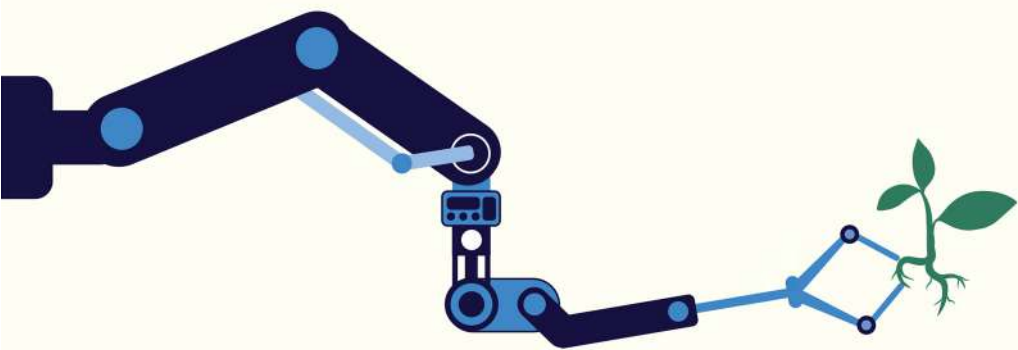


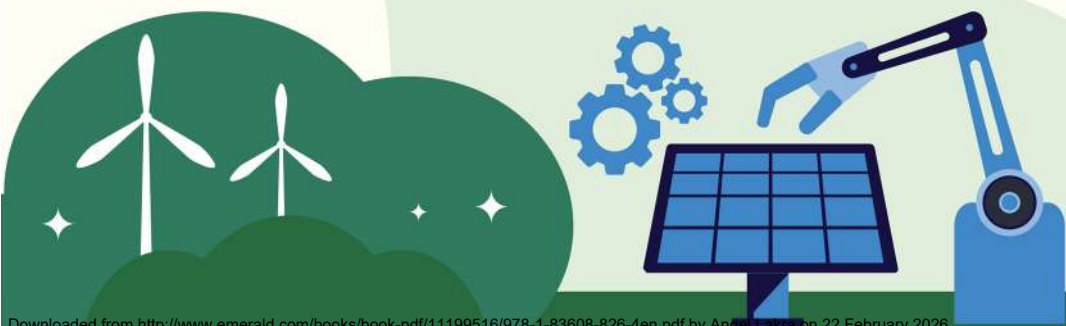


INDUSTRY

5.0

**PIONEERING BUSINESS AND
MANAGEMENT TRANSFORMATIONS**

Editors: Aarti Saini and Vikas Garg



Industry 5.0

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Industry 5.0: Pioneering Business and Management Transformations

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United Kingdom – North America – Japan – India – Malaysia – China

Emerald Publishing Limited
Emerald Publishing, Floor 5, Northspring, 21-23 Wellington Street, Leeds LS1 4DL.

First edition 2026

Editorial matter and selection © 2026 Aarti Saini and Vikas Garg.
Individual chapters © 2026 The authors.
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British Library Cataloguing in Publication Data

A catalogue record for this book is available from the British Library

ISBN: 978-1-83608-827-1 (Print)

ISBN: 978-1-83608-826-4 (Online)

ISBN: 978-1-83608-828-8 (Epub)



INVESTOR IN PEOPLE

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Chapter 6

Leadership Styles in Industry 5.0: Navigating the Human–Tech Interface

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Abstract

The rise of the human–cobot relationship heralded by Industry 5.0 has received widespread recognition. Traditional notions of leadership are rapidly evolving as leaders are tasked with defining, implementing, and managing the transformations brought by Industry 5.0. While much research has centered on technological advancements, their applications, and the digital and managerial competencies needed, there is an increasing need to continually redefine leadership and management practices. This chapter aims to examine and present the emerging leadership styles suited for Industry 5.0. It explores how leaders can successfully guide and motivate teams in a highly automated, data-driven environment without compromising human values, creativity, and employee well-being. The chapter outlines unique features of Industry 5.0 and emphasizes the importance of understanding appropriate leadership approaches amid technological changes. It further provides insights into effective leadership styles and proposes recommendations to strengthen leadership in this new context. By addressing the research gap concerning leadership suited for Industry 5.0, the chapter contributes to management and organizational theory. The findings offer practical guidance for leaders and organizations seeking to adapt their practices to improve performance and employee satisfaction while encouraging further research in this evolving field.

Keywords: Leadership styles; Industry 5.0; empowerment leadership; collaborative leadership; sustainable leadership; vulnerable leadership

Industry 5.0: Pioneering Business and Management Transformations, 71–85

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doi:[10.1108/978-1-83608-826-420261006](https://doi.org/10.1108/978-1-83608-826-420261006)

1. Introduction

Over the years, transformations in the industrial paradigm have significantly impacted the world, people as a society, organizations, and its employees. The industrial paradigm has come a long way from Industry 1.0 (I1.0) to Industry 5.0 (I5.0) steered by significant technological breakthroughs. The phase of I1.0 witnessed dependence on technologies such as mechanization, water, and steam power, which posed simple and easy challenges thus, did not require rigorous scientific techniques (Sharma & Singh, 2020). Electricity production, heavy steel production, chemical advances, and assembly lines for mass production were some prominent characteristics of Industry 2.0 (Rudiyanto et al., 2020). Industry 3.0 (I3.0) witnessed the emergence of advanced technologies such as geometrical modeling, automated drafting, manufacturing/designing/processing integrated by computers (Rebaglia & Sartori, 1987). Industry 4.0 (I4.0) observed technological advancements such as robotics and artificial intelligence (AI) integrated processing, manufacturing, computing, gaming, data analytics, simulation, and security (Puhovichova & Jankelová, 2021). After I4.0, I5.0, an advanced paradigm for industry arrived unannounced as an advancement to I4.0, that encompasses a humanistic, society-driven, sustainability-driven, and mass customization approach (Maddikunta et al., 2022), which drew a lot of attention from around the world.

