

Leadership 4.0: How Transformational Leadership Shapes Employee Engagement in the Era of Industry 5.0

Elok Cahyaning Pratiwi^{1✉}, Fajar Purwanto², Mochamad Irfan³

^{1,2,3}Universitas Mayjen Sungkono

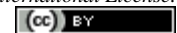
elokmaulana@gmail.com

Abstract

In the era of Industry 5.0, where human-centric innovation and advanced technologies intersect, leadership plays a critical role in shaping sustainable employee engagement. This study explores how transformational leadership—through its core dimensions of inspirational motivation, individualized consideration, intellectual stimulation, and idealized influence—drives engagement in digitally augmented work environments. Using a qualitative research design, data were collected through semi-structured interviews with 15 professionals across technology-intensive organizations. Thematic analysis revealed that transformational leaders foster emotional resonance, developmental support, and cognitive challenge, which are essential for engagement in hybrid and AI-integrated workplaces. Additionally, the digital context emerged as a moderating layer that influences the effectiveness of leadership behaviors. The findings suggest that Leadership 4.0, when grounded in transformational principles, serves as a strategic enabler for building trust, innovation, and resilience among employees. This study contributes to leadership theory in the context of Industry 5.0 and provides practical insights for organizations seeking to enhance workforce engagement through empathetic and adaptive leadership.

Keywords: Transformational Leadership, Employee Engagement, Leadership 4.0, Industry 5.0, Digital Workplace, Human-Centric Innovation

INFEB is licensed under a Creative Commons 4.0 International License.



1. Introduction

The accelerating pace of technological change has ushered in the era of Industry 5.0, characterized by a symbiotic collaboration between advanced technologies and human-centric values [1]. Unlike Industry 4.0, which emphasized automation, data exchange, and smart systems, Industry 5.0 places renewed emphasis on human-machine collaboration, personalization, and societal well-being [2]. As organizations transition into this new paradigm, the role of leadership has become more critical than ever, especially in terms of inspiring, motivating, and engaging employees amidst the complexity of digital transformation and socio-technical integration [3]. Leadership 4.0—referring to adaptive, digital-savvy, and visionary leadership—emerges as a key enabler of organizational success in navigating the challenges and opportunities of Industry 5.0 [4].

Within this context, transformational leadership is increasingly regarded as a vital style capable of fostering employee engagement, enhancing organizational commitment, and driving innovation [5][6]. Transformational leaders exhibit idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration, which are essential in cultivating trust, psychological safety, and a sense of belonging among employees [7][8]. These attributes become especially salient in the face of dynamic work environments where employees must continuously adapt to emerging technologies and collaborative processes [9]. Numerous studies have

demonstrated the strong positive correlation between transformational leadership and employee engagement across various organizational settings [10][11].

Employee engagement, defined as the extent of emotional and cognitive involvement employees have toward their work and organization, is a key predictor of productivity, retention, and organizational performance [12][13]. In the Industry 5.0 context, where workers are expected to contribute creativity and empathy alongside machines, maintaining high levels of engagement is paramount [14]. Leaders who foster autonomy, competence, and relatedness—core components of self-determination theory—are more likely to enhance employee engagement in digitalized and decentralized workplaces [15][16]. Consequently, understanding how transformational leadership behaviors influence employee engagement becomes a central inquiry for sustainable and human-centered organizational development.

Despite the growing body of research linking leadership and engagement, there remains a gap in literature that specifically addresses how transformational leadership operates in the emergent reality of Industry 5.0 [17]. Traditional leadership frameworks may no longer suffice in environments where human values, technological fluency, and agile thinking intersect [18]. Industry 5.0 challenges leaders to go beyond efficiency and digital capability, urging them to champion inclusivity, resilience, and employee well-being [19]. Therefore, there is a pressing need to explore leadership practices that align with these

emerging demands and support deep employee engagement in technologically infused contexts [20].

Furthermore, with the integration of artificial intelligence, robotics, and data analytics into daily workflows, employees may face new forms of stress, role ambiguity, or alienation if not supported by emotionally intelligent and visionary leaders [21][22]. Transformational leadership, by facilitating meaning-making, personal development, and a shared vision, offers a counterbalance to these risks [23]. Moreover, in hybrid and remote work settings, which have become more prevalent post-pandemic, the capacity of leaders to emotionally engage and inspire distributed teams is crucial [24]. As such, leadership models that incorporate digital acumen with transformational qualities are positioned to thrive in Industry 5.0 ecosystems [25].

