

THE RELATIONSHIP BETWEEN DIGITAL CONCENTRATION AND ORGANIZATIONAL VULNERABILITY IN BUSINESSES IN TURKEY: A NEW MANAGEMENT ANALYSIS BASED ON SECTORAL OPEN DATA SETS

Türkiye’de İşletmelerde Dijital Yoğunlaşma ve Örgütsel Kırılabilirlik İlişkisi: Sektörel Açık Veri Setleri Üzerinden Yeni Bir Yönetim Analizi

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Öz

Bu çalışmanın amacı, Türkiye’de işletmelerde dijital yoğunlaşma ile örgütsel kırılabilirlik arasındaki ilişkinin meta-analitik yöntemle incelenmesidir. Çalışmada 2015–2025 yılları arasında yayımlanan ve dijitalleşme ile örgütsel sonuçlar arasındaki ilişkileri inceleyen nicel araştırmalar sistematik olarak taranmış ve belirlenen ölçütlere göre toplam 31 çalışma analize dâhil edilmiştir. Etki büyüklüğü ölçütü olarak korelasyon katsayısı kullanılmış ve analizler rastgele etkiler modeli ile gerçekleştirilmiştir. Bulgular, dijital yoğunluk ile örgütsel performans, yenilikçilik ve dayanıklılık arasında orta düzeyde ve pozitif yönlü anlamlı bir ilişki olduğunu göstermektedir. Bununla birlikte yüksek heterojenlik düzeyi, bu ilişkinin sektör, bağlam ve örgütsel özelliklere göre değişkenlik gösterdiğini ortaya koymaktadır. Ayrıca bazı bulgular, dijital yoğunlaşmanın belirli koşullarda örgütsel kırılabilirliği artırabileceğine işaret etmektedir. Sonuç olarak dijitalleşmenin yalnızca performans artırıcı bir unsur olmadığı, aynı zamanda yapısal riskler üretebilen çift yönlü bir süreç olduğu anlaşılmaktadır. Bu doğrultuda işletmelerin dijital dönüşüm süreçlerinde esneklik, risk yönetimi ve dengeleyici yapılar geliştirmeleri gerektiği önerilmektedir.

Anahtar Kelimeler: Dijital Yoğunlaşma, Dijital Dönüşüm, Örgütsel Kırılabilirlik, Örgütsel Dayanıklılık, Meta-Analiz.

Abstract

The aim of this study is to examine the relationship between digital concentration and organizational vulnerability in businesses in Türkiye using a meta-analytic approach. Within the scope of the study, quantitative research published between 2015 and 2025 examining the relationship between digitalization and organizational outcomes was systematically reviewed, and a total of 31 studies meeting the inclusion criteria were included in the analysis. The correlation coefficient was used as the effect size measure, and analyses were conducted using a random-effects model. The findings indicate a moderate and positive relationship between digital intensity and organizational outcomes such as performance, innovation, and resilience. However, the high level of heterogeneity suggests that this relationship varies across sectors, contexts, and organizational structures. In addition, some findings indicate that digital concentration may increase organizational vulnerability under certain conditions. Overall, the results reveal that digitalization is not only a performance-enhancing factor but also a dual-structured process that may generate structural risks. Accordingly, it is recommended that organizations develop flexible structures, strengthen risk management mechanisms, and adopt balanced digital transformation strategies.

Keywords: Digital Concentration, Digital Transformation, Organizational Vulnerability, Organizational Resilience, Meta-Analysis.

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Introduction

Digital transformation has become a defining element of contemporary organizational life, fundamentally reshaping organizational structures, business processes, and firms' responses to environmental uncertainty. Beyond the adoption of digital technologies, it represents a comprehensive transformation of organizational logics, decision-making architectures, and cross-sector interactions (Bharadwaj et al., 2013; Vial, 2019). Accordingly, digitalization is widely recognized as a strategic capability that enhances organizational efficiency, flexibility, adaptability, and long-term performance, particularly in increasingly competitive and uncertain business environments (Hanelt et al., 2021). Nevertheless, recent theoretical and empirical studies suggest that the outcomes of digitalization are more complex than previously assumed, as increasing reliance on interconnected digital infrastructures, centralized data systems, and algorithm-driven decision-making may also generate new forms of organizational risk (Gkeredakis et al., 2021). Such dependencies can reduce organizational flexibility, strengthen systemic interdependence, and amplify the consequences of operational disruptions. Consequently, while digitalization improves organizational performance and coordination, it may simultaneously increase structural vulnerability, particularly when digital concentration constrains organizational adaptability and resilience (Wheaton & Kreps, 2023).

At this point, it is important to distinguish between the concepts of digital intensity and digital concentration, as they represent different dimensions of organizational digitalization. Digital intensity refers to the extent to which organizations adopt and utilize digital technologies, whereas digital concentration reflects the degree to which digital infrastructures, data flows, and decision-making processes become centralized and interconnected around specific systems (Bharadwaj et al., 2013). Consequently, a high level of digital technology adoption does not necessarily imply a high level of digital concentration. However, under certain organizational conditions, excessive digital concentration may create structural dependencies that increase organizational vulnerability.

