Original Research

Strategic Evolution: Enhancing Digital-Transformation Success through Maturity Models

Punita Raj[1*], Salma Zouaoui[2], Ioana Filipas[3], François Marmier[4], Bertrand Rose[5]

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*** Corresponding Author Email, punitaraj01@gmail.com**

1, 4, 5 – University of Strasbourg, CNRS Icube laboratory, Strasbourg, France
2- Department of Industrial Engineering, University of Strasbourg, CNRS Icube laboratory, Strasbourg, France
3- Department of Industrial Management & Innovation, BETA, University of Strasbourg, Strasbourg, France

Abstract
Today's business environment is very dynamic and calls for Digital-Transformation (DT) as a survival trick, especially in the manufacturing sector. This research aims to find out how maturity models affect the success of DT activities within this industry. Through an analysis of multiple case studies using a qualitative approach, the study explores how maturity models like Capability Maturity Model Integration (CMMI) and Digital-Transformation Maturity Model (DTMM) help organisations direct DT. The outcomes demonstrate that maturity models play important roles in strategic alignment, organisational agility, and operational efficiency/innovation improvement programs. This paper also aims at developing a practical framework for assessing and enhancing their digital strategies through maturity models in manufacturing companies. This research advances current knowledge by giving practical insights and valuable advice to manufacturers throughout their lifetimes as well as showing them that they must always be working towards betterment and including all stakeholders' interests if they are to succeed in implementing technological change.

Keywords - Digital transformation; Digital Maturity models; Strategic alignment; Organisational agility; Operational efficiency

INTRODUCTION

Today, organisations must integrate their processes digitally to keep up with the fast-changing business environment [1]. This has resulted in disruption, connection and innovation which had never been experienced before due to digitalisation influence on traditional business paradigms [2]. However, it is not always easy for organisations to direct through the complexities of DT, often failing to fully exploit its potential as a strategic advantage.

Taking into account the fundamental principles of capability assessment and improvement, maturity models provide an effective way of evaluating the level of an organisation's digital capabilities [3, 4]. Initially developed by the Software Engineering Institute (SEI) at Carnegie Mellon University, these models have become essential tools for companies venturing into DT. Maturity models offer a framework that directs enterprises towards increasing their digital abilities in line with corporate strategy while identifying areas that need advancement and those that need sustenance.

Maturity models have been criticised by various scholars [5] while some advocate for their initial diagnostic value as well as roadmap creation during DT.

Maturity models are important in the context of DT because they offer a complete framework to firms for strategic alignment, operational efficiency and innovation [6]. Maturity levels that have specific processes, practices, and capabilities enable an organisation to assess its current state vis-à-vis the desired future state and follow a path towards digital excellence. Considering different maturity stages through digital maturity assessment will lead organisations to identify gaps; focus on initiatives they undertake or not; appropriately allocate resources to ensure sustainable growth in the age of digitisation.

Also, maturity models provide a common language and point of reference among stakeholders in an organisation thus fostering collaboration and communication together with alignment around objectives of DT [7].

The presence of maturity models creates a common language for digital maturity and capability requirements, aligning collective action efforts, accelerating decision-making processes and fast-tracking DT programs.

This paper provides an in-depth analysis of DT and its strategic applications for the success of organisations focusing on the manufacturing industry. This research investigates what maturity models signify as guiding frameworks in directing the journey to DT based on their history that started in software engineering. The research takes examples from case study analysis works to show how useful these models can be across many different organisational contexts.

Through reviewing prior studies, this study will build upon existing research to provide actionable insights and practical guidance for organisations facing challenges associated with DT within their companies. The transformative potential of maturity models is investigated in relation to achieving successful DT within the manufacturing industry.

This research aims to provide new knowledge in the area of DT through an analysis of maturity models and their strategic applications. It will also empower organisations to thrive in the digital era. Following sections will go into the history of these models, cases studies about them, and finding's reviews. The study concludes with recommendations for further research and applications for practice.

LITERATURE REVIEW

Digital transformation (DT) has now become an imperative for organisations that wish to adapt and thrive amid the current fast-paced business environment. Scholars have, in the past, analysed various aspects of DT in their discussions about its definition, drivers, challenges as well as outcomes. This literature review examines the main findings in order to help us understand fully about digital change and how it relates to organisational strategy and firm performance.

Defining Digital Transformation: DT is a strategic, all-encompassing, customer-focused approach that uses digital technologies for organisational change and innovation [8]. It surpasses merely adopting digital tools or automating processes to include rethinking and reshaping business models, strategies, processes, and culture so as to exploit fully the possibilities presented by digital technology. DT concentrates on improving customer experiences through online platforms using data analytics; it employs AI-based insights as well as personalised experiences online thereby helping companies learn more about what customers want based on their preferences and behaviours [9]. Through these means, businesses can establish loyalty among clients who feel perfectly served by giving them the best experience possible via different digital touchpoints [10].

By encouraging innovation, experimentation, approving and fostering a culture of continual learning; DT enables organisations to be agile and responsive to market changes as well as adapt to rapidly changing technology landscape [11]. To enable iterative development and innovation, agile methodologies and design thinking principles are often used [12]. In the digital era, organisations operate within interconnected ecosystems comprising customers, partners, suppliers, and other stakeholders. For creation of new business models, value propositions and revenue streams companies rely on their ability to make use of digital platforms and ecosystems. Digital-Transformation can only be achieved through collaborative innovation and co-creation with ecosystem partners. Meaningful change is the result of strong leadership, visioning process as well as strategic alignment across the organisation towards ensuring sustainable competitive advantage. Additionally, it is crucial that governance structures for strategic planning purposes include performance metrics for guiding and evaluating DT initiatives [13].

