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Leadership in Industry 5.0: A Systematic Review and Research Agenda for Future Organizations

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Abstract

This study aimed to explore how leadership is being redefined in the transition toward Industry 5.0 and to develop a research agenda for future organizations centered on human–technology collaboration, resilience, and sustainable value creation. This qualitative study used a systematic review-informed exploratory design based on semi-structured interviews with organizational leaders, digital transformation managers, human resource specialists, and innovation experts in Tehran. Participants were selected through purposive and theoretical sampling to ensure maximum variation in organizational sector, managerial experience, and exposure to advanced digital technologies. Data collection continued until theoretical saturation was reached after 22 interviews. Interviews were conducted face-to-face or online, lasted between 45 and 80 minutes, and focused on leadership capabilities, ethical challenges, employee adaptation, human–AI collaboration, resilience, and future organizational requirements in Industry 5.0. All interviews were transcribed verbatim and analyzed using qualitative thematic analysis with the support of NVivo software. The analysis generated four main categories: human-centric digital leadership, collaborative intelligence and human–AI decision-making, ethical and responsible technology governance, and resilience-oriented organizational transformation. The findings indicated that leadership in Industry 5.0 moves beyond technology adoption and requires leaders to protect human agency, redesign work around collaboration between people and intelligent systems, build ethical safeguards into technological decision-making, and create adaptive organizations capable of responding to uncertainty. Participants emphasized that future leaders must combine technological literacy with emotional intelligence, systems thinking, participatory decision-making, and sustainability-oriented strategic judgment. Leadership in Industry 5.0 represents a shift from efficiency-centered digital leadership toward a human-centered, ethically governed, and resilience-based leadership paradigm. The study contributes to leadership theory by proposing an integrated agenda for examining how leaders can balance automation and augmentation, innovation and responsibility, and digital acceleration and human well-being in future organizations.

Keywords: Industry 5.0; leadership; human-centric organization; human–AI collaboration; digital transformation; resilience; qualitative research.

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1. Introduction

The transition from Industry 4.0 to Industry 5.0 marks a significant reorientation in the logic of industrial and organizational transformation. Whereas Industry 4.0 has largely been associated with automation, cyber-physical systems, smart manufacturing, big data analytics, the Internet of Things, and algorithmic optimization, Industry 5.0 introduces a broader socio-technical vision in which technology is not treated merely as a mechanism for productivity but as an enabler of human-centered, sustainable, and resilient organizational development. The European Commission's influential framing of Industry 5.0 emphasizes that the new industrial paradigm complements Industry 4.0 by placing the well-being of workers at the center of production processes, respecting planetary boundaries, and strengthening industrial resilience (Breque et al., 2021). This shift is not simply technological; it is managerial, ethical, cultural, and leadership-related. It raises the question of what kind of

leadership is required when future organizations must simultaneously adopt intelligent technologies, preserve human agency, address environmental imperatives, and remain adaptive under conditions of uncertainty.

The concept of Industry 5.0 has emerged partly as a response to perceived limitations in Industry 4.0. Industry 4.0 enabled substantial advances in connectivity, automation, predictive analytics, and digital integration, yet its dominant logic often emphasized efficiency, productivity, and technological performance. By contrast, Industry 5.0 attempts to rebalance the relationship between humans and machines by emphasizing collaboration rather than replacement. Nahavandi (2019) describes Industry 5.0 as a human-centric solution in which robots and intelligent systems function as collaborators rather than competitors. Similarly, Maddikunta et al. (2022) argue that Industry 5.0 relies on the creativity of human experts working alongside efficient, intelligent, and accurate machines to produce more customized, resource-efficient, and socially valuable outcomes. This human–machine collaboration creates new opportunities for innovation, but it also demands new leadership capabilities. Leaders must understand not only digital infrastructure but also how human judgment, creativity, motivation, trust, and ethical responsibility interact with algorithmic systems.

