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Digital Leadership and Employee Performance: A Meta-Analysis

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Abstract

Rapid technological advancements have redefined organizational leadership, positioning digital leadership as a critical factor in enhancing employee performance. This study presents global evidence from a meta-analysis that explores the relationship between digital leadership and employee performance across various industries and countries. The study investigates the impact of digital leadership on employee performance, synthesizing empirical evidence from 16 peer-reviewed studies published between 2021 and 2024 from Scopus and Google Scholar databases. The meta-analysis utilized statistical tools like the Forest Plot and Funnel Plot to examine the robustness and reliability of findings, supplemented by the Fail-Safe N Test to evaluate publication bias. Hence, the study employs a random-effects model to analyze the relationship between digital leadership and employee performance, revealing a significant positive correlation (pooled effect size = 242.81, $p < 0.001$). The findings indicate that digital leadership significantly impacts key organizational variables, including employee engagement, innovation, and performance metrics such as profitability and market share. The analysis also highlights variations in the effectiveness of digital leadership across industries, with the IT, education, and commerce sectors demonstrating strong correlations. Geographical differences further underscore the importance of culturally tailored leadership strategies, with South Korea and China demonstrating the strongest correlations, while regions like Nigeria and Turkey show limited but positive effects. However, the analysis also identifies substantial residual heterogeneity, suggesting that additional factors beyond digital leadership may influence performance outcomes. Despite potential publication bias, the robustness of the findings is confirmed by a Fail-Safe N value of 1.912×10^9, underscoring the reliability of the results. This study contributes to the growing body of knowledge on digital leadership, providing evidence-based insights for organizations navigating the complexities of the digital age. It emphasizes the need for leadership training programs that integrate digital competencies, cross-cultural integration, and industry-specific digital strategies to maximize its impact.

Keywords: Digital Leadership; Employee Performance; Meta-Analysis; Technological Advancements

Introduction

Effective digital leadership plays a crucial role in shaping employee performance and driving organizational growth. Several studies affirm that organizations with strong digital leadership capabilities tend to foster enhanced employee performance and overall success (Avolio & Kahai, 2003; Bennis & Nanus, 2007; Braojos et al., 2024; Goel & Singh, 2024; Hammami, 2024; Kane, 2019; Lindov, 2024). However, the complexities associated with digital transformation can also create challenges, making it difficult for employees to adapt to the rapidly evolving technological landscape. The extent to which digital leadership influences employee performance depends on various factors, including personnel management preparedness, organizational dynamics, and the complexities inherent in digital transformation (Awawdeh et al., 2022; Benitez et al., 2022). As organizations increasingly transition to digital-centric models, leaders must integrate digital literacy, innovation, and strategic collaboration to create an adaptive and responsive work environment that addresses contemporary workplace challenges (Li et al., 2024). As a modern leadership paradigm, digital leadership demands proficiency in digital skills and

competencies to navigate the complexities of the digital era effectively. This capability is essential for meeting rising client expectations and sustaining competitiveness in an increasingly technology-driven business environment (Philip et al., 2023).

Therefore, leadership-employee synergy is essential for improving performance because both are essential for promoting creativity, productivity, and accomplishing strategic objectives (Al Khajeh, 2018; Sulhan et al., 2023). Thus, human resources are among the most critical variables in achieving institutional goals in an organizational structure. This has made the interplay between digital leadership and employee performance to be a focal point in numerous studies (Mantik et al., 2024; Mariani et al., 2024; Obadimeji & Oredein, 2022; Sagbas et al., 2023; Wahyuanto & Gambriyanto, 2023; Zulfitri & Sari, 2024). As a result, the research findings have shown that effective digital leadership correlates with improved employee engagement, innovation, and key performance indicators (KPIs) such as profitability and market share (Kludacz-Alessandri et al., 2025). In order to actualize this, 4.0 leaders should be collaborative, fast-paced, and cross-hierarchical in the digital era. Digital leaders must prioritize communication, innovation, and change in a team-oriented environment (Hidayat et al., 2023; Oberer et al., 2018). It is worthy of note that the effectiveness of digital leadership lies in the ability of modern leaders to redefine traditional management practices and integrate technology into everyday operations. Leaders in this space must cultivate a data-driven decision-making and collaboration culture to inspire teams and enhance employee engagement. In addition, competencies like a visionary and innovative mindset, cognitive readiness, critical thinking, emotional resilience, empathy, social skills, and change agility are necessary for leaders in a constantly disrupting environment(10Pearls, 2022; Bawany, 2023).