The evolution of industrial paradigms has continuously reshaped leadership styles to address the unique challenges of each era. During I1.0, autocratic leadership, marked by authoritative and controlling approaches, was prevalent (Feder, 2022). Industry 2.0 (I2.0) saw the rise of transactional/performance-based leadership, while I3.0 brought transformational/group/communicative leadership to the forefront (Kuzior et al., 2023). I4.0, characterized by AI and rapid technological advances, introduced new demands for leaders to foster innovation and manage constant change, necessitating leadership that integrates diversity, ethics, and technology (Puhovichova & Jankelová, 2021; Zulkifli et al., 2021). Yet, I4.0 proved inadequate amid today's climate, ecological, and social crises. I5.0 emerged as an enhanced model, prioritizing the three Ps – planet, people, and prosperity (European Commission, 2024). This era's focus on harmonizing human and technological collaboration underscores the need for leadership surpassing traditional approaches.

The evolution of the human–cobot relationship as highlighted by I5.0 has gained global recognition. Yet, it also generates concerns about harmonizing technological integration with human factors. Leaders are now responsible for defining, implementing, and driving change, but traditional leadership concepts are rapidly transforming under the I5.0 revolution (Kleinings, 2024). Existing research on I5.0 has primarily centered on technological progress, its application, the necessity for digital and managerial competencies, and leadership strategies (Poláková et al., 2023; Thomas et al., 2023). Olsson et al. (2024) stressed the urgent and continuous need to adapt management and leadership practices at all organizational levels, particularly in manufacturing, with stronger support for employees during the I5.0 transition.

Consequently, it becomes essential to examine leadership styles that can direct employees toward achieving I5.0 goals. This chapter details I5.0, redefined leadership needs, methodology, results, and contributions to theory and practice.

2. Literature Review

2.1. Defining I5.0

I5.0 provides a vision of industry that aims beyond efficiency and productivity as the sole goals, and reinforces the role and the contribution of industry to society. It places the wellbeing of the worker at the centre of the production process and uses new technologies to provide prosperity beyond jobs and growth while respecting the production limits of the planet. (European Commission, 2024)

Sustainability, human-centricity and resilience are the hallmark features of Industry 5.0. (Cotta et al., 2021, p. 25)

Industry 5.0 is an integration of resilient, sustainable, and human-centric technologies, organizational concepts, and management principles for designing and managing cost efficient, responsive, resilient, sustainable, and human centric value-adding systems at the levels of ecosystems, supply chains, and manufacturing and logistics facilities, data-driven and dynamically and structurally adaptable to changes in the demand and supply environment to secure the provision of society with products and services in a sustainable and human-centric way through the rapid rearrangement and reallocation of its components and capabilities. (Ivanov, 2023, p. 1689)

I5.0 combines well-being, efficiency, productivity, persistence, environmental sustainability, and mass customization and personalization, setting it apart from past industrial paradigms. Unlike I4.0's focus on mechanization, electrification, automation, and digital unification, I5.0 extends beyond these (Kuzior et al., 2023).

2.2. Why Do We Need I5.0?

I5.0 was introduced publicly in Hannover in 2011 as advancement over I4.0 (Poláková et al., 2023). I4.0 aimed to enhance process, efficiency, and automation, focusing on areas like production lines and business–manufacturing integration with limited concern for limited human well-being and environmental sustainability, creating significant workforce challenges, and limited ecological benefits (Cotta et al., 2021; Nahavandi, 2019).

In the transition to I5.0, the shift toward a human-centric revolution poses both significant opportunities and challenges. Unlike I4.0, which prioritized technology to create smart factories and improve efficiency often leading to job losses due to automation (Dahlin, 2019), I5.0 focuses on enhancing human capabilities (Paschek et al., 2019). It centers people, promoting resilience, and sustainability by employing emerging technologies such as networked sensor interoperability, virtual training, intelligent autonomous systems, cobots, sensing technologies, and machine cognition (Cotta et al., 2021; Nahavandi, 2019). The goal extends past economic gains to generating societal value and well-being (Maddikunta et al., 2022).

2.3. Why Leadership Should be Redefined in I5.0?

In today's highly competitive environment marked by rapidly advancing technology, organizations must be ready to adapt. Over the years, research and practice have shown that leaders play a critical role in guiding employees' efforts toward organizational success. Leaders' skills, abilities, competencies, and mindset have attracted considerable scholarly interest because of their significant impact on innovation, creativity, culture, and individual and group dynamics (Radu, 2023). With the integration of humans and technology, I5.0 presents major challenges for leaders, as employees must proactively develop advanced skills to collaborate with new technologies. Effective leadership is essential to drive organizational change by positively influencing, motivating, and resolving employee resistance (Alavi & Gill, 2017; Oreg & Berson, 2019). The transformative, human-cobot synergy of I5.0 calls for examining leadership styles that secure employee commitment. Despite technological advances, essential social skills, critical reflection, empathy, and emotional processing remain beyond automation (Bernard, 2022), requiring multifaceted leadership approaches.

