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The Influence of Transformational Leadership on Intergenerational Employee Resilience Through Technological Innovation in Industry 5.0

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A B S T R A K

Pesatnya perkembangan teknologi digital dan keberagaman generasi dalam angkatan kerja telah meningkatkan kebutuhan akan karyawan yang tangguh (*resilient*) di era Industri 5.0. Penelitian ini bertujuan untuk menguji pengaruh kepemimpinan transformasional terhadap resiliensi karyawan lintas generasi melalui inovasi teknologi sebagai variabel mediasi. Pendekatan eksplanatori kuantitatif digunakan dengan menggunakan data survei yang dikumpulkan dari 100 karyawan Media Cooperation yang dipilih melalui *convenience sampling* dari total populasi sebanyak 256 karyawan. Data dianalisis menggunakan *Structural Equation Modeling–Partial Least Squares* (SEM-PLS).

Hasil penelitian menunjukkan bahwa kepemimpinan transformasional berpengaruh positif dan signifikan terhadap inovasi teknologi dan resiliensi karyawan. Inovasi teknologi juga berpengaruh signifikan terhadap resiliensi karyawan dan memediasi hubungan antara kepemimpinan transformasional dan resiliensi karyawan. Temuan ini menunjukkan bahwa pemimpin transformasional yang mempromosikan inovasi dan mendukung adaptasi digital lebih mampu memperkuat kapasitas adaptif karyawan dalam tenaga kerja multigenerasi. Penelitian ini menyoroti pentingnya kepemimpinan yang berpusat pada manusia (*human-centered leadership*) dan inovasi dalam menumbuhkan resiliensi organisasi. Sebagai kesimpulan, kepemimpinan transformasional yang didukung oleh inovasi teknologi merupakan pendorong utama resiliensi karyawan dalam organisasi yang berorientasi pada Industri 5.0.

Kata Kunci : Kepemimpinan Transformasional, Inovasi Teknologi, Resiliensi Karyawan, Tenaga Kerja Multigenerasi, Industri 5.0

A B S T R A C T

The rapid development of digital technology and generational diversity in the workforce has increased the need for resilient employees in the era of Industry 5.0. This study aims to examine the effect of transformational leadership on employee resilience across generations through technological innovation as a mediating variable. A quantitative explanatory approach was employed using survey data collected from 100 employees of Media Cooperation selected through convenience sampling from a population of 256 employees. Data were analysed using Structural Equation Modeling–Partial Least Squares (SEM-PLS). The results indicate that transformational leadership has a positive and significant effect on technological innovation and employee resilience. Technological innovation also significantly influences employee resilience and mediates the relationship between transformational leadership and employee resilience. These findings suggest that transformational leaders who promote innovation and support digital adaptation are more capable of strengthening employees' adaptive capacity in a multigenerational workforce. The study highlights the importance of human-centered leadership and innovation in fostering organizational resilience. In conclusion, transformational leadership, supported by technological innovation, is a key driver of employee resilience in Industry 5.0-oriented organizations.

Keywords: Transformational Leadership, Technological Innovation, Employee Resilience, Multigenerational Workforce, Industry 5.0

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1. INTRODUCTION

Changes in the global work environment over the past decade have demonstrated increasingly complex dynamics due to accelerated digitalization, economic uncertainty, and shifts in workforce demographic structures (Ahsan & Khawaja, 2024). Organizations are no longer required solely to achieve operational efficiency, but also to maintain the sustainability of human resource performance amid continuous pressure from change (Alsaqer & Ali, 2025). This condition positions humans as strategic elements that must be managed adaptively and with a long-term orientation within modern organizational systems (Sabbah, 2024). These challenges become more pronounced when organizations face generational workforce diversity characterized by differing values, expectations, and adaptation patterns. Therefore, managerial approaches capable of unifying these differences while strengthening employee resilience have become an unavoidable necessity.

