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The Impact of Digital Transformation on Operational Efficiency in Small and Medium Enterprises (SMEs) in Riyadh

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جامعة ميد أوشن

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مشروع بحث التخرج

**أثر التحول الرقمي على الكفاءة التشغيلية في المنشآت الصغيرة والمتوسطة في
مدينة الرياض**

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Declaration and Copyright Notice

I declare that this research manuscript was prepared for the Master of Business Administration programme at Midocean University and that all published ideas and evidence used in the text are acknowledged in the reference list. Copyright in the submitted project is assigned to Midocean University in accordance with the university's regulations.

The empirical analysis in this manuscript is based on an anonymized respondent workbook containing 190 eligible SME responses. The dataset contains no respondent names, identity numbers, commercial-registration numbers, or direct contact details. All analyses are reported in aggregate form for academic purposes only.

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Abstract

This study examines the relationship between digital transformation and operational efficiency in small and medium enterprises (SMEs) in Riyadh and assesses how organizational and skill-related obstacles constrain the achieved level of digital transformation. A descriptive-analytical, cross-sectional quantitative design is specified. Digital transformation is measured through process digitisation, digital technology adoption, digital skills and organizational culture, and systems integration; operational efficiency is measured through process speed, error reduction and quality, resource utilization, and cost efficiency.

The empirical chapter analyzes 190 valid responses from SMEs in Riyadh. The instrument showed excellent internal consistency ($\alpha = 0.895$ to 0.947 across subscales). Overall digital transformation was strongly and positively associated with operational efficiency ($r = 0.650$, $p < .001$). The four digital-transformation dimensions jointly explained 42.9% of the variance in operational efficiency (adjusted R-squared = 0.417). Systems integration was the strongest significant predictor, followed by process digitisation. Technology adoption and digital skills/culture were positive but did not remain independently significant at the .05 level after the four dimensions were entered together. Obstacles had a significant negative association with digital transformation ($\beta = -0.469$, R-squared = 0.220 , $p < .001$). Sector differences were significant for both digital transformation and operational efficiency, while enterprise size and years of operation did not produce significant differences.

The findings indicate that Riyadh SMEs gain operational-efficiency benefits when digital tools are connected into coherent operational systems rather than adopted as isolated applications. The results also show that financial cost, skill shortages, employee resistance, and solution-selection difficulty remain practical barriers that should be addressed by managers, technology providers, and SME-support programmes.

Keywords: digital transformation; operational efficiency; SMEs; Riyadh; process digitisation; digital skills; systems integration; survey responses.

الملخص باللغة العربية

هدفت هذه الدراسة إلى فحص العلاقة بين التحول الرقمي والكفاءة التشغيلية في المنشآت الصغيرة والمتوسطة بمدينة الرياض، وقياس أثر المعوقات التنظيمية والمهارية في مستوى التحول الرقمي المتحقق. واعتمدت الدراسة تصميماً كمياً وصفيّاً تحليلياً مقطعيّاً. وقيس التحول الرقمي من خلال رقمنة العمليات، وتبني التقنيات الرقمية، والمهارات الرقمية والثقافة التنظيمية، وتكامل الأنظمة؛ بينما قيس الكفاءة التشغيلية من خلال سرعة العمليات، وتقليل الأخطاء وتحسين الجودة، واستغلال الموارد، وكفاءة التكلفة.

حلل الفصل الميداني 190 استجابة صالحة من منشآت صغيرة ومتوسطة في الرياض. وأظهرت المقاييس اتساقاً داخلياً مرتفعاً، كما ظهرت علاقة موجبة قوية بين التحول الرقمي الكلي والكفاءة التشغيلية ($r = 0.650, p < 0.001$). وفسرت أبعاد التحول الرقمي الأربعة مجتمعة 42.9% من التباين في الكفاءة التشغيلية. وكان تكامل الأنظمة أقوى متنبئ دال، يليه رقمنة العمليات، بينما كان أثر تبني التقنيات والمهارات والثقافة الرقمية موجباً لكنه لم يبلغ مستوى الدلالة الإحصائية عند إدخال الأبعاد الأربعة معاً. كما كان للمعوقات أثر سلبي دال في مستوى التحول الرقمي ($\beta = -0.469, p < 0.001$).

تشير النتائج إلى أن فوائد الكفاءة التشغيلية ترتبط خصوصاً بقدرة المنشآت على ربط الأنظمة وتدفق البيانات بين العمليات، وليس بمجرد امتلاك أدوات رقمية متفرقة. كما أبرزت الإجابات المفتوحة أن التكلفة، ونقص المهارات الرقمية، ومقاومة التغيير، وصعوبة اختيار الحلول المناسبة من أبرز التحديات العملية.

الكلمات المفتاحية: التحول الرقمي؛ الكفاءة التشغيلية؛ المنشآت الصغيرة والمتوسطة؛ الرياض؛ رقمنة العمليات؛ المهارات الرقمية؛ تكامل الأنظمة؛ بيانات الاستبانة.

Table of Contents

Section	Page
Declaration and Copyright Notice	iii
Acknowledgments	iv
Abstract	v
الملخص باللغة العربية	vi
List of Tables	x
List of Figures	xiii
Key Terminology	xiv
List of Abbreviations	xv
Chapter One: Introduction	1
1.1 Introduction	1
1.2 Problem Statement	3
1.3 Importance of the Study	4
1.3.1 Theoretical (Scientific) Importance	4
1.3.2 Practical (Applied) Importance	5
1.4 Objectives of the Study	5
1.5 Research Questions	6
1.6 Research Hypotheses	7
1.7 The Scientific Theory Adopted in the Study	8
Chapter Two: Literature Review	10
2.1 Introduction	10
2.2 The Dependent Variable: Operational Efficiency	10
2.2.1 Definition and Development of the Concept	10
2.2.2 Measurement of Operational Efficiency in This Study	10
2.3 The Independent Variable: Digital Transformation	11
2.3.1 Definition and Conceptual Dimensions	11
2.4 Previous Studies (Ordered from Oldest to Most Recent)	12

Section	Page
2.4.1 Westerman, Bonnet, and McAfee (2014)	12
2.4.2 Matt, Hess, and Benlian (2015)	12
2.4.3 Li, Su, Zhang, and Mao (2018)	13
2.4.4 Vial (2019)	13
2.4.5 Eller, Alford, Kallmünzer, and Peters (2020)	13
2.4.6 AlMuhayfith and Shaiti (2020)	14
2.4.7 Aldossari and Mokhtar (2020)	14
2.4.8 Tripathi and Singh (2024)	14
2.4.9 Asiri, Al-Somali, and Maghrabi (2024)	15
2.4.10 Alhamami, Hashim, Abdul Hamid, and Ab. Hamid (2024)	15
2.4.11 Mutambik (2024)	15
2.5 Discussion of the Previous Studies: Similarities, Differences, and the Research Gap	16
2.5.1 Points of Agreement Among the Previous Studies	16
2.5.2 Points of Difference Among the Previous Studies	16
2.5.3 The Research Gap and What Distinguishes the Current Study	16
2.6 Theoretical Framework of the Study	17
2.6.1 The Resource-Based View (RBV)	17
2.6.2 The Technology-Organization-Environment (TOE) Framework	17
2.6.3 Process Innovation Theory	18
2.6.4 The Conceptual Model	18
Chapter Three: Research Methodology	19
3.1 Introduction	19
3.2 Research Design	19
3.3 Research Population	20
3.4 Sample Characteristics	20
3.5 Sample Size Determination	20
3.6 Data Collection Procedures and Instrument	21
3.7 Scope and Limitations of the Study	22

Section	Page
3.7.1 Boundaries of the Study	22
3.7.2 Limitations	23
3.8 Statistical Analysis Methods	23
3.9 Ethical Considerations and Data Handling	25
Chapter Four: Field Study, Data Analysis, Findings, and Recommendations	26
4.1 Introduction	26
4.2 Respondent Dataset and Data Screening	26
4.3 Description of the Analytical Sample	27
4.4 Reliability and Measurement Quality	28
4.5 Descriptive Analysis of the Study Variables	29
4.6 Correlation Analysis and Hypothesis Testing	31
4.6.1 Main Relationship Between Digital Transformation and Operational Efficiency	32
4.6.2 Multiple Regression of Operational Efficiency	32
4.6.3 Impact of Obstacles on Digital Transformation	33
4.7 Tests of Differences Across Enterprise Groups	34
4.8 Open-Ended Responses	35
4.9 Discussion of the Findings	36
4.10 Conclusions	37
4.11 Recommendations	37
4.12 Suggestions for Future Research	38
4.13 Chapter Summary	38
References	40
Appendix A1: The Questionnaire (English Version)	43
(الملحق (أ2): الاستبانة (النسخة العربية	52
Appendix B: Item-Level Descriptive Statistics	59
Appendix C: Detailed Item Response Frequencies	62
Appendix D: Item Reliability Diagnostics	119
Appendix E: Anonymized Case-Level Composite Scores	124

Section	Page
Appendix F: Content-Validity Review Form	132
Appendix G: Final Project Criteria Coverage Matrix	134

List of Tables

Table title	Page
Table 4.1. Respondent dataset and screening summary	26
Table 4.2. Respondent sample profile (n = 190)	27
Table 4.3. Internal consistency reliability of the study scales	28
Table 4.4. Descriptive statistics for the principal constructs	30
Table 4.5. Pearson correlation matrix	31
Table 4.6. Multiple regression predicting operational efficiency	32
Table 4.7. Regression of digital transformation on obstacles	33
Table 4.8. Summary of hypothesis decisions	33
Table 4.9. Tests of differences in digital transformation and operational efficiency	34
Table 4.10. Thematic coding of open-ended respondent comments	35
Table 4.11. Finding-linked recommendation matrix	37
Table B.1. Item-level descriptive statistics for the respondent dataset	59
Table C.1. Response distribution for PD1	62
Table C.2. Response distribution for PD2	63
Table C.3. Response distribution for PD3	64
Table C.4. Response distribution for PD4	65
Table C.5. Response distribution for PD5	66
Table C.6. Response distribution for PD6	67
Table C.7. Response distribution for PD7	68
Table C.8. Response distribution for PD8	69

Table title	Page
Table C.9. Response distribution for TA1	70
Table C.10. Response distribution for TA2	71
Table C.11. Response distribution for TA3	72
Table C.12. Response distribution for TA4	73
Table C.13. Response distribution for TA5	74
Table C.14. Response distribution for TA6	75
Table C.15. Response distribution for TA7	76
Table C.16. Response distribution for TA8	77
Table C.17. Response distribution for SC1	78
Table C.18. Response distribution for SC2	79
Table C.19. Response distribution for SC3	80
Table C.20. Response distribution for SC4	81
Table C.21. Response distribution for SC5	82
Table C.22. Response distribution for SC6	83
Table C.23. Response distribution for SC7	84
Table C.24. Response distribution for SI1	85
Table C.25. Response distribution for SI2	86
Table C.26. Response distribution for SI3	87
Table C.27. Response distribution for SI4	88
Table C.28. Response distribution for SI5	89
Table C.29. Response distribution for SI6	90
Table C.30. Response distribution for PS1	91
Table C.31. Response distribution for PS2	92

Table title	Page
Table C.32. Response distribution for PS3	93
Table C.33. Response distribution for PS4	94
Table C.34. Response distribution for PS5	95
Table C.35. Response distribution for EQ1	96
Table C.36. Response distribution for EQ2	97
Table C.37. Response distribution for EQ3	98
Table C.38. Response distribution for EQ4	99
Table C.39. Response distribution for EQ5	100
Table C.40. Response distribution for RU1	101
Table C.41. Response distribution for RU2	102
Table C.42. Response distribution for RU3	103
Table C.43. Response distribution for RU4	104
Table C.44. Response distribution for RU5	105
Table C.45. Response distribution for CE1	106
Table C.46. Response distribution for CE2	107
Table C.47. Response distribution for CE3	108
Table C.48. Response distribution for CE4	109
Table C.49. Response distribution for CE5	110
Table C.50. Response distribution for OB1	111
Table C.51. Response distribution for OB2	112
Table C.52. Response distribution for OB3	113
Table C.53. Response distribution for OB4	114
Table C.54. Response distribution for OB5	115

Table title	Page
Table C.55. Response distribution for OB6	116
Table C.56. Response distribution for OB7	117
Table C.57. Response distribution for OB8	118
Table D.1. Reliability diagnostics for PD	119
Table D.2. Reliability diagnostics for TA	119
Table D.3. Reliability diagnostics for SC	120
Table D.4. Reliability diagnostics for SI	121
Table D.5. Reliability diagnostics for PS	121
Table D.6. Reliability diagnostics for EQ	122
Table D.7. Reliability diagnostics for RU	122
Table D.8. Reliability diagnostics for CE	122
Table D.9. Reliability diagnostics for OB	123
Table E.1. Anonymized case-level composite scores	124
Table F.1. Expert content-validity assessment	132
Table G.1. Criteria coverage matrix	134

List of Figures

Figure title	Page
Figure 2.1. Conceptual model of the study	18
Figure 4.1. Mean scores of the principal study constructs	31

Key Terminology

Term	Operational definition in this study
Digital transformation	Coordinated organizational change enabled by digital technologies and accompanied by process, capability, and structural change.
Operational efficiency	The ability to deliver outputs faster, with fewer errors, better resource use, and lower operating cost.
Process digitisation	Conversion of paper-based or manual workflows into digitally executed, tracked, and automated processes.
Digital technology adoption	Organizational use of tools such as ERP, cloud services, e-invoicing, analytics, electronic payments, and digital channels.
Digital skills and culture	Employee competence, training, leadership, and organizational acceptance of digital ways of working.
Systems integration	The ability of applications and platforms to exchange consistent data without unnecessary re-entry or duplication.
SME	A small or medium enterprise, operationalized in this questionnaire as an enterprise with 5-249 employees.

List of Abbreviations

Abbreviation	Meaning
ANOVA	Analysis of variance
CST	Communications, Space and Technology Commission
DT	Digital transformation
ERP	Enterprise resource planning
OE	Operational efficiency
RBV	Resource-Based View
SME	Small and medium enterprise
SPSS	Statistical Package for the Social Sciences
TOE	Technology-Organization-Environment framework
VIF	Variance inflation factor
ZATCA	Zakat, Tax and Customs Authority

Chapter One: Introduction

1.1 Introduction

There is a certain irony in the digital age: we are surrounded by tools capable of transforming the way businesses operate, yet a considerable number of enterprises — particularly smaller ones — have yet to experience any meaningful change in how they actually work. This gap between technology availability and real-world adoption is not unique to Saudi Arabia, but it is especially pronounced among the small and medium enterprises (SMEs) that form the backbone of Riyadh's economy.

The scale of that backbone explains why the research question matters beyond the individual firm. Monsha'at reported that Saudi Arabia had approximately 1.3 million SMEs at the end of 2023, a 3.1% quarter-on-quarter increase. Riyadh accounted for 43.7% of the national total and hosted more than 571,000 enterprises and over 3 million SME employees (Monsha'at, 2024). Vision 2030 seeks to raise the SME contribution to gross domestic product from the original baseline of about 20% to 35% by 2030. The Vision 2030 2023 results reported an actual SME contribution of 21.9%, indicating progress but also a substantial remaining productivity challenge (Saudi Vision 2030, 2024).

Over the past decade, 'digital transformation' has evolved from a buzzword confined to technology conferences into a genuine strategic imperative. The COVID-19 pandemic, in particular, served as an unexpected accelerant — businesses that had invested in digital infrastructure managed the disruption far better than those that had not. Cloud-based systems kept remote teams coordinated, e-invoicing reduced contact and cash handling, and data analytics helped managers understand customer behavior in real time. In contrast, businesses relying on manual processes and paper-based records found themselves paralyzed almost overnight.

In Saudi Arabia, this reality has been accelerated by Vision 2030 and by programmes led by Monsha'at, the Communications, Space and Technology Commission, and other public institutions. Investments in connectivity, digital government, e-commerce regulation, and mandatory e-invoicing have made digital capability increasingly necessary for private enterprises. ZATCA's e-invoicing programme is a clear example: compliance requires firms to adopt approved digital processes and creates an opportunity to integrate accounting, inventory, sales, and reporting more effectively.

Yet despite this enabling environment, research consistently shows that many SMEs in Riyadh remain at early stages of digital adoption. The reasons are not difficult to understand: limited financial resources, difficulty in identifying the right solutions, shortage of in-house technical expertise, and, perhaps most importantly, uncertainty about whether the investment will actually pay off. This last point — the question of return on digital investment — is precisely what motivates the current study.

This study argues that there is still a meaningful gap in our understanding of how digital transformation translates, in practice, into measurable improvements in operational efficiency for SMEs in Riyadh. Operational efficiency — understood here as the ability to deliver outputs using fewer resources, in less time, with fewer errors and at lower cost — is not just one metric among many. For an SME operating on thin margins in a competitive urban market like Riyadh, operational efficiency can be the difference between growth and stagnation. When more than half a million such enterprises operate in a single region, even modest average gains in efficiency translate into a macroeconomic effect that is directly relevant to the Vision 2030 target mentioned above.

This study therefore specifies a quantitative survey of SMEs in Riyadh to examine whether, and to what degree, process digitisation, technology adoption, digital skills and culture, and systems integration are associated with operational efficiency. It also measures the organizational and skill-related obstacles that may constrain transformation. Chapter Four reports the analysis of 190 confirmed anonymized SME responses collected through the study questionnaire.

The remainder of this study is organised in four chapters. The present chapter sets out the research problem, the importance and objectives of the study, its questions and hypotheses, and the scientific theories on which it is built. Chapter Two reviews the previous studies in chronological order, analyses their points of agreement and difference, and identifies the research gap, before presenting the theoretical framework of the study. Chapter Three describes the research methodology, population and sample, the data collection instrument, the boundaries of the study, and the statistical methods. Chapter Four presents the field study: the analysis of the data, the findings and their discussion against the previous studies, and the recommendations.

1.2 Problem Statement

The starting point for this study is a practical puzzle that many SME owners and managers in Riyadh would recognize immediately: they have heard — from consultants, from

government programmes, from competitors — that going digital will improve their operations. Some have invested in cloud accounting software, point-of-sale systems, or enterprise resource planning (ERP) platforms. But when asked whether these investments have made their businesses more efficient, the answers tend to be uncertain, mixed, or frankly skeptical.

This uncertainty is not irrational. The academic literature on digital transformation and firm performance, while broadly positive in its conclusions, is often based on studies of large corporations with dedicated IT teams, ample budgets, and the organizational capacity to manage complex change processes. The situation in an SME employing twenty or fifty people, operating in a single location, and competing against dozens of similar businesses, is fundamentally different. The technologies may be the same, but the implementation challenges, the risks, and the likely outcomes are not.

