The Role of Digital Transformation in Improving Financial Performance: An Applied Study on Banking Sector in Egypt

.

ABSTRACT

|  |
| --- |
| **Aims:** Incumbent organizations are faced with considerable challenges in developing and sustaining new digital competencies essential in competing in a rapidly changing environment, corresponding with accepted historical path dependencies. This study aims to examine the relationship between digital transformation and financial performance, evidence from the banking sector in Egypt.  **Methodology:** The study focused on data collected from the annual reports and financial statements of 5 banks registered in the Egyptian stock exchange, for 11 years period from 2013 to 2023. The study measured the digital transformation (DT) using three dimensions: digital orientation (DO), digital intensity (DI) and digital maturity (DM), and Financial Performance (FP) was measured through two dimensions: Operating Profit Margin (OPM) and Net Profit Margin (NPM). Controlling for the Non-Performing loans (NPL), Net Interest Margin (NIM), Loan-to-Deposit Ratio (LDR), Total Assets (TA), and Capital Adequacy Ratio (CAR). Using panel data methods, the study first applies unit root tests to assess data stationarity, then multiple regression and Pearson correlations was conducted, followed by both Fixed Effects and Random Effects models. The Hausman test is then used to determine the most appropriate model specification.  **Findings:** The findings revealed that there is a significant impact of digital intensity and digital maturity on operating profit margin while digital orientation does not have a significant impact on operating profit margin. The study also revealed that there is no significant impact of digital orientation, digital intensity or digital maturity on the net profit margin of the banking sector in Egypt. This study also combined dependent variables and independent variables in financial performance and digital transformation respectively through principal component analysis (PCA) and found out that there is no significant impact of digital transformation on financial performance.  Recommendation: Banks should focus on increasing their digital maturity to ensure that investments in digital pay off in terms of operational and financial benefits. Banks should avoid overextending resources, strategic prioritization and careful consideration of digital efforts are essential to counteract any negative impact on profitability.  Conclusion: Banks should not treat digitization as a stand-alone factor, financial organizations should adopt an integrated transformation model that synergistically utilizes strategy, intensity, and maturity in their efforts toward sustained performance outcomes. |
|  |

*Keywords: Digital Transformation, Digital Orientation, Digital Intensity, Digital Maturity, Financial Performance, Operating Profit Margin, Net Profit Margin, Banking Sector, Egypt.*

1. INTRODUCTION

The recognition of potential benefits related to digital transformation is a complex phenomenon resulting from both the use of a wide array of emerging digital technologies in a constantly shifting context (Lanzolla et al., 2018) and from organizational efforts towards the integration of said technologies (Warner and Wager, 2019). The current business organization’s situation has been described as a key problem and high priority issue. Modern research in the fields of management and operations alike unanimously agrees that digital transformation imposed—and will continue to impose—significant effects on—and will further significantly increase—all aspects of business activity (Hess et al., 2016; Lanzolla et al., 2018; Frank et al., 2019). Over the period since the beginning of this century, a rich diversity of research activities have appeared exploring digital transformation in a wide range of industries, with claims in academic and business-oriented publications suggesting that digital transformation's successful execution is related to improved and sustainable improvement in performance (Kane et al., 2015, 2017; Dalenogare et al., 2018; Vial, 2019; Tortorella et al., 2019). Numerous researches also touch upon the failure of the industries, pointing out the fact that although performance can potentially see significant rises through digital transformation, a significant number of companies are meeting with failure in their digital transformation activities and are said to have failure rates ranging from 60 to 85% according to Sailer et al. (2019).

Recent research has emphasized the fact that digital transformation is a complex and multifaceted process (Hess et al., 2016) and is still poorly understood in practical and theoretical models (Parviainen et al., 2017; Lanzolla et al., 2018; Vial, 2019). Success in digital transformation is far more complicated than the implementation of traditional change programs and requires continuous adaptation to a constantly shifting context; the need for continuous adjustment remains until organizations seem to have successfully performed a "transformation" (Kane, 2017). Due to the lack of consistent management with respect to the terminology used in the case of "transformation," the tendency is to view digital transformation as a fixed process—by the time companies adapt to the current situation, drastic changes have occurred several times over (Kane, 2017). Organizations worldwide face the dilemma of having to rapidly and constantly adjust their infrastructures to the demands inherent in the digital world while being bound to carry out this continuous adaptation (Sailer et al., 2019). Unlike in the case of common transformations, the result is constantly shifting, and the degree of flexibility needed to achieve success in the digital context starkly differs from the methods used in the case of the majority of typical organizations (Sailer et al., 2019).

2. TheorEtical Framework

2.1 Digital Transformation

Patel and McCarthy (2000) clarified that the concept digital transformation has ancient roots and first appeared in 2000 as a concept related to digitalization; however, over time the implications changed to refer to a concept driven by new consumer applications and unique characteristics with significant impacts on current business models and institutions. This position was later evidenced through Maria (2020), who claimed that while digital transformation has become a popular topic of discussion, vocabulary and terminology related to digital products, services, and media were fully understood and practiced during the 1990s and early twenty-first century. The first overt definition of the term appeared in the study conducted by Fors and Stolterman (2004), where they described digital transformation as "changes related to the use of digital technology or its impact upon all areas of human society." This indicates that the current society is undergoing drastic changes because of the advances in digital technology (Ebert & Duarte, 2016).

It focuses on the fact that digital transformation resolves the imbalance between what digital consumers need and what is provided by conventional organizations. Berghaus and Back (2016) define digital transformation as a technologically driven change influencing different levels within an organization. Digital transformation includes the digitalization of processes aimed at enhancing efficiency as well as digital innovation, where digital elements are embedded in physical products to extend their performance capacities.

2.1.1 Dimensions of Digital Transformation

According to (Gill & Van boskirk, 2016); (Nasiri M. et al., 2022); ( the dimensions of Digital transformation are represented as follows:

***2.1.1.1 Digital orientation*** would generally imply the degree to which an organization commits to and adopts the incorporation of digital technologies, tools, or strategies. Many organizations use digital technologies to augment their existing operational models, meaning that they do not fully leverage the benefits provided by digital transformation. However, the complexity of stakeholders participating in digital transformation, as well as the difficulty of engaging them along a wide range, creates complexity in value networks. Therefore, financial success through digital transformation becomes a challenging task that requires intentional effort. This effort can be achieved through digital orientation that provides strategic direction in a way that removes operational difficulties and prevents any loss of focused scope. A solid digital orientation can remove operational difficulties since the dedication of a firm to the use of digital technology enables the immediate deployment of diverse digital solutions or the incorporation of new digital elements into existing solutions, allowing financial success. Digital orientation is also critical in reducing operational difficulties, eventually culminating in financial success through monitoring, optimization, and the encouragement of autonomy, while at the same time creating value in the context of digital technologies. Therefore, the creation of strategic direction through digital orientation for companies embarking on digital transformation is inherently connected with the achievement of financial success.

***2.1.1.2 Digital intensity*** represents the variety of fields related to digital transformation in the activities of an organization. A great body of academic literature has confirmed that digital transformation goes beyond merely functional approaches. Instead, the concern of digital transformation in organizations relates to the "comprehensiveness of action," which is crucial for exploiting opportunities and reducing threats related to digital technologies. Previous studies have ascertained that digital businesses can exploit digital technologies along nine different dimensions: strategy, leadership, organizational culture, customer engagement, product and service offerings, technological innovation, production processes, supply chain management, and employees (Salaheldin I., 2006). By analyzing the different aspects of organizational activities associated with digital initiatives, digital intensity is positively related to financial performance. Organizations that digitize their activities strategically—unlike those trying to cover all digital functions—have the propensity to gain higher net profits. This can be explained by the fact that such organizations are able to exploit the benefits of a coherent vision, guiding their digital investments towards a shared goal (i.e., financial success). In addition, dynamic monitoring with respect to the formation of a digital economy can make a considerable contribution to an organization's success in its digital transformation process.

***2.1.1.3 Digital maturity*** encompasses more than the adoption of latest technologies; it entails the realignment of organizational activities to meet the expectations of stakeholders. Conversely, digital maturity entails a continuing process change to accommodate a constantly evolving digital landscape. Nevertheless, Kane et al. (2017) posited that digital maturity entails more than merely the adoption of cutting-edge technologies with the aim of revolutionizing strategy, staff, organization structure, or organizational culture in the stakeholders' interest, but rather involves a structured transformation to bring about sustainable digital change. Secondly, the digital maturity of an organization might potentially impact its financial performance since such organizations tend to possess good governance processes and a distinct vision that ensures digital expenditure aligns with organizational goals (Westerman et al., 2012). According to research conducted by Deloitte, a premier organization in digital change, companies that make the digital technology commitment and manage to implement such technologies manage to achieve a starting financial growth of 15%, with the potential to see the growth head towards 45% upon crossing a level of digital maturity.