Key Drivers: There are several factors that determine DT initiatives in organisations. Cloud computing, the Internet of Things (IoT), artificial intelligence (AI) and big data analytics among others, have opened up opportunities for innovation and efficiency improvement. Organisations must hold DT due to changing customer expectations as well as the effects of digitalisation on market dynamics [14]. Businesses need to adapt their strategies because customers require flawless, personalised and multichannel experiences. To remain relevant and competitive under intense competition and globalisation, companies are forced to adopt digital technologies. Traditional industries are being disrupted by digital native companies

calling for a response from incumbents through digital ventures. Besides that, organisations are compelled to digitise by data safety regulations such as HIPAA, PCI-DSS, GDPR etc. This means that in order to take care of these complexities in DT barrier along with investments made in cybersecurity measures needs to be looked at too.

Challenges: Digital-Transformation is a multifaceted process that poses various challenges for organisations to solve depending on their nature. Some of these include the requirement to rejuvenate obsolete IT infrastructures, surmount cultural barriers and change management, and cope with the shortage of talent and skill gaps [2]. Agility, interoperability as well as scalability can be hindered by legacy systems alongside outdated IT infrastructure which necessitates organisations to revamp such systems while minimising disruptions [15]. Moreover, strong leadership, effective change management practices, culture of innovation and continuous learning are necessary in dealing with cultural resistance [16]. There is also an alarming need for data scientists, AI specialists, cybersecurity experts and digital strategists considering the already existing gap in supply. Data privacy and security concerns are also significant as organisations face increasing scrutiny and regulatory requirements.

Digital-Transformation Initiatives: Digital-Transformation initiatives have strategic implications that help guide organisations toward aligning their goals, resources as well as capabilities with a dynamic digital landscape. It is important to consider aligning these initiatives with business objectives since it helps in the delivery of measurable and tangible business value from digital investments towards sustaining long-term competitiveness [17]. Agile and adaptive strategies are key particularly given rapid technological changes and market disruptions that enable firms to react swiftly to changing customer tastes and preferences. Ecosystem collaboration is also essential as organisations increasingly engage with external partners, suppliers, customers, and industry platforms to co-create value, share resources, and use complementary capabilities [18]. In order for this to be achieved companies must make use of data-driven decision-making so as to optimise processes, personalise customer experiences as well as uncover new business opportunities. Customer-centricity and experience design strategy form a foundation upon which businesses are built; this emphasises on understanding the needs, preferences as well as behaviours of customers for purposes of offering seamless personalised omnichannel experiences. Design thinking principles combined with customer journey mapping can help in value co-creation by customers through product or service development aimed at enhancing brand loyalty [6]. Risk management and cybersecurity considerations are also crucial as they help mitigate threats and safeguard digital assets [19]. Proactive risk management helps the organisations to build trust, mitigate reputational impairment, and safeguard resilience in the face of cyber threats.

***Maturity Models for Digital-Transformation*:** Digital-Transformation maturity models are systematic approaches that evaluate a business's current digital abilities, progress level and preparedness for digital change. They provide the overall overview of the company's digital space comprising technology, procedures, people and culture. Basically, maturity models aim to assist organisations in identifying their actual stage on the way of digitisation process; it helps them to see gaps and possibilities as well as outline actions for further development of digital opportunities [10]. Various dimensions or elements usually make up maturity models including Technology Infrastructure; Organisational Processes; Human Capital; Innovation & Agility; Customer Experience and Data Analytics. As these levels ascend, they stand for different levels of increasing progression into more advanced stages of digitalisation. Digital projects execution, enhancing processes along with developing capabilities represent how an organisation can move across these stages.

Furthermore, organisations could employ established industry association, consulting firms' or academic researchers' existing maturity model or build customised ones to suit their peculiar requirements in terms of industry background and strategic objectives.

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Furthermore, organisations could employ established industry association, consulting firms' or academic researchers' existing maturity model or build customised ones to suit their peculiar requirements in terms of industry background and strategic objectives. However, maturity models can also efficiently measure the contemporary state and plan for future anticipated states, including the identification of essential transformational competences.

Digital-Transformation in Specific Contexts: Digital-Transformation is not only complex but also context-specific, industry-specific and organisation specific. It encompasses a variety of factors including sector-specific conditions, geographical and cultural characteristics as well as size, structure or organisation. Omnichannel, personalisation with improved customer experiences and virtual shopping powered by augmented reality are some practices that retail have embraced. The health care industry relies upon electronic heath records, telemedicine, wearable devices and predictive analytics for holistic personalisation of treatments. On the other hand, Manufacturing incorporates IoT, robotics & AI and big data analytics to form greenfield factories which can practically predict maintenance and provide less expensive production processes [16, 20]. As example, also pace and character of DT is determined depending on the geographic/geo-cultural context.