3. Research Design

This chapter explores the evolving leadership styles needed in I5.0, where advanced AI technologies merge with humanistic approaches. Scientific articles, reports, blogs, and literature have been analyzed to identify leadership requirements shaped by I5.0's characteristics and the essential values leaders must embody. The study examines how leaders can balance automation, data-driven processes, creativity, and well-being. Using a qualitative research design, data has been collected and synthesized to understand the paradigm shift, I5.0's challenges, and leadership approaches that drive innovation, employee engagement, and productivity in this new industrial era. Specifically, the following issues are discussed in this research:

- What is expected from leaders in I5.0?
- What are the core values that a leader needs in I5.0?
- What are the different leadership styles that will ensure a smooth shift to I5.0?
- How to empower leadership styles in I5.0?

4. Results

4.1. Leadership Requirement in the New Paradigm

I5.0 will radically transform corporate operations in the coming decade by prioritizing not only automation and process optimization but also employee well-being, making work more productive and meaningful (Raiche, 2022). Yet, I5.0 presents significant challenges. While it promotes human centricity and collaboration with cobots, it demands advanced machines and employees willing to rapidly up-skill (Abdelmageed & Zayed, 2020; Cotta et al., 2021). Implementing this requires leaders with modern skills who foster learning environments. Failure to adapt can cause panic, anxiety, and depression, as high job demands impact health and well-being (Upadyaya et al., 2016).

Since human centricity, innovation, and technology are crucial pillars of I5.0 era, organizations are expected to create supportive environments that enable employees to engage in re-strategising, redesigning processes, digital transitions, and decision-making (Cotta et al., 2021). Such active participation happens when employees feel motivated and confident that their contributions will be valued. This underscores the need for leadership that respects diverse opinions and involves employees in driving change. Participation adds true value when paired with creativity, which provides a competitive advantage as advanced technologies become widely accessible (Jaussi & Randel, 2014; Sozbilir, 2018). Research shows that leaders who support risk-taking, experimentation, and learning from mistakes foster creativity (Koh et al., 2019; Scrimgeour, 2018; Zhou et al., 2019). As automation and AI increase complexity, employees will require both soft and advanced technical skills (Adel, 2022). Enhancing self-efficacy is essential, as it promotes readiness to master complex tasks (Lunenburg, 2011).

4.2. Leadership 5.0 Core Values

Grounding on the characteristics of I5.0 and the challenges it poses for leaders, the core values that a leader should possess are as follows:

- *Continuous learning*: readiness on the manager's part to learn, unlearn, and relearn according to the changing demands of the business environment and preaching the same to employees.
- *Creative*: increased collaboration between humans and technology requires creativity to elevate the quality of products and services.
- *Trust*: managers need to create an environment of trust so that employees may trust that human–cobots collaboration is for the accomplishment of common goals and there is no danger from machines.
- *Inclusion*: focusing on employees' well-being, social inclusion, and spreading awareness that technology is being included for complementing human capabilities, and not to substitute human resource.
- *Ethical*: ethical issues while using AI must be highlighted for the seamless human–technology collaboration.

- *Network-ties*: focus on understanding others and building strong work relationships which help in fostering collaboration and motivates to indulge in thoughtful decisions.
- *Sustainability*: ensuring efficient utilization of natural, financial, and human resources to maintain the availability of the resources for a longer period.
- *Vulnerability*: being vulnerable opens the door for leaders to design more resilient and inclusive environments as it enables employees to connect with leaders on human grounds.
- *Agility*: leaders need to be flexible to adapt to the changes that are occurring in the environment due to accelerating advancements in technology.

In short, leaders in I5.0 are suggested to equip their teams with skills for human-machine collaboration; balance innovation with empathy and ownership of responsibilities; develop long-term, purpose-driven visions rather than focusing solely on short-term gains; and embrace continuous learning to stay ahead in technological and ethical advancements. There is a clear shift in core leadership values in I5.0 representing a move from “machines replacing humans” to “machines empowering humans,” requiring leaders to adapt accordingly.

4.3. Leadership Styles in I5.0

Adaptive leadership styles integrating the core leadership values required in I5.0 is a noteworthy challenge demanding a shift from the traditional styles of leadership rooted in I4.0 or earlier to modern-day leadership styles, which cater to the modern-day challenges such as guiding employees through digital transformation, experimental mindset, employee welfare, embracing the uncertain, and practicing and professing continuous learning (Fernandez-Vidal et al., 2022; Liu et al., 2024; Olsson et al., 2024). It requires leadership styles focusing on maintaining and re-building trustworthy relationships, a continuous learning environment, up-skilling of employees, and clear ownership of responsibilities (Olsson et al., 2024). Accordingly, the emerging leadership styles are listed below.

4.3.1. Empowerment Leadership

I5.0 highlights the collaboration between humans and AI, where technology handles repetitive tasks, allowing humans to contribute creatively and maximize the benefits of technological progress (Paschek et al., 2019). Hence, organizations must foster environments that support and encourage creativity. Employees’ creativity is shaped by various factors such as organizational culture, leadership support, job autonomy, and job complexity (Koseoglu et al., 2017; Liu et al., 2016). Leaders play a crucial role in cultivating creativity in the workplace (Jiang & Gu, 2017; Shalley & Lemoine, 2018). Over time, several leadership styles have proven effective in achieving organizational goals and enhancing employee performance (Le & Tran, 2020; Wang et al., 2011). Among them, empowering leadership is gaining prominence as it involves delegating authority, promoting job autonomy, knowledge sharing, valuing employees’ input, and encouraging proactive

behavior (Lee et al., 2020; Moreno-Marcial et al., 2024; Zhang et al., 2018). These practices are key drivers and motivators for creativity (Joo et al., 2023; Pattnaik & Sahoo, 2021). Empowering leadership offers the necessary support for creativity to thrive. Research further asserts that transitioning from I4.0 to I5.0 successfully requires employee empowerment and engagement, emphasizing the importance of a human-centric leadership approach (Olsson et al., 2024).

