The impact of Digital Transformation Maturity on Corporate's Competitive Advantage; The Case of the Private Egyptian Transportation Sector

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Abstract

Egypt has been actively pursuing ambitious strategic plans in recent years to align itself with global innovation and development. Consequently, understanding the role of digital transformation maturity has become increasingly crucial, particularly within sectors vital to the Egyptian economy such as private transportation. Organizations in this sector face intense competition and are continually exploring how digital transformation strategies might influence their overall competitive advantage.

This study primarily aims to examine the impact of Digital Transformation Maturity (DTM) on Corporate Competitive Advantage (CCA), considering innovation, cost efficiency, and customer loyalty as key performance indicators. Variables were identified based on existing literature: digital transformation maturity (independent) and three key dimensions Digital Strategy - Technology & Infrastructure - Culture & Leadership, corporate competitive advantage (dependent), innovation, cost efficiency, and customer loyalty. Hypotheses were developed and systematically tested using primary data collected through a structured questionnaire administered to senior management personnel from various transportation firms, with 324 responses utilized in the analysis. Data were analyzed using SPSS and Smart PLS to validate the hypothesized relationships.

The findings reveal significant positive effects of digital transformation maturity on corporate competitive advantage, innovation, and cost efficiency. However, digital transformation did not show a statistically significant direct impact on customer loyalty.

Thus, the study concludes that while digital transformation maturity is crucial for enhancing innovation and cost efficiency, its direct role in customer loyalty may require supplementary traditional approaches and enhanced service quality.

Based on these results, this research recommends that Egyptian private transportation companies actively integrate

robust digital transformation practices to achieve superior competitive performance, particularly through innovation and operational efficiency, while simultaneously nurturing customer relationships through direct service quality improvements. Future research is encouraged to explore the role of digital transformation across other sectors and contexts to strengthen the understanding and generalizability of these findings.

Keywords: Digital Transformation Maturity, Corporate Competitive Advantage, Innovation, Cost Efficiency, Customer Loyalty, Egyptian Private Transportation, Digital Strategy, Technology & Infrastructure , Culture & Leadership

أثر نضج التحول الرقمي على الميزة التنافسية للشركات
حالة قطاع النقل الخاص المصري

الملخص:

تسعى مصر في السنوات الأخيرة إلى تنفيذ خطط استراتيجية طموحة تهدف إلى مواكبة الابتكار والتطور العالمي. وبناءً عليه، أصبح من الضروري بشكل متزايد فهم دور نضج التحول الرقمي، خصوصًا في القطاعات الحيوية للاقتصاد المصري مثل قطاع النقل الخاص. إذ تواجه المؤسسات العاملة في هذا القطاع منافسة شديدة، وتسعى باستمرار إلى استكشاف كيف يمكن لاستراتيجيات التحول الرقمي أن تؤثر على ميزتها التنافسية بشكل عام.

يهدف هذا البحث بشكل أساسي إلى دراسة تأثير نضج التحول الرقمي على الميزة التنافسية للشركات، مع الأخذ في الاعتبار كل من الابتكار، وكفاءة التكاليف، وولاء العملاء كمؤشرات رئيسية للأداء. وقد تم تحديد المتغيرات بناءً على الأدبيات السابقة، حيث شمل المتغير المستقل "نضج التحول الرقمي" بثلاثة أبعاد رئيسية :

الاستراتيجية الرقمية، التكنولوجيا والبنية التحتية، الثقافة والقيادة، في حين تمثّل المتغير التابع في **الميزة التنافسية للشركة،** إلى جانب المتغيرات الفرعية :**الابتكار، كفاءة التكاليف، وولاء العملاء.**

تم تطوير الفرضيات واختبارها بشكل منهجي باستخدام بيانات أولية جُمعت من خلال استبيان منظم وُزّع على القيادات العليا في عدد من شركات النقل، وتم استخدام ٣٢٤ استجابة في التحليل. وقد تم تحليل البيانات باستخدام برنامجي SPSS و Smart PLSللتحقق من صحة العلاقات المفترضة.

أظهرت النتائج وجود تأثيرات إيجابية ذات دلالة إحصائية لنضج التحول الرقمي على كل من **الميزة التنافسية، والابتكار، وكفاءة التكاليف** .ومع ذلك، لم يُظهر التحول الرقمي تأثيرًا مباشرًا ذا دلالة إحصائية على **ولاء العملاء.**

بناءً على ذلك، خلصت الدراسة إلى أن نضج التحول الرقمي يُعد عاملًا محوريًا في تعزيز الابتكار وكفاءة العمليات، إلا أن دوره المباشر في تعزيز ولاء العملاء قد يتطلب دعمًا إضافيًا من خلال الوسائل التقليدية وجودة الخدمة المقدمة.

وتوصي الدراسة شركات النقل الخاصة في مصر بتبني ممارسات رقمية قوية لتعزيز أدائها التنافسي، لا سيما من خلال **الابتكار والكفاءة التشغيلية،** مع العمل بالتوازي على **تعزيز جودة الخدمات** لتقوية علاقاتها مع العملاء. كما تشجع الدراسة الباحثين في المستقبل على استكشاف دور التحول الرقمي في قطاعات وسياقات أخرى، بهدف تعميق الفهم وتعزيز إمكانية تعميم النتائج.

الكلمات المفتاحية:

نضج التحول الرقمي، الميزة التنافسية للشركات، الابتكار، الكفاءة في التكاليف، ولاء العملاء، قطاع النقل الخاص في مصر، الاستراتيجية الرقمية، التكنولوجيا والبنية التحتية، الثقافة والقيادة.

Introduction

1.1 Background:

Technological developments are a major factor in determining an organization's competitiveness in the quickly changing business environment of today. To boost customer satisfaction, increase operational efficiency, and encourage innovation, businesses all across the world are implementing new technology (Farida & Setiawan, 2022). However, companies should first concentrate on broader technological integration, like automating repetitive tasks, deploying cloud computing, and using data analytics tools to build a strong technological foundation, before launching into full-scale digital transformation (Lee et al., 2023). This progressive strategy reduces the risks associated with hurried adoption and guarantees that firms are ready for the challenges of digital transformation.