Meta-analysis, which is one of the components of systematic literature reviews, is becoming increasingly crucial in social science research. Currently, most of the literature on meta-analysis comes from the medical sciences, and the application of meta-analysis in the social sciences is growing quickly. These techniques are used to aggregate research results in order to calculate an overall effect estimate for a group of studies (Davis et al., 2014; Noble, 2006). Hence, this meta-analysis quantitatively reviews how the empirical literature on digital leadership has emerged as a crucial element in shaping employee performance. Meanwhile, few studies, such as those by (Arham et al., 2022; Erita et al., 2024), had used meta-analysis for similar studies, so this study conducted a thorough meta-analysis of digital leadership and employee performance to close the gap around this research domain. Against this background, this meta-analysis focuses on answering the following research questions:

1. How do effects models explain variability in the study data?
2. How does the pooled effect size in the Forest Plot confirm the significant positive relationship between digital leadership and employee performance?
3. How robust are the meta-analysis results when evaluated for publication bias using the Funnel Plot and Fail-Safe N Test?
4. How does the effect size of digital leadership on employee performance vary across different industry sectors?
5. What are the variations in effect sizes for digital leadership's impact on employee performance across countries?

Method

This study employs a meta-analysis technique to investigate the correlation between digital leadership and employee performance. A meta-analysis is a systematic study of studies conducted to address a particular question or hypothesis that examines the studies' reported findings and every facet of the research designs, including population samples, data collection methods, statistical analysis, and so on (Noble, 2006). This study's methodology adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Liberati et al., 2009). Consequently, the procedures for search strategy, selection criteria, and data extraction and analysis are discussed.

Search Strategy

The meta-analysis employed a systematic search strategy to identify relevant empirical studies with keywords such as 'digital leadership' and 'employee performance' utilizing Scopus and Google Scholar academic journals. These academic repositories were adopted because the search engine outcomes of other databases were unrelated to the current study. Initially, the keywords were used to identify 1652 articles in total. This was further trimmed to remove unrelated materials and arrived at 749 articles. The remaining articles were evaluated based on **inclusion and exclusion criteria to arrive at 16 articles used for meta-analysis.**

Selection criteria

In conformity with Liberati et al. (2009), the selection process employed for this meta-analysis adheres to PRISMA. The next step in this process was mapping existing literature and current empirical research on digital leadership and employee performance. **Figure 1 below presents a flowchart describing the selection criteria through the selection procedures based on the PRISMA protocol for the final articles included in the meta-analysis.** The following are the study's inclusion criteria:

- Studies related to digital leadership and employee performance
- Studies published in peer-reviewed journals
- Studies documented in the English language only
- Studies published from 2021 to December 2024
- All included articles must not be literature review