Several specific aspects of this problem deserve attention. First, many SMEs in Riyadh adopt digital tools in a fragmented and uncoordinated way. A business might introduce a digital accounting package but continue to manage inventory through spreadsheets, or adopt an e-invoicing system without connecting it to the broader financial management process. In such cases, the efficiency gains that theory predicts may simply not materialize, because the real value of digital transformation lies in integrated, end-to-end process improvement, not in isolated tool adoption.

Second, there is the question of capability. Even where the right tools are in place, operational efficiency benefits depend on employees who know how to use them effectively. Digital skills gaps are widely documented in the SME sector, and Saudi businesses are no exception. A well-designed ERP system operated by staff who are uncomfortable with technology and poorly trained on the platform may actually slow down operations rather than speeding them up — at least in the short to medium term. This is why the present study does not treat obstacles as a side issue: it measures the impact of organizational and skill-related obstacles on the level of digital transformation directly, as one of its stated objectives.

Third, the SME literature consistently highlights the problem of limited resources. SMEs cannot afford the costly and prolonged implementation processes that large organizations can manage. They need digital solutions that are quick to deploy, easy to use, and demonstrably effective from relatively early in the adoption process. Understanding which specific digital investments deliver the clearest efficiency returns — and which do not — is therefore a practical and urgent question.

The central research problem can be summarized as follows: there is a shortage of empirical, locally grounded evidence about the specific relationship between digital

transformation and operational efficiency in SMEs operating in Riyadh. Without this evidence, SME managers are making important investment decisions based on general assumptions, vendor promises, or the experience of businesses that may be very different from their own. This situation gives rise to the main research question that guides this study:

What is the impact of digital transformation on operational efficiency in small and medium enterprises in Riyadh?

Answering this question requires examining both what kind of digital transformation SMEs in Riyadh have undergone, and how that transformation (or lack of it) shows up in the efficiency of their day-to-day operations. It also requires being specific about which dimensions of digital transformation matter most — because 'going digital' is not a single, homogeneous act but a complex set of choices about technologies, processes, skills, and organizational culture.

1.3 Importance of the Study

1.3.1 Theoretical (Scientific) Importance

While digital transformation and operational performance have been studied extensively in the context of large organizations, the specific dynamics within SMEs remain comparatively underexplored. This study makes several theoretical contributions.

First, it adds to the growing body of knowledge on digital transformation in emerging market SMEs. The majority of foundational studies on digital transformation (such as Vial, 2019; Matt et al., 2015) were conducted in Western, high-income contexts. Their frameworks, while valuable, do not always translate straightforwardly to a context like Riyadh, where SMEs operate within a distinctive regulatory environment shaped by Vision 2030, a labour market with specific characteristics, and business norms that differ from those in Europe or North America.

Second, the study contributes to the theoretical understanding of the mechanisms through which digital transformation produces efficiency gains. It is not sufficient to establish that digital transformation and operational efficiency are correlated; theory requires an account of how and why this relationship exists, and whether it varies depending on the type of digital investment or the characteristics of the business. By testing the effects of multiple specific dimensions of digital transformation (process digitization, technology adoption, digital skills and culture, and systems integration), the study builds a more granular theoretical picture.

Third, the study provides a locally validated measurement framework for both digital transformation and operational efficiency in the SME context, together with a measured scale of the organizational and skill-related obstacles that constrain transformation. Such instruments are valuable for future researchers working in similar settings.

1.3.2 Practical (Applied) Importance

The practical relevance of this study extends to several stakeholder groups.

For SME owners and managers, the study provides evidence-based guidance on which digital investments are most likely to improve operational efficiency, thereby helping them make better-informed decisions about how to allocate limited resources. The findings also highlight common pitfalls and barriers, helping managers avoid mistakes that have cost other businesses time and money.

For government agencies and policymakers, particularly Monsha'at and CITC, the study provides a clearer picture of where the main gaps and obstacles lie in SME digital adoption in Riyadh. This can inform the design of more targeted and effective support programmes, training initiatives, and incentive structures.

For consultants and technology solution providers, the findings offer insights into what SME clients are experiencing in terms of efficiency outcomes from digital investments, which can help in tailoring solutions and setting realistic expectations.

Finally, the study contributes to the broader Vision 2030 agenda by generating knowledge that supports the development of a productive, efficient, and digitally capable SME sector in Saudi Arabia.

1.4 Objectives of the Study

General Objective: To examine the impact of digital transformation on operational efficiency in small and medium enterprises operating in Riyadh, and to identify which dimensions of digital transformation contribute most significantly to efficiency improvements.

Specific Objectives:

1. To map the current level and pattern of digital transformation adoption in SMEs in Riyadh across four dimensions: process digitisation, digital technology adoption, digital skills and organisational culture, and systems integration.

2. To assess the current level of operational efficiency in these SMEs using indicators that capture process cycle time and speed, error rates, resource utilisation, and cost efficiency.

3. To test the statistical significance and direction of the relationship between each digital transformation dimension and overall operational efficiency.

4. To identify which dimensions of digital transformation have the strongest predictive power with respect to operational efficiency outcomes in the study sample.

5. To measure the level of impact of organizational and skill-related obstacles on the level of digital transformation in SMEs in Riyadh.

6. To formulate actionable recommendations for SME managers, policymakers, and support agencies based on the empirical findings of the study.

1.5 Research Questions

Main Research Question: What is the impact of digital transformation on operational efficiency in small and medium enterprises in Riyadh?

Sub-Questions:

1. What is the current level and nature of digital transformation adoption in SMEs operating in Riyadh?

2. What is the current level of operational efficiency in SMEs in Riyadh, as measured by process speed, error rates, resource utilisation, and cost indicators?

3. Is there a statistically significant relationship between the overall degree of digital transformation and operational efficiency in Riyadh SMEs?

4. Which specific dimensions of digital transformation — process digitisation, digital technology adoption, digital skills and organisational culture, or systems integration — have the greatest effect on operational efficiency?

5. What is the level of impact of organizational and skill-related obstacles on the level of digital transformation in SMEs in Riyadh?

6. Are there significant differences in digital transformation levels and operational efficiency across different sectors, enterprise sizes, or years of operation?

1.6 Research Hypotheses

On the basis of the research problem, the literature review, and the theoretical framework, the following hypotheses are proposed for empirical testing:

Main Hypothesis:

H1: There is a statistically significant positive relationship between the overall level of digital transformation and operational efficiency in SMEs in Riyadh.

H0: There is no statistically significant relationship between digital transformation and operational efficiency in SMEs in Riyadh.

Sub-Hypotheses:

H1-1: There is a statistically significant positive relationship between the digitization of internal business processes and operational efficiency in SMEs in Riyadh.

H1-2: There is a statistically significant positive relationship between the adoption of digital technologies (ERP, cloud computing, e-invoicing, data analytics) and operational efficiency in SMEs in Riyadh.

H1-3: There is a statistically significant positive relationship between digital skills and an organizational culture supportive of digital adoption, and operational efficiency in SMEs in Riyadh.

H1-4: There is a statistically significant positive relationship between the integration of digital systems and platforms and operational efficiency in SMEs in Riyadh.

H1-5: There is a statistically significant negative relationship between organizational and skill-related obstacles and the level of digital transformation in SMEs in Riyadh.

These hypotheses are tested using the statistical methods described in Chapter Three. The null hypothesis is rejected if the p-value is less than 0.05 in the relevant tests.

1.7 The Scientific Theory Adopted in the Study

The study rests on three complementary theoretical perspectives, which are presented here in summary and developed in full in the theoretical framework at the end of Chapter Two.

The Resource-Based View (RBV): First developed by Penrose (1959) and formalised in the management literature by Barney (1991), the RBV posits that firms derive sustainable competitive advantage from unique, valuable, rare, and difficult-to-imitate resources and capabilities. In the digital transformation context, digital capabilities constitute exactly the kind of dynamic resource that the RBV predicts should confer advantage: SMEs with more developed digital capabilities should be better positioned to improve their operational efficiency, because those capabilities allow them to process information faster, coordinate activities more effectively, and respond more quickly to operational problems.

The Technology-Organization-Environment (TOE) Framework: Introduced by Tornatzky and Fleischer (1990), the TOE framework examines how three contextual factors — the technological context, the organizational context, and the environmental context — interact to shape a firm's technology adoption decisions and their outcomes. The TOE framework is particularly well suited to the current research because it explicitly accounts for the environmental context of Vision 2030 and the broader Saudi digital economy, as well as the organizational constraints that characterize SMEs. It also provides the theoretical basis for treating organizational and skill-related obstacles as measurable determinants of the level of digital transformation.

Process Innovation Theory: Davenport (1993) and Hammer and Champy (1993) laid the foundations for thinking about how information technology can fundamentally redesign business processes, rather than merely automating existing ones. Process innovation theory holds that the real efficiency gains from digitalization come not from replacing manual steps with automated ones, but from rethinking how processes are designed — eliminating unnecessary steps, reducing handoffs, improving coordination, and enabling real-time information sharing across the organization.

Together, these three frameworks form the theoretical spine of the conceptual model that guides the study's design, data collection, and interpretation: the RBV explains why digital capabilities should matter; the TOE framework situates the SME within its Saudi context and explains why obstacles constrain transformation; and process innovation theory explains the micro-level mechanism through which transformation becomes efficiency.

Chapter Two: Literature Review

2.1 Introduction

This chapter reviews the academic and institutional literature that underpins the study. It begins by defining and analysing the two variables at the heart of the research: operational efficiency (the dependent variable) and digital transformation (the independent variable). It then presents the previous studies most directly relevant to the research, arranged in chronological order from the oldest to the most recent, so that the development of thinking in this field can be traced over time. Each study is described in terms of its aim, methodology, and main findings. The chapter then analyses the previous studies collectively — identifying the points on which they agree, the points on which they differ, and what remains unresolved — before stating the research gap explicitly and clarifying what distinguishes the current study from all that preceded it. The chapter closes with the theoretical framework of the study.

2.2 The Dependent Variable: Operational Efficiency

2.2.1 Definition and Development of the Concept

Operational efficiency is a concept with a long history in management science, predating the digital age by many decades. In its most basic formulation, operational efficiency refers to the ratio of useful output to the resources consumed in producing that output. A more efficient operation achieves the same or better results while using less time, fewer resources, and generating less waste.

In the context of contemporary organizations, operational efficiency is typically measured across several dimensions. Lean management frameworks, which have been widely adopted since the 1980s in manufacturing and more recently in services, identify waste (Muda) in the form of overproduction, waiting, unnecessary movement, excess inventory, and defects (Womack and Jones, 2003). Eliminating or reducing these forms of waste is the core operational efficiency challenge.

2.2.2 Measurement of Operational Efficiency in This Study

For the purposes of this study, operational efficiency is understood to encompass four main components: (1) process cycle time — the speed with which key operational processes are completed; (2) error rates and quality — the frequency of mistakes, rework, and customer complaints; (3) resource utilization — the degree to which labour, equipment, and other

resources are productively deployed rather than sitting idle; and (4) cost efficiency — the achievement of operational outputs at lower unit cost. These four dimensions are consistent with the measurement approaches used in several recent studies in the digital transformation literature (see, for example, Eller et al., 2020; Li et al., 2018).

It is worth noting that operational efficiency and organizational performance are related but distinct concepts. Operational efficiency is a relatively narrow, process-level construct; organizational performance encompasses broader outcomes including financial profitability, market share, customer satisfaction, and innovation capacity. This study focuses specifically on operational efficiency rather than the broader construct, on the grounds that it is more directly and immediately influenced by digital transformation initiatives and is more amenable to reliable measurement in an SME context through a questionnaire survey.

2.3 The Independent Variable: Digital Transformation

2.3.1 Definition and Conceptual Dimensions

The term 'digital transformation' has been defined and operationalized in many different ways in the academic literature, which itself reflects how rapidly the phenomenon has evolved. One of the most widely cited conceptual frameworks is that of Vial (2019), who, after a systematic review of 282 papers, defined digital transformation as a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies. This definition is useful precisely because it anchors digital transformation in process change rather than technology adoption alone — a distinction that matters for this study, because it is the process change, not the technology itself, that ultimately drives efficiency.

Building on this and related work, the present study operationalizes digital transformation through four dimensions: (1) process digitisation — the degree to which core operational processes such as invoicing, inventory management, and human resources have been digitised and automated; (2) digital technology adoption — the extent of adoption of specific technologies including ERP systems, cloud computing, e-invoicing platforms, data analytics tools, and digital communication platforms; (3) digital skills and organisational culture — the level of staff digital competency, the quality of training provided, and the extent to which the organisational culture supports digital innovation and change; and (4) systems integration — the degree to which different digital tools and platforms are integrated with one another so that data flows seamlessly between systems.

In addition, and in line with the fifth objective of the study, the research measures the organizational and skill-related obstacles that constrain the level of digital transformation — including resource limitations, resistance to change, weak digital leadership, and shortages of qualified staff. Treating these obstacles as a measured variable, rather than a background assumption, allows the study to quantify their impact on the transformation level actually achieved by SMEs in Riyadh.

2.4 Previous Studies (Ordered from Oldest to Most Recent)

The studies below are presented in chronological order. For each study, the aim, methodology, and principal findings are summarised, together with its relevance to the current research.

2.4.1 Westerman, Bonnet, and McAfee (2014)

Aim and method: Drawing on a multi-year research programme involving hundreds of organizations, Westerman, Bonnet, and McAfee examined how digital capability and leadership capability combine to create business value.

Findings: Technology investment alone did not distinguish high performers. Organizations classified as digital masters combined strong technology use with governance, leadership, employee engagement, and coordinated transformation management.

Relevance: The study supports the inclusion of digital skills and organizational culture alongside technology adoption in the present multidimensional model.

2.4.2 Matt, Hess, and Benlian (2015)

Aim and method: This conceptual study proposed a managerial framework for digital transformation strategy.

Findings: A coherent strategy must address technology use, changes in value creation, structural change, and financial considerations. Fragmented tool adoption is unlikely to produce the same results as coordinated transformation.

Relevance: The multidimensional view justifies measuring process, technology, skills and culture, and integration separately rather than treating digital transformation as a single purchase decision.

2.4.3 Li, Su, Zhang, and Mao (2018)

Aim and method: Li and colleagues used qualitative evidence from SME entrepreneurs to explain digital transformation from a capability perspective.

Findings: SMEs generated value when they sensed digital opportunities, made focused investments, and reconfigured existing resources and routines. Capability shortages and resource constraints slowed transformation.

Relevance: The findings provide theoretical support for the obstacles scale and for examining organizational capability rather than technology ownership alone.

2.4.4 Vial (2019)

Aim and method: Vial conducted a systematic review of 282 publications and developed an integrated framework and research agenda for digital transformation.

Findings: Digital transformation is an organizational improvement process triggered by combinations of digital technologies. Value creation depends on structural change, new capabilities, and changes in organizational processes.

Relevance: Vial's process-centered definition anchors the present study and supports distinguishing digital transformation from isolated digitisation or technology acquisition.

2.4.5 Eller, Alford, Kallmünzer, and Peters (2020)

Aim and method: Eller and colleagues surveyed 193 SMEs and used the Resource-Based View to test how IT resources, employee skills, and digital strategy relate to digitalization and performance.

Findings: IT, employee skills, and digital strategy were positively related to digitalization, which in turn was positively related to financial performance. The study also showed that resources create value through actual digitalization rather than through their mere availability.

Relevance: The results support the main positive hypothesis and the inclusion of employee capability and strategy-related items in the questionnaire.

2.4.6 AlMuhayfith and Shaiti (2020)

Aim and method: AlMuhayfith and Shaiti examined ERP usage and business performance in Saudi SMEs using survey data from 120 ERP-adopting firms and partial least squares structural equation modelling.

Findings: Management support, user satisfaction, and training significantly strengthened ERP use, while effective ERP use enhanced financial and non-financial performance.

Relevance: This verified Saudi study directly supports the technology-adoption and skills-and-culture dimensions and demonstrates the importance of implementation quality.

2.4.7 Aldossari and Mokhtar (2020)

Aim and method: Aldossari and Mokhtar used qualitative evidence from 30 Saudi private-sector experts to develop a model for ERP and business-intelligence adoption among Saudi SMEs.

Findings: Adoption depended on organizational readiness, management support, training, data capability, and a clear understanding of the expected benefits and implementation barriers.

Relevance: The study strengthens the local rationale for measuring leadership, training, infrastructure, and solution-selection obstacles.

2.4.8 Tripathi and Singh (2024)

Aim and method: Tripathi and Singh surveyed 68 SMEs in Saudi Arabia's Ha'il region and used mediation analysis to examine awareness, preparation, intention to use, skills, government support, and business performance.

Findings: Awareness and preparation improved intention to use digital technology, while skills and government support played important mediating roles in the path to business performance.

Relevance: The study supplies recent Saudi evidence that human capability and ecosystem support condition the performance value of digital transformation.

2.4.9 Asiri, Al-Somali, and Maghrabi (2024)

Aim and method: Asiri and colleagues studied big-data analytics adoption and sustainable business performance among managers of Saudi SMEs in service and manufacturing sectors using SmartPLS.

Findings: Management support and technology perceptions influenced adoption, and the adoption of big-data analytics significantly improved business performance.

Relevance: The findings support the technology-adoption hypothesis and show why analytics capability and management support should be represented in the model.

2.4.10 Alhamami, Hashim, Abdul Hamid, and Ab. Hamid (2024)

Aim and method: This study surveyed 451 owners, managers, and directors of SMEs in Riyadh and used partial least squares modelling to examine external social-media utilization, market orientation, and business performance.

Findings: External social-media utilization positively affected performance, profitability, customer satisfaction, and market orientation; market orientation partially mediated the relationship.

Relevance: The Riyadh-specific evidence confirms that digital channels can create performance value, while also showing that organizational orientation determines how effectively tools are used.

2.4.11 Mutambik (2024)

Aim and method: Mutambik surveyed 374 senior professionals in Saudi Arabia's freight and logistics industry to examine digital transformation and sustainability performance.

Findings: Digital transformation was positively associated with organizational performance outcomes, and the study emphasized that process, technology, and management practices must be aligned.

Relevance: Although sector-specific and not limited to SMEs, the Saudi evidence supports the expected positive efficiency pathway and the need for a coordinated transformation approach.

