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Digital transformation: An empirical analysis of operational efficiency, customer experience, and competitive advantage in Jordanian Islamic banks

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A B S T R A C T

This research aims to investigate the impact of digital transformation on the operational efficiency, customer experience, competitive advantage, organizational performance, and risk management in Jordanian Islamic banks. A descriptive analytical method was used, collecting primary data from a survey of 68 employees across four Islamic banks. Statistical tools, including linear regression and correlation, were used for data analysis and hypothesis testing. The findings revealed that digital transformation significantly influences the operational efficiency, competitive advantage, customer experience, organizational performance, and risk management of Islamic banks at a significance level of $\alpha \leq 0.05$. While digital transformation generally enhanced operational outcomes and customer experience, it also increased exposure to risks such as electronic attacks, fraud, and privacy concerns. The results highlight the importance of integrating digital transformation in Islamic banking while employing robust risk management strategies. These findings provide insights for policymakers, bank managers, and researchers in formulating strategic initiatives for digital transformation in the banking sector. The research contributes to the literature by focusing on the role of digital transformation in Islamic banking, a less-explored area in academic studies. This research also presents valuable implications for practice, specifically for banks and regulators to balance the potential of digital transformation with the associated risks.

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1. Introduction

The dawn of the Fourth Industrial Revolution marks a transformative era, primarily driven by rapid advancements in digital technologies (Almaiah et al., 2022a,b; Saad et al., 2022). This period is characterized by the sweeping adoption of digital tools like the Internet and social networks, reshaping the global economic and social landscape (Khassawneh, 2014; Lutfi et al., 2022a). As highlighted by scholars such as Roblek et al. (2020), this era transcends technological advancements, embodying a holistic digital transformation with profound implications for sustainable development. Nowhere is this transformation more evident than in the financial sector, where digitalization has catalyzed the emergence of innovative business models, notably within FinTech "Financial Technology" companies. By leveraging digital platforms and technologies, these companies have revolutionized financial services delivery (Marei et al., 2023; Wang et al., 2022). Digitalization serves as a strategic tool, transforming organizational value chains and enhancing customer and stakeholder value, thereby boosting organizational

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performance (Hatamlah et al., 2023; Lutfi et al., 2022b). In the realm of finance, it paves the way for new value propositions, business model innovation, and transformed ecosystems, contributing to both operational efficiency and sustainable development.

In the banking industry, a sector at the forefront of the digital revolution, significant changes are taking place, driven by the integration of advanced digital technologies (Rabbani et al., 2023). This transformation is especially pronounced in Islamic banks, which not only navigate the usual challenges of digitalization but also adhere to unique principles governed by Islamic law, such as the prohibition of interest (Riba) and the requirement of asset-backed financing. The digital transformation journey for Islamic banks in Jordan is thus layered with additional complexity (Alrfai et al., 2023). Jordan's active pursuit of digital banking initiatives, aligned with its vision for a digital economy, provides a fertile ground for Islamic banks to explore innovative ways of integrating digital technologies while staying true to their foundational principles (Jardak & Ben Hamad, 2022; Atif et al., 2021).

This evolution within Islamic banks is further catalyzed by national strategies steered by the Jordanian government and the Central Bank of Jordan (CBJ). The National Digital Transformation Strategy 2021-2025, for instance, outlines a framework for integrating digital technologies in the banking sector, placing a strong emphasis on developing the digital infrastructure essential for the operational efficiency of Islamic banks. Complementing this is the National Electronic Payments Strategy 2023-2025, which focuses on accelerating the adoption of digital and contactless payments, aligning with the principles of efficiency and customer convenience. The "Central Bank of Jordan "CBJ's support for digital wallets and e-Fawateercom for electronic bill payments exemplifies the efforts toward financial inclusion and digital accessibility. Furthermore, the National Artificial Intelligence (AI) Strategy and the Executive Plan 2023-2027 underscore the use of AI and data analytics to enhance the customer experience and competitive edge in banking operations. Collectively (Almaiah et al., 2022e), these strategies form a supportive ecosystem that guides Islamic banks in Jordan toward a holistic and secure digital transformation.

Building upon this dynamic environment, this study aims to assess the impact of digital transformation on Islamic banks in Jordan. It delves into operational efficiency, competitive advantage, customer experience, and organizational performance, while considering the potential risks (Alrawad et al., 2023a; Alshirah et al., 2022). The primary question, 'How does digital transformation impact the operations of Islamic banks in Jordan?' seeks to explore the multifaceted influence of this technological shift.

Understanding the impact of digital transformation is crucial in the context of the Fourth Industrial Revolution, which is reshaping industries globally, including banking. This is especially relevant for Islamic banks in Jordan, whose operations are deeply intertwined with Islamic principles. These banks play a vital role in Jordan's economy, and understanding the complexities they face in their digital transformation journey is invaluable for policymakers, banking professionals, and investors. Moreover, this study can offer insights applicable to other countries with significant Islamic finance sectors.