4.3.2. Collaborative Leadership

The leader encourages cross-functional and human-machine collaboration by acting as a facilitator, breaking silos to foster teamwork among diverse stakeholders, including machines as “intelligent collaborators.” When a manager oversees human–robot teams where humans make strategic decisions while robots handle repetitive tasks, it reflects collaborative leadership. Collaborative leadership plays a key role in I5.0, particularly in manufacturing industries since it emphasizes the collaboration of humans with machines and teamwork for a sustainability and positive environment at work (Tóth et al., 2023). This style of leadership requires new-age skills in the leaders, such as analytical and creative thinking, empathy, balancing technological advances with social responsibilities, open communication, effectiveness in the management of change, and sustainable eco-friendly decisions (Chew & Zainal, 2024).

4.3.3. Sustainable Leadership

As an advanced version of I4.0, I5.0 is built on environmental sustainability, well-being, efficiency, and productivity, which demands the application of leadership strategies that balance environmental, social, and economic considerations while leveraging advanced technologies and human creativity to drive innovation and sustainable growth (Rame et al., 2024; Saniuk et al., 2022). A sustainable leadership style emerges as the need of the hour, which focuses on aligning business objectives with environmental and societal goals by integrating sustainability into core strategies, ensuring long-term benefits for the planet and stakeholders. I5.0 emphasizes introducing eco-friendly practices in manufacturing to achieve more with less by extending the life-cycle of resources and mitigating resource wastage through implementing circular economy practices while driving innovation (Bozic, 2024). Sustainable leadership aims to create a harmonious balance where advanced technologies amplify human potential, reduce environmental impact, and foster societal welfare and inclusive economic growth (Ahsan & Khawaja, 2024; Narkhede et al., 2024).

4.3.4. Ethical and Inclusive Leadership

I5.0 poses huge challenges yet new openings to leaders for integrating advanced technologies with human creativity while ensuring fairness, transparency, and inclusivity (Adel & Alani, 2024; Verma, 2024). This raises the need for such leadership in the I5.0 era, which ensures ethical decision-making and diversity and

inclusivity in AI usage to ensure the reduction in societal biases; maintain fairness in terms of availability of AI technologies irrespective of geographical location; and foster creativity by considering individuals carrying varied experiences and perspectives (Zowghi & Bano, 2024). Ethical and inclusive leadership recognizes that all employees and stakeholders should have access to the digital tools, skills, and resources needed to thrive in a digital economy (Tagscherer & Carbon, 2023). Such leaders address biases in technology, promote fairness, and give voice to employees, experiencing which, employees find their leaders trustworthy and feel motivated to dedicate more energy to complete the assigned task (Umirzakovich, 2024; Yang et al., 2020).

4.3.5. Resilient Leadership

15.0 highlights continuous learning, agility, and adaptability as some of the significant characteristics to successfully navigate through the changes emerging because of the ever-increasing advancements in technology. Developing resilience in leaders enables them to effectively navigate challenges, recover from setbacks, and maintain organizational stability, which ensures that leaders can cope, withstand, and thrive in the face of uncertainty (Dartey-Baah, 2015). Resilient leaders uphold adopting advanced digital skills such as predictive analytics, digital twins, and Internet of Things to improve operational resilience, which enables leaders to make effective decisions and system optimization, ensuring organizations can adapt to disruptions effectively (Joel et al., 2024). Such leadership builds organizational agility to handle disruptions, where the leaders focus on adaptability, emphasizing continuous learning and leveraging real-time data for decision-making (Arifin & Purwanti, 2023).

4.3.6. Vulnerable Leadership

Skills such as emotional intelligence and negotiation, which could be seen in the top 10 skill list of 2020 are nowhere in the top 10 skills of 2025 list (Gray, 2016). However, new skills appeared in the top 10 skills of 2025 such as resilience and flexibility (Whiting, 2020). This highlights the demand for leadership that develops resilience among employees; equips employees to handle work-related stress efficiently; and promotes flexibility as and when the need arises. As such, vulnerable leadership stands out as a significant leadership style among many as leaders who embrace vulnerability in leadership are capable of creating a positive work environment. Vulnerable leaders are the leaders who accept their own mistakes and work on them; are open to asking for help; and embrace risk. Such leaders understand that “Leading from a place of connection and influence is more powerful than leading from a place of fear or compliance” (Morgan, 2023). Witnessing such behavior from leaders, employees experience a work environment which encourages employees to see failures as an opportunity to learn and grow. As a result, employees are less bothered about failures and are more willing to take risks and experiment. Along with promoting resilience among employees whenever one encounters a failure, such a work environment also facilitates innovation.

Leadership vulnerability helps in providing a work environment in which every mistake and/or failure becomes an opportunity for learning and adapting.