With the emergence of Industry 5.0, the paradigm of industrial development has shifted from technology dominance toward a more human-centered approach. Industry 5.0 emphasizes balance between the utilization of advanced technologies and human values, sustainability, and organizational resilience (Boudreaux, 2024). This concept has been widely promoted in policies and strategic discourses developed by the European Commission, which positions humans as active partners of technology rather than mere objects of automation. In this context, the success of industrial transformation depends heavily on employees' psychological readiness and adaptive capacity in responding to changes in work systems. Consequently, employee resilience becomes a crucial factor in ensuring organizational survival and growth amid rapid structural changes.

Employee resilience is not only related to individuals' ability to withstand work-related pressures, but also reflects their capacity to adapt to technological changes, work system transformations, and new competency demands (Zaman, 2025). Resilient employees tend to exhibit cognitive flexibility, emotional endurance, and continuous learning readiness within dynamic work environments (Bataineh et al., 2025). However, resilience levels are not always uniform, particularly in organizations composed of multigenerational employees. Each generation possesses distinct social experiences, technological exposure, and work cultures, which influence how they respond to change. These differences have the potential to create adaptation gaps if they are not managed appropriately.

Generational diversity in the workplace carries strategic implications for organizational leadership. Senior generations generally possess high levels of experience and job stability, yet they may encounter challenges in adopting new technologies (Kurniawan, 2025). Conversely, younger generations tend to be more technologically adaptive, but they often hold higher expectations regarding work meaning and organizational support (Ramadhan et al., 2025). This situation requires leaders to bridge differences in values, communication patterns, and work styles across generations. Without effective leadership, these differences risk reducing team cohesion and weakening overall organizational resilience.

In addressing these challenges, transformational leadership is regarded as one of the leadership approaches most relevant to contexts of change and diversity. This leadership style emphasizes leaders' ability to build a shared vision, provide inspiration, and encourage individual potential development (Normi et al., 2025). The concept of transformational leadership was first introduced by James MacGregor Burns and later further developed by Bernard M. Bass, emphasizing leaders' roles in transforming followers' values and motivations. In organizational practice, transformational leaders focus not only on short-term performance targets, but also on strengthening employees' adaptive capacities (Ahmed et al., 2025). This approach becomes increasingly important as organizations undergo transformation toward technology-based work systems.

Leadership transformation cannot be separated from the role of technological innovation in modern organizations. Technological innovation has significantly changed work processes, communication patterns, and decision-making mechanisms within organizations (Nasir et al., 2022). The adoption of new technologies requires employees to continuously learn and adjust to dynamic and digitally driven systems (Thoopkerd & Apisakkul, 2022). Under these conditions, leadership plays a strategic role in creating an innovation-supportive climate, reducing resistance to change, and building employees' trust in technology (Wijaya et al., 2025). With appropriate leadership support, technological innovation can become a source of empowerment rather than pressure for multigenerational employees.

Overall, the dynamics of Industry 5.0, generational workforce diversity, and accelerated technological innovation shape a new landscape in human resource management. Organizations are required not only to adopt technology, but also to ensure that humans remain at the center of every transformation process (Salam & Wijaya, 2024). In this context, leadership that integrates human values with technological innovation becomes a key factor in building employee resilience (Suryani & Dwiputra, 2025). Multigenerational employee resilience does not emerge automatically, but is formed through interactions among leadership styles, work environments, and the technological systems employed (Gutu et al., 2022). Therefore, a deeper understanding of the relationship between transformational leadership, technological innovation, and employee resilience is increasingly relevant in addressing contemporary organizational challenges.

Previous studies indicate that employee and organizational resilience are strongly influenced by leadership styles and work environment dynamics characterized by technological change. Senbeto and Hon (2021) found that employee resilience in technologically turbulent environments develops through crisis leadership capable of managing tensions between stability and change. Bai et al. (2025) demonstrated that transformational leadership significantly affects organizational resilience through the strengthening of dual innovation, namely exploratory and exploitative innovation. Meanwhile, Yu and Xiang (2024) showed that transformational leadership directly enhances organizational resilience and team innovation performance, supported by mediating and moderating mechanisms that reinforce intervariable relationships.