Moreover, developed vs. developing economies might have better a digital infrastructure or higher levels of digital literacy that speed up the integration with hard-tech solutions in many ways(arguments). Speed and success of DT initiatives are not only influenced, but highly dependent on cultural attitudes towards technology/technological innovation/risk-taking. This ability to change at a rapid pace is why organisations working in cultures where experimentation and agility are valued can more easily adjust to digital. The size and structure of the organisations also influence their journey with DT [21-23]. Limited resources and organisational inertia of SMEs render it difficult to introduce new technologies, though digitalised solutions enable agile and niche-specific phenomena for many small companies who are effective competition to larger rivals [10]. Big enterprises frequently struggle with legacy systems, siloed departments, and resistance to change, but may have improved resources and competences to advance in transformative digital projects.

Digital-Transformation and Sustainability: Digital-Transformation and Sustainability are inter-connected areas in our life that can greatly contribute to sustainability of the environment, society as well economy. These realms cover methods of addressing smart energy management, circular economy measures and green supply chains [24, 25]. For example, because of digital technologies i.e., IoT sensors and smart meters real-time energy monitoring has become a norm for building operations and manufacturing plants around the world that helps improve efficiency in how our buildings consume electrical power. Sharing and re-using resources, extending the life of products as long as possible, and avoiding waste generation are a few examples in which digital platforms help to accelerate the transition towards circular economy [25]. Better and easily accessible internet could solve social sustainability, allowing people to work from home or have flexible hours with both digital inclusion that would allow healthcare for all.

Efforts aimed at reducing digital inequality include offering cheap Internet connection and computer education can benefit society and members of society. Digital technologies can also improve work–life separation and accommodate various flexibility needs for workers while decreasing commuting and, thus, carbon footprint. E-conomy sustainability enhancement can be by digital entrepreneurship, skills, and business models. New technologies facilitate the introduction of innovations formed by new entrepreneurs, new business models, new products and services to solve society's problems and advance the economy [26]. Training and education for skills development enhances the required skill set necessary to occupy the available jobs, and enables people to deal with the aspects of the new world digital economy for the enhancement of economic development [27]. The combination of the DT and sustainability can go hand in hand in solving some of the contemporary environmental, social and economic issues.

RESEARCH GOALS

Building upon the insights gleaned from the literature review, this study aims to address the following research goals: Building upon the insights gleaned from the literature review, this study aims to address the following research goals:

- **Understanding Digital-Transformation Dynamics:** Examine the shift to digital, a concept, drivers, challenges, and its management from a strategic perspective. This entails an examination of, first, what DT is and signifies along with the drivers and risks organisations endure, and lastly, the strategic consequences that the move bears. This goal will be based on the supporting works by [28-29, 9].
- **Exploring Maturity Models:** Sample current maturity models for digital business, review their structures, elements and cases. The emphasis is made on the description of how these models contribute to the organisation's preparedness and effectiveness when employing DT. This involves studying the nature and components of various maturity models and their application in various organisations. Information is derived from papers by [30-31].
- **Analysing Digital-Transformation in Specific Contexts:** Research features and characteristics of DT in different contexts like education (HE), health care and production. Preface This goal entails having an understanding of each of the identified sectors and the day-to-day issues, potential, and approaches surrounding it. In this regard, through employing crisp category, the study seeks to pinpoint strengths and weaknesses of DT within a certain sector.

Benavides et al. [32], Kraus et al. [10], and Castelo-Branco et al. [33] can be considered as the basis for the presented investigation.

- **Examining the Intersection of Digital-Transformation and Sustainability:** Assess the relationships between digital business and sustainability: Look into the ways and extent to which digital initiatives and strategies for green and inclusive growth can be achieved. This entails reviewing the case and theoretical literatures that discuss the role of digital allowing in supporting sustainability.

The purpose of the research is to establish how digital initiatives might be aligned to more general sustainability ambitions. Li et al. [21], Elia et al. [18], and Ghadge et al. [3]'s research informs this analysis.

Whereas, achieving these research objectives, this study aims to add a new knowledge to the existing literature about the dynamics of digitalisation, present ideas and experience about strategies and frameworks for organisational DT maturity, and to unveil the part which digitalisation can play to support the accomplishment of sustainability goals of organisations and industries in different sectors. Thus, the proposed framework should provide useful insights for both researchers and implementers of DT strategies.

RESEARCH METHODOLOGY

This study uses qualitative research methodology to investigates the managerial implications of maturity models for DT. It is appropriate to incorporate quantitative methods when developing a broad understanding of the phenomena like Organisational Change and DT to grasp further intricate factors and stakeholders' experience [34]. Thus, the research is intended to identify the process and factors influencing the use of maturity models, their strengths and barriers in such contexts of practical implementations. The qualitative approach supports the existing quantitative research to DT and maturity models by offering realistic research findings that enhance the theoretical knowledge and its implementation. Unlike some literature, which may provide only a theoretical insight on these concepts, it fills a gap to explain real-life application of these ideas.