Leadership theory has historically evolved in response to changing organizational forms. Classical leadership models were largely shaped by hierarchical, bureaucratic, and efficiency-oriented organizations. Later theories, including transformational, servant, authentic, distributed, adaptive, and complexity leadership, reflected growing attention to motivation, values, collective learning, and organizational adaptability. In digitally transforming organizations, leadership has increasingly been conceptualized as the capacity to guide technology-enabled change, foster innovation, and align digital transformation with strategic objectives. Vial (2019) defines digital transformation as a process in which digital technologies create disruptions that trigger strategic responses and structural changes in organizations. In this context, leadership becomes essential because digital technologies do not automatically produce organizational value. Their effects depend on managerial interpretation, cultural readiness, skill development, governance structures, and the degree to which employees experience technological change as empowering or threatening.

Industry 5.0 intensifies these leadership challenges because it requires leaders to move beyond the traditional digital transformation agenda. A leader in Industry 5.0 must not only support digital adoption but also ensure that technology remains aligned with human dignity, employee well-being, sustainability, and resilience. The central leadership task is therefore not the implementation of technology itself, but the governance of human–technology relations. This includes designing work systems where human expertise is augmented by artificial intelligence, collaborative robots, digital twins, and data-driven decision tools without reducing employees to passive operators of technological systems. Jarrahi (2018) argues that human–AI symbiosis is especially valuable in organizational decision-making because humans and AI contribute different strengths: machines can process large volumes of data, while humans remain essential for contextual interpretation, ethical reasoning, creativity, and judgment under ambiguity. Leadership in Industry 5.0 must therefore be capable of orchestrating complementarities between computational intelligence and human intelligence.

The rise of artificial intelligence further complicates leadership in future organizations. AI systems increasingly influence recruitment, performance monitoring, production planning, customer service, risk assessment, and strategic decision-making. However, AI introduces tensions between automation and augmentation. Raisch and Krakowski (2021) argue that automation and augmentation cannot be fully separated in management because AI applications often produce both effects simultaneously. A system designed to augment managerial judgment may

gradually automate parts of that judgment; conversely, automation may generate new forms of human oversight and interpretation. This paradox is particularly relevant for Industry 5.0 because the paradigm is built on the promise that technology should enhance rather than marginalize the human role. Leaders must therefore manage the boundary between human authority and machine recommendation, clarify accountability, and prevent algorithmic systems from eroding professional autonomy, fairness, and trust.

Another reason leadership is central to Industry 5.0 is that the new paradigm requires organizations to integrate sustainability and resilience into their operating logic. Sustainability in Industry 5.0 involves more than environmental compliance. It requires circular thinking, responsible resource use, long-term stakeholder orientation, and the alignment of innovation with social and ecological goals. Resilience refers to the capacity of organizations to anticipate, absorb, adapt to, and recover from disruption. The COVID-19 pandemic, supply chain instability, climate-related risks, geopolitical uncertainty, and rapid technological change have all intensified interest in resilient organizational systems. Industry 5.0 responds to these challenges by shifting attention from narrow productivity toward long-term organizational viability. Leadership must therefore become more systemic, anticipatory, and ethically grounded. Leaders are expected to balance short-term performance pressures with long-term sustainability, employee well-being, technological robustness, and institutional trust.

Complexity leadership theory offers a useful lens for understanding these requirements. Uhl-Bien et al. (2007) argue that leadership in knowledge-producing organizations should enable adaptive capacity in complex systems rather than rely only on formal authority and top-down control. Industry 5.0 organizations are complex adaptive systems in which human actors, digital platforms, intelligent machines, supply networks, regulatory pressures, and ecological constraints interact dynamically. Leadership in such systems cannot be limited to command and control. It must create conditions for learning, experimentation, distributed problem-solving, and emergent innovation. This is especially important because Industry 5.0 does not provide a single standardized model of organizational design; rather, it requires context-specific configurations of technology, skills, values, and governance.

Human-centricity is perhaps the most distinctive feature of Industry 5.0, but it remains underdeveloped as a leadership construct. In many organizations, “human-centered” digital transformation is used rhetorically without being translated into concrete managerial practices. A truly human-centric leadership approach requires leaders to ask whether employees have meaningful influence over technological decisions, whether digital systems improve or intensify work, whether employees are trained to collaborate with intelligent systems, and whether technology supports autonomy, learning, safety, and inclusion. It also requires attention to psychological responses to technology, including trust, anxiety, resistance, perceived surveillance, and fear of replacement. Leadership in Industry 5.0 must therefore combine digital competence with emotional intelligence, communication, participatory change management, and ethical sensitivity.