A significant aspect of this research is its focus on how digital transformation influences customer experience and organizational performance in Islamic banks. Enhanced customer experience, a key result of effective digital transformation, is critical in promoting customer loyalty and financial performance. This relationship is supported by recent studies (Yu et al., 2022; Peng & Tao, 2022; Zhai et al., 2022) highlighting the strategic importance of customer-centric approaches in the banking sector's digital era.

This study addresses a critical gap in the existing literature by providing a comprehensive analysis of the impact of digital transformation on Islamic banks in Jordan, particularly in areas of operational efficiency, competitive advantage, and customer experience. The unique compliance with Islamic principles in these banks presents a rich context for exploring the ways digital transformation is navigated while adhering to foundational values.

Therefore, this research offers valuable insights for academic researchers, banking professionals, and policymakers. It supports strategic decision-making and the successful integration of digital technologies within the unique framework of Islamic banking principles, using a descriptive analytical approach.

The remainder of the paper is organized as follows: Section 2 reviews the relevant literature; Section 3 explains the research methodology; Section 4 presents the study findings; and the final section offers recommendations and future research directions.

2. Literature Review and Hypotheses Development

The Fourth Industrial Revolution (4IR) represents a significant shift in the global landscape, characterized by the convergence of digital, physical, and biological systems. This transformation is notably evident in the banking sector, where advancements in AI, big data, blockchain, and the Internet of Things (IoT) are reshaping operations (Mavlutova et al., 2022). Scholars such as Schwab (2017) emphasize that the 4IR has the potential to redefine customer experiences, operational processes, and business models in banking, a trend increasingly embraced worldwide (Bican & Brem, 2020; Scardovi, 2017; Kraus et al., 2021).

Within this transformative era, Islamic banks face the unique challenge of aligning modern technologies with Shariah law. Research by Chong and Liu (2009) and Ahmed (2019) highlights the way digital transformation can enhance transparency and inclusivity in Islamic banking, ensuring compliance with Islamic principles. However, research specifically on Islamic banks in Jordan, such as that conducted by Al-Jabri and Sohail (2012) and Alalwan et al. (2017), remains limited, especially in illustrating the comprehensive impact of digital transformation.

The integration of digital technologies like AI, cloud computing, and data analytics is pivotal in enhancing operational efficiency and securing a competitive edge in the banking sector. Studies by Verhoef et al. (2021) demonstrate how digital transformation leads to disruptive innovations in banking. Additionally, the research of Kitsios and Kamariotou (2021) and Van Veldhoven and Vanthienen (2022) supports the notion that digital transformation is necessary for sustained success and not just a strategic choice in the rapidly evolving business landscape.

Adopting digital transformation involves navigating challenges such as cybersecurity, talent acquisition, and the integration of digital tools (Kraus et al., 2022). However, the potential benefits, including improved efficiency, cost savings, and enhanced innovation, are significant (Gil-Gomez et al., 2020; Baiyere et al., 2020). These benefits are particularly relevant for Islamic banks, where digital technologies can lead to improved operational processes and customer service delivery in line with Islamic banking principles (Mustafa et al., 2023).

Despite the extensive discourse on digital transformation in the global banking sector, there is a notable gap in the literature specifically concerning Islamic banks in Jordan. While studies like those by Al-Jabri and Sohail (2012) and Alalwan et al. (2017) have begun exploring the adoption of Internet and mobile banking in Jordan, they do not fully capture the broader impact of digital transformation on operational efficiency, performance, competitive advantage, and risk management within the Jordanian Islamic banking context (Shatnawi et al., 2022). This gap is significant, considering the unique challenges and opportunities faced by Islamic banks due to religious, ethical, and legal considerations in the digital era. Furthermore, the existing literature largely overlooks how these banks can strategically leverage digital transformation while adhering to Shariah law. Therefore, this study aims to fill this gap by providing an in-depth analysis of the ways digital transformation affects Islamic banks in Jordan, contributing to a more nuanced understanding of the intersection between modern technological advancements and Islamic banking principles. Based on these objectives, we propose the following hypotheses:

Main Hypothesis: *There is no statistically significant impact at the significance level ($\alpha \leq 0.05$) of digital transformation on Islamic banks operating in Jordan.*

Fig. 1 represents the suggested study model and an explanation of each variable is provided in the following sub-sections.

2.1. Operational Efficiency (OE) is understood as the degree to which an organization efficiently converts inputs into outputs, a concept of paramount importance in the context of digital transformation (DT) in banking sectors (Nadkarni & Haider, 2022; Akhtar et al., 2023). In the case of Islamic banks operating in Jordan, OE can be measured by the extent to which DT facilitates banking processes, reduces costs, and ultimately contributes to overall performance.

The adoption of digital technology in Islamic banks is anticipated to streamline processes, minimize manual intervention, and reduce errors, thereby leading to enhanced OE. Research in the service sector, including studies by Wujarso (2023) and Shehadeh et al. (2023a), has demonstrated a significant positive impact of DT on OE, particularly in Islamic banks. The literature further suggests that leveraging advanced technologies like AI, cloud computing, and data analytics can significantly enhance operational efficiency and drive superior business outcomes (Bican & Brem, 2020).

