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DIGITAL TRANSFORMATION: A COMPARATIVE ANALYSIS OF SME DIGITAL MATURITY MODELS*

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Abstract. Digital transformation is increasingly recognised as a critical driver for competitiveness and sustainability in today's digital economy. However, small and medium-sized enterprises (SMEs) often face significant resource constraints when implementing effective change. This paper undertakes a systematic review and comparative analysis of five prominent digital transformation maturity models. These models were selected for review based on their scholarly relevance, as determined through systematic filtering of relevance criteria within peer-reviewed academic sources. The study investigates the transformation process by examining models, thereby identifying common dimensions, varying maturity level structures, and implementation approaches that influence the process. A six-step framework was created to guide SMEs in selecting and tailoring a digital maturity model that aligns with their strategic objectives and operational realities. Following a thorough review and comparison of a range of models, a six-step framework was developed to assist SMEs in selecting and customising a digital maturity model aligned with their strategic objectives and operational realities. The framework under discussion places particular emphasis on three key aspects. Firstly, it is essential to undertake a thorough contextual analysis. Secondly, it is crucial to evaluate the available resources. Finally, the framework advocates a phased implementation strategy to ensure a sustainable digital transformation journey. The findings have implications for both academic discourse and practical application. They furnish SMEs with actionable insights that facilitate navigation of the challenges of digital innovation and enhancement of overall business performance.

Keywords: digital transformation; digital maturity; maturity models; SMEs; comparative analysis

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1. Introduction

Digital transformation has become a fundamental driver of business growth and sustainability in the digital economy. The focus has shifted from merely implementing the latest information systems to necessitating a comprehensive restructuring of business processes, operational models, and corporate culture (Silva et al., 2025). Digital transformation is defined as integrating digital technologies across all business functions, with the fundamental purpose of reshaping operations, customer interactions and value delivery mechanisms (Dwivedi et al., 2020). Furthermore, digital transformation is linked to sustainable business practices. Scholars and practitioners alike assert that digital innovation should not be exclusively oriented towards the pursuit of profit. Instead, environmental sustainability and social responsibility should be considered (George & Schillebeeckx, 2022; Martínez-Peláez et al., 2023; Zhang et al., 2022).

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For organisations that successfully manage digital transformation, the rewards are significant. As Westerman et al. (2014) demonstrate, companies that effectively integrate technology and leadership capabilities tend to achieve higher profitability and competitive advantages over their peers. However, it should be noted that not all digital transformation strategies are equally effective. Indeed, research has shown that poorly executed digitalisation efforts can lead to substantial financial losses, devastatingly affecting small and medium-sized enterprises (Westerman et al., 2014).

The European Commission states that SMEs comprise over 99% of EU businesses and provide around two-thirds of all jobs (Brodny & Tutak, 2022). SMEs have fewer than 250 employees, a turnover of under €50 million, or revenues of under €43 million. They contribute over half of the EU's GDP and add over 50% of the value of the non-financial corporate economy. SMEs often struggle with financial constraints, lack of skilled staff, lower risk tolerance and limited access to funding. (Kádárová et al., 2023) (Nebati et al., 2023) Furthermore, their diminished scale and weaker financial reserves render them more susceptible to market fluctuations and technological transitions.

Notwithstanding the challenges SMEs face, the digital transformation process offers considerable opportunities for these enterprises. By leveraging digital tools, SMEs can optimise business processes and reduce operational costs through automation and digital workflow management. Li (2022) posits that a Digital Transformation Maturity Model (DTMM or DMM) constitutes an efficacious approach to facilitating digital transformation in SMEs. As Gollhardt et al. (2020) demonstrate, these models analyse multiple dimensions of digital transformation, including technology adoption, organisational strategy, leadership, culture, and ecosystem integration. These models enable SMEs to methodically evaluate their digital maturity and compare their progress with industry benchmarks (Blatz et al., 2018). Digital maturity models are of significance to companies as they provide a structured framework for assessing and identifying gaps, prioritising initiatives, and aligning strategies with long-term goals. In addition, they serve to reduce the risk of costly missteps during transformation.

Research shows that digitally mature organisations outperform their competitors financially. A Deloitte study found digitally mature companies are three times more likely to exceed industry averages in financial performance. This success is attributed to enhanced efficiency, improved quality, better customer satisfaction and increased employee engagement. Advanced digital maturity also enables innovation and adaptation to market changes (Gurumurthy et al., 2020)

To become a 'Digital Master', effective leadership and change management are key. However, some DMMs lack a comprehensive assessment framework. This makes choosing the right DMM crucial for SMEs to improve their digital transformation (Westerman et al., 2014). This article therefore, investigates the degree to which a DMM is required in the SME context and addresses the following research questions:

- RQ1: What are the most common dimensions of digital maturity models?
- RQ2: What maturity-level structures and assessment methods characterise each of the selected digital transformation maturity models, and how do these structural choices affect their complexity and suitability for resource-constrained SMEs?
- RQ3: Which organisational or local factors most strongly shape an SME's decision to adopt one digital maturity model over another?
- RQ4: Which of the reviewed maturity models provides SMEs with the most feasible, actionable and results-oriented path toward digital transformation?

The answers to these questions will generate an evidence-based decision framework that helps SMEs navigate the crowded landscape of digital maturity models. In doing so, the study aims to advance scholarly understanding of digital transformation while equipping practitioners with a pragmatic roadmap toward “Digital Mastery”.

2. Theoretical Background

Digital transformation (DT) is the integration of advanced technologies, including artificial intelligence, big data analytics, cloud computing, the Internet of Things, and more, across an organisation (Vial, 2019; Henriette et al., 2016). This integration aims to reconfigure the processes of value creation and delivery. Integrating digital capabilities within products, processes, and business relationships enables firms to transition from automation to a novel operating logic that is data-driven, interconnected, and perpetually adaptive. DT has evolved from early IT-centric initiatives seeking process automation to enterprise-level programmes synchronising digital investments with business strategy (Fitzgerald et al., 2013; Matt et al., 2015). Organisations that effectively manage this transition gain a competitive advantage in innovation speed, operational efficiency, and customer relevance. Conversely, organisations that fail to do so face an increasing risk of becoming obsolete due to intensified competition.

Firstly, integrating technology, including cloud-based ERP systems, AI-driven analytics, and robotic process automation, underpins scalability and the capacity for real-time decision-making (Vial, 2019; Radicić & Petković, 2023). Secondly, cultural change is indispensable. A leadership-driven climate of experimentation, learning, and agility has been shown to mitigate resistance and unlock the full value of digital tools (Kotter, 2006; Kane et al., 2015; Goran et al., 2017; Hartl, 2019; Shin et al., 2023; Firican, 2023). Thirdly, business-model innovation leverages digital affordances such as platform plays, subscriptions, and data monetisation to create novel revenue streams and fend off disruption (Rogers, 2016; Lee, 2017; Vial, 2019; Lee & Mangalaraj, 2022; Rojas-Segura et al., 2023; Kao et al., 2024; Oncioiu et al., 2019; Robertsone & Lapiņš, 2023). Finally, the use of data and AI to personalise omnichannel journeys is a key element of customer-experience enhancement, driving loyalty and margin growth (Verhoef et al., 2015; Lemon & Verhoef, 2016; Verhoef et al., 2021; Aloysius et al., 2023; Li et al., 2023; Luo et al., 2023; Shi et al., 2024).

Despite encountering financial and human-capital constraints that hinder growth (OECD SME and Entrepreneurship Outlook, 2023), SMEs have the potential to leverage digital technologies to expand market reach, streamline operations, and fortify customer relationships (Telukdarie et al., 2022; Medina et al., 2024; Sagala & Őri, 2024; Silva et al., 2025). Empirical studies have confirmed a positive correlation between digital maturity and competitive performance in SMEs (Bouwman et al., 2019). The most significant challenges are as follows: high initial costs (Ferreira et al., 2019), workforce skill deficits (Telukdarie et al., 2022), cultural and organisational inertia (Kotter, 2006), and heightened cybersecurity exposure (Von Solms & Van Niekerk, 2013). These impediments have been shown to exacerbate one another, thereby impeding transformation efforts when not addressed holistically. SMEs that succeed in DT display strong commitment from the top of the management structure, an articulated digital vision, and sustained investment in workforce upskilling (Sebastian et al., 2017; Vey et al., 2017). Agile, iterative processes support rapid experimentation, while partnerships with technology providers and research institutions help compensate for internal resource constraints (Yoo et al., 2012).