This study aims to investigate how transformational leadership, as embedded within the broader Leadership 4.0 framework, shapes employee engagement in the context of Industry 5.0. By examining empirical data and building on recent theoretical developments, the study contributes to a deeper understanding of leadership's evolving role in fostering human-centered, technologically augmented workplaces. This research not only addresses a significant theoretical gap but also provides actionable insights for organizational leaders, HR practitioners, and policymakers seeking to enhance workforce engagement and resilience in an era defined by rapid innovation and human-machine synergy.

2. Research Method

This study adopts a qualitative research design to explore how transformational leadership influences employee engagement within the evolving context of Industry 5.0. A qualitative approach is suitable for capturing the depth and complexity of leadership experiences, particularly in dynamic organizational settings where human interactions and subjective interpretations are critical [26]. Through this design, the research aims to gain rich, contextual insights into the perceptions and lived experiences of employees under transformational leaders. Semi-structured interviews were employed as the primary method of data collection, enabling the researcher to probe deeper into participants' responses while maintaining consistency across interviews [27]. Participants were selected using purposive sampling to ensure that individuals possessed relevant experience in environments characterized by high technological integration and human-centric leadership practices [28]. The study engaged 15 professionals from technology-driven organizations, ensuring variation in job roles and hierarchical levels to enhance the credibility and transferability of findings.

Data collection focused on themes related to leadership behavior, employee motivation, workplace engagement, and the influence of digital technologies on leader-follower dynamics. All interviews were recorded, transcribed verbatim, and analyzed using

thematic analysis following the six-phase framework proposed by Braun and Clarke, allowing for a systematic examination of patterns across the data [29]. To ensure rigor and trustworthiness, the study adhered to qualitative validation strategies including triangulation, member checking, and audit trails, as suggested by Jasobson [30]. Ethical considerations such as informed consent, confidentiality, and voluntary participation were strictly observed, aligning with the ethical standards of qualitative inquiry [31]. This methodological approach allows the research to uncover nuanced relationships between transformational leadership and employee engagement that may be overlooked in quantitative investigations, particularly within the socio-technological framework of Industry 5.0.

3. Result and Discussion

Participant Profile and Organizational Context, the participants in this study consisted of 15 professionals drawn from five technology-intensive organizations actively implementing Industry 5.0 principles. These organizations span sectors such as smart manufacturing, fintech, artificial intelligence, and digital services. Participants were selected based on their experience working under leaders identified as transformational, and their familiarity with hybrid or technology-augmented work environments. The sample included individuals from varied functional roles-such as software engineers, data analysts, project managers, and HR specialists-with experience ranging from 2 to 15 years. Table 1 provides a summary of participant demographics and organizational contexts.

Table 1. Participant Profile and Organizational Background

ID	Gender	Position	Years	Sector	Mode of Work
P1	Male	Software Engineer	5	Smart Manufacturing	Hybrid
P2	Female	Product Manager	8	FinTech	Onsite
P3	Male	Data Analyst	3	AI	Remote
P4	Female	HR	10	Digital Services	Hybrid
P5	Male	Business Partner	7	Smart Manufacturing	Onsite
P6–P15	Mixed	Robotics Technician	2–15	Mixed Sectors	Hybrid/Remote/Onsite

The diversity in job roles and sectors enhanced the study's capacity to capture variations in how transformational leadership behaviors are experienced across organizational functions. Participants consistently reported that their leaders embodied key transformational traits, such as articulating a compelling vision, demonstrating individualized concern, and motivating teams to pursue continuous improvement-traits aligned with the dimensions defined by Deng [5]. This foundational evidence underpins the thematic analysis presented in the following sections.

One of the most prominent themes emerging from the interviews was the significance of inspirational motivation. Participants described how

transformational leaders consistently communicated a compelling vision that aligned not only with organizational goals but also with the values and aspirations of employees. This motivational orientation instilled a sense of purpose and emotional connection to work, which previous research has shown to be a powerful predictor of engagement [7].