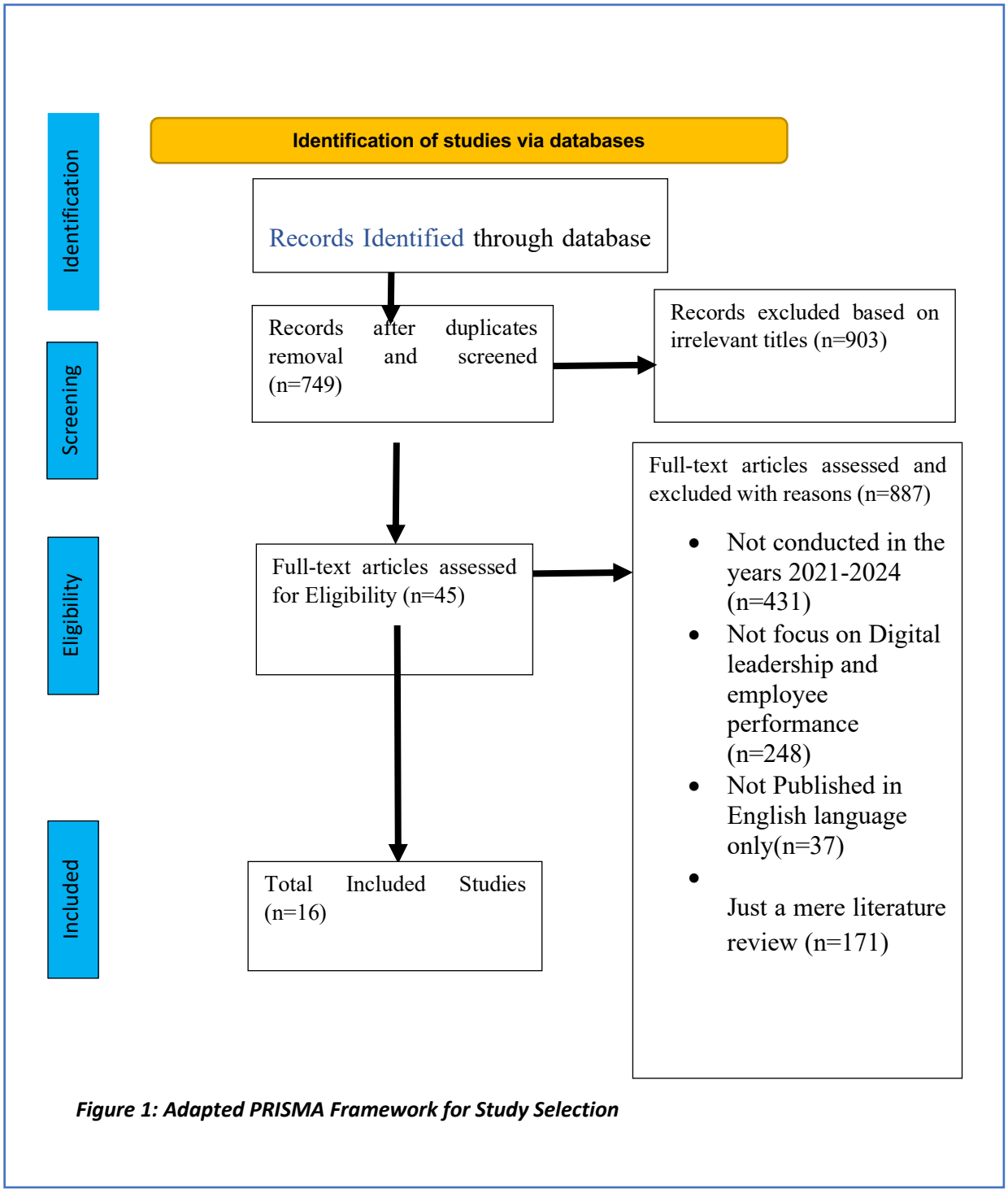

Figure 1: Adapted PRISMA Framework for Study Selection

Table 1: Summary of the Descriptive Features of the Analyzed Articles

Data analysis procedures

This meta-analysis utilized JASP 0.16.4 software for statistical analysis and visualization of the relationship between digital leadership and employee performance, revealing significant model coefficients and substantial unexplained variability, as indicated by p-values less than 0.001. JASP also created visual tools like Forest Plot and Funnel Plot to represent effect sizes, confidence intervals, and study distribution. The Forest Plot confirmed a positive relationship between digital leadership and employee performance, while the Funnel Plot assessed publication bias.