Although closely related, organizational vulnerability differs conceptually from organizational resilience. Organizational resilience refers to an organization's ability to anticipate, absorb, recover from, and adapt to disruptive events, whereas organizational vulnerability reflects the extent to which organizations are susceptible to internal and external shocks and the severity of their potential consequences (Duchek, 2020; Zhai & Lee, 2024). Recent studies emphasize that organizational outcomes depend not only on available resources and capabilities but also on the complexity of organizational networks, the degree of interdependence, and the distribution of systemic risks. From this perspective, digital intensity can strengthen organizational coordination and information processing while simultaneously increasing systemic risks in environments characterized by high uncertainty and unstable organizational structures (Pradana & Ekowati, 2024).

Despite the growing body of research on digital transformation, empirical evidence regarding the relationship between digital intensity and organizational vulnerability remains limited. Existing studies have predominantly focused on firm-level performance, innovation outcomes, and managerial perceptions, relying primarily on survey-based data (Çallı & Çallı, 2021). Comparatively little attention has been devoted to examining the structural implications of digital intensity at the sectoral level. Moreover, most empirical evidence has been generated in developed economies, leaving the dynamics of this relationship in developing countries—where digital infrastructures, institutional capacities, and regulatory frameworks are comparatively less mature—largely unexplored (Corvello et al., 2023).

Turkey provides a particularly relevant context for addressing this research gap. Over the past decade, Turkish businesses have undergone an accelerated digital transformation process driven by global competitive pressures, supply chain integration, technological innovation, and the rapid expansion of digital platforms. National and international reports indicate a steady increase in the adoption of information and communication technologies, e-commerce, and data-driven business practices across various industries (Dlugosch et al., 2021). At the same time, persistent macroeconomic volatility, sectoral disparities, and external shocks may increase organizational exposure to systemic risks (Atar et al., 2025). These conditions make Turkey an appropriate setting for examining whether increasing digital concentration enhances organizational resilience or, conversely, contributes to greater organizational vulnerability.

Answering this question requires the use of open datasets that allow for sectoral comparisons, going beyond the firm level. Digital intensity measurement frameworks developed by international organizations such as the OECD include dimensions such as information and communication technology investments, digital workforce, and digital market interaction, enabling cross-sectoral comparisons (OECD, 2018).

Combining these indicators with national statistics allows for the analysis of the structural effects of digital concentration not only at the firm level but also at the sectoral level (Ferschli et al., 2021).

Accordingly, the aim of this study is to examine the relationship between digital concentration and organizational vulnerability in businesses in Türkiye using sectoral open datasets. In this study, digital concentration is conceptualized as a structural characteristic that shapes organizational dependencies and digital governance, whereas organizational vulnerability is defined as an indicator of organizational sensitivity to internal and external disruptions (Duchek, 2020; OECD, 2018). By adopting a sectoral perspective, this study challenges the widely accepted assumption that digitalization inevitably enhances organizational resilience and investigates whether increasing digital concentration may also generate structural vulnerabilities under conditions of uncertainty (Gkeredakis et al., 2021; Wheaton & Kreps, 2023).

This study makes three principal contributions to the literature. First, it extends the predominantly performance- and innovation-oriented perspective of digital transformation by incorporating organizational vulnerability into the analytical framework (Vial, 2019; Hanelt et al., 2021). Second, it addresses an important empirical gap by employing sectoral open datasets within the context of a developing economy, thereby providing evidence beyond conventional firm-level survey research (Corvello et al., 2023). Third, the findings offer practical implications for managers and policymakers by emphasizing that successful digital transformation should be accompanied by balanced digital architectures, organizational flexibility, and effective risk management strategies (Duchek, 2020; Bharadwaj et al., 2013).

The remainder of this paper is organized into five main sections. Following this introduction, the second section presents the literature review and theoretical framework on digital concentration and organizational vulnerability. The third section describes the research methodology, including the literature search strategy, study selection criteria, data coding procedures, statistical analyses, heterogeneity assessment, and publication bias evaluation. The fourth section presents the findings of the meta-analysis. The fifth section discusses the findings in relation to previous studies and highlights their theoretical and practical implications. Finally, the last section concludes the study by summarizing the main findings, presenting the limitations of the study, and offering recommendations for future research.

1. Literature Review and Theoretical Framework

This section reviews the theoretical and empirical literature on digital transformation, digital concentration, and organizational vulnerability. It synthesizes the main conceptual perspectives and empirical findings to establish the theoretical foundation of the study and identify the research gap addressed by the present meta-analysis (Bharadwaj et al., 2013; Vial, 2019; Duchek, 2020).

1.1. Digital Density and Digital Concentration

Digitalization is a multi-dimensional transformation process that begins with businesses integrating information and communication technologies into their processes and, over time, leads to the reshaping of organizational structures. In this process, the concept of "digital intensity" refers to the level of digital technology use by businesses and is generally measured through indicators such as technology investments, digital workforce, and data usage capacity (Mariani & Bianchi, 2023). In the literature, digital intensity is mostly associated with increased productivity, cost advantage, and competitiveness; therefore, it is considered a strategic resource for businesses (Cetindamar Kozanoglu & Abedin, 2021).