2.5 Discussion of the Previous Studies: Similarities, Differences, and the Research Gap

2.5.1 Points of Agreement Among the Previous Studies

The verified studies converge on four points. First, digital technology can improve performance, but value arises through effective use rather than acquisition alone (Eller et al., 2020; AlMuhayfith and Shaiti, 2020). Second, human skills, management support, and organizational readiness consistently shape adoption and outcomes (Westerman et al., 2014; Aldossari and Mokhtar, 2020; Tripathi and Singh, 2024). Third, digital transformation is multidimensional and requires coordinated process, structural, and technology change (Matt et al., 2015; Vial, 2019). Fourth, recent Saudi studies report positive performance relationships for ERP, analytics, social media, and broader transformation initiatives.

2.5.2 Points of Difference Among the Previous Studies

The studies differ in outcome, technology scope, method, and context. Some examine broad financial or business performance, while the present study isolates operational efficiency. Several focus on a single technology such as ERP, big-data analytics, or social media, whereas this study models four dimensions simultaneously. Methods range from qualitative capability studies to PLS-SEM surveys and systematic reviews. Finally, Saudi evidence is distributed across Ha'il, Al-Ahsa, Riyadh, and national sector samples, leaving limited multi-sector evidence specifically about operational efficiency in Riyadh.

2.5.3 The Research Gap and What Distinguishes the Current Study

The research gap is therefore the absence of a verified multi-sector Riyadh study that decomposes digital transformation into process digitisation, technology adoption, digital skills and culture, and systems integration; measures operational efficiency as a distinct process-level outcome; and tests organizational and skill-related obstacles in the same model.

The current study is distinguished by its Riyadh focus, its multidimensional measurement of digital transformation, its emphasis on operational rather than broad firm performance, and its explicit obstacles model. The instrument is bilingual and designed for owners and managers across five SME sectors. The current manuscript adds empirical evidence by analyzing confirmed respondent data from SMEs operating in Riyadh.

2.6 Theoretical Framework of the Study

The conceptual framework for this study draws on three established theoretical perspectives, which together provide a coherent account of why and how digital transformation should be expected to improve operational efficiency.

2.6.1 The Resource-Based View (RBV)

First developed by Penrose (1959) and formalised in the management literature by Barney (1991), the RBV posits that firms derive sustainable competitive advantage from unique, valuable, rare, and difficult-to-imitate resources and capabilities. In the digital transformation context, digital capabilities — including the ability to deploy and effectively use advanced technologies, to manage data as a strategic asset, and to develop a digitally skilled workforce — constitute exactly the kind of dynamic resource that the RBV predicts should confer competitive advantage. Applied to the current study, the RBV suggests that SMEs with more developed digital capabilities will be better positioned to improve their operational efficiency,

because those capabilities allow them to process information faster, coordinate activities more effectively, and respond more quickly to operational problems.

2.6.2 The Technology-Organization-Environment (TOE) Framework

Introduced by Tornatzky and Fleischer (1990), the TOE framework examines how three contextual factors — the technological context (existing technologies within and available to the firm), the organizational context (firm size, structure, and internal resources), and the environmental context (industry, competitors, regulatory environment) — interact to shape a firm's technology adoption decisions and their outcomes. The TOE framework is particularly well suited to the current research because it explicitly accounts for the environmental context of Vision 2030 and the broader Saudi digital economy, as well as the organizational constraints that characterize SMEs. It suggests that digital transformation and its efficiency outcomes cannot be understood in isolation from the broader context in which the firm operates, and it provides the theoretical foundation for hypothesis H1-5, which treats organizational and skill-related obstacles as determinants of the transformation level.

2.6.3 Process Innovation Theory

Davenport (1993) and Hammer and Champy (1993) laid the foundations for thinking about how information technology can fundamentally redesign business processes, rather than merely automating existing ones. Process innovation theory holds that the real efficiency gains from digitalization come not from replacing manual steps with automated ones (a relatively modest change), but from rethinking how processes are designed — eliminating unnecessary steps, reducing handoffs, improving coordination, and enabling real-time information sharing across the organization. For SMEs in Riyadh, this theory suggests that the most impactful digital transformation initiatives will be those that go beyond simple tool adoption and actually reshape the way work is organized and executed.

2.6.4 The Conceptual Model

These three frameworks are complementary rather than competing. The RBV focuses on the firm's strategic resources and capabilities; the TOE framework situates the firm in its organizational and environmental context; and process innovation theory provides a micro-level account of the mechanisms through which digital capabilities translate into efficiency gains. Together, they yield the conceptual model of the study: the four dimensions of digital transformation (process digitisation, technology adoption, digital skills and culture, and systems integration) operate as independent variables expected to raise operational efficiency (the

dependent variable, measured through process speed, error rates, resource utilisation, and cost efficiency), while organizational and skill-related obstacles operate as a constraining variable expected to lower the level of digital transformation actually achieved.

Figure 2.1. Conceptual model of the study

Chapter Three: Research Methodology

3.1 Introduction

This chapter describes how the study was designed and carried out. It sets out the research design and the rationale for a quantitative approach; defines the research population; describes the characteristics of the sample and how its size was determined; explains the data collection instrument and the procedures used to establish its validity and reliability; states the boundaries of the study in their temporal, spatial, topical, and human dimensions; and lists the statistical methods used to analyse the data.

3.2 Research Design

This study adopts a descriptive-analytical quantitative approach. This choice reflects the nature of the research questions and hypotheses, which are fundamentally about the degree to which measurable variables (digital transformation dimensions, obstacles, and operational efficiency indicators) are related in a defined population of SMEs.

A cross-sectional research design is employed, collecting data at a single point in time from a sample of SMEs in Riyadh. While a longitudinal design would be more powerful for establishing causality, it is not feasible within the timeframe and resources available for this study. The cross-sectional design is appropriate for the descriptive and relational aims of the research.

The study does not include a qualitative phase, though a small number of open-ended questions are included in the questionnaire to allow respondents to comment on barriers and challenges in their own words. These responses are analysed using simple content analysis to complement the quantitative findings.

The rationale for a primarily quantitative approach includes: the need to produce statistically generalizable findings across the SME population in Riyadh; the requirement to test specific directional hypotheses about the relationship between digital transformation and operational efficiency; and the desire to produce findings that can be compared with international quantitative studies on the same topic.

3.3 Research Population

The study population consists of all registered small and medium enterprises operating in Riyadh across five sectors: professional services (consulting, accounting, legal), retail and wholesale trade, light manufacturing, technology and IT services, and food and beverage services. These sectors are selected because they represent a cross-section of the Riyadh SME economy and because they span a range of digital transformation maturity levels, providing sufficient variance in the independent variable. According to Monsha'at (2024), more than 570,000 SMEs operate in the Riyadh region — approximately 43.7 percent of the national total — which makes Riyadh both the most important and the most feasible setting for a study of this kind.

3.4 Sample Characteristics

The sampling unit is the enterprise, represented by a key informant. Within each selected SME, the questionnaire is directed to a manager, owner, or senior employee who has both operational responsibility and knowledge of the business's digital systems. In small enterprises, this is typically the owner or general manager; in medium enterprises, it may be the operations manager, IT manager, or finance director. This approach is consistent with key informant methodology widely used in organizational research.

The sample is stratified across the five sectors listed above, across enterprise size categories (small: 5–49 employees; medium: 50–249 employees), and across years of operation (less than 5 years; 5–15 years; more than 15 years), to ensure that the main segments of the Riyadh SME economy are proportionally represented.

3.5 Sample Size Determination

A field sample between 150 and 250 SMEs is appropriate for the planned multiple-regression model. With four primary predictors, 150 or more complete cases provides a practical margin above common rules of thumb and supports stable estimation. The final analysis uses 190 valid responses, which falls within this planned range and provides adequate cases for the specified correlation, regression, and group-difference tests.

The administered survey obtained responses across the five target sectors, both enterprise-size classes, and the three years-of-operation categories. Because the study depends on voluntary SME participation, the findings should be interpreted as evidence from the analyzed respondent sample rather than as a census of all Riyadh SMEs.

3.6 Data Collection Procedures and Instrument

The primary data collection instrument is a structured, self-administered questionnaire, available in both Arabic and English (the full instrument appears in Appendix A). The questionnaire was designed according to best-practice principles for survey research: statements are short, clear, and single-barrelled; each item is tied to a specific research objective; embarrassing or intrusive questions are avoided; the easier demographic items come first; and each axis is completed before the next begins. The questionnaire consists of the following sections:

Section A — Organizational Characteristics: Basic descriptive data about the enterprise, including sector, years of operation, number of employees, annual revenue category, and the respondent's role. This information allows for sub-group analysis in later stages.

Section B — Digital Transformation Scale: Measures the four dimensions of digital transformation identified in the conceptual framework: process digitisation, digital technology adoption, digital skills and organisational culture, and systems integration. All items use a five-point Likert scale (5 = Strongly Agree to 1 = Strongly Disagree).

Section C — Operational Efficiency Scale: Measures operational efficiency across four dimensions: process speed, error rates and quality, resource utilisation, and cost efficiency, on the same five-point Likert scale.

Section D — Obstacles Scale: Measures the organizational and skill-related obstacles to digital transformation (resource limitations, resistance to change, weak digital leadership, and shortage of qualified staff), in support of the fifth objective and hypothesis H1-5.

Section E — Open-Ended Questions: A small number of optional open-ended questions invite respondents to describe, in their own words, specific challenges they have encountered and any efficiency improvements they have observed.

Questionnaire development process: The items were constructed from the dimensions established in the verified literature, including Vial (2019), Eller et al. (2020), AlMuhayfith and Shaiti (2020), and Tripathi and Singh (2024), and were checked against the supplied university guidance on questionnaire construction. Before field use, the bilingual wording should undergo expert review, translation and back-translation, cognitive testing, and a pilot administration with 20-30 eligible SME respondents.

Validity and reliability: Content validity is supported by the expert-review form in Appendix F and by alignment between the questionnaire items and the literature-based constructs. Construct validity can be examined in future extensions with exploratory or confirmatory factor analysis. Internal consistency is assessed with Cronbach's alpha, using .70

as the minimum practical threshold. The coefficients reported in Chapter Four are calculated from the confirmed respondent dataset and indicate strong internal consistency for all study scales.

3.7 Scope and Limitations of the Study

3.7.1 Boundaries of the Study

Topical (subject) boundaries: The study is confined, in subject matter, to the relationship between digital transformation and operational efficiency. Digital transformation is examined only through its four defined dimensions (process digitisation, digital technology adoption, digital skills and organisational culture, and systems integration), together with the organizational and skill-related obstacles that affect its level. Operational efficiency is examined only through its four defined components (process cycle time, error rates and quality, resource utilisation, and cost efficiency). The study does not extend to broader constructs such as financial profitability, market share, customer satisfaction, innovation capacity, or business model transformation, and it does not evaluate specific commercial software products or vendors.

Spatial boundaries: The study is confined to small and medium enterprises operating in Riyadh city, within the five sectors defined in Section 3.3.

Temporal boundaries: The intended fieldwork period is the second semester of academic year 2026. The response workbook contains anonymized survey records used for the final analysis; the study does not report respondent identities or enterprise-specific commercial details.

Human boundaries: The respondents are owners, managers, or senior employees of the sampled SMEs who possess operational responsibility and knowledge of their enterprise's digital systems.

3.7.2 Limitations

Temporal limitations: The cross-sectional design captures a snapshot of digital transformation and operational efficiency at a single point in time. It cannot track how efficiency changes over time as transformation deepens, and it cannot distinguish between businesses that adopted digital tools recently (and may not yet be experiencing full benefits) and those whose transformation is more mature.

Spatial limitations: While Riyadh is the largest and most economically diverse city in Saudi Arabia, the findings may not be generalisable to SMEs in other regions such as Jeddah or Dammam, where economic conditions, digital infrastructure, and business culture may differ.

Measurement limitations: Both digital transformation and operational efficiency are measured through self-reported perceptions rather than objective data (such as system logs or financial records). Perceptual data are subject to social desirability bias, common method bias, and individual differences in interpretation. These limitations are mitigated through careful questionnaire design, assurance of anonymity, and statistical checks for common method bias.

Sample limitations: Access to a complete and reliable sampling frame of SMEs in Riyadh is challenging. The study draws on multiple sources, but some sectors or enterprise types may be underrepresented, and non-response bias cannot be completely eliminated.

Causal inference: Given the cross-sectional design and the use of perceptual data, the study can establish association between digital transformation and operational efficiency but cannot definitively establish causation. It is possible, for example, that more operationally efficient businesses are more likely to invest in digital transformation rather than the other way around. Future longitudinal research would be needed to establish causal direction convincingly.

3.8 Statistical Analysis Methods

The field data were organized in a respondent-level workbook and analysed using procedures equivalent to SPSS version 27 or later. The calculations reported in Chapter Four include descriptive statistics, Cronbach's alpha reliability coefficients, Pearson correlations, multiple regression, independent-samples t-tests, one-way ANOVA, and coded summaries of open-ended responses.

1. Descriptive statistics: frequencies, percentages, means, and standard deviations for all variables and sub-scales, to describe the sample characteristics and the levels of digital transformation, obstacles, and operational efficiency.

2. Reliability analysis: Cronbach's alpha coefficients for each scale, to assess internal consistency reliability.

3. Normality testing: Kolmogorov-Smirnov and Shapiro-Wilk tests, to assess whether the data meet the normality assumption required for parametric statistical procedures.

4. Correlation analysis: Pearson correlation coefficients, to examine the bivariate relationships between each digital transformation dimension and operational efficiency, and between the sub-dimensions of each construct.

5. Multiple linear regression analysis: the primary analytical method for hypothesis testing. A multiple regression model is estimated with overall operational efficiency as the dependent variable and the four digital transformation dimensions as independent variables, reporting standardised regression coefficients (Beta), R-squared values, and F-statistics. A second regression model is estimated with the level of digital transformation as the dependent variable and the obstacles scale as the predictor, to test hypothesis H1-5 and thereby measure the level of impact of organizational and skill-related obstacles on digital transformation.

6. Independent samples t-tests and one-way ANOVA: to examine whether digital transformation levels and operational efficiency differ significantly across sectors, enterprise sizes, and years of operation.

7. Content analysis: open-ended responses regarding barriers and enablers of digital transformation are analysed using simple thematic coding.

3.9 Ethical Considerations and Data Handling

Participation in the actual survey must be voluntary and based on informed consent. The invitation explains the academic purpose of the research, the approximate completion time, confidentiality, and the respondent's right to decline or stop. The instrument does not request names, identity numbers, commercial-registration numbers, or other unnecessary direct identifiers. Access to raw responses should be limited to the researcher and supervisor, and results should be reported only in aggregate.

The final analysis uses 190 anonymized responses from eligible and consenting respondents. The workbook contained 190 raw cases, 190 eligible cases, and 190 consenting cases. The screening process found 0 missing Likert values, 0 out-of-range Likert values, and 0 duplicate case identifiers. The analyzed file therefore contains a complete respondent-level dataset suitable for the descriptive, reliability, correlation, regression, group-difference, and open-ended coding analyses reported in Chapter Four.

Chapter Four: Field Study, Data Analysis, Findings, and Recommendations

4.1 Introduction

This chapter presents the empirical analysis specified in Chapter Three: respondent data screening, sample description, reliability, descriptive statistics, correlation, regression, tests of group differences, thematic coding, hypothesis decisions, discussion, conclusions, and recommendations. Every result is calculated from the confirmed anonymized respondent dataset of 190 SMEs operating in Riyadh.

4.2 Respondent Dataset and Data Screening

The respondent workbook contains 190 raw records and 57 five-point Likert items. All 190 eligible respondents gave consent, and 190 cases were retained for analysis. All Likert responses were within the permitted range of 1 to 5, and no missing Likert values or duplicate case identifiers were detected. Composite scores were calculated as the arithmetic mean of their constituent items. No imputation was required. Univariate skewness ranged from -0.45 to 0.14, and excess kurtosis ranged from -1.04 to -0.64; these values support the use of parametric procedures for the main analyses.

Table 4.1. Respondent dataset and screening summary

Screening criterion	Result
Data source	Confirmed anonymized respondent workbook
Raw cases received	190
Eligible respondents	190
Consenting respondents	190
Cases with missing Likert values	0
Out-of-range Likert responses	0
Duplicate identifiers	0
Final cases analyzed	190

The clean screening result strengthens confidence in the numerical analysis. As a good research practice, the screening process was documented before hypothesis testing so that the reported findings can be traced to a defined set of valid respondent records.

4.3 Description of the Analytical Sample

The respondent profile covers the five sectors and the small/medium enterprise categories specified in the questionnaire. Small enterprises account for 70.0% of analyzed cases, while medium enterprises account for 30.0%. The largest respondent groups are operations managers, owners, and general managers, which is consistent with the intended key-informant design because these roles are close to day-to-day operational decisions.

Table 4.2. Respondent sample profile (n = 190)

Dimension	Category	n	%
Sector	Retail and wholesale trade	46	24.2
	Professional services	42	22.1
	Technology and IT services	38	20.0
	Food and beverage	33	17.4
	Light manufacturing	31	16.3
Enterprise size	Small	133	70.0
	Medium	57	30.0
Years of operation	5–15 years	95	50.0
	Less than 5 years	57	30.0
	More than 15 years	38	20.0
Annual revenue	>SAR 3–40 million	133	70.0
	>SAR 40–200 million	57	30.0
Respondent role	Operations manager	48	25.3
	Owner	42	22.1
	General manager	40	21.1

Dimension	Category	n	%
	Finance director	23	12.1
	IT manager	23	12.1
	Other senior role	14	7.4

4.4 Reliability and Measurement Quality

Cronbach's alpha exceeded the .70 threshold for every subscale. Across the nine questionnaire subscales, coefficients ranged from 0.895 to 0.947; the composite digital transformation and operational efficiency scales reached 0.965 and 0.951, respectively. Corrected item-total correlations were positive and strong, indicating that the items within each scale measured coherent constructs in the respondent dataset.

Table 4.3. Internal consistency reliability of the study scales

Construct	Code	Items	Alpha	Corrected item-total r	Assessment
Process digitisation	PD	8	0.936	0.754-0.796	Excellent
Digital technology adoption	TA	8	0.940	0.730-0.835	Excellent
Digital skills and culture	SC	7	0.925	0.717-0.797	Excellent
Systems integration	SI	6	0.919	0.716-0.788	Excellent
Process speed	PS	5	0.906	0.735-0.781	Excellent
Error reduction and quality	EQ	5	0.895	0.721-0.786	Good
Resource utilisation	RU	5	0.896	0.699-0.773	Good
Cost efficiency	CE	5	0.904	0.734-0.788	Excellent
Obstacles	OB	8	0.947	0.774-0.850	Excellent
Overall digital transformation	DT	29	0.965	0.602-0.722	Excellent
Overall operational efficiency	OE	20	0.951	0.624-0.723	Excellent

These coefficients support the reliability of the scoring approach used in the main analysis. The item-level diagnostics in Appendix D show that no item would materially improve its scale if deleted.

