
Resilience	• Our organization effectively manages challenges during technological transitions. • We have a flexible organizational structure that adapts to change. • Our company has a history of successfully navigating industry shifts.	0.92	4.84	0.34
Ethics	• Ethical considerations are an essential part of our technological decisions. • We consider the impact of technology on society and the environment. • Our organization has a code of ethics that guides technological integration.	0.86	4.22	0.49

Notes: SD = Standard deviation
Source: Own compilation

Table 4: Exploratory Factor Analysis

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	Component			
Items	*Technology*	*Adaptation*	*Resilience*	*Ethics*
T1	0.895			
T2	0.895			
T3	0.884			
A1		0.932		
A2		0.862		
A3		0.883		
R1			0.911	
R2			0.911	
R3			0.829	
E1				0.929
E2				0.908
E3				0.712

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 6 iterations.