**Table (1): Digital Transformation Dimensions**

|  |  |  |
| --- | --- | --- |
| Dimensions of Digital Transformation | Contribution to Financial success of companies | Reference |
| Digital orientation | - Paves the way toward functional changes  - Improves existing operational strategies  - Provides strategic direction  - Mitigates operational difficulties  - Mitigates loss of concentrated scope  - Reduces operational difficulties  - Results in operational and financial benefits  - Enhances cost efficiencies  - Poses competitive advantages | Porter and Heppelmann (2014), Matt et al. (2015), Hess et al. (2016), Libert et al. (2016), Koh et al. (2019), Martinez et al. (2019), Rubbio et al. (2019), Tortorella et al. (2019), Vial (2019), Singh et al. (2020), Kindermann et al. (2021), Arias-Perez and Velez-Jaramillo (2022) |
| Digital intensity | * Assists in exploiting opportunities and preventing threats caused by digital technologies * Reaps the benefits of a strong vision when aligning digital investments with a common direction * Alleviates decision-making difficulties regarding the scale and scope of operations * Promotes engagement in more areas of digital transformation within companies’ current capacities * Assists in the development of a clear vision and control over the selection of the domain within which a company wants to cover digital technologies * Assists is reducing the complex nature and the need to be selective about the scope of digital technologies used * Helps to manage the number of engaged actors and complexity | Westerman et al. (2012), Nambisan et al. (2017), Singh and Hess (2017), Dattee et al. (2018), Warner and W€ager (2019)  Westerman et al. (2012), Matt et al. (2015), Hess et al. (2016), Nambisan et al. (2017), Dattee et al. (2018), Vial (2019) |
| Digital maturity | * Assists in the development of a clear vision and effective governance, which facilitates the targeting of digital investments in accordance with company objectives * Increases the effectiveness of commitments to the use of and the utilization of digital technologies * Enhances the effects of Industry 4.0 technologies | Westerman et al. (2012), Kane et al. (2017), Arkhipova and Vaia (2018), Fettermann et al. (2018), Khin and Ho (2019), Gurumurthy et al. (2020) |

*Source: Nasiri M. et al., 2022*

2.2 Financia performance

***2.2.1 Operating Profit Margin and Net Profit Margin.*** Two operational measures that highlight financial performance can be used to measure financial performance within organizations: the operating profit margin and the net profit margin. These measures are also used in other research to explore the performance-digital transformation nexus (Eldaia et al., 2025, Wamba et al., 2020; Sousa-Zomer et al., 2020, Shatnawi et al., 2022, Binsaddig et al., 2023, Nalliboyina et al., 2023, Ab Halim et al., 2014).

Al-Amawi et al. (2023) conducted Panel data (2010–2019) with multiple regression. The study included all 13 ASE-listed commercial banks (130 bank-year observations), Profitability measured by Net Profit Margin (NPM) (as well as Tobin’s Q for market value, in a separate model). Al-Amawi found out that Digital transformation via virtual banking services significantly improved banks’ NPM. The regression showed a positive relationship between investment in those digital services and higher net profit margins.

Jikrillah and Fadah (2023) carried out the operation using panel data from 2018 to 2020 and the exploratory method using Partial Least Squares Structural Equation Modeling (PLS-SEM). Digital banking adoption was scored based on the availability of mobile banking services in each bank. The main variables considered were the financial performance measures in terms of Return on Assets (ROA) and Net Profit Margin (NPM). According to the study results, digital transformation did not have a statistically significant effect on the Indonesian banks' profitability under consideration. Specifically, the use of mobile banking did not significantly impact ROA or NPM.

Conversely, Kaddumi et al. (2023) adopted a mixed-method methodology that combined survey methods and panel regression analysis. The study used financial data for the period 2012-2020 and a questionnaire on the adoption of FinTech integration. The study collected 115 responses from Jordanian banks, using multivariate regression methods to derive relationships between FinTech indices and different performance measures. Interestingly, Kaddumi put emphasis on financial performance measures, using Net Profit Margin (NPM) as the dependent variable. The study concluded that digital transformation through FinTech adoption had a positive and significant effect on Jordanian banks' profitability.

3. Methodology

3.1 The Research question

Reviewing the past research, the researcher concluded that there is a scarceness in the studies that directly links between the two proposed variables (Digital Transformation & Financial Performance). Accordingly, the researchers have developed the following question: What is the impact of digital transformation on the financial performance of the Egyptian banking sector?

3.2 The Research Objectives

* Identify the dimensions of digital transformation for the Egyptian banking sector.
* Recognizing the measures of financial performance for the Egyptian banking sector.
* Determine the impact of digital transformation on the financial performance for the Egyptian banking sector.

3.3 Hypothesis Development

Many businesses have come to an agreement concerning the high potential for success that comes from digital transformation (Hess et al., 2016; Vial, 2019). In addition, many research studies have determined that digital technology has the potential to bring about changes in operations, subsequently yielding cost-efficiency, competitive advantage, and benefits in both operational and financial areas through improved monitoring and optimization (Porter and Heppelmann, 2014).

It was emphasized in 2019 that high failure rates in investments in digital assets indicate a significant lack of knowledge about how digital transformation affects financial performance (Libert et al., 2016; Matt et al., 2015; Vial, 2019). Libert et al. (2016) argue that the effect of digital transformation is not always something that can be measured in traditional key performance indicators (KPIs), instead underscoring the requirement for intermediate metrics. For example, such metrics as revenue calculated from the number of apps created and levels of satisfaction among users while using them could be signs that Apple's working practices are operationally efficient. In addition, most benefits derived from digital transformation come through pioneering ways of working, such as those for customer engagement or new ways for creating value through networks in a digital environment. Based on these findings, the main hypothesis would be formulated as follows:

**H1: There is no statistically significant impact of Digital Transformation Dimensions (Digital Orientation, Digital Intensity, Digital Maturity) on the financial performance in the Egyptian banking sector.**

Additionally, many businesses leverage digital technology to enhance their current operations; however, this could hinder their ability to maximize benefits from digital transformations (Liberte et al., 2016). Nevertheless, complexity in value networks has increased due to involvement from various stakeholders in digital transformations, leading to an added challenge in managing such entities across a broad frontier. Therefore, financial success in digital transformations is faced with notable challenges (Matt et al., 2015; Vial, 2019). To overcome operation-related obstacles and preclude a narrow focus, this research is organized around the concept of digital orientation by delivering strategic direction (Kindermann et al., 2021). Since digital orientation, when coordinated around its aim of leveraging digital technology, enables organizations to implement innovative digital solutions at high speed or embed innovative digital elements into existing frameworks, organizations can attain financial success while overcoming operation-based obstacles (Arias-Perez and Velez-Jaramillo, 2022; Vial, 2019). In addition, Porter and Heppelmann (2014) contend that digital orientation is essential in overcoming operation-based challenges, eventually leading to financial success based on autonomy, optimization, and supervision, together with creation of value within digital technology (Arias-Perez and Velez-Jaramillo, 2022). Thus, financial performance comes naturally together with digital orientation through provision of strategic direction for businesses undertaking digital transformations (Kindermann et al., 2021; Hess et al., 2016; Matt et al., 2015; Wang and Bai, 2021).

A significant amount of academic research shows that digital transformation goes beyond a single functional perspective (Vial, 2019; Hess et al., 2016). In contrast, there is a noted need for the "comprehensiveness of action" that organizations need to embrace to properly capitalize upon opportunities and counter threats from digital technology along the way toward realizing digital transformation (Warner and Wager, 2019; Singh and Hess, 2017). Experienced across different dimensions of business operations as related to digital initiatives, digital intensity shows a correlation with financial results. Westerman et al. (2012) state that companies that pursue a strategic approach toward digitization realize higher net incomes than those that undertake digital activities without direction.