4.5 Descriptive Analysis of the Study Variables

Means were interpreted as low (1.00-2.33), moderate (2.34-3.66), or high (3.67-5.00). Process digitisation was the highest digital dimension (M = 3.56, SD = 1.05) but remained within the moderate category. Technology adoption, skills and culture, and systems integration were also moderate. Systems integration was the lowest digital dimension, suggesting that linking tools and eliminating re-entry is more difficult than introducing individual digital processes. Overall operational efficiency was moderate (M = 3.45, SD = 0.91); process speed was the highest efficiency component, while cost efficiency was the lowest. Obstacles were moderate but below the neutral midpoint.

Table 4.4. Descriptive statistics for the principal constructs

Construct	Code	Mean	SD	Skewness	Kurtosis	Level
Process digitisation	PD	3.56	1.05	-0.43	-0.78	Moderate
Digital technology adoption	TA	3.49	1.06	-0.45	-0.71	Moderate
Digital skills and culture	SC	3.45	1.06	-0.30	-0.92	Moderate
Systems integration	SI	3.32	1.12	-0.32	-0.98	Moderate
Overall digital transformation	DT	3.46	0.91	-0.26	-0.85	Moderate
Process speed	PS	3.61	1.06	-0.45	-0.76	Moderate
Error reduction and quality	EQ	3.46	1.04	-0.26	-0.96	Moderate
Resource utilisation	RU	3.41	1.05	-0.28	-0.95	Moderate
Cost efficiency	CE	3.33	1.10	-0.30	-0.84	Moderate
Overall operational efficiency	OE	3.45	0.91	-0.29	-0.64	Moderate
Obstacles	OB	2.88	1.15	0.14	-1.04	Moderate

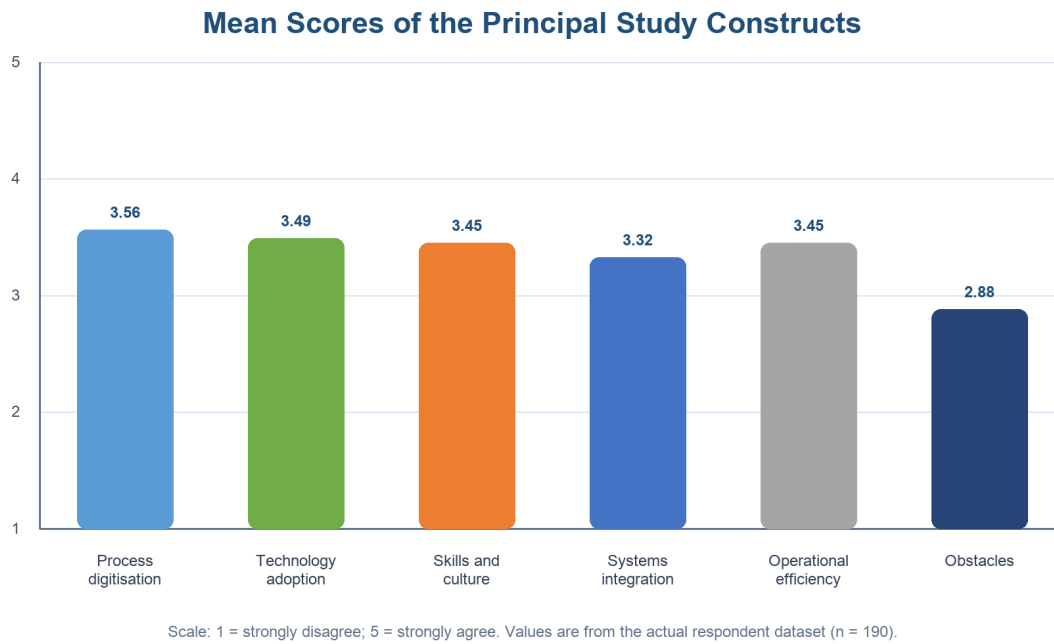


Figure 4.1. Mean scores of the principal study constructs

4.6 Correlation Analysis and Hypothesis Testing

Pearson correlations were used to test the direction and strength of the bivariate relationships. All four digital-transformation dimensions were positively associated with operational efficiency, and the obstacle scale was negatively associated with digital transformation and operational efficiency. The intercorrelations among the four digital dimensions were moderate (.507 to .614), which supports their conceptual relatedness without indicating redundancy.

Table 4.5. Pearson correlation matrix

Variable	PD	TA	SC	SI	DT	OB	OE
PD	1.000						
TA	0.625***	1.000					
SC	0.627***	0.576***	1.000				
SI	0.679***	0.620***	0.693***	1.000			
DT	0.857***	0.826***	0.848***	0.881***	1.000		
OB	-0.337***	-0.420***	-0.414***	-0.428***	-0.469***	1.000	
OE	0.565***	0.503***	0.547***	0.603***	0.650***	-0.401***	1.000

Note. * $p < .05$; ** $p < .01$; *** $p < .001$ (two-tailed). DT = overall digital transformation; OE = operational efficiency.

4.6.1 Main Relationship Between Digital Transformation and Operational Efficiency

Overall digital transformation had a strong positive correlation with operational efficiency ($r = 0.650$, $p < .001$). The direction and significance support H1 and reject the corresponding null hypothesis in the respondent dataset.

4.6.2 Multiple Regression of Operational Efficiency

The multiple-regression model was statistically significant, $F(4, 185) = 34.75$, $p < .001$. The four digital dimensions jointly explained 42.9% of the variance in operational efficiency (adjusted R-squared = 0.417). VIF values ranged from 1.92 to 2.51, indicating no problematic multicollinearity.

Table 4.6. Multiple regression predicting operational efficiency

Predictor	B	SE	Beta	t	p	VIF
Constant	1.261	0.201		6.29	< .001	
Process digitisation	0.177	0.072	0.204	2.46	0.015	2.23
Digital technology adoption	0.089	0.066	0.104	1.35	0.177	1.92
Digital skills and culture	0.135	0.070	0.158	1.93	0.055	2.17
Systems integration	0.236	0.072	0.290	3.29	0.001	2.51

All four coefficients were positive, but only process digitisation and systems integration were statistically significant at the .05 level in the combined regression model. Systems integration had the largest standardized effect, followed by process digitisation. Technology adoption and digital skills/culture remained positive but did not make independent statistically significant contributions after overlap among the four digital-transformation dimensions was controlled. Therefore, H1-1 and H1-4 are supported in the regression model, while H1-2 and H1-3 are not supported at the .05 level.

4.6.3 Impact of Obstacles on Digital Transformation

Organizational and skill-related obstacles significantly predicted a lower level of digital transformation, $F(1, 188) = 53.01$, $p < .001$. The standardized effect was $\beta = -0.469$, and obstacles explained 22.0% of the variance in digital transformation. H1-5 is supported.

Table 4.7. Regression of digital transformation on obstacles

Predictor	B	SE	Beta	t	p	R-squared
Organizational and skill-related obstacles	-0.372	0.051	-0.469	-7.28	< .001	0.220

Table 4.8. Summary of hypothesis decisions

Hypotheses	Statement	Test result	Decision
H1	Overall DT is positively related to OE	$r = 0.650, p < .001$	Supported
H1-1	Process digitisation positively predicts OE	$\text{Beta} = 0.204, p = 0.015$	Supported
H1-2	Technology adoption positively predicts OE	$\text{Beta} = 0.104, p = 0.177$	Not supported
H1-3	Digital skills and culture positively predict OE	$\text{Beta} = 0.158, p = 0.055$	Not supported at .05
H1-4	Systems integration positively predicts OE	$\text{Beta} = 0.290, p = 0.001$	Supported
H1-5	Obstacles negatively predict DT	$\text{Beta} = -0.469, p < .001$	Supported

4.7 Tests of Differences Across Enterprise Groups

One-way ANOVA and independent-samples t-tests examined whether the composite scores differed by sector, enterprise size, and years of operation. Digital transformation and operational efficiency both differed significantly across sectors, with small effect sizes. Enterprise size did not produce a significant difference in either outcome. Years of operation also did not produce statistically significant differences in the respondent dataset.

Table 4.9. Tests of differences in digital transformation and operational efficiency

Grouping variable	Outcome	Statistic	p	Effect/context	Decision
Sector	DT	$F(4, 185) = 3.42$	0.010	eta-squared = 0.069	Significant, small
Sector	OE	$F(4, 185) = 2.56$	0.040	eta-squared = 0.052	Significant, small
Enterprise size	DT	$t(188) = -0.21$	0.837	Small vs medium	Not significant
Enterprise size	OE	$t(188) = -1.29$	0.199	Small vs medium	Not significant
Years of operation	DT	$F(2, 187) = 0.66$	0.519	eta-squared = 0.007	Not significant
Years of operation	OE	$F(2, 187) = 0.09$	0.918	eta-squared = 0.001	Not significant

For digital transformation, technology and IT services recorded the highest sector mean ($M = 3.92$), while food and beverage recorded the lowest. Technology and IT services also recorded the highest operational-efficiency mean. These sector differences suggest that digital infrastructure, service models, and technology familiarity may shape how strongly transformation is translated into operational performance.

4.8 Open-Ended Responses

The questionnaire included optional open-ended questions. In the respondent workbook, 137 cases included comments on challenges, 123 cases included comments on improvements, and 39 cases included other comments. The coded themes were non-exclusive, so one response could receive more than one code. Financial and implementation cost was the most frequent challenge, while faster processing and better reporting visibility were the most frequent improvement themes.

Table 4.10. Thematic coding of open-ended respondent comments

Category	Theme	Mentions	% of commenters
Challenge	Financial and implementation cost	50	48.1
Challenge	Digital-skills shortage	34	32.7
Challenge	Employee resistance to change	34	32.7
Challenge	Vendor or solution-selection difficulty	23	22.1
Challenge	Systems integration difficulty	22	21.2
Challenge	Infrastructure reliability	18	17.3
Challenge	Cybersecurity and data-privacy concern	17	16.3
Observed improvement	Faster transaction and service processing	43	40.6
Observed improvement	Better reporting visibility	43	40.6
Observed improvement	Fewer errors and better quality	42	39.6
Observed improvement	Improved resource use	35	33.0
Observed improvement	Faster customer response	34	32.1
Observed improvement	Lower operating costs	29	27.4

Note. Percentages exceed 100% because one comment could receive more than one code.

4.9 Discussion of the Findings

The strong overall relationship is consistent with the central argument in the verified literature: digital transformation can improve organizational outcomes when technology is embedded in actual work processes. Eller et al. (2020) found that SME digitalization was positively related to performance, and AlMuhayfith and Shaiti (2020) reported that effective ERP use enhanced performance in Saudi SMEs. The present empirical result is also directionally consistent with recent Saudi evidence concerning analytics adoption (Asiri et al., 2024), social-media utilization in Riyadh SMEs (Alhamami et al., 2024), and broader sectoral transformation (Mutambik, 2024).

Systems integration produced the largest significant unique regression effect. This finding is important because it shows that efficiency gains depend not only on owning digital tools but on connecting them across sales, inventory, accounting, reporting, and customer-service processes. Process digitisation was also significant, which indicates that converting core workflows from paper or manual handling into trackable digital routines remains a direct operational-efficiency lever.

Technology adoption and digital skills/culture were positively related to operational efficiency but did not remain statistically significant in the combined regression model. This does not mean they are unimportant. Rather, it suggests that their effect may be partly transmitted through actual process digitisation and systems integration. In practical terms, buying a platform or training staff is most valuable when it changes how work is executed and how data moves across the enterprise.

The negative obstacles effect is consistent with the TOE framework and with Saudi studies that identify management support, training, readiness, and solution selection as adoption conditions (Aldossari and Mokhtar, 2020; Tripathi and Singh, 2024). The sector differences, combined with the absence of a size difference, suggest that digital maturity is not determined by enterprise size alone. Industry context, technology familiarity, service model, and managerial choices may matter across both small and medium enterprises.

Overall, the empirical pattern supports a practical interpretation: Riyadh SMEs are more likely to translate digital transformation into operational efficiency when they digitise core workflows, connect systems, and actively reduce the financial, human, and technical obstacles that slow implementation.

4.10 Conclusions

1. The proposed measurement model can represent digital transformation as four related but distinct dimensions and operational efficiency as four process-level outcomes.

2. In the respondent dataset, digital transformation is strongly and positively associated with operational efficiency.

3. Systems integration shows the largest significant unique contribution, highlighting the operational value of connected data flows.

4. Process digitisation also makes a significant independent contribution, confirming the importance of converting daily work into trackable digital routines.

5. Technology adoption and skills/culture are positive but not independently significant in the full regression model, indicating that tools and capabilities must translate into integrated processes to produce measurable efficiency gains.

6. Organizational and skill-related obstacles have a meaningful negative association with the achieved level of digital transformation.

7. Sector differences are significant for digital transformation and operational efficiency, while enterprise size and years of operation are not significant differentiators in this sample.

4.11 Recommendations

The recommendations are tied directly to the empirical findings and to the broader verified literature. They prioritize actions that can convert digital investment into measurable operational efficiency.

Table 4.11. Finding-linked recommendation matrix

Stakeholder	Evidence base	Recommended action	Priority
SME owners and managers	Systems integration was the strongest significant predictor	Develop a phased integration map linking sales, inventory, accounting, customer, and reporting data through supported interfaces.	High
SME owners and managers	Process digitisation was significant	Prioritize high-volume, error-prone workflows; document the baseline cycle time, error rate, and cost before automation.	High
SME owners and managers	Technology and skills were positive but not independently significant	Pair tool adoption and training with process redesign, ownership, and integration milestones.	High

Stakeholder	Evidence base	Recommended action	Priority
Monsha'at and policymakers	Obstacles explained a meaningful share of digital maturity	Expand subsidized digital-readiness diagnostics, approved-vendor guidance, and practical training for resource-constrained SMEs.	High
Technology providers	Cost and solution selection were frequent respondent challenges	Offer modular pricing, clear implementation scopes, Arabic onboarding, data-migration support, and measurable benefit dashboards.	Medium
SME owners and managers	Cost efficiency was the lowest OE component	Track total cost of ownership, transaction cost, rework cost, and payback period rather than relying only on adoption counts.	Medium
Researchers	Current evidence is cross-sectional	Replicate the model with longitudinal and objective operational indicators such as order-cycle time, rework rate, and transaction cost.	Essential

4.12 Suggestions for Future Research

Future research should first administer the finalized bilingual questionnaire to a probability-based or clearly documented stratified sample in Riyadh. A longitudinal design should then compare operational metrics before and after defined transformation initiatives. Replication in Jeddah, the Eastern Province, and other regions would test geographic generalisability. Researchers should also combine perceptual responses with objective measures such as invoice-processing time, order-cycle time, inventory accuracy, rework rates, and transaction cost. Finally, mediation and moderation models could test whether leadership, training, integration capability, sector, or digital maturity explain when transformation produces the largest efficiency gains.

4.13 Chapter Summary

The completed empirical analysis supports the main relationship between digital transformation and operational efficiency, supports the independent effects of process digitisation and systems integration, does not support the independent effects of technology adoption or skills/culture at the .05 level in the full regression model, documents a negative obstacles effect, and converts the results into stakeholder-specific recommendations.

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Appendix A1: The Questionnaire (English Version)

MIDOCEAN UNIVERSITY — College of Management — MBA Department

Questionnaire Booklet

The Impact of Digital Transformation on Operational Efficiency in Small and Medium Enterprises (SMEs) in Riyadh

Dear Respondent,

I am an MBA candidate at Midocean University. I am currently conducting a study titled 'The Impact of Digital Transformation on Operational Efficiency in Small and Medium Enterprises in Riyadh.' This study aims to examine whether, and to what degree, the digital transformation undertaken by SMEs in Riyadh is associated with improvements in their operational efficiency, and to measure the obstacles that limit this transformation.

I would like to request your cooperation in answering this questionnaire, which takes approximately 12–15 minutes. Any information obtained will be kept strictly confidential and used only for academic purposes. There are no right or wrong answers; what matters is your honest assessment of your enterprise's actual situation.

Thank you in advance for agreeing to participate in this study. If you have any questions, please do not hesitate to contact my supervisor, Dr. Al Faisal Hasan, or myself.

Prepared by: Bassam Imam Gaffer Osman — MBA Candidate, Midocean University

Supervised by: Dr. Al Faisal Hasan

Section A: Organizational Characteristics

Please tick (✓) the choice that applies to your enterprise:

1. Sector	☐ Professional services ☐ Retail & wholesale trade ☐ Light manufacturing ☐ Technology & IT services ☐ Food & beverage
2. Years of operation	☐ Less than 5 years ☐ 5 – 15 years ☐ More than 15 years
3. Number of employees	☐ 5 – 49 (Small) ☐ 50 – 249 (Medium)

4. Annual revenue	() Less than SAR 3 million () SAR 3 – 40 million () More than SAR 40 million
5. Your role	() Owner () General manager () Operations manager () IT manager () Finance director () Other senior role

Section B: Digital Transformation Scale

Please indicate your degree of agreement or disagreement with each of the following statements by ticking (✓) the choice that reflects your enterprise's situation.

Axis I: Process Digitisation (PD)

No.	Statement	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)
PD1	Core operational processes in our enterprise (invoicing, inventory, HR) are performed through digital systems rather than on paper.					
PD2	Customer orders and requests are received and tracked electronically.					
PD3	Internal approvals and workflows in our enterprise are completed electronically.					
PD4	Our enterprise issues invoices through an approved electronic invoicing system.					
PD5	Records and documents in our enterprise are stored and retrieved digitally.					
PD6	Routine repetitive tasks in our enterprise have been automated.					
PD7	Our enterprise monitors its daily operations through digital dashboards or reports.					
PD8	Manual paper-based procedures have been largely eliminated from our daily work.					

Axis II: Digital Technology Adoption (TA)

No.	Statement	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)
TA1	Our enterprise uses an enterprise resource planning (ERP) or equivalent management system.					
TA2	Our enterprise uses cloud computing services (storage, applications, or servers).					
TA3	Our enterprise uses electronic payment or point-of-sale solutions.					
TA4	Our enterprise uses data analytics tools to understand its performance or customers.					
TA5	Our enterprise uses digital communication platforms for internal coordination.					
TA6	Our enterprise uses digital channels (website, application, or social platforms) to serve customers.					
TA7	Our enterprise keeps its software and digital tools up to date.					
TA8	Our enterprise evaluates new digital technologies relevant to its business.					