1.2 Research Problem:

Egypt's transportation sector is being profoundly impacted by digital transformation, which is improving customer satisfaction, safety, and efficiency. The following are some significant methods and statistics that illustrate this shift: Egypt's urban mobility has changed as a result of the growth of ride-hailing applications like Careem and Uber. The expansion of e-commerce and logistics has been aided by digital transformation. As of 2021, Uber had 2 million customers in Egypt, and Careem

also holds a significant market share, suggesting a shift towards more tech-driven personal transport alternatives. A 2022 industry Research projects that the logistics industry in Egypt will expand at a compound annual growth rate (CAGR) of 12.1% from 2022 to 2027, propelled by digital solutions that improve freight and delivery service efficiency (Ahmed, et al., 2021).

1.3 Research Gab:

Many studies have examined the connection between competitive advantage and the maturity of digital transformation, but many have not sufficiently addressed the particular difficulties and situations that apply to Egyptian businesses. The impact of green marketing orientation on competitive advantage, for example, was studied by (Papadas et al., 2018); however, the results are mostly relevant to Western markets and might not be directly applicable to the Egyptian corporate climate. Similar to this, (Udriyah et al., 2018)'s study on textile SMEs in Malaysia provided insightful information about market orientation and innovation, but it ignored the socioeconomic and cultural elements affecting Egyptian businesses. This disparity highlights the need for context-specific studies that look at how digital transformation maturity models can be modified to successfully boost competitive advantage in Egypt's unique market dynamics.

1.4 Research Significance:

By improving our knowledge of how different levels of Digital Transformation Maturity (DTM) affect a company's capacity to maintain and bolster its competitive advantage, this study has substantial scientific and practical significance. According to empirical research, companies with greater levels of digital maturity outperform those with lower levels in terms of market positioning, operational effectiveness, and financial performance (Almeida et al., 2023).

1.5 Research Objectives:

Investigating and testing the effect of digital transformation maturity on sustainable competitive advantage in the Egyptian private transportation market is the primary goal of this study. the following is the research goal:

1. Examine how Sustainable Competitive Advantage (SCA) and Digital Transformation Maturity (DTM) relate to one another.
2. How much an organizational innovation capability is impacted by the maturity of its digital Transformation.
3. Determine an organization's Digital Transformation Maturity and how it affects its cost advantages
4. To analyze the influence of Digital Transformation Maturity on fostering customer loyalty in a competitive market environment.

1.6 Research Questions:

The study raises the following key questions in light of the research objectives:

1. What is the relationship between Sustainable Competitive Advantage and Digital Transformation Maturity (DTM)?
2. How does Digital Transformation Maturity contribute to the enhancement of organizational innovation
3. How does Digital Transformation Maturity affect an organization's ability to attain and sustain cost-based competitive advantages?
4. To what extent does Digital Transformation Maturity influence customer loyalty as a dimension of corporate competitiveness?

1.7 Research Scope:

With an emphasis on Egyptian private transportation companies, this study examines the effects of digital transformation maturity on corporate's competitive advantages.

Theoretical background and the literature Review:

2.1 Digital Transformation Maturity:

2.1.1 Digital Transformation Definition:

Currently, there is no commonly accepted definition for the term "digital transformation" (Schallmo et al., 2017). The term

"transformation" expresses a fundamental change within the organization, which impacts strategy, structure (Matt et al., 2015) and the distribution of power (Wischnevsky & Damanpour, 2006). Digital transformation itself can be seen as an ongoing process of adoption to a significantly changing digital landscape in order to meet the digital expectations of customers, employees and partners. This process of adoption has to be actively designed, initiated and executed (Berghaus & Back, 2016; Kane et al., 2017). McKinsey developed a definition which states that digital is less about any one process and more about how companies run their business (Dörner & Edelman, 2015). Their definition of "digital" can be broken down into three areas: creating value at the new frontiers of the business world, optimizing the processes that directly affect the customer experience, and building foundational capabilities that support the entire overall business initiative.

2.1.2. Digital Transformation Maturity Definition:

Even after nearly 50 years of research in the subject of maturity models in general, a jargon jungle of related concepts persists. Terms such as framework, stages of growth model, stage model, change model, and maturity model are used synonymously (Becker et al., 2010). Additionally, an examination of the relevant literature reveals that different interpretations of the term Digital Maturity exist (Hellweg et al., 2021). To date, there is no standard definition for this

phenomenon (Aslanova & Kulichkina 2020). To lay a solid foundation for the following systematic literature review, we refer to these short definitions: Digital Maturity is "the status of a company's digital transformation" – it describes "what a company has already achieved with regard to transformation efforts" (Chanias & Hess, 2016). Here, efforts encompass implemented changes both from an operational perspective, as well as acquired capabilities with regards to the mastering of the organization's digital transformation process.

2.1.4. Digital Transformation Maturity Aspects:

The digital transformation as a disruptive or incremental change process. It starts with the adoption and use of digital technologies, then evolving into an implicit holistic transformation of an organization. Morakanyane et al. (2017), compared several definitions of digital transformation (Liu et al., 2011; Bharadwaj et al., 2013; Fitzgerald et al., 2013; Lucas et al., 2013; Mithas et al., 2013; Westerman et al., 2014; Henriette et al., 2015; Piccinini et al., 2015; Schuchmann and Seufert, 2015; Chanias and Hess, 2016; Hess et al., 2016) and proposed that digital transformation is "an evolutionary process that leverages digital capabilities and technologies to enable business models, operational processes and customer experiences to create value". Overall, the definitions of Henriette et al. (2016), and of Morakanyane et al. (2017), are proposing good

definitions of digital transformation. Especially the definition of Henriette et al. (2016) underlines that in the context of using and adopting digital technology a holistic transformation of an organization is required in order to create value.