Capability Maturity Models (CMMs) offer staged diagnostic frameworks that chart the progression from ad-hoc digital activity to optimised, continuously improving practice (Paulk et al., 1993; Wendler, 2012; Becker et al., 2009). As posited by Paulk et al. (1993) and de Bruin et al. (2005), the most common models delineate five levels – initial, managed, defined, quantitatively managed, and optimising – against which firms benchmark their digital capabilities and identify targeted improvements. Domain-specific variants, including the Digital Maturity Model and Industry 4.0 Maturity Model, adapt the CMM principles to evaluate the readiness for emerging technologies and effective resource allocation (Berghaus & Back, 2016; Katuu, 2020). Maturity models serve three primary functions: descriptive, prescriptive, and comparative. These models depict anticipated trajectories of capability growth (Roeglinger & Poepplbuss, 2011). For resource-constrained SMEs, streamlined and flexible maturity models provide actionable roadmaps while avoiding the diagnostic overload common in enterprise-scale frameworks (Schumacher et al., 2016; Mittal et al., 2018; Gökalp & Martinez, 2021). Adopting such models has been demonstrated to facilitate incremental progress, cost-effective technology investment, and evidence-based monitoring of digital initiatives.

From a foundational theory perspective, the concept of digital transformation capability is most persuasively illuminated by three complementary lenses. The Resource-Based View posits that sustainable competitive advantage is derived from possessing and exploiting information assets and analytics competencies that are valuable, rare, inimitable, and non-substitutable (Barney, 1991). The Dynamic-Capabilities school posits that firms perpetually discern, appropriate, and metamorphose these assets within volatile contexts (Teece et al., 1997; Eisenhardt & Martin, 2000). Finally, the Technology–Organisation–Environment (TOE) view situates adoption decisions at the intersection of perceived technological advantage, organisational readiness, and competitive pressure (Oliveira & Fraga Martins, 2011; Baker, 2012). The integration of these theories elucidates the rationale behind accumulating resources and implementing context-sensitive adaptation in the context of mature digital capabilities.

The successful execution of digital transformation is contingent upon implementing meticulous change management processes that align technology with human behaviour. As posited by Lewin, the three-stage model of unfreezing, changing, and refreezing is predicated on the importance of destabilising legacy routines prior to institutionalising digital ones (Lewin, 1947). As contemporary syntheses have highlighted, readiness, vision clarity, and participative communication are significant predictors of employee acceptance (Armenakis & Bedeian, 1999). A review of Kotter's eight-step model reveals that visible short-term wins and empowered coalitions accelerate digital uptake (Appelbaum et al., 2012). Table 1 synthesises common dimensions reported across the literature.

Table 1. Synthesises common dimensions

Dimension	Representative Definitions
Strategy & Governance	Vision, leadership, funding, KPIs
Processes & Operations	Standardisation, automation, integration depth
Technology	IT infrastructure, platforms, interoperability
Data Management	Quality, accessibility, analytics capability
People & Culture	Skills, change readiness, learning climate
Customer Value	Digital products, channels, experience

The integration of these strands gives rise to a multilevel conceptual model. Contextual antecedents and adaptation mechanisms mediate the relationship between the chosen digital maturity model and performance, innovation and customer experience outcomes. Constructive theorising encourages explicit mapping of the variables in question and the rationale behind their relationship. Recent papers advocate visual articulation to translate diagnostic insights into actionable roadmaps. Despite the rapid proliferation of models, systematic reviews have exposed two persistent research gaps. Firstly, empirically validated criteria are absent to match specific SME contexts with an appropriate DMM. Secondly, there is a paucity of cross-industry evidence on the performance payoff of progressing through maturity (Teichert, 2019; Gökalp & Martinez, 2021). The present study contributes to the existing literature in two ways. Firstly, it provides a selection framework for practitioners and offers a theory-driven agenda for scholars.

3. Methodology

The selected methodology is written consecutively in the following chapters as researchers proceeded.

3.1 Search Strategy

Following PRISMA guidelines, we executed a systematic search in Scopus, Web of Science, Google Scholar and ScienceDirect for the string ("digital transformation" OR "digitalisation") AND ("maturity model*" OR "self-assessment" OR "maturity") AND SME covering January 2010 – December 2024. An open-access filter maximised replicability while including grey literature and conference papers reduced publication bias.

3.2 Inclusion Criteria

Records were retained when they contained these factors:

1. proposed a digital-maturity model (DMM);
2. explicitly targeted SMEs or provided evidence of SME adaptability;
3. contained a complete model description (levels, dimensions, assessment method), and
4. were available in English under open access.

3.3 Screening & Reliability

All 450 hits were exported to reference-management software. After automated and manual duplicate removal, 320 unique records remained. Reviewers then screened titles/abstracts and full texts against the criteria above. Inter-rater reliability exceeded $\kappa = 0.80$ at each stage; disagreements were resolved by authors' consensus. Sequential filtering (content relevance $\rightarrow$ applicability to resource-constrained settings $\rightarrow$ methodological rigour) yielded a final corpus of five DMMs (see Table 2).

Table 2. Stepwise selection of resources

Filtering Action	Number of Articles
Initial Search	450
Duplicate & Date Exclusion	320
Content Screening	150
Applicability Check	20
Final Fit & Rigor	5

3.4 Evaluation Framework

Multi-criteria decision (MCDA) rubric with four criteria—scope (weight = 0.25), complexity (0.25), validation evidence (0.25) and actionability (0.25) was developed. We centred the multi-criteria decision analysis on four factors, i.e. scope, complexity, validation evidence and actionability. Scope tells managers how many organisational domains the model covers (critical for seeing the "whole picture"). Complexity reflects the practical burden: the required number of questions, workshop time, and analytical skills. Validation gauges how rigorously the model has been empirically tested (case studies, surveys, Delphi panels), ensuring credibility. Actionability measures the clarity and granularity of the improvement guidance that follows the assessment—often the decisive benefit SMEs seek. To avoid embedding a priori bias in the analysis, each criterion was assigned an equal weight (0.25). A sensitivity test confirmed that moderate weight shifts (± 0.10) did not materially change the model rankings. Each model was appraised with a multi-criteria decision analysis (MCDA) (see Table 3) rubric comprising four equally weighted dimensions:

Table 3. Multi-criteria decision analysis (MCDA)

Criterion	Weight
Scope (breadth of organisational areas covered)	0.25
Complexity (assessment workload, item count)	0.25
Validation evidence (empirical grounding)	0.25
Actionability (clarity of improvement guidance)	0.25

Items were rated on a 0–5 Likert scale and normalised to percentage scores to facilitate cross-model comparison and sensitivity analysis.

4. Summary of Reviewed Maturity Models

The five maturity models were chosen through a systematic screening of peer-reviewed sources to ensure scholarly relevance, yielding a balanced and methodologically sound comparison set that remains practical for resource-constrained SMEs while spanning the full conceptual breadth of the digital-maturity literature. First, three of the models—Medina et al. (2024), Blatz et al. (2018) and Schallmo et al. (2020)—were expressly designed for SMEs, meeting the study's primary inclusion criterion of direct small-firm applicability; the remaining two—Aras & Büyüközkan (2023) and Tubis (2023)—although sector-agnostic, provide flexible, multi-dimensional structures that empirical work has shown can be tailored to smaller enterprises, thus ensuring external validity without sacrificing SME relevance. Second, the set embodies methodological diversity: Blatz offers a lean three-level scheme suited to rapid baseline assessments, Medina and Aras employ richer five-level scales grounded in Design Science or systematic-review rigour, while Tubis adds a two-tier (organisational/process) lens that exposes intra-firm maturity gaps; this range of level structures and dimensional depths enables a nuanced analysis of complexity–benefit trade-offs. Third, all five models include self-assessment instruments and action-oriented roadmaps, satisfying the study's requirement that candidates

support diagnosis and improvement—critical for SMEs that must quickly translate insights into concrete steps. Fourth, each model reports at least pilot-level empirical validation (e.g., cross-industry German survey data for Blatz, a French/Swiss SME pilot for Medina, and a manufacturing case for Tubis), allowing the researchers to compare evidence-based performance rather than purely conceptual propositions. Finally, the models collectively survived a transparent filtering pipeline—from an initial 450 articles to five finalists—based on open-access availability, recency, SME focus, and methodological rigour. This ensures the comparison rests on a systematically defensible foundation rather than convenience sampling. Together, these criteria are diverse yet comparable, empirically grounded yet adaptable, and universally accessible while remaining sharply focused on the digital transformation realities of SMEs. Table 6 summarises the key characteristics of models.