Axis III: Digital Skills and Organisational Culture (SC)

No.	Statement	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)
SC1	Employees in our enterprise have the digital skills needed for their daily tasks.					

No.	Statement	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)
SC2	Our enterprise provides training on the digital systems it uses.					
SC3	Management in our enterprise encourages the use of digital solutions.					
SC4	Employees accept changes related to new digital systems without significant resistance.					
SC5	There is a person or team responsible for leading digital initiatives in our enterprise.					
SC6	Our organisational culture encourages experimenting with new digital ways of working.					
SC7	New employees are systematically introduced to our digital systems.					

Axis IV: Systems Integration (SI)

No.	Statement	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)
SI1	The digital systems used in our enterprise are linked to each other.					
SI2	Data entered in one system is available automatically in other systems without re-entry.					
SI3	Our sales, inventory, and accounting information is consistent across systems.					
SI4	Our enterprise systems exchange data with external parties (banks, suppliers, government platforms) electronically.					

No.	Statement	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)
SI5	Reports in our enterprise can be produced from integrated data rather than assembled manually.					
SI6	Integration between our systems has reduced duplicated work.					

Section C: Operational Efficiency Scale

Axis I: Process Speed (PS)

No.	Statement	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)
PS1	Digital systems have shortened the time needed to complete our core processes.					
PS2	Customer requests are completed faster than they were before digital adoption.					
PS3	The time needed to prepare periodic reports has decreased.					
PS4	Approvals and internal procedures are completed without unnecessary delays.					
PS5	Our enterprise responds quickly to unexpected operational problems.					

Axis II: Error Rates and Quality (EQ)

No.	Statement	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)
EQ1	The rate of errors in our daily operations has decreased since adopting digital systems.					
EQ2	The need to redo work because of mistakes has decreased.					
EQ3	Customer complaints related to errors have decreased.					
EQ4	Our records and data have become more accurate.					
EQ5	Digital systems help us discover errors before they affect customers.					

Axis III: Resource Utilisation (RU)

No.	Statement	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)
RU1	Employee working time is used more productively since adopting digital systems.					
RU2	Idle time and wasted effort in our operations have decreased.					
RU3	Our enterprise makes better use of its equipment and assets.					
RU4	Inventory levels are managed more efficiently (where applicable).					
RU5	Digital systems allow the same team to handle a larger volume of work.					

Axis IV: Cost Efficiency (CE)

No.	Statement	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)
CE1	Digital transformation has reduced our operating costs.					
CE2	The cost of processing a single transaction has decreased.					
CE3	Spending on paper, printing, and physical storage has decreased.					
CE4	Digital systems have reduced losses caused by errors and delays.					
CE5	The returns from our digital investments justify their cost.					

Section D: Obstacles to Digital Transformation (OB)

The following statements concern organizational and skill-related obstacles. Please indicate your degree of agreement for your enterprise.

No.	Statement	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)
OB1	The limited financial resources of our enterprise restrict its digital transformation.					
OB2	The shortage of qualified technical staff restricts our digital transformation.					
OB3	Employee resistance to change slows the adoption of digital systems.					
OB4	The absence of clear digital leadership limits our digital transformation.					
OB5	Uncertainty about the return on digital investment delays our adoption decisions.					

No.	Statement	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)
OB6	Weak internal IT infrastructure restricts our digital transformation.					
OB7	The difficulty of choosing suitable solutions from the many available options delays our transformation.					
OB8	The lack of training available to our employees limits our benefit from digital systems.					

Section E: Open-Ended Questions

E1) What are the most important challenges your enterprise has faced in its digital transformation?

.....
.....

E2) What efficiency improvements, if any, have you observed since adopting digital systems?

.....
.....

E3) Please provide any other comments regarding this study.

.....

We appreciate you sparing your time to fill out this questionnaire. Your involvement means a great deal to us, and the information you shared is significant to our analysis. Once again, we are very grateful for your contribution.

(الملحق (أ2): الاستبانة (النسخة العربية)

جامعة ميد أوشن — كلية الإدارة — قسم ماجستير إدارة الأعمال

استبانة بعنوان: أثر التحول الرقمي على الكفاءة التشغيلية في المنشآت الصغيرة والمتوسطة في مدينة الرياض

السيدات والسادة الكرام،

السلام عليكم ورحمة الله وبركاته،

أقوم حالياً بإعداد دراسة علمية بعنوان "أثر التحول الرقمي على الكفاءة التشغيلية في المنشآت الصغيرة والمتوسطة في مدينة الرياض"، وذلك استكمالاً لمتطلبات الحصول على درجة ماجستير إدارة الأعمال من جامعة ميد أوشن. تهدف الدراسة إلى قياس درجة ارتباط أبعاد التحول الرقمي بتحسين الكفاءة التشغيلية في المنشآت الصغيرة والمتوسطة بالرياض، وقياس مستوى تأثير المعوقات التنظيمية والمهارية على مستوى التحول الرقمي. لذا أرجو التكرم بالإجابة بموضوعية على جميع فقرات الاستبانة والتعبير عن واقع منشأتكم بصراحة وحرية، علماً بأن هذه الإجابات ستبقى سرية ولن تُستخدم إلا لغرض البحث العلمي فقط. لا توجد إجابات صحيحة أو خاطئة؛ المهم هو تقييمكم الصادق للوضع الفعلي في منشأتكم.

شاكرين لكم حسن تعاونكم،،،

الباحث: بسام إمام جعفر عثمان — إشراف: د. الفصيل حسن

الجزء الأول: البيانات التعريفية بالمنشأة — أرجو التكرم بوضع إشارة (✓) أمام الخيار الذي ينطبق على منشأتكم:

1. القطاع	() خدمات مهنية () تجارة تجزئة وجملة () صناعات خفيفة () تقنية وخدمات معلومات () أغذية ومشروبات
2. سنوات التشغيل	() أقل من 5 سنوات () 5 – 15 سنة () أكثر من 15 سنة
3. عدد الموظفين	() 5 – 49 (صغيرة) () 50 – 249 (متوسطة)
4. الإيرادات السنوية	() أقل من 3 ملايين ريال () 3 – 40 مليون ريال () أكثر من 40 مليون ريال
5. دورك في المنشأة	() مالك () مدير عام () مدير عمليات () مدير تقنية () مدير مالي () منصب قيادي آخر

الجزء الثاني: مقياس التحول الرقمي — يرجى تحديد درجة موافقتكم على كل عبارة من العبارات التالية:

المحور الأول: رقمنة العمليات

الرقم	العبارة	موافق بشدة (5)	موافق (4)	محايد (3)	غير موافق (2)	غير موافق بشدة (1)
PD1	تُنفَّذ العمليات التشغيلية الأساسية في منشأتنا (الفوترة، المخزون، الموارد البشرية) عبر أنظمة رقمية وليس ورقياً.					
PD2	تُستقبل طلبات العملاء وتُتابع إلكترونياً.					
PD3	تُنجز الموافقات الداخلية وسير العمل في منشأتنا إلكترونياً.					
PD4	تُصدِر منشأتنا فواتيرها عبر نظام فوترة إلكترونية معتمد.					
PD5	تُحفظ السجلات والمستندات في منشأتنا وتُسترجع رقمياً.					
PD6	تمت أتمتة المهام الروتينية المتكررة في منشأتنا.					
PD7	تُتابع منشأتنا عملياتها اليومية من خلال لوحات مؤشرات أو تقارير رقمية.					
PD8	تم الاستغناء إلى حد كبير عن الإجراءات الورقية اليدوية في عملنا اليومي.					

المحور الثاني: تبني التقنيات الرقمية

الرقم	العبارة	موافق بشدة (5)	موافق (4)	محايد (3)	غير موافق (2)	غير موافق بشدة (1)
TA1	تستخدم منشأتنا نظام تخطيط موارد المؤسسات (ERP) أو نظام إدارة مماثل.					
TA2	تستخدم منشأتنا خدمات الحوسبة السحابية (تخزين أو تطبيقات أو خوادم).					
TA3	تستخدم منشأتنا حلول الدفع الإلكتروني أو نقاط البيع.					
TA4	تستخدم منشأتنا أدوات تحليل البيانات لفهم أدائها أو عملائها.					
TA5	تستخدم منشأتنا منصات تواصل رقمية للتنسيق الداخلي.					
TA6	تستخدم منشأتنا قنوات رقمية (موقع إلكتروني أو تطبيق أو منصات تواصل) لخدمة العملاء.					
TA7	تحرص منشأتنا على تحديث برمجياتها وأدواتها الرقمية.					

الرقم	العبارة	موافق بشدة (5)	موافق (4)	محايد (3)	غير موافق (2)	غير موافق بشدة (1)
TA8	تقوم منشأتنا بتقييم التقنيات الرقمية الجديدة ذات الصلة بنشاطها.					

المحور الثالث: المهارات الرقمية والثقافة التنظيمية

الرقم	العبارة	موافق بشدة (5)	موافق (4)	محايد (3)	غير موافق (2)	غير موافق بشدة (1)
SC1	يملك الموظفون في منشأتنا المهارات الرقمية اللازمة لمهامهم اليومية.					
SC2	توفر منشأتنا تدريباً على الأنظمة الرقمية التي نستخدمها.					
SC3	تشجع الإدارة في منشأتنا على استخدام الحلول الرقمية.					
SC4	يتقبل الموظفون التغييرات المتعلقة بالأنظمة الرقمية الجديدة دون مقاومة كبيرة.					
SC5	يوجد شخص أو فريق مسؤول عن قيادة المبادرات الرقمية في منشأتنا.					
SC6	تشجع ثقافتنا التنظيمية على تجربة أساليب عمل رقمية جديدة.					
SC7	يتم تعريف الموظفين الجدد بأنظمتنا الرقمية بشكل منهجي.					

المحور الرابع: تكامل الأنظمة

الرقم	العبارة	موافق بشدة (5)	موافق (4)	محايد (3)	غير موافق (2)	غير موافق بشدة (1)
SI1	الأنظمة الرقمية المستخدمة في منشأتنا مرتبطة ببعضها البعض.					
SI2	البيانات المدخلة في نظام واحد تتوفر تلقائياً في الأنظمة الأخرى دون إعادة إدخال.					
SI3	معلومات المبيعات والمخزون والمحاسبة لدينا متسقة عبر الأنظمة.					

الرقم	العبارة	موافق بشدة (5)	موافق (4)	محايد (3)	غير موافق (2)	غير موافق بشدة (1)
SI4	تتبادل أنظمة منشأتنا البيانات إلكترونياً مع الجهات الخارجية (البنوك، الموردين، المنصات الحكومية).					
SI5	يمكن إصدار التقارير في منشأتنا من بيانات متكاملة بدلاً من تجميعها يدوياً.					
SI6	قلل التكامل بين أنظمتنا من الأعمال المكررة.					

الجزء الثالث: مقياس الكفاءة التشغيلية

المحور الأول: سرعة العمليات

الرقم	العبارة	موافق بشدة (5)	موافق (4)	محايد (3)	غير موافق (2)	غير موافق بشدة (1)
PS1	قلصت الأنظمة الرقمية الوقت اللازم لإنجاز عملياتنا الأساسية.					
PS2	تُحجز طلبات العملاء بشكل أسرع مما كانت عليه قبل التحول الرقمي.					
PS3	انخفض الوقت اللازم لإعداد التقارير الدورية.					
PS4	تُحجز الموافقات والإجراءات الداخلية دون تأخير غير ضروري.					
PS5	تستجيب منشأتنا بسرعة للمشكلات التشغيلية غير المتوقعة.					

المحور الثاني: معدلات الأخطاء والجودة

الرقم	العبارة	موافق بشدة (5)	موافق (4)	محايد (3)	غير موافق (2)	غير موافق بشدة (1)
EQ1	انخفض معدل الأخطاء في عملياتنا اليومية منذ اعتماد الأنظمة الرقمية.					
EQ2	قللت الحاجة إلى إعادة العمل بسبب الأخطاء.					

الرقم	العبارة	موافق بشدة (5)	موافق (4)	محايد (3)	غير موافق (2)	غير موافق بشدة (1)
EQ3	انخفضت شكاوى العملاء المتعلقة بالأخطاء.					
EQ4	أصبحت سجلاتنا وبياناتنا أكثر دقة.					
EQ5	تساعدنا الأنظمة الرقمية على اكتشاف الأخطاء قبل أن تؤثر على العملاء.					

المحور الثالث: استغلال الموارد

الرقم	العبارة	موافق بشدة (5)	موافق (4)	محايد (3)	غير موافق (2)	غير موافق بشدة (1)
RU1	يُستغل وقت عمل الموظفين بشكل أكثر إنتاجية منذ اعتماد الأنظمة الرقمية.					
RU2	انخفض الوقت الضائع والجهد المهدر في عملياتنا.					
RU3	تستفيد منشأتنا بشكل أفضل من معداتها وأصولها.					
RU4	تُدار مستويات المخزون بكفاءة أعلى (حيثما ينطبق ذلك).					
RU5	تتيح الأنظمة الرقمية لنفس الفريق التعامل مع حجم أكبر من العمل.					

المحور الرابع: كفاءة التكلفة

الرقم	العبارة	موافق بشدة (5)	موافق (4)	محايد (3)	غير موافق (2)	غير موافق بشدة (1)
CE1	خفّض التحول الرقمي تكاليفنا التشغيلية.					
CE2	انخفضت تكلفة معالجة المعاملة الواحدة.					
CE3	انخفض الإنفاق على الورق والطباعة والتخزين المادي.					
CE4	قللت الأنظمة الرقمية الخسائر الناتجة عن الأخطاء والتأخير.					
CE5	العوائد من استثماراتنا الرقمية تبرر تكلفتها.					

الجزء الرابع: معوقات التحول الرقمي (المعوقات التنظيمية والمهارية)

الرقم	العبارة	موافق بشدة (5)	موافق (4)	محايد (3)	غير موافق (2)	غير موافق بشدة (1)
OB1	تحد الموارد المالية المحدودة لمنشأتنا من تحولها الرقمي.					
OB2	يحد نقص الكوادر الفنية المؤهلة من تحولنا الرقمي.					
OB3	تبطئ مقاومة الموظفين للتغيير اعتماد الأنظمة الرقمية.					
OB4	يحد غياب قيادة رقمية واضحة من تحولنا الرقمي.					
OB5	يؤخر عدم اليقين بشأن العائد من الاستثمار الرقمي قراراتنا في التبني.					
OB6	يحد ضعف البنية التحتية التقنية الداخلية من تحولنا الرقمي.					
OB7	تؤخر صعوبة اختيار الحلول المناسبة من بين الخيارات الكثيرة المتاحة تحولنا.					
OB8	يحد نقص التدريب المتاح لموظفينا من استفادتنا من الأنظمة الرقمية.					

الجزء الخامس: أسئلة مفتوحة

1) ما أهم التحديات التي واجهتها منشأتكم في التحول الرقمي؟

.....

2) ما التحسينات في الكفاءة التشغيلية التي لاحظتموها منذ اعتماد الأنظمة الرقمية (إن وجدت)؟

.....

3) هل لديكم أي ملاحظات أخرى حول موضوع الدراسة؟

.....

نشكر لكم وقتكم وتعاونكم، ونقدر مشاركتكم القيمة في هذه الدراسة.

Appendix B: Item-Level Descriptive Statistics

The table below provides the mean, standard deviation, and interpretation level for every closed questionnaire item based on the 190 valid respondent records. The full item wording and response options appear in Appendix A, while detailed response frequencies appear in Appendix C.

Table B.1. Item-level descriptive statistics for the respondent dataset

Scale	Item	Statement	Mean	SD	Level
PD	PD1	Core operational processes in our enterprise (invoicing, inventory, HR) are performed through digital systems rather than on paper.	3.61	1.26	Moderate
PD	PD2	Customer orders and requests are received and tracked electronically.	3.70	1.12	High
PD	PD3	Internal approvals and workflows in our enterprise are completed electronically.	3.41	1.33	Moderate
PD	PD4	Our enterprise issues invoices through an approved electronic invoicing system.	3.56	1.26	Moderate
PD	PD5	Records and documents in our enterprise are stored and retrieved digitally.	3.63	1.28	Moderate
PD	PD6	Routine repetitive tasks in our enterprise have been automated.	3.54	1.31	Moderate
PD	PD7	Our enterprise monitors its daily operations through digital dashboards or reports.	3.61	1.23	Moderate
PD	PD8	Manual paper-based procedures have been largely eliminated from our daily work.	3.46	1.28	Moderate
TA	TA1	Our enterprise uses an enterprise resource planning (ERP) or equivalent management system.	3.32	1.28	Moderate
TA	TA2	Our enterprise uses cloud computing services (storage, applications, or servers).	3.62	1.27	Moderate
TA	TA3	Our enterprise uses electronic payment or point-of-sale solutions.	3.51	1.31	Moderate
TA	TA4	Our enterprise uses data analytics tools to understand its performance or customers.	3.55	1.27	Moderate
TA	TA5	Our enterprise uses digital communication platforms for internal coordination.	3.47	1.29	Moderate
TA	TA6	Our enterprise uses digital channels (website, application, or social platforms) to serve customers.	3.43	1.25	Moderate
TA	TA7	Our enterprise keeps its software and digital tools up to date.	3.47	1.27	Moderate
TA	TA8	Our enterprise evaluates new digital technologies relevant to its business.	3.56	1.21	Moderate
SC	SC1	Employees in our enterprise have the digital skills needed for their daily tasks.	3.54	1.31	Moderate
SC	SC2	Our enterprise provides training on the digital systems it uses.	3.59	1.26	Moderate
SC	SC3	Management in our enterprise encourages the use of digital solutions.	3.46	1.20	Moderate
SC	SC4	Employees accept changes related to new digital systems without significant resistance.	3.32	1.26	Moderate

