Leveraging Strategic Management for a Sustainable Digital Economy

Mehtap Özşahin
https://orcid.org/0000-0003-2527-4166
Gebze Technical University, Turkey

Vladimir Simovic
Institute of Economic Sciences, Serbia & Australian University, Kuwait

Alper Erturk
Australian University, Kuwait

IGI Global
Scientific Publishing
Publishing Tomorrow's Research Today

Vice President of Editorial	Melissa Wagner
Director of Acquisitions	Mikaela Felty
Director of Book Development	Jocelynn Hessler
Production Manager	Mike Brehm
Cover Design	Jose Rosado

Published in the United States of America by
IGI Global Scientific Publishing
701 East Chocolate Avenue
Hershey, PA, 17033, USA
Tel: 717-533-8845 | Fax: 717-533-7115
Website: https://www.igi-global.com E-mail: cust@igi-global.com

Library of Congress Cataloging-in-Publication Data

Names: Özşahin, Mehtap, DATE- editor | Simović, Vladimir M. editor | Ertürk, Alper, DATE- editor
Title: Leveraging strategic management for a sustainable digital economy / edited by: Mehtap Özşahin, Vladimir Simovic, Alper Erturk.
Description: Hershey PA : IGI Global Scientific Publishing, [2026] | Includes bibliographical references. | Summary: "This book aims to serve as a comprehensive resource exploring the interplay between strategic management practices and the pursuit of a sustainable digital economy"-- Provided by publisher.
Identifiers: LCCN 2025028995 (print) | LCCN 2025028996 (ebook) | ISBN 9798337350523 hardcover | ISBN 9798337350530 paperback | ISBN 9798337350547 ebook
Subjects: LCSH: Information technology--Management | Business--Data processing | Organizational change | Strategic planning
Classification: LCC HD30.2 .L477 2026 (print) | LCC HD30.2 (ebook)
LC record available at https://lccn.loc.gov/2025028995
LC ebook record available at https://lccn.loc.gov/2025028996

British Cataloguing in Publication Data
A Cataloguing in Publication record for this book is available from the British Library.

Detailed Table of Contents

In an era shaped by algorithms, platforms, and digital precarity, success can no longer be defined solely by employment speed, income, or visibility. This chapter introduces the Passion–Platform–Power (PPP) Framework as a human-centered and strategic model for redefining success through digital empowerment. Positioning passion as a strategic asset, platforms as both enablers and gatekeepers, and power as sustainable impact grounded in ethics and agency, the chapter bridges creativity, strategic management, and higher education. Through an applied Four-Year Digital Passion Roadmap, portfolio-based learning, and digital risk literacy, it demonstrates how universities can transform student journeys from coursework to career. Rather than promoting compulsory monetization, the passion economy is framed as a space for cultivating future-ready skills, integrity, and resilience. The chapter offers educators, managers, and policymakers an actionable framework to prepare empowered individuals capable of shaping meaningful, ethical, and sustainable futures within the global digital ecosystem.

The rapid evolution of the digital economy is transforming industries, governance, and societies, presenting both unprecedented opportunities and sustainability challenges. This chapter explores how Artificial Intelligence can enhance strategic foresight by bridging gaps in decision-making under uncertainty. Traditional foresight methods often fail to capture the complexity and pace of digital disruption, climate risks, and socio-economic shifts. AI-driven tools such as machine learning, predictive analytics, and natural language processing enable the detection of weak signals, risk forecasting, and scenario modeling. Case studies in sustainable finance and renewable energy illustrate how AI-backed foresight improves resource efficiency, anticipates market volatility, and strengthens climate resilience. Ethical considerations, including transparency, bias, and inclusivity, are discussed alongside hybrid models combining human judgment with AI intelligence. The chapter concludes that AI-enhanced foresight is a transformative capability that advances sustainable digital economies.

Today, generating useful insights from huge, disparate datasets is tough for organizations in a data driven landscape. This chapter looks into advanced big data visualization techniques and frameworks for effective big data visualization by way of compelling, interactive and scalable visuals. The real time processing principles, Data to Insight model, architecture layers and the key algorithms supporting real time processing are discussed. Tools, techniques for storytelling and sector specific applications for applications from healthcare and finance to manufacturing and governance are examined in detail to highlight the transformative role of visualization.

It then focuses on the emerging trends like AI integration and cloud system which overcome the challenges of scalability, user engagement and data quality.

This chapter, "Change Management in Tech-Driven Sustainable Organizations," explores how organizations can align digital transformation with sustainability goals. Positioned within the book "Leveraging Strategic Management for a Sustainable Digital Economy," it offers a comprehensive guide to managing change at the intersection of technology and sustainable development. The chapter covers foundational and advanced change management models—such as Lewin's, Kotter's, and ADKAR—while incorporating sustainability-specific frameworks like the circular economy. Key drivers and barriers to change are identified, with strategic solutions emphasizing leadership, innovation, stakeholder engagement, and ethical governance. Through practical case studies, it illustrates successes and failures in sectors like energy and retail. The chapter concludes by discussing future trends including green AI and circular business models.

This chapter, "Strategic Leadership for Digital Sustainability," examines how organizations can align digital transformation with sustainability goals through visionary leadership. It introduces digital sustainability as a strategic imperative, emphasizing the role of leadership in fostering responsible innovation, ethical governance, inclusivity, and environmental stewardship. The chapter explores transformational, servant/ethical, and adaptive leadership approaches and their application in cultivating sustainable digital infrastructures and cultures. It offers practical strategies for aligning digital initiatives with sustainability, including stakeholder engagement, risk management, and change leadership. Real-world case studies illustrate successful implementations, while a proposed Digital-Sustainability Leadership (D.S.L.) Framework provides a roadmap for future-ready leadership. It argues that strategic leadership is essential to navigating the dual agendas of technological advancement and sustainable development.

In the fast-paced business world of today, performance management is a phrase that is used in many different fields and at all levels of an organisation. Global rivalry, quick technology advancement, interconnectedness, and economic liberalisation have all made it harder for organisations to survive. In order to improve agility and boost business outcomes, companies are using strategic performance management (SPM) frameworks that incorporate goal alignment, real-time analytics, and continuous feedback. This shift is particularly relevant in the context of Kuwait, where digital transformation—a major pillar of Vision 2035 aimed at transitioning the nation toward a knowledge-based economy—demands data-driven approaches to performance management. This chapter adds to the expanding body of knowledge on digital-era HR practices by linking people management to the goals of national development to establish sustainable, high-performing workplaces in Kuwait.

This study aims to explore digital tools such as blockchain, the internet of things, artificial intelligence (AI), and big data analytics, and how these tools could be used to optimize supply chain operations across environmental, economic, and social dimensions. Key performance indicators (KPIs) will focus on enhancing resource efficiency, enabling real-time traceability, reducing carbon footprint, and improving stakeholder collaboration. The research identifies the role of digital transformation in aligning sustainability with operational excellence. Through an extensive literature review, this study highlights best practices in the adoption of these technologies across various industries. This research contributes to both academic and practical discussions by providing an integrative conceptual framework that links digital innovation with sustainable supply chain performance, offering actionable insights for managers and policymakers striving to meet evolving environmental standards and market expectations.

Global Value Chains (GVCs) emerged as a defining feature of international trade following the liberalization of global markets and the advancement of information and communication technologies in the second half of the twentieth century. Initially driven by multinational enterprises (MNEs) through strategies such as foreign direct investment, offshoring, and outsourcing, GVCs evolved into complex networks connecting suppliers, producers, and consumers across multiple geographies. However, the landscape of global trade is undergoing a significant transformation. Recent disruptions, including the global financial crisis, the COVID-19 pandemic, and rising geopolitical tensions, have exposed vulnerabilities in hyper-globalized production systems. In response, a paradigm shift toward regionalization, friend shoring, supply chain resilience, and technological innovation is reshaping GVC structures. Concurrently, digitalization has lowered barriers for small and medium-sized enterprises (SMEs), enabling them to integrate into international trade networks and assume more strategic roles.

This study aims to explore how digital maturity level (DML) affects financial performance (FP) in the service sector firms listed on Borsa Istanbul in Türkiye. Using panel data of 59 service companies for the years 2016–2022, this study employs a text mining approach to calculate DML of the firms from their annual reports and uses panel regression analysis to examine the interplay between DML and FP. The results indicate that there is a U-shaped relationship between DML and FP of service sector firms. Companies that have a greater orientation towards digitalization face a decreasing FP in the short term but get increasing financial benefits in the long run. However, this relationship varies across the sectors of information, communication and publishing activities, construction and public works and transportation and

Results indicate that local stakeholders are increasingly eager to adopt digital tools to enhance destination marketing, improve visitor experiences. Nonetheless, challenges such as digital exclusion, inadequate infrastructure, and lack of policy coordination hinder wider adoption. Furthermore, it provides actionable policy suggestions and outlines future research avenues, positioning the rural Himalayas of West Bengal.

The accelerating digital transformation of healthcare systems highlights the growing importance of digital equity within a sustainable digital health economy. This chapter examines access, digital literacy, infrastructure, policy inclusion, and socio-economic disparities shaping the use of digital health tools. Using interdisciplinary literature and critical discourse analysis from a critical realist perspective, it explores key enablers and barriers across patients, providers, and policymakers, and identifies practical directions for equitable and sustainable digital health strategies.

This chapter provides a comprehensive overview of different nanoparticle synthesis techniques that have been extensively reported by researchers. These include conventional physical and chemical methods such as sol–gel synthesis, chemical reduction, hydrothermal and solvothermal techniques, and precipitation methods, as well as environmentally friendly green synthesis approaches utilizing plant extracts, microorganisms, and biomolecules. Green synthesis, in particular, has gained significant attention due to its sustainability, cost-effectiveness, and reduced environmental impact. The discussion highlights how the choice of synthesis method influences the efficiency of nanoparticles in wastewater treatment applications and underscores the importance of optimizing synthesis parameters to achieve desired

properties.The chapter also discusses the importance of developing sustainable and scalable strategies for the practical implementation of AI and nanotechnology in wastewater management.

Preface

The transition toward a sustainable digital economy represents one of the most significant transformations of the contemporary era. As digital technologies continue to redefine industries, institutions, and societies, the role of strategic management has become increasingly central in guiding this transformation toward long-term sustainability, inclusivity, and resilience. This volume brings together a rich collection of scholarly contributions that examine how organizations can leverage strategic thinking to navigate the complexities of digitalization while addressing pressing economic, environmental, and social challenges.

Digital transformation today extends far beyond technological adoption; it requires a reconfiguration of organizational capabilities, leadership paradigms, and governance structures. Across sectors, decision-makers are tasked with balancing innovation with responsibility, efficiency with equity, and growth with sustainability. The chapters in this book collectively explore these tensions and offer frameworks, models, and empirical insights that illuminate pathways toward sustainable digital development.