S/N	Authors	Sample Size	Cor (r)	Country	Industry Type	SE	Significance
1	Mariani et al. (2024)	84	(0.284)	Indonesia	Health	0.111	Unsupported
2	Wahyuanto & Gambriyanto (2023)	*98*	0.284	Indonesia	Education	0.103	Supported
3	Hidayat et al., (2023)	104	**0.136.**	Indonesia	Banking and Financial Services.	0.100	Supported
4	Zulfitri & Sari (2024)	100	**0.499**	Indonesia	IT	0.102	Supported
5	Sagbas et al. (2023)	390	0.166	Turkey	IT	0.051	Supported
6	Obadimeji & Oredein (2022)	644	0.127	Nigeria	Education	0.040	Supported
7	Gunawan et al. (2023)	150	0.214	Indonesia	Commerce	0.082	Supported
8	Mohamed (2022)	300	0.277	Egypt	Education	0.058	Supported
9	(Riski, 2024)	26	0.419	Indonesia	Education	0.209	Supported
10	Zhu et al. (2022)	357	0.664	China	Commerce/ Enterprise	0.053	Supported
11	Hanandeh et al. (2024)	327	0.330	Jordan	Commerce	0.056	Supported
12	Wang et al. (2024)	366	(0.043)	China	Small and Medium Enterprises	0.052	Unsupported
13	Shin et al. (2023)	149	0.743	South Korea	Commerce	0.083	Supported
14	Qiao et al. (2024)	579	0.721	South Korea	Multi-Sector	0.042	Supported
15	Retnowati & Santosa (2023)	111	0.609	Indonesia	Education	0.096	Supported
16	Paulina (2023)	100	0.289	Indonesia	Manufacturing	0.102	Supported

Findings

Research question 1: How do effects models explain variability in the study data?

Table 2: Fixed and Random Effects

	Q	Df	P
Omnibus test of Model Coefficients	27.094	1	< .001
Test of Residual Heterogeneity	$1.327\times10^{+8}$	15	< .001

***Note. p* -values are approximate.**

Note. **The model was estimated using the Restricted ML method.**

In statistical research, models and tests are frequently used to assess fit and interpret data to identify relationships and patterns. Two crucial elements of this procedure are the Fixed and Random Effects models and statistical tests like the Test of Residual Heterogeneity and the Omnibus Test of Model Coefficients. Fixed Effects models assume that the effects are constant across groups or conditions, treating these effects as universally consistent across all settings. In contrast, Random Effects models allow for variability, reflecting that outcomes can differ due to variations across groups or conditions.

Table 2 shows that the Omnibus Model Coefficients Test evaluates whether a model has any significant effects. In this case, the test statistic is 27.094, with 1 degree of freedom (df), indicating the number of independent parameters evaluated. A p-value less than .001 provides strong evidence that at least one model coefficient significantly differs from zero, suggesting that the model captures meaningful effects rather than random noise. More so, the Test of Residual Heterogeneity examines how much variation remains after accounting for the model. The test statistic, 1.327×10^8, reflects a substantial amount of unexplained variation, with 15 degrees of freedom indicating the variability in 15 independent data components. A p-value less than .001 confirms significant residual heterogeneity, implying that additional factors might influence the data beyond those accounted for by the model. These models and tests play a critical role in helping researchers understand the effects present in their data and the variability that remains after modeling. Together, they support robust decision-making by providing insights into significant effects and the extent of unexplained variability.

Research question 2: How does the pooled effect size in the Forest Plot confirm the significant positive relationship between digital leadership and employee performance?