2.1.5. Digital Transformation Benefits / Importance:

According to (Pereira et.al, 2022) digital transformation is crucial for organizations aiming to thrive in today's rapidly evolving business landscape. It encompasses the integration of digital technologies across all areas of a business, fundamentally changing how operations are conducted and how value is delivered to customers. This transformation is not merely about adopting new technologies but involves a cultural shift that encourages innovation and agility. Companies that embrace digital transformation can enhance their efficiency, improve customer experiences, and create new revenue streams, positioning themselves competitively in the global market. Furthermore, it plays a vital role in sustainability efforts, enabling businesses to optimize resources and reduce their environmental impact through data-driven decision-making and innovative practices. Thus, digital transformation is essential for fostering resilience and adaptability in an increasingly interconnected world.

2.1.6. Digital Transformation Maturity Benefits / Importance:

According to (Lee, 2024) Understanding the benefits of achieving higher maturity levels can significantly influence a company's strategic decisions and operational effectiveness. Here are some key benefits associated with digital transformation maturity:

Enhanced Competitiveness: Organizations with higher digital maturity are better positioned to leverage digital technologies, leading to improved competitiveness in the market. This includes the ability to respond more swiftly to market changes and customer demands.

Operational Efficiency: Digital transformation maturity often results in streamlined processes and improved operational efficiency. Companies can automate routine tasks, reduce errors, and optimize resource allocation, which contributes to cost savings and productivity gains.

Innovation and Agility: Organizations that achieve higher levels of digital maturity are typically more innovative and agile. They can quickly adapt to new technologies and market trends, fostering a culture of continuous improvement and innovation.

Improved Customer Experience: Digital maturity facilitates the implementation of customer-centric strategies, enhancing customer engagement and satisfaction. Companies can leverage technologies such as AI and analytics to personalize customer interactions and improve service delivery.

Sustainable Growth: Companies that successfully navigate their digital transformation journey are more likely to achieve sustainable growth. By integrating digital strategies into their core business models, they can create long-term value and resilience against market disruptions.

2.1.7. Previous Studies / Theoretical Models (Critical Analysis):

(Thordsen, et, al. 2023) stated that Digital Maturity Models (DMMs) have been designed specifically to assess an organization's digital status quo and to provide concrete measures to increase its level of digital maturity. The Authors presented an exemplary DMM, designed for telecommunication service providers. The dimensions and evolutionary stages can be identified on the first sight. In average, DMMs encompass six dimensions across four to six evolutionary stages, respectively (Ochoa-Urrego and Peña, 2020).

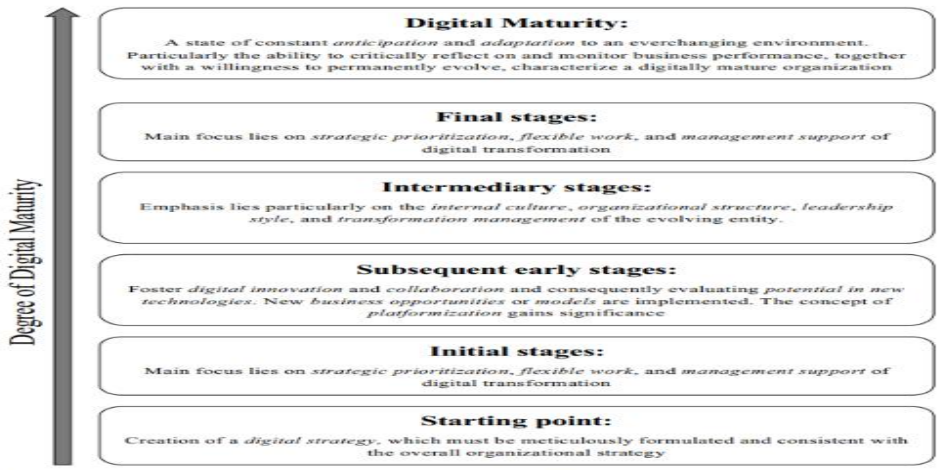


Fig. 2 Synthesis of typical evolutionary stages of current DMMs

Moreover, the Authors highlighted that the remarkable similarities can be observed. In general, DMMs suggest resembling progressions to achieving digital maturity (Ochoa-Urrego and Peña, 2020). The following illustration depicts the typical path to an organization's digital maturity as it is presented by existing DMMs (Fig. 2).

While they have different areas of interest, Teichert (2019) and Haryanti et al. (2023) both investigate digital maturity models. Teichert highlights the need for more comprehensive and specialised approaches while criticising current models for their lack of domain-specific applicability and cultural integration. To illustrate the continuous difficulty of creating thorough and useful frameworks for digital maturity, Haryanti et al. present the DX-SAMM model, which has culture as one of its seven dimensions but has drawbacks because of its theoretical underpinnings and lack of empirical validation.

2.2. Competitive Advantage:

2.2.1. Competitive Advantage Definition:

(Sigalas, 2015) defined Competitive advantage as the above industry average manifested exploitation of market opportunities and neutralization of competitive threats. this definition provides enough semantic openness together with an adequate level of objectivity, separating the CA concept from its sources, and its resulting causal effects like "performance" or others.

Historically, the CA concept was "born" around the 1960s under the strategic management research area, being one of its most relevant conceptual "pillars" on which scholar's focus was "swinging" between two research streams: the RBV and the IO View (Hoskisson et al., 1999). In terms of scholarship literature, the IO view had an external (industry) perspective, whose central "belief" was that firms' performance was explained by the industry's structure and characteristics like density (Porter, 1981).

2.2.2. Competitive Advantage Aspects:

RBV's view, with an internal (firm) perspective, placed the main emphasis of research work in the quest for understanding firms' heterogeneity and in how competitive advantages were achieved, with a fundamental "belief" that firms' sustainable performance was directly related to idiosyncratic internal arrangements of resources and that resource endowment asymmetries justified differences in performance within an industry (Wernerfelt, 1984).

Increased market's turbulence and dynamics brought an evolution to the RBV view, called "dynamic capabilities". This new perspective added a more in-depth understanding of the mechanisms in the genesis of firms' CAs under highly dynamic environments—namely the organizational capabilities, supported and conditioned by firms' positions and paths (Teece et al., 1997).

2.2.3. Competitive Advantage Benefits / Importance:

Competitive advantage refers to the attributes or capabilities that allow an organization to outperform its competitors. Research has identified several benefits associated with achieving and maintaining a competitive advantage. Here are some key benefits:

Increased Profitability: Organizations that successfully leverage their competitive advantages can achieve higher profit margins compared to their competitors. This is often due to unique resources or capabilities that are difficult for others to replicate (Thoran, 2022).