Table 4. Summary of key characteristics

Model	Levels	Items	Validation	Primary Strength
Blatz et al. (2018)	3	18	6 German SMEs (pilot)	Feasibility
Schallmo et al. (2020)	4–5	33	Workshops (n = 12)	Participatory design
Tubis (2023)	5	105	Survey (n = 42)	Process granularity
Medina et al. (2024)	5	27	Case studies (3 Swiss SMEs)	Diagnostic depth
Aras & Büyüközkan (2023)	5	24	Expert Delphi (15)	Holistic roadmap

The Digital Business Transformation for SMEs: Maturity Model for Systematic Roadmap - The model under scrutiny was analysed by Medina et al. (2024), who provided a self-assessment tool online and a structured roadmap to facilitate SMEs' digital transformation. Considering the rapid technological advancements and the heterogeneity of SMEs' digital literacy levels, this framework is designed to assist businesses in evaluating their current digital maturity and methodically enhancing their digital competence. The model synthesises theoretical and practical perspectives, thereby ensuring that businesses possess a clear strategic direction.

The Digital Business Transformation for SMEs: Maturity Model for Systematic Roadmap (Medina et al., 2024) is built upon (Berghaus & Back, 2016) and adjusted by using a Design Science Research (DSR) approach, which is widely applied in information systems and technology-driven studies. The DSR methodology is centred on the design, construction and evaluation of artefacts, ensuring that the model is practically relevant and scientifically rigorous.

The DMM, which has been meticulously designed for this purpose, enables the assessment of the digital maturity of an SME across nine distinct dimensions, encompassing a total of 27 maturity criteria. It is important to note that each criterion is comprised of five levels of maturity. The present study is subject to several constraints. While acknowledging the merits of drawing on the dimensions and criteria and their pertinence to the setting, they elected not to revisit the dimensions of digital maturity. In addition, the evaluation was conducted with a limited sample size of SME managers. Furthermore, it is important to acknowledge that all artefacts were conceived and evaluated in French within the Swiss Jura Arc region. This may limit the broader applicability of the findings.

Maturity Model of Digitization for SMEs - An analysis of the Maturity Model of Digitisation for SMEs (Blatz et al., 2018) provides small and medium-sized enterprises with a self-assessment tool and a structured roadmap to guide their digital transformation efforts. The overarching objective of this framework is to assist businesses in assessing their current digitisation status and methodically advancing towards higher levels of digital competence. The model synthesises insights from empirical research with practical implementation considerations, ensuring organisations possess a clear strategic direction. The Maturity Model of Digitisation for SMEs (Blatz et al., 2018) is a construct built upon prior maturity-model research and applies recognised academic methods for survey design and data analysis. To this end, they reviewed existing maturity models, subsequently developing a six-dimensional assessment tool and validating it through quantitative and qualitative means. This stepwise methodology is employed to ensure that the resulting maturity model is both relevant and empirically grounded.

The model under investigation is composed of six core dimensions: (1) Strategy & Leadership, (2) Company Culture & Organization, (3) IT Infrastructure, (4) Data Maturity, (5) Processes & Operations, and (6) Product (Use-Phase). It is asserted that this structure facilitates a nuanced appraisal of a company's digital maturity. Each dimension is subdivided into a series of quantifiable elements, which are then typically evaluated using a five-point Likert scale. A weighted approach is then employed to produce an overall maturity score, which is subsequently mapped onto three maturity levels. This tiered structure provides SMEs with a straightforward means of identifying which areas, such as management buy-in, data governance, or process automation, require the most attention.

Notwithstanding the study's practical applications, it is important to acknowledge the limitations inherent to the research design. Notably, the authors collated 81 initial datasets but ultimately deemed only 55 suitable for analysis, a factor which may limit the generalisability of the findings. The participating firms were drawn from various sectors, including but not limited to industrial manufacturing, information technology and telecommunications, and consulting. This diversity necessitates a bespoke approach to weighting dimensions tailored to each industry's specific requirements. Moreover, the emphasis on German SMEs may restrict applicability to diverse cultural or regulatory environments. Nevertheless, by highlighting correlations across dimensions, particularly between senior leadership support and an organisation's openness to new technologies, this model underscores the interdependency of strategic, technological, and cultural factors in driving digital transformation among SMEs.

An Approach for a Digital Maturity Model for SMEs based on Their Requirements - Another model that has been analysed by Schallmo et al. (2020) proposes a Digital Maturity Model (DMM) that has been tailored to small and medium-sized enterprises (SMEs). The authors ensure that the model addresses practical requirements while remaining grounded in research by synthesising empirical insights derived from SME interviews and a systematic literature review.

The proposed Digital Maturity Model (Schallmo et al., 2020) does not adhere to a single design science research framework in the strict sense of the term. Instead, it employs a stepwise, deductive methodology. Initially, the authors collated SME-specific requirements for digital maturity through workshops and interviews. Subsequently, a comparison is made between these real-world needs and existing maturity models to identify gaps in coverage and usability. The analysis undertaken has resulted in the identification of six focal dimensions. It is vital to acknowledge the significance of the following aspects for the specific needs of SMEs: Digital Strategy, Partner Interface, Processes, Employees & Technologies, Products & Services, and Customer Interface. Each dimension comprises a series of pertinent questions or indicators, thus facilitating a comprehensive, systematic self-assessment of digital progress.

However, it should be noted that the study is subjected to several constraints. The recommendations are primarily derived from a restricted series of interviews conducted with SMEs in Southern Germany. This methodological approach may constrain the findings' generalisability across diverse regions or industrial domains. Furthermore, a clear, standardised questionnaire reflecting all six dimensions is still under development. Nevertheless, by emphasising direct input from SME stakeholders, the model offers a pragmatic pathway for smaller firms seeking to map their digital maturity and prioritise transformation initiatives.

Holistic Digital Maturity Model Based on a Systematic Literature Review - The present study analysed the holistic digital maturity model by Aras & Büyüközkan (2023), the objective of which is to guide organisations through their digital transformation journey by providing a comprehensive self-assessment framework and a structured roadmap for improvement. It is acknowledged that contemporary enterprises encounter intricate challenges pertaining to people, processes and technology. The model under discussion herein focuses on assisting businesses in evaluating their current level of digital maturity and systematically charting a course towards higher degrees of digital competence. Integrating theoretical insights from a systematic literature review and practical perspectives on organisational readiness ensures that companies possess a clearly defined strategic direction.

The proposed Holistic Digital Maturity Model is predicated on a four-stage approach: Awareness, Readiness, Planning, and Execution, to capture an organisation's full transformation lifecycle. The authors have identified six core dimensions, which are further subdivided into 24 sub-dimensions. These dimensions are drawn from gaps identified in existing academic research and consultancy-based maturity models. The six core dimensions are as follows: Digital Strategy, Value, Processes, Technology, People & Culture, and Governance & Leadership. The model is sector-independent, thus allowing businesses of diverse sizes and industries to identify existing maturity gaps, prioritise digital initiatives, and align these with broader strategic goals.

However, the study acknowledges several constraints. While the conceptual design is comprehensive, further empirical validation is required across various organisational contexts to confirm its universal applicability. Furthermore, integrating dynamic cultural or regional factors may necessitate further customisation for specific sectors. Nevertheless, the holistic maturity model under discussion here offers a wide-ranging, methodical assessment tool enabling organisations to systematically evaluate their digital transformation readiness. In addition, it provides a framework within which they can develop an actionable roadmap for improvement and sustain long-term digital progress.

Digital Maturity Assessment Model for the Organizational and Process Dimensions - The final model examined in this study is the Digital Maturity Assessment Model for the Organisational and Process Dimensions (Tubis, 2023). This model offers manufacturing and service enterprises a two-level self-assessment tool and a roadmap to guide their digital transformation. It is acknowledged that digital initiatives can vary considerably in nature, whether targeting an entire organisation or specific operational processes (e.g. production, logistics). This model provides a structured approach for businesses to assess their current digital maturity and formulate a strategic plan to progress towards higher levels of digitalisation.

The Digital Maturity Model (DMM-OP) is predicated on the principle that digital transformation should be evaluated in two distinct yet interconnected dimensions:

1. The organisational dimension concerns company-wide aspects such as strategy, corporate culture, data management and business-partner relationships.
2. Process Dimension – This concept pertains to the digital transformation of operational levels, such as production or logistics processes. Sub-areas such as performance management, process management, employee behaviours, and the supporting technology infrastructure are assessed in detail.

Each dimension is divided into specific areas: data management, cyber security, performance management, and employee development. These areas are then subdivided into five maturity levels, ranging from "Basic" through "Discovery", "Developed", "Integrated" and "Leadership". The model employs a continuous representation approach, scoring each area independently. This, in turn, enables organisations to prioritise digital improvements in line with their strategic objectives. A diagnostic questionnaire comprising 105 binary items facilitates self-assessment, providing a comprehensive overview of each maturity area. This approach enables the establishment of clear benchmarks between different divisions within the same enterprise or across multiple organisations.

It is worth noting that the study incorporates an implementation example from a mid-sized electronics manufacturing company. The organisation's production division exhibited comparatively elevated degrees of digital maturity, predominantly attaining "Integrated" levels as indicated by the metrics. Conversely, the logistics division demonstrated a more pronounced presence of intermediate levels, categorised as "Discovery" or "Developed". These observations underscore the pivotal role of parallel improvements across various organisational divisions in facilitating comprehensive digital transformation.