Digital maturity involves more than the adoption of new technologies; it involves a remodeling of the processes of banking to meet the needs of stakeholders. Essentially, digital maturity is an ongoing process of managing an emerging digital context (Kane et al., 2017). To gain more in-depth knowledge of the current approaches taken by banks to deal with digital transformation, content analysis will be applied, as the method allows for an objective and systematic evaluative framework to be used to analyze communication content (Berelson, 1952). The banks will be placed in one of four pre-defined maturity levels (based on Westerman et al., 2012), which are developed based on the level of digital transformation initiatives implemented. It is anticipated that strong evidence will appear of an increased intensity in these digital transformation activities as one moves through maturity levels. The maturity levels 1 to 4 employed in this study were taken from the study by Gokalp and Martinez (2021) as shown in table (2), who compared 18 maturity models to develop their own model for digital transformation capability maturity. The current study will take their model to outline the maturity levels relevant for measuring digital maturity. The hypothesis can therefore be defined as:

**H2: There is no statistically significant impact of Digital Transformation Dimensions on the Operating Profit margin of the Egyptian banking sector.**

**H3: There is no statistically significant impact of Digital Transformation Dimensions on the Net Profit margin of the Egyptian banking sector.**

3.4 Research Variables:

**3.4.1 Digital Transformation (Independent Variable):**

Digital Transformation can be measured by Digital Orientation, Digital Intensity, Digital Maturity.

**3.4.2 Financial Performance (Dependent Variable):**

The financial performance can be measured by the Net Profit margin and the Operating Profit margin.

**3.4.3 Control Variables:**

The main control variables used to isolate the impact of digital transformation on performance are Non-Performing Loans (NPL), Net Interest Margin (NIM), Loan to Deposit ratio (LDR), Total Assets (TA) and Capital Adequacy ratio (CAR).

**Table (2): Research Variables**

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | Source | Analyzation | Scale |
| Digital Orientation | Annual Reports | Number of mentions of digital related keywords in the annual reports | Nominal |
| Digital Intensity | Annual Reports | Number of digital transformation areas (strategy, leadership, organization and culture, customers, products and services, technology, production and processes, supply chain and employees) covered in the annual reports | Scale from 1 to 9 |
| Digital Maturity | Annual Reports | Level of digital transformation maturity based on content analysis of the initiatives described in annual reports | Scale from 1 to 4 |
| Net Profit Margin | Financial Statements | Directly Concluded from database | Percentage |
| Operating Profit Margin | Financial Statements | Directly Concluded from database | Percentage |

*Source: (Nasiri M. et al., 2022, Gokalp, Martinez, 2021)*

3.5 Population and sample:

The Egyptian banking sector listed on the stock exchange contains a total of 13 banks, among them are specialized and Islamic banks. The sample used by the researcher was 3 Commercial banks and 2 Islamic banks resulting in 5 banks in total. These 5 banks were chosen because of the availability of the required data in annual reports and financial statements for the predetermined period (2013 to 2023). So the sample is Banque Du Caire (BDC), Commercial International Bank (CIB), Qatar National Bank (QNB), Al Baraka Bank (BKB) and Abu Dhabi Islamic Bank (ADIB).

3.6 Research Methods:

Both Analytical and Descriptive methods will be used in this research in which:

**3.6.1Analytical research** methods in which the researcher will be analyzing the 5 prementioned banks listed in the Egyptian stock exchange data such as annual reports and financial statements for the past 11 years from 2013 to 2023.

**3.6.2 Descriptive research** methods involve systematic description of traits, conduct, and patterns in digital transformation and financial performance in the banking sector in Egypt, considering the 5 chosen banks as sample. Descriptive research approaches focus on what and how in a specified environment in opposition to experimental or explanatory research approach on causality.

3.7 Data Collection Method:

Data applied in this study will come from genuine information gathered from primary and secondary sources such as financial statements and annual reports from under-study banks. Using real data has an advantage because it is based on tangible evidence, hence reducing error or personal bias found in theoretically derived or personally declared information, which is important in maintaining validity and reliability in the study. Data collection can be done through various methods, such as administering questionnaires or surveys, interviewing and focus groups, use of direct observation methods (e.g., ethnographic research), and applying experimental procedures conducted in a controlled laboratory environment (Naeem et al., 2023).

A multiple regression method will be used by the researcher to test the research hypothesis whether there is an effect of the digital transformation on the financial performance of the Egyptian commercial banks. Since that there are only 5 banks taken as sample on the Egyptian stock exchange which will yield insufficient historical data, the researcher will be dividing the annual data driven from the annual reports to a quarterly data which will yield a 44 observation for each bank and 220 total observations, using the following equation (Diz A.c., 1966):

**Q1 =** Wt-1 + (7.5/12) (Wt – Wt-1)

**Q2 =** Wt-1 + (10.5/12) (Wt – Wt-1)

**Q3 =** Wt + (1.5/12) (Wt-1 – Wt)

**Q4 =** Wt + (4.5/12) (Wt+1 – Wt)

Where as;

Q1: First Quarter

Q2: Second Quarter

Q3: Third Quarter

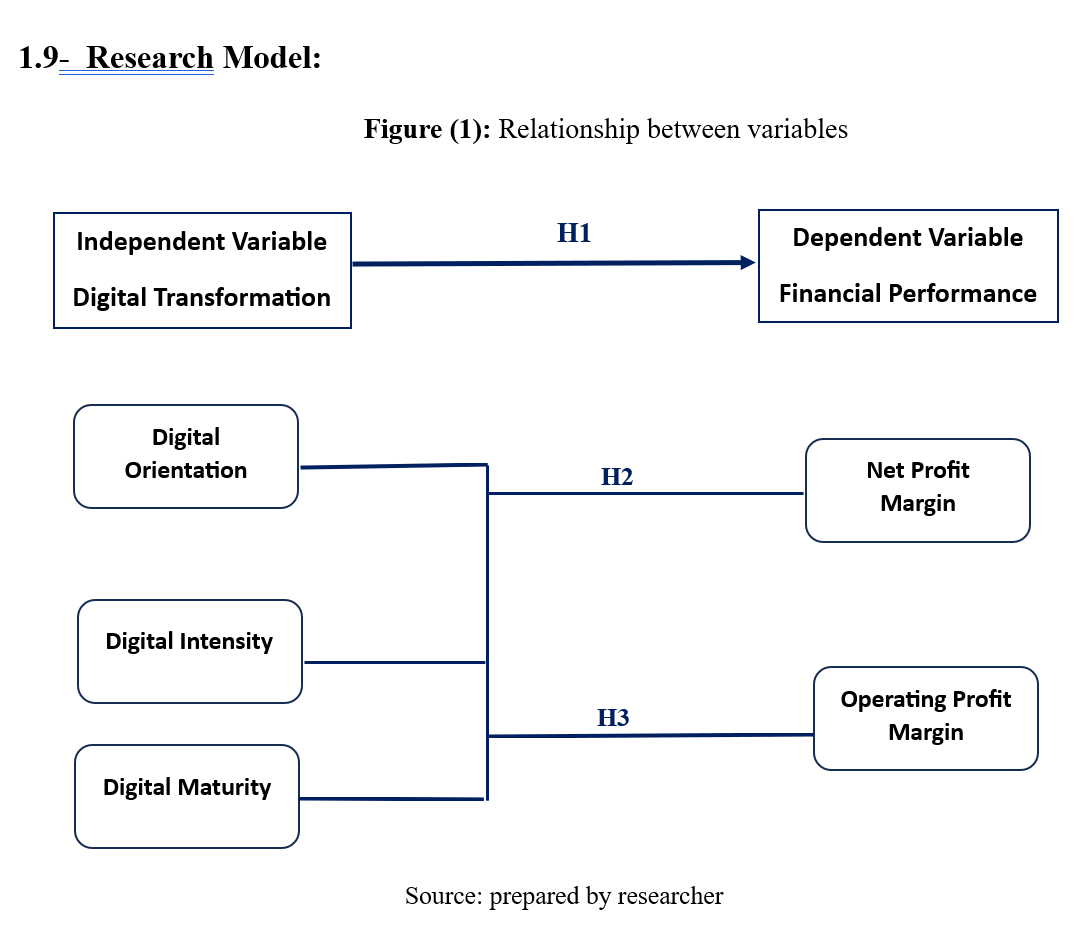
Q4: Fourth Quarter

Wt : The Variable Value in the Current Year

Wt-1 : The Variable Value in the Previous Year

Wt+1 : The Variable Value in the Next Year

7.4/12, 10.5/12, 1.5/12, 4.5/12: Constant Values



***Figure (1): Study model***

*Source: Prepared by the researchers*

4. results and discussion

The researchers conducted 32 different multiple regression models to test the research hypothesis. 22 models were used to measure the main hypothesis through principal component analysis (PCA). The researchers combined dependent variables and independent variables in financial performance and digital transformation respectively. Using different combinations of control variables in each model to get the most suitable model that interprets the relationship between digital transformation and financial performance (Appendix 3). The 10 remaining models were divided into 5 models testing the relationship between operating profit margin and digital transformation dimensions using different control variables (Appendix 1). The last 5 models were used to examine the relationship between net profit margin and digital transformation dimensions using different control variables (Appendix 2). The researchers then selected the most appropriate model depending on the model diagnostics that is the most significant. As shown in table (4).