Market Positioning: A strong competitive advantage enables firms to position themselves effectively in the market, allowing them to capture a larger market share and establish brand loyalty among customers. This positioning is often linked to differentiation strategies that highlight unique product features or superior service (Farida, 2022).

Sustainable Growth: Companies that maintain a competitive advantage are better equipped to achieve sustainable growth over time. This is because they can continuously innovate and adapt to changing market conditions, ensuring long-term viability (Thoran, 2022).

Enhanced Customer Satisfaction: Organizations that effectively utilize their competitive advantages often provide

superior value to customers, leading to increased satisfaction and loyalty. This can result in repeat business and positive word-of-mouth referrals (Thoran, 2022).

Operational Efficiency: Competitive advantages can lead to improved operational efficiencies, as organizations streamline processes and reduce costs. This efficiency can stem from unique technologies, skilled personnel, or optimized supply chains (Farida, 2022).

Innovation Capabilities: Firms with a competitive advantage are often more innovative, as they have the resources and capabilities to invest in research and development. This innovation can lead to new products, services, or processes that further enhance their market position (Farida, 2022)..

Resilience Against Competition: A well-established competitive advantage provides a buffer against competitive pressures, allowing organizations to withstand market fluctuations and aggressive tactics from rivals (Thoran, 2022).

2.2.4. Previous Studies / Theoretical Model (Critical Analysis):

Using agility, innovation, and customer relationships, Yuleva-Chuchulayna (2019) focuses on SMEs and contends that differentiation, not cost leadership, is their competitive edge. Wang et al. (2024), on the other hand, adopt a more comprehensive strategy, focusing on the importance of

technology, human resources, and organizational structure while analyzing cost and differentiation advantages across industries. Wang et al. emphasize internal capabilities as important factors that contribute to long-term competitiveness, while Yuleva-Chuchulayna adapts methods to the limitations of SMEs.

Yuleva-Chuchulayna (2019), explores the unique challenges and opportunities that SMEs face in a competitive business environment. It emphasizes that SMEs must develop effective strategies to leverage their inherent strengths, such as agility, innovation, and close customer relationships, to gain competitive advantages. The article categorizes competitive advantages into cost leadership and differentiation, noting that while cost leadership is often unattainable for SMEs due to resource constraints, differentiation through unique product offerings and superior customer service is more feasible. The author also discusses the importance of digital marketing as a tool for SMEs to compete against larger firms, highlighting the role of the resource-based view in formulating strategies that capitalize on internal capabilities. Ultimately, Yuleva-Chuchulayna argues that understanding and developing competitive advantages tailored to the specific context of SMEs is crucial for their success in a rapidly changing market landscape.

Wang

2.3. Digital Transformation and Competitive Advantage:

Academic perspectives on the relationship between DT and competitive advantage are divided. One view argues that the rapid evolution of digital technologies undermines the sustainability of competitive advantage, making SCA temporary and rare in today's complex economic environment (D'Aveni et al., 2010; McGrath, 2013). In contrast, another perspective suggests that digital technologies, such as big data, digital platforms, and blockchain, enable firms to build and maintain SCA by improving adaptability and performance (Garmaki et al., 2023; Kristoffersen et al., 2021; Liu et al., 2023; Sarfraz et al., 2023).

This view emphasizes that digital capabilities allow organizations to seize new opportunities and achieve superior outcomes. Nevertheless, the mechanisms linking DT and SCA remain complex and multifaceted (Xue et al., 2022). To address this, the first objective of this research is to explore how DT helps SMEs build and sustain SCA in competitive environments.

2.4. Digital Transformation Maturity and Competitive Advantage:

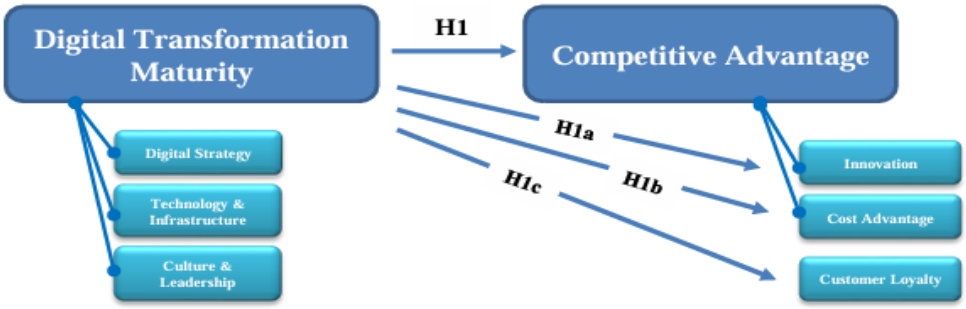
According to Lee et al. (2022), his study provides a thorough examination of digital maturity, especially when considering healthcare institutions such as EyeHosp during the COVID-19 pandemic. Digital maturity, according to the authors, is a dynamic process that entails coordinating an organization's activities, culture, people, and structure in order to successfully

use technology to gain a competitive edge. Continuous learning, cross-functional cooperation, operational agility, customer-centric strategies, data-driven decision-making, and creative leadership are the six essential digital maturing behaviors they identify. In order to demonstrate how these habits change in various contexts, the research used a longitudinal case study. It also highlights the significance of timing and creative agency in accomplishing significant digital transformation. Consequently, this leads to enhanced organizational effectiveness and adaptability in a swiftly evolving technological environment. Overall, the paper provides valuable insights into the importance of digital maturity in achieving competitive advantage.