Despite increasing scholarly attention to Industry 5.0, leadership remains a relatively fragmented area within this literature. Much of the existing research focuses on enabling technologies, manufacturing applications, sustainability, human–robot collaboration, and policy-level visions. Less is known about how leaders interpret Industry 5.0, what capabilities they consider necessary, how they manage the transition from digital automation to human-centered collaboration, and how leadership practices should evolve in future organizations. This gap is theoretically and practically important. Without leadership models appropriate to Industry 5.0, organizations may adopt advanced technologies while reproducing outdated managerial assumptions. They may invest in AI,

robotics, and analytics without developing the cultural, ethical, and human capabilities required to use these technologies responsibly.

The present study addresses this gap by exploring leadership in Industry 5.0 through a qualitative, interview-based inquiry informed by systematic review logic. Rather than treating Industry 5.0 as a purely technological stage, the study conceptualizes it as a socio-technical leadership challenge. The research focuses on how organizational leaders and experts understand the leadership capabilities required for Industry 5.0, how they perceive the relationship between humans and intelligent technologies, and what research agenda is needed for future organizations. By grounding the analysis in participants' experiences and connecting the findings with existing literature on Industry 5.0, digital transformation, AI-enabled management, and complexity leadership, the study contributes to a more integrated understanding of leadership in future organizations.

Accordingly, the aim of this study was to identify and conceptualize the key leadership dimensions required in Industry 5.0 and to develop a research agenda for future organizations based on qualitative evidence from leaders and experts in Tehran.

2. Methods and Materials

This study employed a qualitative exploratory design to investigate leadership in Industry 5.0 from the perspective of organizational leaders, digital transformation professionals, human resource managers, innovation specialists, and academic experts in Tehran. Although the article is theoretically positioned within the systematic review and research agenda tradition, the empirical data collection was based exclusively on semi-structured interviews, as the purpose was to generate an interpretive understanding of leadership capabilities and challenges in Industry 5.0. The qualitative design was appropriate because leadership in Industry 5.0 remains an emerging phenomenon that requires rich, contextual, and experience-based data rather than predefined quantitative measurement.

Participants were selected through purposive sampling followed by theoretical sampling. The initial inclusion criteria were: at least five years of managerial, consulting, academic, or professional experience related to digital transformation, leadership, human resource management, innovation, smart manufacturing, or organizational development; familiarity with emerging technologies such as artificial intelligence, automation, data analytics, robotics, or digital platforms; and willingness to participate in an in-depth interview. Theoretical sampling was used during data collection to include participants who could clarify emerging categories, challenge preliminary interpretations, or provide contrasting perspectives. Data collection continued until theoretical saturation was reached, meaning that additional interviews no longer generated substantially new conceptual insights.

A total of 22 participants took part in the study. The sample included senior managers, middle managers, digital transformation consultants, HR specialists, technology project managers, and university faculty members. Participants were drawn from technology-based companies, manufacturing firms, consulting organizations, knowledge-based enterprises, and academic institutions in Tehran. This diversity allowed the study to capture different interpretations of leadership in Industry 5.0 across organizational contexts. Ethical considerations were observed throughout the study. Participation was voluntary, informed consent was obtained, and participants were assured that their identities and organizational affiliations would remain confidential. Participants were coded as P1 to P22.

Data were collected through semi-structured interviews. An interview guide was developed based on the conceptual literature on Industry 5.0, leadership, digital transformation, human–AI collaboration, responsible innovation, and organizational resilience. The interview guide included open-ended questions designed to elicit participants' experiences, interpretations, and expectations regarding leadership in future organizations. Sample questions included: "How do you understand the difference between leadership in Industry 4.0 and Industry 5.0?", "What capabilities will leaders need to manage human–technology collaboration?", "How should leaders protect human values in AI-enabled organizations?", "What ethical risks do you associate with Industry 5.0?", and "What organizational conditions are necessary for resilience and sustainability in future organizations?"