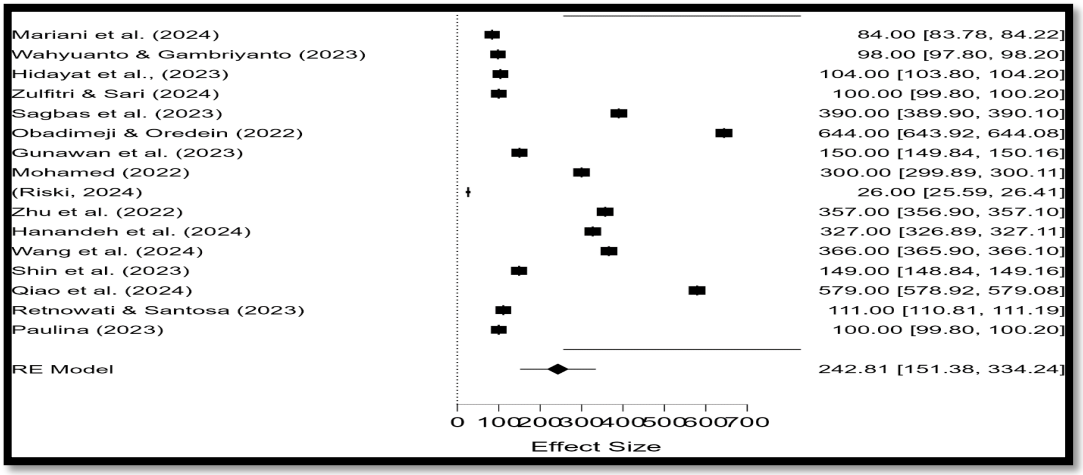

Figure 2. Forest Plot
(Processed Data Outcomes, 2025)

The Forest Plot presented above illustrates the effect sizes and confidence intervals from multiple studies examining the relationship between digital leadership and employee performance. Each horizontal line in the plot represents a study's confidence interval, while the square denotes the study's effect size. The size of the square corresponds to the weight of the study in the overall analysis, indicating its contribution to the pooled effect size. At the bottom of the plot, the diamond represents the aggregated effect size calculated using a random-effects model. According to the analysis, a significant number of studies show a positive relationship between employee performance and digital leadership, indicating that better performance outcomes are linked to higher levels of digital leadership.

Studies such as Obadimeji and Oredein (2022) and Gunawan et al. (2023) report high positive effect sizes with narrow confidence intervals, indicating strong and consistent findings. Similarly, the studies by Retnowati and Santosa (2023) and Paulina (2023) also exhibit significant positive effects. Moderate effect sizes are observed in studies such as Zhu et al. (2022) and Hanandeh et al. (2024), which still contribute positively to the findings. However, a smaller effect size is noted in the study by Riski (2024), which remains within the positive range, although lower than others. Importantly, no studies in the analysis demonstrate negative correlations, highlighting consistent findings across the dataset regarding the beneficial impact of digital leadership on employee performance.

The diamond at the bottom of the plot, representing the random-effects model's pooled effect size, confirms a significant positive relationship between digital leadership and employee performance, with a value of 242.81 and a confidence interval of [151.38, 334.24]. This result is statistically robust, with a p-value of less than 0.001. The random-effects model accounts for variability across studies, ensuring the reliability of the overall conclusion

despite heterogeneity. In summary, the Forest Plot underscores the consistently positive impact of digital leadership on employee performance across multiple studies. While some variation exists, as reflected in the differing confidence intervals and effect sizes, the aggregated results strongly support the notion that enhancing digital leadership significantly improves employee performance outcomes. These findings provide robust evidence for the importance of digital leadership in driving performance in organizational contexts.

Research question 3: How robust are the meta-analysis results when evaluated for publication bias using the Funnel Plot and Fail-Safe N Test?