4.3.7. *Blended Leadership*

Thomas et al. (2023) expanded contemporary transformational-servant-digital leadership styles to fit the demands of I5.0, proposing that effective leaders blend transformational and servant leadership. This combination supports a clear vision, high standards, trust, autonomy, and collaboration among employees to develop the capabilities essential for I5.0. They recommend applying transformational leadership at higher levels, servant leadership at middle levels, and digital leadership operationally as a practical strategy for organizational effectiveness. Transformational leadership at the top ensures sustainability, hyper-customization, and innovation, while servant leadership promotes human-centric, resilient teamwork at middle levels. Digital leadership at the operational level facilitates smart manufacturing and predictive maintenance, strengthening competitiveness. As I5.0 redefines business by prioritizing humanity, evolving leadership styles do not replace traditional approaches but enrich them with value-driven principles. Leaders need to combine multiple styles depending on the situation rather than rely on a single dominant approach. Selecting and integrating leadership styles thoughtfully to address both internal and external challenges is critical to organizational success. An effective leadership style should combine the essential values necessary to thrive within I5.0's dynamic context.

4.4. *Empowering Leadership Styles in I5.0*

Strengthening contemporary leadership approaches in the I5.0 era requires cultivating a mindset and value system rooted in human-centricity, sustainability, ethics, and human–technology synergy. Leaders must be nurtured on multiple fronts: embedding human-centric values through well-being, creativity, and collaborative decision-making; advancing human–machine collaboration via training, open attitudes, and augmentation; and fostering ethical, inclusive, and sustainable thinking. Collaborative leadership can be encouraged by flattening hierarchies, promoting knowledge sharing, and integrating 360-degree feedback. Building adaptive, resilient mindsets demands proactive management, contingency planning, and lifelong learning. Embracing digital tools require training on analytics for real-time decisions, AI for actionable insights, and gamification to engage teams effectively. Purpose-driven leadership can be promoted through a clear vision, aligned goals, and metrics that prioritize people and sustainability. Establishing networks of collaborative leaders involves communities, mentorships, and partnerships to exchange experiences, challenges, and best practices. Transitioning from traditional to cutting-edge leadership styles is supported by training programs on ethical AI, human-centric design, and sustainability; digital collaboration platforms like slack, teams, and asana; AI-powered tools such as predictive analytics; and engagement systems like workday and SAP success factors, customized to organizational needs and contexts.

5. Discussion

I5.0 emerged as an extended yet better version of I4.0 and of previous industrial paradigms with the focus on societal challenges and realities such as human well-being, resilience, sustainability, efficiency and productivity, and low-cost mass customization along with the inclusion of advanced technology and machines (Alves et al., 2023; Carayannis et al., 2021). This industrial era requires organizations to create a working environment which promotes healthy relationships between humans and technology; positive influence on employees' creativity; and ensures individual well-being (Cotta et al., 2021). The leaders of the future must create a culture in the organization where employees are valued; feel important; motivated to be skilled and reskilled; and welcomed to experiment as they are one of the significant pillars of human-centric I5.0. Ethics, inclusion, resilience, creativity, and sustainability are the core values of the leadership styles observed in the leaders for I5.0.

The human-machine interactions pose a huge challenge for organizations. Training and preparing people to work alongside machines and robots as partners is one of the significant challenges. Leaders have been performing a pivotal role in synergizing the performance of employees toward organizational success through exhibiting requisite leadership styles over different industrial paradigms (Kuzior et al., 2023). As such, it becomes significant to explore and identify leadership styles that will ensure successful human-technology collaboration. However, much research has not been conducted to identify leadership styles that can successfully face the changes, conflicts, and provocations of I5.0 (Moreno-Marcial et al., 2024). Therefore, identifying leadership values and leadership styles that will cater to the demands of I5.0 becomes invaluable. This study briefly explains the shift in industrial paradigm from I4.0 to I5.0; highlighting the trends for future styles of leadership; and core values that leaders need to imbibe to lead successfully in this industrial era and its successful transformation.

5.1. Theoretical and Practical Implications

The progression of industrial development globally has triggered a shift in leadership styles, each evolving to meet the specific challenges of its era (Kuzior et al., 2023). This study contributes to leadership literature by emphasizing the vital role of leadership in Industry 5.0. It identifies essential leadership values – continuous learning, ethics, vulnerability, agility, and sustainability – that are necessary to lead and support human resources in this human-centric age. Leadership plays a critical role in enhancing employee creativity, job satisfaction, well-being, and psychological safety (Carmeli et al., 2010; Paais & Pattiruhu, 2020; Park & Jo, 2018). Existing literature prior to I5.0 often references leadership styles such as transformational, empathic, transactional, servant, and authentic leadership (Eva et al., 2019; Gardner et al., 2011; Jian, 2022; Purwanto et al., 2020). However, research specifically focused on leadership styles suited for I5.0 remains limited (Moreno-Marcial et al., 2024).

Considering the increasing relevance of leadership in this human–technology integrated era, this study addresses the gap by identifying leadership styles essential for managing the unique challenges of I5.0, particularly in enabling effective human–cobot collaboration. The findings support leaders in navigating this evolving landscape, fostering ethical, safe, and sustainable workplaces where people and machines can coexist. Equipping leaders with appropriate values and tools will not only reduce fear of failure but also encourage creativity and foster an adaptive mindset – enabling employees to continuously learn, unlearn, and relearn to meet changing demands.

5.2. Limitations and Future Direction

The leadership styles discussed in this research are based solely on a review of existing literature, both offline and online, without empirical validation from I5.0 organizations. Consequently, this chapter may not comprehensively cover all leadership styles currently practiced in I5.0 settings. As a theoretical work, it reflects conceptual perspectives rather than expert opinions. Since I5.0 is a relatively new phenomenon that has yet to be widely implemented across organizations, sectors, and economies, future empirical studies examining real-world practices and leadership approaches in I5.0 environments could provide deeper insights and further strengthen understanding in this field.