**4.1 Research Variables Data Analysis**

**4.1.1 Digital Orientation:**

***Figure (2) Digital Orientation***

*Source: Annual reports of the selected banks*

Figure (2) reflects a clear classification in terms of the level of digital orientation of the five banks. The timeline can be divided into three main phases: Phase 1 (2013 – 2016): All financial institutions started at basic levels of digital transformation. No significant digital variations were noted. This is an evolving development in terms of digital technology uptake in Egypt's banking industry. Phase 2 (2017 – 2020): CIB started to perform better than its competitors, showing significant growth starting in 2018. QNB and BDC each exhibited slow but relatively subdued growth. This period coincides with the growing spread of online banking services and mobile apps in Egypt. Phase 3 (2020 – 2023): The year witnessed an unprecedented digital shift, possibly fueled by the COVID-19 pandemic, which increased the need for digitalized services and decreased reliance on physical locations. (CIB, 2021). CIB peaked in Q1-2021 (exceeding 275 points), followed by BDC and ADIB, which saw significant surges. ADIB saw a sudden and sharp spike in 2022, followed by a drop, which could indicate the existence of a temporary or short-term digital initiative. QNB and BKB showed steady but slow growth, free of high volatility.

**4.1.2 Digital Intensity**

***Figure (3) Digital Intensity***

*Source: Annual reports of the selected banks*

During the studied period figure (3) showed that there has been an observable and sustained build-up of digital intensity, which is an indication of an ongoing strategic shift within Egyptian banks towards formalizing digital transformation.

Starting from 2013 with slight involvement in digital spaces, most financial institutions today report information associated with 7 to 9 of 9 dimensions of transformation, which shows extensive organizational integration of digital components. The timeline can be divided into three main phases: Phase 1 (2013–2016):Digital intensity was low and inconsistent across the sector. Most banks covered only a few dimensions like technology or products/services. Reporting on strategic and cultural dimensions (e.g., leadership, organization, employees) was limited or absent. This denotes the exploratory or preliminary stage of digital transformation in Egypt's banking sector. Phase 2 (2017–2019):A noticeable shift in momentum began around 2016–2017. Banks started an extensive rollout of their digital focus, including strategy, leadership, customer engagement, and internal organizational culture. Digital transformation moved from being a siloed IT initiative to a bank-wide strategic theme. The increase in intensity was gradual but steady, suggesting institutional solidarity. Phase 3 (2020–2023): Following the COVID-19 pandemic, digital intensity surged across the sector. Nearly all banks converged at high intensity levels (7–9 areas covered). The crisis acted as a stimulus, with financial institutions embracing digital options in most areas of supply chains, remote work, staff training, customer interaction channels, and core banking processes (CIB, 2021). By 2023, digital transformation became a widespread and ongoing theme in annual reports.

**4.1.3 Digital Maturity**

***Figure (4) Digital Maturity***

*Source: Annual reports of the selected banks*

The industry has witnessed an extensive shift from Level 1 to Levels 3 and 4 in the last decade. From 2013 to 2017, most banks were operating at Level 1 or 2, indicating digital transformation was vision-driven but fragmented. By 2020–2023, most banks reached Level 3, and some achieved Level 4, reflecting institutionalized, data-driven digital maturity. As shown in figure (4). Phase 1 (2013–2016):Most banks were either at Level 1 or moving towards achieving Level 2. The focus was on launching digital initiatives and creating digital strategies, but the implementation was limited. The sector was in its formative years, balancing digital transformation against the larger organizational goals. Phase 2 (2017–2020):Banks started achieving their Level 2 and Level 3, which refer to: Implementing digital initiatives within different divisions. The adoption of digital technologies in fundamental banking activities. Managed organizational change and cultural adaptation. This period likely saw major IT investments, process redesign, and staff upskilling. Phase 3 (2020–2023):A significant number of banks reached or came close to Level 4: The use of real-time data systems. Use of AI, mobile banking, cloud platforms, and advanced analytics. Institutionalization of continuous improvement and adaptive models. Digital maturity has moved from an aspirational goal to a fundamental capability that supports performance, competitiveness, and risk management.

**4.1.4 Operating Profit Margin**

Figure (5) shows OPM fluctuations quarter-to-quarter for all banks, most remained within the 0.20–0.40 range, reflecting moderate and relatively stable profitability from operations over the 11-year period. No bank consistently dominates throughout the entire period, but some trends are visible. Phase 1 (2013–2016): High volatility across most banks. ADIB and BKB show the highest peaks, sometimes with values higher than 0.45 to 0.50, reflecting high initial profitability with high volatility. BDC starts at one of the lowest operating profit margins (around 0.10–0.15) but shows an increasing pattern of improvement. Phase 2 (2017–2020): Most banks begin to stabilize their OPMs in a more consistent range. CIB and QNB maintain mid-range stability around 0.30–0.35. BDC shows a clear rising trend, reflecting the enhancement of operational efficiency. Phase 3 (2020–2023):Greater fluctuations return, especially post-COVID-19. BDC suffered a considerable decline in 2022, possibly due to outside disruptions, provisioning needs, or digital transformation program expenses. Both ADIB and BKB demonstrate relatively strong margins, though affected by sporadic fluctuations. CIB and QNB show consistent margins around 0.30–0.35, indicating operational resilience.

***Figure (5) Operating Profit Margin***

*Source: Financial Statements for the selected banks*

**4.1.5 Net Profit Margin**

The prevailing trend is that the total profit margins of all banks experience slight changes, tending to range from 0.10 to 0.30, although exceptions exist in certain instances. Relative to Operating Profit Margin, Net Profit Margin is more volatile, indicating the role of non-operating expenses like provisions, taxation, as well as financial instability. Phase 1 (2013–2016): Meaningful variations were observed in all banks, especially in ADIB and BKB, showing notable variations of 0.10 to 0.40. BDC started with an NPM value on the lower end of the range (0.05–0.10) indicating reduced bottom-line profitability or higher reliance on operating expenses and provisions. Some banks, such as QNB and CIB, showed more stable profit margins in the range of 0.20–0.30, indicating a strong financial structure from the beginning. Phase 2 (2017–2020): The sector saw partial stabilization in NPMs. BDC showed improvement, rising from below 0.10 to about 0.20. QNB and ADIB performed at moderate levels. Egypt's economic reforms, especially the 2016 devaluation of the pound, were to affect spending habits, distribution of resources, as well as overall profitability, in this period. Phase 3 (2020–2023): Relative convergence in performance: most banks clustered between 0.15 and 0.25. A major dip for BDC in 2022, possibly related to economic shocks, provisioning, or investment costs (e.g., digital infrastructure). CIB and ADIB consistently maintained NPM in the upper middle range (0.25–0.30), suggesting strong financial health. QNB exhibited some level of stability, while BKB continued to experience fluctuations.

***Figure (6) Net Profit Margin***

*Source: Financial Statements for the selected banks*

The graphical analysis of trends across five Egyptian banks across the period from Q1 2013 through Q4 2023 shows a clear trend linking elements of digital transformation and financial performance. Digital Orientation (DO) shows a clear upward trend which aligns with increases in Operating Profit Margin (OPM), which implies that banks having a clear-cut strategic framework for digital initiatives are likely to experience enhanced operational effectiveness in the longer term. However, Digital Intensity (DI), particularly when there are sudden spikes, does not always align with increases in OPM or Net Profit Margin (NPM); indeed, there are points when spikes in DI align with decreasing profitability as well, which could reflect cost pressures or inefficiencies due to high or uncorrelated digital efforts. By contrast, Digital Maturity (DM) seems to play a stabilizing role—banks reaching higher levels of maturity show more stable and sustained financial performance. The dynamics between these variables are further affected along with an apparent lag effect: increases in DO and DM typically come before corresponding increases in OPM and NPM several quarters later. Overall, the information depicted in graphs shows that while digital change is crucial for profitability, its effectiveness depends upon an interdependent combination of intensity, strategic direction, and maturity, and the financial benefits take time rather than arriving suddenly.