- ***Case Study Selection:*** Since the focus was on the ability of the organisations to deliver value to their shareholders, clients and stakeholders, a purposive sampling technique was used, where 32 cases from diverse industries and locations with organisations of various sizes were sampled. The cases were selected based on empirical research evidence of the maturity models being applied in DT programs (Table I). The criteria for choosing the cases included the degree of digital change initiatives, how the maturity models were aligned with the organisation's goals, and the performance improvements resulting from their adoption. Table I Case Study Selection
- ***Data Collection:*** Information was gathered from the analysed cases that include information on the organisation background, DT goals, maturity model frameworks used, processes of implementing DM, and strategic performance. Thus, each of the selected case studies was carefully analysed to identify specific qualitative data necessary to understand the effectiveness of maturity models to support DT.
- ***Data Analysis:*** After extracting data from the selected case studies, quantitative data analysis procedures such as thematic analysis and pattern analysis were considered in order to analyse the data in a mannerised way. Key themes and concepts were revealed and compared with the findings about the use of maturity models in DT covering success factors, challenges, and strategic implications.
- ***Synthesis of Findings:*** To arrive at universal conclusions on the dynamic of digital transformation's strategic development through maturity models, the findings were drawn from the analysed case studies. These were done through distillation of the key lessons learnt every time across the several cases and analysis of patterns and trends.
- ***Triangulation:*** To increase the internal validity of the research and the credibility of the findings of the research, information from the various case studies was triangulated.
- ***Ethical Considerations:*** Issues of ethics were incorporated right from the design of the study up to the completion of the study when informing the participants, confidentiality and data privacy were maintained. Thus, this qualitative research approach was intended to provide the study with significant findings regarding the SWOT of DT maturity models and valuable recommendations for organisations interested in using on the said models for their DT processes.

TABLE I
CASE STUDY SELECTION.

Component	Details	Justification	Keywords/Criteria
Case Study Selection	Initially 32 cases from diverse industries and locations were selected in total using purposive sampling, focusing on the application of maturity models in digital transformation programs.	The selected cases represent a broad spectrum of industry sectors, organisational sizes, and geographical locations, providing a comprehensive understanding of how maturity models are applied in different contexts.	Diversity, Relevance, Representation, Applicability
Selection Criteria	Cases were selected based on empirical evidence of maturity models being applied in digital transformation programs, with a focus on how these models aligned with organisational goals and resulted in performance improvements.	This selection criterion ensures that the cases are directly relevant to the study's objectives, highlighting real-world applications of maturity models in diverse settings.	Empirical Evidence, Alignment with Goals, Performance Impact
Industry Representation	Cases included organisations from various industries, such as manufacturing, finance, retail, telecommunications, and technology.	The inclusion of multiple industries ensures that the findings are not industry-specific but can be generalised across different sectors. This approach provides a holistic view of maturity model applications.	Cross-Industry Analysis, Generalisability, Sector Diversity
Organisational Size	Cases were drawn from organisations of varying sizes, including SMEs and large multinational corporations.	Including organisations of different sizes allows the study to explore how maturity models are implemented in various organisational contexts, from resource-constrained SMEs to large enterprises with complex infrastructures.	Scalability, Organisational Complexity, Resource Variability
Geographical Diversity	The cases were selected from different geographical regions to capture a global perspective on the application of maturity models.	Geographic diversity ensures that the study considers different market conditions, regulatory environments, and cultural factors, making the findings more globally applicable.	Global Perspective, Cultural Relevance, Market Conditions
Literature Review Selection	Literature sources were chosen based on their contribution to the theoretical framework of digital transformation and maturity models, particularly focusing on studies that provide empirical data or case study analysis.	The literature selected for review supports the theoretical underpinnings of the study, ensuring that the research is grounded in existing knowledge while also identifying gaps that the study seeks to fill.	Theoretical Foundation, Empirical Support, Gap Identification
Keywords for Literature Search	Keywords used in the literature search included "digital transformation," "maturity models," "organisational change," "strategic alignment," "industry case studies," and "empirical research."	These keywords were selected to ensure a comprehensive search that would capture the most relevant studies related to the application of maturity models in digital transformation.	Digital Transformation, Maturity Models, Strategic Alignment, Empirical Studies
Justification for Literature Gaps	Literature gaps were identified where theoretical insights lacked real-world application or where specific industries or organisational contexts were underrepresented.	The identification of these gaps justified the selection of case studies that could address these areas, thus contributing new insights to the field.	Gap Identification, Contribution to Knowledge, Underrepresented Contexts

Component	Details	Justification	Keywords/Criteria
Relevance to Research Questions	Both the selected case studies and literature were aligned with the study's primary research questions, ensuring that they directly contributed to answering the core issues being investigated.	Aligning the selection with research questions ensures that all data and insights gathered are relevant and contribute to the study's objectives.	Research Alignment, Direct Contribution, Focused Inquiry

RESULTS

This section reports on the results from multi-case study research, thereby, presenting a rich description of how the use of maturity models has been approached in the context of DT in a range of Industries and Settings. From the analysis of these case studies, best practices and lessons to be learned in order to improve DT initiatives with the help of maturity models are provided. The detailed analysis of the important findings is presented in the Table II below.

CASE STUDIES

• ***Digital Transformation at LEGO:*** LEGO, a Danish toy company, strategically employed maturity models to adapt its business model in response to shifting consumer preferences and technological advancements [35]. Using maturity models, LEGO improved customer experiences through collaborative mobile apps, user-generated content platforms, and immersive digital experiences like LEGO Worlds. The company's transformation involved using digital design tools, 3D printing technology, and augmented reality (AR) experiences, which simplified innovation in product development. Moreover, LEGO's maturity in digital solutions enabled the optimisation of its supply chain operations, leading to improved inventory management and production efficiency. The company's progression through digital maturity phases resulted in augmented customer engagement, streamlined operations, and significant revenue growth. This case represents how a traditional company can strategically use maturity models to initiate innovation, improve brand engagement, and reinvent its business model.