References

- Abdelmageed, S., & Zayed, T. (2020). A study of literature in modular integrated construction-critical review and future directions. *Journal of Cleaner Production*, 277, 124044.
- Adel, A. (2022). Future of industry 5.0 in society: Human-centric solutions, challenges and prospective research areas. *Journal of Cloud Computing*, 11(1), 40.
- Adel, A., & Alani, N. H. (2024). Human-centric collaboration and industry 5.0 framework in smart cities and communities: Fostering sustainable development goals 3, 4, 9, and 11 in society 5.0. *Smart Cities*, 7(4), 1723.
- Ahsan, M. J., & Khawaja, S. (2024). Sustainable leadership impact on environmental performance: Exploring employee well-being, innovation, and organizational resilience. *Discover Sustainability*, 5(317). <https://doi.org/10.1007/s43621-024-00422-z>
- Alavi, S. B., & Gill, C. (2017). Leading change authentically: How authentic leaders influence follower responses to complex change. *Journal of Leadership & Organizational Studies*, 24(2), 157–171.
- Alves, J., Lima, T. M., & Gaspar, P. D. (2023). Is industry 5.0 a human-centred approach? A systematic review. *Processes*, 11(1), 193.
- Arifin, R., & Purwanti, H. (2023). Examining the influence of leadership agility, organizational culture, and motivation on organizational agility: A comprehensive analysis. *Golden Ratio of Human Resource Management*, 3(1), 33–54.
- Bernard, M. (2022). *10 skills robots can't replace in the workplace (yet)*. <https://www.forbes.com/sites/bernardmarr/2022/05/20/10-skills-robots-cant-replace-in-the-workplace-yet/>
- Bozic, V. (2024). *Industry 5.0: A future of human–machine collaboration and sustainability*. ResearchGate. <https://doi.org/10.13140/RG.2.2.36602.71362>

- Carayannis, E. G., Dezi, L., Gregori, G., & Calo, E. (2021). Smart environments and techno-centric and human-centric innovations for Industry and Society 5.0: A quintuple helix innovation system view towards smart, sustainable, and inclusive solutions. *Journal of the Knowledge Economy*, 13, 926–955.
- Carmeli, A., Reiter-Palmon, R., & Ziv, E. (2010). Inclusive leadership and employee involvement in creative tasks in the workplace: The mediating role of psychological safety. *Creativity Research Journal*, 22(3), 250–260.
- Chew, Y. C., & Zainal, S. R. M. (2024). Revolutionising talent management in society 5.0: Empowering organisations through collaborative talent management in the intelligence era. *Journal of Electrical Systems*, 20(4s), 1306–1321.
- Dahlin, E. (2019). Are robots stealing our jobs?. *Socius*, 5, 2378023119846249.
- Cotta, J., Breque, M., De Nul, L., & Petridis, A. (2021). *Industry 5.0: Towards a sustainable, human-centric and resilient European industry*. European Commission Research and Innovation (R&I) Series Policy Brief.
- Dartey-Baah, K. (2015). Resilient leadership: A transformational-transactional leadership mix. *Journal of Global Responsibility*, 6(1), 99–112.
- European Commission. (2024). *Industry 5.0*. European Commission. Retrieved November 18, 2024, from https://research-and-innovation.ec.europa.eu/research-area/industrial-research-and-innovation/industry-50_en
- Eva, N., Robin, M., Sendjaya, S., Van Dierendonck, D., & Liden, R. C. (2019). Servant leadership: A systematic review and call for future research. *The Leadership Quarterly*, 30(1), 111–132.
- Eze, C. M. (2023). Leadership style and organisational performance: An exploration. *Nnamdi Azikiwe Journal of Political Science*, 8(2), 71–85.
- Feder, M. (2022). *What is Autocratic leadership?* <https://www.phoenix.edu/blog/what-is-autocratic-leadership.html>
- Fernandez-Vidal, J., Perotti, F. A., Gonzalez, R., & Gasco, J. (2022). Managing digital transformation: The view from the top. *Journal of Business Research*, 152, 29–41.
- Gardner, W. L., Coglisier, C. C., Davis, K. M., & Dickens, M. P. (2011). Authentic leadership: A review of the literature and research agenda. *The Leadership Quarterly*, 22(6), 1120–1145.
- Gray, A. (2016). *The 10 skills you need to thrive in the Fourth Industrial Revolution*. <https://www.weforum.org/agenda/2016/01/the-10-skills-you-need-to-thrive-in-the-fourth-industrial-revolution/>
- Ivanov, D. (2023). The Industry 5.0 framework: Viability-based integration of the resilience, sustainability, and human-centricity perspectives. *International Journal of Production Research*, 61(5), 1683–1695.
- Jaussi, K. S., & Randel, A. E. (2014). Where to look? Creative self-efficacy, knowledge retrieval, and incremental and radical creativity. *Creativity Research Journal*, 26(4), 400–410. <http://dx.doi.org/10.1080/10400419.2014.961772>.
- Jian, G. (2022). From empathic leader to empathic leadership practice: An extension to relational leadership theory. *Human Relations*, 75(5), 931–955.
- Jiang, W., & Gu, Q. (2017). Leader creativity expectations motivate employee creativity: A moderated mediation examination. *The International Journal of Human Resource Management*, 28(5), 724–749.
- Joel, O. S., Oyewole, A. T., Odunaiya, O. G., & Soyombo, O. T. (2024). Leveraging artificial intelligence for enhanced supply chain optimization: A comprehensive review of current practices and future potentials. *International Journal of Management & Entrepreneurship Research*, 6(3), 707–721.
- Joo, B. K., Yim, J. H., Jin, Y. S., & Han, S. J. (2023). Empowering leadership and employee creativity: The mediating roles of work engagement and knowledge sharing. *European Journal of Training and Development*, 47(9), 881–899.