Interviews were conducted either face-to-face or through secure online platforms, depending on participant availability. Each interview lasted between 45 and 80 minutes. With participants' permission, interviews were audio-recorded and then transcribed verbatim. Field notes were also written after each interview to document contextual impressions, emerging analytical ideas, and possible follow-up questions. Data collection and preliminary analysis occurred simultaneously, allowing the researcher to refine interview questions and pursue emerging themes in later interviews. Theoretical saturation was achieved after the twentieth interview, but two additional interviews were conducted to confirm the stability and conceptual adequacy of the emerging categories.

Data were analyzed using thematic analysis with the support of NVivo software. The analysis followed an iterative process involving familiarization with transcripts, initial coding, focused coding, category development, theme refinement, and interpretation. In the first stage, all transcripts were read several times to gain an overall understanding of participants' accounts. In the second stage, meaningful units of text were coded inductively. Codes reflected leadership capabilities, technological concerns, ethical issues, employee experiences, organizational practices, and future-oriented recommendations. In the third stage, similar codes were grouped into broader subcategories. In the fourth stage, subcategories were integrated into main categories that captured the core dimensions of leadership in Industry 5.0.

NVivo was used to organize transcripts, manage codes, compare participant groups, retrieve coded segments, and develop category structures. Analytical rigor was strengthened through constant comparison, memo writing, peer debriefing, and member checking with selected participants. Credibility was supported by prolonged engagement with the data and the use of direct participant quotations. Transferability was enhanced by describing the study context and participant characteristics. Dependability was addressed through documentation of coding decisions and analytical memos. Confirmability was supported by maintaining an audit trail of coding revisions and category development.

3. Findings and Results

A total of 22 participants were interviewed. Of these, 14 participants were male and 8 were female. In terms of age, 4 participants were between 30 and 39 years old, 10 were between 40 and 49 years old, and 8 were 50 years old or above. Regarding education, 3 participants held master's degrees and 19 held doctoral degrees or were doctoral candidates. In terms of professional role, 6 participants were senior organizational managers, 5 were digital transformation or technology managers, 4 were human resource managers or organizational development specialists, 4 were university faculty members, and 3 were management consultants. Participants' work experience ranged from 7 to 28 years, with an average of approximately 16 years. Regarding organizational sector, 8

participants were from technology-based or knowledge-based firms, 6 from manufacturing and industrial organizations, 4 from consulting firms, and 4 from academic or research institutions.

The first main category was human-centric digital leadership. Participants consistently emphasized that leadership in Industry 5.0 must begin with a redefinition of the human role in technologically advanced organizations. Unlike Industry 4.0, which many participants associated with automation, system integration, and efficiency, Industry 5.0 was described as a paradigm that places people at the center of digital transformation. Participants argued that leaders should not treat employees as obstacles to automation but as creative, interpretive, and ethical actors whose capabilities must be strengthened through technology. This category included subcategories such as employee empowerment, digital trust-building, human dignity, participatory technology adoption, and psychological readiness for change. One participant stated, “The main mistake is to think that Industry 5.0 means more machines and fewer people. For me, it means better machines and stronger people working together” (P7). Another participant explained, “If leaders only buy technology but do not listen to employees, the organization becomes digital on the surface but remains traditional inside” (P14). These statements indicate that human-centric leadership requires more than employee training; it requires a shift in managerial mindset from control to enablement. Participants believed that leaders must create spaces where employees can question, adapt, and co-design technological systems. They also emphasized that employee well-being should become a strategic criterion in technology decisions. In this sense, human-centric digital leadership refers to the leader’s ability to align digital transformation with human development, autonomy, psychological safety, and meaningful work.

The second main category was collaborative intelligence and human–AI decision-making. Participants argued that Industry 5.0 leadership requires the capacity to combine human judgment and machine intelligence in organizational decision processes. They noted that AI systems can support leaders by identifying patterns, forecasting risks, optimizing operations, and reducing information overload. However, they also warned that AI outputs should not be treated as neutral or unquestionably superior. Leaders must understand when to rely on algorithms, when to challenge them, and how to preserve human accountability. One participant noted, “AI can show us correlations, but it cannot understand the political, emotional, and ethical context of every decision. That part is still leadership” (P3). Another stated, “The future leader is not someone who competes with artificial intelligence, but someone who knows how to ask better questions from it” (P11). The category included subcategories such as algorithmic literacy, decision accountability, human oversight, data-informed judgment, and hybrid decision routines. Participants described collaborative intelligence as a leadership capability that enables organizations to benefit from AI without surrendering responsibility to it. They emphasized that leaders should develop a language of collaboration between technical experts and non-technical managers. They also argued that decision-making in Industry 5.0 should become more transparent, explainable, and participatory. This finding suggests that leadership in future organizations depends on the ability to design decision architectures in which AI augments human intelligence while human actors retain interpretive and ethical responsibility.