2.5. Research Conceptual Model:

Based on empirical literatures, the herein below figure expressed the relationship between the Digital Transformation Maturity and the Competitive Advantage in the Egyptian Private Transportation Sector. Based on that, according to previous studies explored the main dimensions to measure the Digital Transformation Maturity as an Independent Variable for Example, Organizational Culture (Teichert, 2019); Strategy, Organizational Structure, Technology, Employees, Customers, Business Processes, and Culture (Haryanti et al., 2023); Performance Management, Defect Prevention, Customer Availability, Requirement Management, Collaborative Development, and Regular Delivery (Sallam et al., 2024);

Customer Experience, Innovation, and Process Digitization (Rodriguez et.al, 2024); Strategy, Customers, Employees, Process Management, Technology And Data Management, Organizational Culture, and Innovation (Merdin et al., 2023); Technology, People, Process, Strategy, and Environment (Jäkel et al., 2024); Organizational Culture, Leadership, and Technological Infrastructure (Lee et al.,2024); Strategy, Organization, Customer, Technology, Operations, Innovations, and Process Improvement (Vásquez, 2024); Digitization of Business Processes, Digital Infrastructure, Data-Driven Management, Customer Orientation Principles, Product Value Management, Research and Development, Digital Culture, and Digital Partnerships (Ilin et al.,2022).



2.6. Hypothesis:

Main Hypothesis:

H1: There is a positive relationship between Digital Transformation Maturity (DTM) and Sustainable Competitive Advantage (SCA).

Sub-Hypotheses:

H1a: The Digital Transformation Maturity has a direct positive Impact on the corporate's Innovation.

H1b: The Digital Transformation Maturity has a direct positive Impact on the corporate's cost Advantage.

H1c: The Digital Transformation Maturity has a direct positive Impact on the corporate's Customer Loyalty.

Research Methodology

3.1. Methodology and Data Collection Procedure:

This research employs disruptive analysis to investigate The impact of Digital Transformation Maturity on Corporate's Competitive Advantage; The Case of the Private Egyptian Transportation Sector. To gather primary data for this research, a quantitative techniques approach will be employed, a structured survey will be distributed to a larger sample of professionals within the Private Egyptian Transportation companies. The survey will include closed-ended questions designed to quantify the impact of disruptive Digital Transformation Maturity on Corporate's Competitive Advantage. Data collected will be analyzed statistically to identify patterns and correlations.

The study collecting primary data through the survey questionnaires consist of four sections each and were employed to collect data from the sample of the Egyptian private transportation companies: Section A consists of three dimensions of the Digital Transformation Maturity; (Digital Strategy, Technology & Infrastructure, Culture & Leadership) adapted from the developed questionnaire NYARIKI, 2013 and Kamasak, 2008. In Section B, this study utilizes the scale of previous studies with three main dimensions to scale the corporate's competitive advantage (Innovation, Cost Advantage & Customer Loyalty).

3.2. Population:

The Egyptian private transportation sector plays a vital role in the country's economy, facilitating the movement of people and goods through various modes, including taxis, ride-hailing services like Uber and Careem, buses, and freight trucks. Ride-hailing platforms have gained popularity for providing convenient alternatives to traditional taxis, improving accessibility and pricing transparency ("Ride-Hailing Services in Egypt: Opportunities and Challenges," World Bank). However, the sector faces challenges such as traffic congestion, inadequate infrastructure, regulatory issues, and competition between traditional providers and new services, with safety and vehicle maintenance being ongoing concerns ("Urban Transport in Egypt: Current Status and Future Challenges," International

Transport Forum). The government is working to regulate the sector with licensing for ride-hailing services and driver safety measures, though enforcement varies.

3.3. Sample Size:

Sampling technique was employed to select the respondents who are managers of various departments since they are the top/senior management that make strategic decisions and coordinate resources. The managers were drawn from several departments which include Strategic Management, Information Technology, Human Resource, Finance, Accounts, Supply Chain, Production, Quality Assurance, Engineering, Internal Audit, Procurements, and Marketing.

The study applied the Sampling Technique, while the research focus on the Egyptian private transportation sector companies which is consider a large population widely geographically dispersed therefore the researcher selector specific companies which are represent the study population (the private sector transportation). The researcher carefully follows the following steps in order to define the sample size:

Step No. 1: Define the Population: The Egyptian private transportation sector includes approximately 1,986 companies in transportation and warehousing, with around 684 operating in transit and ground passenger transportation, while private sector

investments accounted for 11% of total transport investments in 2022/2023 (Mordor Intelligence, 2024).

Step No. 2: Divided the sample into Clusters: carefully selected the clusters to well represent the population. Each cluster has a similar distribution of characteristics as the distribution of the population as a whole. Therefore, the researcher divided the population into four main companies working in the Egyptian transportation industry (Gobus, Bluebus, Elasema & Golden Horse). The following table shows the total employees' number of the selected companies:

S	Company name	Employee numbers
1	Gobus	1,150
2	Bluebus	850
3	Elasema	670
4	Golden Horse	400
Total Emploees		**3,070**

Based on the selected companies the total employees' number is (3,070) which is consider my research population. Therefore, the Sample size represent the population calculate by the following formula:

(Population Size) = 3,070 Confidence Level is 95%, Confidence interval is 5%, Z score is 1.96

The sample size will be **342**

Statistical Data Analysis

This chapter presents a comprehensive statistical analysis of the data collected to examine the impact of Digital Transformation Maturity on Corporate Competitive Advantage within the private Egyptian transportation sector. The analysis employs a mixed-methods quantitative approach, utilizing both preliminary statistical analyses through SPSS version 29 and advanced Structural Equation Modeling using Partial Least Squares (SEM-PLS) methodology via SmartPLS version 3.

The research framework conceptualizes Digital Transformation Maturity as a multidimensional construct comprising three critical dimensions: Digital Strategy, Technological & Infrastructure, and Culture & Leadership. These dimensions collectively represent the independent variables in the structural model. Conversely, Corporate Competitive Advantage serves as the dependent variable, operationalized through three distinct competitive dimensions: Innovation, Cost Advantage, and Customer Loyalty. All constructs were measured using validated scales adapted from established literature and administered through a five-point Likert scale questionnaire to ensure measurement precision and reliability.

4.3 Introduction to PLS-SEM

Structural Equation Modeling using Partial Least Squares (SEM-PLS) represents a sophisticated statistical methodology particularly well-suited for examining complex relationships

between multiple theoretical constructs in organizational research contexts. This research employs SEM-PLS to investigate the intricate relationships between Digital Transformation Maturity dimensions and Corporate Competitive Advantage factors within the Egyptian transportation sector. The selection of PLS-SEM methodology aligns with the exploratory nature of this research and the need to examine both measurement and structural relationships simultaneously while accommodating the relatively moderate sample size and the formative-reflective nature of the theoretical constructs under investigation.