- Kleinings, H. (2024). *Industry 5.0: Leadership in the era of AI*. <https://levity.ai/blog/leadership-ai>
- Koh, D., Lee, K., & Joshi, K. (2019). Transformational leadership and creativity: A meta-analytic review and identification of an integrated model. *Journal of Organizational Behavior*, 40(6), 625–650.
- Koseoglu, G., Liu, Y., & Shalley, C. E. (2017). Working with creative leaders: Exploring the relationship between supervisors' and subordinates' creativity. *The Leadership Quarterly*, 28(6), 798–811.
- Kuzior, A., Zozul'ak, J., & Balahurovska, I. (2023). *The evolution of leadership styles during the industrial development of society* (pp. 299–312). Modernity of Industry and Services.
- Le, B. P., & Tran, Q. T. (2020). Leadership practice for building trust of followers: Decisive factors of organizational performance. *SEISENSE Journal of Management*, 3(2), 45–57.
- Lee, A., Legood, A., Hughes, D., Tian, A. W., Newman, A., & Knight, C. (2020). Leadership, creativity and innovation: A meta-analytic review. *European Journal of Work and Organizational Psychology*, 29(1), 1–35.
- Liu, D., Jiang, K., Shalley, C. E., Keem, S., & Zhou, J. (2016). Motivational mechanisms of employee creativity: A meta-analytic examination and theoretical extension of the creativity literature. *Organizational Behavior and Human Decision Processes*, 137, 236–263.
- Liu, S., Li, P., Wang, J., & Liu, P. (2024). Toward industry 5.0: Challenges and enablers of intelligent manufacturing technology implementation under the perspective of sustainability. *Heliyon*, 10(15). <https://doi.org/10.1016/j.heliyon.2024.e35162>
- Lunenburg, F. C. (2011). Self-efficacy in the workplace: Implications for motivation and performance. *International Journal of Management, Business, and Administration*, 14(1), 1–6.
- Maddikunta, P. K. R., Pham, Q. V., Prabadevi, B., Deepa, N., Dev, K., Gadekallu, T. R., Ruby, R., & Liyanage, M. (2022). Industry 5.0: A survey on enabling technologies and potential applications. *Journal of Industrial Information Integration*, 26, 100257.
- Moreno-Marcial, A., Moreno-Marcial, P., Mendoza-Romero, G., & Bueno-García, M. (2024). An analysis of leadership and proactivity to face the challenges of industry 5.0. In J. Sanchis Sáez, V. Pla Boscà, P. Galindo Villardón, & J. Barzola Montesés (Eds.), *E3S web of conferences* (Vol. 532, p. 02007). EDP Sciences.
- Morgan, J. (2023). *The reality of vulnerable leadership*. Duke Corporate Education. <https://www.dukece.com/insights/the-reality-of-vulnerable-leadership/>
- Nahavandi, S. (2019). Industry 5.0—A human-centric solution. *Sustainability*, 11(16), 4371.
- Narkhede, G., Chinchani, S., Narkhede, R., & Chaudhari, T. (2024). Role of Industry 5.0 for driving sustainability in the manufacturing sector: An emerging research agenda. *Journal of Strategy and Management*. <https://doi.org/10.1108/JSMA-06-2023-0144>
- Olsson, A. K., Eriksson, K. M., & Carlsson, L. (2024). Management toward Industry 5.0: A co-workshop approach on digital transformation for future innovative manufacturing. *European Journal of Innovation Management*, 28(1), 65–84.
- Oreg, S., & Berson, Y. (2019). Leaders' impact on organizational change: Bridging theoretical and methodological chasms. *Academy of Management Annals*, 13(1), 272–307.
- Paaais, M., & Pattiruhu, J. R. (2020). Effect of motivation, leadership, and organizational culture on satisfaction and employee performance. *The Journal of Asian Finance, Economics and Business*, 7(8), 577–588.
- Park, S., & Jo, S. J. (2018). The impact of proactivity, leader-member exchange, and climate for innovation on innovative behavior in the Korean government sector. *Leadership & Organization Development Journal*, 39(1), 130–149.
- Paschek, D., Mocan, A., & Draghici, A. (2019, May). Industry 5.0—The expected impact of next industrial revolution. In *Thriving on future education, industry, business, and*