• ***Industry 4.0 Implementation at Siemens:*** Siemens, a global leader in electrification, automation, and digitalisation, embarked on an Industry 4.0 transformation by strategically covering maturity models to enhance its manufacturing processes. The adoption of advanced technologies such as IoT devices, sensors, and robotics facilitated autonomous production and real-time data analytics, thereby allowing seamless integration and communication across machines, systems, and processes [36]. Siemens utilised digital twin technology to create virtual replicas of its physical assets, consenting predictive maintenance and optimisation of apparatus performance. Submitting big data analytics and machine learning algorithms for real-time data analysis authorised proactive decision-making and continuous improvement. Robust cybersecurity measures further protected Siemens' digital infrastructure. This case validates how Siemens used digital maturity models to revolutionise its manufacturing processes and accomplish operational excellence through digitalisation.

• ***Digital-Transformation in Small and Medium-sized Enterprises (SMEs):*** A German family-owned manufacturing company successfully utilised maturity models to guide its DT strategy and maintain competitiveness in a digitalised market [37]. The company automated monotonous tasks, employed advanced data analytics tools, and optimised its supply chain management. Improved customer engagement was achieved through digital channels such as social media and e-commerce platforms. The company also prioritised employee training and upskilling programs, which fostered a culture of innovation and continuous improvement. This case highlights the importance of strategic planning, leadership commitment, and employee engagement in driving successful DT initiatives in SMEs, highlighting the role of maturity models in transforming smaller enterprises.

• ***Digital-Transformation at Walmart:*** Walmart, a traditional retail giant, strategically applied digital maturity models to transform its operations and remain competitive in the digital age. The company expanded its online presence through strategic acquisitions and partnerships, thereby enhancing its e-commerce infrastructure [38]. Walmart integrated online and offline channels by offering services like click-and-collect and in-store pickups. The application of advanced technologies, such as RFID tagging, IoT sensors, and blockchain, optimised Walmart's supply chain operations. Additionally, data analytics and personalisation were employed to understand customer preferences and tailor marketing campaigns. The structured application of maturity models enabled Walmart to achieve revenue growth, improved customer satisfaction, and improved operational agility.

• ***Digitalisation in Manufacturing at BMW:*** BMW, a leading automotive manufacturer, employed digital maturity models to transform its manufacturing operations. The company adopted smart production systems that utilised IoT sensors, connected devices, and advanced robotics for real-time monitoring of equipment performance, predictive maintenance, and remote

troubleshooting. These efforts reduced downtime and increased productivity [32]. By implementing digital twins to simulate and optimise manufacturing processes and utilising big data analytics and artificial intelligence for actionable insights, BMW advanced its digital maturity. Additionally, the adoption of 3D printing for high-precision, customisable components and the use of collaborative robots improved worker safety and throughput. BMW's digitalisation efforts, guided by maturity models, have driven innovation, agility, and competitiveness, accelerating the time-to-market for new vehicles.

• ***Digital-Transformation in Financial Services at JPMorgan Chase:*** JPMorgan Chase, a global financial institution, utilised digital maturity models to drive its DT, fundamentally changing the banking industry. The company invested heavily in digital platforms, allowing customers to perform various banking transactions anytime and anywhere [39]. By employing big data analytics, JPMorgan Chase personalised services to meet individual customer needs, enhancing satisfaction and loyalty. The company introduced mobile payment solutions and digital wallets, integrating with popular platforms like Apple Pay and Google Pay. Additionally, the exploration of blockchain and distributed ledger technology for cross-border payments, trade finance, and securities settlement illustrated the firm's digital maturity progression. Robotic process automation was utilised to automate repetitive tasks, improving operational efficiency and accuracy.

• ***Digitalisation in Supply Chain Management at Amazon: Amazon***, an e-commerce giant, pioneered the use of maturity models to guide DT in supply chain management. The company made substantial investments in robotics technology, such as Kiva robots, to automate tasks and improve operational efficiency [40]. AI and machine learning algorithms were used to optimise supply chain operations by analysing data, allowing dynamic pricing strategies and personalised product recommendations. IoT devices and sensor technology provided real-time monitoring of inventory, equipment, and vehicles, offering valuable insights into asset utilisation and performance. Innovations such as drone delivery, autonomous vehicles, and delivery lockers contributed to faster, more convenient, and contactless delivery options. Amazon's digitalisation efforts, informed by maturity models, have resulted in operational efficiency, cost savings, and improved customer satisfaction, creating an agile, responsive, and resilient supply chain network capable of meeting global e-commerce demands.

• ***Digital-Transformation in Telecommunications at Verizon:*** Verizon, a global telecommunications company, applied digital maturity models to lead its DT, focusing on modernising infrastructure, enhancing customer experiences, and driving innovation through digital technologies [26]. Key initiatives included the deployment of a 5G network, which offers faster data speeds and improved connectivity. Verizon's 5G Ultra-Wideband network is set to revolutionise industries such as healthcare, manufacturing, and entertainment with AR, VR, and autonomous vehicles. The company also offered IoT solutions and services to optimise operations and unlock new revenue streams. Verizon's cloud infrastructure and edge computing capabilities enabled businesses to accelerate DT and determine innovation. By embracing emerging technologies, modernising infrastructure, and prioritising customer-centricity, Verizon has maintained its leadership position, demonstrating the effectiveness of maturity models in delivering transformative digital experiences.