The implementation of SEM-PLS analysis in this research follows the systematic seven-step procedure established by Hair et al. (2017), ensuring methodological rigor and comprehensive evaluation of both measurement and structural model components. The first step involves specifying the structural model, which articulates the theoretical relationships between Digital Transformation Maturity as the exogenous latent variable and Corporate Competitive Advantage as the endogenous latent variable. This specification incorporates the hypothesized direct relationships between the three dimensions of digital transformation maturity and the three dimensions of competitive advantage, establishing the foundation for subsequent analytical procedures.

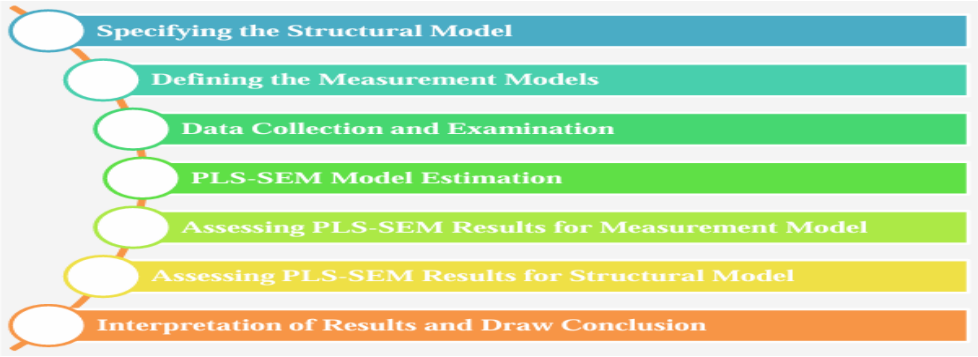


Figure. 4.7: PLS-SEM Systematic Procedures
Source: Hair et al. (2017)

The second step encompasses defining the measurement models for each latent construct, determining whether constructs should be modeled as reflective or formative based on theoretical considerations and the nature of indicator relationships. The third step involves comprehensive data collection and examination procedures, including the preliminary analyses previously discussed regarding outlier detection, missing data treatment, normality assessment, and common method bias evaluation. The fourth step focuses on PLS-SEM model estimation using SmartPLS software, employing appropriate algorithms and bootstrapping procedures to generate path coefficients and significance levels.

4.4 Measurement Model Assessment in PLS-SEM

The measurement model assessment represents a critical phase in SEM-PLS analysis that establishes the psychometric foundation for subsequent structural model evaluation and

hypothesis testing. This assessment systematically examines the relationships between latent constructs and their corresponding indicator variables to ensure that the measurement instruments adequately capture the theoretical concepts they are intended to represent. The measurement model evaluation precedes structural model assessment because reliable and valid measurement constitutes an essential prerequisite for meaningful interpretation of relationships between latent constructs.

Table 4.4: Measurement Model Assessment Rules

Evaluation Items	**Measurement Items**	**Fitting Criteria**	
		Cut off	***Preferable***
Convergent Validity	Indicator Loadings	> 0.40	> 0.70
	Average Variance Extracted	> 0.40	> 0.50
Discriminant Validity	HTMT	< 1.00	< 0.90
Reliability Assessment	Cronbach's Alpha, Composite Reliability	> 0.60	> 0.70
Source: Researcher's Development			

Discriminant validity assessment evaluates the extent to which a construct differs from other constructs in the model, ensuring that each latent variable captures unique variance not explained by other constructs. The Heterotrait-Monotrait ratio (HTMT) serves as the primary criterion for discriminant validity assessment, representing a more rigorous and reliable approach compared to traditional

methods such as the Fornell-Larcker criterion. HTMT values below 1.00 indicate adequate discriminant validity, while values below 0.90 represent preferable levels that provide greater confidence in construct distinctiveness.

4.4.3 Internal Consistency Reliability Assessment

Internal consistency reliability assessment examines the degree to which measurement items within each construct demonstrate coherent and consistent measurement of the intended theoretical concept. This evaluation ensures that indicators comprising each latent variable work together harmoniously to provide stable and dependable construct measurement. Reliability assessment serves as a fundamental prerequisite for establishing measurement model adequacy and provides essential foundation for meaningful interpretation of structural relationships between constructs. The assessment of internal consistency reliability employs multiple complementary metrics that collectively evaluate different aspects of measurement consistency. Cronbach's Alpha represents the traditional reliability coefficient that examines the intercorrelations among items within each construct, with values above 0.70 indicating acceptable reliability for research purposes. Composite Reliability provides an alternative reliability measure that accounts for the varying loadings of individual indicators, often yielding slightly higher values than Cronbach's Alpha and representing a more appropriate reliability assessment for PLS-SEM applications.

4.7 Structural Model Assessment in PLS-SEM

The structural model assessment represents the culminating phase of PLS-SEM analysis, where the theoretical relationships between latent constructs are systematically evaluated to determine the validity and significance of hypothesized pathways. This comprehensive evaluation builds upon the established measurement model adequacy to examine the directional relationships between Digital Transformation Maturity and Corporate Competitive Advantage constructs. The structural model assessment employs multiple criteria to ensure robust evaluation of theoretical propositions while providing insights into the practical significance of observed relationships.

The assessment framework encompasses six fundamental criteria that collectively establish the validity and reliability of structural relationships. Collinearity assessment examines whether predictor constructs demonstrate excessive correlation that might compromise the statistical independence required for meaningful path coefficient interpretation. Path coefficient evaluation determines the strength and significance of hypothesized relationships through bootstrapping procedures that generate confidence intervals and significance tests. The coefficient of determination assesses the explanatory power of predictor constructs in accounting for variance in dependent variables.