Furthermore, several studies emphasize the importance of innovation and digital transformation as mechanisms for strengthening resilience. Salam et al. (2025) found that the effect of transformational leadership on business resilience is indirect, operating through innovation capability and competitive advantage. He et al. (2023) revealed that digital transformation plays a strategic role in building organizational resilience by enhancing structural flexibility and adaptive capabilities. Meanwhile, Pratiwi et al. (2025) emphasized that transformational leadership within the Leadership 4.0 framework enhances employee engagement as a foundation for organizational readiness in facing Industry 5.0 challenges.

Although numerous studies have examined the relationships among transformational leadership, innovation, and resilience, most research still focuses on organizational or team levels without explicitly considering differences in multigenerational employee characteristics. Additionally, existing studies are largely grounded in Industry 4.0 or general digital transformation frameworks, leaving the Industry 5.0 perspective, which emphasizes human–technology collaboration and human values, relatively underexplored. Prior research also tends to position innovation as an outcome variable rather than as a mediating mechanism in building employee resilience. These limitations indicate opportunities to deepen understanding of how transformational leadership operates indirectly through technological innovation. Therefore, a more integrative and contextual approach is needed to examine employee resilience in the contemporary industrial era.

Based on these research gaps, this study is directed at examining the effect of transformational leadership on multigenerational employee resilience through technological innovation within the context of Industry 5.0. This study aims to provide both conceptual and empirical insights into effective leadership mechanisms in addressing generational diversity and technological acceleration. Theoretically, this research is expected to enrich leadership and organizational behaviour literature by integrating Industry 5.0 perspectives with multigenerational employee resilience. Practically, the findings are anticipated to serve as a reference for organizational leaders in designing more human-centered leadership and innovation strategies. Thus, this study is expected to make a meaningful contribution to strengthening human resource resilience amid increasingly complex work environment changes.

2. RESEARCH METHODS

This study employs a quantitative approach with an explanatory research design to examine the causal relationships among transformational leadership, technological innovation, and multigenerational employee resilience within the context of Industry 5.0. The quantitative approach is selected because it enables objective hypothesis testing through statistical analysis based on numerical data. Explanatory research aims to clarify both direct and indirect effects among variables formulated

in the conceptual model. Data were collected at a single point in time, making this study cross-sectional in nature. The analysis focuses on employees' perceptions of leadership, technological innovation, and work resilience.

The population of this study consists of all employees of Media Coorporation, totaling 256 individuals. From this population, a sample of 100 respondents was selected and considered sufficient for analysis using Partial Least Squares based Structural Equation Modeling. The sampling technique applied was convenience sampling, namely the selection of respondents based on accessibility and employees' willingness to participate in the study. This technique was chosen in consideration of time constraints, access limitations, and organizational conditions. Although non-probabilistic in nature, convenience sampling is deemed appropriate for organizational research with operational limitations. The sample size meets the minimum requirement for SEM-PLS, which is more than ten times the largest number of structural paths in the model.

The research instrument used was a structured questionnaire developed based on variable indicators aligned with the theoretical framework. Transformational leadership was measured using four main indicators, namely idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration. Technological innovation was measured through indicators of technology adoption capability, organizational support for digital innovation, utilization of technology in work processes, and openness to system updates. Multigenerational employee resilience was measured through indicators of adaptability to change, endurance in facing work pressure, learning flexibility, and readiness to face technological challenges. All indicators were measured using a five-point Likert scale, ranging from 1, strongly disagree, to 5, strongly agree.

Data collection was conducted directly by distributing questionnaires to respondents who met the criteria as active employees of Media Corporation. Prior to analysis, the collected data were examined for completeness to ensure the absence of invalid responses. Descriptive statistical analysis was used to provide an overview of respondent characteristics and response distributions. Subsequently, data were analysed at the latent construct level in accordance with the specified measurement model and structural model. The entire analytical process was carried out systematically to maintain the validity and reliability of the research findings.

Data analysis in this study employed Partial Least Squares Structural Equation Modelling using the SmartPLS software. SEM-PLS was chosen because it is capable of testing complex models involving latent variables and does not require normally distributed data. The stages of analysis included evaluation of the measurement model, or outer model, through tests of convergent validity, discriminant validity, and construct reliability, as well as evaluation of the structural model, or inner model, through assessment of path coefficients, R-squared values, and the significance of intervariable relationships. In addition, mediation effect testing of technological innovation was conducted to examine the role of this variable in strengthening the relationship between transformational leadership and multigenerational employee resilience. The results of these analyses form the basis for drawing conclusions and research implications. The research model is visualized in Figure 1.