Nevertheless, the study does consider several factors. Using a self-assessment tool necessitates establishing an evaluation team whose mission is to interpret the results. In some instances, the team may be supplemented by domain experts. Furthermore, organisations aspiring towards upper-echelon maturity ("Leadership") should proactively monitor emerging best practices and may find it advantageous to seek external guidance. The model provides companies with a clear roadmap by defining separate organisational and process-level assessments.

This ensures that transformation initiatives are holistic (company-wide) and aligned with each division's operational realities.

4.1 Commonalities among the Models

All models use multi-dimensional structures (with 5–9 main or macro-dimensions). They typically employ a tiered (usually 3–5) maturity-level scheme. They offer self-assessment instruments (questionnaires or structured frameworks). Emphasis on roadmap or action-oriented guidance post-assessment. Each has at least some form of empirical illustration or partial validation.

Table 5. Commonalities of Analysed Models

Feature	Medina et al., 2024	Blatz et al., 2018	Schallmo et al., 2020	Aras & Büyükožkan, 2023	Tubis, 2023
Primary Purpose	Guide SMEs in assessing digital maturity and providing a structured roadmap.	Help SMEs measure digitisation progress and plan strategic improvements.	Propose a digital maturity approach tailored to SMEs' requirements.	Provide a holistic model to guide the digital transformation journey.	Offer a two-level (org & process) assessment for digital transformation.
Intended Audience	Multi-sector SMEs (though could be adapted to larger firms).	Mainly SMEs (multi-sector)	Primarily SMEs in diverse industries.	Cross-sector (public/private) – entire organisations.	Cross-sector, with an example from manufacturing SMEs.
Number of Core Dimensions	9 dimensions (each 5 levels).	6 dimensions (Strategy, Culture, IT Infra, Data Maturity, Processes, Product).	6 main dimensions (Strategy, Org., Tech, etc.)	6 main dimensions (e.g., Strategy, Value, Processes, Technology, People).	2 “macro-dimensions” (Org & Process), subdivided into 11 areas total.
Assessment Levels	5 maturity levels (from basic to advanced)	3 maturity levels (basic, moderate, advanced).	Varies (~5 levels), referencing a stepwise progression.	5-level scale (Basic → Discovery → ... → Leading).	5 levels (Basic → Discovery → Developed → Integrated → Leadership).
Self-Assessment Tool	Yes: online or structured framework with 27 criteria (5 levels each).	Yes: 6 dimensions, multiple choice items; weighted dimension scoring.	Yes (conceptual plus partial validation in SME use-cases).	Yes: includes a 4-phase journey (Awareness→ Readiness→ ...) and dimensions.	Yes: 105-question diagnostic; each dimension scored individually.
Focus on Implementation Roadmap	Yes: emphasises incremental steps for each dimension and each maturity level.	Yes: post-assessment recommendations for dimension-specific improvements.	Yes: addresses “where to start,” especially crucial for SMEs.	Yes: 4-phase approach (Awareness, Readiness, Planning, Execution).	Yes: 4-phase PDCA-based approach (diagnosis, scoring, improvement steps)
Validation / Empirical Evidence	Small group tested (French/Swiss region) + constraints in generalising.	Survey-based results & cross-industry usage in Germany.	Concept tested among regional SMEs.	Illustrative example with sector-independent coverage; up-to-date references.	Demonstrated a manufacturing SME for verification & validation.

4.2 Differences among the Models

Some use just 3-6 main dimensions (Blatz et al., 2018; Schallmo et al., 2020), while others have more comprehensive breakdowns (Medina's et al. (2024) - 9 dims, Aras and Buyukozkan's (2023) - 24 sub-dims, Tubis's (2023) 2 macro + 11 total areas. Most are SME-focused, but (Aras & Buyukozkan, 2023) specifically addresses cross-sector public & private. Ranges from 3-tier (Blatz) to 5-tier (Medina et al. 2024; Aras & Buyukozkan, 2023; Tubis, 2023. Some rely on simpler questionnaires (Blatz's et al. (2018) approach), while

others offer extensive question banks (Tubis, 2023 with 105 items). Varies from small pilot tests (Medina et al., 2024) to structured case studies (Tubis, 2023), with ongoing calls for broader empirical studies.

Table 6. Differences among the Models

Aspect	Medina et al., 2024	Blatz et al., 2018	Schallmo et al., 2020	Aras & Büyükoğkan, 2023	Tubis, 2023
Number of Dimensions / Sub-Dims	9 dimensions, each has 3 maturity criteria (27 total) across 5 levels.	6 main dimensions (Strategy & Leadership, Culture & Org, IT Infra, Data, etc.).	Typically, 6 major categories, each broken down further.	6 dimensions (Strategy, Value, Processes, Technology, People & Culture, Governance), 24 sub-dims.	2 macro-dimensions (Organizational vs. Process) with 11 total areas (some has sub-areas).
Industry / Sector Focus	Primarily validated in French/Swiss SMEs; emphasis on small group constraints.	Cross-industry SME orientation (esp. Germany).	SMEs in different sectors, focusing heavily on SME needs and constraints	Broad cross-sector scope for both private and public organisations.	Example from electronics manufacturing; flexible enough for multi-sector.
Maturity-Level Details	Each dimension has a 5-tier scale from basic to advanced, referencing DSR approach.	3-tier scale (relatively simpler: basic, intermediate, advanced).	Usually 4–5-tier scale but flexible, as validated with SMEs	5-level scale from “Basic” → “Discovery” → “Developed” → “Integrated” → “Leading.”	5-level scale from “Basic” → “Discovery” → “Developed” → “Integrated” → “Leadership.”
Assessment Method	Structured self-assessment with 27 criteria. Includes small pilot with SME managers.	Weighted dimension scoring (6 sets of questions) leading to an overall average.	Proposes robust stepwise approach: workshop-based, interviews, readiness checks.	Dimension scoring approach; includes 4-phase journey	105 yes/no questions, each dimension scored. “Continuous representation” for each area
Main Uniqueness / Novelty	Integrates a Design Science Research methodology specifically tested in the French region.	Emphasises a shorter maturity scale (3 levels) and strongly focuses on SMEs.	Explicitly co-created SMEs: ensures the approach addresses their real-world constraints.	Holistic + sector-independent; merges organisational culture, governance, strategy, etc.	Two-tier approach (Org + process) ensures parallel sub-evaluations. 105-item tool.
Roadmap / Implementation Emphasis	Outlines a systematic plan for each dimension, but validation is constrained by a small sample.	Recommends dimension-wise improvement steps after diagnosing.	Stresses alignment with SME business strategy & constraints, with each dimension’s roadmaps.	4-phase model (Awareness → Readiness → Planning → Execution) for a full digital transformation.	PDCA-like cycle for each dimension/area, bridging org-level strategy w/ process-level improvements.
Depth of Sub-criteria	27 total maturity criteria (3 per dimension).	6 main dims, further broken into items, but simpler vs 27 or 24 sub-dim.	Balanced (6 dims) approach, typically with detailed sub-criteria if needed.	24 subdimensions; quite detailed breakdown, requires structured team effort.	11 areas / some sub-areas. Some areas are quite extensive.
Validation / Case Examples	Pilot test in Swiss Jura Arc region with small group of SME managers.	Survey-based cross-industry pilot results in mid-sized German firms.	Qualitative pilot among local/regional SMEs, needs more large-scale validation.	Illustrative multi-sector potential; partial example usage from the authors.	Single electronics-manufacturing SME used for verification & improvement suggestions.

All five models aim to help businesses understand their digital maturity across multiple organisational and operational factors. Despite their shared goals (assessment plus improvement roadmap), they diverge in the number of dimensions, depth of sub-dimensions, and implementation details. Some take a holistic approach to an entire organisation; others also zoom in on specific processes (especially in manufacturing or logistics). Each

includes a tiered maturity scale to show how organisations can evolve from relatively simple digitisation efforts to robust transformations that embed digital capabilities at all enterprise levels.

4.3 MDCA Results

Applying the four-factor MCDA rubric to the five shortlisted models produced the criterion-level scores shown in Table 7. These results quantify each framework's relative strengths and weaknesses along the dimensions of scope, complexity, validation evidence and actionability.

Table 7. MCDA results.