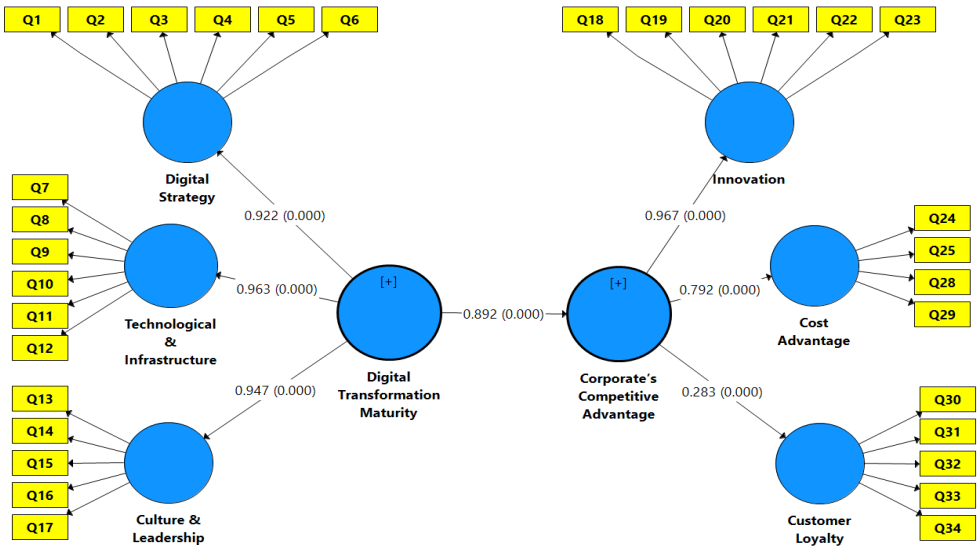


Fig . 4.14: Structural model

Table 4.12: Structural Model Assessment Rules

Criteria	Guidelines	References
Path coefficients	Significance: $p \leq 0.05$	(Hair et al., 2017)
Coefficient of determination (R^2)	$R^2 < 0.1$, Negligible	Falk & Miller (1992)
	$R^2 >= 0.1$, Adequate	
Effect Size (f^2)	f^2 between 0.02-0.14, small; f^2 between 0.15-0.34, moderate; $f^2 \geq 0.35$, High.	Cohen (1988)
Cross-validated redundancy (Q^2)	Predictive Relevance Using blindfolding $Q^2 > 0$	(Chin, 1998)
Goodness of Fit (GoF)	GoF less than 0.1, no fit; GoF between 0.1 to 0.25, small; GoF between 0.25 to 0.36, medium; GoF greater than 0.36, large.	(Wetzels et al., 2009)
Source: Researcher's Development		

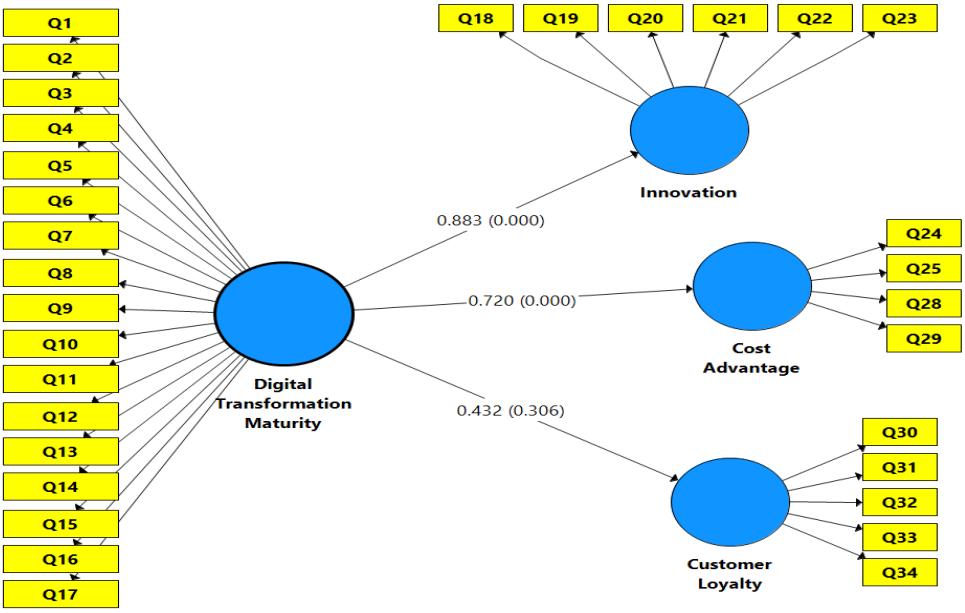


Fig. 4.15: Sub-Hypotheses

Effect size analysis quantifies the practical importance of significant relationships by determining the magnitude of influence that predictor constructs exert on dependent variables. Cross-validated redundancy evaluation employs blindfolding procedures to assess the predictive relevance of the structural model for dependent constructs. Goodness of fit assessment provides overall evaluation of model adequacy through standardized fit indices that indicate how well the theoretical model represents the observed data relationships.

Conclusion, Practical Implications & Limitation and Recommendation for Future Researches:

5.1 Conclusion & Key Findings:

5.1.1. Conclusion:

This chapter synthesizes and elaborates on the findings from the analysis presented in the study, focusing on the impact of Digital Transformation Maturity on Corporate Competitive Advantage within the Egyptian private transportation sector. It highlights significant theoretical and practical implications, identifies study limitations, and offers comprehensive recommendations for future research.

In summary, this research highlights the pivotal role of digital transformation maturity in enhancing organizational competitive advantage, particularly through innovation and cost efficiency within the Egyptian private transportation sector. Although customer loyalty showed limited direct correlation with digital maturity, the findings underscore the complexity inherent in customer relationship management. Moving forward, organizations are advised to implement a holistic digital transformation strategy, integrating technology, strategy formulation, and cultural evolution to achieve sustainable competitive advantage. These insights provide both theoretical enrichment and practical guidance, paving the way for future empirical exploration and strategic advancement in the domain of digital transformation.

The primary aim of this study was to assess the extent to which Digital Transformation Maturity Influences Corporate Competitive Advantage using Partial Least Squares Structural Equation Modeling (PLS-SEM). The analysis confirmed the following hypotheses:

Main Hypothesis (H1): Digital Transformation Maturity significantly affects Corporate Competitive Advantage ($\beta = 0.892$, $p < 0.001$), highlighting digital transformation's substantial role in shaping competitive dynamics.