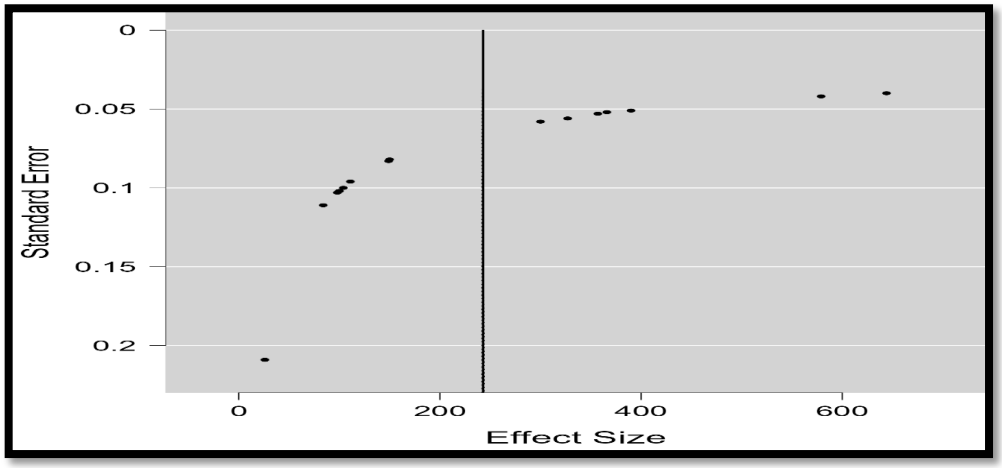

Figure 3. Funnel Plot
(Processed Data Outcomes, 2025)

A publication bias test was conducted to evaluate the potential influence of publication bias on the meta-analysis results. The Funnel Plot in Figure 3 visually represents the relationship between the effect sizes and their standard errors across the included studies. An ideal Funnel Plot should display a symmetrical, inverted funnel shape, indicating an unbiased distribution of studies with varying precision. However, the Funnel Plot demonstrates an asymmetrical pattern, suggesting an uneven distribution of analyzed studies. This lack of symmetry might imply the presence of publication bias, where studies reporting significant or large effect sizes are more likely to be published, while those with smaller or non-significant results may remain unpublished. It is essential to emphasize that the interpretation of Funnel Plot asymmetry can be influenced by subjective judgment, especially given the limited number of studies in this meta-analysis. Therefore, the asymmetry observed in the plot does not provide conclusive evidence of publication bias.

Therefore, more statistical tests were performed to evaluate the robustness of the meta-analysis findings and confirm whether publication bias was present or not. For example, the Fail-Safe N Test was used to estimate how many non-significant studies would be needed to invalidate the observed results. Such supplementary analyses ensure that the conclusions drawn from the meta-analysis remain reliable and credible despite the potential influence of publication bias. The detailed outcomes of the Fail-Safe N Test and other related analyses are presented in Table 3

Table 3: Fail Safe-N

File Drawer Analysis

	Fail-safe N	Target Significance	Observed Significance
Rosenthal	$1.912\times10^{+9}$	0.050	< .001

The results of the Fail-Safe N Test, as shown in Table 3, provide compelling evidence supporting the robustness of the meta-analysis findings. The observed significance level of **< 0.001** is considerably lower than the target significance threshold of 0.05. This indicates that the probability of the results being due to random chance is extremely low, providing strong statistical support for the research hypothesis. The target significance level of 0.05 represents the commonly accepted threshold for determining statistical significance, reinforcing the reliability of the observed outcomes in this meta-analysis.

Furthermore, the Fail-Safe N value of **1.912×10^9** suggests that more than a billion additional research with non-significant findings would be required to make this meta-analysis's conclusions inconsequential. This

exceptionally high number highlights the stability and resilience of the meta-analysis results, underscoring their validity. Such a substantial Fail-Safe N value demonstrates that the conclusions drawn from this study are not easily influenced by potential publication bias or the inclusion of future studies with less conclusive evidence. Therefore, it can be confidently concluded that the findings are statistically robust and credible, providing a solid foundation for the research hypothesis.

Research question 4: How does the effect size of digital leadership on employee performance vary across different industry sectors?