Model	Scope (%)	Complexity (%)	Validation (%)	Actionability (%)
Blatz et al., 2018	72	90	55	84
Schallmo et al., 2020	76	70	68	78
Tubis, 2023	80	60	72	81
Medina et al., 2024	88	50	75	66
Aras & Büyüközkan, 2023	85	55	80	69

The percentage scores derive from a 0–5 Likert rubric multiplied by 20. A score of 5 (100 %) indicates the model excels on that criterion; 3 (60 %) is adequate; 1 (20 %) is weak. For example, Blatz et al. (2018) earned 90 % on complexity because its three-level, 18-item survey can be completed in under an hour, whereas Medina's et al. (2024) richer 27-item, five-level tool scored 50 %. Conversely, Medina's et al. (2024) broad nine-dimension coverage pushed its scope to 88 %, eclipsing Blatz's et al. (2018) 72 %. Validation scores reflect the size and rigour of empirical testing: Aras & Büyüközkan (2023) (Delphi with 15 experts) reached 80 %, whereas Blatz et al. (2018) relied on a small pilot (55 %). Finally, actionability rewards models that translate scores into concrete roadmaps or PDCA cycles: Tubis (2023) (process-level prescriptions) and Blatz et al. (2018) (targeted next steps) scored above 80 %, while Medina's et al. (2024) academic depth but lighter implementation guidance limited it to 66 %. Each number mirrors a transparent, criteria-specific judgement grounded in publicly documented model attributes.

5. Discussion

Across Europe, small and medium-sized enterprises (SMEs) frequently encounter limitations due to constrained resources, smaller workforces, and more circumscribed profit margins. Nonetheless, an increasing number of studies are demonstrating that digital transformation is a key driver of competitiveness and operational efficiency, even for smaller businesses. In such circumstances, the selection of a digital maturity model that is appropriate to the situation becomes a pivotal decision. As demonstrated in the extant literature, the five models under discussion – namely, Medina et al. (2024), Blatz et al. (2018), Schallmo et al. (2020), Aras & Büyüközkan (2023), and Tubis (2023) – provide structured guidance. However, given the differing levels of complexity, focus areas and implementation approaches, the models may offer varying levels of benefit to SMEs.

SMEs characteristically function within the confines of stringent cost controls, necessitating that large-scale digital projects must demonstrate both quantifiable added value and manageable complexity. Whilst certain models – such as those proposed by Medina et al. (2024) or Aras & Büyüközkan (2023) – exhibit relatively robust, multi-layered dimensions (e.g., nine or more sub-dimensions) and a strongly research-based approach, it should be noted that these models may require additional time and expertise, which many SMEs may find challenging to acquire. Conversely, models like Blatz et al. (2018) offer a reduced set of dimensions (6) and a more straightforward three-level maturity scale. This leaner framework can be more accessible to SMEs with limited managerial capacity and fewer staff to devote to extensive audits. Schallmo et al. (2020) similarly emphasise a co-creative design with small businesses, ensuring that the maturity assessment aligns with real-world SME constraints. This is a considerable advantage in industrial environments. However, Schallmo's et al. (2020) approach may necessitate additional facilitation or workshops, which not all SMEs are equipped to host.

In sectors such as automotive parts manufacturing or electronics, which are prevalent in Slovakia or Germany, logistics and production processes are already subject to significant competition and time constraints. In such cases, it is imperative to undertake a more profound process-level analysis. Tubis's (2023) two-tiered model, which differentiates between organisational and process dimensions, could prove valuable in situations where SMEs require a comprehensive analysis of the disparities between, for instance, well-digitised production lines and under-digitised logistics flows. However, the Tubis (2023) framework, which utilises a 105-item questionnaire, is moderately time-intensive, necessitating the presence of internal teams with the capacity to undertake structured self-assessment and data collection. Whilst it is acknowledged that some SMEs may not have ready access to specialised digital transformation experts, the step-by-step procedure (modelled on a continuous improvement cycle) has been shown to reduce confusion and aid the systematic planning of improvements (Smith, 2023).

RQ1: What are the most common dimensions of digital maturity models?

Analysis shows a clear core set of dimensions that recur in every model:

- Strategy/Leadership/Governance – the presence of a digital vision, top-management support and steering mechanisms
- Processes and Operations – how far routine activities are digitalised, automated and continuously improved
- Technology/IT Infrastructure – availability, integration and scalability of digital tools, platforms and data architectures
- Data and Information Management – quality, accessibility and analytic use of data (explicit in four models, implicit in Tubis (2023)).
- People and Culture – employee skills, change readiness and innovation culture
- Customer/Value /Product and Services – the extent to which offerings and customer interfaces are digitally enabled

Some models add extra lenses (e.g., Customer-Interface, Governance, or a separate “Value” dimension), but the six elements above constitute the common denominator.

RQ2: What maturity-level structures and assessment methods characterise each of the selected digital transformation maturity models, and how do these structural choices affect their complexity and suitability for resource-constrained SMEs?

The number of levels and questions is the main driver of complexity. Three-level schemes such as Blatz cut preparation and scoring effort dramatically, whereas five-level, multi-sub-dimension tools yield deeper insights but demand more staff time, facilitation skills and analytic competence.

RQ3: Which organisational or local factors most strongly shape an SME's decision to adopt one digital maturity model over another?

The identified highlights of analysis are several contextual determinants:

1. Resource availability – budget, managerial time, in-house analytical skill; lean models win when these are scarce.
2. Primary transformation goal – a rapid company-wide snapshot vs. a deep process-level diagnosis (drives preference for Blatz et al. (2018) vs Tubis (2023)).
3. Variation in maturity across departments – large intra-firm gaps push firms toward two-tier or process-sensitive models such as Tubis (2023).
4. Digital culture and employee readiness – if people & culture are the bottleneck, models that weigh those factors heavily (Schallmo et al., 2020; Aras & Büyüközkan, 2023) are favoured.
5. Sector or regional specifics – e.g., manufacturing SMEs in Slovakia or Germany needing logistics detail may lean to Tubis (2023); firms in the Swiss Jura Arc validated, as in Medina et al. (2024).
6. Tolerance for workshop or co-creation formats – organisations that value participatory design adopt Schallmo et al.'s (2020) interview/workshop-driven approach.

RQ4: Which of the reviewed maturity models provides SMEs with the most feasible, actionable and results-oriented path toward digital transformation?

Blatz et al. (2018) emerge as the most immediately feasible: the 3-level, 6-dimension survey can be executed quickly, yields a clear scorecard and proposes targeted next steps—ideal when management capacity is tight. Tubis (2023) offers the most actionable process-specific roadmap: its organisational-vs-process split and PDCA-style guidance let a firm prioritise concrete improvements in the weakest department and track them over time. Schallmo et al. (2020) appear in the middle: workshop facilitation makes actions tangible and culturally embedded, but it needs coordination effort. Medina (2024) and Aras & Büyüközkan (2023) deliver the deepest, research-grounded advice; however, their breadth and granularity mean they are best reserved for SMEs that can commit greater time and analytical resources or that have already mastered a baseline model and want a more rigorous second stage.

Consequently, for a typical resource-constrained SME starting out, Blatz et al. (2018) is the most pragmatic single-model choice; Tubis (2023) is the best when departmental imbalance is a critical issue; Schallmo et al. (2020) provide a collaborative path when staff engagement is paramount. SMEs with the capacity for a more elaborate exercise can layer the holistic Medina et al. (2024) or Aras and Büyüközkan (2023) frameworks on top of an initial quick scan. The analysis of several models resulted in creating a six-step framework (see Figure 1). The purpose of this framework is to enable SMEs to make a systematic choice of the digital maturity model and to implement it, with the model in question being one that matches both the company's internal capacity and its strategic transformation goals. The result is a targeted, realistic digital transformation roadmap rather than an overly complex or insufficiently robust approach.

