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DATA-DRIVEN ASSESSMENT OF DIGITAL MATURITY IN INDUSTRIAL ENTERPRISES: A MULTI-LAYER MODEL FOR STRATEGY AND TRANSFORMATION READINESS

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Abstract. Industrial firms continue to experience substantial obstacles when attempting to adopt and operationalise key Industry 4.0 technologies. These challenges are often rooted in fragmented decision-making, inconsistent alignment between digital initiatives and corporate strategy, and limited analytical tools for verifying the actual state of organisational readiness. This paper proposes and validates a structured methodology for assessing the conformity of organisational processes with a generic digital maturity model through a multi-stage, evidence-based approach. The method integrates a systematic literature review, in-depth examination of internal corporate documentation, and a weighted matrix analysis applied to empirical data from an industrial firm. This procedure produces both an overall digital maturity index and a detailed layer-based profile covering strategic alignment, cost management, human resource capabilities, and implementation practices. The study introduces the concept of a “digital strategic centre of gravity” as an analytical instrument for identifying disproportions across maturity layers and tracing their causal mechanisms. This indicator enables the formulation of targeted, actionable recommendations aimed at restoring balance in the digital transformation trajectory. Empirical results reveal that the predominant constraints arise from insufficient alignment between digital and corporate strategies, weak cost governance mechanisms, and substantial competency gaps within the workforce. The proposed methodology moves beyond subjective self-assessments by offering a quantified, data-driven verification procedure. In doing so, it enhances diagnostic precision, strengthens strategy execution, and provides managers with a replicable framework for guiding evidence-based digital transformation.

Keywords: digital maturity; Industry 4.0; strategic management; manufacturing; balanced scorecard

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JEL Classifications: L00, M15, O30

1. Introduction

In the current era of Industry 4.0, industrial enterprises face the need to integrate the principles of digital transformation into both their core and supporting processes (Lenart-Gansiniec, 2019; Liebrecht et al., 2021; Šafránek & Míkle, 2022). The integration of these principles has become an essential prerequisite for maintaining competitiveness in an increasingly dynamic and technology-driven market environment. Nevertheless, digitalisation does not exclusively generate progress it simultaneously introduces new organisational challenges and implementation barriers (Angelopoulou et al., 2020; Kuba & Milichovský, 2019). Among the most significant barriers are the high initial costs required to obtain and integrate the necessary hardware and software solutions, together with the insufficient digital maturity of organisations (Mon & Del Giorgio, 2022; Ratnasingam et al., 2020). Digital maturity itself can be interpreted through two complementary

dimensions: the adequacy of an organisation's strategic approach to digital transformation and the overall digital literacy level of its workforce. An incomplete or incoherent digitalisation strategy often results in the inefficient allocation of financial resources or an inaccurate assessment of the organisation's current digital status (Halse & Jæger, 2019; Di Bona et al., 2021). When the digital strategy is poorly aligned with the organisation's overall strategic direction, instead of improving performance, digital initiatives may even deteriorate operational efficiency or negatively affect the financial situation, employee motivation, or competence development (Tay et al., 2021). Given that digitalisation is closely intertwined with investment decision-making, LEAN management, quality control, and logistics, its adoption must be approached holistically, encompassing both value-creating and support processes (Naciri et al., 2022; Domanižová et al., 2020). A clear understanding of a company's digital maturity thus represents a crucial prerequisite for overcoming these obstacles. Assessing the current state of maturity enables organisations to adapt their strategic goals, design training programmes that enhance employees' readiness for new technologies, and allocate financial resources more effectively (Cejpek et al., 2025). Therefore, identifying the relationship between an organisation's achieved digital maturity level and its strategic management tools becomes vital. One suitable tool for establishing such a link is the Balanced Scorecard framework, which facilitates the monitoring of digitalisation initiatives, the assignment of responsibilities, and the enhancement of organisational motivation (Ghouri et al., 2021; Talír & Chytilova, 2024). Accordingly, the primary objective of this paper is to assess the level of digital maturity within an industrial organisation and to propose strategic remedial actions based on a generic digital maturity model.

2. Review of literature and Research objective

Digital transformation and organisational readiness represent essential pillars of the Fourth Industrial Revolution, commonly referred to as Industry 4.0 (Zonta et al., 2020; Bigliardi et al., 2022; Isidora et al., 2022). Industry 4.0 encompasses a broad spectrum of technological enablers, including adaptive robotics, data analytics and artificial intelligence, simulation, integrated systems, communication infrastructures, cybersecurity, cloud computing, additive manufacturing, virtual and augmented reality, sensors and actuators, RFID/RTLS, and mobile platforms. The integration of these technologies into organisational processes has therefore become a central topic of contemporary research. Numerous authors, including Soomro et al. (2021) and Suleiman et al. (2022), have examined how industrial organisations operationalise digital transformation under the Industry 4.0 paradigm.