Effectiveness of Maturity Models

The effectiveness of maturity models in determining DT success is evident across various industries and organisational contexts. These models provide structured frameworks that enable organisations to assess their digital maturity, identify areas for improvement, and strategically plan transformation efforts. For example, LEGO's application of maturity models facilitated the integration of advanced technologies, leading to innovation and efficiency gains. Similarly, Siemens' and JPMorgan Chase's structured use of maturity models enabled them to align digital initiatives with business objectives, resulting in significant operational improvements and customer satisfaction.

Strategic Alignment and Organisational Agility

Maturity models play a crucial role in ensuring strategic alignment and enhancing organisational agility. By assessing various dimensions of digital capability, these models help organisations identify gaps and align their digital initiatives with broader business goals [36]. For instance, Walmart and Siemens used maturity models to prioritise DT initiatives that were strategically important, ensuring they could respond quickly to market changes and technological advancements (Table II). This strategic alignment enabled them to achieve greater agility, allowing them to capitalise on new opportunities and maintain competitive advantage.

Table II
Findings from the case Studies and Literature Review

Aspect	Key Findings	Implications	References
Strategic Alignment	Maturity models ensure digital initiatives align with the organization's strategic goals.	Enhances overall strategic coherence and effectiveness, ensuring digital transformation contributes to long-term business objectives.	Verhoef et al. [6]
Organizational Agility	Regular evaluation of digital maturity allows organizations to quickly adapt to changes.	Facilitates proactive adjustments to strategies, enabling organizations to capitalize on new opportunities and mitigate risks in a dynamic environment.	Kraus et al. [10]
Cross-Functional Collaboration	Maturity models foster synchronization across different departments.	Improves resource allocation and leverages subject-matter expertise, enhancing the effectiveness of digital transformation initiatives.	Kao et al. [8]
Cultural Transformation	Continuous use of maturity models encourages a culture of innovation and adaptability.	Promotes open-mindedness, flexibility, and a willingness to experiment, driving continuous improvement and successful digital transformation.	Malysheva and Kharlamova, [5]
Work Process Optimization	Systematic assessment identifies deficiencies in existing processes and structures.	Guides organizations in reconfiguring operations, adopting new technologies, and redesigning structures to better support digital transformation.	Matarazzo et al. [7]
Stakeholder Engagement	Effective communication and alignment with stakeholders are crucial for success.	Ensures sustained engagement and support, making it easier to implement changes and achieve strategic goals.	Sjödin et al. [23]
Continuous Improvement	The cyclical nature of strategic alignment through maturity models promotes ongoing refinement.	Enhances organizational resilience and sustainability by enabling continuous learning and adaptation to emerging challenges.	Pan and Zhang, [22]
Performance Measurement	Use of balanced scorecards and KPIs to track digital transformation progress.	Provides a clear mechanism for measuring the impact of digital initiatives, ensuring they deliver value and align with strategic objectives.	Lichtenthaler, [25]
Risk Management	Maturity models offer frameworks to identify and mitigate risks associated with digital transformation.	Helps organizations proactively address potential threats, such as cybersecurity risks, ensuring a more secure and resilient digital transformation process.	Tsakalidis et al. [26]
Resource Allocation Efficiency	Maturity models guide the effective allocation of resources towards high-impact digital initiatives.	Optimizes the use of financial, human, and technological resources, ensuring that investments in digital transformation yield maximum returns.	Nebati et al., [41]
Employee Empowerment and Training	The implementation of maturity models often necessitates targeted employee training and skill development.	Fosters a workforce that is better equipped to handle digital tools and processes, increasing overall organizational competency and readiness for digital transformation.	Joel et al., [14]
Technology Integration	Maturity models facilitate the seamless integration of new technologies into existing systems.	Ensures that technological advancements are adopted efficiently, minimizing disruptions and maximizing the benefits of digital innovations.	Nambisan et al. [42]
Change Management	Maturity models provide a structured approach to managing the changes brought by digital transformation.	Enhances the organization's ability to navigate the complexities of transformation, ensuring smoother transitions and higher adoption rates.	Horváth and Szabó, [2]
Market Competitiveness	Organizations using maturity models can better benchmark their digital maturity against industry standards.	Enables companies to identify gaps relative to competitors and to innovate more effectively, improving their market position and competitive edge.	Singh and Hess, [38]
Customer Experience Enhancement	Maturity models enable organizations to align digital initiatives with customer needs and preferences.	Results in improved customer satisfaction and loyalty by delivering more personalized and efficient digital services.	Ghadge et al. [3]

Aspect	Key Findings	Implications	References
Innovation Acceleration	Maturity models encourage the exploration of emerging technologies and new business models.	Drives faster innovation cycles and helps organizations stay ahead of industry trends, leading to sustained growth and differentiation in the market.	Warner and Wäger, [17]

Improved Operational Efficiency and Innovation

One of the key outcomes of applying maturity models is improved operational efficiency and innovation. By providing a structured approach to identify inefficiencies and bottlenecks, maturity models guide organisations in streamlining operations and improving overall efficiency [21]. Companies like BMW and Amazon have leveraged these models to optimise manufacturing processes and supply chain operations, resulting in faster time-to-market and innovative product offerings. Additionally, the structured adoption of new technologies, facilitated by maturity models, has driven continuous improvement and fostered a culture of innovation.