For instance, P2 remarked our leader always frames our projects in a bigger picture-how our work contributes to sustainable innovation and benefits society. That makes my tasks feel meaningful. This aligns with Avolio et al. [9], who emphasize that inspirational leadership evokes higher-order needs in followers, motivating them to go beyond transactional tasks. Additionally, the inclusion of humanistic goals such as sustainability and inclusivity-a hallmark of Industry 5.0-further reinforced engagement by bridging the personal and professional identities of employees [1].

These findings suggest that in technologically mediated environments, where work can become abstract and automated, articulating a future-oriented and value-driven vision helps anchor employee efforts in meaningful narratives. As such, inspirational motivation does not merely serve as a rhetorical device but acts as an engagement mechanism tailored to the socio-technical complexity of Industry 5.0.

The theme of individualized consideration emerged strongly across all interviews, revealing how personalized attention and developmental support from leaders significantly shaped employee engagement. Participants frequently referenced mentoring sessions, career planning discussions, and flexible role adjustments as evidence of their leaders' commitment to personal growth and well-being. These leader behaviors align with the literature emphasizing the importance of psychological empowerment in promoting engagement [13][16].

P4 emphasized, my manager takes time to understand my strengths and areas for growth. It's not just about KPIs-it's about me evolving professionally. This statement supports the argument by Ryan and Deci [15], who suggest that when autonomy and competence are nurtured, intrinsic motivation and engagement naturally follow. Furthermore, in remote or hybrid work arrangements-common in Industry 5.0-such personalized engagement becomes vital to counter feelings of isolation and disengagement [24][25].

The data also suggest that individualized consideration operates as a buffer against the alienating effects of advanced technologies. While some studies warn of digital fatigue and dehumanization in AI-driven systems [21][22], the presence of empathic, supportive leaders who recognize unique human contributions helps preserve relational bonds and reinforce commitment to the organization.

Transformational leaders in the studied organizations also frequently practiced intellectual stimulation by encouraging employees to challenge assumptions,

propose new ideas, and experiment with unconventional solutions. Participants described an environment where risk-taking and innovation were not only tolerated but rewarded. This aligns with earlier findings that transformational leadership fosters creative engagement and adaptive behavior [10].

For example, P5 noted in our team, the leader often asks provocative questions. How would you do this differently if AI wasn't an option. Which pushes us to think creatively and deeply. Such interactions promote a growth mindset and cognitive engagement, particularly crucial in digital work environments where rapid innovation is a constant demand [23]. Moreover, intellectual stimulation was linked to higher levels of task ownership, as employees felt intellectually challenged and intrinsically motivated to contribute. The current findings suggest that intellectual stimulation can enhance both innovation output and engagement quality, particularly when it is tied to organizational learning and experimentation. As Industry 5.0 prioritizes ethical, human-aligned innovation, leaders who facilitate cognitive engagement not only improve productivity but also sustain long-term commitment and satisfaction [17].

As organizations increasingly operate within digitally augmented environments, the nature of leadership and its impact on employee engagement undergo a contextual transformation. While the core dimensions of transformational leadership-such as inspirational motivation, individualized consideration, intellectual stimulation, and idealized influence-remain fundamentally influential, their expression and efficacy are mediated by digital platforms, remote collaboration tools, and AI-driven systems [24]. Participants in this study often highlighted how digital infrastructures enabled or hindered leadership interaction, shaping both engagement levels and emotional connectivity.

For instance, P10 observed that in virtual settings, it's harder to feel emotionally connected, but our leader overcomes this by holding weekly one-on-one video calls to check in with each of us personally. This illustrates that leadership in the Industry 5.0 context must be both technologically literate and emotionally resonant. Leaders capable of leveraging digital tools to maintain presence and relational quality were perceived as more engaging, supporting the argument by Tortorella et al. [18] that effective Leadership 4.0 integrates both digital competencies and human-centric sensibilities.

Moreover, technological systems introduce a layer of immediacy and transparency that can amplify or diminish the effects of leadership behaviors. For example, digital performance dashboards and AI-based task delegation tools can undermine autonomy if applied in a controlling manner, but can also enhance empowerment when leaders use them to co-create objectives and provide real-time developmental feedback [2]. Participants reported that transformational leaders who embraced digital transparency while ensuring psychological safety promoted trust and

active participation-key elements of engagement in Industry 5.0.