**4.2 Correlation Matrix**

**Table (3): Variables Correlation Matrix**



*Source: Prepared by the researchers using SPSS*

The correlation matrix (table 3) shows high interconnections between the aspects of digital transformation and financial performance measures. The Operating Profit Margin (OPM) and Net Profit Margin (NPM) have a high and statistically significant correlation (r = .712, p < 0.01), which implies that these two indicators tend to move together. Digital Orientation (DO) has a significant, though low, positive correlation with OPM (r = .181, p < 0.01) and NPM (r = .214, p < 0.01), which means that having a solid digital strategy and vision is moderately associated with good financial performance. In contrast, Digital Intensity (DI) and Digital Maturity (DM) do not have significant relationships with OPM or NPM, indicating that an increase in initiative volume or reaching higher maturity does not necessarily result in higher profitability. However, DO has significant relationships with DI (r = .706, p < 0.01) and DM (r = .725, p < 0.01), while DI and DM have a high relationship with each other (r = .965, p < 0.01), indicating a high conceptual and applied relationship between these constructs. Overall, although all aspects of digital transformation are highly interrelated, only Digital Orientation has a direct, though limited, relationship with financial performance, which further stresses the need for strategic direction rather than intensity or maturity alone.

**4.3 RESEARCH MODELS**

**Table (4): Research Models**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Operating Profit Margin | Net Profit Margin | Financial Performance |
| Dependant Variables | Model 1 | Model 10 | Model 32 |
|  |  |  |  |
| **Controls** |  |  |  |
| Non-Performing Loans | -1.55\*\*(.012) |  | -29.79\*\*\*(.00) |
| Net Interest Margin |  |  |  |
| Loan to Deposit Ratio |  |  |  |
| Total Assets |  |  | 7.76 (.18) |
| Capital Adequacy Ratio |  | -0.05\*\*\*(.00) | -1.02\*\*\*(.00) |
|  |  |  |  |
| **Main Variables** |  |  |  |
| Digital Transformation |  |  | 0.06 (.19) |
| Digital Orientation | -0.0001 (.23) | 9.97 (.99) |  |
| Digital Intensity | -0.018\*\*\*(.006) | -0.002 (.54) |  |
| Digital Maturity | 0.053\*\*\*(.002) | 0.008 (.39) |  |
|  |  |  |  |
| **Checking Diagnostics** |  |  |  |
| F | 23.25254\*\*\* | 50.560\*\*\* | 53.200\*\*\* |
| |  | | --- | |  | | .46 | .66 | .67 |
|  | .44 | .64 | .66 |
| AIC | -2.13 | -3.33 | 2.25 |
| Schwarz criterion | -1.99 | -3.19 | 2.39 |
| Sum squared resid | 1.40 | 0.41 | 110.14 |
| **Note that:** |  |  |  |
| \*\*\*p ≤ 0.001, \*\* 0.001 < p ≤ 0.01, \* 0.01 < p ≤ 0.1 | | |  |

*Source: Prepared by the researchers using EViews*

**4.3.1 Research Diagnostics**

The researcher performed a model diagnostic for the panel data collected to ensure the validity and reliability of the research models. Then 3 models were selected from the 32 models performed based on their F-statistics, R-squared, Adjusted R-squared, Sum squared resid, Akaike info criterion and Schwarz criterion.

**4.3.2 Results analysis and Discussion**

For the main hypotheses **H1 (Effect of Digital Transformation on Financial Performance)** the researchers selected model (32) as shown in table (4), according to the diagnostics done before to test this relationship. The result indicated that digital transformation does not affect financial performance (β = 0.06, p-Value = .19, not Sig.). For the first sub hypotheses **H2 (Effect of Digital Transformation Dimensions on Operating Profit margin)** the researchers selected model (1) according to the diagnostics done before to test this relationship. The result indicated that digital orientation does not affect operating profit margin (β = -0.00, p-Value = .23, not Sig.), while, , Digital Intensity do have a significant effect on the operating profit margin (β = -0.01, p-Value < .01, Sig.), digital maturity also do have a significant effect on the operating profit margin (β = 0.05, p-Value < .01, Sig.). For the Second sub hypotheses **H3 (Effect of Digital Transformation Dimensions on Net Profit margin)** the researchers selected model (10) according to the diagnostics done before to test this relationship. The result indicated that digital orientation does not affect net profit margin (β = 9.97, p-Value =.99, not Sig.), Digital Intensity does not have a significant effect on the net profit margin (β = -0.00, p-Value = .54, not Sig.), digital maturity also does not have a significant effect on the net profit margin (β = 0.00, p-Value = .39, not Sig.).

The results present that digital maturity has a positive effect on organizational effectiveness, such that banking organizations that have well-defined and cohesively integrated digital platforms would likely benefit from enhanced cost management and overall performance. In contrast, an increase in digital intensity shows a negative correlation with OPM, suggesting that amplification of digital initiatives in isolation without a framework or maturity could exert financial strains upon operations. The alignment or orientation, representing the strategic emphasis laid upon digital transformation, does not reflect a meaningful impact upon OPM. Further, none of those factors normally related to digital transformation exhibit a perceivable effect, showing that net profitability is rather vulnerable to exogenous economic and risk variables rather than those related to internal digital competencies. Model 32 provides an integrated view using composite indices for OPM and finance transformation. This model shows maximum explanatory potential among all considered models, highlighting the firm inter-play between finance and digital variables when estimated under an integrated framework. However, even under this vast framework, an effect of financial performance from digital transformation eludes identification, suggesting that while digital transformation is crucial, its financial benefits would arise only upon being complemented by effective cost control, stringent financial vigilance, and strategic coordination. Overall, these findings reflect upon the complex and multifaceted nature of impact from various discrete variables integrated under digital transformation, whereby maturity functions as a relatively stable factor contributing to efficacy, while orientation and intensity singularly fail in delivering profitability without proper crafting and supervision.

5. Conclusion

The aim of this research was to explore the impact of different facets of digital transformation—more specifically Digital Orientation (DO), Digital Intensity (DI), and Digital Maturity (DM)—on the financial performance measures of banks in Egypt, using Net Profit Margin (NPM) and Operating Profit Margin (OPM) as the dependent variables. Data were collected from the quarterly financial reports of five Egyptian commercial banks for the period from Q1 2013 to Q4 2023. The findings suggest that, while digital transformation is important for improving bank performance, its cost implications depend upon how it is implemented. Sustainable digital maturity increases operating effectiveness, while high digital intensity without strategic fit can result in reduced profit margins. Having a digital orientation alone is not enough if it is not followed through. Overall, digital transformation has maximum benefits when it is integrated, well-coordinated, and compatible with risk and resource management.

6- MANAGERIAL iMPLICATIONS

* Prioritizing Digital Maturity: Banks should focus on increasing their digital maturity through well-established governance, employee training, and integrating processes to ensure that investments in digital pay off in terms of operational and financial benefits.
* Reaching Equilibrium in Digital Intensity: While an expansion in digital initiatives is important, financial institutions should avoid overextending resources. Strategic prioritization and careful consideration of digital efforts are essential to counteract any negative impact on profitability
* Having strategic alignment for execution requires a focus on digital underpinned by operationally enabled and executable strategies. Banks and other financial institutions need to ensure that their digital goals are clearly defined and then executed through a coordinated approach.
* Analyzing Factors Outside Digital Innovation That Impact Profitability: With net profitability being defined by factors such as credit risk and capital adequacy, banks need to ensure that efforts around creating digital transformations complement integrated financial and risk management models.
* Adoption of an Integrated Model for Transformation: Instead of treating digitization as a stand-alone factor, financial organizations should adopt an integrated transformation model that synergistically utilizes strategy, intensity, and maturity in their efforts toward sustained performance outcomes.

7- Research limits

* The present study seeks to develop metrics for digital transformation based on empirical evidence collected from the Egyptian banking sector's annual reports. Although this is a feasible and viable approach, available information is less than complete. Future research could consider further sources that provide a higher level of comprehensiveness, accuracy, and variety.
* Second, this present study is looking into the impact of digitalization upon financial performance in enterprises, although for future work, there is a need for further in-depth analysis into impacts at the regional level. This would strengthen understanding of how financial performance is impacted from a macroeconomic perspective within the framework of a digital economy, hence enabling the formulation and implementation of targeted policies at a regional level.
* Lastly, this research will focus solely on publicly traded banks in the Egyptian banking industry. Due to differences in policy orientations, socio-economic developments, and technological sophistication among various countries, future research may evaluate the merit for expanding the scope further to cover other geographical areas or different business sectors, hence enhancing the generality of findings obtained from current research.
* Finally, the total banking industry in Egypt consists of 7 commercial banks, 3 Islamic banks, and 3 specialized banks. Out of this population, the researcher could obtain available data, so the sample consisted of only 3 commercial banks and 2 Islamic banks for the period 2013 to 2023, which gave the required information to carry out the research.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

References

Arias-Perez, J. and Velez-Jaramillo, J. (2022), “Ignoring the three-way interaction of digital orientation, not-invented-here syndrome and employee’s artificial intelligence awareness in digital innovation performance: a recipe for failure”, Technological Forecasting and Social Change, Vol. 174, p. 121305.