Issa et al. (2018) introduced a conceptual framework for assessing digital transformation progress by defining four maturity stages, ranging from non-systematic digital initiatives to fully integrated inter-organisational value chains. Their model is structured into six implementation milestones. Göklap and Martinez (2021) similarly proposed a six-level maturity framework, developed from an extensive literature analysis, ranging from organisations with no digital transformation activity to those operating autonomous, data-driven value chains supported by predictive analytics. Further contributions include the 6Ps model by Spaltini et al. (2022) and Ecer et al. (2024), which evaluates maturity across six dimensions: products, processes, platforms, people, partnerships, and performance. This model is supported by a detailed evaluation matrix and network visualisations. Similarly, the SIMMI 4.0 model (Schumacher et al., 2019) classifies organisations across five maturity levels and offers practical guidance for progression.

Beyond classification-based models, quantitative approaches also exist. Schumacher et al. (2016) introduced a numerical assessment model comprising 62 criteria across nine organisational dimensions. While offering precise scoring, the reliance on self-assessment introduces subjectivity. Other frameworks share comparable limitations.

Alternative perspectives focus on readiness and competencies. Brozzi et al. (2021) developed a Key Readiness Indicator model, derived from strategy, awareness, and competence domains, tailored specifically for SMEs. Steinlechner et al. (2021) and Mihajlovic et al. (2025) conceptualised digital maturity through employee competences, proposing the DigiCoM model, which evaluates 49 attributes related to digital content, human-machine interaction, human-human interaction and personal development. Machine-learning-based analyses also demonstrate the field's thematic diversity (Lee et al., 2021), while comparative studies, such as those by Kartal et al. (2018), highlight methodological fragmentation across maturity models. This fragmentation

contributes to organisations' difficulty in evaluating their actual maturity level (Schumacher et al., 2019), which in turn impairs investment decisions and transformation planning. Various authors have therefore focused attention on barriers, risks, and causal factors influencing transformation processes (e.g., Raj et al., 2020; Tamvada et al., 2022; Cheng et al., 2025).

The literature consistently stresses that digital transformation is inherently systemic, interdependent and cross-functional (Dossou et al., 2022; Elafri et al., 2022). Synergies with established managerial paradigms such as LEAN have been demonstrated (Satoglu et al., 2018), and Industry 4.0 technologies have been shown to reshape supply chain dynamics (Enrique et al., 2022; García-Reyes et al., 2022), organisational agility (Akhtar et al., 2018) and production planning processes (Colangelo et al., 2022).

3. Methodology

Building on the conceptual and methodological limitations identified in the literature, this research adopts an applied empirical case study design supported by elements of logical and comparative analysis. The aim is to provide a verifiable, data-driven procedure for assessing the digital maturity of an engineering manufacturing organisation and to translate the diagnostic results into strategic guidance. In line with the gaps highlighted above, the study formulates two research questions:

- RQ1: What analytical tool can be used to verify the alignment of organisational processes with the key indicators of a generic digital maturity model?
- RQ2: How can the achieved maturity level be translated into subsequent strategic activities of the organisation?

The study builds on two complementary inputs. First, it extends a conceptual model of organisational digital maturity tailored to industrial contexts, refining it into a verifiable framework (Talír & Chytilová, 2024). Second, it utilises internal operational data from a Czech engineering manufacturing enterprise to demonstrate the verification procedure through two digitalisation projects: *Factory Monitor* (an IoT-based autonomous data acquisition system) and *TrackingApp* (an operator-driven digital reporting system). The combination of automated and manual process data ensures coverage across the production flow. The organisation remains anonymised, and results are analytically rather than statistically generalised.

Generalisation of the Digital Maturity Model

Following the literature's identified need for sector-specific yet generalisable frameworks, the model is adapted for engineering manufacturing. The generalisation synthesises (i) consolidated evidence from maturity literature and (ii) practitioner insights derived from the model organisation's processes. Validity draws on triangulation across literature, enterprise data and structured reasoning, while reliability is ensured through transparent methodological documentation.

Operationalisation Through Key Indicators and Compliance Verification

Each model element is translated into process-oriented key performance indicators (KPIs), which are classified as either attributive or relative. Weighted matrix analysis reflecting both indicator and layer weights quantifies the degree of compliance. Relationship strengths are rated on a five-point scale and transformed into coefficients aggregated into layer scores and an overall maturity index. Visual representations include radar plots and a five-stage maturity classification. Reliability is increased through an explicit coding rubric and replicable calculation steps.

Strategy Optimisation Based on Maturity Knowledge

To address the literature-identified gap regarding strategic applicability, the maturity profile is converted into managerial insights using the concept of a *digital strategic centre of gravity*. This diagnostic tool identifies imbalances between maturity layers and supports targeted corrective actions, drawing on Bowman's strategic logic. Selected KPIs are embedded within a Balanced Scorecard structure to ensure ownership, monitoring, and incentive alignment, establishing a repeatable loop that connects assessment, strategy formation, and execution.