Technologies such as artificial intelligence, cloud computing, and data analytics have been identified as crucial components in fortifying operational efficiency. They streamline intricate processes and steer organizations toward superior business outcomes, as observed by Kitsios and Kamariotou (2021) and Kraus et al. (2021). However, the specific relationship between DT and OE in the unique context of Islamic banks in Jordan remains an under-researched area. Considering the distinct operational characteristics of these banks, including their adherence to Sharia law, exploring the effect of DT on OE can reveal insightful findings. Therefore, to address this gap, our study formulates the following hypothesis:

H_1: *There is no statistically significant effect at the significance level ($\alpha \leq 0.05$) of digital transformation on operational efficiency at Islamic banks operating in Jordan.*

2.2. Competitive Advantage (CA) can be defined as the superior position a business entity attains when it can provide the same value as its competitors but at a lower cost or can charge higher prices by providing greater value through differentiation. In the context of Islamic banks operating in Jordan, CA can be gauged by their ability to offer unique, value-added services to their customers effectively and efficiently, enabled by DT (Mohammadian & Bafti, 2023).

CA is a crucial element in assessing the impact of DT, particularly in the banking sector where competition is fierce. Research across various global contexts, including both developed and developing economies, has consistently highlighted the positive influence of DT on attaining a competitive edge. For instance, studies have shown that digital technologies significantly enhance CA in sectors such as financial technologies (Leão & da Silva, 2021), mobile payments (Shehadeh et al., 2023b), and broader FinTech services (Do et al., 2022). The integration of cutting-edge technologies not only provides a competitive

advantage but has also become essential for survival in today's dynamic marketplace (Zaoui & Souissi, 2020). DT acts as a dynamic force reshaping business paradigm, ushering in a new era where adaptability and innovation are key to organizational development (Chen et al., 2021). Leveraging DT allows companies to automate processes, gain deeper insights through advanced analytics, and stay ahead of the curve (Baiyere et al., 2020; Van Veldhoven & Vanthienen, 2022). In Islamic banking, DT is expected to create CA by offering services that are compliant with Sharia law, providing personalized customer experiences, and ensuring efficient operations. Research, including that of Shehadeh et al. (2023a), points to the positive impact of DT on CA in service sectors, including Islamic banking. However, research exploring the impact of DT on CA specifically in the context of Islamic banks in Jordan remains limited. Given the unique operational environment of these institutions, understanding the influence of DT can provide distinct insights. Therefore, our study proposes the following hypothesis:

H_2: *There is no statistically significant effect at the significance level ($\alpha \leq 0.05$) of digital transformation on the (CA) at Islamic banks operating in Jordan.*

2.3 Customer Experience (CE) is a crucial concept in the banking sector, particularly within the context of digital transformation (DT). Defined as the customer's perception and reaction resulting from the actual or anticipated use of a company's products or services (Sahu, Deng, & Mollah, 2018), CE is a determinant of success in the increasingly digitalized banking landscape. For Islamic banks operating in Jordan, the implementation of DT can significantly enhance CE by offering convenient, user-friendly, and personalized banking services.

CE is a vital indicator in assessing the effectiveness of DT, especially in the service sector where customer interaction is key (Huseynov, 2021). A growing body of research across diverse global contexts has consistently highlighted DT's positive impact on CE (Ramesh, 2022). This enhancement is evident in various sectors, including financial technologies (Abuhasan & Moreb, 2021), mobile banking (Mariia et al., 2020), and broader FinTech services (Ahmed et al., 2021). The literature also emphasizes the transformative role of digital technologies in improving customer engagement and decision-making processes (Baiyere et al., 2020; Bican & Brem, 2020; Nwankpa & Roumani, 2016). In the specific realm of Islamic banking, DT is expected to improve CE by providing seamless, prompt, and secure services that adhere to Sharia law (Masoud & Basahel, 2023). Studies like those of Abuhasan and Moreb (2021) have highlighted the positive effects of DT on the CE in banking services. However, research focusing on the impact of DT on CE, particularly within the context of Islamic banks in Jordan, is not extensive. Given the unique operational environment and service offerings of these banks, exploring how DT influences CE can yield new and valuable insights (Nadkarni & Haider, 2022). Therefore, our study proposes to explore this under-researched area through the following hypothesis:

H_3: *There is no statistically significant effect at the significance level ($\alpha \leq 0.05$) of digital transformation on the customer experience at Islamic banks operating in Jordan.*

This hypothesis aims to investigate the specific nuances of how DT affects CE in the unique setting of Islamic banks in Jordan, contributing to a deeper understanding of the interplay between digital innovations and customer perceptions in the banking sector.

2.4. Organizational Performance (OP) is a multifaceted construct that encompasses various aspects such as profitability, operational efficiency, market share, and customer satisfaction. DT has the potential to enhance OP by streamlining operations, improving service quality, fostering innovation, and enhancing customer satisfaction.