Ab Halim, M. S., M Haniff, M. S., Mat Junoh, M. Z., & Osman, A. (2014). Financial Performance and the Management Issues of Bumiputera Construction Firms in the Malaysian Construction Industry. Journal of Scientific Research and Reports, 3(9), 1190–1202. <https://doi.org/10.9734/JSRR/2014/8418>

Arkhipova, D., Vaia, G. (2019). Partnering for Digital Innovation: A Competence-Based Study. In: Kotlarsky, J., Oshri, I., Willcocks, L. (eds) Digital Services and Platforms. Considerations for Sourcing. Global Sourcing 2018. Lecture Notes in Business Information Processing, vol 344. Springer, Cham. <https://doi.org/10.1007/978-3-030-15850-7_1>

Al-Amawi, L., Al-Amarneh, A., Mustafa, J., & Dahbour, S. (2023). The Impact of Virtual Banking Services Cost on Profitability: Applied Study on Jordanian Commercial Banks. WSEAS Transactions on Business and Economics, 20, 1289–1297. <https://doi.org/10.37394/23207.2023.20.115>

Binsaddig, R., Ali, A., Ali, B., & Alkawi, T. (2023). The effect of capital and liquidity risks on financial performance: An empirical examination on banking industry. Uncertain Supply Chain Management, 11(2), 593–600.

Berghaus, S., & Back, A. (2016). Stages in Digital Business Transformation: Results of an Empirical Maturity Study". Tenth Mediterranean Conference on Information Systems.

Berelson, B. (1952). *Content analysis in communication research*. New York: Free Press.

Dalenogare, L.S., Benitez, G.B., Ayala, N.F. and Frank, A.G. (2018), “The expected contribution of industry 4.0 technologies for industrial performance”, International Journal of Production Economics, Vol. 204, pp. 383-394.

Dattee, B., Alexy, O. and Autio, E. (2018), “Maneuvering in poor visibility: how firms play the ecosystem game when uncertainty is high”, Academy of Management Journal, Vol. 61 No. 2, pp. 466-498.

Ebert, C., & Duarte,, C. H. (2016). Requirements Engineering for the Digital Transformation: An Industry Panel.. 24th IEEE International Requirements Engineering Conference.

Eldaia et al., 2025, Biometric analysis on financial performance of banks: key drivers of market, management and investors decisions. VoL. 12, no. 1, 2474208, <https://doi.org/10.1080/23311975.2025.2474208>

Frank, A.G., Dalenogare, L.S. and Ayala, N.F. (2019), “Industry 4.0 technologies: implementation patterns in manufacturing companies”, International Journal of Production Economics, Vol. 210, pp. 15-26.

Fors, A., & Stolterman, E. (2004). *Information technology and the good life*. In B. Kaplan, D. P. Truex, D. Wastell, A. T. Wood-Harper, & J. I. DeGross (Eds.), *Information Systems Research: Relevant Theory and Informed Practice* (pp. 687–692). Boston, MA: Springer. <https://doi.org/10.1007/1-4020-8095-6_41>

Gill, M., & Van boskirk, S. (2016). Forrester's Digital Maturity Model 4.0. Cambridge, Massachusetts.

Gurumurthy, R., Schatsky, D. and Camhi, J. (2020), Uncovering the Connection Between Digital Maturity and Financial Performance, Deloitte Insights, p. 23.

Gökalp, E., & Martinez, V. (2021). Digital transformation capability maturity model enabling the assessment of industrial manufacturers. *Computers in Industry*, 132, 103522. <https://doi.org/10.1016/j.compind.2021.103522>

Hess, T., Matt, C., Benlian, A. and Wiesb€ock, F. (2016), “Options for formulating a digital transformation strategy”, MIS Quarterly Executive, Vol. 15 No. 2, pp. 123-139.

Jikrillah, S., & Fadah, I. (2022). Financial Performance of Indonesia Banking: The Impact of Digital Banking. Proceedings of the 3rd International Conference of Islamic Finance and Business, ICIFEB 2022, 19-20 July 2022, Jakarta, Indonesia, 281. European Alliance for Innovation.

Kane, G.C., Palmer, D., Nguyen-Phillips, A., Kiron, D. and Buckley, N. (2017), “Achieving digital maturity”, MIT Sloan Management Review, Vol. 59 No. 1, pp. 1-29.

Kane, G.C., Palmer, D., Phillips, A.N., Kiron, D. and Buckley, N. (2015), “Strategy, not technology, drives digital transformation”, MIT Sloan Management Review and Deloitte University Press, Vol. 14, pp. 1-25.

Koh, L., Orzes, G. and Jia, F.J. (2019), “The fourth industrial revolution (Industry 4.0): technologies disruption on operations and supply chain management”, International Journal of Operations and Production Management, Vol. 39 Nos 6/7/8, pp. 817-828.

Kindermann, B., Beutel, S., de Lomana, G.G., Strese, S., Bendig, D. and Brettel, M. (2021), “Digital orientation: conceptualization and operationalization of a new strategic orientation”, European Management Journal, Vol. 39 No. 5, pp. 645-657.

Khin, S. and Ho, T.C. (2019), “Digital technology, digital capability and organizational performance”, International Journal of Innovation Science, Vol. 11 No. 2, pp. 177-195.

Kaddumi, T. A., Baker, H., Nassar, M. D., & A-Kilani, Q. (2023). Does Financial Technology Adoption Influence Bank’s Financial Performance: The Case of Jordan. *Journal of Risk and Financial Management*, 16(9), 413. <https://doi.org/10.3390/jrfm16090413>

Lanzolla, G., Lorenz, A., Miron-Spektor, E., Schilling, M. Solinas, G. and Tucci, C.L. (2018), “Digital transformation: what is new if anything?”, Academy of Management Discoveries, Vol. 4 No. 3, pp. 378-387.

Libert, B., Beck, M. and Wind, Y. (2016), “Questions to ask before your next digital transformation”, Harvard Business Review, Vol. 60 No. 12, pp. 11-13.

Pereira, C. S., Natércia, D., David, F., Maria, J. F., & Fernando, M. (2020). An Educational Approach for Present and Future of Digital Transformation in Portuguese Organizations. Applied Sciences 10, no. 3: 757.

Matt, C., Hess, T. and Benlian, A. (2015), “Digital transformation strategies”, Business and Information Systems Engineering, Vol. 57 No. 5, pp. 339-343.

Martinez, V., Zhao, M., Blujdea, C., Han, X., Neely, A. and Albores, P. (2019), “Blockchain-driven customer order management”, International Journal of Operations and Production Management, Vol. 39 Nos 6/7/8, pp. 993-1022.

Nasiri, M., Saunila, M. and Ukko, J. (2022), "Digital orientation, digital maturity, and digital intensity: determinants of financial success in digital transformation settings", International Journal of Operations & Production Management, Vol. 42 No. 13, pp. 274-298.

Nalliboyina , S. B., & Chalam , G. V. (2023). Factors Determining the Financial Performance of Public Sector Banks in India. Asian Journal of Economics, Business and Accounting, 23(14), 57–71. <https://doi.org/10.9734/ajeba/2023/v23i141005>

Nambisan, S., Lyytinen, K., Majchrzak, A. and Song, M. (2017), “Digital innovation management: reinventing innovation management research in a digital world”, MIS Quarterly, Vol. 41 No. 1, pp. 223-238.

Naeem, M., Ozuem, W., Howell, K., & Ranfagni, S. (2023). A step-by-step process of thematic analysis to develop a conceptual model in qualitative research. International Journal of Qualitative Methods, 22, 1–18. https://doi.org/10.1177/16094069231205789.

Parviainen, P., Tihinen, M., Kääriäinen, J., & Teppola, S. (2017). Tackling the digitalization challenge: how to benefit from digitalization in practice. International Journal of Information Systems and Project Management, 5(1), 63-77.

Patel, K., & McCarthy, M. (2000). Digital transformation: the essentials of e-business leadership. NewYork: KPMG/McGraw-Hill.

Porter, M.E. and Heppelmann, J.E. (2014), “How smart, connected products are transforming competition”, Harvard Business Review, Vol. 92, pp. 11-64.

Rubbio, I., Bruccoleri, M., Pietrosi, A. and Ragonese, B. (2019), “Digital health technology enhances resilient behaviour: evidence from the ward”, International Journal of Operations and Production Management, Vol. 40 No. 1, pp. 34-67.

Shatnawi, S.A., Marei, A., Hanefah, M.M., Eldaia, M., & Alaaraj, S. (2022). The effect of audit committee on financial performance of listed companies in Jordan: The moderating effect of enterprise risk management*. Journal of Management Information and Decision Sciences, 25*(S2), 1-10.