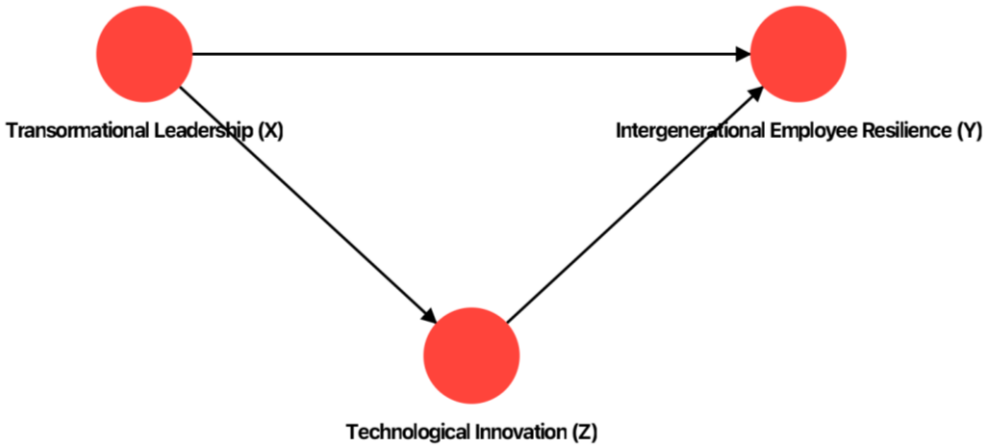

Figure 1. Research Model

3. RESULTS AND DISCUSSION

A. Results

This section presents the characteristics of the respondents as an initial step in explaining the profile of the research data analysed.

Table 1. General Characteristics of Respondents

Category	Subcategory	Frequency	Percentage (%)
Gender	Male	58	58.0
	Female	42	42.0
Age	≤ 30 years	34	34.0
	31–40 years	41	41.0
	> 40 years	25	25.0
Generation	Generation Z	28	28.0
	Generation Y (Millennial)	44	44.0
	Generation X	28	28.0
Length of Service	≤ 5 years	37	37.0
	6–10 years	39	39.0
	> 10 years	24	24.0

Based on Table 1, the majority of respondents are male, with the largest age proportion falling within the range of 31 to 40 years. In terms of generation, respondents are predominantly from Generation Y or millennials, followed evenly by Generation X and Generation Z. Most respondents have a length of service between six and ten years, indicating that the majority possess sufficient work experience to assess leadership style, technological innovation, and levels of resilience within the organization. This composition reflects generational diversity that is relevant to the focus of the study. Therefore, the respondent data are considered representative for examining multigenerational employee resilience.

The research data were subsequently analysed using the Structural Equation Modelling Partial Least Squares approach with the assistance of SmartPLS software. The resulting output is visualized in Figure 1.