A defining feature of this volume is its interdisciplinary scope. It bridges strategic management with emerging domains such as artificial intelligence, big data analytics, blockchain, and digital platforms, while also addressing critical areas including supply chains, human resource management, global value chains, healthcare, tourism, and environmental sustainability. This breadth reflects the pervasive impact of digitalization and underscores the need for integrated, systems-level approaches to strategy.

Equally important is the human dimension emphasized throughout the book. From empowering individuals in the digital economy to fostering ethical leadership, enhancing workforce capabilities, and addressing digital equity, the contributions highlight that sustainable transformation is ultimately driven by people. Organizations must cultivate not only technological competence but also ethical awareness, adaptability, and collaborative capacity.

The volume also provides a global perspective, drawing on insights from diverse geographic and institutional contexts. These varied viewpoints reveal how digital transformation unfolds differently across regions while also pointing to shared challenges such as regulatory complexity, digital divides, and the need for innovation-driven growth. By integrating theoretical advancements with practical applications, this book aims to inform both academic inquiry and strategic practice.

CHAPTER OVERVIEW

Chapter 1 introduces a human-centered strategic framework for digital empowerment, emphasizing the interplay of individual passion, digital platforms, and ethical power in shaping sustainable success.

Chapter 2 explores the role of artificial intelligence in enhancing strategic foresight, enabling organizations to anticipate risks and opportunities within a rapidly evolving digital and sustainability landscape.

Chapter 3 examines advanced big data visualization techniques and frameworks that support real-time, insight-driven decision-making across multiple sectors.

Chapter 4 analyzes strategic change management approaches that align digital transformation initiatives with sustainability goals through leadership, governance, and capability development.

Chapter 5 investigates leadership models that integrate digital transformation with sustainability imperatives, highlighting the importance of ethical, adaptive, and visionary leadership.

Chapter 6 discusses data-driven performance management systems in the digital era, focusing on the integration of analytics, human resource practices, and leadership for organizational effectiveness.

Chapter 7 explores the integration of digital technologies such as artificial intelligence, blockchain, and IoT in enhancing the sustainability and performance of supply chains.

Chapter 8 analyzes the intersection of artificial intelligence and digital nomadism, and its implications for the future of work, policy development, and global labor dynamics.

Chapter 9 reviews the evolution of e-commerce within the digital economy, identifying key drivers, research trends, and the broader socio-economic impacts of digital trade.

Chapter 10 investigates the transformation of global value chains, highlighting the shift from multinational dominance toward greater participation and empowerment of small and medium-sized enterprises.

Chapter 11 explores the relationship between digital maturity and financial performance, demonstrating how digitalization impacts organizational outcomes over time.

Chapter 12 examines the implications of virtual currencies for financial systems, particularly in relation to regulatory challenges and emerging risks in digital financial environments.

Chapter 13 investigates the role of smart tourism and emerging technologies in enabling sustainable development in rural and underdeveloped regions.

Chapter 14 explores issues of digital equity in healthcare, focusing on access, inclusion, and the socio-economic factors shaping digital health systems.

Chapter 15 examines innovative approaches to wastewater treatment, highlighting the role of artificial intelligence and nanotechnology in advancing environmental sustainability.

Together, these chapters provide a comprehensive and forward-looking exploration of how strategic management can be leveraged to build a sustainable digital economy. The insights presented aim to support scholars, practitioners, and policymakers in designing strategies that not only harness technological innovation but also contribute to a more equitable and sustainable future.

Chapter 11
Uncovering Digital Maturity and Financial Performance Relationship in the Service Sectors

Mustafa Kemal Yilmaz
Ibn Haldun University, Turkey

Mine Aksoy
http://orcid.org/0000-0002-4773-1770
Yalova University, Turkey

Esra Cengiz Tirpan
http://orcid.org/0000-0001-7675-5635
Bilecik Seyh Edebali University, Turkey

Mehtap Özşahin
http://orcid.org/0000-0003-2527-4166
Gebze Technical University, Turkey

Erman Coşkun
Bahçeşehir University, Turkey

Özgür Uysal
Central Security Depository and Trade Depository of Türkiye, Turkey

ABSTRACT

This study aims to explore how digital maturity level (DML) affects financial performance (FP) in the service sector firms listed on Borsa Istanbul in Türkiye. Using panel data of 59 service companies for the years 2016–2022, this study employs a text mining approach to calculate DML of the firms from their annual reports and uses panel regression analysis to examine the interplay between DML and FP. The results indicate that there is a U-shaped relationship between DML and FP of service sector firms. Companies that have a greater orientation towards digitalization face a decreasing FP in the short term but get increasing financial benefits in the long run. However, this relationship varies across the sectors of information, communi-

DOI: 10.4018/979-8-3373-5052-3.ch011

cation and publishing activities, construction and public works and transportation and storage. The findings provide valuable insights for companies to structure right digitalization strategies to ensure sustainable financial gains.

INTRODUCTION

The rapid advancement of digital technologies (DT) has revolutionized business landscape, offering new opportunities for firms, reshaping business models, and significantly influencing operations (Lei et al., 2022). By employing digital means, companies have become more competent to achieve long-term goals through the integration of new data resources at low cost and speed up their response to market demands (Verhoef et al., 2019). According to the World Economic Forum (2024), an estimated 70 percent of new value created over the coming decade will be based on digitally enabled business models. Therefore, it is essential to examine the influence of digitalization on firm performance. This is particularly true for emerging markets that aggressively struggle to shift to an intelligence-based economy.

The impact of digitalization on firm performance comes from enabling improvements in efficiency, revenue growth, product/service quality, customer satisfaction, employee engagement, and a greater focus on innovation (Deloitte, 2023). For instance, digitalization helps firms grow revenue by improving customer experience and the development of new products and services. Therefore, ambitious firms should boost growth and innovation to tap high potential of digitalization. Despite the advantages that digitalization offers for business community, there are limited discussion of its impact on service sectors, where advanced DT such as artificial intelligence (AI), generative AI, Internet of Things (IoT), virtual reality (VR), and big data analytics are frequently employed (Vial, 2019).

Recent discussions on digital transformation highlight important differences in how industries adopt and benefit from new digital tools. Digitalization plays a more transformative role in service sectors compared to manufacturing sectors in many countries (Ribeiro-Navarrete et al., 2021; Ndubuisi et al., 2023). By 2019, services accounted for 55 percent of the GDP and 45 percent of employment in emerging markets (Nayyar et al. 2021). Digitalization in service sectors offers several advantages, i.e. automating processes, cutting costs, minimizing human errors, and encouraging an innovation culture (Parida et al., 2019). DT allows firms to better understand customer preferences and deliver more customized services. Digitalization also enables firms to create new business models such as subscription-based, or platform-based services, altering the value chain (Lee & Lim, 2018). The Covid-19 pandemic has remarkably sped up digital transformation in service sectors, particularly influencing healthcare, education, and entertainment. DT assist firms to better serve customers

during this turbulence by developing their capabilities through agility, flexibility, and resilience (Chin et al., 2023).

Despite growing global interest in the strategic value of digital transformation, research coverage remains uneven across country groups. Most of the studies investigating the impact of digitalization on firm performance have been conducted in developed markets. There are relatively few studies (Cherkasova & Slepushenko, 2021; Masoud & Basahel, 2023; Valaskova et al., 2025; Yonghong et al., 2023) that explore the effects of digital maturity (DM) on financial performance (FP) in emerging markets, where digitalization plays a key role in increasing productivity, reducing costs, and facilitating access to global markets (Dahlman et al., 2016). This study seeks to explore the impact of DM on FP by conducting a text mining analysis of the annual reports of service sector firms listed on Borsa Istanbul in Türkiye, a well-suited setting that shows high level of digitalization among emerging markets. Digital transformation of Türkiye diverges from many of its peers across key indicators, such as ICT adoption and digital infrastructure. Many Turkish firms actively embrace digital transformation as their priority to improve operational efficiency and consumer experience through investments in AI, and data analytics technologies. These attempts significantly influence firm-level digital transformation trajectories, an issue shared with many emerging markets where uneven digital readiness hampers corporate performance. This research only focuses on service sectors where digitalization intensively shapes operational processes and customer experiences. In conducting the study, digitalization maturity index (DMI) scores were calculated from 2016 to 2022 as Turkish firms have given pace to digitalization strategies in recent years. The study also examines whether the relationship between DM and FP differs among the sub-sectors.

This research contributes to literature in three folds. First, by mapping the digital maturity level (DML) of the firms based on counts of the digitalization related keywords in the annual reports, the study employs text mining analysis to calculate DML scores of the entities. Second, the study explores the interplay between DML and FP for the service sectors, focusing on how the degree of DML affects FP. In this sense, it guides service sector firms in emerging markets and provides valuable insights in refining their digitalization strategies to enhance competitiveness. Finally, this paper provides new evidence in an emerging market setting where corporate digitalization has been rapidly developing. Thus, it offers clear intiutions for the significance of digitalization, motivating emerging market firms to assess changes in their business environments and adopt proper digital technologies to boost FP.

The rest of the paper is organized as follows: Section 2 presents the theoretical and conceptual framework and formulates the hypothesis. Section 3 gives the data, variables, and methodology. Section 4 provides the empirical findings. Finally,

Section 5 concludes the study by outlining the theoretical and practical implications, as well as suggesting directions for future research.

2. THEORETICAL AND CONCEPTUAL FRAMEWORK AND HYPOTHESIS DEVELOPMENT

2.1. Theoretical and Conceptual Framework

Technology is a fundamental resource for strategic investment in digital transformation, but achieving this transformation requires alignment with a firm's internal resources (Brinch et al., 2021). Resource-based view (RBV) is one of the most prominent theories to explain the impact of digital orientation on firm performance (Mikalef et al., 2019; Rivard et al., 2006; Rodriguez & Rodriguez, 2005). According to the RBV, digitalization is a strategic resource that is valuable, scarce, and difficult to replicate in the business environment (Barney, 1991). Many studies suggest that firms that leverage digitalization as a key resource tend to outperform their competitors (Dubey et al., 2019; Huang & Wang, 2020). This study employs RBV, believing that tangible and intangible aspects of digitalization raise FP.

In recent years, the rapid development and integration of advanced digitalization have enabled digital servitization, accelerating the growth of service firms (Gebauer et al., 2021). Digital servitization is the process of transforming a firm by means of a service combination and the intensive use of digital technologies and is beneficial in delivering the outcomes for customers. On this respect, AI, IoT, big data, blockchain, and VR equip service firms with the necessary tools for creating customer-focused business models (Paiola & Gebauer 2020). Smart technologies highly influence firm performance by allowing entities to align their business processes in ways that boost customer satisfaction (Immonen & Sintonen, 2015; Roy et al., 2017). At the firm level, digitalization stimulates product and service innovation and offers new opportunities, empowering firms to provide broader value propositions to customers by collecting and analyzing data from various sources and generating new business models through implementing sophisticated strategies. In this sense, as claimed by many studies (Fernandez-Portillo et al., 2022; Kuang et al., 2023), digital enhancement improves operational and financial performance and leads to greater efficiency by leveraging innovative capabilities and optimizing the allocation of resources.