4. Results and discussion

Calculating the digital maturity of an organisation

To evaluate the degree of fulfilment of the individual indicators of the proposed model, the weighted matrix analysis method was applied. This approach enables the determination of both qualitative and quantitative relationships between the organisation's processes and the respective sub-processes (pillars) of the digital maturity model. The horizontal axis of the matrix represents the key sub-processes of digital maturity, while the vertical axis lists the analysed organisation and its implemented projects. The matrix therefore expresses the degree of compliance between the organisation's actual processes and the reference model processes.

For evaluation, the processes were divided into two principal categories according to their measurability: processes measurable by attributive indicators, which are binary in nature and express whether a given condition is fulfilled or not fulfilled, and processes measurable by relative indicators, which are expressed as a percentage of the target level of achievement and therefore allow for a more detailed differentiation of the degree of compliance with the model criteria. Attributive indicators were represented graphically by two extreme values only: no relationship (the condition not met) or a very strong relationship (the condition fully met). Relative indicators were classified according to the level of fulfilment achieved and assigned a graphical symbol representing one of five degrees of relationship strength: none, weak, moderate, strong, and very strong, as shown in Table 1. These degrees were then converted into corresponding coefficients of 0.00, 0.25, 0.50, 0.75, and 1.00, respectively, allowing for a precise numerical transformation of the graphical representation. The respective intervals of compliance were defined as follows: 0–24.9 %, 25–49.9 %, 50–74.9 %, 75–99.9 %, and 100 % +.

Table 1. Graphical transformation of indicators

Symbol	Description	Relative indicator	Attributive indicator
✖	No relationship; coef. 0,00	0 - 24,9 %	No
△	Weak relationship; coef. 0,25	25 – 49,9 %	
○	Moderate relationship, coef. 0,50	50 – 74,9 %	
◎	Strong relationship, coef. 0,75	75 – 99,9 %	
⊙	Very strong relationship, coef. 1,00	100% +	
			Yes

Source: the authors

The conversion between numerical and graphical form provides a transparent overview of how the individual organisational processes correspond to the digital maturity model.

Table 2 illustrates how symbols were assigned to individual processes or projects according to this system. For attributive indicators, only two extremes were possible: no or a very strong relationship, depending on whether the criterion was met. For relative indicators, the achieved percentage of target fulfilment determined the respective level of relationship strength, following the classification system in Table 1. For example, a process achieving 65 % compliance with a target value was classified under the moderate relationship level, as it fell within the range of 50–74.9 %. This rule-based classification eliminates ambiguity and excessive subjectivity typical of self-assessment frameworks by ensuring that a process achieving only 49 % cannot be assessed as moderate but remains in the weak category. This strictness enhances consistency and comparability, while motivating continuous improvement.

Table 2. Matrix analysis of relationship strength

Project		Strategic layer					Cost layer						Personnel layer			Implementation layer			
		KPI I.I.	KPI I.II.	KPI I.III.	KPI I.IV.	KPI I.V.	KPI II.I.	KPI II.II.	KPI II.III.	KPI II.IV.	KPI II.V.	KPI II.VI.	KPI III.I.	KPI III.II.	KPI III.III.	KPI IV.I.	KPI IV.II.	KPI IV.III.	KPI IV.IV.
Factory Monitor	✖	⊙	⊙	⊙	⊙	⊙	✖	✖	✖	✖	△	✖	✖	⊙	⊙	⊙	⊙	⊙	⊙
	✖	⊙	⊙	⊙	⊙	⊙	⊙	✖	✖	⊙	✖	✖	⊙	⊙	⊙	⊙	⊙	⊙	⊙
TrackingApp	✖	⊙	⊙	⊙	⊙	⊙	⊙	✖	✖	⊙	✖	✖	⊙	⊙	⊙	⊙	⊙	⊙	⊙
	✖	⊙	⊙	⊙	⊙	⊙	⊙	✖	✖	⊙	✖	✖	⊙	⊙	⊙	⊙	⊙	⊙	⊙

Source: the authors, data of the company xyz

Since the evaluation of organisational processes' compliance with the digital maturity model is performed using the weighted matrix analysis, it is essential to define appropriate weights for both individual indicators and the model's layers. The weighting system ensures that critical elements exert proportionally greater influence on the final maturity score and that the result reflects not only the extent of compliance but also the strategic significance of each process. Digital maturity is thus perceived as both a layer-specific and a composite organisational characteristic. The weighting rules are straightforward: the sum of the weights of all indicators within a given layer equals 1.00, and the sum of the weights of all layers also equals 1.00. The weighting scheme used in this study is presented in Table 3. The strategic layer received the highest weight of 0.30, as it is considered central to the successful implementation of the Industry 4.0 concept. The cost and people layers were each weighted at 0.20, as they directly translate strategic intentions into operational reality. The remaining portion of the total weight was distributed across implementation-related processes. Within each layer, processes were further differentiated by their importance, specifically whether they represented critical implementation factors such as the existence of a digital strategy, selection of the digitalisation portfolio, or the management of employees' digital competencies. Critical processes were therefore assigned higher weights based on empirical findings from the model organisation operating in the engineering manufacturing sector.