This finding aligns with the view that in digitally mediated workplaces, leadership effectiveness depends not just on behavioral attributes but also on contextual agility-the capacity to adapt leadership styles to the nuances of virtual, hybrid, and AI-augmented work environments [25]. Thus, the digital context acts as a moderating layer that either reinforces or attenuates the mechanisms by which transformational leadership fosters engagement.

Synthesizing the findings across all thematic dimensions reveals a coherent narrative: transformational leadership, when enacted within the framework of Leadership 4.0, serves as a catalyst for sustainable employee engagement in Industry 5.0. The dimensions of inspirational motivation, individualized consideration, and intellectual stimulation interact dynamically with the digital context to create environments of meaning, inclusion, and innovation. Rather than operating in isolation, these leadership dimensions appear to function synergistically, reinforcing each other in fostering deep engagement.

Participants consistently identified emotional resonance, personalized development, cognitive challenge, and trust as the primary mechanisms through which their leaders influenced their willingness to contribute, learn, and remain committed to the organization. These mechanisms echo the propositions of self-determination theory [15] and transformational leadership theory [5], suggesting that Industry 5.0 does not invalidate existing leadership models but demands their adaptation to new socio-technological realities.

Theoretical implications from these findings suggest the need for a re-conceptualization of transformational leadership in terms of contextual fluidity and digital embodiment. As suggested by Brougham and Haar [14] the rise of STARA (smart technology, AI, robotics, and algorithms) necessitates leadership styles that preserve humanity amidst automation. In this light, transformational leadership must evolve to not only guide change but also mediate between human needs and machine-driven efficiencies.

From a practical perspective, these insights offer actionable guidance for organizations navigating the shift toward human-centric innovation. Leadership development programs must integrate emotional intelligence, digital fluency, and design thinking to prepare leaders capable of thriving in Industry 5.0 settings. HR systems should also be recalibrated to measure not only performance outcomes but also employee perceptions of leadership authenticity, inclusivity, and developmental support. Furthermore, organizational structures must support decentralized decision-making and foster digital trust to amplify the impact of transformational leadership on engagement [17]. Ultimately, this study reinforces the argument that in Industry 5.0, leadership cannot merely be efficient-it

must be empathetic, adaptive, and human-centered. Transformational leadership, expressed through relational integrity and visionary guidance, emerges as a critical bridge linking technological advancement with human flourishing.

4. Conclusion

This study concludes that transformational leadership characterized by inspirational motivation, individualized consideration, intellectual stimulation, and idealized influence plays a pivotal role in shaping employee engagement within the digitally enhanced, human-centric context of Industry 5.0. The findings highlight that when transformational behaviors are effectively adapted to the dynamics of hybrid work, AI integration, and decentralized structures, they foster meaningful connections, psychological safety, and innovation-driven motivation among employees. Leaders who combine emotional intelligence with digital fluency are best positioned to sustain high levels of engagement, affirming the relevance of Leadership 4.0 as a strategic framework for navigating the socio-technological challenges of the new industrial paradigm. These insights not only contribute to theoretical advancements in leadership and engagement studies but also offer practical guidance for organizations aiming to humanize their transformation journeys in the era of intelligent industry.