However, improvements in corporate performance through digitalization do not take place until the human resources of a firm gain the required expertise (Skorupinska & Torrent-Sellens, 2017). Therefore, the progress of digitalization and the amelioration of financial results may take some time depending upon the management of digital processes (Vu, 2011). For instance, many companies lever-

age data analytics to uncover insights and predict emerging trends, enabling them to make swift decisions and promptly respond to consumer demand. However, big data investment may pay off over time (Wamba et al., 2017). On this respect, the DML of firms has paramount importance. Fernandez-Portillo et al. (2022) indicate that increased level of digitalization is associated with improved firm performance. Based on interviews with firms from 11 countries, Bouwman et al. (2018) state that firms with a higher level of digitalization have more efficient and innovative business models.

Despite growing scholarly attention to the impact of digitalization on firm performance, the findings are mixed. Many studies (e.g. Fernandez-Portillo et al., 2022; Guo & Xu, 2021; Martín-Peña et al., 2019; Vitari & Raguseo, 2016; Zeng et al., 2022) have found a positive relationship between these two constructs, whereas some others have identified either a negative or negligible impact of digitalization on firm performance due to increased operational costs arising from adaptation pressures, integration expenses, and resistance to change (AlMulhim, 2021; Gebauer et al., 2020; Jardak & Ben Hamad, 2022). Dobbs et al. (2015) assert that firms in sectors that are more agile in adapting to digital transformation experience increased FP, and those with higher levels of DM achieve better FP. Similarly, Bughin and van Zeebroeck (2017) claims that firms that use their digital potential have higher revenues than that of the average firm. Wroblewski (2018) analyzes whether firms with higher DM outperform their less mature competitors in Sweden and indicates that DM raised operational efficiency and return on equity.

Table A1 in the Appendix provides a summary of the selected studies examining the relationship between DML and FP.

2.2. Hypothesis Development

Leveraging digital transformation enables firms to improve operational efficiency, increase customer engagement, and gain valuable insights into market trends. It also empowers them to explore new markets, generate additional revenue streams, and develop innovative business models. However, digitalization is a challenging process that demands substantial investment in technology, skill development, and cultural transformation. As argued by Lichtenthaler (2019), firms need the capabilities and knowledge of using DT to increase FP.

Numerous studies have emphasized the positive impact of digitalization on FP, highlighting the importance of service-oriented strategies in realizing financial benefits (Zhou et al., 2023). Majority of these studies claim that firms may enhance efficiency by leveraging the digital skills of employees, increasing productivity and reducing costs. Martín-Peña et al. (2019) and Mithas et al. (2012) find that digitalization has a substantial effect on revenue growth. Kohtam¨aki et al. (2020) examined

131 Swedish manufacturing firms and identified a U-shaped relationship between digitalization and FP. They find that at low to moderate level of digitalization, the interaction effect is negative, but as digitalization increases from moderate to high level, the effect becomes positive, enhancing FP. Cherkasova and Slepushenko (2021) conduct a study of 482 Russian firms across 20 industries from 2017 to 2019 and indicated that digitalization positively influences FP, with the most significant impact observed at high DM.

In the journey of digital transformation, prioritizing cost reduction can amplify the benefits of digitalization (He & Liu, 2019). However, in the early stages of digitalization, investment in software, hardware, and skilled human resources can substantially raise costs, decreasing FP (Dutta et al., 2014). As the digitalization process deepens, return on assets (ROA) will gradually increase since the impact of digitalization on FP has a certain lag (Yonghong et al., 2023). In a recent study of Norwegian firms listed on Oslo Børs, Andersen (2023) discovers that ROA exhibites a U-shaped effect for most technology trends, with a one-year lag. Similarly, Truant et al. (2021) argue that firms in the early stages of digitalization exhibit lower levels of FP compared to those with more advanced digital management practices.

Thus, the interplay between DM and FP is a dynamic process. Digital transformation may have a positive impact on FP only after firms adapt to digitalization by incurring high costs and adjusting organizational structure and business processes. Building on these discussions, we put forward the following hypothesis:

Hypothesis: There is a U-shaped relationship between the digital maturity level and financial performance.

Figure 1. Research framework

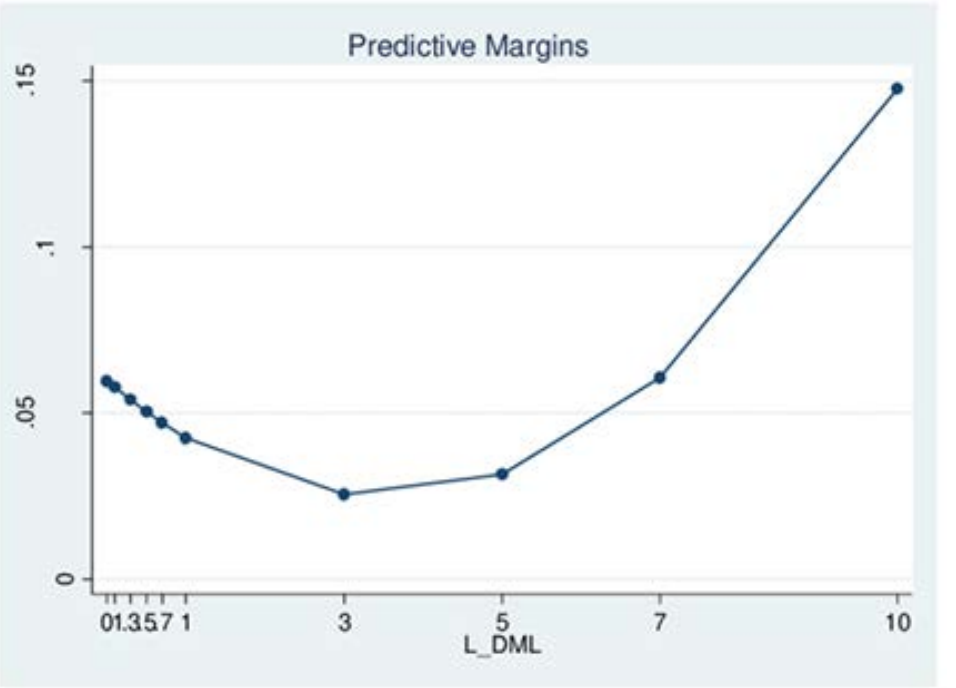


Figure 1 illustrates the research framework and the proposed relationship.

3. DATA AND METHODOLOGY

3.1. Data Sample

This study focuses only on the service sector and covers 59 non-financial firms listed on Borsa Istanbul for the period of 2016-2022. This timeframe is deliberately chosen as the firms had to prepare their financial statements according to inflation accounting application that entered into force by December 31, 2023. Table 1 reports the sub-sectors in the sample. Services represent 54 percent of the GDP in Türkiye by 2023, and their share does not display a remarkable change since 2015 (Worldbank, 2024). Service sectors more intensively deal with customer-focused digital affairs compared to manufacturing sector, aiming to improve consumer

satisfaction. Firms with less than 4 years of observation data were excluded from the sample. The panel data analysis was conducted with a total of 59 firms and 388 observations to test the hypothesis.

Table 1. The distribution of the service sectors in the sample

Service sectors	No. of firms
Wholesale and retail trade	15
Electricity, gas and water	10
Construction and public works	8
Hotel and restaurants	8
Transportation and storage	6
Information, communication and publishing activities	5
Real estate activities	3
Educational health sports and entertainment services	2
Professional, scientific and technical activities	1
Administrative and support service activities	1
Total	59

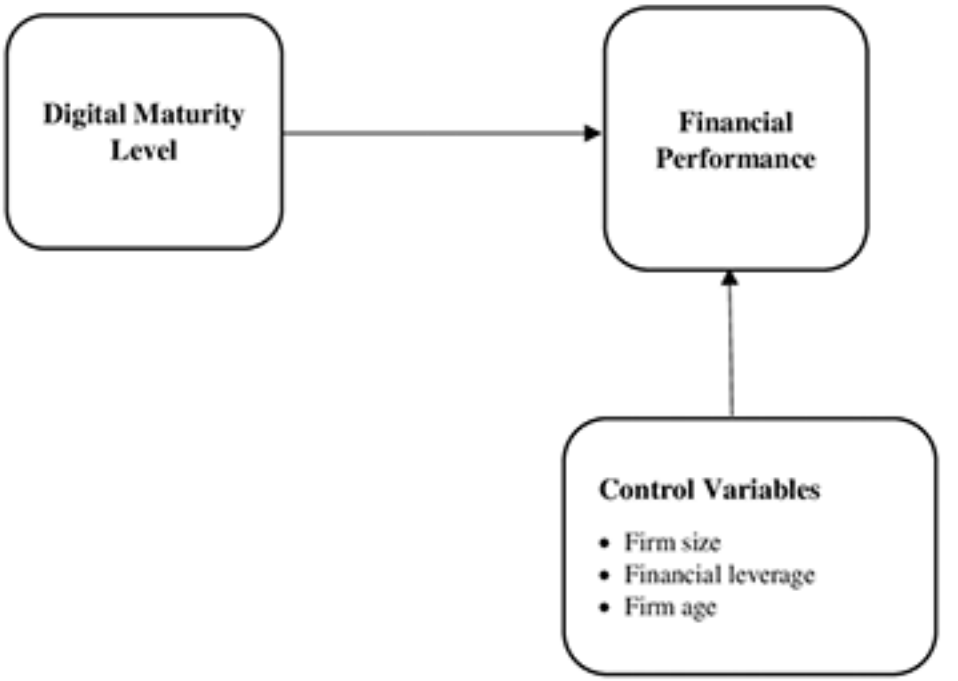
3.2. Variable Measurement

Our dependent variable is financial performance. Following prior studies (e.g. Kuang et al., 2023; Yonghong et al., 2023; Zeng et al., 2022), return on assets (ROA) was used as a financial performance indicator. It is measured by dividing net income to total assets.

Calculated digital maturity level (DML) is used as the independent variable. It quantifies the extent to which firms leverage DT to enhance customer interactions, streamline operational processes, and transform business models (Hess et al., 2016; Verhoef et al., 2019). There is a lack of research focusing on quantifying DML due to its complex nature as a firm-wide strategic change (Gurbaxani & Dunkle, 2019; Libert et al., 2016), making it challenging to measure. Following the relevant literature (Fu & Li, 2023; Guo & Xu, 2021; Wu et al., 2021; Zeng et al., 2022), text mining analysis was applied to the annual reports of firms to measure DML. Text mining analysis can involve different methods such as word frequency analysis, the presence of specific words, regularities in data, tagging/annotation (Dreisbach et al., 2019; Rybchak & Basystiuk, 2017). MAXQDA, which is a software designed for qualitative and mixed-method data analysis, was employed to analyze the frequencies of the DM related keywords in the annual reports (Marjaei et al., 2019).