Extensive research across diverse sectors and nations has underscored the positive influence of DT on OP. For instance, empirical evidence from the manufacturing sector (Guo & Xu, 2021), financial sector (Do et al., 2022), power enterprises (Lin & Xie, 2023), and small and medium-sized enterprises (SMEs) (Chen et al., 2016; Mubarak et al., 2019) consistently demonstrates DT's beneficial impact on firm performance. In the banking industry, DT is revolutionizing traditional practices, enabling more efficient, effective, and innovative services. The impact of DT has been particularly notable on Islamic banking, which possesses distinct operational and service principles. Shehadeh et al. (2023a) found that DT significantly enhances operational efficiency and competitive advantage in Islamic banks. The positive correlation between digital technology adoption and various performance indicators is further supported by studies such as those of Gil-Gomez et al. (2020), Manita et al. (2020), and Verhoef et al. (2021). For instance, Ukko et al. (2019) reported that a firm's performance is influenced by its strategy for digital transformation. Businesses investing in digital initiatives typically witness increased productivity, cost savings, and innovation (Bican & Brem, 2020; Gil-Gomez et al., 2020). Additionally, the capacity to adapt to technological changes is often linked to resilience in the face of market disruptions, as highlighted by Kraus et al. (2022), Kraus et al. (2021), and Van Veldhoven and Vanthienen (2022). Nwankpa and Roumani (2016) found that DT positively influences innovation and, in turn, firm performance. However, the specific impact of DT on OP in Islamic banks operating in Jordan remains an under-researched area. Given the unique operational environment and service principles of Islamic banks in Jordan, exploring the effects of DT in this context can provide valuable and distinct insights. Consequently, our study aims to fill this gap by proposing the following hypothesis:

H_4: *There is no statistically significant effect at the significance level ($\alpha \leq 0.05$) of digital transformation on (OP) at Islamic banks operating in Jordan.*

2.5. Risk is a critical aspect that has the potential to shape the outcomes of digital transformation. In the dynamic landscape of digital transformation (DT), the Islamic banking sector in Jordan stands at the intersection of significant opportunities and emerging challenges.

The advent of DT has been instrumental in enhancing operational efficiency and competitive advantage within these institutions, as highlighted by Shehadeh et al. (2023a). However, this transition is not without its complexities, introducing new forms of risk that encompass cybersecurity threats, data privacy issues, and technological uncertainties (Almaiah et al,. 2023). The successful adoption and implementation of DT initiatives hinge on understanding and adeptly managing these risks (Alrawad et al., 2023b). The global financial industry's evolution has been markedly influenced by the advancement of technologies like data analytics, machine learning, and artificial intelligence. As noted by Levine (1993) and Demirgüç-Kunt et al. (2018), these technologies have been pivotal in driving growth and fostering financial inclusion. Yet, the widespread application of cyber technology in banking operations, extensively reviewed by Uddin et al. (2020a); Uddin et al. (2023) and Uddin et al. (2020b), has also paved the way for vulnerabilities and instabilities, particularly stemming from overinvestment in digital infrastructure. Assessments by the World Economic Forum (2019) of the inherent risks in emerging technologies such as artificial intelligence and blockchain resonate with the challenges highlighted by Aseef et al. (2005), Choo (2011), and McConnell et al. (2013), who underscore the inevitability of human error, system faults, and security breaches in technological applications. These factors contribute to the intricacies of the risk landscape in the era of digitalization. Furthermore, the existing literature underscores the impact of DT on risk management across diverse sectors (Almaiah et al., 2022a). Studies in the manufacturing sector (Guo & Xu, 2021), the power industry (Lin & Xie, 2023), and the financial sector (Do et al., 2022) have elucidated the risks associated with DT, offering critical insights into the multifaceted nature of these challenges.

In this context, our study seeks to explore the impact of DT on risk in Islamic banks in Jordan. In formulating the following hypothesis, which is grounded in the theory of information asymmetry (Akerlof, 1970; Alrawad et al., 2023c; Bergh et al., 2019), we delve into the complexities of digital technologies, including AI, and their potential to create information asymmetry and moral hazards (Mirrlees, 1999).

Hence, our study proposes the following hypothesis:

H_5: *There is no statistically significant effect at the significance level ($\alpha \leq 0.05$) of digital transformation on risks at Islamic banks operating in Jordan.*