Sailer, K., Budgen, A., Lonsdale, N., Turner, A., & Penn, A. (2019). Evidence-based design: Theoretical and practical reflections of an emerging approach in office architecture. *Intelligent Buildings International*, 11(3-4), 178–199.

Salaheldin I., (2007), “The Impact of Organizational Characteristics on AMT Adoption: A Study of Egyptian Manufacturers” Emerald Insight, Journal of Manufacturing Technology, Vol.18 No. 4, pp. 443-460.

Singh, A., Klarner, P. and Hess, T. (2020), “How do chief digital officers pursue digital transformation activities? The role of organization design parameters”, Long Range Planning, Vol. 53 No. 3, p. 101-890.

Singh, A. and Hess, T. (2017), “How chief digital Officers promote the digital transformation of their companies”, MIS Quarterly Executive, Vol. 16 No. 1, pp. 1-17.

Sousa-Zomer, T.T., Neely, A. and Martinez, V. (2020), "Digital transforming capability and performance: a microfoundational perspective", International Journal of Operations & Production Management, Vol. 40 No. 7/8, pp. 1095-1128.

Diz, A.C., (1966), “Money and prices in Argentina 1935-1962, Ph.D. Dissertation, University of Chicago

Tortorella, G.L., Giglio, R. and van Dun, D.H. (2019), “Industry 4.0 adoption as a moderator of the impact of lean production practices on operational performance improvement”, International Journal of Operations and Production Management, Vol. 39 Nos 6/7/8, pp. 860-886.

Vial, G. (2019), “Understanding digital transformation: a review and a research agenda”,”, The Journal of Strategic Information Systems, Vol. 28 No. 2, pp. 118-144.

Warner, K.S. and W€ager, M. (2019), “Building dynamic capabilities for digital transformation: an ongoing process of strategic renewal”, Long Range Planning, Vol. 52 No. 3, pp. 326-349.

Westerman, G., Tannou, M., Bonnet, D., Ferraris, P. and McAfee, A. (2012), “The digital advantage: how digital leaders outperform their peers in every industry”, working paper MIT Sloan Management and Capgemini Consulting, MA, Vol. 2, pp. 2-23.

Wamba-Taguimdje, S.-L., Fosso Wamba, S., Kala Kamdjoug, J.R. and Tchatchouang Wanko, C.E. (2020), "Influence of artificial intelligence (AI) on firm performance: the business value of AI-based transformation projects", Business Process Management Journal, Vol. 26 No. 7, pp. 1893-1924.

APPENDIX

Appendex (1): OPM Models

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
|  | Operating Profit Margin | | | | |
| Dependent Variables | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
|  |  |  |  |  |  |
| **Controls** |  |  |  |  |  |
| Non-Performing Loans | -1.55\*\*(0.012) |  |  |  |  |
| Net Interest Margin |  | -0.61 (.67) |  |  |  |
| Loan to Deposit Ratio |  |  | 0.16 (.12) |  |  |
| Total Assets |  |  |  | -2.21 (.69) |  |
| Capital Adequacy Ratio |  |  |  |  | -0.03 (.27) |
|  |  |  |  |  |  |
| **Main Variables** |  |  |  |  |  |
| Digital Transformation |  |  |  |  |  |
| Digital Orientation | -0.00 (.23) | -0.00 (.44) | -0.00 (.41) | -0.00 (0.43) | -0.00 (.44) |
| Digital Intensity | -0.02\*\*\*(0.00) | -0.02\*\*\*(0.00) | -0.01\*\*\*(.00) | -0.02\*\*\*(.00) | -0.02\*\*(.013) |
| Digital Maturity | 0.05\*\*\*(.00) | 0.06\*\*\*(0.00) | 0.05\*\*\*(.00) | 0.05\*\*\*(.00) | 0.05\*\*\*(.00) |
|  |  |  |  |  |  |
| **Checking Diagnostics** |  |  |  |  |  |
| F | 23.25\*\*\* | 21.82\*\*\* | 22.33\*\*\* | 21.27\*\*\* | 21.51\*\*\* |
| |  | | --- | |  | | 0.46 | 0.45 | 0.45 | 0.45 | 0.45 |
| |  | | --- | |  | | 0.44 | 0.43 | 0.43 | 0.43 | 0.43 |
| AIC | -2.13 | -2.10 | -2.11 | -2.12 | -2.13 |
| Schwarz criterion | -1.99 | -1.96 | -1.97 | -1.98 | -1.99 |
| Sum squared resid | 1.40 | 1.44 | 1.42 | 1.37 | 1.37 |
| **Note that:** |  |  |  |  |  |
| \*\*\*p ≤ 0.001, \*\* 0.001 < p ≤ 0.01, \* 0.01 < p ≤ 0.1 | | |  |  |  |

Appendex (2): nPM Models

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
|  | Net Profit Margin | | | | |
| Dependant Variables | Model 6 | Model 7 | Model 8 | Model 9 | Model 10 |
|  |  |  |  |  |  |
| **Controls** |  |  |  |  |  |
| Non-Performing Loans | -1.35\*\*\*(.00) |  |  |  |  |
| Net Interest Margin |  | -0.16 (.84) |  |  |  |
| Loan to Deposit Ratio |  |  | 0.17\*\*\*(.00) |  |  |
| Total Assets |  |  |  | -4.45 (.15) |  |
| Capital Adequacy Ratio |  |  |  |  | -0.05\*\*\*(.00) |
|  |  |  |  |  |  |
| **Main Variables** |  |  |  |  |  |
| Digital Transformation |  |  |  |  |  |
| Digital Orientation | -6.35 (.41) | -2.15 (.79) | -1.48 (.85) | -2.17 (.99) | 9.97 (.99) |
| Digital Intensity | -0.00 (.14) | -0.00\*(.09) | -0.00\*(.09) | -0.00 (.14) | -0.00 (.54) |
| Digital Maturity | 0.01\*\*\*(0.00) | 0.01 (.10) | 0.01 (0.18) | -0.01 (.15) | 0.00 (.39) |
|  |  |  |  |  |  |
| **Checking Diagnostics** |  |  |  |  |  |
| F | 52.10\*\*\* | 46.70\*\*\* | 49.57\*\*\* | 47.49\*\*\* | 50.56\*\*\* |
| |  | | --- | |  | | 0.66 | 0.63 | 0.65 | 0.64 | 0.66 |
| |  | | --- | |  | | 0.65 | 0.62 | 0.63 | 0.63 | 0.64 |
| AIC | -3.31 | -3.23 | -3.27 | -3.29 | -3.33 |
| Schwarz criterion | -3.17 | -3.10 | -3.13 | -3.15 | -3.19 |
| Sum squared resid | 0.43 | 0.46 | 0.44 | 0.42 | 0.41 |
| **Note that:** |  |  |  |  |  |
| \*\*\*p ≤ 0.001, \*\* 0.001 < p ≤ 0.01, \* 0.01 < p ≤ 0.1 | | |  |  |  |

Appendex (3): Financial Performance

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
|  | Financial Performance | | | | |
| Dependent Variables | Model 11 | Model 12 | Model 13 | Model 14 | Model 15 |
|  |  |  |  |  |  |
| **Controls** |  |  |  |  |  |
| Non-Performing Loans | -31.61\*\*\*(.00) |  |  | -24.48\*\*\*(.00) | -32.24\*(.00) |
| Net Interest Margin |  |  |  |  | -11.77 (.39) |
| Loan to Deposit Ratio |  |  |  | 3.07\*\*\*(0.00) |  |
| Total Assets |  | -5.19 (.31) |  |  |  |
| Capital Adequacy Ratio |  |  | -0.70\*\*(0.016) |  |  |
|  |  |  |  |  |  |
| **Main Variables** |  |  |  |  |  |
| Digital Transformation | 0.06 (.17) | 0.11\*\*(0.015) | 0.12\*\*\*(0.00) | 0.03 (.46) | 0.08 (.10) |
| Digital Orientation |  |  |  |  |  |
| Digital Intensity |  |  |  |  |  |
| Digital Maturity |  |  |  |  |  |
|  |  |  |  |  |  |
| **Checking Diagnostics** |  |  |  |  |  |
| F | 16.50\*\*\* | 57.09\*\*\* | 5.43\*\*\* | 13.73\*\*\* | 51.42\*\*\* |
| |  | | --- | |  | | 0.13 | 0.62 | 0.04 | 0.16 | 0.62 |
| |  | | --- | |  | | 0.12 | 0.61 | 0.03 | 0.14 | 0.61 |
| AIC |  | 2.38 |  |  | 2.48 |
| Schwarz criterion |  | 2.49 |  |  | 2.60 |
| Sum squared resid | 145.01 | 127.58 | 126.59 | 139.86 | 143.13 |
| **Note that:** |  |  |  |  |  |
| \*\*\*p ≤ 0.001, \*\* 0.001 < p ≤ 0.01, \* 0.01 < p ≤ 0.1 | | |  |  |  |