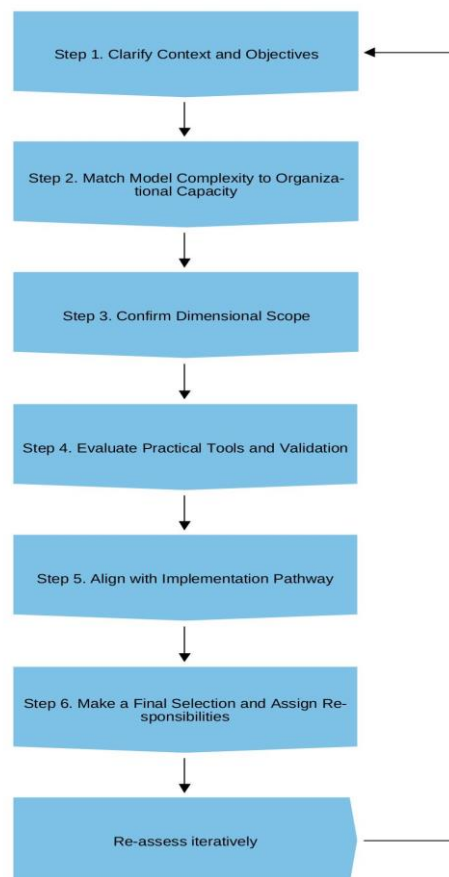


Figure 1. Six step framework

1. Clarify Context and Objectives
 - Identify Digital Goal - Determine whether the main impetus is a rapid baseline assessment or a deep dive into multiple departments. Also, establish immediate vs. long-term objectives: cost savings, process reengineering, new market entry, etc.
 - Map Constraints - List major constraints (limited budgets, minimal transformation expertise, or time-pressed managers). Note any strategic or cultural barriers (resistance to technology, staff skill gaps, etc.).
2. Match Model Complexity to Organisational Capacity
 - Gauge Resource Availability - Assess how much managerial time is available for surveys/workshops and the level of internal expertise in data analysis or facilitation. If resources are sparse, leaner approaches (e.g., Blatz's simpler 3-level scale) might be preferable.
 - Depth vs. Simplicity Trade-off - Decide if you need a quick, high-level maturity snapshot (Blatz et al., 2018), a moderate-level approach with structured co-creation (Schallmo et al.), or a deeply holistic one (Aras & Büyüközkan (2023), Tubis (2023), or Medina et al. (2024)). Consider departmental analysis (Tubis (2023)) if uneven readiness across departments is a core issue.
3. Confirm Dimensional Scope
 - Organisational vs Process Dimension - If your SME's operations vary widely in maturity (e.g., advanced production but under-digitised logistics), a two-tier model like Tubis (2023) will better expose departmental disparities. Alternatively, if the entire organisation (people, culture, governance) needs uniform digitisation, frameworks like Aras & Büyüközkan (2023) or Medina et al. (2024) capture broad transformations.
 - Focus on People and Culture - If staff buy-in or cultural change is the biggest blocker, prefer a model that weighs these factors heavily (Aras & Büyüközkan (2023), Tubis (2023), or Schallmo (2020), which all emphasise employee engagement).
4. Evaluate Practical Tools and Validation
 - Review Self-Assessment Instruments - For minimal overhead, look at models with concise surveys (Blatz et al., 2018) or moderate question sets (Schallmo (2020)). If you can handle extensive questionnaires and deeper reporting (Medina (2024), Aras & Büyüközkan (2023), or Tubis (2023)), you'll gain richer, more granular results.
 - Check Empirical Support - Ensure the model's track record aligns with your enterprise's sector or scale. Consider whether partial or full validation (e.g., pilot tests, published case studies) increases confidence.
5. Align with Implementation Pathway
 - Phased Roadmap - All chosen models provide a multistage approach (e.g., Blatz's dimension-based improvements or Aras & Büyüközkan's 4-phase transformation). Ensure the steps are feasible for your timeline. If departmental-level improvement is key, confirm the model easily decomposes improvements among distinct units (Tubis's process dimension or Schallmo's workshop approach).
 - Incremental vs. Comprehensive Rollout - If you aim to pilot in just one area (say, logistics) before scaling up, confirm the model is flexible enough to handle partial deployments. Confirm that the model provides broader synergy strategies for more integrated transformations (culture, data, technology, etc.).
6. Make a Final Selection and Assign Responsibilities
 - Pick the Model - Synthesise context, resource fit, scope, and tool preference to finalise which maturity model best meets your SME's priorities. If no single model fits perfectly, adapt the dimension sets from multiple references (e.g., combine a simpler scale with a more robust departmental assessment).
 - Define the Self-Assessment Team - Establish an internal cross-functional group (managers, department heads, possibly external experts). Train them on the model's rating scales, data collection needs, and outcome interpretation.

The digital strategy under review should be subject to regular re-assessment, with follow-up maturity evaluations to be conducted at regular intervals (e.g. every 6–12 months). These evaluations aim to track progress, measure improvement, and refine the strategy based on lessons learned.

If an SME has limited prior experience with transformation and a constrained schedule, Blatz et al. (2018) may represent the most pragmatic initial option because of its uncomplicated 3-tier scale and direct scoring methodology. Those seeking a more process-specific diagnosis — particularly if they run advanced production lines but less sophisticated logistics — may benefit from Tubis (2023), which distinctly addresses organisational- versus process-level maturity and can highlight departmental gaps. Schallmo et al. (2020) adopt an SME-oriented approach, yet the necessity for more workshop-style engagements remains a requirement that can be met by SMEs that prefer collaborative design sessions. Meanwhile, Medina et al. (2024) and Aras & Büyüközkan (2023) may offer stronger theoretical rigour and broader cross-sector adaptability, but they can be more resource-intensive. The optimal choice is ultimately contingent on the objectives of the SME in question, the prevailing digital culture, and the entity's capacity to engage in a comprehensive, multi-phase evaluation. SMEs can chart a realistic yet impactful path to digital maturity by selectively blending the clarity of simpler models with the thoroughness of multi-layer ones. The proposed assessment framework is intended to assist in identifying the most appropriate digital maturity model for SME companies, thereby serving as a guideline for selecting the optimal model.

Conclusions

This study aimed to help small and medium-sized enterprises (SMEs) cut through the crowded field of digital maturity models and choose an assessment that fits their strategic intent and day-to-day constraints. A PRISMA-guided review distilled 450 scholarly and practitioner records into five rigorously documented maturity models. Despite different labels, all converge on six core dimensions—strategy, processes, technology, data, people-culture and customer/value—organised in tiered levels that link diagnosis to improvement planning.

To make those differences actionable, we applied a transparent multi-criteria decision analysis (MCDA) using four equally weighted factors: scope, complexity, validation evidence and actionability. The scoring (0–5 Likert × 20 %) highlighted a clear complexity–benefit trade-off. The three-level Blatz model scored highest on feasibility/actionability (90 % and 84 %) and thus suits “quick-scan” baselines. Tubis also excelled in actionability (81 %) thanks to its process-specific roadmap, while Medina achieved the broadest scope (88 %) and strongest diagnostic depth, albeit with the highest assessment burden. These quantitative insights feed directly into the proposed six-step selection framework, which guides SMEs to map resources, maturity gaps and cultural readiness before choosing or sequencing models along a phased digital transformation journey.

Academically, the work synthesises fragmented literature into an evidence-based decision logic; managerially, it offers resource-constrained firms a pragmatic path toward digital mastery that balances ambition with feasibility. Limitations remain. The open-access search protocol may have missed pay-walled models, MCDA weights were set heuristically rather than through a formal Delphi, and some reviewed frameworks have been validated only in single-region pilots—leaving cross-industry generalisability uncertain. Future research should stress-test alternative weighting schemes, expand empirical validation across sectors and geographies, and track performance outcomes as firms progress through maturity levels. By iteratively grounding theory in practice, scholars and practitioners can ensure that digital maturity assessments remain living, actionable tools rather than academic artefacts.

Research Limitations and Future Research

It is important to acknowledge the limitations inherent in the literature search process. Specifically, the study employed designated key phrases and an “open access” criterion across the Google Scholar, Web of Science, Scopus, and ScienceDirect databases. Consequently, the search results were confined to sources in which the specified key phrases appeared in the title, abstract, or indexed keywords, as databases such as Web of Science and Scopus do not provide access to the complete texts of indexed articles. This approach may have inadvertently excluded relevant studies in which the key phrases were present solely within the full text. Furthermore, it was determined that certain digital maturity models (DMM) for SMEs may have been underrepresented due to the constraints imposed by the search process.

Although the multi-criteria decision analysis brings structure and transparency, its results rest on several assumptions constraining generalisability. First, the scoring is based on a small sample of five models, so correlations and rank orders should be interpreted as indicative rather than definitive. Second, the equal weighting (0.25 each) and 0–5 Likert ratings reflect weights set heuristically rather than through the quantitative method; different weighting schemes could alter the aggregate rankings. Third, some sub-scores (e.g., "actionability") had to be inferred from qualitative descriptions in the source papers rather than field testing, introducing subjective bias. Therefore, readers should view the MCDA outcomes as a decision-support aid, not a prescriptive league table, and perform sensitivity checks before applying the scores to their contexts.

Subsequent research endeavours will concentrate on evaluating the proposed assessment framework through its practical implementation in various SME settings. This will enable iterative refinements based on empirical evidence and stakeholder feedback. The process has been designed to guarantee that the framework is adaptable to different SMEs' unique operational constraints and strategic priorities. The ultimate objective of this process is to enhance the framework's effectiveness as a tool for guiding digital transformation initiatives in resource-constrained environments.