- society, *proceedings of the MakeLearn and TIIM international conference*, Piran, Slovenia (pp. 15–17).
- Pattnaik, S. C., & Sahoo, R. (2021). Employee engagement, creativity and task performance: Role of perceived workplace autonomy. *South Asian Journal of Business Studies*, 10(2), 227–241.
- Poláková, M., Suleimanová, J. H., Madzik, P., Copuš, L., Molnárová, I., & Polednová, J. (2023). Soft skills and their importance in the labour market under the conditions of Industry 5.0. *Heliyon*, 9(8). <https://doi.org/10.1016/j.heliyon.2023.e18670>
- Puhovichova, D., & Jankelová, N. (2021). Leadership in conditions of Industry 4.0. In D. Hrušovská, M. Kmety Barteková, M. Trúchliková, & M. Raková (Eds.), *SHS web of conferences* (Vol. 115, p. 03013). EDP Sciences.
- Purwanto, A., Bernarto, I., Asbari, M., Wijayanti, L. M., & Hyun, C. C. (2020). Effect of transformational and transactional leadership style on public health centre performance. *Journal of Research in Business, Economics, and Education*, 2(1), 304–314.
- Radu, C. (2023). Fostering a positive workplace culture: Impacts on performance and agility. In A. A. Vilas Boas (Ed.), *Human resource management – An update*. IntechOpen.
- Raiche, J. P. (2022). Industry 5.0: Revolutionizing work by putting people first. 2 – *Proaction International – Performance Insight*. Retrieved November 18, 2024, from <https://blog.proactioninternational.com/en/industry-5.0-the-next-industrial-revolution-is-people-centric>
- Rame, R., Purwanto, P., & Sudarno, S. (2024). Industry 5.0 and sustainability: An overview of emerging trends and challenges for a green future. *Innovation and Green Development*, 3(4), 100173.
- Rebaglia, B., & Sartori, S. (1987). Mechanics, electronics and computer science: Their integration in manufacturing. *Impact of Science on Society*, 146, 139–147.
- Rudiyanto, F. S., Sachari, A., Sabana, S., & Pasaribu, Y. M. (2020). The role of technology and social transformation challenge in industrial revolution 1.0–4.0. In Farkas et al. (Eds.), *Toward industry 4.0: Challenges and opportunities for industrial technology and other sector* (pp. 214–227). FoITIC.
- Saniuk, S., Grabowska, S., & Straka, M. (2022). Identification of social and economic expectations: Contextual reasons for the transformation process of Industry 4.0 into the Industry 5.0 concept. *Sustainability*, 14(3), 1391.
- Scrimgeour, H. (2018). *The importance of mistakes in the creative process*. <https://medium.com/virgin-com-spotlight/the-importance-of-mistakes-in-the-creative-process-c53ba845477>
- Shalley, C. E., & Lemoine, G. J. (2018). Leader behaviors and employee creativity: Taking stock of the current state of research. In Mainemelis et al. (Eds.), *Creative leadership* (pp. 79–94). Routledge.
- Sharma, A., & Singh, B. J. (2020). Evolution of industrial revolutions: A review. *International Journal of Innovative Technology and Exploring Engineering*, 9(11), 66–73.
- Sözbilir, F. (2018). The interaction between social capital, creativity and efficiency in organizations. *Thinking Skills and Creativity*, 27, 92–100.
- Tagscherer, F., & Carbon, C. C. (2023). Leadership for successful digitalization: A literature review on companies' internal and external aspects of digitalization. *Sustainable Technology and Entrepreneurship*, 2(2), 100039.
- Thomas, A., Chawla, Y., Varma, A., & Szlechter, P. (2023). The role of business leaders in Industry 5.0. In A. Visvizi, O. Troisi, & V. Corvello (Eds.), *The international research & innovation forum* (pp. 629–640). Springer International Publishing.
- Tóth, A., Nagy, L., Kennedy, R., Bohuš, B., Abonyi, J., & Ruppert, T. (2023). The human-centric Industry 5.0 collaboration architecture. *MethodsX*, 11, 102260.
- Umirzakovich, T. F. (2024). Corporate governance: A critical framework to foster trust, transparency, accountability, fairness, and stakeholder protection. *Economy and Innovation*, 46, 171–180.

- Upadaya, K., Vartiainen, M., & Salmela-Aro, K. (2016). From job demands and resources to work engagement, burnout, life satisfaction, depressive symptoms, and occupational health. *Burnout Research*, 3(4), 101–108.
- Verma, D. (2024). Industry 5.0: A human-centric and sustainable approach to industrial development. *Transition*, 12(5), 17–21.
- Wang, G., Oh, I.-S., Courtright, S. H., & Colbert, A. E. (2011). Transformational leadership and performance across criteria and levels: A meta-analytic review of 25 years of research. *Group & Organization Management*, 36(2), 223–270.
- Whiting, K. (2020). *These are the top 10 job skills of tomorrow – And how long it takes to learn them*. <https://www.weforum.org/agenda/2020/10/top-10-work-skills-of-tomorrow-how-long-it-takes-to-learn-them/>
- Yang, Y., Li, Z., Su, Y., & Zhang, X. (2020). The role of thriving at work and overall fairness in the future work self-employee creativity relationship. *International Journal of Manpower*, 41(3), 289–302.
- Zhang, S., Ke, X., Frank Wang, X. H., & Liu, J. (2018). Empowering leadership and employee creativity: A dual-mechanism perspective. *Journal of Occupational and Organizational Psychology*, 91(4), 896–917.
- Zhou, J., Wang, X. M., Bavato, D., Tasselli, S., & Wu, J. (2019). Understanding the receiving side of creativity: A multidisciplinary review and implications for management research. *Journal of Management*, 45(6), 2570–2595.
- Zowghi, D., & Bano, M. (2024). AI for all: Diversity and inclusion in AI. *AI Ethics*, 4, 873–876.
- Zulkifli, S. L. A., Omar, S. S., Ariffin, Z. Z., Mahadi, N., & Yaakop, A. Y. (2021). A review of leadership approaches in the industrial revolution of 4.0 era. *Online Journal for TVET Practitioners*, 6(2), 21–27.