Scale	Item	Statement	Mean	SD	Level
SC	SC5	There is a person or team responsible for leading digital initiatives in our enterprise.	3.47	1.30	Moderate
SC	SC6	Our organisational culture encourages experimenting with new digital ways of working.	3.54	1.28	Moderate
SC	SC7	New employees are systematically introduced to our digital systems.	3.23	1.30	Moderate
SI	SI1	The digital systems used in our enterprise are linked to each other.	3.22	1.36	Moderate
SI	SI2	Data entered in one system is available automatically in other systems without re-entry.	3.45	1.33	Moderate
SI	SI3	Our sales, inventory, and accounting information is consistent across systems.	3.21	1.34	Moderate
SI	SI4	Our enterprise systems exchange data with external parties (banks, suppliers, government platforms) electronically.	3.33	1.26	Moderate
SI	SI5	Reports in our enterprise can be produced from integrated data rather than assembled manually.	3.27	1.38	Moderate
SI	SI6	Integration between our systems has reduced duplicated work.	3.48	1.25	Moderate
PS	PS1	Digital systems have shortened the time needed to complete our core processes.	3.48	1.25	Moderate
PS	PS2	Customer requests are completed faster than they were before digital adoption.	3.73	1.23	High
PS	PS3	The time needed to prepare periodic reports has decreased.	3.74	1.25	High
PS	PS4	Approvals and internal procedures are completed without unnecessary delays.	3.53	1.32	Moderate
PS	PS5	Our enterprise responds quickly to unexpected operational problems.	3.58	1.16	Moderate
EQ	EQ1	The rate of errors in our daily operations has decreased since adopting digital systems.	3.59	1.23	Moderate
EQ	EQ2	The need to redo work because of mistakes has decreased.	3.53	1.21	Moderate
EQ	EQ3	Customer complaints related to errors have decreased.	3.36	1.28	Moderate
EQ	EQ4	Our records and data have become more accurate.	3.48	1.23	Moderate
EQ	EQ5	Digital systems help us discover errors before they affect customers.	3.35	1.27	Moderate
RU	RU1	Employee working time is used more productively since adopting digital systems.	3.53	1.22	Moderate
RU	RU2	Idle time and wasted effort in our operations have decreased.	3.33	1.24	Moderate
RU	RU3	Our enterprise makes better use of its equipment and assets.	3.21	1.29	Moderate
RU	RU4	Inventory levels are managed more efficiently (where applicable).	3.43	1.22	Moderate
RU	RU5	Digital systems allow the same team to handle a larger volume of work.	3.55	1.29	Moderate
CE	CE1	Digital transformation has reduced our operating costs.	3.17	1.34	Moderate
CE	CE2	The cost of processing a single transaction has decreased.	3.42	1.30	Moderate
CE	CE3	Spending on paper, printing, and physical storage has decreased.	3.29	1.32	Moderate
CE	CE4	Digital systems have reduced losses caused by errors and delays.	3.43	1.23	Moderate

Scale	Item	Statement	Mean	SD	Level
CE	CE5	The returns from our digital investments justify their cost.	3.32	1.32	Moderate
OB	OB1	The limited financial resources of our enterprise restrict its digital transformation.	2.96	1.35	Moderate
OB	OB2	The shortage of qualified technical staff restricts our digital transformation.	2.91	1.32	Moderate
OB	OB3	Employee resistance to change slows the adoption of digital systems.	2.96	1.35	Moderate
OB	OB4	The absence of clear digital leadership limits our digital transformation.	2.93	1.42	Moderate
OB	OB5	Uncertainty about the return on digital investment delays our adoption decisions.	2.85	1.33	Moderate
OB	OB6	Weak internal IT infrastructure restricts our digital transformation.	2.70	1.32	Moderate
OB	OB7	The difficulty of choosing suitable solutions from the many available options delays our transformation.	3.01	1.33	Moderate
OB	OB8	The lack of training available to our employees limits our benefit from digital systems.	2.75	1.34	Moderate

Appendix C: Detailed Item Response Frequencies

This appendix provides one audit page for each closed questionnaire item. The tables show how the 190 respondents were distributed across the five-point Likert scale, together with the item mean, standard deviation, and interpretation level. These pages make the statistical chapter traceable to the questionnaire item level.

Appendix C.1: PD1 - Process digitisation

Core operational processes in our enterprise (invoicing, inventory, HR) are performed through digital systems rather than on paper.

Table C.1. Response distribution for PD1

Score	Response option	n	%
1	Strongly disagree	14	7.4
2	Disagree	27	14.2
3	Neutral	38	20.0
4	Agree	52	27.4
5	Strongly agree	59	31.1

Interpretation: PD1 recorded a mean of 3.61 ($SD = 1.26$), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.2: PD2 - Process digitisation

Customer orders and requests are received and tracked electronically.

Table C.2. Response distribution for PD2

Score	Response option	n	%
1	Strongly disagree	8	4.2
2	Disagree	22	11.6
3	Neutral	41	21.6
4	Agree	67	35.3
5	Strongly agree	52	27.4

Interpretation: PD2 recorded a mean of 3.70 (SD = 1.12), which falls in the high category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.3: PD3 - Process digitisation

Internal approvals and workflows in our enterprise are completed electronically.

Table C.3. Response distribution for PD3

Score	Response option	n	%
1	Strongly disagree	20	10.5
2	Disagree	31	16.3
3	Neutral	45	23.7
4	Agree	40	21.1
5	Strongly agree	54	28.4

Interpretation: PD3 recorded a mean of 3.41 (SD = 1.33), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.4: PD4 - Process digitisation

Our enterprise issues invoices through an approved electronic invoicing system.

Table C.4. Response distribution for PD4

Score	Response option	n	%
1	Strongly disagree	15	7.9
2	Disagree	27	14.2
3	Neutral	38	20.0
4	Agree	56	29.5
5	Strongly agree	54	28.4

Interpretation: PD4 recorded a mean of 3.56 (SD = 1.26), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.5: PD5 - Process digitisation

Records and documents in our enterprise are stored and retrieved digitally.

Table C.5. Response distribution for PD5

Score	Response option	n	%
1	Strongly disagree	15	7.9
2	Disagree	26	13.7
3	Neutral	36	18.9
4	Agree	51	26.8
5	Strongly agree	62	32.6

Interpretation: PD5 recorded a mean of 3.63 (SD = 1.28), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.6: PD6 - Process digitisation

Routine repetitive tasks in our enterprise have been automated.

Table C.6. Response distribution for PD6

Score	Response option	n	%
1	Strongly disagree	14	7.4
2	Disagree	36	18.9
3	Neutral	33	17.4
4	Agree	47	24.7
5	Strongly agree	60	31.6

Interpretation: PD6 recorded a mean of 3.54 (SD = 1.31), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.7: PD7 - Process digitisation

Our enterprise monitors its daily operations through digital dashboards or reports.

Table C.7. Response distribution for PD7

Score	Response option	n	%
1	Strongly disagree	9	4.7
2	Disagree	32	16.8
3	Neutral	44	23.2
4	Agree	44	23.2
5	Strongly agree	61	32.1

Interpretation: PD7 recorded a mean of 3.61 (SD = 1.23), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.8: PD8 - Process digitisation

Manual paper-based procedures have been largely eliminated from our daily work.

Table C.8. Response distribution for PD8

Score	Response option	n	%
1	Strongly disagree	19	10.0
2	Disagree	26	13.7
3	Neutral	41	21.6
4	Agree	56	29.5
5	Strongly agree	48	25.3

Interpretation: PD8 recorded a mean of 3.46 (SD = 1.28), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.9: TA1 - Digital technology adoption

Our enterprise uses an enterprise resource planning (ERP) or equivalent management system.

Table C.9. Response distribution for TA1

Score	Response option	n	%
1	Strongly disagree	17	8.9
2	Disagree	39	20.5
3	Neutral	45	23.7
4	Agree	45	23.7
5	Strongly agree	44	23.2

Interpretation: TA1 recorded a mean of 3.32 (SD = 1.28), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.10: TA2 - Digital technology adoption

Our enterprise uses cloud computing services (storage, applications, or servers).

Table C.10. Response distribution for TA2

Score	Response option	n	%
1	Strongly disagree	13	6.8
2	Disagree	28	14.7
3	Neutral	40	21.1
4	Agree	47	24.7
5	Strongly agree	62	32.6

Interpretation: TA2 recorded a mean of 3.62 (SD = 1.27), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.11: TA3 - Digital technology adoption

Our enterprise uses electronic payment or point-of-sale solutions.

Table C.11. Response distribution for TA3

Score	Response option	n	%
1	Strongly disagree	17	8.9
2	Disagree	29	15.3
3	Neutral	43	22.6
4	Agree	43	22.6
5	Strongly agree	58	30.5

Interpretation: TA3 recorded a mean of 3.51 (SD = 1.31), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.12: TA4 - Digital technology adoption

Our enterprise uses data analytics tools to understand its performance or customers.

Table C.12. Response distribution for TA4

Score	Response option	n	%
1	Strongly disagree	16	8.4
2	Disagree	24	12.6
3	Neutral	46	24.2
4	Agree	48	25.3
5	Strongly agree	56	29.5

Interpretation: TA4 recorded a mean of 3.55 (SD = 1.27), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.13: TA5 - Digital technology adoption

Our enterprise uses digital communication platforms for internal coordination.

Table C.13. Response distribution for TA5

Score	Response option	n	%
1	Strongly disagree	16	8.4
2	Disagree	32	16.8
3	Neutral	42	22.1
4	Agree	47	24.7
5	Strongly agree	53	27.9

Interpretation: TA5 recorded a mean of 3.47 (SD = 1.29), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.14: TA6 - Digital technology adoption

Our enterprise uses digital channels (website, application, or social platforms) to serve customers.

Table C.14. Response distribution for TA6

Score	Response option	n	%
1	Strongly disagree	17	8.9
2	Disagree	25	13.2
3	Neutral	56	29.5
4	Agree	43	22.6
5	Strongly agree	49	25.8

Interpretation: TA6 recorded a mean of 3.43 (SD = 1.25), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.15: TA7 - Digital technology adoption

Our enterprise keeps its software and digital tools up to date.

Table C.15. Response distribution for TA7

Score	Response option	n	%
1	Strongly disagree	18	9.5
2	Disagree	23	12.1
3	Neutral	52	27.4
4	Agree	46	24.2
5	Strongly agree	51	26.8

Interpretation: TA7 recorded a mean of 3.47 (SD = 1.27), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.16: TA8 - Digital technology adoption

Our enterprise evaluates new digital technologies relevant to its business.

Table C.16. Response distribution for TA8

Score	Response option	n	%
1	Strongly disagree	17	8.9
2	Disagree	18	9.5
3	Neutral	42	22.1
4	Agree	68	35.8
5	Strongly agree	45	23.7

Interpretation: TA8 recorded a mean of 3.56 (SD = 1.21), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.17: SC1 - Digital skills and organisational culture

Employees in our enterprise have the digital skills needed for their daily tasks.

Table C.17. Response distribution for SC1

Score	Response option	n	%
1	Strongly disagree	17	8.9
2	Disagree	30	15.8
3	Neutral	35	18.4
4	Agree	50	26.3
5	Strongly agree	58	30.5

Interpretation: SC1 recorded a mean of 3.54 (SD = 1.31), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.18: SC2 - Digital skills and organisational culture

Our enterprise provides training on the digital systems it uses.

Table C.18. Response distribution for SC2

Score	Response option	n	%
1	Strongly disagree	16	8.4
2	Disagree	24	12.6
3	Neutral	38	20.0
4	Agree	56	29.5
5	Strongly agree	56	29.5

Interpretation: SC2 recorded a mean of 3.59 (SD = 1.26), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.19: SC3 - Digital skills and organisational culture

Management in our enterprise encourages the use of digital solutions.

Table C.19. Response distribution for SC3

Score	Response option	n	%
1	Strongly disagree	11	5.8
2	Disagree	29	15.3
3	Neutral	61	32.1
4	Agree	39	20.5
5	Strongly agree	50	26.3

Interpretation: SC3 recorded a mean of 3.46 (SD = 1.20), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.20: SC4 - Digital skills and organisational culture

Employees accept changes related to new digital systems without significant resistance.

Table C.20. Response distribution for SC4

Score	Response option	n	%
1	Strongly disagree	19	10.0
2	Disagree	31	16.3
3	Neutral	52	27.4
4	Agree	46	24.2
5	Strongly agree	42	22.1

Interpretation: SC4 recorded a mean of 3.32 (SD = 1.26), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.21: SC5 - Digital skills and organisational culture

There is a person or team responsible for leading digital initiatives in our enterprise.

Table C.21. Response distribution for SC5

Score	Response option	n	%
1	Strongly disagree	17	8.9
2	Disagree	30	15.8
3	Neutral	45	23.7
4	Agree	43	22.6
5	Strongly agree	55	28.9

Interpretation: SC5 recorded a mean of 3.47 (SD = 1.30), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.22: SC6 - Digital skills and organisational culture

Our organisational culture encourages experimenting with new digital ways of working.

Table C.22. Response distribution for SC6

Score	Response option	n	%
1	Strongly disagree	18	9.5
2	Disagree	22	11.6
3	Neutral	46	24.2
4	Agree	48	25.3
5	Strongly agree	56	29.5

Interpretation: SC6 recorded a mean of 3.54 (SD = 1.28), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.23: SC7 - Digital skills and organisational culture

New employees are systematically introduced to our digital systems.

Table C.23. Response distribution for SC7

Score	Response option	n	%
1	Strongly disagree	22	11.6
2	Disagree	36	18.9
3	Neutral	49	25.8
4	Agree	42	22.1
5	Strongly agree	41	21.6

Interpretation: SC7 recorded a mean of 3.23 (SD = 1.30), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.24: SI1 - Systems integration

The digital systems used in our enterprise are linked to each other.

Table C.24. Response distribution for SI1

Score	Response option	n	%
1	Strongly disagree	25	13.2
2	Disagree	42	22.1
3	Neutral	32	16.8
4	Agree	49	25.8
5	Strongly agree	42	22.1

Interpretation: SI1 recorded a mean of 3.22 (SD = 1.36), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.25: SI2 - Systems integration

Data entered in one system is available automatically in other systems without re-entry.

Table C.25. Response distribution for SI2

Score	Response option	n	%
1	Strongly disagree	21	11.1
2	Disagree	28	14.7
3	Neutral	38	20.0
4	Agree	51	26.8
5	Strongly agree	52	27.4

Interpretation: SI2 recorded a mean of 3.45 (SD = 1.33), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.26: SI3 - Systems integration

Our sales, inventory, and accounting information is consistent across systems.

Table C.26. Response distribution for SI3

Score	Response option	n	%
1	Strongly disagree	23	12.1
2	Disagree	44	23.2
3	Neutral	36	18.9
4	Agree	45	23.7
5	Strongly agree	42	22.1

Interpretation: SI3 recorded a mean of 3.21 (SD = 1.34), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.27: SI4 - Systems integration

Our enterprise systems exchange data with external parties (banks, suppliers, government platforms) electronically.

Table C.27. Response distribution for SI4

Score	Response option	n	%
1	Strongly disagree	17	8.9
2	Disagree	36	18.9
3	Neutral	47	24.7
4	Agree	48	25.3
5	Strongly agree	42	22.1

Interpretation: SI4 recorded a mean of 3.33 (SD = 1.26), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.28: SI5 - Systems integration

Reports in our enterprise can be produced from integrated data rather than assembled manually.

Table C.28. Response distribution for SI5

Score	Response option	n	%
1	Strongly disagree	28	14.7
2	Disagree	30	15.8
3	Neutral	41	21.6
4	Agree	44	23.2
5	Strongly agree	47	24.7

Interpretation: SI5 recorded a mean of 3.27 (SD = 1.38), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.29: SI6 - Systems integration

Integration between our systems has reduced duplicated work.

Table C.29. Response distribution for SI6

Score	Response option	n	%
1	Strongly disagree	16	8.4
2	Disagree	25	13.2
3	Neutral	53	27.9
4	Agree	44	23.2
5	Strongly agree	52	27.4

Interpretation: SI6 recorded a mean of 3.48 (SD = 1.25), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.30: PS1 - Process speed

Digital systems have shortened the time needed to complete our core processes.

Table C.30. Response distribution for PS1

Score	Response option	n	%
1	Strongly disagree	14	7.4
2	Disagree	34	17.9
3	Neutral	36	18.9
4	Agree	58	30.5
5	Strongly agree	48	25.3

Interpretation: PS1 recorded a mean of 3.48 (SD = 1.25), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.31: PS2 - Process speed

Customer requests are completed faster than they were before digital adoption.

Table C.31. Response distribution for PS2

Score	Response option	n	%
1	Strongly disagree	11	5.8
2	Disagree	24	12.6
3	Neutral	37	19.5
4	Agree	52	27.4
5	Strongly agree	66	34.7

Interpretation: PS2 recorded a mean of 3.73 (SD = 1.23), which falls in the high category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.32: PS3 - Process speed

The time needed to prepare periodic reports has decreased.

Table C.32. Response distribution for PS3

Score	Response option	n	%
1	Strongly disagree	11	5.8
2	Disagree	22	11.6
3	Neutral	46	24.2
4	Agree	37	19.5
5	Strongly agree	74	38.9

Interpretation: PS3 recorded a mean of 3.74 (SD = 1.25), which falls in the high category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.33: PS4 - Process speed

Approvals and internal procedures are completed without unnecessary delays.

Table C.33. Response distribution for PS4

Score	Response option	n	%
1	Strongly disagree	17	8.9
2	Disagree	31	16.3
3	Neutral	35	18.4
4	Agree	48	25.3
5	Strongly agree	59	31.1

Interpretation: PS4 recorded a mean of 3.53 (SD = 1.32), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.34: PS5 - Process speed

Our enterprise responds quickly to unexpected operational problems.

Table C.34. Response distribution for PS5

Score	Response option	n	%
1	Strongly disagree	10	5.3
2	Disagree	25	13.2
3	Neutral	49	25.8
4	Agree	57	30.0
5	Strongly agree	49	25.8

Interpretation: PS5 recorded a mean of 3.58 (SD = 1.16), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.35: EQ1 - Error reduction and quality

The rate of errors in our daily operations has decreased since adopting digital systems.

Table C.35. Response distribution for EQ1

Score	Response option	n	%
1	Strongly disagree	10	5.3
2	Disagree	32	16.8
3	Neutral	43	22.6
4	Agree	46	24.2
5	Strongly agree	59	31.1

Interpretation: EQ1 recorded a mean of 3.59 (SD = 1.23), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.36: EQ2 - Error reduction and quality

The need to redo work because of mistakes has decreased.

Table C.36. Response distribution for EQ2

Score	Response option	n	%
1	Strongly disagree	11	5.8
2	Disagree	29	15.3
3	Neutral	51	26.8
4	Agree	47	24.7
5	Strongly agree	52	27.4

Interpretation: EQ2 recorded a mean of 3.53 (SD = 1.21), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.37: EQ3 - Error reduction and quality

Customer complaints related to errors have decreased.

Table C.37. Response distribution for EQ3

Score	Response option	n	%
1	Strongly disagree	16	8.4
2	Disagree	39	20.5
3	Neutral	41	21.6
4	Agree	49	25.8
5	Strongly agree	45	23.7

Interpretation: EQ3 recorded a mean of 3.36 (SD = 1.28), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.38: EQ4 - Error reduction and quality

Our records and data have become more accurate.