The third main category was ethical and responsible technology governance. Participants repeatedly raised concerns about privacy, surveillance, bias, accountability, transparency, and the unintended consequences of intelligent technologies. They argued that Industry 5.0 leaders must act not only as technology adopters but also as ethical governors of digital systems. This category included subcategories such as algorithmic fairness, data privacy, responsible monitoring, transparency, accountability, and stakeholder trust. Several participants

expressed concern that digital transformation projects in organizations are often implemented faster than ethical guidelines are developed. One participant stated, “Technology enters the organization quickly, but ethics enters slowly. Leadership must close this gap” (P18). Another participant explained, “Employees will not trust Industry 5.0 if they feel every movement is being monitored. Smart systems should support people, not create a digital prison” (P5). Participants believed that ethical governance should be embedded in leadership processes from the beginning of technology adoption. This includes defining acceptable uses of employee data, clarifying who is responsible when AI-supported decisions cause harm, ensuring transparency in automated evaluations, and involving employees in discussions about digital monitoring. Participants also argued that responsible technology governance is essential for legitimacy. Organizations that fail to address ethical risks may experience resistance, mistrust, reputational harm, and weakened employee commitment. Therefore, ethical leadership in Industry 5.0 requires leaders to institutionalize values, not merely express them rhetorically.

The fourth main category was resilience-oriented organizational transformation. Participants viewed Industry 5.0 as a response to instability, uncertainty, and environmental complexity. They argued that future organizations must be capable of adapting to technological disruption, market volatility, environmental pressures, workforce changes, and global crises. Leadership in this context requires systems thinking, strategic flexibility, learning capacity, and distributed problem-solving. One participant stated, “Resilience is not only having backup systems. It is having people who can think, collaborate, and redesign work when the plan fails” (P9). Another participant noted, “In Industry 5.0, the leader should not be the only brain of the organization. Intelligence must be distributed across people, teams, and technologies” (P21). This category included subcategories such as adaptive culture, strategic agility, sustainability orientation, continuous learning, and distributed leadership. Participants emphasized that resilience should not be reduced to crisis management. Instead, it should be embedded in everyday organizational routines, including scenario planning, cross-functional collaboration, employee upskilling, knowledge sharing, and flexible structures. They also connected resilience with sustainability, arguing that organizations cannot be resilient in the long term if they ignore ecological and social responsibilities. Thus, resilience-oriented leadership in Industry 5.0 means building organizations that can learn continuously, absorb shocks, and transform without sacrificing human values or sustainability commitments.

Based on the four main categories, the study proposes a research agenda for leadership in Industry 5.0. First, future research should conceptualize human-centric leadership as a measurable and multidimensional construct that includes empowerment, well-being, autonomy, participation, and meaningful work. Second, scholars should examine how leaders manage human–AI collaboration in different decision contexts, especially where algorithmic recommendations interact with ethical judgment and professional expertise. Third, research should investigate governance mechanisms that protect privacy, fairness, transparency, and accountability in AI-enabled organizations. Fourth, future studies should explore the relationship between leadership, resilience, and sustainability in Industry 5.0 organizations. Fifth, comparative research across industries and national contexts is needed to examine whether leadership requirements differ between manufacturing, services, technology firms, public organizations, and knowledge-based enterprises. Finally, future research should develop integrated leadership models that combine digital literacy, ethical reasoning, systems thinking, emotional intelligence, and collaborative intelligence.