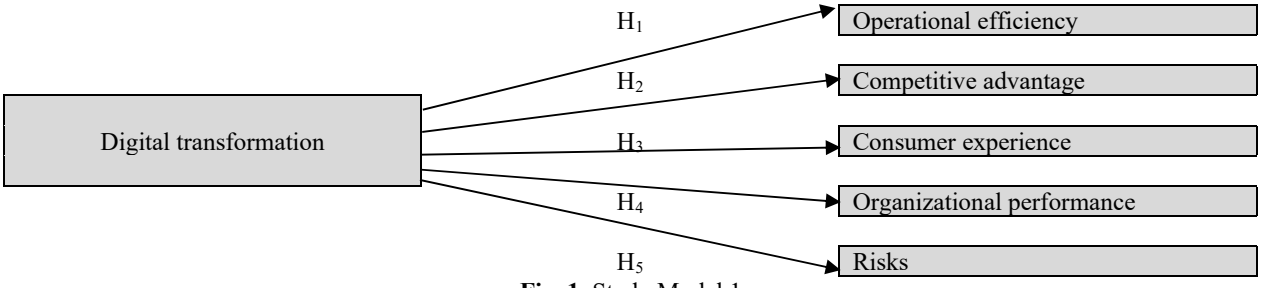

Fig. 1. Study Model 1

3. Research Methodology

To achieve the objectives of the current study, a descriptive analytical method was employed. This method was chosen as it allows for meaningful insights and conclusions to be drawn from the data regarding the digital transformation (DT) in Islamic banks in Jordan. Further, it enables the testing of hypotheses and analysis of data to elucidate the findings of the study. The research was conducted in 2021, during the post-initial outbreak phase of the COVID-19 pandemic. As highlighted by the FSB (2022), the pandemic has had a substantial impact on the acceleration of the digitization of financial services, which can potentially influence the perceptions of bank managers about the relevance of implementing digital strategies and their effect on banks. Therefore, the timing of this study potentially placed it in a period where the influence of the pandemic could impact the views of the respondents.

3.1. Population and Sample of the Study

The study's population included all the Islamic banks operating in Jordan, such as the Jordan Islamic Bank, Islamic International Arab Bank, Al Rajhi Bank, and Safwa Islamic Bank. The sample was selected based on the comprehensive knowledge of employees about DT strategies within these banks, specifically those employed in the technical departments and departments directly involved in implementing digital strategies, including senior management, IT teams, and operations. To ensure a higher response rate, reminders were sent to participants, and the importance of their participation in the research was effectively communicated. A total of 120 questionnaires were disseminated among the four banks, with 30 given to each bank. Out of the 120, 80 were retrieved, providing a response rate of 66.66%. Among the retrieved questionnaires, 12 were

discarded due to incomplete information or errors in filling, leaving a final count of 68 valid responses for analysis. The final response rate, therefore, stood at 56.66%.

3.2. Data Collection

Data collection for the study relied on both primary and secondary sources. Secondary data sources included previous research reports, white papers, and scholarly articles to establish the theoretical framework of the study. On the other hand, primary data were collected through a self-administered questionnaire, which was designed using a five-point Likert scale and distributed among the study sample. Following data collection, the responses were processed and analyzed using Statistical Package for the Social Sciences (SPSS) software version 19.0 to calculate various statistical measures and conduct statistical tests, providing valuable insights to support the study topic.

3.3. Study Instrument

The questionnaire was carefully designed to accurately examine the variables of the study. It underwent a rigorous review process by a panel consisting of 8 academic and industry experts to ascertain its validity and reliability. The purpose of the questionnaire was to capture the attitudes of the study sample toward DT and its impact on Islamic banks in Jordan.

The questionnaire was divided into five domains, each focusing on a specific aspect of DT in the banking industry, such as operational efficiency, competitive advantage, customer experience, organizational performance, and potential risks. Each domain contained four or five items, each providing a five-point Likert scale ranging from "1—strongly disagree" to "5—strongly agree". To ensure the instrument accurately measured the variables under investigation and reflected the credibility of the sample responses, validity and reliability tests were conducted on the questionnaire.

3.4. Instrument Stability Test

The stability of the instrument and the repeatability of the results were tested using Cronbach's alpha coefficient. This measure evaluates the internal consistency of the responses, thereby confirming the reliability of the instrument. Cronbach's alpha is a value between 0 and 1, and a Cronbach's alpha value between 0.6 and 0.8 is considered statistically acceptable depending on the nature and size of the sample and research field (Alsyouf et al., 2023). The results of this test indicated that the questionnaire displayed satisfactory stability across all items, confirming its reliability for hypothesis testing. Table 1 shows that Cronbach's alpha values for all the variables and the overall questionnaire exceeded the minimum acceptable threshold of 0.6, indicating the satisfactory internal consistency and reliability of the responses. Therefore, the questionnaire could be confidently used for data collection in this study.

Table 1
Results of Cronbach's Alpha test for the reliability of the questionnaire

Variable	*Number of Items*	*Alpha Coefficient Value*	*Result*
(OE)	5	0.863	Acceptable
(CA)	5	0.752	Acceptable
(CE)	5	0.884	Acceptable
(OP)	4	0.937	Acceptable
Risks	4	0.859	Acceptable
All Variables	-	0.892	Acceptable

To further understand the respondents' attitudes toward DT and its impact on Islamic banks, the researcher utilized the mean to measure the central tendency of the responses and the variance to measure the dispersion of the responses. These statistical measures aided in the generalization of the study's results to the population.

4. Analysis and Results

4.1. Demographic and Functional Characteristics of the Study Sample

To analyze the results of the study, the researcher reviewed the demographic characteristics of the population through a detailed description of the characteristics of the study sample based on their responses to the items mentioned in the questionnaire within the personal and general data items, as shown in Table 2.