References

- Aloysius, E. J., Mukthar, J. K. P., Mukthar, M., & Madhu, Dhruvakumar. (2023). Digital Transformation for Business Sustainability (A. Edward J., K. P. Jaheer Mukthar, M. Dhruvakumar, & T. K. Murugesan, Eds.). Springer Nature Singapore. <https://doi.org/10.1007/978-981-99-7058-2>
- Appelbaum, S. H., Habashy, S., Malo, J. L., & Shafiq, H. (2012). Back to the future: Revisiting Kotter's 1996 change model. *Journal of Management Development*, 31(8), 764-782. <https://doi.org/10.1108/02621711211253231>
- Aras, A., & Büyüközkan, G. (2023). Digital Transformation Journey Guidance: A Holistic Digital Maturity Model Based on a Systematic Literature Review. *Systems*, 11(4). <https://doi.org/10.3390/systems11040213>
- Armenakis, A. A., & Bedeian, A. G. (1999). Organisational Change: A Review of Theory and Research in the 1990s. *Journal of Management*, 25(3) <https://doi.org/10.1177/014920639902500303>
- Baker, J. (2012). The Technology–Organization–Environment Framework. In: Dwivedi, Y., Wade, M., Schneberger, S. (eds) Information Systems Theory. Integrated Series in Information Systems, vol 28. Springer, New York, NY. https://doi.org/10.1007/978-1-4419-6108-2_12
- Barney, J. (1991). Firm Resources and Sustained Competitive Advantage. *Journal of Management*, 17(1), 99-120. <https://doi.org/10.1177/014920639101700108>
- Becker, J., Knackstedt, R., & Pöppelbuß, J. (2009). Developing Maturity Models for IT Management. *Business & Information Systems Engineering*, 1(3), 213-222. <https://doi.org/10.1007/s12599-009-0044-5>
- Berghaus, S., & Back, A. (2016). Stages in Digital Business Transformation: Results of an Empirical Maturity Study. <http://aisel.aisnet.org/mcis2016/22>
- Blatz, F., Bulander, R., & Dietel, M. (2018). Maturity model of digitisation for SMEs. 2018 IEEE International Conference on Engineering, Technology and Innovation (ICE/ITMC), Stuttgart, Germany, 2018, pp. 1-9. <https://doi.org/10.1109/ICE.2018.8436251>
- Bouwman, H., Nikou, S., & de Reuver, M. (2019). Digitalisation, business models, and SMEs: How do business model innovation practices improve performance of digitalising SMEs? *Telecommunications Policy*, 43(9). <https://doi.org/10.1016/j.telpol.2019.101828>
- Brodny, J., & Tutak, M. (2022). Digitalisation of Small and Medium-Sized Enterprises and Economic Growth: Evidence for the EU-27 Countries. *Journal of Open Innovation: Technology, Market, and Complexity*, 8(2). <https://doi.org/10.3390/joitmc8020067>
- de Bruin, T., Freeze, R., Kulkarni, U., Rosemann, M., Bruin, de, de Bruin, S., Freeze, R., & Carey, W. (2005). Under-standing the Main Phases of Developing a Maturity Assessment Model. ACIS 2005 Proceedings, Vol. 109. <http://aisel.aisnet.org/acis2005/109>
- Dwivedi, Y. K., Hughes, D. L., Coombs, C., Constantiou, I., Duan, Y., Edwards, J. S., Gupta, B., Lal, B., Misra, S., Prashant, P., Raman, R., Rana, N. P., Sharma, S. K., & Upadhyay, N. (2020). Impact of COVID-19 pandemic on information management research and practice: Transforming education, work and life. *International Journal of Information Management*, 55. <https://doi.org/10.1016/j.ijinfomgt.2020.102211>

Gurumurthy, R., & Camhi, J. (2020, May 26). *Uncovering the connection between digital maturity and financial performance*. Deloitte Insights. <https://www2.deloitte.com/us/en/insights/topics/digital-transformation/digital-transformation-survey.html>

Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: What are they? *Strategic Management Journal*, 21(10-11), 1105-1121. [https://doi.org/10.1002/1097-0266\(200010/11\)21:10/11<1105::AID-SMJ133>3.0.CO;2-E](https://doi.org/10.1002/1097-0266(200010/11)21:10/11<1105::AID-SMJ133>3.0.CO;2-E)

Ferreira, J. J. M., Fernandes, C. I., & Ferreira, F. A. F. (2019). To be or not to be digital, that is the question: Firm innovation and performance. *Journal of Business Research*, 101, 583-590. <https://doi.org/10.1016/j.jbusres.2018.11.013>

Firican, D. A. (2023). Digital Transformation and Digital Culture: A Literature Review of the Digital Cultural Attributes to Enable Digital Transformation. Proceedings of the International Conference on Business Excellence, 17(1), 791-799. <https://doi.org/10.2478/picbe-2023-0073>

Fitzgerald, M., Kruschwitz, N., Bonnet, D., & Welch, M. (2013). Embracing Digital Technology. *MIT Sloan Management Review*. <https://sloanreview.mit.edu/projects/embracing-digital-technology/>

George, G., & Schillebeeckx, S. J. D. (2022). Digital transformation, sustainability, and purpose in the multinational enterprise. *Journal of World Business*, 57(3), 101326 <https://doi.org/10.1016/j.jwb.2022.101326>

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

Gollhardt, T., Halsbenning, S., Hermann, A., Karsakova, A., & Becker, J. (2020). Development of a Digital Transformation Maturity Model for IT Companies. Proceedings - 2020 IEEE 22nd Conference on Business Informatics, CBI 2020, 1, 94-103. <https://doi.org/10.1109/CBI49978.2020.00018>

Goran, J., Laberge, L., & Srinivasan, R. (2017). Culture for a digital age. <https://www.mckinsey.com/~media/mckinsey/industries/technology%20media%20and%20telecommunications/high%20tech/our%20insights/culture%20for%20a%20digital%20age/culture-for-a-digital-age.pdf?shouldIndex=false>

Hartl, E. (2019). A Characterisation of Culture Change in the Context of Digital Transformation. 25th Americas Conference on Information Systems (AMCIS 2019), Cancun, Mexico, August 15-17, 2019. In: AMCIS 2019 Proceedings https://aisel.aisnet.org/amcis2019/national_cultures_and_is/national_cultures_and_is/2

Henriette, E., Feki, M., & Boughzala, I. (2016). Digital Transformation Challenges. *Digital Transformation Challenges*, 33. <http://aisel.aisnet.org/mcis2016http://aisel.aisnet.org/mcis2016/33>

Kádárová, J., Lachvajdierová, L., & Sukopová, D. (2023). Impact of Digitalization on SME Performance of the EU27: Panel Data Analysis. *Sustainability*, 15(13). <https://doi.org/10.3390/su15139973>

Kao, L. J., Chiu, C. C., Lin, H. T., Hung, Y. W., & Lu, C. C. (2024). Unveiling the dimensions of digital transformation: A comprehensive taxonomy and assessment model for business. *Journal of Business Research*, 176. <https://doi.org/10.1016/j.jbusres.2024.114595>

Katuu, S. (2020). Enterprise Resource Planning: Past, Present, and Future. *New Review of Information Networking*, 25(1), 37-46. <https://doi.org/10.1080/13614576.2020.1742770>

Kotter, J. P. (2006). Leading Change Why Transformation Efforts Fail. www.hbrreprints.org

Lee, C. K. H. (2017). A GA-based optimisation model for big data analytics supporting anticipatory shipping in Retail 4.0. *International Journal of Production Research*, 55(2), 593-605. <https://doi.org/10.1080/00207543.2016.1221162>

Lee, I., & Mangalaraj, G. (2022). Big Data Analytics in Supply Chain Management: A Systematic Literature Review and Research Directions. *Big Data and Cognitive Computing*, 6(1). <https://doi.org/10.3390/bdcc6010017>

Lemon, K. N., & Verhoef, P. C. (2016). Understanding customer experience throughout the customer journey. *Journal of Marketing*, 80(6), 69-96. <https://doi.org/10.1509/jm.15.0420>

Lewin, K. (1947). Frontiers in Group Dynamics. *Human Relations*, 1(1). <https://doi.org/10.1177/001872674700100103>

Li, L. (2022). Evaluation of Digital Transformation Maturity of Small and Medium-Sized Entrepreneurial Enterprises Based on Multicriteria Framework. *Mathematical Problems in Engineering* <https://doi.org/10.1155/2022/7085322>

Li, M., Liu, N., Kou, A., & Chen, W. (2023). Customer concentration and digital transformation. *International Review of Financial Analysis*, 89. <https://doi.org/10.1016/j.irfa.2023.102788>