Appendex (3) cont.: Financial Performance

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
|  | Financial Performance | | | | |
| Dependent Variables | Model 16 | Model 17 | Model 18 | Model 19 | Model 20 |
|  |  |  |  |  |  |
| **Controls** |  |  |  |  |  |
| Non-Performing Loans | -25.01\*\*\*(.00) | -29.15\*\*\*(.00) |  |  |  |
| Net Interest Margin | -13.91 (.30) | -14.01 (.26) | -5.00 (.71) |  | -9.28 (.47) |
| Loan to Deposit Ratio | 3.20\*\*\*(.00) |  | 4.64\*\*\*(.00) | 3.23\*\*\*(.00) | 3.39\*\*\*(.00) |
| Total Assets |  |  |  |  |  |
| Capital Adequacy Ratio |  | -0.81\*\*\*(.00) |  | -0.53\*(.06) | -0.55\*(.06) |
|  |  |  |  |  |  |
| **Main Variables** |  |  |  |  |  |
| Digital Transformation | 0.06 (.25) | 0.11\*\*(.02) | 0.06 (.25) | 0.07 (.10) | 0.09\*(.08) |
| Digital Orientation |  |  |  |  |  |
| Digital Intensity |  |  |  |  |  |
| Digital Maturity |  |  |  |  |  |
|  |  |  |  |  |  |
| **Checking Diagnostics** |  |  |  |  |  |
| F | 47.34\*\*\* | 53.00\*\*\* | 8.19\*\*\* | 7.07\*\*\* | 47.64\*\*\* |
| |  | | --- | |  | | 0.64 | 0.67 | 0.10 | 0.09 | 0.64 |
| |  | | --- | |  | | 0.62 | 0.66 | 0.08 | 0.07 | 0.63 |
| AIC | 2.45 | 2.25 |  |  | 2.32 |
| Schwarz criterion | 2.59 | 2.39 |  |  | 2.46 |
| Sum squared resid | 138.15 | 110.41 | 152.26 | 121.52 | 118.48 |
| **Note that:** |  |  |  |  |  |
| \*\*\*p ≤ 0.001, \*\* 0.001 < p ≤ 0.01, \* 0.01 < p ≤ 0.1 | | |  |  |  |

Appendex (3) cont.: Financial Performance

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
|  | Financial Performance | | | | |
| Dependent Variables | Model 21 | Model 22 | Model 23 | Model 24 | Model 25 |
|  |  |  |  |  |  |
| **Controls** |  |  |  |  |  |
| Non-Performing Loans |  |  | -27.25\*\*\*(.00) | -28.36\*\*\*(.00) | -27.83\*\*\*(.00) |
| Net Interest Margin | -6.48 (.62) |  |  |  | -9.93 (.43) |
| Loan to Deposit Ratio |  | 4.75\*\*\*(.00) |  |  |  |
| Total Assets | 2.34 (.70) |  | -2.05 (.67) |  | -1.85 (.71) |
| Capital Adequacy Ratio | -0.79\*\*(.02) |  |  | -0.77\*\*\*(.00) |  |
|  |  |  |  |  |  |
| **Main Variables** |  |  |  |  |  |
| Digital Transformation | 0.13\*\*(.01) | 0.05 (.27) | 0.06 (.20) | 0.08\*(.05) | 0.08 (.13) |
| Digital Orientation |  |  |  |  |  |
| Digital Intensity |  |  |  |  |  |
| Digital Maturity |  |  |  |  |  |
|  |  |  |  |  |  |
| **Checking Diagnostics** |  |  |  |  |  |
| F | 44.12\*\*\* | 12.85\*\*\* | 57.09\*\*\* | 12.61\*\*\* | 49.93\*\*\* |
| |  | | --- | |  | | 0.63 | 0.10 | 0.65 | 0.15 | 0.65 |
| |  | | --- | |  | | 0.61 | 0.09 | 0.64 | 0.14 | 0.64 |
| AIC | 2.37 |  | 2.28 |  | 2.29 |
| Schwarz criterion | 2.51 |  | 2.41 |  | 2.43 |
| Sum squared resid | 124.45 | 149.34 | 115.23 | 112.43 | 114.88 |
| **Note that:** |  |  |  |  |  |
| \*\*\*p ≤ 0.001, \*\* 0.001 < p ≤ 0.01, \* 0.01 < p ≤ 0.1 | | |  |  |  |

Appendex (3) cont.: Financial Performance

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |
|  | Financial Performance | | | | | | |
| Dependent Variables | Model 26 | Model 27 | Model 28 | Model 29 | Model 30 | Model 31 | Model 32 |
|  |  |  |  |  |  |  |  |
| **Controls** |  |  |  |  |  |  |  |
| Non-Performing Loans | |  |  |  |  |  | -29.79\*\*\*(.00) |
| Net Interest Margin | -2.30 (.86) | -2.58 (.84) |  |  | -7.22 (.57) |  |  |
| Loan to Deposit Ratio |  |  | 3.66\*\*\*(.00) |  | 3.73\*\*\*(.00) | 3.53\*\*\*(.00) |  |
| Total Assets | -5.15 (.32) |  | -5.66 (.91) | 2.03 (.73) | -3.81 (.94) | 5.84 (.33) | 7.76 (0.18) |
| Capital Adequacy Ratio | | -0.70\*\*(.016) |  | -0.77\*\*(.02) |  | -0.70\*\*(.03) | -1.01\*\*\*(.00) |
|  |  |  |  |  |  |  |  |
| **Main Variables** |  |  |  |  |  |  |  |
| Digital Transformation | 0.12\*\*(.02) | 0.13\*\*(.014) | 0.04 (.34) |  | 0.06 (.27) | 0.05 (.28) | 0.06 (.19) |
| Digital Orientation |  |  |  |  |  |  |  |
| Digital Intensity |  |  |  |  |  |  |  |
| Digital Maturity |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| **Checking Diagnostics** |  |  |  |  |  |  |  |
| F | 48.71\*\*\* | 3.56\*\* | 53.15\*\*\* | 50.57\*\*\* | 46.39\*\*\* | 47.79\*\*\* | 53.20\*\*\* |
| |  | | --- | |  | | 0.62 | 0.04 | 0.64 | 0.63 | 0.64 | 0.64 | 0.67 |
| |  | | --- | |  | | 0.60 | 0.03 | 0.63 | 0.61 | 0.62 | 0.63 | 0.66 |
| AIC | 2.39 |  | 2.33 | 2.36 | 2.34 | 2.32 | 2.25 |
| Schwarz criterion | 2.51 |  | 2.46 | 2.49 | 2.48 | 2.46 | 2.39 |
| Sum squared resid | 127.56 | 127.55 | 120.71 | 124.60 | 120.53 | 118.24 | 110.14 |
| **Note that:** |  |  |  |  |  |  |  |
| \*\*\*p ≤ 0.001, \*\* 0.001 < p ≤ 0.01, \* 0.01 < p ≤ 0.1 | | |  |  |  |  |  |

Appendex (4).: Hausman test for research models

|  |  |  |
| --- | --- | --- |
| Model No | Hausman Test | Result |
| 1 | .00 | Fixed |
| 2 | .00 | Fixed |
| 3 | .00 | Fixed |
| 4 | .00 | Fixed |
| 5 | .00 | Fixed |
| 6 | .00 | Fixed |
| 7 | .00 | Fixed |
| 8 | .00 | Fixed |
| 9 | .00 | Fixed |
| 10 | .00 | Fixed |
| 11 | .96 | Random |
| 12 | .00 | Fixed |
| 13 | .54 | Random |
| 14 | .90 | Random |
| 15 | .01 | Fixed |
| 16 | .00 | Fixed |
| 17 | .00 | Fixed |
| 18 | .10 | Random |
| 19 | .28 | Random |
| 20 | .00 | Fixed |
| 21 | .00 | Fixed |
| 22 | .81 | Random |
| 23 | .00 | Fixed |
| 24 | .68 | Random |
| 25 | .00 | Fixed |
| 26 | .00 | Fixed |
| 27 | .26 | Random |
| 28 | .00 | Fixed |
| 29 | .01 | Fixed |
| 30 | .00 | Fixed |
| 31 | .00 | Fixed |
| 32 | .00 | Fixed |