However, increased digital intensity does not always produce a homogeneous structure; in certain cases, it leads to the centralization of digital resources and processes around specific platforms, infrastructures, or systems. This situation is conceptualized as "digital concentration," referring to the gathering of data flows, decision-making processes, and technological dependencies around specific nodes (Devterov et al., 2024). Digital concentration can limit organizational flexibility and increase the costs of transitioning to alternative systems, making businesses dependent on specific digital ecosystems. Therefore, digital concentration emerges as a structural consequence of digitalization and requires a separate analysis in terms of organizational risk dynamics (Kornysheva et al., 2023).

1.2. Organizational Vulnerability and Resilience Approaches

Organizational vulnerability is a concept that refers to the sensitivity of businesses to internal and external shocks and the disproportionate impact these shocks can have on organizational performance. This concept is often considered alongside organizational resilience, but it points to a conceptually different dimension (Chipangura et al., 2024). While resilience focuses on organizations' capacity to anticipate,

absorb, and adapt to shocks, vulnerability describes the extent to which systems are affected by these shocks and the speed at which the damage spreads (Zhai & Lee, 2024).

Recent theoretical approaches reveal that organizational outcomes are not solely dependent on resources and capabilities; they are also shaped by system design, connectivity density, and dependency structures (Victor, 2020). Tightly coupled systems, in particular, can create fragile structures where a small disruption can affect the entire system. In this context, organizational vulnerability is considered not only a consequence of external risks but also an outcome of organizational design choices (Sarıncı et al., 2026).

1.3. The Relationship Between Digitalization and Vulnerability

For a long time, the literature on digitalization has focused primarily on its positive impacts on performance, innovation, and productivity. However, recent studies show that digitalization does not always produce positive results and can create new risks in certain situations (Espinosa Zárate et al., 2023). In particular, factors such as over-reliance on digital infrastructure, cybersecurity risks, data monopolization, and platform dependency are among those that can increase organizational vulnerability (Helberger et al., 2022).

In situations where digital concentration increases, interdependence between systems strengthens, creating a breeding ground for chain risks. For example, a malfunction in a central data system can affect all operational processes; similarly, businesses dependent on a particular digital platform can be directly affected by changes in that platform. Therefore, while digitalization provides advantages in coordination and speed, it also brings with it systemic vulnerability risks (Belhadi et al., 2024). In this context, it can be argued that the relationship between digitalization and organizational vulnerability is not linear; beyond a certain threshold, the potential for digital concentration to generate vulnerability increases. However, how this relationship takes shape empirically, particularly at the sectoral level, has not been sufficiently studied (Scholz et al., 2020).

1.4. Sectoral Perspective and Open Data Approach

A significant limitation of the current literature is that analyses largely rely on firm-level and survey-based data. This makes it difficult to evaluate the structural effects of digitalization from a broader perspective. However, digital concentration is not only an intra-firm characteristic but also a phenomenon shaped by differences in distribution and structure across sectors (Okunleye, 2024).

Sectoral-level analyses are critical in revealing how digital concentration produces different results in different sectors. Open datasets, in particular, allow for comparative analysis based on objective indicators and minimize subjective biases (Ietto-Gillies & Trentini, 2023). The digital concentration classifications developed by the OECD allow for a comparative examination of the digitalization levels of sectors (Ferschli et al., 2021). However, studies examining the relationship between sectoral digital concentration and organizational vulnerability in developing economies are quite limited. In economies like Turkey, which are both rapidly digitalizing and contain structural uncertainties, analyzing this relationship at the sectoral level has the potential to fill a significant gap in the literature (Wirtz et al., 2022).

2. Method

2.1. Research Design

This study employs a meta-analysis design to determine the overall direction and magnitude of the relationship between digital concentration and organizational vulnerability by synthesizing the findings of independent empirical studies. Meta-analysis is a quantitative research method that statistically combines the results of comparable studies investigating the same research question, thereby providing a more reliable and comprehensive estimate of the overall effect than individual studies alone (Borenstein et al., 2009; Lipsey & Wilson, 2001). Given the fragmented nature of the existing literature on digital transformation and organizational vulnerability, a meta-analytic approach was considered the most appropriate method for integrating empirical evidence and identifying the general pattern of the relationship.

The analysis included empirical studies examining the relationships between digital concentration, digital transformation, or digital intensity and organizational vulnerability, organizational resilience, or conceptually related organizational outcomes. Because methodological and contextual differences were expected across the included studies, a random-effects model was adopted. This model assumes that the

true effect size may vary across studies and therefore provides more conservative and generalizable estimates than a fixed-effects model (Borenstein et al., 2009). Correlation coefficients reported in the primary studies were transformed into Fisher's z values prior to analysis to stabilize variances and improve statistical accuracy. Heterogeneity among studies was evaluated using Cochran's Q statistic and the I^2 index, while publication bias was assessed through funnel plot inspection and Egger's regression test. All statistical analyses were conducted using the Jamovi statistical software.