Table 2
Demographic characteristics

Characteristic	Categories	Percentage (%)	Characteristic	Categories	Percentage (%)
Gender	Male	70.6%	Bank	Jordanian Islamic Banks	14.7%
	Female	29.4%		Islamic International Arab Bank	57.4%
Age	20-35	26.5%		Safwa Islamic Bank	11.8%
	35-50	47.1%		Al-Rajhi Bank	16.2%
	50+	26.5%			
Education	Diploma	16.2%	Work Experience	1-5 years	11.8%
	Bachelor's degree	80.9%		6-10 years	8.8%
	Master's degree	0%		11-15 years	47.1%
	PhD	2.9%		More than 15 years	32.4%

Table 2 shows that most of the respondents were males (70%) aged 35-49 (47.1%), most of them holding a bachelor's degree (80.9%) and having 11-15 years of experience (47.1%). The largest number of respondents were from the Islamic International Arab Bank (57.4%).

4.2. Presenting and Analyzing Data of Study Variables

To analyze the attitudes of the study sample toward DT in Islamic banks, data were processed using mean values and standard deviations. The weighted mean was calculated (4/5 = 0.8) to categorize the results, and the distribution levels were identified as Non-existent (1-1.79), Few (1.8-2.59), Medium (2.6-3.39), High (3.4-4.19), and Very high (4.2-5). Therefore, the study sample largely agreed on the significance of relationships. This suggests a consensus among respondents about the importance of DT in boosting OE, CA, CE, OP and Risk.

4.3. Study Hypotheses Test Results

We tested the main hypothesis, namely, the absence of a significant effect of DT on Islamic banks in Jordan, using regression analysis. Prior to this, we conducted pretests to ensure data normality and independent variable correlation. This is important as it safeguards against inaccurate or unreliable results. Data from each of the dependent variables (totaling 68) followed a normal distribution as per the Gaussian process, since they exceeded the threshold of 30. We utilized linear regression to examine the influence of an independent variable on a dependent variable. The nature of this independent variable could be either continuous or categorical. To summarize, the results from our regression analysis of the main and sub-hypotheses will be discussed in the following sections.

4.3.1. The first sub-hypothesis: There is no statistically significant effect at the significance level $\alpha \leq 0.05$ of digital transformation on operational efficiency in Islamic banks operating in Jordan.

Table 3
Coefficient of determination value and the coefficient of multiple correlation

Model	Variable	R	R-Square	Adjusted-Square	Std. Error of Estimate
1	OP	0.537	0.289	0.278	0.77333
1	CA	0.633	0.401	0.392	0.74978
1	CE	0.642	0.412	0.403	0.56905
1	OP	0.480	0.230	0.230	0.53270
1	Risk	0.502	0.252	0.252	0.77621

Table 4
Multiple regression results

	Unstandardized Coefficients		Standard Coefficients		
Variable	Beta	Std. Error	Beta	T	Sig.
Intercept	0.840	0.572		1.468	0.147
OE	0.885	0.170	0.537	5.217	0.000
CA	0.308	0.555	0.633	0.555	0.580
CE	1.001	0.421	0.642	2.378	0.020
OP	2.459	0.394	0.480	6.237	0.000
RISK	0.895	0.574	0.502	1.559	0.124

The data presented in Table 3 and Table 4 offer key insights into the impact of DT on the OE, CA, CE, OP and risk of Islamic banks operating in Jordan:

The coefficient of determination was 0.29, implying that nearly 29% of the variations in OE could be ascribed to DT. This signifies a substantial influence of digitalization on the efficiency of these banks' operations.

The statistical significance of the impact of DT on OE was evident. With an impact factor of 0.885 and a p-value of 0.000 (which is less than 1%), there is a clear and substantial statistical impact. This leads us to reject the first sub-hypothesis stating no significant effect of DT on OE in Islamic banks in Jordan at the $\alpha \leq 0.05$ significance level. Instead, the alternative hypothesis, which proposes a significant impact of DT on OE, is accepted. This outcome aligns with the findings of Santiago Carbo-Valverde's 2017 study, which suggested that digitization has the potential to lower marginal costs and enhance productivity in financial services.

Table 3 and Table 4 reveal interesting findings about the influence of DT on the CA of Islamic banks operating in Jordan: The coefficient of determination was 0.40, suggesting that approximately 40% of the changes in CA can be attributed to DT. This indicates a substantial role of digitalization in shaping the competitive edge within these institutions. The substantial and statistically significant impact of DT on CA is evident. An impact factor of 1.102 and a p-value of 0.000 (which is less than 1%) indicate significant influence. Consequently, the second sub-hypothesis, which assumes no significant effect of DT on the CA of Islamic banks in Jordan at the $\alpha \leq 0.05$ significance level, is rejected. The alternative hypothesis, which posits a significant impact of DT on the competitive advantage, is accepted. This conclusion is in line with the study by Hadia and Hmoodb (2020), which demonstrated a significant correlation between DT strategies and financial competition edge. Their

correlation index reached a notable high of 0.917, affirming the substantial role of digital strategies in shaping financial competition.

In addition, Table 3 and Table 4 shed light on the role of DT in shaping the CE in Islamic banks in Jordan: With a coefficient of determination valued at 0.41, roughly 41% of the changes in CE can be traced back to DT. This signifies a strong influence of digitalization on CE.