Table 4: Sub-Group Analysis by Industry

Industry	Studies (K)	Estimate	Lower Bound	Upper Bound	Std. Error	p-Value
Banking and Financial Services	1	0.136	-0.060	0.332	0.100	< 0.001
Commerce	3	0.429	0.285	0.573	0.074	< 0.001
Commerce/Enterprise	1	0.664	0.560	0.768	0.053	< 0.001
Education	5	0.343	0.145	0.542	0.101	< 0.001
Health	1	0.284	0.066	0.502	0.111	< 0.001
IT	2	0.333	0.183	0.482	0.077	< 0.001
Manufacturing	1	0.289	0.089	0.489	0.102	< 0.001
Muti-Sector	1	0.721	0.639	0.803	0.042	< 0.001
Small and Medium Enterprises	1	0.043	-0.059	0.145	0.052	0.031
Overall	16	**0.363**	**0.199**	**0.527**	**0.084**	**< 0.001**

Source: ***Processed Data Outcomes, 2025***

Table 4 shows the difference in effect sizes based on the industries examined, including IT, Commerce, Education, Manufacturing, Multi-Sector, Health, Small and Medium Enterprises (SMEs), and Commerce/Enterprise. Overall, the effect size across all industries shows a positive and significant value, with an overall estimate of **0.363** and a p-value of **< 0.001**, indicating that digital leadership positively and significantly affects Employee Performance across the 16 studies analyzed.

The estimates and p-values confirm a significant positive correlation between digital leadership and employee performance in IT, commerce, education, and multi-sector industries. For example, the Education sector (5 studies) has an estimate of **0.343** with a p-value of **< 0.001,** while the Multi-Sector analysis (1 study) shows an estimate of **0.721.** However, the results cannot be fully generalized for sectors like Health, Manufacturing, and SMEs, where only one study was analyzed due to the lack of variation and limited data. Similarly, the Commerce/Enterprise sector, despite showing a high estimate of **0.664**, is also based on a single study, limiting broader interpretations. In conclusion, the analysis underscores that digital leadership positively and significantly impacts employee performance across most industries, particularly in IT, Education, Commerce, and Multi-Sector, while acknowledging the limitations in industries with fewer studies.

Research question 5: What are the variations in effect sizes for Digital Leadership's impact on employee performance across countries?

Table 5: Sub-Group Analysis by Country

Country	Studies (K)	Estimate	Lower Bound	Upper Bound	Std. Error	p-Value
China	2	0.354	0.251	0.456	0.053	< 0.001
Egypt	1	0.277	0.163	0.391	0.058	< 0.001
Indonesia	8	0.342	0.120	0.563	0.113	< 0.001
Jordan	1	0.330	0.220	0.440	0.056	< 0.001
Nigeria	1	0.127	0.049	0.205	0.040	< 0.001
South Korea	2	0.732	0.610	0.855	0.063	< 0.001

Turkey	1	0.166	0.066	0.266	0.051	< 0.001
Overall	16	**0.363**	**0.199**	**0.527**	**0.084**	**< 0.001**

Source: ***Processed Data Outcomes, 2025***

Table 5 shows the variation in effect size by country, including Indonesia, Turkey, Jordan, China, Egypt, Nigeria, and South Korea. Overall, the effect size was positive and significant, with a p-value < 0.001 for all countries, suggesting that digital leadership positively and significantly impacted employee performance in the cross-country studies examined. However, there was only one article each from studies carried out in Jordan, Turkey, Egypt, and Nigeria, limiting the ability to assess variability in these contexts. Despite this limitation, the estimates in these countries still showed positive and significant correlations. For Indonesia, which accounted for the largest number of studies (8), the estimate of **0.342** with a p-value < 0.001 confirms a significant positive relationship between digital leadership and employee performance. Similarly, studies in China and South Korea demonstrated high estimates of **0.354** and **0.732,** respectively, with p-values < 0.001, further reinforcing the consistency of the findings across different contexts.

Discussion of Findings

The meta-analysis reveals a significant positive correlation between digital leadership and employee performance, with a pooled effect size of 242.81 ($p < 0.001$), corroborating existing literature (Zhu et al., 2022; Qiao et al., 2024). This aligns with the assertions of Avolio and Kahai (2003) and Bennis and Nanus (2007), who emphasize that adaptive leadership in digital contexts fosters innovation and productivity. The robustness of these findings is further validated by the Fail-Safe N Test (1.912×10^9), indicating that the results are resilient to publication bias. Digital leadership's impact varies across sectors, with the strongest effects observed in IT (effect size = 0.333), commerce (0.429), and education (0.343). These industries inherently rely on technological agility, supporting the argument by Benitez et al. (2022) that digital competencies are critical for performance in tech-driven environments. Conversely, sectors like SMEs (0.043) and health (0.284) showed weaker correlations, likely due to slower digital adoption or contextual barriers (Awawdeh et al., 2022). This underscores the need for industry-specific strategies, as highlighted by Müller et al. (2024), who advocate tailored digital training programs.