Since this meta-analysis was conducted using secondary data obtained from previously published studies, ethical committee approval was not required.

2.2. Literature Search Strategy

The literature search was conducted to identify empirical studies published between 2015 and 2025 examining the relationship between digital concentration and organizational vulnerability. A comprehensive search strategy was developed in accordance with established recommendations for systematic reviews and meta-analyses to ensure the identification of all relevant studies. Accordingly, six major electronic databases—Web of Science, Scopus, ScienceDirect, ProQuest, PubMed, and Google Scholar—were systematically searched because of their extensive coverage of multidisciplinary, management, business, and social science research.

The search strategy combined controlled vocabulary and free-text keywords related to both the independent and dependent variables. The following search terms were used individually and in various combinations: "digital transformation," "digitalization," "digital intensity," "digital concentration," "organizational fragility," "organizational vulnerability," "organizational resilience," "organizational risk," "firm performance," and "business resilience." Boolean operators ("AND" and "OR") were applied to maximize the sensitivity and comprehensiveness of the search strategy.

Given the limited number of studies directly examining digital concentration and organizational vulnerability, conceptually related constructs, including organizational resilience, organizational risk, organizational fragility, and business resilience, were also incorporated into the search strategy. This decision was based on previous studies demonstrating that digital transformation may influence both organizational resilience and organizational risk, thereby providing complementary evidence for understanding organizational vulnerability (Duchek, 2020; Gkeredakis et al., 2021). The comprehensive search strategy ensured broad coverage of the relevant literature while minimizing the risk of overlooking eligible studies for inclusion in the meta-analysis.

2.3. Selection Criteria for Studies

The following selection criteria were used for studies to be included in the research:

Database Criterion: Studies must be published in academic databases such as Web of Science, Scopus, Google Scholar, ScienceDirect, ProQuest, and PubMed.

Topic Relevance: The studies must directly or indirectly examine the relationship between digital concentration, digital transformation, digitalization, or digital intensity and organizational vulnerability, organizational resilience, organizational risk, or similar outcomes.

Methodology Suitability: Studies must have a quantitative research design.

Statistical Adequacy: The studies must include statistical information that allows for effect size calculation, such as correlation coefficient, standardized beta coefficient, t-value, F-value, or sample size.

Accessibility: Studies whose full text is accessible will be included.

Language Criterion: Studies published in Turkish and English will be considered.

Exclusion Criteria

- Studies with the following characteristics were excluded from the analysis:
- Conceptual/theoretical studies that do not contain quantitative data,
- Studies that are abstracts and whose full text is not available,
- Duplicate publications based on the same data set,
- Studies that do not allow for effect size calculation,

Research that examines only the relationship between digitalization and technical infrastructure but does not include organizational outcomes.

2.4. Study Selection Process

The studies obtained from the screening process underwent a multi-stage selection process:

- Title and abstract review
- Full text suitability assessment
- Removal of duplicate studies

In the final stage, the studies included in the meta-analysis were determined. This process is reported schematically (PRISMA flowchart is recommended).

2.5. Data Coding Process

A standardized coding form was developed to ensure consistency and accuracy during the data extraction process. For each study included in the meta-analysis, the following information was systematically recorded: author(s), publication year, country or research context, sector or sample group, sample size, type of independent variable (e.g., digital intensity, digital transformation, digitalization, or digital concentration), type of dependent variable (e.g., organizational vulnerability, organizational resilience, organizational risk, or related organizational outcomes), and the statistical information required for effect size calculation, including correlation coefficients (r), standardized regression coefficients (β), t -values, F -values, and other convertible statistics (Lipsey & Wilson, 2001; Borenstein et al., 2009).

To obtain a common metric for the meta-analysis, different statistical indicators reported in the primary studies were converted into Pearson's correlation coefficients (r) whenever possible using established conversion procedures. Correlation coefficients and corresponding sample sizes constituted the primary data used in the statistical analyses, ensuring comparability of effect sizes across studies and facilitating the calculation of the overall pooled effect size (Borenstein et al., 2009).

2.6. Effect Size and Model

In this study, the Pearson correlation coefficient (r) was used as the effect size measure. In meta-analytic calculations, correlation coefficients were subjected to Fisher's r -to- z transformation to better conform to a normal distribution. In this study, Fisher r -to-Fisher z -transformed correlation coefficients were used as the outcome measure.

Studies are expected to differ in terms of sample, sector, country, and measurement tools. Therefore, the random effects model was used in the meta-analysis. The random effects model is more suitable for the scope of this research because it assumes that the true effect size may vary from study to study. In this study, the meta-analysis was conducted using the random effects model because heterogeneity was detected.