4. Discussion and Conclusion

The present study explored leadership in Industry 5.0 and developed a research agenda for future organizations based on qualitative interviews with leaders and experts in Tehran. The findings revealed four main categories: human-centric digital leadership, collaborative intelligence and human–AI decision-making, ethical and responsible technology governance, and resilience-oriented organizational transformation. Together, these categories indicate that leadership in Industry 5.0 cannot be understood as a simple extension of digital leadership or technology management. Rather, it represents a broader socio-technical leadership paradigm in which leaders must align intelligent technologies with human development, ethical responsibility, organizational resilience, and sustainable value creation. This finding is consistent with the European Commission's conceptualization of Industry 5.0 as a paradigm that moves beyond shareholder value and productivity-centered industrial logic toward human-centric, sustainable, and resilient development (Breque et al., 2021). It also supports the argument that Industry 5.0 is not a rejection of Industry 4.0 but a corrective and complementary evolution that repositions technology in relation to human and societal purposes.

The first finding concerned human-centric digital leadership. Participants emphasized that Industry 5.0 leaders must place employees, human dignity, and meaningful work at the center of technological transformation. This finding aligns with Nahavandi's (2019) view that Industry 5.0 should be understood as a human-centric solution in which intelligent machines collaborate with humans rather than replace them. It also supports Maddikunta et al.'s (2022) argument that Industry 5.0 depends on the creative contribution of human experts working with intelligent machines to achieve customized and resource-efficient outcomes. The present study extends these ideas by showing that human-centricity is not only a technological design principle but also a leadership responsibility. Participants did not define human-centric leadership merely as training employees to use technology; instead, they described it as involving employees in technology decisions, protecting psychological safety, reducing fear of replacement, and ensuring that technological adoption strengthens rather than weakens employee agency. This is important because organizations may claim to be human-centered while implementing technologies in ways that increase surveillance, workload intensification, or employee alienation. Therefore, leadership in Industry 5.0 requires a deliberate shift from technology-centered implementation to human-centered transformation.

The second finding concerned collaborative intelligence and human–AI decision-making. Participants viewed future leadership as the ability to combine human judgment and machine intelligence in decision processes. This finding is consistent with Jarrahi's (2018) argument that AI and humans possess complementary strengths in organizational decision-making. AI can process large datasets and detect patterns, while humans remain essential for contextual understanding, moral interpretation, creativity, and judgment under ambiguity. The finding also aligns with Raisch and Krakowski's (2021) automation–augmentation paradox, which suggests that automation and augmentation are interdependent in management practice. Participants in the present study recognized this paradox by arguing that AI can enhance leadership decisions but can also create overreliance, opacity, and accountability problems. The contribution of this study is that it identifies collaborative intelligence as a leadership capability rather than merely a technological condition. Leaders must know how to ask meaningful questions from AI systems, interpret algorithmic outputs, challenge biased or incomplete recommendations, and communicate

AI-supported decisions to employees. This suggests that future leadership development programs should include algorithmic literacy, data ethics, and hybrid decision-making skills.

The third finding concerned ethical and responsible technology governance. Participants emphasized privacy, fairness, transparency, accountability, and trust as central concerns in Industry 5.0 leadership. This finding is compatible with the broader literature on AI-enabled management, which warns that algorithmic systems can reshape authority, decision rights, and accountability in organizations (Raisch & Krakowski, 2021). It also reflects the human-centric logic of Industry 5.0, because a technological system cannot be considered human-centered if it undermines privacy, autonomy, or fairness. The present study extends previous research by showing that ethical governance is perceived by leaders and experts as a practical organizational capability. Participants argued that ethics should not be postponed until after technology implementation; it should be embedded in design, procurement, data management, performance evaluation, and employee communication. This finding is particularly important in contexts where digital monitoring and algorithmic evaluation are expanding rapidly. Leaders must define what kinds of data collection are legitimate, how employee data should be protected, how algorithmic decisions can be appealed, and who is accountable when AI-supported decisions generate harmful outcomes. Thus, ethical leadership in Industry 5.0 is not limited to personal moral character; it requires institutional governance mechanisms.

The fourth finding concerned resilience-oriented organizational transformation. Participants described Industry 5.0 leadership as the capacity to build organizations that can adapt, learn, and transform under conditions of uncertainty. This finding aligns with complexity leadership theory, which emphasizes adaptive capacity, learning, and emergent problem-solving in complex systems (Uhl-Bien et al., 2007). It also corresponds with Vial's (2019) view that digital transformation involves strategic responses to technological disruptions and organizational barriers. However, the present study suggests that Industry 5.0 expands the meaning of resilience beyond technological robustness or crisis recovery. Participants associated resilience with distributed intelligence, employee learning, sustainability, flexible structures, and cross-functional collaboration. This indicates that resilience in Industry 5.0 is both technical and social. Organizations need reliable digital infrastructures, but they also need people who can interpret change, coordinate across boundaries, and redesign work processes. Leaders therefore play a central role in connecting technological resilience with human and organizational resilience.