Figure 2 shows the flow diagram for the calculation of the Digital Maturity Index scores, i.e. a proxy for the digital orientation of the firms.

Figure 2. The flow diagram for the calculation of the Digital Maturity Index scores



The following steps were followed to calculate the DMI scores:

Step 1: 238 keywords were selected for different levels of digital orientation in firms to construct a digital scale based on literature review, and the interviews held with the experts. To construct a comprehensive vocabulary set, a content analysis was conducted on policy documents and sectoral reports on digitalization. Strategic and technical reports issued by prominent institutions—the Turkish Industry and Business Association (2017, 2020), the Ministry of Development (2018), the Ministry of Science, Industry and Technology (2018), and the Digital Türkiye Platform (2019, 2021)—were examined. Based on the recurring concepts and themes within these sources, a set of relevant keywords pertaining to digital transformation was identified. The preliminary keyword list was subsequently reviewed by nine domain experts, and the final dictionary was refined in accordance with their feedback.

Step 2: The 238 keywords were coded and classified under 5 categories by consulting with 4 academicians and 5 professionals (total of 9 coders). Category 1 includes the most basic DM associated keywords, while category 5 consists of the highest-level DM associated keywords. The sample keywords in each category are presented in Table 2.

Step 3: The annual reports of firms were processed, and the frequency of the 238 keywords was calculated by using MAXQDA software. For this analysis, pdf documents with text conversion errors were excluded. Ultimately, 388 observations were used for the years 2016-2022 to calculate the DMI score for each firm.

Step 4: When the frequency results were analyzed, it was observed that 15 words in our list were not used in any report. Thus, they were excluded, and DMI index scores were calculated based on 223 words.

Step 5: Total DMI scores were calculated by normalizing total frequencies of 223 words by the page number in each report as follows:

$$\sum_{i=1}^{223}(\text{word} * \text{frequency}) / \text{ number of pages in report}$$

Table 2. The keywords used in the calculation of the digital maturity level scores

Category 1	**Intranet, Internet, Server, Network Infrastructure**
Category 2	Smart TV, Smartphone, Mobility, Internet Access, Network Coverage, Network Function, Network Map, Productive, Productivity, Effectiveness
Category 3	Network Security, Information Security, Digitization, Transformation, Fiber Optic, Broadband, Quick Adaptation, Decision Making, Mobile Device, Operational Improvement, Performance Management System
Category 4	Agile, Network Automation, Smart Solutions, Smart Technology, Smart Manufacturing, Data Analytics, Cloud Computing, Cloud Security, Data Privacy, Data Lake, Digital Twin, Digital Business, Digital Workforce, 5G, Optimization, Automation, Robot, Cyber Security, Sustainability, Innovation, Edge Computing
Category 5	Artificial Intelligence, Big Data, Deep Learning, Smart Factory, Smart Agriculture, Augmented Reality, Blockchain, Business Intelligence, Digital Transformation, Image Recognition, Internet of Things, Machine Learning, Metaverse, Robotic Process Automation, Virtual Factory, Virtual Reality, Sentiment Analysis

The annual report is a formal document in which listed firms publicly disclose their financial performance for the fiscal year. It provides insights into the firm's strategic decisions and outlook. If a firm has significant strategic shifts, these changes should be clearly disclosed in the annual report. Given the public nature of this report, firms exercise care in the wording to ensure transparency. Thus, firms

should provide relevant information about their digitalization progress in the annual report (Fernández-Rovira et al., 2021; Sheng et al., 2019).

Control variables

Following prior studies (Jardak & Hamad, 2022; Kuang et al., 2023; Nasiri et al., 2020; Zhao et al., 2024), firm size (SIZE), financial leverage (LEV) and firm age (AGE) were used as control variables. SIZE was calculated by taking the natural logarithm of the firm's total assets. LEV was measured by dividing total liabilities to total assets. AGE shows the period since the company was founded and is included in the model by taking its natural logarithm.

3.3. Methodology

Using Stata, the panel regression analysis was employed to evaluate the impact of DML on FP by estimating the following models (Equations 1 and 2). A dummy variable was incorporated for each year to account for any unique characteristics of the chosen period. First, FP was regressed on DML and control variables in Equation (1).

$$ROA_{i,t} = \alpha + \beta_1 DML_{i,t-1} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,t} + \beta_4 AGE_{i,t} + \sum_{k=1}^{7} \lambda_k Year + e_{i,t}$$

(1

To demonstrate a U-shaped relationship, FP was regressed on DML and its squared term, DML^2, as shown in Equation 2. A significant negative coefficient for DML^2 suggests an inverted U-shaped relationship, while a significant positive coefficient for DML^2 indicates a U-shaped relationship (Haans, Pieters, & He, 2016).

$$ROA_{i,t} = \alpha + \beta_1 DML_{i,t-1} + \beta_2 DML^2_{i,t-1} + \beta_3 SIZE_{i,t} + \beta_4 LEV_{i,t} + \beta_5 AGE_{i,t} + \sum_{k=1}^{7} \lambda_k Year + e_{i,t} \quad (2)$$

4. EMPIRICAL FINDINGS

4.1. Descriptive Statistics

Table 3 presents the summary of the descriptive statistics, while Table 4 displays the correlation matrix. The Variance Inflation Factor (VIF) values for the explana-

tory variables are below 10, indicating that multicollinearity is not a problem. The mean score of ROA is 0.04 with a standard deviation of 0.122, implying that FP varies little among the firms in the sample. This variable also exhibits a significant positive correlation with DML as indicated by the coefficient of 0.119, showing that as the DM of a firm increases, the degree of digital adaptation significantly contributes to FP. The average DM score is only 1.323, suggesting that the level of digitalization among service sector firms in Borsa Istanbul remains relatively low. For LEV, a significant negative correlation was noted with ROA, whereas no substantial correlation is discernible with the AGE. Finally, SIZE has a positive and insignificant correlation with ROA.

Table 3. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
ROA	388	.04	.122	-.587	.683
DML	388	1.323	1.567	0	10.905
SIZE	388	13.857	2.143	9.254	20.176
LEV	388	.566	.278	-.119	1.175
AGE	388	3.267	.663	0	4.489

Table 4. Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)
(1) ROA	1.000				
(2) DML	0.119*	1.000			
(3) SIZE	0.064	0.517*	1.000		
(4) LEV	-0.366*	0.202*	0.381*	1.000	
(5) AGE	0.034	0.041	0.329*	0.038	1.000

** $p<0.05$*

4.2. Estimation Results

In Table 5, Model 1 shows the estimation results for equation (1) and Model 2 provides the estimation results for equation (2). Since our hypothesis posits a U-shaped relationship between DML and FP, the quadratic term of DML is incorporated into Model 2 to empirically test this expected relationship. Figure 3 displays the scatter plot with fitted lines depicting the relationship between DML and FP.

The red line represents the quadratic fit for the relationship between DML and FP. Quadratic fitting approximates discrete data using an analytical equation, offering a more intuitive and accurate representation of the relationship between DML and FP compared to other fitting methods. Hausman's test (1978) indicates that the random-effects model is appropriate for Model 1, while the fixed-effects model is recommended for Model 2.

Figure 3. Fitting diagram of the digital maturity level and financial performance

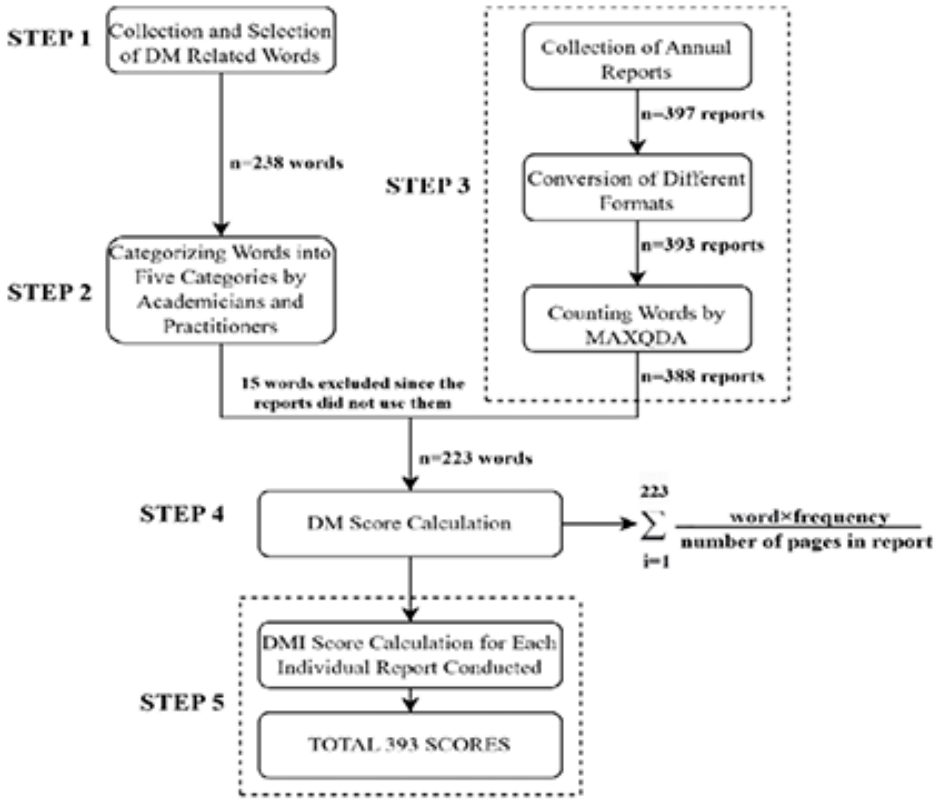
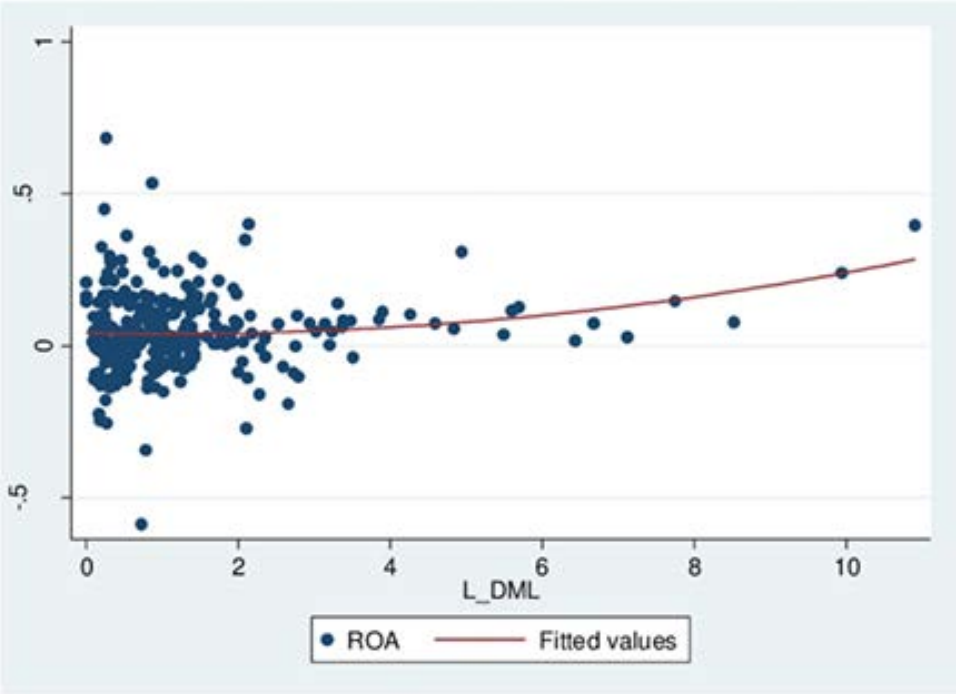