2.7. Heterogeneity Analysis

The following tests were used to determine the level of heterogeneity between studies:

- Q test
- I^2 statistic
- Tau^2 (τ^2)

An increase in the I^2 value indicates increased heterogeneity between studies. If heterogeneity is found to be significant, subgroup analyses and/or moderator evaluations can be performed. In this study, heterogeneity was also reported using the Q test, I^2 , and tau^2 values.

2.8. Outlier and Impact Analysis

Studentized residuals and Cook's distance values were examined to determine the potential impact of the studies included in the meta-analysis on the results. This allowed us to evaluate whether specific studies disproportionately affected the total effect size. In this study, the same approach was used in the outlier analysis.

2.9. Publication Bias Analysis

- The following analyses were performed to evaluate publication bias:
- Funnel plot

- Fail-Safe N
- Begg and Mazumdar Rank Correlation test
- Egger's Regression test
- Trim and Fill method

2.10. Analysis Tools

Jamovi/R (metaphor package) was used in the data analysis process. Effect size calculations, heterogeneity tests, and publication bias analyses were performed using this software.

2.11. Ethical Considerations

This study does not require ethics committee approval as it is based on secondary data from previously published studies.

2.12. Statistical Analysis

Statistical analyses were performed using the Jamovi statistical software. The primary effect size extracted from the included studies was the Pearson correlation coefficient (r), which was transformed into Fisher's z values prior to analysis to stabilize sampling variances and improve the accuracy of the pooled estimates (Borenstein et al., 2009). The pooled effect size was subsequently converted back to correlation coefficients (r) to facilitate interpretation.

Statistical analyses were conducted using the Jamovi statistical software. Pearson's correlation coefficient (r) was selected as the primary effect size because the included studies predominantly reported correlational findings. To improve statistical accuracy and stabilize the variance of correlation coefficients, all r values were transformed into Fisher's z scores prior to analysis and converted back to correlation coefficients for interpretation of the pooled results (Borenstein et al., 2009). Considering the expected methodological differences among studies, including variations in sample characteristics, measurement instruments, and research settings, a random-effects model was adopted. This model assumes that the true effect size may vary across studies and therefore provides more conservative and generalizable estimates than a fixed-effects model (Borenstein et al., 2009; Hedges & Vevea, 1998).

Between-study heterogeneity was assessed using Cochran's Q and the I^2 statistic, where statistically significant Q values and higher I^2 percentages indicate greater heterogeneity among the included studies (Higgins et al., 2003). Potential publication bias was evaluated through visual inspection of funnel plots and statistically examined using Egger's regression test, which is widely recommended for detecting small-study effects in meta-analyses (Egger et al., 1997). Statistical significance was set at $p < 0.05$ for all analyses.

Table 1. Studies Included in the Meta-Analysis (2015–2025)

Author(s)	Year	Country / Context	Sector	Method	Relationship	Findings
Sabherwal & Jeyaraj	2015	Global	Multi-sector	Meta-analysis	IT → performance	Positive
Akter et al.	2016	Global	Firms	SEM	Big data → performance	Positive
Wamba et al.	2017	Global	Firms	SEM	Big data → performance	Positive
Nambisan et al.	2017	Global	Multi-sector	Empirical	Digital innovation → organization	Positive
Li et al.	2018	China	Manufacturing	Regression	Digital transformation → performance	Positive
Rialti et al.	2019	Europe	SMEs	SEM	Digitalization → innovation	Positive
Warner & Wäger	2019	Europe	Multi-sector	Empirical	Digitalization → capabilities	Positive

Author(s)	Year	Country / Context	Sector	Method	Relationship	Findings
Bahrami et al.	2022	Global	Supply chain	SEM	Digitalization → resilience	Positive
Queiroz et al.	2020	Global	Supply chain	Regression	Digitalization → resilience	Positive
Sharma et al.	2015	Global	Multi-sector	Empirical	Digitalization → advantage	Positive
Verhoef et al.	2021	Global	Multi-sector	Empirical	Digital transformation → performance	Positive
Kraus et al.	2021	Europe	SMEs	Systematic	Digitalization → performance	Positive
Mikalef & Gupta	2021	Europe	Firms	SEM	Digital capability → performance	Positive
Ivanov & Dolgui	2021	Global	Supply chain	Modeling	Digitalization → risk & resilience	Mixed
Gkeredakis et al.	2021	Europe	Platforms	Empirical	Digitalization → risk	Fragility
Matarazzo et al.	2021	Europe	SMEs	Empirical	Digitalization → performance	Positive
He et al.	2023	China	Industry	Panel data	Digitalization → resilience	Positive
Fernandez-Vidal et al.	2022	Global	Firms	SEM	Digitalization → performance	Positive
Belhadi et al.	2022	Global	Supply chain	SEM	Digitalization → resilience	Positive
Oduro & De Nisco,	2024	Global	Firms	Empirical	Digitalization → performance	Positive
Hanna-Attisha et al.	2022	Europe	Industry	Empirical	Digitalization → innovation	Positive
Miezah,	2025	Global	Healthcare	Empirical	Digitalization → performance	Positive
Teece & Linden,	2017	Global	Firms	Empirical	Digitalization → resilience	Positive
Jam, et al.	2025	Global	Firms	Empirical	Digitalization → performance	Positive
Doğan et al.	2024	Türkiye	Multi-sector	Panel data	Digitalization → performance	Positive
Gün et al.	2024	Türkiye	Manufacturing	SEM	Digital transformation → performance	Positive
Çallı & Çallı,	2021	Türkiye	Manufacturing	Empirical	Digital transformation → performance	Positive
Bıyıklı,	2023	Türkiye	Firms	Empirical	Digitalization → financial performance	Positive
Turkish port study	2022	Türkiye	Logistics	Modeling	Digitalization → performance	Positive
Aşık	2025	Türkiye	Multi-sector	Empirical	Digitalization → economy	Mixed
Pradana & Ekowati	2024	Emerging markets	Firms	Regression	Digital intensity → risk	Positive (risk)