Another important implication of the findings is that leadership in Industry 5.0 requires integration across multiple leadership traditions. Human-centric leadership resonates with servant, authentic, and inclusive leadership because it emphasizes dignity, trust, participation, and employee development. Collaborative intelligence connects with digital leadership and knowledge leadership because it requires the orchestration of expertise across human and technological actors. Ethical technology governance relates to responsible leadership because it requires accountability to stakeholders and long-term social consequences. Resilience-oriented transformation connects with adaptive and complexity leadership because it emphasizes learning, emergence, and systemic responsiveness. Therefore, Industry 5.0 leadership should not be treated as a completely separate leadership theory but as an integrative framework that combines established leadership insights under new socio-technical conditions.

The findings also have implications for the distinction between Industry 4.0 and Industry 5.0. Participants did not reject the importance of automation, analytics, and digital systems. Instead, they argued that these technologies must be governed by a more advanced leadership logic. Industry 4.0 leadership often focused on digital readiness,

process automation, operational efficiency, and technology adoption. Industry 5.0 leadership adds questions of human agency, ethical responsibility, sustainability, and resilience. This does not make Industry 4.0 obsolete; rather, it suggests that Industry 5.0 is a normative and managerial evolution of the digital transformation agenda. Leaders in future organizations must therefore avoid two extremes: technological determinism, which assumes that digital systems automatically create progress, and technological resistance, which rejects intelligent systems because of their risks. The Industry 5.0 leader must instead develop a balanced approach that uses technology to expand human and organizational capabilities while actively governing its risks.

The research agenda emerging from this study highlights several important directions. First, future studies should develop validated measures of Industry 5.0 leadership capabilities. Current leadership scales may not adequately capture algorithmic literacy, human–AI collaboration, digital ethics, or sustainability-oriented resilience. Second, longitudinal research is needed to examine how leadership practices evolve as organizations move from early digital transformation to more mature Industry 5.0 configurations. Third, comparative studies across countries and industries could reveal how institutional, cultural, and regulatory contexts shape leadership in Industry 5.0. Fourth, future research should examine employee perspectives, because leadership claims about human-centricity must be tested against employee experiences of autonomy, trust, workload, surveillance, and well-being. Fifth, research should investigate how leadership development programs can prepare managers for hybrid decision-making, ethical technology governance, and collaborative intelligence.

The findings also suggest that future organizations will require new leadership development architectures. Traditional leadership training that focuses only on communication, motivation, and strategy will be insufficient. Leaders will need interdisciplinary learning that combines management, data literacy, ethics, sustainability, systems thinking, organizational psychology, and technology governance. They will also need experiential learning environments where they can practice making decisions with AI systems, responding to ethical dilemmas, managing employee concerns about automation, and designing resilient work systems. This is especially relevant because many leaders are expected to guide digital transformation without fully understanding the technical and ethical implications of the systems they adopt. Industry 5.0 leadership development should therefore be continuous, reflective, and practice-based.

In sum, the study shows that leadership in Industry 5.0 is a multidimensional capability that integrates human-centricity, collaborative intelligence, ethical governance, and resilience. These dimensions are mutually reinforcing. Human-centric leadership builds trust and engagement; collaborative intelligence improves decision quality; ethical governance protects legitimacy; and resilience-oriented transformation enables long-term adaptability. If any of these dimensions is neglected, Industry 5.0 may fail to achieve its promise. A technologically advanced organization without human-centric leadership may become efficient but alienating. A human-centered organization without collaborative intelligence may fail to benefit from AI and automation. A digitally mature organization without ethical governance may lose trust. A resilient organization without sustainability may survive short-term shocks while contributing to long-term instability. Therefore, leadership in Industry 5.0 must be understood as an integrated socio-technical practice.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

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Conflict of Interest

The authors report no conflict of interest.

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