Figure 4. The non-linear relationship between digital maturity level and financial performance



The result for ROA in Model 2 satisfies the fundamental criteria for a U-shaped relationship. The nonlinear relationship between DML and FP is shown in Figure 4. The linear term is negatively ($\beta = -0.048$, $p < 0.05$) and the squared term of DML is positively ($\beta = 0.004$, $p < 0.01$) associated with ROA. Following Haans et al. (2016) and Lind and Mehlum (2010), our findings were validated using the "utest". The null hypothesis of the "utest" posits that the relationship is either monotonic or exhibits an inverse U-shape. The alternative hypothesis is that the relationship is U-shape. In Model 2, the overall test for the non-existence of a U-shaped relationship for ROA yields a t-value of 2.50 and a corresponding p-value of 0.008, suggesting that the null hypothesis is rejected at a significance level of 1%. The findings, along with Figure 3, provide additional confirmation of the U-shaped relationship between DML and FP, supporting our hypothesis. Firms in the mature stage of digitalization exhibit higher FP compared to those in the initial stage, demonstrating that a greater digital orientation has an increasingly positive effect on FP. Hence, the relatively negative effect of digitalization decreases after the firm gets into the maturity stage. This outcome validates the findings of the prior studies (Guo & Xu, 2021; Kohtam¨aki et al., 2020; Yonghong et al., 2023).

Of the control variables, financial leverage is negatively and significantly related to ROA in Models 1 and 2 at 1% level. Firm size, firm age and the constant term are not significant in any models. The result for firm size may stem from the fact that large firms may have a small impact on digitalization level due to high costs that do not depend on the digital presence level. Conversely, small firms benefit less from advanced DT due to the large investment required.

Table 5. Panel regression results

	Model 1	**Model 2**
Variables	ROA	ROA
DML_{t-1}	0.003	-0.048**
	(0.008)	(0.019)
DML^2_{t-1}		0.004***
		(0.002)
$SIZE_t$	0.007	0.038
	(0.007)	(0.046)
LEV_t	-0.180***	-0.262***
	(0.034)	(0.073)
AGE_t	0.000	0.139
	(0.015)	(0.089)
Constant	0.021	-0.734
	(0.068)	(0.680)
Observations	328	328
Number of firms	59	59
R-squared		0.381

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.3. Ad Hoc Analysis

An ad hoc analysis was conducted to determine if our findings vary across sub-sectors. Figure 5 presents the results. There is an U-shaped relationship between DM and FP for most of the sub-sectors. Initial investment and integration challenges first decrease FP, while the benefits outweigh initial difficulties and lead to financial

success in the mature stage of digitalization. The following part briefly reviews the relationship of DM and FP for sub-sectors.

Digitalization in wholesale and retail sectors is crucial due to the dominance of e-commerce. DT optimize operations, improve customer experiences, and help build agile models. POS system, personalized shopping experiences, supply chain management softwares are some examples of digitalization. Firms initially face challenges due to the high costs of integrating DT into the inventory, and supply chain management systems, posing financial problems. Long-term benefits emerge gradually with enhanced customer engagement, improved operational efficiency, and wider market access as Kumar and Sandhu (2018) argue.

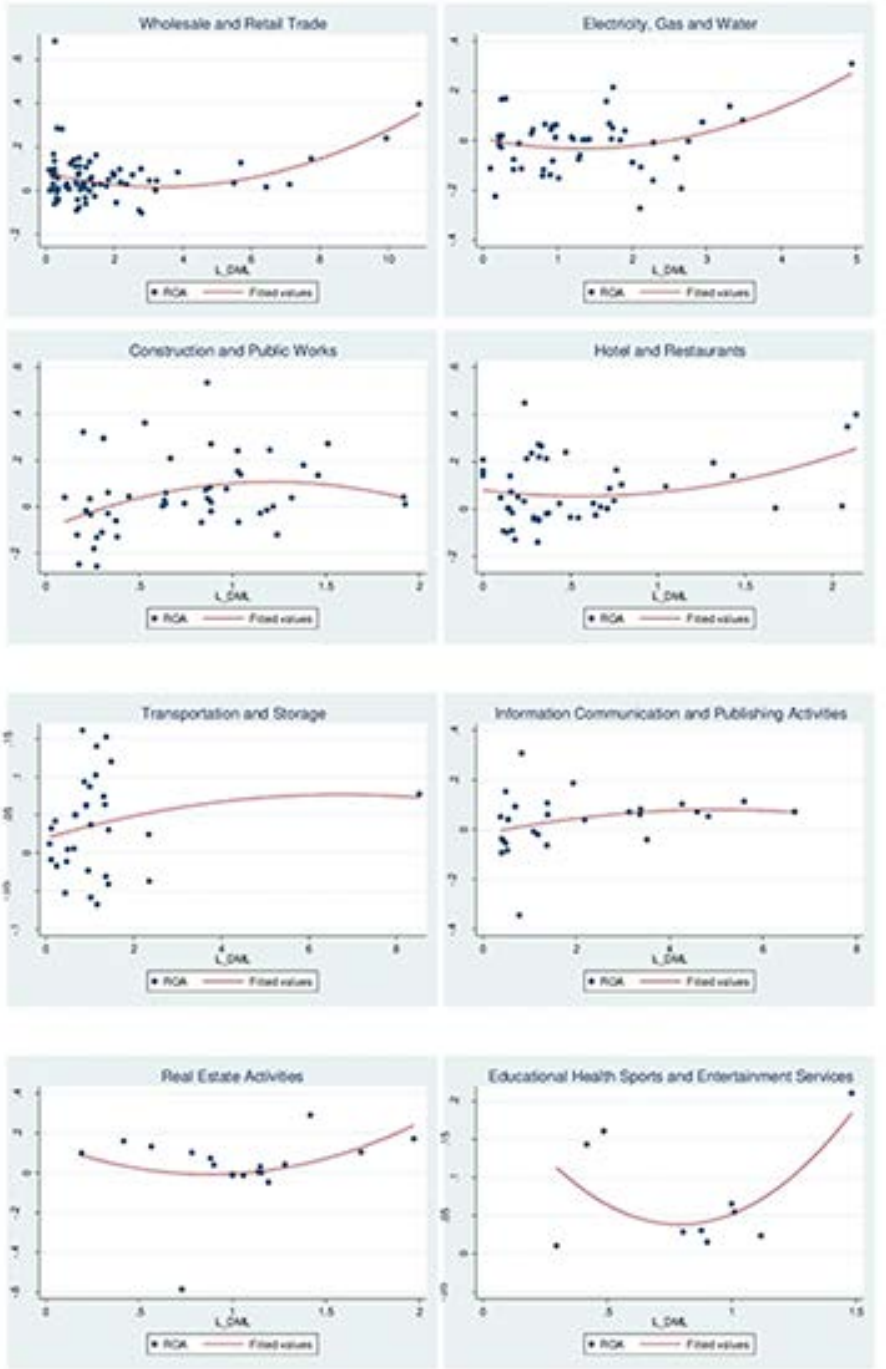
In the electricity, gas and water sector, DT enable better reliability, improved operations, and grid resiliency. This sector is heavily asset-intensive, with high fixed costs related to infrastructure, generation, and distribution, leading to financial losses at the early-stage of digitalization. AI-driven grid optimization, and IoT-enabled sensors reduce operating costs by preventing downtime and optimizing energy and water distribution. High DM empowers utilities to deploy smart grids and water management systems, leading to cost savings, improved demand forecasting and excess capacity reduction. Dynamic pricing, and consumption insights via mobile apps raise customer satisfaction, and result in increasing revenue streams.

In the hotels and restaurants sector, front office technologies assist customer processes and back-office technologies streamline administrative tasks, overcoming low productivity (Lee, Jang & Kim, 2024). This is important since the operations of these sectors have low profit margin and high labor intensity (Mun & Jang, 2018). DT helps firms reduce labor intensity through automation, data-driven decisions, and optimization, leading to higher FP at high DML.

Firms in real estate sector incur high implementation costs at the early stage of digitalization. This matter temporarily reduces FP. AI-driven property valuations, virtual tours, and online mortgage processing, enable companies to better predict market trends, optimize property valuations, and personalize client experiences, boosting FP in the high DML.

In education, health, sport and entertainment services, online learning platforms, telemedicine tools, sports analytics systems, and digital ticketing require high investment costs, and when it is coupled with employee training and workflow restructuring, it reduces FP. Advanced DM enables significant cost savings and efficiency through the automation of repetitive tasks (e.g. appointment scheduling in healthcare, ticket sales in entertainment) and data-driven decision-making (e.g. personalized education, training based on sports analytics).

Figure 5. Fitting diagram of the digital maturity level and financial performance for sub-sectors



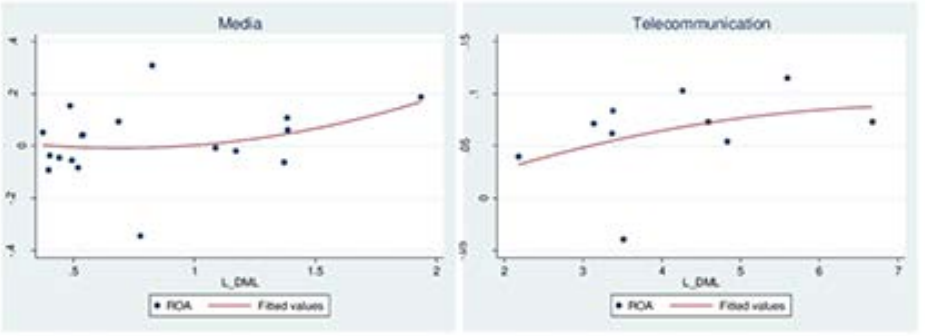
On the other hand, an inverted U-shaped relationship was observed in the scatter diagrams for the information, communication and publishing, construction and public works, transportation and storage sectors. These sub-sectors were decomposed, and their graphics were plotted in Figure 6.