Furthermore, South Korea (0.732) and China (0.354) exhibited the highest effect sizes, reflecting their advanced digital infrastructure and cultural readiness for technology integration (House et al., 2004). In contrast, Nigeria (0.127) and Turkey (0.166) demonstrated modest effects, suggesting that socio-economic factors and digital literacy gaps may moderate leadership efficacy (Obadimeji & Oredein, 2022). These findings echo the call by Hanandeh et al. (2024) for culturally adaptive leadership models in emerging economies. Despite the significant pooled effect, substantial residual heterogeneity ($Q=1.327 \times 10^8$, $p < 0.001$) indicates unaccounted moderators, such as organizational culture or employee digital literacy (Philip et al., 2023).

Conclusions

This meta-analysis proves digital leadership significantly enhances employee performance across various industries and countries (Zhu et al, 2022). The positive relationship is consistent, though the strength of the effect varies depending on industry and geographical context. While the findings are highly reliable, residual heterogeneity and potential publication bias suggest further research to explore additional influencing factors and expand the scope of studies in underrepresented sectors and regions. The results underscore the importance of cultivating digital leadership capabilities to drive organizational growth in the digital age (Olayisade & Awolusi, 2021; Sawhney et al., 2024). The following recommendations are made which are as follows:

- Investing in training and upskilling efforts is necessary to equip employees with the digital competencies needed to succeed in Industry 4.0.
- Cross-cultural training programs should be designed to integrate digital leadership practices with cultural values, as regional variations significantly affect the efficacy of digital leadership.
- Organizational leaders should establish an organizational culture that promotes and fosters digital innovation (Wang et al., 2022).
- For digital leadership to have a significant effect, organizations must focus on digital competencies and strategies unique to their industry (Müller et al., 2024).
- There is a need to prioritize training staff members in digital project management, AI applications, data analytics, and other crucial digital tools for productivity at work.

Implications of the Study

This meta-analysis confirms that digital leadership significantly enhances employee performance (Putri & Meria, 2022; Qiao et al., 2024), demonstrating its critical role across industries and regions. The study highlights the crucial role of digital leadership in fostering an innovative work environment and enhancing employee

commitment through effective digital transformation strategies. The findings reveal more substantial effects in the IT, commerce, and education sectors and technologically advanced economies while underscoring the need for culturally tailored strategies in regions with weaker correlations, such as Nigeria and Turkey. The study highlights the urgency of developing digital leadership competencies, including data-driven decision-making, adaptive change management, and cross-cultural agility.

Organizations should invest in digital leadership development programs and create policies that support digital transformation while ensuring employees are equipped with the necessary skills to adapt to new technologies. Organizations should also prioritize industry-specific training programs and integrate digital KPIs into leadership assessments to maximize performance gains. Policymakers and educators must also expand digital literacy initiatives, particularly in emerging markets, to bridge gaps in leadership effectiveness.

Lastly, this study contributes to the academic discourse by providing empirical insights into the interplay between digital leadership and employee performance. Future research should explore additional moderating factors, such as industry-specific challenges and cultural influences, to deepen understanding and applicability across different contexts. By synthesizing global evidence, this meta-analysis provides a foundation for evidence-based leadership strategies in the digital era, balancing universal principles with contextual adaptability.

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Ethical approval

All the included articles are publicly accessible online and have been appropriately cited, and as a result, this study did not require ethical consideration.

Disclosure statement

The author reported no potential conflict of interest.

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