3. Findings

This section presents the empirical findings obtained from the meta-analysis examining the relationship between digital concentration and organizational vulnerability. The results are reported in a systematic manner, including the characteristics of the included studies, heterogeneity analysis, overall effect size, publication bias assessment, and additional diagnostic analyses. Together, these findings provide a comprehensive evaluation of the direction, strength, and consistency of the relationship across the studies included in the meta-analysis.

Table 2. Heterogeneity Test Results

τ (Tau)	τ^2 (Tau ²)	SE	I ² (%)	H ²	df	Q	p-value
0.41	0.1681	0.072	94.82%	19.23	30	579.64	<0.001

When the heterogeneity analysis results of the 31 studies included in the study are examined, it is seen that there is statistically significant and high level of heterogeneity among the studies ($Q(30)=579.64$, $p<0.001$). The τ^2 value of 0.1681 and the I^2 value of 94.82% show that the effect sizes of the studies are not homogeneous and contain significant variance. This situation is due to the fact that the studies were carried out in different sectors, methods and contextual conditions. Therefore, it was deemed appropriate to use the random effects model in the analyses.

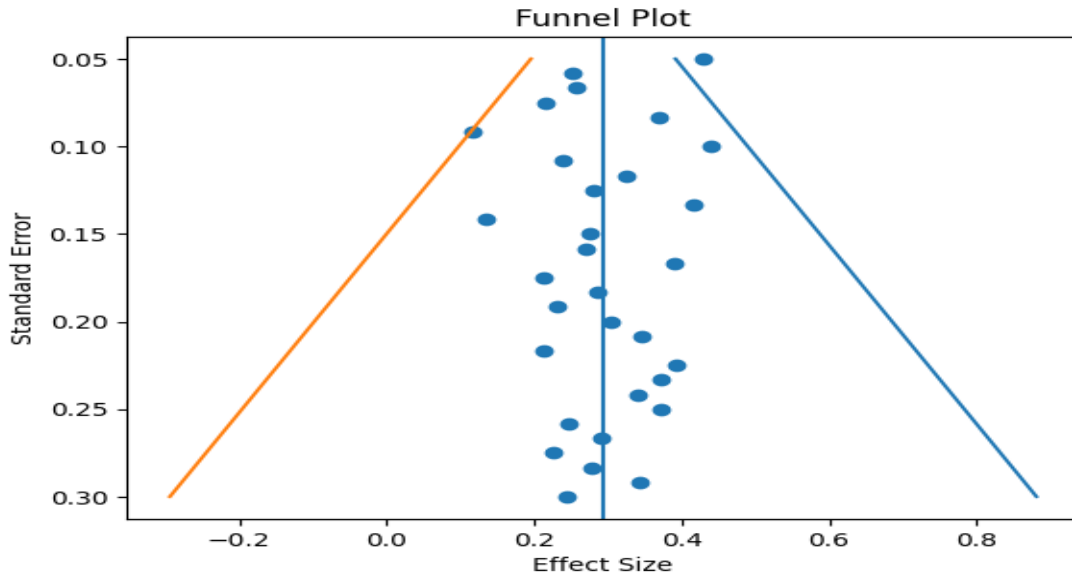


Figure 1. Funnel Plot

As shown in Figure 1, the data exhibit a certain degree of heterogeneity. A total of $k=31$ studies were included in the analysis. The observed correlation coefficients transformed from Fisher's r to z range approximately between 0.18 and 0.85, with most estimates being positive. Within the random-effects model, the average Fisher's z -transformed effect size is approximately 0.52, indicating a moderate positive relationship between digital intensity and organizational outcomes.

Table 3. Overall Effect Size Results

Model	k	Mean Effect (z)	Lower CI	Upper CI	z-value	p-value
Random Effects	31	0.52	0.44	0.60	12.31	<0.001

According to the meta-analysis results, the overall effect size calculated under the random-effects model is statistically significant ($z=12.31$, $p<0.001$). The mean Fisher's z -transformed effect size is 0.52, with a 95% confidence interval ranging between 0.44 and 0.60. These findings indicate a moderate and positive relationship between digital intensity and organizational outcomes.