Media and telecommunication sectors exhibit distinct patterns. Media sector shows an upward trend in FP as DML increases. Digitally mature firms successfully diversify revenue streams through subscription models, digital advertising and data-driven content personalization (Lozić & Čiković, 2021). Telecommunication sector exhibits a linear positive relationship between DM and FP, reflecting steady improvement in FP as DM raises. 5G connectivity, and digital communication tools drives consistent revenue growth. Unlike media sector, telecommunication sector faces fewer financial problems in the early stage of digitalization since investments in digital infrastructure directly align with their long-run goals.

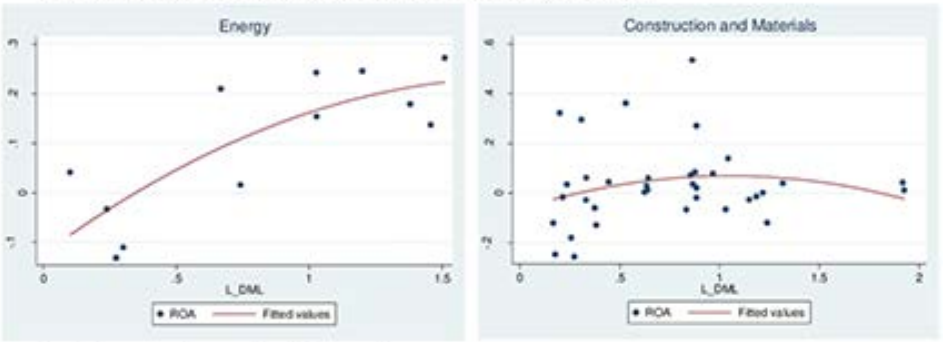
The construction and public works sectors can be divided into energy and construction and materials sectors. In energy sector, FP improves consistently as DM increases, with gains accelerating at high DML. Energy firms leverage advanced analytics and AI to optimize operations across the value chain, i.e. generation, transmission, and distribution. At the high DML, digital platforms enhance customer engagement through personalized services, smart meters, and real-time energy consumption insights. Construction and material sector, on the other hand, conduct project-based works. Early digitalization improves efficiency and raise FP, whereas excessive reliance on DT lead resistance from workers, negatively affecting FP.

In the transportation and storage sectors, airlines have a U-shaped curve, whereas other transportation firms have an inverse U-shape curve. Airlines bear high upfront costs in adopting DT such as customer relationship management system, and advanced fleet management tools, temporarily decreasing FP. However, at the high DML, airlines benefit from integrated systems, i.e. AI-driven pricing, predictive maintenance for aircraft, and automated customer services, and reduce costs and improve service quality. High DML also improves customer experience through personalized services, i.e. booking platforms, real-time updates (Heiets et al., 2022; Menon et al., 2019). It allows airlines to leverage big data for optimizing flight schedules, route planning, and fuel efficiency, contributing to financial gains. Unlike airlines, firms in other transportation sectors adopt DT incrementally. Fleet tracking, route optimization, and digital logistics improve operational efficiency and cost management, leading to steady financial gains.

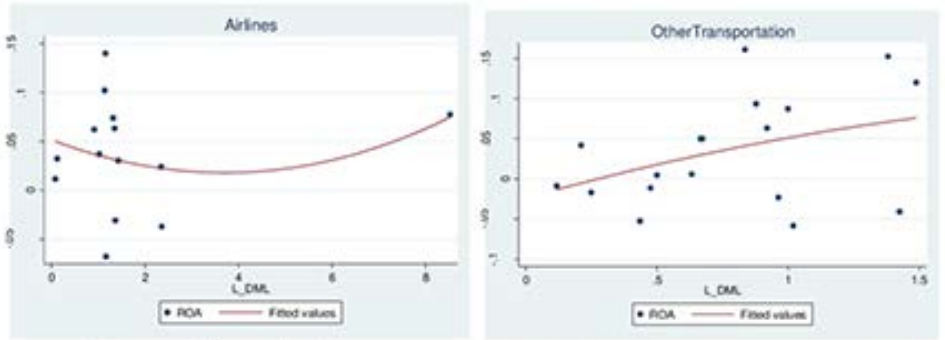
Figure 6. Fitting diagram of the digital maturity level and financial performance for sectors that have an inverse U-shaped relationship



a. Information, communication and publishing activities



b. Construction and public works



c. Transportation and storage

4.4. Addressing the Endogeneity Problem

The relationship between DML and FP may suffer from reverse causality, leading to an endogeneity issue. Firms with lower performance are more inclined to implement digital transformation to modify their operations. To address this endogeneity concern, the generalized method of moments (GMM) approach (1991) was employed to conduct endogeneity tests.

Following prior studies (Wintoki et al., 2012; Yilmaz et al., 2023), a diagnostic test for strict exogeneity was conducted, as recommended by Wooldridge (2010), according to the Equation 3:

$$Y_{it} = \alpha + \beta X_{it} + \gamma Z_{it+1} + \Omega_{it+1} + u_{it} + e_{it} \quad (3)$$

Where "Zit+1" represents the future values of DML and DML^2 and "Ωit+1" are the future values of SIZE, LEV, and AGE.

Wooldridge test results are presented in Table 6, Model 1. The coefficient estimates for the future values of DML ($\beta = -0.040$, $p < 0.05$) and DML^2 ($\beta = 0.004$, $p < 0.05$) are significantly different from zero. This indicates that there may be an endogeneity problem. Additionally, an F-test examining the joint effect of the coefficient estimates for all future values is significant (2.03, $p < 0.10$). The results of the Wooldridge strict exogeneity test for the dependent variable ROA indicate endogeneity, as they reject Wooldridge's null hypothesis.

After confirming the endogeneity among the variables, we adopted Blundell and Bond's (1998) two-step system (generalized method of moment [GMM]) as the preferred approach to address the endogeneity issues potentially arising from the dynamic nature of our model. We utilized the two-step GMM approach incorporating Windmeijer's (2005) correction. LEV, AGE, and year dummies were considered as exogenous variables, while treating DML, DML^2 and SIZE as endogenous.

The validity of the two-step GMM method can be assessed using various post-estimation tests. Among these tests, Arellano–Bond AR (1) and AR (2) test statistics indicate whether there is first and second order autocorrelation in the model, while Sargan and Hansen (1958, 1982) test statistics indicate whether instrumental variables are valid. Among the autocorrelation tests, the AR(1) test result ($p < 0.05$) is expected to be statistically significant and negative, while the AR(2) test result ($p > 0.1$) is expected to be statistically insignificant. This indicates that although there may be first-order autocorrelation in the model, there is no issue with second-order autocorrelation (Arellano, 2003). The Sargan and Hansen ($p > 0.1$) test results show that the instrumental variables used are valid. Furthermore, the exogeneity of the instrumental variables can be evaluated using the difference Hansen test.

The difference Hansen test shows that there is no endogeneity problem. Thus, the assumptions required for estimation with system GMM are met.

In Table 6, the one-year lagged ROA (0.247, $p<0.05$), the two-year lagged DML (0.073, $p<0.05$) and DML^2 (-0.007, $p<0.05$) and three years lagged DML (-0.095, $p<0.01$) and DML^2 (0.013, $p<0.01$) and one-year lagged LEV (-0.145, $p<0.01$) coefficients were significant. The fact that the one-year lagged ROA was significant shows that previous ROA values have significant effects on the current ROA values. The GMM coefficient estimates for the independent and control variables align with and support the estimates from the models presented in Table 5.

Table 6. Wooldridge test results (Model 1) and GMM results (Model 2)

	Model 1	**Model 2**
Variables	ROA	ROA
DML_{t-1}	-0.001	-0.011
	(0.025)	(0.038)
DML^2_{t-1}	-0.000	0.002
	(0.002)	(0.003)
$SIZE_t$	0.081	
	(0.056)	
LEV_t	-0.234***	
	(0.080)	
AGE_t	1.026	-0.016
	(1.009)	(0.017)
DML_t	-0.040**	
	(0.018)	
DML^2_t	0.004**	
	(0.002)	
$SIZE_{t+1}$	-0.059	
	(0.035)	
LEV_{t+1}	-0.084	
	(0.069)	
AGE_{t+1}	-1.159	
	(1.335)	
ROA_{t-1}		0.247**

continued on following page

Table 6. Continued

	Model 1	Model 2
		(0.109)
DML_{t-2}		0.073**
		(0.034)
DML_{t-3}		-0.095***
		(0.034)
DML^2_{t-2}		-0.007**
		(0.003)
DML^2_{t-3}		0.013***
		(0.004)
$SIZE_{t-1}$		0.001
		(0.010)
LEV_{t-1}		-0.145***
		(0.049)
Constant	0.434	0.255***
	(1.341)	(0.080)
Number of instruments		71
Arellano–Bond AR (1)		-2.07**
Arellano–Bond AR (2)		-1.29
Hansen test (p value)		49.25 (0.758)
Observations	269	210
R-squared	0.288	
Number of HisseID	59	56

Year dummies are treated as exogenous variables, and they are unreported.
The model is estimated with system GMM, two-step, Windmeijer correction.
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5. CONCLUSIONS AND DISCUSSIONS

Given the accelerated evolution of information technologies, digital transformation has become a vital strategic focus for firms aiming to improve their performance in the dynamic business environment. The implementation of digital technologies provides a competitive advantage by reducing costs and increasing quality, leading to a different positioning in the market. To achieve this goal and display better financial

results from digital resources, firms must have talented employees with adequate training. This study explores whether digital maturity level of firms affects financial performance by running text mining analysis to the annual reports of service sector firms listed on Borsa Istanbul for the years 2016-2022. MAXQDA software was used to analyze the frequencies of digitalization related keywords in the annual reports.

The findings indicate a distinct U-shaped relationship between DML and FP. The initial excitement surrounding digital transformation can wane as firms struggle with the cultural shift required for successful digitalization. As argued by Kane et al. (2015), organizational culture is one of the primary barriers to digital transformation, as employees often resist new technologies that challenge established routines. Westerman, Bonnet, and McAfee (2014) emphasize that without strong digital leadership and a culture that supports experimentation, firms fail to sustain momentum in their digital efforts. Therefore, companies initially experience a decline in FP as they bear the investment and adaptation costs of digitalization. This decline can be attributed to their inability to fully leverage digital tools due to cultural adaptation and internal resistance. Managers should also gain the required expertise to efficiently use these tools, which take some time depending upon the integration speed of digital processes. As entities develop a more mature digital culture, the preliminary negative effects gradually diminish with a time lag and become positive with the deepening of digitalization process. This may be due to better acceptance and utilization of DT by employees and executive managers. This finding indicates that the cost of some DT investments, e.g. data analytics, AI, might be so high that the time-to-payoff would be extensive, influencing FP over time as argued by Wamba et al. (2017). Thus, as firms embrace digital transformation and reach a certain level of digital maturity, they reap the rewards of digital investments such as better relationships with customers, suppliers and other stakeholders, leading to significant improvements in FP. Finally, the findings reveal that the relationship between DML and FP varies across information, communication and publishing activities, construction and public works, and transportation and storage sectors due to diverse characteristics of firms in these sub-sectors.