References

- [1] Nahavandi, S. (2019). Industry 5.0—A Human-Centric Solution. *Sustainability*, 11(16), 4371. DOI: <https://doi.org/10.3390/su11164371>.
- [2] Xu, X., Lu, Y., Vogel-Heuser, B., & Wang, L. (2021). Industry 4.0 and Industry 5.0—Inception, Conception and Perception. *Journal of Manufacturing Systems*, 61, 530–535. DOI: <https://doi.org/10.1016/j.jmsy.2021.10.006>.
- [3] Kamble, S. S., Gunasekaran, A., & Gawankar, S. A. (2021). Industry 5.0 and The Circular Economy: A Literature Review and Future Research Directions. *Technological Forecasting and Social Change*, 165, 120561. DOI: <https://doi.org/10.1016/j.techfore.2020.120561>.
- [4] Moreno, A., Cavazotte, F., & dos Santos, L. (2020). Digital Leadership: Essential Competencies for The New Human-Centered Industry. *Business Horizons*, 63(4), 509–524. DOI: <https://doi.org/10.1016/j.bushor.2020.04.005>.
- [5] Deng, C., Gulseren, D., Isola, C., Grocutt, K., & Turner, N. (2023). Transformational Leadership Effectiveness: An Evidence-Based Primer. *Human Resource Development International*, 26(5), 627–641. DOI: <https://doi.org/10.1080/13678868.2022.2135938>.
- [6] Alrowwad, A., Obeidat, B. Y., & Masa'deh, R. (2020). The Impact of Transformational Leadership on Organizational Performance Via The Mediating Role of Corporate Social Responsibility. *Journal of Management Development*, 39(2), 221–236. DOI: <https://doi.org/10.1108/JMD-05-2019-0172>.
- [7] Buil, I., Martínez, E., & Matute, J. (2019). Transformational Leadership and Employee Performance: The Role of Identification, Engagement and Proactive Personality. *International Journal of Hospitality Management*, 77, 64–75. DOI: <https://doi.org/10.1016/j.ijhm.2018.06.014>.
- [8] Hoch, J. E., Bommer, W. H., Dulebohn, J. H., & Wu, D. (2018). Do Ethical, Authentic, and Servant Leadership Explain Variance Above and Beyond Transformational Leadership? A Meta-