- Luo, Y., Cui, H., Zhong, H., & Wei, C. (2023). Business environment and enterprise digital transformation. *Finance Research Letters*, 57. <https://doi.org/10.1016/j.frl.2023.104250>
- Martínez-Peláez, R., Ochoa-Brust, A., Rivera, S., Félix, V. G., Ostos, R., Brito, H., Félix, R. A., & Mena, L. J. (2023). Role of Digital Transformation for Achieving Sustainability: Mediated Role of Stakeholders, Key Capabilities, and Technology. *Sustainability*, 15(14). <https://doi.org/10.3390/su151411221>
- Matt, C., Hess, T., & Benlian, A. (2015). Digital Transformation Strategies. *Business and Information Systems Engineering*, 57(5), 339-343. <https://doi.org/10.1007/s12599-015-0401-5>
- Medina, M. J., De Santo, A., Oswald, P., Sokhn, M., & Colla, V. (2024). Digital Business Transformation for SMEs: Maturity Model for Systematic Roadmap. In: Rocha, A., Adeli, H., Dzemyda, G., Moreira, F., Colla, V. (eds) *Information Systems and Technologies. WorldCIST 2023. Lecture Notes in Networks and Systems*, vol 801. Springer, Cham. https://doi.org/10.1007/978-3-031-45648-0_23
- Mittal, S., Khan, M. A., Romero, D., & Wuest, T. (2018). A critical review of smart manufacturing & Industry 4.0 maturity models: Implications for small and medium-sized enterprises (SMEs). *Journal of Manufacturing Systems*, 49, pp. 194-214. <https://doi.org/10.1016/j.jmsy.2018.10.005>
- Nebati, E. E., Ayvaz, B., & Kusakci, A. O. (2023). Digital transformation in the defense industry: A maturity model combining SF-AHP and SF-TODIM approaches. *Applied Soft Computing*, 132. <https://doi.org/10.1016/j.asoc.2022.109896>
- OECD SME and Entrepreneurship Outlook 2023. (2023). OECD. <https://doi.org/10.1787/342b8564-en>
- Oliveira, T., & Fraga Martins, M. (2011). Literature Review of Information Technology Adoption Models at Firm Level. *The Electronic Journal Information Systems Evaluation*, 14, 110. <https://academic-publishing.org/index.php/ejise/article/view/389>
- Oncioiu, I., Bunget, O. C., Türkes, M. C., Capusneanu, S., Topor, D. I., Tamas, A. S., Rakos, I. S., & Hint, M. S. (2019). The impact of big data analytics on company performance in supply chain management. *Sustainability*, 11(18). <https://doi.org/10.3390/su11184864>
- Paulk, M. C., Weber, C. V., Curtis, B., & Chrissis, M. B. (1993). Capability Maturity Model. *IEEE Software*, 10(4), 18-27. <https://doi.org/10.1109/52.219617>
- Roeglinger, M. & Poeppelbuss, J. (2011). What makes a useful maturity model? A framework of general design principles for maturity models and its demonstration in business process management. Discussion Paper WI-327 Proceedings of the Nineteenth European Conference on Information Systems (ECIS 2011), Association for Information Systems (AIS), June 2011. Paper 28 <https://fim-rc.de/Paperbibliothek/Veroeffentlicht/327/wi-327.pdf>
- Radicic, D., & Petković, S. (2023). Impact of digitalisation on technological innovations in small and medium-sized enterprises (SMEs). *Technological Forecasting and Social Change*, 191, 122474 <https://doi.org/10.1016/j.techfore.2023.122474>
- Robertson, G., & Lapina, I. (2023). Digital transformation as a catalyst for sustainability and open innovation. *Journal of Open Innovation: Technology, Market, and Complexity*, 9(1). <https://doi.org/10.1016/j.joitmc.2023.100017>
- Rogers, D. L. (2016). *The Digital Transformation Playbook: Rethink Your Business for the Digital Age*. Columbia University Press. <https://doi.org/10.7312/roge17544>
- Rojas-Segura, J., Faith-Vargas, M., & Martinez-Villavicencio, J. (2023). Conceptualising digital transformation using semantic decomposition. *Tec Empresarial*, 17(3), 63-75. <https://doi.org/10.18845/te.v17i3.6850>
- Sagala, G. H., & Öri, D. (2024). Toward SMEs digital transformation success: a systematic literature review. *Information Systems and E-Business Management*, 22, 667-719. <https://doi.org/10.1007/s10257-024-00682-2>
- Schallmo, D., Lang, K., Hasler, D., Kepler, J., & Ehlig-Klassen, K. (2020). . An Approach for a Digital Maturity Model for SMEs Based on Their Requirements. In: Schallmo, D.R.A., Tidd, J. (eds) *Digitalization. Management for Professionals*. Springer, Cham. https://doi.org/10.1007/978-3-030-69380-0_6
- Schumacher, A., Erol, S., & Sihni, W. (2016). A Maturity Model for Assessing Industry 4.0 Readiness and Maturity of Manufacturing Enterprises. *Procedia CIRP*, 52, 161-166. <https://doi.org/10.1016/j.procir.2016.07.040>
- Sebastian, I. M., Ross, J. W., Beath, C., Mocker, M., Moloney, K. G., & Fonstad, N. O. (2017). How Big Old Companies Navigate Digital Transformation. <https://publikationen.reutlingen-university.de/frontdoor/deliver/index/docId/1501/file/1501.pdf>
- Shi, H., Liu, Y., & Yang, Y. (2024). Enterprise digital transformation and supply chain stability. *Finance Research Letters*, 63. <https://doi.org/10.1016/j.frl.2024.105299>

- Shin, J., Mollah, M. A., & Choi, J. (2023). Sustainability and Organisational Performance in South Korea: The Effect of Digital Leadership on Digital Culture and Employees' Digital Capabilities. *Sustainability*, 15(3). <https://doi.org/10.3390/su15032027>
- Silva, R. P., Mamede, H. S., & Santos, V. (2025). A new proposed model to assess the digital organisational readiness to maximise the results of the digital transformation in SMEs. *Journal of Innovation and Knowledge*, 10(1). <https://doi.org/10.1016/j.jik.2024.100644>
- Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic Capabilities and Strategic Management. *Strategic Management Journal*, 18(7). <https://doi.org/10.1093/oso/9780198781806.003.0019>
- Teichert, R. (2019). Digital transformation maturity: A systematic review of literature. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, 67(6), 1673-1687. <https://doi.org/10.1118/actaun201967061673>
- Telukdarie, A., Dube, T., Matjuta, P., & Philbin, S. (2022). The opportunities and challenges of digitalisation for SME's. *Procedia Computer Science*, 217, 689-698. <https://doi.org/10.1016/j.procs.2022.12.265>
- Tubis, A. A. (2023). Digital Maturity Assessment Model for the Organizational and Process Dimensions. *Sustainability*, 15(20). <https://doi.org/10.3390/su152015122>
- Verhoef, P. C., Broekhuizen, T., Bart, Y., Bhattacharya, A., Qi Dong, J., Fabian, N., & Haenlein, M. (2021). Digital transformation: A multidisciplinary reflection and research agenda. *Journal of Business Research*, 122, 889-901. <https://doi.org/10.1016/j.jbusres.2019.09.022>
- Verhoef, P. C., Kannan, P. K., & Inman, J. J. (2015). From Multi-Channel Retailing to Omni-Channel Retailing. Introduction to the Special Issue on Multi-Channel Retailing. *Journal of Retailing*, 91(2), 174-181. <https://doi.org/10.1016/j.jretai.2015.02.005>
- Vey, K., Fandel-Meyer, T., Zipp, J. S., & Schneider, C. (2017). Learning & Development in Times of Digital Transformation: Facilitating a Culture of Change and Innovation. *International Journal of Advanced Corporate Learning (IJAC)*, 10(1), 22. <https://doi.org/10.3991/ijac.v10i1.6334>
- Vial, G. (2019). Understanding digital transformation: A review and a research agenda. In *Journal of Strategic Information Systems*, 28(2), 118-144. <https://doi.org/10.1016/j.jsis.2019.01.003>
- Von Solms, R., & Van Niekerk, J. (2013). From information security to cyber security. *Computers and Security*, 38, 97-102. <https://doi.org/10.1016/j.cose.2013.04.004>
- Wendler, R. (2012). The maturity of maturity model research: A systematic mapping study. *Information and Software Technology*, 54(12), 1317-1339. <https://doi.org/10.1016/j.infsof.2012.07.007>
- Westerman, G., Bonnet, D., & McAfee, A. (2014). *Leading Digital: Turning Technology into Business Transformation*. Harvard Business Press. <https://hbsp.harvard.edu/product/17039-HBK-ENG>
- Yoo, Y., Boland, R. J., Lyytinen, K., & Majchrzak, A. (2012). Organising for innovation in the digitised world. *Organization Science*, 23(5), 1398-1408. <https://doi.org/10.1287/orsc.1120.0771>
- Zhang, C., Chen, P., & Hao, Y. (2022). The impact of digital transformation on corporate sustainability - new evidence from Chinese listed companies. *Frontiers in Environmental Science*, 10. <https://doi.org/10.3389/fenvs.2022.1047418>

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