Adoption Challenges and Success Factors

While maturity models offer significant benefits, their adoption and implementation can present challenges, such as organisational resistance to change and resource constraints [22]. For example, SMEs may struggle with the complexity of maturity model frameworks and the need for substantial investments in technology and training. However, success factors such as strong leadership commitment, stakeholder engagement, and tailored frameworks can mitigate these challenges. Companies like Siemens and JPMorgan Chase have demonstrated that executive sponsorship and a clear vision for DT are critical for overcoming resistance and ensuring successful implementation.
Table 2 Findings from the case Studies and Literature Review

Discussion

Strategic Alignment and Organisational Agility: The practical application of maturity models demonstrates their critical role in achieving strategic alignment and enhancing organisational agility. Maturity models provide organisations with a structured roadmap that reflects their current digital state and guides future DT efforts in alignment with comprehensive strategic objectives. Strategic alignment, in this context, is the process through which an organisation's digital initiatives are closely integrated with its overarching strategic plans, goals, and objectives. This alignment ensures that DT efforts are not isolated but are integral to the organisation's broader strategic vision, thereby increasing overall strategic coherence and effectiveness.

Maturity models further enable organisations to become more agile in response to dynamic business environments [13]. By regularly assessing their digital maturity, organisations can quickly adapt to emerging opportunities or mitigate potential threats. This continuous evaluation fosters an environment where companies can proactively adjust their strategies to counter competitive pressures and capitalise on new market opportunities. Moreover, maturity models facilitate internal synchronisation across various functions and departments by establishing a standardised language and approach to DT. This unified framework allows organisations to pool resources and use subject-matter expertise across functional areas, thereby enhancing their ability to implement digital initiatives effectively and efficiently.

Implications for Work Processes and Structures: The application of maturity models has significant applications for work processes and organisational structures. Maturity models systematically assess and identify deficiencies within existing processes and structures, aligning them with the objectives of DT. This assessment is crucial for identifying areas where reconfiguration or optimisation is needed to support DT initiatives effectively [43]. Organisations aiming to elevate their digital maturity may need to optimise operational processes, implement new technologies, or redesign organisational structures to better use digital assets. This may involve restructuring teams, enhancing cross-functional collaboration, and investing in employee training to build the necessary digital competencies.

Moreover, the continuous application of maturity models fosters a culture of innovation and adaptability. By regularly assessing digital maturity and setting goals for improvement, these models instil a sense of urgency and drive for innovation within the organisation. This culture encourages open-mindedness and flexibility among the workforce, allowing employees to explore, experiment, and adapt in pursuit of DT objectives. The analysis indicates that maturity models significantly impact

work activities and organisational structures, guiding organisations in defining their digital maturity level, managing change, and encouraging innovative solutions that enhance overall performance.

Practical Framework for Strategic Alignment: Implementing a maturity model requires a practical and pragmatic framework for achieving strategic alignment in DT. Such a framework guides organisations in planning and executing a comprehensive technology strategy that aligns with the organisation's strategic directions [36]. The process begins with evaluating the organisation's current state of digitalisation across key pillars, including technology, data, and people. This assessment is crucial for analysing organisational capabilities, processes, and assets, allowing for the identification of strengths and areas requiring improvement.

A maturity model framework also enables organisations to track progress over time, helping them recognise key focus areas where DT initiatives should begin. It is essential to establish SMART (Specific, Measurable, Achievable, Relevant, Time-bound) strategic objectives before embarking on DT efforts. These objectives should align with the organisation's mission and vision, ensuring that digital initiatives contribute to long-term strategic goals. Additionally, mechanisms such as balanced scorecards can be employed to measure the value of digitalisation initiatives and assess their impact on organisational performance. Periodic assessment and modification of key performance indicators (KPIs) are also necessary to ensure that DT efforts remain aligned with the organisation's evolving strategic objectives.

Stakeholder engagement is another critical component of a successful DT strategy. Effective communication, alignment of stakeholders with strategic goals, and continuous feedback loops are essential for sustaining engagement and driving successful outcomes. Organisations must regularly review and adjust their DT programs to ensure they remain relevant and effective in achieving their strategic objectives. This continuous evaluation process helps identify successful strategies that can be replicated and underlying issues that require resolution. Managers and decision-makers should use these insights to refine their approach to DT, ensuring that resources are allocated effectively and that the organisation remains on track to achieve its strategic goals.