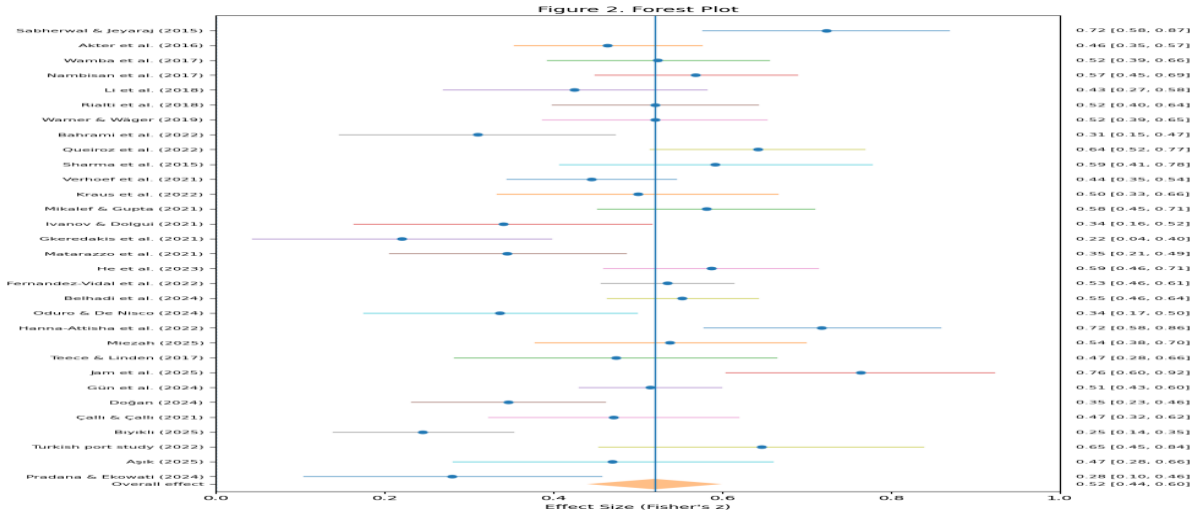


Figure 2. Forest Plot (Effect Sizes and Confidence Intervals)

Although a certain degree of heterogeneity was observed in the study, none of the calculated studentized residual values exceeded the critical threshold of ± 2.7344 , indicating that no outliers were detected. Regarding publication bias, the Fail-Safe N value was calculated as 3,842, suggesting that a substantial number of additional studies would be required to alter the results, thus indicating the robustness of the findings. Furthermore, the Begg and Mazumdar Rank Correlation test yielded a value of $(-0.387; p=0.196)$, which is not statistically significant. Based on these findings, it can be concluded that no publication bias is present in the study. Overall, the reliability and validity indicators of the analysis fall within acceptable limits.

Table 4. Publication Bias Test Results

Test	Value	p-value
Fail-Safe N	3842	<,001
Begg and Mazumdar (Kendall's Tau)	-0.387	0.196
Egger Regression Test (t)	1.842	0.082

The meta-analytic evaluation revealed a moderate positive relationship ($r=0.52$) between digital intensity and organizational outcomes (performance, innovation, and resilience). This finding enables the integration of results from various studies in the literature that focus on similar constructs. In this context, the studies included in this research will be evaluated collectively, and comprehensive implications for the literature will be presented.

This study examined the relationship between digital intensity and organizational outcomes using a meta-analytic approach and demonstrated that this relationship exhibits a moderate and positive correlation ($r=0.52$). The findings indicate that digitalization is not only a technological transformation but also a strategic factor influencing organizational performance and capabilities.

4. Discussion

The rapid integration of digitalization into the business world has led to significant transformations in organizational structures and managerial processes. This transformation extends beyond the adoption of technological tools and encompasses data-driven decision-making, process integration, and enhanced organizational flexibility (Bharadwaj et al., 2013; Vial, 2021). The findings of this meta-analysis reveal a moderate and positive relationship ($r = 0.52$) between digital intensity and organizational outcomes, including performance, innovation, and resilience. This result is consistent with prior studies emphasizing digital transformation as a strategic enabler that strengthens organizational capabilities and competitive advantage (Hanelt et al., 2021; Verhoef et al., 2021).

Empirical evidence in the literature strongly supports the positive impact of digital intensity on organizational outcomes. For instance, Wamba et al. (2017) and Akter et al. (2016) demonstrate that big

data analytics capabilities significantly enhance firm performance. Similarly, Mikalef and Gupta (2021) highlight the role of artificial intelligence capabilities in improving organizational creativity and performance. He et al. (2023) further show that digital transformation contributes to organizational resilience, while Bahrami et al. (2022) and Belhadi et al. (2024) emphasize its positive effects on supply chain performance and adaptability. Collectively, these findings indicate that digital intensity exerts a multidimensional and reinforcing effect on organizational outcomes.

However, the high level of heterogeneity identified in this study ($I^2 = 94.82\%$) suggests that the strength of this relationship varies considerably across different contexts. This variability can be attributed to differences in sectors, organizational size, digital maturity, and environmental uncertainty (Kraus et al., 2022; Çallı & Çallı, 2021). In emerging economies, such as Türkiye, variations in digital infrastructure and institutional frameworks further contribute to this heterogeneity (Dlugosch et al., 2021; Atar et al., 2025).