5.1. Theoretical and Managerial Implications

5.1.1. Theoretical implications

This study offers important theoretical implications and enriches the literature on the relationship between digital maturity and firm performance. Within the theoretical framework of the RBV, this study pinpoints the strategic features of digitalization as a competitive resource to show how accelerated digitalization may increase financial performance. However, as argued by Lichtenthaler (2019), having

digital technologies as strategic resources is not enough. Firms should dynamically combine their human and digital architecture to sustain competitive advantages. This approach also aligns with the intelligence-based view that highlights the importance of integrating digital technologies to enhance firm performance. Thus, our findings have significant implications for the RBV, enriching its relevance and application in digital era.

5.1.2. Managerial implications

This study yields several implications for companies and policy makers. For companies, the digitization process requires significant investment in technology, skills and cultural change. Therefore, it is important for firms to have a well-defined digitization strategy, considering the specific needs and goals of the company. Firms should not only consider the technological aspect of digital transformation but also align it with strategic objectives to maximize its financial impact. On this respect, they must cultivate skillful human resources with different digital experiences to boost the financial benefits of digitalization. Second, the notification and disclosure of digital progresses in the annual report have an impact on the perceived value, encouraging investors to increase their investment. Thus, companies should pay close attention to the value offerings on digitalization and take the necessary actions for positively influencing the perception of stakeholders through their reports and disclosures. Ultimately, firms should gradually formulate digitalization strategies and maneuver digital sphere in a reasonable manner to get expected financial gains.

Promoting the digital maturity of firms also requires the efforts of government and policymakers. It is essential for government to encourage digitalization on firm level through preferential policies. Policymakers should also strengthen cybersecurity and data governance matters. To address the risk of information leakage resulting from digital transformation, policymakers should empower data protection regulations concerning intellectual property rights, enhance cross-sector standards for secure data sharing, and expand compliance support programs to help firms implement robust protective measures. For emerging markets, policymakers must also address structural constraints such as limited digital infrastructure and unequal access to high-speed internet, which can hinder firms' ability to adopt advanced technologies. They should design capacity-building initiatives that support small and medium-sized firms in acquiring the skills and resources needed to participate in the digital economy.

5.2. Limitations of the Study and Future Research

We recognize that our study has several limitations that offer avenues for future exploration. First, the sample consists of only Turkish companies. This may hinder the generalizability of the results due to the different set of digital capabilities in other emerging markets. Future research may extend the coverage and make cross-country analysis. Second, this study includes only service sector firms. Digital orientation of manufacturing firms may reveal different results due to their diverse profile. Third, this work does not use any moderating or mediating variable that may further explain the interplay between digital maturity and financial performance. Future studies may employ moderating or mediating variables to get more refined results. Finally, there is limited data and information available on digitalization in the annual reports of firms due to corporate confidentiality. Future research may collect primary data to enhance the validity of the findings.

REFERENCES

AlMulhim, A. F. (2021). Smart supply chain and firm performance: The role of digital technologies. *Business Process Management Journal*, *27*(5), 1353–1372. DOI: 10.1108/BPMJ-12-2020-0573

Andersen, E. (2023). *Digital technology on financial performance.* BI Norwegian Business School, Master Thesis.

Arellano, M. (2003). *Panel data econometrics*. Oxford University Press. DOI: 10.1093/0199245282.001.0001

Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The Review of Economic Studies*, *58*(2), 277–297. DOI: 10.2307/2297968

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, *17*(1), 99–120. DOI: 10.1177/014920639101700108

Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, *87*(1), 115–143. DOI: 10.1016/S0304-4076(98)00009-8

Bouwman, H., Nikou, S., Molina-Castillo, F. J., & de Reuver, M. (2018). The impact of digitalization on business models. *Digital Policy. Regulation & Governance*, *20*(2), 105–124.

Brinch, M., Gunasekaran, A., & Wamba, S. F. (2021). Firm-level capabilities towards big data value creation. *Journal of Business Research*, *131*, 539–548. DOI: 10.1016/j.jbusres.2020.07.036

Bughin, J., & van Zeebroeck, N. (2017). The best response to digital disruption. *MIT Sloan Management Review.* https://sloanreview.mit.edu/article/the–right–response–to–digital–disruption/

Cherkasova, V. A., & Slepushenko, G. A. (2021). The impact of digitalization on the financial performance of Russian companies. *Finance: Theory and Practice*, *25*(2), 128–142.

Chin, H.-S., Marasini, D. P., & Lee, D.-H. (2023). Digital transformation trends in service industries. *Service Business*, *17*(1), 11–36. DOI: 10.1007/s11628-022-00516-6

Dahlman, C., Mealy, S., & Wermelinger, M. (2016). *Harnessing the digital economy for developing countries.* OECD Development Centre Working Paper, 334. DOI: DOI: 10.1787/18151949

Deloitte. (2023). *Uncovering the connection between digital maturity and financial performance*. https://www2.deloitte.com/content/dam/insights/us/articles/6561_digital-transformation/DI_Digital-transformation.pdf

Dobbs, R., Koller, T., Ramaswamy, S., Woetzel, J., Manyika, J., Krishnan, R., & Andreula, N. (2015). *Playing to win: The new global competition for corporate profits*. McKinsey Global Institute.

Dreisbach, C., Koleck, T. A., Bourne, P. E., & Bakken, S. (2019). A systematic review of natural language processing and text mining of symptoms from electronic patient-authored text data. *International Journal of Medical Informatics*, *125*, 37–46. DOI: 10.1016/j.ijmedinf.2019.02.008 PMID: 30914179

Dubey, R., Gunasekaran, A., Childe, S. J., Blome, C., & Papadopoulos, T. (2019). Big data and predictive analytics and manufacturing performance: Integrating institutional theory, resource-based view and big data culture. *British Journal of Management*, *30*(2), 341–361. DOI: 10.1111/1467-8551.12355

Dutta, A., Lee, H., & Yasai-Ardekani, M. (2014). Digital systems and competitive responsiveness: The dynamics of IT business value. *Information & Management*, *51*(6), 762–773. DOI: 10.1016/j.im.2014.05.005

Fernandez-Portillo, A., Almodovar-Gonzalez, M., Sanchez-Escobedo, M. C., & Coca-Perez, J. L. (2022). The role of innovation in the relationship between digitalisation and economic and financial performance. A company-level research. *European Research on Management and Business Economics*, *28*(3), 100190. DOI: 10.1016/j.iedeen.2021.100190

Fernández-Rovira, C., Valdés, J. Á., Molleví, G., & Nicolas-Sans, R. (2021). The digital transformation of business. Towards the datafication of the relationship with customers. *Technological Forecasting and Social Change*, *162*, 120339. DOI: 10.1016/j.techfore.2020.120339

Fu, T., & Li, J. (2023). An empirical analysis of the impact of ESG on financial performance: The moderating role of digital transformation. *Frontiers in Environmental Science*, *11*, 1256052. DOI: 10.3389/fenvs.2023.1256052

Gebauer, H., Fleisch, E., Lamprecht, C., & Wortmann, F. (2020). Growth paths for overcoming the digitalization paradox. *Business Horizons*, *63*(3), 313–323. DOI: 10.1016/j.bushor.2020.01.005

Gebauer, H., Paiola, M., Saccani, N., & Rapaccini, M. (2021). Digital servitization: Crossing the perspectives of digitization and servitization. *Industrial Marketing Management*, *93*, 382–388. DOI: 10.1016/j.indmarman.2020.05.011

Guo, L., & Xu, L. (2021). The effects of digital transformation on firm performance: Evidence from China's manufacturing sector. *Sustainability (Basel)*, *13*(22), 12844. DOI: 10.3390/su132212844

Gurbaxani, V., & Dunkle, D. (2019). Gearing up for successful digital transformation. *MIS Quarterly Executive*, *18*(3), 6. DOI: 10.17705/2msqe.00017

Haans, R. F., Pieters, C., & He, Z. L. (2016). Thinking about U: Theorizing and testing U-and inverted U-shaped relationships in strategy research. *Strategic Management Journal*, *37*(7), 1177–1195. DOI: 10.1002/smj.2399

Hansen, L. P. (1982). Large sample properties of generalized method of moments estimators. *Econometrica*, *50*(4), 1029–1054. DOI: 10.2307/1912775

He, F., & Liu, H. (2019). Assessment of the performance enhancemen effect of digital change in real enterprises from the perspective of digital economy. *Reformation*, *04*, 137–148.

Heiets, I., La, J., Zhou, W., Xu, S., Wang, X., & Xu, Y. (2022). Digital transformation of airline industry. *Research in Transportation Economics*, *92*, 101186. DOI: 10.1016/j.retrec.2022.101186

Hess, T., Matt, C., Benlian, A., & Wiesböck, F. (2016). Options for formulating a digital transformation strategy. *MIS Quarterly Executive*, *15*(2), 123–139.

Huang, C., Wang, H. T., & Huang, T.-Y. (2020). Initial evidence on the impact of big data implementation on firm performance. *Information Systems Frontiers*, *22*(2), 475–487. DOI: 10.1007/s10796-018-9872-5

Immonen, M., & Sintonen, S. (2015). Evolution of technology perceptions over time. *Information Technology & People*, *28*(3), 589–606. DOI: 10.1108/ITP-12-2013-0219

Jardak, M. K., & Ben Hamad, S. (2022). The effect of digital transformation on firm performance: Evidence from Swedish listed companies. *The Journal of Risk Finance*, *23*(4), 329–348. DOI: 10.1108/JRF-12-2021-0199

Kane, G. C., Palmer, D., Phillips, A. N., Kiron, D., & Buckley, N. (2015). Strategy, not technology, drives digital transformation. *MIT Sloan Management Review*.

Kohtam¨aki, M., Parida, V., Patel, P. C., & Gebauer, H. (2020). The relationship between digitalization and servitization: The role of servitization in capturing the financial potential of digitalization. *Technological Forecasting and Social Change*, *151*(6), 119804. DOI: 10.1016/j.techfore.2019.119804

Kuang, Y., Fan, M., Fan, Y., Jiang, Y., & Bin, J. (2023). Digitalization, financing constraints and firm performance. *Frontiers in Environmental Science*, *11*, 1090537. DOI: 10.3389/fenvs.2023.1090537

Kumar, V., & Sandhu, A. (2018). From bricks to mobile: The evolution of the retail shop and the role of technology. *Journal of the Academy of Marketing Science*, *46*(4), 537–556.