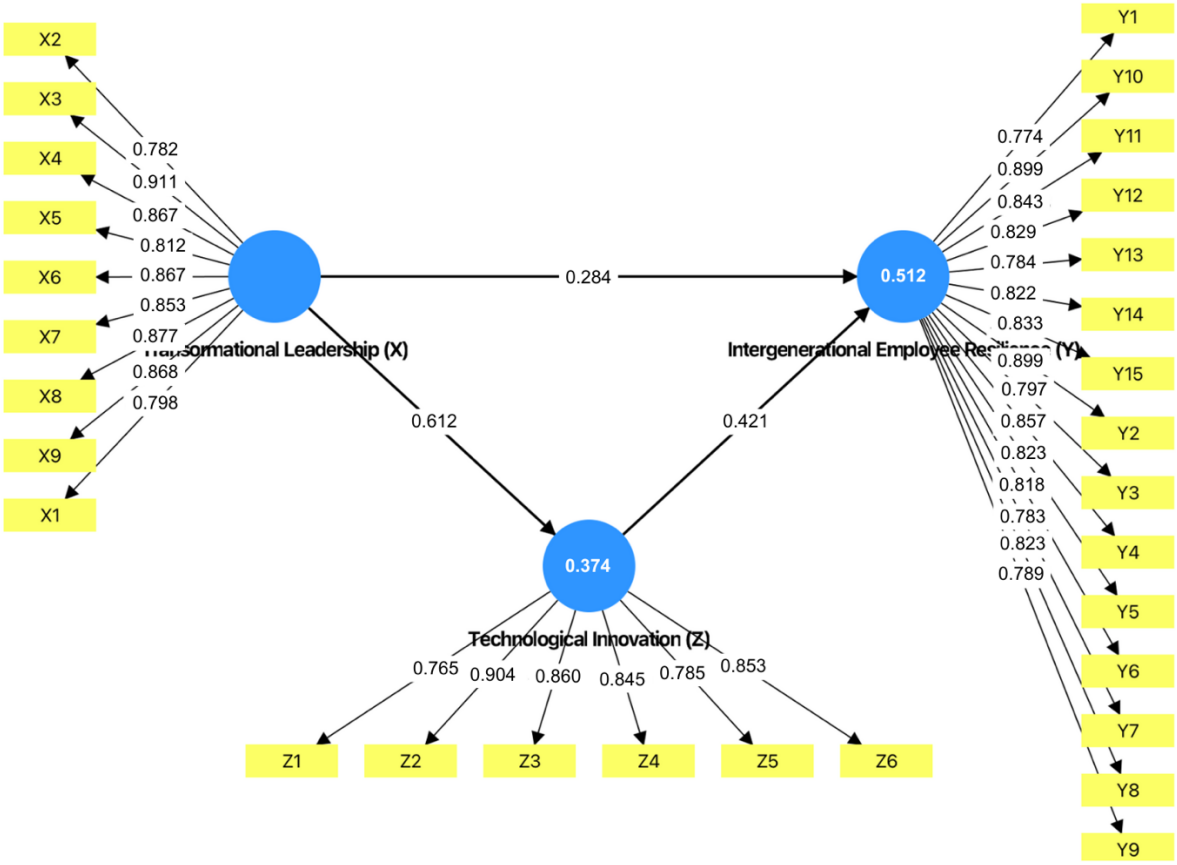

Figure 2. Results of SEM-PLS Analysis

The research model illustrates the structural relationships among transformational leadership as the independent variable, technological innovation as the mediating variable, and multigenerational employee resilience as the dependent variable. The direction of the arrows in the model represents the causal relationships tested, including both direct and indirect effects. The displayed path coefficient values reflect the strength and direction of influence among variables. In addition, the R-square values for the endogenous variables indicate the proportion of variance explained by the exogenous variables in the model. Overall, this structural model provides empirical evidence of the mechanism through which transformational leadership strengthens employee resilience via technological innovation.

Before testing the structural relationships, the data were first subjected to an outer model evaluation to assess the validity and reliability of the measurement constructs.

Table 2. Results of Outer Model Evaluation

Variable	Items	Outer Loading	AVE	Composite Reliability
Transformational Leadership (X)	X1.1–X1.12	0.782–0.911	0.648	0.943
Technological Innovation (M)	M1.1–M1.8	0.765–0.904	0.631	0.928
Employee Resilience (Y)	Y1.1–Y1.10	0.774–0.899	0.659	0.936

The results of the outer model evaluation indicate that all indicators have outer loading values above the minimum threshold of 0.70, thus meeting the criteria for convergent validity. The Average Variance Extracted values for all variables also exceed 0.50, indicating that each construct explains more than half of the variance of its indicators. In addition, the composite reliability values for all variables are above 0.70, demonstrating strong internal consistency. Therefore, all constructs in this study are declared valid and reliable for use in subsequent analyses.

Discriminant validity evaluation was conducted to ensure that each construct in the model is empirically distinct and does not overlap in measurement.