There is a statistically significant effect of DT on the CE. The impact factor was 0.85 with a statistical significance of 0.000, which is less than 1%. As a result, the third sub-hypothesis, suggesting no statistically significant effect at the significance level $\alpha \leq 0.05$ of DT on the CE in Islamic banks in Jordan, is rejected. On the contrary, the alternative hypothesis, proposing a statistically significant effect of DT on CE, is accepted. These findings align with the Mbama study in 2018, which emphasized the positive influence of digital banking services on CE, satisfaction, loyalty, and profitability. It suggested that the DT of banking services makes them more convenient, accessible, user-friendly, and beneficial. This allows customers to access services faster than by visiting physical branches, saving time and money, reducing stress and effort, and enhancing CE. Furthermore, Table 3 and Table 4 provide insightful details on the influence of DT on the OP of Islamic banks in Jordan: The coefficient of determination was 0.23, suggesting that approximately 23% of the variations in OP can be accounted for by DT. This illustrates the considerable influence of digitalization on the OP of these banks.

The data clearly demonstrate a statistically significant impact of DT on OP. With an impact factor of 0.52 and a p-value of 0.000 (which is less than 1%), we reject the fourth sub-hypothesis, which asserts no significant effect of DT on the OP in Islamic banks in Jordan at the $\alpha \leq 0.05$ significance level. Instead, we accept the alternative hypothesis, which proposes a significant impact of DT on OP. These findings are in harmony with the research of Vally and Divya (2018), which established that the spread of digital payment technology has enhanced the banking sector's performance. Moreover, these findings echo Mbama's 2018 study, which determined that banks leverage digital banking services to enhance performance across various measures such as efficiency, cost-to-income ratio, return on assets, revenue growth, balance sheet strength, sales growth, and profitability. The closure of physical branches, leading to cost savings and reductions in manual processes, has a positive influence on profits, further underlining the crucial role of DT in enhancing OP. Indeed, Table 3 and Table 4 provide compelling insights into the relationship between DT and risks in Islamic banks in Jordan: The coefficient of determination was 0.25, indicating that about 25% of changes in risk are attributable to DT. This suggests a noteworthy influence of digitalization on risk levels within these banks.

The data show a statistically significant impact of DT on risks. With an impact factor of 0.81 and a statistical significance of 0.000 (less than 1%), we reject the fifth sub-hypothesis, which asserts that DT has no statistically significant effect on risks in Islamic banks in Jordan at the $\alpha \leq 0.05$ significance level. Instead, we accept the alternative hypothesis, which contends that DT significantly affects risk levels. This conclusion aligns with Mbama's 2018 study, which confirmed that digitization exposes banks to a range of operational and security risks, including electronic attacks, fraud, and privacy issues. Considering the values of the coefficient of determination from the previous hypotheses (0.29, 0.40, 0.41, 0.23, 0.25), it is evident that there is a statistically significant effect of DT on Islamic banks operating in Jordan at the $\alpha \leq 0.05$ significance level. As a result, we reject the main hypothesis, which states that there is no statistically significant effect of DT on Islamic banks in Jordan. In contrast, we accept the alternative hypothesis, which proposes a significant influence of DT on these institutions.

5. Discussion

The regression analysis revealed a profound impact of digital transformation (DT) on various aspects of Islamic banks in Jordan, aligning with the global trends highlighted in the broader literature. Kraus et al. (2022), and Van Veldhoven and Vanthienen (2022) emphasized DT as a key strategy for success in today's fast-paced market, a trend that our study confirms within the Islamic banking sector.

Our study observed significant improvements in operational efficiency (coefficient of determination: 0.29), supported by findings from Atif et al. (2021), indicating the statistical significance of DT's impact. This aligns with Bican and Brem (2020), Kitsios and Kamariotou (2021), and Van Veldhoven and Vanthienen (2022), who noted the transformative role of advanced technologies like AI and cloud computing in streamlining processes and enhancing business outcomes. This improvement in operational efficiency is not only a strategic enhancement but also, as our study shows, a crucial factor in the sustained success of Islamic banks.

Similarly, our findings on competitive advantage (coefficient of determination: 0.40) and customer experience (0.41) resonate with the work of Baiyere et al. (2020), Nwankpa and Roumani (2016), and Rashwan and Kassem (2021). These studies underline how digital technologies transform customer engagement and decision-making processes, aspects our research found to be significantly enhanced in Islamic banks through DT.

Our study also observed a moderate but notable impact of DT on organizational performance (coefficient of determination: 0.23). This aligns with the insights of Gil-Gomez et al. (2020) and Manita et al. (2020), who noted a positive correlation between digital technology adoption and various performance indicators. The long-term benefits of DT, as reported by Jardak and Ben Hamad (2022) and supported by Tsou and Chen (2023), further substantiate our findings, indicating that digital technology usage has a positive influence on organizational innovation and performance. However, the shift toward a digital

approach introduces challenges, as noted in our study's findings on increased risk (coefficient of determination: 0.25). This is consistent with the observations of Kraus et al. (2022) and Gil-Gomez et al. (2020), who highlighted the need to navigate issues like cybersecurity and the integration of digital tools. Our study reflects these challenges, suggesting that while DT offers numerous advantages, it also necessitates robust strategies for risk management.