Table C.38. Response distribution for EQ4

Score	Response option	n	%
1	Strongly disagree	14	7.4
2	Disagree	29	15.3
3	Neutral	46	24.2
4	Agree	53	27.9
5	Strongly agree	48	25.3

Interpretation: EQ4 recorded a mean of 3.48 (SD = 1.23), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.39: EQ5 - Error reduction and quality

Digital systems help us discover errors before they affect customers.

Table C.39. Response distribution for EQ5

Score	Response option	n	%
1	Strongly disagree	17	8.9
2	Disagree	34	17.9
3	Neutral	50	26.3
4	Agree	44	23.2
5	Strongly agree	45	23.7

Interpretation: EQ5 recorded a mean of 3.35 (SD = 1.27), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.40: RU1 - Resource utilisation

Employee working time is used more productively since adopting digital systems.

Table C.40. Response distribution for RU1

Score	Response option	n	%
1	Strongly disagree	11	5.8
2	Disagree	31	16.3
3	Neutral	46	24.2
4	Agree	50	26.3
5	Strongly agree	52	27.4

Interpretation: RU1 recorded a mean of 3.53 (SD = 1.22), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.41: RU2 - Resource utilisation

Idle time and wasted effort in our operations have decreased.

Table C.41. Response distribution for RU2

Score	Response option	n	%
1	Strongly disagree	17	8.9
2	Disagree	33	17.4
3	Neutral	51	26.8
4	Agree	48	25.3
5	Strongly agree	41	21.6

Interpretation: RU2 recorded a mean of 3.33 (SD = 1.24), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.42: RU3 - Resource utilisation

Our enterprise makes better use of its equipment and assets.

Table C.42. Response distribution for RU3

Score	Response option	n	%
1	Strongly disagree	22	11.6
2	Disagree	39	20.5
3	Neutral	42	22.1
4	Agree	51	26.8
5	Strongly agree	36	18.9

Interpretation: RU3 recorded a mean of 3.21 (SD = 1.29), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.43: RU4 - Resource utilisation

Inventory levels are managed more efficiently (where applicable).

Table C.43. Response distribution for RU4

Score	Response option	n	%
1	Strongly disagree	14	7.4
2	Disagree	32	16.8
3	Neutral	47	24.7
4	Agree	53	27.9
5	Strongly agree	44	23.2

Interpretation: RU4 recorded a mean of 3.43 (SD = 1.22), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.44: RU5 - Resource utilisation

Digital systems allow the same team to handle a larger volume of work.

Table C.44. Response distribution for RU5

Score	Response option	n	%
1	Strongly disagree	14	7.4
2	Disagree	31	16.3
3	Neutral	42	22.1
4	Agree	42	22.1
5	Strongly agree	61	32.1

Interpretation: RU5 recorded a mean of 3.55 (SD = 1.29), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.45: CE1 - Cost efficiency

Digital transformation has reduced our operating costs.

Table C.45. Response distribution for CE1

Score	Response option	n	%
1	Strongly disagree	31	16.3
2	Disagree	24	12.6
3	Neutral	54	28.4
4	Agree	43	22.6
5	Strongly agree	38	20.0

Interpretation: CE1 recorded a mean of 3.17 (SD = 1.34), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.46: CE2 - Cost efficiency

The cost of processing a single transaction has decreased.

Table C.46. Response distribution for CE2

Score	Response option	n	%
1	Strongly disagree	19	10.0
2	Disagree	32	16.8
3	Neutral	37	19.5
4	Agree	54	28.4
5	Strongly agree	48	25.3

Interpretation: CE2 recorded a mean of 3.42 (SD = 1.30), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.47: CE3 - Cost efficiency

Spending on paper, printing, and physical storage has decreased.

Table C.47. Response distribution for CE3

Score	Response option	n	%
1	Strongly disagree	25	13.2
2	Disagree	28	14.7
3	Neutral	46	24.2
4	Agree	49	25.8
5	Strongly agree	42	22.1

Interpretation: CE3 recorded a mean of 3.29 (SD = 1.32), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.48: CE4 - Cost efficiency

Digital systems have reduced losses caused by errors and delays.

Table C.48. Response distribution for CE4

Score	Response option	n	%
1	Strongly disagree	13	6.8
2	Disagree	37	19.5
3	Neutral	39	20.5
4	Agree	58	30.5
5	Strongly agree	43	22.6

Interpretation: CE4 recorded a mean of 3.43 (SD = 1.23), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.49: CE5 - Cost efficiency

The returns from our digital investments justify their cost.

Table C.49. Response distribution for CE5

Score	Response option	n	%
1	Strongly disagree	22	11.6
2	Disagree	31	16.3
3	Neutral	48	25.3
4	Agree	43	22.6
5	Strongly agree	46	24.2

Interpretation: CE5 recorded a mean of 3.32 (SD = 1.32), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.50: OB1 - Organisational and skill-related obstacles

The limited financial resources of our enterprise restrict its digital transformation.

Table C.50. Response distribution for OB1

Score	Response option	n	%
1	Strongly disagree	35	18.4
2	Disagree	38	20.0
3	Neutral	50	26.3
4	Agree	33	17.4
5	Strongly agree	34	17.9

Interpretation: OB1 recorded a mean of 2.96 (SD = 1.35), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.51: OB2 - Organisational and skill-related obstacles

The shortage of qualified technical staff restricts our digital transformation.

Table C.51. Response distribution for OB2

Score	Response option	n	%
1	Strongly disagree	36	18.9
2	Disagree	39	20.5
3	Neutral	49	25.8
4	Agree	39	20.5
5	Strongly agree	27	14.2

Interpretation: OB2 recorded a mean of 2.91 (SD = 1.32), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.52: OB3 - Organisational and skill-related obstacles

Employee resistance to change slows the adoption of digital systems.

Table C.52. Response distribution for OB3

Score	Response option	n	%
1	Strongly disagree	34	17.9
2	Disagree	41	21.6
3	Neutral	46	24.2
4	Agree	36	18.9
5	Strongly agree	33	17.4

Interpretation: OB3 recorded a mean of 2.96 (SD = 1.35), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.53: OB4 - Organisational and skill-related obstacles

The absence of clear digital leadership limits our digital transformation.

Table C.53. Response distribution for OB4

Score	Response option	n	%
1	Strongly disagree	40	21.1
2	Disagree	40	21.1
3	Neutral	42	22.1
4	Agree	30	15.8
5	Strongly agree	38	20.0

Interpretation: OB4 recorded a mean of 2.93 (SD = 1.42), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.54: OB5 - Organisational and skill-related obstacles

Uncertainty about the return on digital investment delays our adoption decisions.

Table C.54. Response distribution for OB5

Score	Response option	n	%
1	Strongly disagree	36	18.9
2	Disagree	49	25.8
3	Neutral	38	20.0
4	Agree	41	21.6
5	Strongly agree	26	13.7

Interpretation: OB5 recorded a mean of 2.85 (SD = 1.33), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.55: OB6 - Organisational and skill-related obstacles

Weak internal IT infrastructure restricts our digital transformation.

Table C.55. Response distribution for OB6

Score	Response option	n	%
1	Strongly disagree	42	22.1
2	Disagree	51	26.8
3	Neutral	44	23.2
4	Agree	28	14.7
5	Strongly agree	25	13.2

Interpretation: OB6 recorded a mean of 2.70 (SD = 1.32), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.56: OB7 - Organisational and skill-related obstacles

The difficulty of choosing suitable solutions from the many available options delays our transformation.

Table C.56. Response distribution for OB7

Score	Response option	n	%
1	Strongly disagree	32	16.8
2	Disagree	38	20.0
3	Neutral	49	25.8
4	Agree	38	20.0
5	Strongly agree	33	17.4

Interpretation: OB7 recorded a mean of 3.01 (SD = 1.33), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix C.57: OB8 - Organisational and skill-related obstacles

The lack of training available to our employees limits our benefit from digital systems.

Table C.57. Response distribution for OB8

Score	Response option	n	%
1	Strongly disagree	43	22.6
2	Disagree	46	24.2
3	Neutral	42	22.1
4	Agree	34	17.9
5	Strongly agree	25	13.2

Interpretation: OB8 recorded a mean of 2.75 (SD = 1.34), which falls in the moderate category. The distribution above shows the balance between disagreement, neutrality, and agreement for this specific statement.

Appendix D: Item Reliability Diagnostics

This appendix reports corrected item-total correlations and Cronbach's alpha if each item were deleted. The values support the reliability decision in Chapter Four by showing whether any item weakens its assigned scale.

Appendix D: PD - Process digitisation

Table D.1. Reliability diagnostics for PD

Item	Statement	Corrected item-total r	Alpha if deleted
PD1	Core operational processes in our enterprise (invoicing, inventory, HR) are performed through digital systems rather than on paper.	0.774	0.928
PD2	Customer orders and requests are received and tracked electronically.	0.757	0.929
PD3	Internal approvals and workflows in our enterprise are completed electronically.	0.754	0.929
PD4	Our enterprise issues invoices through an approved electronic invoicing system.	0.768	0.928
PD5	Records and documents in our enterprise are stored and retrieved digitally.	0.793	0.926
PD6	Routine repetitive tasks in our enterprise have been automated.	0.792	0.927
PD7	Our enterprise monitors its daily operations through digital dashboards or reports.	0.773	0.928
PD8	Manual paper-based procedures have been largely eliminated from our daily work.	0.796	0.926

Appendix D: TA - Digital technology adoption

Table D.2. Reliability diagnostics for TA

Item	Statement	Corrected item-total r	Alpha if deleted
TA1	Our enterprise uses an enterprise resource planning (ERP) or equivalent management system.	0.730	0.935
TA2	Our enterprise uses cloud computing services (storage, applications, or servers).	0.760	0.933
TA3	Our enterprise uses electronic payment or point-of-sale solutions.	0.777	0.932
TA4	Our enterprise uses data analytics tools to understand its performance or customers.	0.785	0.932
TA5	Our enterprise uses digital communication platforms for internal coordination.	0.816	0.929
TA6	Our enterprise uses digital channels (website, application, or social platforms) to serve customers.	0.809	0.930
TA7	Our enterprise keeps its software and digital tools up to date.	0.835	0.928
TA8	Our enterprise evaluates new digital technologies relevant to its business.	0.766	0.933

Appendix D: SC - Digital skills and organisational culture

Table D.3. Reliability diagnostics for SC

Item	Statement	Corrected item-total r	Alpha if deleted
SC1	Employees in our enterprise have the digital skills needed for their daily tasks.	0.797	0.910
SC2	Our enterprise provides training on the digital systems it uses.	0.783	0.912
SC3	Management in our enterprise encourages the use of digital solutions.	0.717	0.918
SC4	Employees accept changes related to new digital systems without significant resistance.	0.741	0.916
SC5	There is a person or team responsible for leading digital initiatives in our enterprise.	0.745	0.916
SC6	Our organisational culture encourages experimenting with new digital ways of working.	0.770	0.913
SC7	New employees are systematically introduced to our digital systems.	0.794	0.911

Appendix D: SI - Systems integration

Table D.4. Reliability diagnostics for SI

Item	Statement	Corrected item-total r	Alpha if deleted
SI1	The digital systems used in our enterprise are linked to each other.	0.788	0.902
SI2	Data entered in one system is available automatically in other systems without re-entry.	0.774	0.904
SI3	Our sales, inventory, and accounting information is consistent across systems.	0.716	0.912
SI4	Our enterprise systems exchange data with external parties (banks, suppliers, government platforms) electronically.	0.781	0.903
SI5	Reports in our enterprise can be produced from integrated data rather than assembled manually.	0.783	0.903
SI6	Integration between our systems has reduced duplicated work.	0.782	0.903

Appendix D: PS - Process speed

Table D.5. Reliability diagnostics for PS

Item	Statement	Corrected item-total r	Alpha if deleted
PS1	Digital systems have shortened the time needed to complete our core processes.	0.772	0.883

Item	Statement	Corrected item-total r	Alpha if deleted
PS2	Customer requests are completed faster than they were before digital adoption.	0.770	0.883
PS3	The time needed to prepare periodic reports has decreased.	0.760	0.885
PS4	Approvals and internal procedures are completed without unnecessary delays.	0.781	0.881
PS5	Our enterprise responds quickly to unexpected operational problems.	0.735	0.891

Appendix D: EQ - Error reduction and quality

Table D.6. Reliability diagnostics for EQ

Item	Statement	Corrected item-total r	Alpha if deleted
EQ1	The rate of errors in our daily operations has decreased since adopting digital systems.	0.721	0.876
EQ2	The need to redo work because of mistakes has decreased.	0.723	0.876
EQ3	Customer complaints related to errors have decreased.	0.740	0.872
EQ4	Our records and data have become more accurate.	0.736	0.873
EQ5	Digital systems help us discover errors before they affect customers.	0.786	0.862

Appendix D: RU - Resource utilisation

Table D.7. Reliability diagnostics for RU

Item	Statement	Corrected item-total r	Alpha if deleted
RU1	Employee working time is used more productively since adopting digital systems.	0.764	0.869
RU2	Idle time and wasted effort in our operations have decreased.	0.759	0.870
RU3	Our enterprise makes better use of its equipment and assets.	0.724	0.878
RU4	Inventory levels are managed more efficiently (where applicable).	0.699	0.883
RU5	Digital systems allow the same team to handle a larger volume of work.	0.773	0.867

Appendix D: CE - Cost efficiency

Table D.8. Reliability diagnostics for CE

Item	Statement	Corrected item-total r	Alpha if deleted
CE1	Digital transformation has reduced our operating costs.	0.788	0.876
CE2	The cost of processing a single transaction has decreased.	0.774	0.879
CE3	Spending on paper, printing, and physical storage has decreased.	0.734	0.888
CE4	Digital systems have reduced losses caused by errors and delays.	0.744	0.886
CE5	The returns from our digital investments justify their cost.	0.757	0.883

Appendix D: OB - Organisational and skill-related obstacles

Table D.9. Reliability diagnostics for OB

Item	Statement	Corrected item-total r	Alpha if deleted
OB1	The limited financial resources of our enterprise restrict its digital transformation.	0.813	0.940
OB2	The shortage of qualified technical staff restricts our digital transformation.	0.774	0.942
OB3	Employee resistance to change slows the adoption of digital systems.	0.815	0.940
OB4	The absence of clear digital leadership limits our digital transformation.	0.807	0.940
OB5	Uncertainty about the return on digital investment delays our adoption decisions.	0.850	0.937
OB6	Weak internal IT infrastructure restricts our digital transformation.	0.793	0.941
OB7	The difficulty of choosing suitable solutions from the many available options delays our transformation.	0.801	0.941
OB8	The lack of training available to our employees limits our benefit from digital systems.	0.803	0.940

Appendix E: Anonymized Case-Level Composite Scores

The table below reports anonymized case-level composite scores. It excludes respondent names, contact details, and enterprise identifiers and is included to support auditability of the aggregate results. Composite scores are item means on the five-point scale.

Table E.1. Anonymized case-level composite scores

Case	Sector	Size	PD	TA	SC	SI	DT	OE	OB
1	Professional services	Small	5.00	3.88	5.00	3.17	4.26	3.45	2.88
2	Technology & IT services	Small	3.25	3.62	4.71	4.17	3.94	3.80	1.88
3	Light manufacturing	Small	3.75	1.50	3.00	2.00	2.56	4.05	3.12
4	Food & beverage	Small	2.62	2.75	3.00	3.50	2.97	2.75	2.38
5	Food & beverage	Small	3.12	3.75	3.00	2.67	3.13	3.60	1.38
6	Professional services	Small	2.62	3.00	1.57	1.17	2.09	1.70	4.75
7	Light manufacturing	Small	4.75	4.38	2.57	3.33	3.76	3.15	4.00
8	Food & beverage	Small	2.25	2.00	1.86	2.00	2.03	2.30	3.50
9	Light manufacturing	Small	3.88	4.38	2.43	2.67	3.34	1.85	4.75
10	Light manufacturing	Small	3.50	3.62	4.57	3.83	3.88	3.75	3.25
11	Technology & IT services	Medium	4.50	3.50	4.57	3.00	3.89	4.30	3.88
12	Light manufacturing	Small	3.62	1.88	3.29	1.33	2.53	3.40	4.62
13	Professional services	Medium	1.88	4.00	3.57	1.67	2.78	1.90	1.88
14	Technology & IT services	Small	4.12	3.62	3.71	3.33	3.70	4.55	2.88
15	Retail & wholesale trade	Small	4.62	4.00	3.29	3.83	3.94	3.90	1.50
16	Professional services	Small	2.12	3.12	3.00	3.50	2.94	4.40	3.50
17	Technology & IT services	Small	3.50	3.88	2.71	3.83	3.48	3.75	5.00
18	Professional services	Medium	4.50	4.25	3.00	4.00	3.94	4.10	2.88
19	Professional services	Small	4.75	5.00	5.00	4.83	4.90	4.20	1.88
20	Retail & wholesale trade	Small	5.00	3.75	4.86	4.33	4.49	4.95	3.38
21	Retail & wholesale trade	Medium	4.12	4.00	4.71	5.00	4.46	5.00	1.88
22	Food & beverage	Medium	3.38	4.50	3.14	4.33	3.84	4.20	1.38
23	Light manufacturing	Small	1.25	1.38	2.00	1.83	1.61	2.55	4.62
24	Food & beverage	Small	3.62	3.00	3.43	3.67	3.43	3.45	5.00
25	Light manufacturing	Small	4.25	2.25	3.43	2.83	3.19	2.40	4.38
26	Professional services	Small	2.25	2.62	3.14	4.00	3.00	1.95	4.88