Table 3. Discriminant Validity (Fornell–Larcker and HTMT)

Variable	Transformational Leadership	Technological Innovation	Employee Resilience
Transformational Leadership	**(0.805)**	0.742	0.781
Technological Innovation	0.684	**(0.794)**	0.768
Employee Resilience	0.701	0.719	**(0.812)**

The diagonal values shown in parentheses represent the square root of the AVE for each variable, while the values below the diagonal indicate correlations among constructs. The values above the diagonal represent the Heterotrait–Monotrait ratio. The results indicate that all square root AVE values are greater than the inter-construct correlations, and all HTMT values are below the threshold of 0.90. These findings demonstrate that each construct has adequate discriminant validity and measures distinct concepts empirically. Therefore, discriminant validity in this research model is confirmed.

Significance testing was conducted to assess the strength and direction of the relationships among variables in the structural model.

Table 4. Results of Path Significance Testing

Relationship Between Variables	Path Coefficient (β)	t-statistic	p-value
X→ Z	0.612	8.734	0.000
X → Y	0.284	3.126	0.002
Z → Y	0.421	5.987	0.000

The results of the significance test indicate that all relationships among variables have t-statistic values greater than 1.96 and p-values below 0.05. This indicates that transformational leadership has a positive and significant effect on technological innovation and multigenerational employee resilience. In addition, technological innovation is also proven to have a significant effect on employee resilience. These findings confirm that technological innovation plays an important role as a mediating mechanism in the relationship between transformational leadership and employee resilience.

Indirect effect testing was conducted to examine the role of technological innovation as a mediating variable in the relationship between transformational leadership and multigenerational employee resilience.

Table 5. Results of Indirect Effect Testing

Indirect Relationship	Indirect Coefficient (β)	t-statistic	p-value
X → Z → Y	0.258	4.912	0.000

The results indicate that the indirect path from transformational leadership to employee resilience through technological innovation has a positive coefficient value of 0.258, with a t-statistic greater than 1.96 and a p-value below 0.05. These findings indicate that technological innovation plays a significant mediating role in the research model. In other words, the influence of transformational leadership on multigenerational employee resilience does not occur solely through direct effects, but is also strengthened through increased technological innovation within the organization. This result emphasizes the importance of leadership that promotes the utilization of technology as a means of strengthening employees' adaptive capacity.

The R-square value is used to assess the extent to which exogenous variables explain variation in endogenous variables within the research model analysed using SmartPLS.

Table 6. R-Square Values

Endogenous Variable	R-Square
Technological Innovation	0.374
Employee Resilience	0.512

An R-square value of 0.374 indicates that transformational leadership explains 37.4 percent of the variance in technological innovation. Meanwhile, an R-square value of 0.512 indicates that transformational leadership and technological innovation jointly explain 51.2 percent of the variance in multigenerational employee resilience. Based on SEM-PLS evaluation criteria, these values are categorized as moderate to strong, indicating that the research model has adequate predictive capability. These results reinforce that the combination of transformational leadership and technological innovation is an important factor in building employee resilience in the Industry 5.0 era.

B. Discussion

The results of this study indicate that transformational leadership has a positive and significant effect on employee resilience across generations, highlighting the critical role of leadership in strengthening individuals' adaptive capacity amid dynamic work environments. This finding is consistent with Senbeto and Hon (2021), who emphasize that leadership responsiveness to crisis and technological turbulence can enhance employee resilience. Transformational leaders contribute to creating alignment between organizational demands and employees' psychological capacities. In a multigenerational context, such leadership becomes increasingly important due to differences in experience and readiness for change. Therefore, transformational leadership can be regarded as a fundamental foundation for sustaining employee resilience.

The findings also confirm that transformational leadership positively influences technological innovation within organizations. This result supports the study by Bai et al. (2025), which demonstrates that transformational leadership fosters innovation as a strategic mechanism for enhancing organizational resilience. Leaders who provide inspiration and intellectual stimulation are more effective in encouraging the adoption and development of new technologies. Technological innovation in this context is not merely an outcome, but a process shaped by leadership values and behaviors. Consequently, transformational leadership functions as a catalyst for building an innovative culture that is adaptive to change.