Lee, S., & Lim, S. (2018). *Living innovation: from value creation to the greater good*. Emerald Publishing Limited. DOI: 10.1108/9781787567139

Lee, W., Jang, S. S., & Kim, H. S. (2024). The effect of digital transformation: Boosting productivity in the restaurant industry. *International Journal of Hospitality Management*, *123*, 103896. DOI: 10.1016/j.ijhm.2024.103896

Lei, L., Yang, S., & Chen, N. (2022). The impact of digital transformation on enterprise investment efficiency. *Soft Science*, *36*(11), 23–29.

Libert, B., Beck, M., & Wind, Y. (2016). Questions to ask before your next digital transformation. *Harvard Business Review*, *60*(12), 11–13.

Lichtenthaler, U. (2019). An intelligence-based view of firm performance: Profiting from artificial intelligence. *Journal of Innovation Management*, *7*(1), 7–20. DOI: 10.24840/2183-0606_007.001_0002

Lind, J. T., & Mehlum, H. (2010). With or Without U? – The appropriate test for a U-shaped relationship. *Oxford Bulletin of Economics and Statistics*, *72*(1), 109–118. DOI: 10.1111/j.1468-0084.2009.00569.x

Lozić, J., & Čiković, K. F. (2021). The impact of digital transformation on the business efficiency of the New York Times. *UTMS Journal of Economics, 12*(2), 225-239.

Marjaei, S., Yazdi, F. A., & Chandrashekara, M. (2019). MAXQDA and its application to LIS research. *Library Philosophy and Practice,* 1-9. Retrieved from https://www.proquest.com/scholarly-journals/maxqda-application-lis-research/docview/2236131089/se-2

Martín-Peña, M.-L., Sánchez-López, J.-M., & Díaz-Garrido, E. (2019). Servitization and digitalization in manufacturing: The influence on firm performance. *Journal of Business and Industrial Marketing*, *35*(3), 564–574. DOI: 10.1108/JBIM-12-2018-0400

Masoud, R., & Basahel, S. (2023). The effects of digital transformation on firm performance: The role of customer experience and IT innovation. *Digital*, *3*(2), 109–126. DOI: 10.3390/digital3020008

Menon, V., Sigurdsson, V., Larsen, M., Fagerstrøm, A., Sørensen, H., Marteinsdottir, H. G., & Foxall, G. R. (2019). How to grow brand post engagement on Facebook and twitter for airlines? An empirical investigation of design and content factors. *Journal of Air Transport Management*, *79*, 90–95. DOI: 10.1016/j.jairtraman.2019.05.002

Mikalef, P., Boura, M., Lekakos, G., & Krogstie, J. (2019). Big data analytics and firm performance: Findings from a mixed-method approach. *Journal of Business Research*, *98*, 261–276. DOI: 10.1016/j.jbusres.2019.01.044

Mithas, S., Tafti, A., Bardhan, I. R., & Goh, J. M. (2012). Information technology and firm profitability: Mechanisms and empirical evidence. *Management Information Systems Quarterly*, *36*(1), 205–224. DOI: 10.2307/41410414

Mun, S. G., & Jang, S. S. (2018). Restaurant operating expenses and their effects on profitability enhancement. *International Journal of Hospitality Management*, *71*, 68–76. DOI: 10.1016/j.ijhm.2017.12.002

Nasiri, M., Ukko, J., Saunila, M., Rantala, T., & Rantanen, H. (2020). Digital-related capabilities and financial performance: The mediating effect of performance measurement systems. *Technology Analysis and Strategic Management*, *31*(12), 1393–1406. DOI: 10.1080/09537325.2020.1772966

Nayyar, G., Hallward-Driemeier, M., & Davies, E. (2021). *At Your Service: the Promise of Services-Led Development*. World Bank Publications., DOI: 10.1596/978-1-4648-1671-0

Ndubuisi, G., Owusu, S., Asiama, R., & Avenyo, E. K. (2023). Drivers of services sector growth acceleration in developing countries. World Institute for Development Economics Research (WIDER). *Working Paper*, *2023*(87).

Paiola, M., & Gebauer, H. (2020). Internet of things technologies, digital servitization and business model innovation in BtoB manufacturing firms. *Industrial Marketing Management*, *89*, 245–264. DOI: 10.1016/j.indmarman.2020.03.009

Parida, V., Sjödin, D., & Reim, W. (2019). Reviewing literature on digitalization, business model innovation, and sustainable industry: Past achievements and future promises. *Sustainability (Basel)*, *11*(2), 1102391. DOI: 10.3390/su11020391

Ribeiro-Navarrete, S., Botella-Carrubi, D., Palacios-Marqués, D., & Orero-Blat, M. (2021). The effect of digitalization on business performance: An applied study of KIBS. *Journal of Business Research*, *126*, 319–326. DOI: 10.1016/j.jbusres.2020.12.065

Rivard, S., Raymond, L., & Verreault, D. (2006). Resource-based view and competitive strategy: An integrated model of the contribution of information technology to firm performance. *The Journal of Strategic Information Systems*, *15*(1), 29–50. DOI: 10.1016/j.jsis.2005.06.003

Rodriguez, J. L., & Rodriguez, R. M. G. (2005). Technology and export behaviour: A resource-based view approach. *International Business Review*, *14*(5), 539–557. DOI: 10.1016/j.ibusrev.2005.07.002

Roy, S. K., Balaji, M., Sadeque, S., Nguyen, B., & Melewar, T. (2017). Constituents and consequences of smart customer experience in retailing. *Technological Forecasting and Social Change*, *124*, 257–270. DOI: 10.1016/j.techfore.2016.09.022

Rybchak, Z., & Basystiuk, O. (2017). Analysis of methods and means of text mining. *ECONTECHMOD: An International Quarterly Journal on Economics of Technology and Modelling Processes*, *6*(2), 73–78.

Sargan, J. D. (1958). The estimation of economic relationships using instrumental variables. *Econometrica*, *26*(3), 393–415. DOI: 10.2307/1907619

Sheng, J., Amankwah-Amoah, J., & Wang, X. (2019). Technology in the 21st century: New challenges and opportunities. *Technological Forecasting and Social Change*, *143*, 321–335. DOI: 10.1016/j.techfore.2018.06.009

Skorupinska, A., & Torrent-Sellens, J. (2017). ICT, innovation and productivity: Evidence based on eastern European manufacturing companies. *Journal of the Knowledge Economy*, *8*(2), 768–788. DOI: 10.1007/s13132-016-0441-1

Truant, E., Broccardo, L., & Dana, L. (2021). Digitalisation boosts company performance: An overview of Italian listed companies. *Technological Forecasting and Social Change*, *173*, 121173. DOI: 10.1016/j.techfore.2021.121173

Valaskova, K., Nagy, M., & Juracka, D. (2025). Digital transformation and financial performance: An empirical analysis of strategic alignment in the digital age. *Journal of Enterprising Communities: People and Places in the Global Economy*, *19*(5), 1178–1205. DOI: 10.1108/JEC-11-2024-0241

Verhoef, P. C., Broekhuizen, T., Bart, Y., Bhattacharya, A., Dong, J. Q., Fabian, N., & Haenlein, M. (2019). Digital transformation: A multidisciplinary reflection and research agenda. *Journal of Business Research*, *122*(1), 889–901.

Vial, G. (2019). Understanding digital transformation: A review and a research agenda. *The Journal of Strategic Information Systems*, *28*(2), 118–144. DOI: 10.1016/j.jsis.2019.01.003

Vitari, C., & Raguseo, E. (2016). Digital data, dynamic capability and financial performance: An empirical investigation in the era of big data. *Systemes d'Information Management*, *21*(3), 63–92. DOI: 10.3917/sim.163.0063

Vu, K. M. (2011). ICT as a source of economic growth in the information age: Empirical evidence from the 1996-2005 period. *Telecommunications Policy*, *35*(4), 357–372. DOI: 10.1016/j.telpol.2011.02.008

Wamba, S. F., Gunasekaran, A., Akter, S., Ren, S. J., Dubey, R., & Childe, S. J. (2017). Big data analytics and firm performance: Effects of dynamic capabilities. *Journal of Business Research*, *70*, 356–365. DOI: 10.1016/j.jbusres.2016.08.009

Westerman, G., Bonnet, D., & McAfee, A. (2014). *Leading digital: Turning technology into business transformation*. Harvard Business Review Press.

Windmeijer, F. (2005). A finite sample correction for the variance of linear efficient two-step GMM estimators. *Journal of Econometrics*, *126*(1), 25–51. DOI: 10.1016/j.jeconom.2004.02.005

Wintoki, M. B., Linck, J. S., & Netter, J. M. (2012). Endogeneity and the dynamics of internal corporate governance. *Journal of Financial Economics*, *105*(3), 581–606. DOI: 10.1016/j.jfineco.2012.03.005

Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data*. The MIT Press.

World Economic Forum. (2024). The digital economy. https://intelligence.weforum.org/topics/a1Gb0000001SH21EAG

Worldbank. (2024). World Development Indicators: Structure of value. https://wdi.worldbank.org/table/4.2

Wroblewski, J. B. (2018). *Digitalization and firm performance: Are digitally mature firms outperforming their peers?* Lund University School of Economics and Management, Master Thesis.

Wu, F., Hu, H. Z., Lin, H. Y., & Ren, X. Y. (2021). Digital transformation of enterprises and capital market performance: Empirical evidence from stock liquidity. *Journal of Management World*, *37*(07), 130–144.

Yilmaz, M.K., Hacioglu, U., Tatoglu, E., Aksoy, M., & Duran, S. (2023). Measuring the impact of board gender and cultural diversity on corporate governance and social performance: evidence from emerging markets. *Economic Research-Ekonomska Istraživanja, 36(*2).

Yonghong, L., Jie, S., Ge, Z., & Ru, Z. (2023). The impact of enterprise digital transformation on financial performance-Evidence from Mainland China manufacturing firms. *MDE. Managerial and Decision Economics*, *44*(4), 2110–2124. DOI: 10.1002/mde.3805

Zeng, H., Ran, H., Zhou, Q., Jin, Y., & Cheng, X. (2022). The financial effect of firm digitalization: Evidence from China. *Technological Forecasting and Social Change*, *183*, 121951. DOI: 10.1016/j.techfore.2022.121951

Zhao, X., Li, X., Li, Y., & Wang, Z. (2024). The impact of digital transformation on firm performance. *Industrial Management & Data Systems*, *124*(8), 2567–2587. DOI: 10.1108/IMDS-09-2023-0661

Zhou, Y., Ock, Y.-S., Alnafrah, I., & Dagestani, A. A. (2023). What aspects explain the relationship between digital transformation and financial performance of firms? *Journal of Risk and Financial Management*, *16*(11), 110479. DOI: 10.3390/jrfm16110479