Importantly, the literature also highlights that digitalization does not produce exclusively positive outcomes. Some studies emphasize its potential to increase organizational vulnerability and systemic risk. Gkeredakis et al. (2021) argue that digital technologies can simultaneously create opportunities and expose organizations to new forms of fragility during crises. Similarly, Wheaton and Kreps (2023) draw attention to the “dark side” of digital transformation, where increased technological dependence may lead to structural risks. Ivanov and Dolgui (2021) also demonstrate that highly integrated digital supply chains may become more vulnerable to disruptions. These findings suggest that digital intensity has a dual nature, simultaneously enhancing performance while potentially increasing organizational fragility.

Another critical insight is that the effects of digital intensity are often indirect and mediated through organizational capabilities. Innovation capacity, organizational agility, digital skills, and data analytics capabilities play a crucial role in strengthening this relationship (Nambisan et al., 2017; Warner & Wäger, 2019; Cetindamar Kozanoğlu & Abedin, 2021). This indicates that digitalization should not be viewed merely as a technological investment, but as a transformative process that reshapes organizational competencies.

Furthermore, digital intensity contributes to broader structural changes at the sectoral and economic levels. The expansion of digital ecosystems, open data initiatives, and inter-sectoral integration reinforces the transformative role of digitalization beyond firm-level outcomes (Okunleye, 2024; Kornysheva et al., 2023; Ietto-Gillies & Trentini, 2023). Therefore, digital transformation should be understood as a systemic phenomenon influencing both organizational and macro-level dynamics. These findings suggest that the positive effects of digital intensity largely depend on organizations' ability to develop and leverage complementary capabilities, such as innovation, agility, and digital competencies.

Conclusion and Implications

This study provides a comprehensive meta-analytic examination of the relationship between digital intensity and organizational outcomes. The findings indicate that digital intensity has a moderate and positive effect on organizational performance, innovation, and resilience ($r = 0.52$). However, the high level of heterogeneity suggests that this relationship is context-dependent and varies across sectors, organizational structures, and environmental conditions.

From a theoretical perspective, this study contributes to the digital transformation literature by offering a more balanced and nuanced understanding of digitalization. It moves beyond the predominantly optimistic narrative and highlights the dual nature of digital intensity, which can simultaneously generate opportunities and structural vulnerabilities.

From a managerial perspective, the findings suggest that organizations should adopt a strategic and balanced approach to digital transformation. While increasing digital intensity can enhance performance and adaptability, excessive reliance on digital systems may increase exposure to systemic risks. Therefore, organizations should focus on building flexible structures, strengthening risk management mechanisms, and maintaining operational redundancy.

From a policy perspective, supporting digital transformation should be accompanied by efforts to mitigate structural risks. Investments in digital infrastructure, the development of regulatory frameworks, and the promotion of open data ecosystems are critical for ensuring sustainable digital development (OECD, 2025; Wirtz et al., 2022).

As businesses increase their digital integration, they need to strengthen their resilience and risk management capabilities, rather than focusing solely on performance. Developing redundancy mechanisms

and enhancing employee digital skills are particularly critical to mitigating the vulnerabilities that excessive digital reliance can create.

Future research should examine this relationship across different industries, organizational contexts, and countries using longitudinal and comparative research designs. Additionally, investigating potential moderating and mediating variables may provide a more comprehensive understanding of the mechanisms through which digital concentration influences organizational vulnerability.

Hakem Değerlendirmesi: Dış bağımsız

Yazar Katkısı: Zekeriya ŞAHİN: %100

Destek ve Teşekkür Beyanı: Çalışma için destek alınmamıştır. Yazar, bu makalenin kalitesinin artırılmasına yönelik değerli yorumları ve yapıcı katkıları nedeniyle derginin hakemlerine ve editör ekibine teşekkür eder.

Etik Onay: Bu çalışma etik onay gerektiren herhangi bir insan veya hayvan araştırması içermemektedir.

Çıkar Çatışması Beyanı: Çalışma ile ilgili herhangi bir kurum veya kişi ile çıkar çatışması bulunmamaktadır.

Peer Review: Independent double-blind

Author Contributions: Zekeriya ŞAHİN: 100%

Funding and Acknowledgement: No funding or financial support was received for this study. The author would like to thank the reviewers and the editorial team of the journal for their valuable comments and constructive contributions to improving the quality of this manuscript.

Ethics Approval: This study does not contain any human or animal research that requires ethical approval.

Conflict of Interest: There is no conflict of interest with any institution or person related to the study.

How to Cite: Şahin, Zekeriya. (2026). The Relationship Between Digital Concentration and Organizational Vulnerability in Businesses in Turkey: A New Management Analysis Based on Sectoral Open Data Sets. *Mediterranean Social Studies Journal*, 3(2), 26-40. <https://doi.org/10.64412/MediTerra.2026.281>

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