Sub-Hypotheses:
H1-1 (Innovation): Supported ($\beta = 0.883$, $p < 0.001$), demonstrating that organizations embracing digital transformation can notably enhance their innovation capabilities.

H1-2 (Cost Advantage): Supported ($\beta = 0.720$, $p < 0.001$), affirming that digital transformation substantially contributes to improved operational efficiency and reduced costs.

H1-3 (Customer Loyalty): Not Supported ($\beta = 0.432$, $p = 0.306$), indicating that customer loyalty might be influenced predominantly by direct customer engagement and service quality rather than digital maturity.

5.2 Practical Implications:

5.2.1. Practical Implications

1. **Developing a Comprehensive Digital Transformation Strategy**:

- **Integration Across Departments**: Leaders should ensure that digital transformation initiatives are not confined to IT or technical teams. Instead, a cross-functional approach that includes marketing, finance, operations, and human resources is essential to embed digital thinking across the organization.
- **Roadmap for Digital Maturity**: Organizations should create a clear roadmap that outlines their digital transformation objectives, milestones, and key performance indicators (KPIs) to track progress over time. This roadmap should evolve based on feedback and shifting market conditions.

2. **Fostering a Culture of Innovation**:

- **Innovation Labs and Incubators**: Establish innovation labs or incubator programs that encourage employees to experiment with new ideas and technologies, providing them with the resources and support needed to bring concepts to fruition.
- **Training and Upskilling Programs**: Organizations should invest in training programs focused on digital skills and innovation methodologies (e.g., design thinking, agile project management) to empower employees at all levels to contribute to the organization’s digital initiatives.

3. **Leveraging Data for Decision-Making**:

- **Investment in Analytics Tools**: To harness the benefits of DTM, organizations should invest in advanced data analytics tools that can provide insights into customer behaviors, operational efficiency, and market trends. This data-driven approach aids in making informed, strategic decisions.
- **Continuous Feedback Mechanisms**: Implement systems for gathering regular feedback from customers and employees, enabling firms to adapt their offerings in real time and enhance customer satisfaction.

4. **Enhancing Customer Engagement and Relationship Management**:

- **Personalization Strategies**: Leveraging customer data to offer personalized services and tailored marketing efforts can significantly enhance customer engagement. Organizations should develop platforms that foster personalized interactions, whether through marketing campaigns, loyalty programs, or customer service initiatives.
- **Omnichannel Customer Experience**: It is crucial for organizations to create a seamless customer experience across multiple channels (online and offline), combining digital tools with traditional methods of engagement to cater to diverse customer preferences and enhance loyalty.

5.2.2. Theoretical Implications

This research contributes to the existing body of literature on digital transformation by providing empirical evidence regarding the relationship between DTM and CCA. It reinforces theories that advocate for the integration of technology with strategic management practices, further highlighting the necessity for organizations to adapt to the rapidly evolving digital landscape to remain competitive.

The findings offer significant theoretical contributions, enriching existing literature by highlighting several key points:

Digital Transformation as a Strategic Capability: This study underscores digital transformation not merely as a technological initiative but as a comprehensive strategic capability crucial for competitive advantage. By integrating digital strategy, technology infrastructure, and organizational culture, firms can effectively enhance their competitive positioning.

Differential Impact on Competitive Advantage Dimensions: The results illustrate a differential influence of digital transformation maturity across competitive advantage dimensions, reinforcing the necessity of nuanced theoretical models that acknowledge diverse outcomes of digital initiatives.

Complex Dynamics of Customer Loyalty: The lack of direct significant influence on customer loyalty suggests complexities within customer relationship dynamics, emphasizing that digital

transformation alone may not suffice to enhance loyalty without complementary strategies focused on direct customer service.

5.3 Limitations and Recommendation for Future Researches:

5.3.1. Limitations of the Study

This study recognizes certain limitations, such as its focus on the Egyptian private transportation sector, which may not be representative of other industries or regions. Additionally, the reliance on self-reported data may introduce biases. Future research should aim to replicate these findings in diverse contexts and employ longitudinal approaches to assess the long-term impact of digital transformation initiatives on competitive advantage.

In conclusion, this research highlights the critical nature of digital transformation maturity as a foundational component for organizations seeking to sustain and enhance their competitive advantage. By embracing innovation and efficiency while also addressing customer relationships, businesses can navigate the challenges of a rapidly evolving market landscape more effectively.

This research encountered several limitations which should be considered when interpreting the findings:

Sector-Specific Findings: The study focused exclusively on the Egyptian private transportation sector, potentially limiting the generalizability of the results to other sectors or geographical contexts.

Cross-Sectional Data Collection: Employing a cross-sectional research design restricts causal inferences, highlighting a need

for longitudinal studies that can better track temporal dynamics and causation.

Demographic Constraints: The respondent demographic displayed a pronounced gender imbalance and concentration within certain age and experience groups, possibly affecting the broader applicability of the findings.

5.3.2. Future Research Recommendations:

Addressing the identified limitations and further expanding the theoretical and practical understanding of digital transformation's role in competitive advantage, the following areas are recommended for future research:

Broader Sectoral and Geographic Scope: Future studies should include diverse industry sectors and geographic contexts to enhance generalizability and robustness of findings, contributing to a more comprehensive theoretical framework.

Longitudinal Research Designs: Implementing longitudinal studies would help clarify causal relationships and track the progression and long-term effects of digital transformation initiatives on competitive advantage dimensions.

Exploration of Additional Variables: Further research should investigate additional influential variables, such as service quality, technological adaptability, market competitiveness, and consumer behavior patterns, particularly concerning customer loyalty.

Moderating and Mediating Effects: Investigating potential moderating roles of managerial experience, organizational size, and sector-specific regulatory environments would provide deeper insights into the contextual effectiveness of digital transformation strategies.

Qualitative and Mixed-Methods Approaches: Integrating qualitative research methodologies or mixed-method approaches could yield richer contextual insights and a deeper understanding of organizational dynamics underpinning digital transformation.

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