In conclusion, our research contributes to the growing body of literature on digital transformation by providing empirical evidence from the Islamic banking sector in Jordan. It underscores the imperative of DT as not just a strategic option but a necessity for thriving in the modern business landscape, which is marked by rapid technological advancement and heightened competition. This study advocates for Islamic banks to embrace DT while effectively managing the associated risks, ensuring a balanced approach to innovation and security in the digital era.

6. Theoretical and Practical Implications

6.1. Theoretical Implications

This study significantly contributes to the understanding of digital transformation (DT) within the unique context of Islamic banking in Jordan. Our analysis underscores the pivotal role of DT in enhancing operational efficiency, competitive advantage, customer experience, and organizational performance, while also amplifying risk profiles. This aligns with and expands upon the Theory of Digital Transformation, particularly in the sphere of Islamic finance—a domain where the literature is currently limited, especially in developing countries. Our findings thus fill a crucial gap, offering a foundational basis for future research. They underline the importance of considering the context-specific variables associated with DT, such as cultural and religious factors. Furthermore, while our study focuses on Jordan, the insights gained may have broader implications for the global digital transformation in Islamic banking. This study can serve as a foundation for understanding the impact of DT in similar banking contexts, highlighting the importance of cultural and religious factors in different regions.

6.2. Managerial and Practical Implications

The transition to digital transformation (DT) in Islamic banks in Jordan presents several managerial and practical implications, vital for aligning with modern banking demands while adhering to Shariah principles. Strategic planning for DT is essential; banks need to integrate digital initiatives in customer service, online transaction systems, and digital banking services, ensuring these innovations comply with financial regulations. Risk management is pivotal in this digital era, requiring banks to strengthen their frameworks against cybersecurity threats and data privacy concerns, highlighting the need for robust digital risk management strategies and investment in advanced security infrastructures. Furthermore, employee training programs focusing on digital literacy and awareness are critical to ensure a workforce adept at navigating the digital landscape. Engaging customers through educational programs about digital banking's benefits and risks will enhance their understanding and trust. This research also guides policymakers in crafting regulations that encourage digital innovation while safeguarding data and maintaining Shariah compliance. Leveraging partnerships with FinTech companies can provide access to innovative, compliant digital solutions, leading to enhanced product offerings and customer experiences. Lastly, establishing efficient feedback mechanisms on digital services allows banks to gather insights into user experiences, aiding continuous improvement in their digital offerings. By embracing these strategies, Islamic banks can effectively capitalize on DT, offering improved services and maintaining Shariah compliance while adeptly managing the associated risks.

7. Conclusion

In conclusion, this study provides a comprehensive analysis of the impact of digital transformation (DT) on various facets of Islamic banks in Jordan. Contrary to the initial hypotheses, our findings reveal a significant and multifaceted influence of DT across several key areas: operational efficiency, competitive advantage, customer experience, organizational performance, and risk management. The regression analysis demonstrated that DT significantly improves operational efficiency, enhances competitive advantage, and elevates customer experience. These aspects are vital in the current era of rapid digital evolution and increasing customer expectations. The positive correlation between DT and improved organizational performance, albeit moderate, further substantiates the beneficial role of DT in the banking sector. However, the study also brings to the fore the heightened risk exposure associated with DT, highlighting the introduction of new operational and security risks. This necessitates a strategic approach to risk management, ensuring that the advancements brought by DT do not compromise the security and stability of banking operations. The findings of this study contribute to the growing body of literature on digital transformation in the financial sector, offering valuable insights for Islamic banks in Jordan and similar institutions worldwide. They underscore the need for these banks to embrace digital innovation judiciously, balancing the pursuit of efficiency and a competitive edge with the imperative of managing emerging risks.

In essence, the study advocates for a holistic and balanced approach to DT, where its potential to revolutionize banking operations is harnessed, while concurrently addressing the challenges it presents. This balance is crucial for Islamic banks in Jordan and the broader banking industry to thrive and remain resilient in an increasingly digitized world.

8. Limitations and Future Research Directions

While our study offers significant insights, it is not without limitations. Firstly, our research focuses solely on Islamic banks in Jordan, suggesting the need for future research to explore DT in other financial contexts and regions, to understand the varied impacts of cultural and contextual factors. Future studies might benefit from a comparative analysis between Jordanian Islamic banks and their counterparts in other regions to understand the universal and unique aspects of digital transformation in Islamic finance. Such studies could illuminate how regional differences influence the adoption and impact of digital technologies in banking.

Secondly, our study examines a limited number of variables related to DT. Future research should explore additional factors, such as organizational culture, leadership dynamics, and employee skill sets, which are crucial in the context of digital transformation. Additionally, future research could employ advanced econometric techniques, such as wavelet coherence analysis, to provide a more dynamic understanding of the relationships explored in this study.

Lastly, our reliance on secondary data could be complemented by future studies adopting a mixed-methods approach. Incorporating qualitative research, such as interviews with banking officials and detailed case studies, would provide deeper, more nuanced insights into the processes and impacts of DT in Islamic banking. Despite these limitations, our research contributes valuable perspectives on the implications of DT for Islamic banks in Jordan.

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