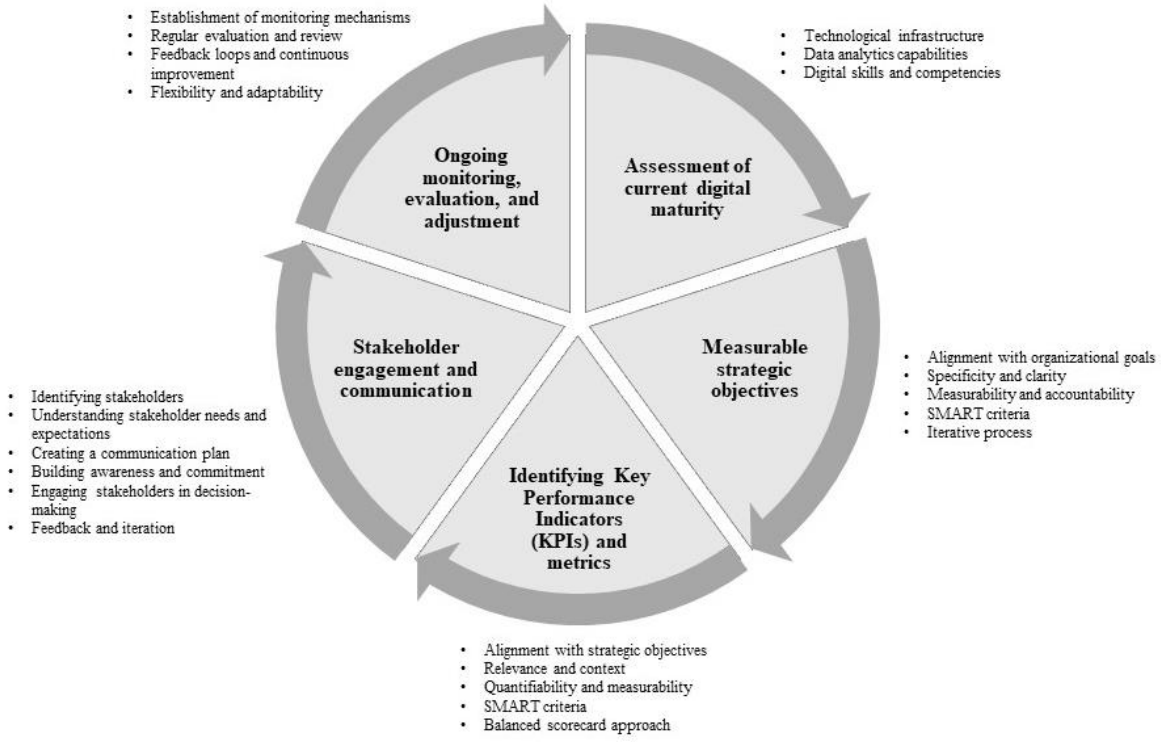

Figure 1
PRACTICAL FRAMEWORK OF STRATEGIC ALIGNMENT

Interconnectedness and Continual Improvement: Strategic alignment in DT is integrally cyclical, involving incessant feedback and improvement. The interconnectedness of strategic alignment processes improves an organisation's ability to adapt and advance in response to new challenges and opportunities. Digital assessment strategies play a vital role in evaluating an organisation's maturity level, setting goals, determining KPIs, and driving constant improvement. The cyclical process of strategic alignment safeguards that organisations can adapt their plans and methods as needed to improve efficiency and effectiveness in executing their DT strategies.

The integration of interdisciplinary cooperation within the organisation fosters a shared understanding of objectives, values, and challenges, enhancing overall organisational resilience. Knowledge management and organisational learning are critical in this context, as they accelerate the rate of innovation and adaptability. By ensuring that every aspect of the organisation is interconnected and continually improved upon, organisations can build resilience and sustainability in the face of digital disruption. The evidence-based findings presented in this discussion provide valuable theoretical frameworks for strategic alignment, allowing organisations to respond to DT challenges with greater purpose and precision.

CONCLUSION

Digital-transformation is a central strategy for survival to competency especially for manufacturing firms in today's fast-changing business environment. This research aimed at establishing the role of maturity models in the DT undertaking in relation to two widely used models: CMMI and DTMM. Conducting a case study analysis on multiple cases for this research has proven the important role of maturity models in facilitating strategic alignment, supporting agility, and increasing organisational operational effectiveness as well as innovation.

The case studies of LEGO, Siemens, BMW and other organisations reveal that the maturity model is the systematic approach to evaluate the company's digital maturity, define the directions for the further development and match the company's digital strategies to the overall business strategy. This alignment ensures that DT initiatives are harmonised with strategic planning to increase their relevance to a firm's vision which in turn increases executive decision-making coherency and effectiveness.

In addition, the study reveals the relevance of monitoring and reassessing student's progress with the help of maturity models. Thus, constant assessment of the digital maturity level enables organisations to quickly adapt to the changes in the business environment, exploiting new opportunities and staying relevant. Through the maturity models, the organisations can harness the member's experience and resources from different areas, as it eradicates the barrier of functional specialisation.

Thus, the given maturity models present significant consequences for work processes and structures. They require adaptation within organisations, such as where new and efficient methods of working, new technologies, and adjustment of the roles for using digital resources to the maximum. This reorganises fosters lean and agile culture as well as encourages experimentation, learning from mistakes and testing of solutions with the aim of determining DT.

Therefore, for helping organisations in the right usage of maturity models, the study has proposed a strategic alignment framework. This framework makes it possible to establish a detailed plan of how to evaluate the level of digital maturity, define realistic and quantifiable objectives and goals based on a strategic vision, identify the role and tasks of stakeholders, and monitor the effectiveness of a company's activities and make the necessary corrections. This application of the framework is a cyclical one and that in some way means that there is always some process going on to keep an organisation's DT efforts both relevant and efficient.

In essence, maturity models are rather valuable instruments that should not be neglected when it comes to managing digitalisation strategies in the manufacturing context and other industries. Organisations can use them as a conceptual framework that enforces a systematic and thorough method for identifying, designing, and implementing digital strategies, allowing organisations to manage digitalisation initiatives proactively and effectively. Thus, through such initiatives as strategic alignment, operational efficiency, and innovation, the maturity models allow entities to be successful and effective in the digital environment and gain sustainable competitive advantages. These models have only been implemented in a limited number of contexts and organisations; therefore, empirical research in other industry sectors and organisations should be encouraged to verify the models' success and identify possible ways to improve their applicability.

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