Furthermore, this study finds that technological innovation significantly enhances employee resilience. This result aligns with He et al. (2023), who argue that digital transformation strengthens organizational resilience by improving flexibility and adaptive capabilities. Technological innovation enables employees to work more efficiently, responsively, and confidently in the face of disruption. Within the Industry 5.0 paradigm, technology is not only an automation tool but also a means of human empowerment. Therefore, technological innovation directly contributes to strengthening resilience among employees across generations.

The indirect effect analysis reveals that technological innovation mediates the relationship between transformational leadership and employee resilience. This finding is consistent with Salam et al. (2025), who demonstrate that the influence of transformational leadership on resilience occurs indirectly through innovation mechanisms. This mediating role indicates that leadership effectiveness alone is insufficient without adequate technological and systemic support. Technological innovation serves as a bridge that connects leadership vision with employees' adaptive capacity. Thus, the effectiveness of transformational leadership in fostering resilience is highly dependent on how well organizations manage technological innovation.

In the context of multigenerational workforces and Industry 5.0, the findings of this study extend existing insights on transformational leadership. The results support Pratiwi et al. (2025), who assert that transformational leadership remains highly relevant in enhancing employee engagement and readiness in the Industry 5.0 era. In addition, the findings align with Kent and Darmasetiawan (2023), who highlight the role of transformational leadership in bridging generational gaps in the workplace. Human-centered leadership enables the harmonious integration of values, technology, and generational diversity. Therefore, transformational leadership emerges as a strategic approach for managing multigenerational human resources.

Despite its contributions, this study has several limitations that should be acknowledged. The use of convenience sampling within a single organization limits the generalizability of the findings, as also noted by Tayal et al. (2018). Moreover, the cross-sectional research design restricts the ability to capture changes in employee resilience over time, as suggested by Yu and Xiang (2024). This study also does not incorporate additional variables such as organizational culture or employee innovative behaviour, which could further enrich the research model, as indicated by Sibassaha et al. (2025) and Bux et al. (2025). Therefore, future research is recommended to adopt longitudinal designs, involve organizations across multiple sectors, and expand the research constructs to achieve a more comprehensive understanding of employee resilience in the digital transformation era.

4. CONCLUSION

This study demonstrates that transformational leadership plays a significant role in enhancing employee resilience across generations within the context of Industry 5.0. The findings indicate that transformational leadership has a positive and direct effect on employee resilience, as well as an indirect effect through technological innovation. Leaders who inspire, intellectually stimulate, and provide individualized consideration are able to foster a work environment that supports adaptability and psychological strength among employees from different generational cohorts. Furthermore, technological innovation was proven to function as an effective mediating mechanism that strengthens the relationship between leadership and resilience. These results confirm that resilience in multigenerational organizations is not formed solely through individual capacity, but through the interaction between leadership practices and technology-driven work systems. Overall, the model exhibits a moderate to strong explanatory power, indicating that transformational leadership and technological innovation are critical determinants of employee resilience in contemporary organizations.

The findings of this study provide important theoretical and practical implications. From a theoretical perspective, this research enriches the leadership and organizational behaviour literature by integrating transformational leadership, technological innovation, and employee resilience within the emerging framework of Industry 5.0. It also extends prior studies by emphasizing multigenerational employee contexts and the mediating role of technological innovation. Practically, the results suggest that organizations should prioritize the development of transformational leadership competencies to strengthen employee resilience amid technological change. Managers are encouraged to actively support digital innovation, provide continuous learning opportunities, and foster an inclusive environment that accommodates generational diversity. By aligning leadership practices with human-centered technological innovation, organizations can enhance their workforce's adaptability, sustainability, and long-term performance.

Based on the findings, future research is recommended to explore this model in different organizational sectors and cultural contexts to enhance generalizability. Subsequent studies may also incorporate additional variables such as organizational culture, psychological capital, or digital readiness to deepen the understanding of resilience formation. Longitudinal research designs are suggested to capture changes in employee resilience over time. From a managerial standpoint, organizations should invest in leadership development programs that emphasize transformational values and technological awareness. Additionally, structured digital training initiatives tailored to different generational needs are recommended to ensure that technological innovation becomes a source of empowerment rather than stress for employees.

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