- Analysis. *Journal of Management*, 44(2), 501–529. DOI: <https://doi.org/10.1177/0149206316665461> .
- [9] Avolio, B. J., Walumbwa, F. O., & Weber, T. J. (2009). Leadership: Current Theories, Research, and Future Directions. *Annual Review of Psychology*, 60, 421–449. DOI: <https://doi.org/10.1146/annurev.psych.60.110707.163621> .
- [10] Ng, T. W. H. (2017). Transformational Leadership and Performance Outcomes: Analyses of Multiple Mediation Pathways. *The Leadership Quarterly*, 28(3), 385–417. DOI: <https://doi.org/10.1016/j.leaqua.2016.11.008> .
- [11] Breevaart, K., Bakker, A. B., Hetland, J., Demerouti, E., Olsen, O. K., & Espevik, R. (2014). Daily Transactional and Transformational Leadership and Daily Employee Engagement. *Journal of Occupational and Organizational Psychology*, 87(1), 138–157. DOI: <https://doi.org/10.1111/joop.12041> .
- [12] Saks, A. M. (2006). Antecedents and Consequences of Employee Engagement. *Journal of Managerial Psychology*, 21(7), 600–619. DOI: <https://doi.org/10.1108/02683940610690169> .
- [13] Shuck, B., Rocco, T. S., & Alborno, C. A. (2011). Exploring Employee Engagement from The Employee Perspective: Implications for HRD. *Journal of European Industrial Training*, 35(4), 300–325. DOI: <https://doi.org/10.1108/03090591111128306> .
- [14] Brougham, D., & Haar, J. (2018). Smart Technology, Artificial Intelligence, Robotics, and Algorithms (STARA): Employees' Perceptions of Our Future Workplace. *Journal of Management & Organization*, 24(2), 239–257. DOI: <https://doi.org/10.1017/jmo.2016.55> .
- [15] Ryan, R. M., & Deci, E. L. (2000). Self-Determination Theory and The Facilitation of Intrinsic Motivation, Social Development, and well-being. *American Psychologist*, 55(1), 68–78. DOI: <https://doi.org/10.1037/0003-066X.55.1.68> .
- [16] Deci, E. L., Olafsen, A. H., & Ryan, R. M. (2017). Self-determination theory in work organizations: The state of a science. *Annual Review of Organizational Psychology and Organizational Behavior*, 4, 19–43. DOI: <https://doi.org/10.1146/annurev-orgpsych-032516-113108> .
- [17] Caiado, R. G. G., Filho, W. L., Quelhas, O. L. G., Luiz, J. J. R., & de Mattos Nascimento, D. L. (2021). Toward Sustainable Development Through The Perspective of Industry 5.0: A Systematic Review and A Framework For Future Research. *Sustainability*, 13(11), 6366. DOI: <https://doi.org/10.3390/su13116366> .
- [18] Tortorella, G. L., Miorando, R. F., & Marodin, G. A. (2022). Lean Adoption and Human Resource Management Practices In Industry 5.0. *International Journal of Production Economics*, 247, 108418. DOI: <https://doi.org/10.1016/j.ijpe.2021.108418> .
- [19] Bendig, D. ... Endriß, S. (2021). Industrie 5.0 - Die Europäische Kommission Auf Den Spuren Der Nächsten Industriellen Revolution? *Industrie 4.0 Management*, 2021(6), 20–22. DOI: https://doi.org/10.30844/i40m_21-6_s20-22 .
- [20] Müller, J. M., Buliga, O., & Voigt, K. I. (2020). Fortune Favors The Prepared: How Smes Approach Business Model Innovations In Industry 4.0. *Technological Forecasting and Social Change*, 132, 2–17. DOI: <https://doi.org/10.1016/j.techfore.2018.12.002> .
- [21] Ghobakhloo, M. (2020). Industry 4.0, Digitization, And Opportunities for Sustainability. *Journal of Cleaner Production*, 252, 119869. DOI: <https://doi.org/10.1016/j.jclepro.2019.119869> .
- [22] Saythongkeo, V., Le, V. D., & Tran, L. T. T. (2022). Leadership Styles and Innovation Performance: The Role of Coopetition Capability and In-Learning in Financial Service Firms. *SAGE Open*, 12(2). DOI: <https://doi.org/10.1177/21582440221079901> .
- [23] Li, J., Li, X., Huang, Y., & Yu, K. (2022). How Does Digital Leadership Affect Employee Creativity? The Mediating Role of Digital Entrepreneurial Orientation. *Technological Forecasting and Social Change*, 174, 121293. DOI: <https://doi.org/10.1016/j.techfore.2021.121293> .
- [24] Dirani, K. M., Abadi, M., Alizadeh, A., Barhate, B., Garza, R. C., Gunasekara, N., ... & Majzun, Z. (2020). Leadership Competencies And The Essential Role of Human Resource Development In Times of Crisis: A Response To COVID-19 Pandemic. *Human Resource Development International*, 23(4), 380–394. DOI: <https://doi.org/10.1080/13678868.2020.1780078> .
- [25] Wieland, A., Handfield, R. B., & Durach, C. F. (2021). Mapping The Landscape of Future Research Themes In Supply Chain Management. *Journal of Business Logistics*, 42(2), 133–138. DOI: <https://doi.org/10.1111/jbl.12265> .
- [26] Lewis, S. (2015, July 11). Qualitative Inquiry and Research Design: Choosing Among Five Approaches. Health Promotion Practice. SAGE Publications Inc. DOI: <https://doi.org/10.1177/1524839915580941> .
- [27] Kallio, H., Pietilä, A. M., Johnson, M., & Kangasniemi, M. (2016). Systematic Methodological Review: Developing A Framework for A Qualitative Semi-Structured Interview Guide. *Journal of Advanced Nursing*, 72(12), 2954–2965. DOI: <https://doi.org/10.1111/jan.13031> .
- [28] Palinkas, L. A., Horwitz, S. M., Green, C. A., Wisdom, J. P., Duan, N., & Hoagwood, K. (2015). Purposeful Sampling For Qualitative Data Collection and Analysis In Mixed Method Implementation Research. *Administration and Policy in Mental Health and Mental Health Services Research*, 42(5), 533–544. DOI: <https://doi.org/10.1007/s10488-013-0528-y> .
- [29] Braun, V., & Clarke, V. (2006). Using Thematic Analysis In Psychology. *Qualitative Research in Psychology*, 3(2), 77–101. DOI: <https://doi.org/10.1191/1478088706qp0630a> .
- [30] Jacobson, D. (2019). Naturalistic Inquiry. In *International Encyclopedia of Human Geography, Second Edition* (pp. 267–272). Elsevier. DOI: <https://doi.org/10.1016/B978-0-08-102295-5.10579-7> .
- [31] Orb, A., Eisenhauer, L., & Wynaden, D. (2001). Ethics in Qualitative Research. *Journal of Nursing Scholarship*, 33(1), 93–96. DOI: <https://doi.org/10.1111/j.1547-5069.2001.00093.x> .