Case	Sector	Size	PD	TA	SC	SI	DT	OE	OB
27	Food & beverage	Medium	3.38	3.12	4.43	3.33	3.56	4.20	3.38
28	Light manufacturing	Small	4.88	3.50	4.57	5.00	4.49	3.55	1.75
29	Retail & wholesale trade	Small	5.00	2.12	1.86	3.17	3.04	4.45	4.00
30	Food & beverage	Small	3.62	1.62	1.57	2.17	2.25	1.20	4.00
31	Professional services	Medium	3.50	3.50	3.14	3.67	3.45	4.05	2.62
32	Technology & IT services	Small	4.62	4.75	3.14	4.67	4.30	3.85	1.62
33	Light manufacturing	Medium	1.12	2.38	1.86	1.67	1.76	3.50	4.50
34	Professional services	Medium	2.50	2.25	2.43	1.00	2.04	1.55	4.88
35	Food & beverage	Small	4.12	4.38	4.29	3.83	4.16	2.90	4.62
36	Food & beverage	Small	2.75	3.00	4.00	4.00	3.44	2.60	4.75
37	Light manufacturing	Small	3.25	3.75	3.86	3.17	3.51	3.05	1.00
38	Retail & wholesale trade	Small	2.75	1.25	2.43	1.50	1.98	2.60	3.00
39	Light manufacturing	Small	3.50	4.12	4.86	3.83	4.08	2.90	2.75
40	Retail & wholesale trade	Small	3.12	3.75	4.71	3.83	3.86	3.95	2.12
41	Food & beverage	Small	4.12	2.00	2.00	3.00	2.78	3.05	4.75
42	Technology & IT services	Small	3.50	3.00	2.43	2.67	2.90	2.10	2.75
43	Professional services	Medium	3.38	1.88	2.00	1.17	2.10	2.50	4.00
44	Professional services	Small	3.75	3.50	3.43	3.83	3.63	4.30	3.88
45	Food & beverage	Medium	4.88	4.88	3.29	4.50	4.38	4.90	2.00
46	Technology & IT services	Small	3.00	4.00	3.29	3.00	3.32	3.55	2.38
47	Professional services	Small	3.12	3.88	2.86	3.50	3.34	2.35	3.62
48	Retail & wholesale trade	Small	4.50	4.25	3.86	3.50	4.03	3.80	1.88
49	Food & beverage	Medium	4.62	4.62	4.43	4.50	4.54	4.65	4.75
50	Light manufacturing	Small	3.62	4.25	4.43	4.00	4.08	4.00	3.00
51	Technology & IT services	Small	4.38	4.00	3.43	4.00	3.95	3.60	1.62
52	Technology & IT services	Small	4.25	3.88	3.29	4.00	3.85	4.30	2.75
53	Technology & IT services	Small	3.38	2.62	2.43	2.83	2.81	2.45	1.25
54	Food & beverage	Small	3.62	3.88	3.29	3.00	3.45	2.40	4.25
55	Professional services	Small	4.62	4.38	4.71	4.00	4.43	3.70	1.88
56	Food & beverage	Small	4.38	4.25	4.29	4.67	4.39	4.45	5.00
57	Technology & IT services	Small	3.38	4.62	4.00	1.17	3.29	2.40	3.12
58	Light manufacturing	Small	3.75	3.88	3.71	3.67	3.75	3.70	3.62
59	Light manufacturing	Medium	4.88	4.88	4.86	4.67	4.82	4.85	2.38
60	Light manufacturing	Medium	3.12	3.75	3.14	2.67	3.17	3.90	1.88
61	Technology & IT services	Small	5.00	5.00	4.71	5.00	4.93	4.75	1.25

Case	Sector	Size	PD	TA	SC	SI	DT	OE	OB
62	Retail & wholesale trade	Medium	4.00	4.12	2.14	2.83	3.27	3.90	1.50
63	Professional services	Small	3.62	2.88	3.57	3.33	3.35	3.85	2.12
64	Retail & wholesale trade	Small	4.25	4.50	5.00	5.00	4.69	4.95	2.75
65	Light manufacturing	Medium	4.12	3.25	4.71	4.50	4.15	4.35	1.25
66	Retail & wholesale trade	Small	2.12	2.88	2.14	1.67	2.20	2.55	3.62
67	Retail & wholesale trade	Medium	3.75	3.38	3.43	3.67	3.56	3.35	1.12
68	Retail & wholesale trade	Small	3.50	4.88	4.14	4.50	4.25	4.70	2.38
69	Retail & wholesale trade	Small	2.88	4.75	3.86	3.83	3.83	3.15	1.62
70	Food & beverage	Small	4.00	2.50	3.29	2.50	3.07	3.05	3.62
71	Technology & IT services	Small	4.25	5.00	4.29	4.67	4.55	4.05	2.38
72	Technology & IT services	Small	3.25	1.25	2.29	2.33	2.28	4.40	3.12
73	Retail & wholesale trade	Small	3.88	3.25	3.14	2.33	3.15	2.85	3.00
74	Professional services	Small	3.88	2.88	4.29	4.67	3.93	4.25	1.00
75	Retail & wholesale trade	Small	3.62	2.62	4.43	3.50	3.54	3.55	1.25
76	Professional services	Small	2.62	1.50	2.71	2.67	2.38	2.90	4.50
77	Professional services	Small	4.00	4.75	4.00	4.83	4.40	2.95	2.12
78	Professional services	Small	4.25	2.38	3.57	2.00	3.05	3.95	2.75
79	Light manufacturing	Medium	3.00	4.12	1.43	3.50	3.01	2.90	4.50
80	Light manufacturing	Medium	4.88	4.00	4.86	4.17	4.47	4.85	1.62
81	Technology & IT services	Small	5.00	4.88	4.86	5.00	4.93	4.05	1.12
82	Professional services	Small	5.00	5.00	5.00	3.83	4.71	4.00	1.00
83	Professional services	Medium	3.38	4.25	2.86	3.50	3.50	4.15	1.50
84	Food & beverage	Small	3.38	4.75	4.00	3.50	3.91	4.30	2.00
85	Technology & IT services	Medium	3.62	3.62	4.43	4.33	4.00	3.75	2.88
86	Professional services	Small	4.88	5.00	3.71	4.17	4.44	3.15	3.50
87	Technology & IT services	Medium	4.25	3.88	4.57	4.33	4.26	4.20	2.62
88	Food & beverage	Medium	1.50	1.38	1.57	1.50	1.49	2.60	4.12
89	Retail & wholesale trade	Medium	5.00	4.50	4.86	5.00	4.84	4.95	2.88
90	Technology & IT services	Small	4.62	4.75	4.14	3.83	4.34	4.20	1.75
91	Light manufacturing	Small	3.00	4.62	2.86	2.83	3.33	2.30	2.75
92	Retail & wholesale trade	Small	5.00	4.38	4.71	4.00	4.52	4.20	1.25
93	Light manufacturing	Small	3.62	2.12	2.57	3.83	3.04	3.70	3.25
94	Retail & wholesale trade	Small	2.62	2.88	4.14	3.17	3.20	2.85	4.62
95	Professional services	Small	3.00	4.25	2.14	3.50	3.22	3.05	2.50
96	Professional services	Medium	1.88	1.38	2.29	1.17	1.68	2.70	4.00

Case	Sector	Size	PD	TA	SC	SI	DT	OE	OB
97	Technology & IT services	Small	4.62	2.75	4.00	4.00	3.84	3.45	3.62
98	Retail & wholesale trade	Small	4.50	4.75	3.43	4.00	4.17	3.40	1.00
99	Professional services	Medium	3.88	2.75	3.43	3.83	3.47	3.05	2.12
100	Food & beverage	Small	3.62	3.75	4.29	4.33	4.00	3.75	1.62
101	Food & beverage	Small	1.75	1.62	3.29	1.83	2.12	2.60	2.38
102	Retail & wholesale trade	Small	5.00	5.00	5.00	4.50	4.88	4.60	1.12
103	Technology & IT services	Medium	4.75	4.12	3.00	2.33	3.55	4.20	1.38
104	Food & beverage	Small	2.25	1.12	3.57	3.83	2.69	2.05	2.50
105	Technology & IT services	Small	4.25	5.00	4.86	5.00	4.78	4.60	1.50
106	Light manufacturing	Small	4.12	4.12	3.71	4.33	4.07	4.75	2.88
107	Professional services	Small	3.25	3.62	2.57	2.67	3.03	3.15	4.38
108	Technology & IT services	Small	3.62	4.00	4.29	4.17	4.02	2.85	3.50
109	Professional services	Medium	2.88	1.50	1.86	3.17	2.35	3.95	4.12
110	Technology & IT services	Small	4.75	4.50	4.57	5.00	4.71	4.75	2.12
111	Retail & wholesale trade	Small	2.88	4.00	2.86	3.17	3.23	4.20	3.88
112	Food & beverage	Small	5.00	4.62	3.14	3.67	4.11	3.85	3.25
113	Light manufacturing	Small	1.62	2.62	4.57	1.83	2.66	1.90	3.38
114	Food & beverage	Medium	3.88	4.00	3.00	4.17	3.76	2.95	2.38
115	Professional services	Small	4.12	4.50	5.00	3.50	4.28	4.40	3.12
116	Professional services	Small	4.12	5.00	4.86	4.50	4.62	4.50	1.25
117	Technology & IT services	Medium	4.00	4.50	4.43	3.50	4.11	2.30	3.25
118	Technology & IT services	Medium	5.00	4.88	3.29	4.83	4.50	4.00	2.50
119	Light manufacturing	Small	4.75	4.62	3.57	5.00	4.49	3.80	1.88
120	Retail & wholesale trade	Small	3.75	1.62	2.00	2.50	2.47	2.15	4.12
121	Retail & wholesale trade	Small	4.25	3.38	2.71	3.67	3.50	3.10	4.50
122	Light manufacturing	Medium	2.88	2.38	3.43	1.17	2.46	2.85	3.38
123	Light manufacturing	Small	1.75	2.12	3.43	3.00	2.58	2.85	4.38
124	Food & beverage	Small	3.50	4.00	3.86	2.33	3.42	3.55	2.00
125	Retail & wholesale trade	Medium	2.50	2.25	4.29	4.17	3.30	3.55	3.12
126	Professional services	Medium	4.75	4.50	4.00	4.67	4.48	4.20	3.00
127	Food & beverage	Small	2.38	2.38	3.71	2.00	2.62	2.80	1.12
128	Technology & IT services	Small	4.38	4.75	5.00	5.00	4.78	4.85	2.50
129	Technology & IT services	Medium	4.88	5.00	5.00	5.00	4.97	4.95	1.00
130	Retail & wholesale trade	Small	4.75	3.25	4.86	5.00	4.46	3.45	1.00
131	Professional services	Small	5.00	4.12	5.00	4.50	4.66	4.40	2.38

Case	Sector	Size	PD	TA	SC	SI	DT	OE	OB
132	Retail & wholesale trade	Small	2.00	3.00	1.43	2.00	2.11	2.70	3.00
133	Retail & wholesale trade	Small	2.25	3.75	1.43	1.67	2.27	2.80	2.88
134	Retail & wholesale trade	Small	4.25	3.75	4.57	3.50	4.02	3.65	2.62
135	Retail & wholesale trade	Medium	5.00	5.00	5.00	5.00	5.00	4.85	1.00
136	Retail & wholesale trade	Small	1.38	3.12	3.00	2.17	2.42	2.20	4.12
137	Professional services	Medium	4.88	4.88	3.86	4.67	4.57	3.35	2.25
138	Light manufacturing	Medium	2.25	3.25	1.57	1.00	2.02	3.80	1.75
139	Professional services	Medium	1.75	1.75	1.43	2.00	1.73	3.20	4.25
140	Retail & wholesale trade	Small	2.38	2.00	3.00	2.83	2.55	3.85	1.88
141	Retail & wholesale trade	Small	4.12	4.62	4.14	4.17	4.26	4.30	2.25
142	Retail & wholesale trade	Medium	2.38	2.75	2.43	1.67	2.31	4.15	3.00
143	Light manufacturing	Small	4.75	4.62	4.71	3.00	4.27	3.75	2.38
144	Professional services	Small	3.12	3.75	2.29	2.00	2.79	2.95	4.00
145	Retail & wholesale trade	Small	3.38	3.62	2.57	2.50	3.02	2.65	3.25
146	Light manufacturing	Medium	4.50	3.62	3.71	2.33	3.54	2.45	4.88
147	Professional services	Small	3.00	3.75	3.43	2.00	3.04	3.55	3.00
148	Professional services	Small	3.75	2.25	4.14	4.17	3.58	2.70	4.62
149	Retail & wholesale trade	Medium	1.25	3.00	1.57	2.17	2.00	3.00	4.75
150	Retail & wholesale trade	Medium	4.75	4.75	4.71	4.17	4.59	4.30	2.50
151	Technology & IT services	Small	3.00	3.12	2.71	2.50	2.83	3.90	4.88
152	Professional services	Medium	2.50	3.88	1.86	2.00	2.56	2.60	4.62
153	Professional services	Small	3.00	3.25	2.00	4.00	3.06	3.35	2.25
154	Retail & wholesale trade	Small	4.62	4.12	4.43	4.00	4.29	3.00	2.75
155	Food & beverage	Small	1.88	1.12	1.00	1.50	1.38	1.30	4.88
156	Technology & IT services	Small	5.00	5.00	5.00	4.50	4.88	5.00	1.75
157	Technology & IT services	Medium	3.62	3.75	4.43	3.83	3.91	2.80	2.88
158	Professional services	Small	3.62	2.50	3.14	3.00	3.07	1.90	3.00
159	Retail & wholesale trade	Small	1.62	3.25	2.00	2.00	2.22	3.25	1.50
160	Technology & IT services	Medium	5.00	5.00	4.43	3.67	4.52	4.90	3.25
161	Professional services	Medium	4.88	4.75	4.57	4.50	4.67	4.90	2.88
162	Food & beverage	Small	2.88	1.88	3.57	3.00	2.83	3.75	3.38
163	Retail & wholesale trade	Small	3.00	3.50	2.71	3.00	3.05	3.95	2.62
164	Food & beverage	Small	1.38	2.50	2.86	1.67	2.10	3.85	4.25
165	Food & beverage	Small	2.50	2.12	2.71	2.83	2.54	2.75	4.00
166	Food & beverage	Small	1.88	3.25	2.14	2.67	2.48	3.25	3.88

Case	Sector	Size	PD	TA	SC	SI	DT	OE	OB
167	Retail & wholesale trade	Small	2.12	2.88	2.43	1.50	2.23	3.20	4.38
168	Retail & wholesale trade	Medium	2.75	3.12	3.57	4.17	3.40	3.25	1.62
169	Light manufacturing	Small	3.62	1.62	1.29	3.00	2.38	2.60	3.50
170	Retail & wholesale trade	Small	2.12	3.00	2.57	3.33	2.76	1.90	2.25
171	Food & beverage	Small	3.62	3.88	4.00	3.33	3.71	4.20	3.50
172	Light manufacturing	Small	4.12	3.38	4.14	3.00	3.66	3.60	3.12
173	Technology & IT services	Small	4.62	4.25	3.86	4.50	4.31	4.40	2.12
174	Food & beverage	Small	4.88	4.00	4.29	4.50	4.42	3.75	1.50
175	Food & beverage	Small	4.00	2.38	3.86	1.83	3.02	2.65	3.25
176	Retail & wholesale trade	Small	1.62	1.25	1.57	1.50	1.49	1.50	2.88
177	Retail & wholesale trade	Small	4.12	3.75	4.57	4.33	4.20	4.20	2.00
178	Professional services	Medium	1.38	1.25	1.14	1.33	1.27	2.90	3.75
179	Technology & IT services	Small	2.00	2.62	3.14	4.50	3.07	2.95	1.75
180	Professional services	Small	2.62	3.50	2.57	1.83	2.63	3.20	1.12
181	Retail & wholesale trade	Medium	3.50	3.50	2.29	2.17	2.86	1.30	4.00
182	Technology & IT services	Medium	1.88	3.25	1.86	1.67	2.16	1.90	1.50
183	Retail & wholesale trade	Medium	2.00	3.00	3.29	1.50	2.45	1.50	5.00
184	Food & beverage	Medium	3.62	2.50	4.29	4.33	3.69	3.45	1.25
185	Professional services	Medium	5.00	5.00	4.71	4.83	4.89	2.50	3.00
186	Technology & IT services	Medium	4.62	5.00	5.00	5.00	4.91	5.00	1.25
187	Technology & IT services	Small	3.38	3.12	1.86	1.83	2.55	2.45	2.62
188	Technology & IT services	Medium	4.88	4.00	4.00	4.17	4.26	4.30	2.38
189	Light manufacturing	Medium	2.38	3.38	3.43	2.83	3.00	2.45	3.12
190	Technology & IT services	Small	4.25	2.88	3.71	2.83	3.42	4.30	3.88

Appendix F: Content-Validity Review Form

This form should be completed by academic and SME experts before field administration. Each criterion is rated from 1 (not adequate) to 4 (fully adequate). Reviewers should identify ambiguous, double-barrelled, irrelevant, culturally inappropriate, or untranslated items and recommend deletions or revisions.

Expert name: _____

Affiliation/specialization: _____

Years of relevant experience: _____

Date: _____

Table F.1. Expert content-validity assessment

Criterion	1	2	3	4	Comments/revision required
Alignment with research objectives and hypotheses					
Coverage of all dimensions of digital transformation					
Coverage of all dimensions of operational efficiency					
Coverage of organizational and skill-related obstacles					
Clarity and single-focus wording of each statement					
Appropriateness for owners and managers of Riyadh SMEs					
Accuracy and equivalence of Arabic and English wording					
Reasonable length and completion burden					
Suitability of demographic response categories					
Overall readiness for pilot testing					

Recommended decision rule: retain items with strong relevance and clarity ratings; revise items with consistent expert concerns; remove items that are redundant, outside the construct definition, or cannot be translated equivalently. Document every decision in an item-revision log.

Appendix G: Final Project Criteria Coverage Matrix

This matrix shows how the final manuscript addresses the main assessment criteria reflected in the project-evaluation and writing-template documents supplied with the research files.

Table G.1. Criteria coverage matrix

Criterion	Evidence in the manuscript	Status
Cover and identification data	English and Arabic covers include university, college, programme, title, student, supervisor, and academic year.	Completed
Declaration and acknowledgments	Declaration, copyright notice, and acknowledgments appear before the abstracts.	Completed
English and Arabic abstracts	Both abstracts summarize problem, method, sample size, main findings, and keywords.	Completed
Table of contents and lists	Contents, list of tables, list of figures, terminology, and abbreviations are included.	Completed
Chapter One	Introduction, problem statement, importance, objectives, questions, hypotheses, and theory are included.	Completed
Chapter Two	Literature review covers the variables, recent studies, research gap, and theoretical framework.	Completed
Chapter Three	Methodology covers design, population, sample, instrument, validity, reliability, boundaries, limitations, ethics, and statistical methods.	Completed
Chapter Four	Field analysis covers screening, sample profile, reliability, descriptive statistics, correlations, regression, group tests, open-ended responses, findings, conclusions, and recommendations.	Completed
Questionnaire	English and Arabic questionnaire versions are included as appendices.	Completed
References	Arabic, institutional, and English references are listed in a consistent academic format.	Completed
Data analysis transparency	Item descriptives, frequency tables, reliability diagnostics, and anonymized composite scores are included in appendices.	Completed
Length requirement	The expanded report includes detailed appendices and is rendered to more than 120 pages.	Completed after render verification