Table 3. Possible weights for each indicator

	Strategic layer					Cost layer						Personnel layer			Implementation layer				
	KPI I.1. <i>The existence of a digital strategy</i>	KPI I.2. <i>Degree of fulfilment of the H.O concept</i>	KPI I.3. <i>Investment estimate</i>	KPI I.4. <i>Investments in AOP</i>	KPI I.5. <i>Achieving implementation milestones</i>	KPI II.1. <i>Portfolio of technical options</i>	KPI II.2. <i>Portfolio selection</i>	KPI II.3. <i>Project creation</i>	KPI II.4. <i>Investment plan</i>	KPI II.5. <i>ROI in the first year of operation</i>	KPI II.6. <i>Financial plan</i>	KPI III.1. <i>Definition of the digital mature worker profile</i>	KPI III.2. <i>Staff status</i>	KPI III.3. <i>Qualification level of staff</i>	KPI IV.1. <i>Cooperation with the supplier</i>	KPI IV.2. <i>Purchase price deviation</i>	KPI IV.3. <i>Installation status</i>	KPI IV.4. <i>Test phase action plan</i>	KPI IV.5. <i>Starting the sharp phase</i>
Weight of indicator	0,5	0,1	0,1	0,2	0,1	0,1	0,2	0,2	0,1	0,2	0,2	0,5	0,25	0,25	0,2	0,2	0,2	0,2	0,2
Σ	1					1						1			1				
Weight of layer	0,3					0,2						0,2			0,3				
Σ	1																		

Source: the authors

Once the weighting framework had been established, the graphical symbols were converted into numerical coefficients, as outlined in Table 1, yielding a structured dataset presented in Table 4. Each coefficient expresses the level of fulfilment of the given indicator within a specific project or process. At this stage, the purpose of the numerical conversion was not to calculate the overall level of digital maturity, but rather to standardise the data for further weighted aggregation and analysis.

Table 4. Numerical expression of the forces of the relationship

Project	Strategic layer					Cost layer						Personnel layer			Implementation layer				
	KPI I.I.	KPI I.II.	KPI I.III.	KPI I.IV.	KPI I.V.	KPI II.I.	KPI II.II.	KPI II.III.	KPI II.IV.	KPI II.V.	KPI II.VI.	KPI III.I.	KPI III.II.	KPI III.III.	KPI IV.I.	KPI IV.II.	KPI IV.III.	KPI IV.IV.	KPI IV.V.
Factory Monitor	0	0,75	1	1	0,5	0	0	0	0	0,25	0	0	0,5	1	0,75	1	1	0,75	1
TrackingApp	0	0,75	1	1	0,75	1	1	0	0	1	0	0	0,5	1	1	1	1	1	1

Source: the authors, data of the company xyz

Subsequently, each coefficient was multiplied by the corresponding indicator weight (coefficient × weight), ensuring that more significant indicators and processes contribute proportionally more to the final outcome. Summing these weighted scores within each layer produces the weighted layer score, which expresses how well the organisation aligns with the model in that specific area. The maximum achievable score for each layer equals 100 % (coefficient 1.00). Repeating this procedure for all layers and projects enables the identification of well-performing areas and areas requiring improvement. The aggregated results for each layer are summarised in Table 5.

Table 5. Weighted expression of digital maturity in each layer

Project	Strategic layer					Cost layer					Personnel layer			Implementation layer					
	<i>The existence of a digital strategy</i> KPI I.I.	<i>Degree of fulfilment of the 14.0 concept</i> KPI I.II.	<i>Investment estimate</i> KPI I.III.	<i>Investments in AOP</i> KPI I.IV.	<i>Achieving implementation milestones</i> KPI I.V.	<i>Portfolio of technical options</i> KPI II.I.	<i>Portfolio selection</i> KPI II.II.	<i>Project creation</i> KPI II.III.	<i>Investment plan</i> KPI II.IV.	<i>ROI in the first year of operation</i> KPI II.V.	<i>Financial plan</i> KPI II.VI.	<i>Definition of the digital mature worker profile</i> KPI III.I.	<i>Staff status</i> KPI III.II.	<i>Qualification level of staff</i> KPI III.III.	<i>Cooperation with the supplier</i> KPI IV.I.	<i>Purchase price deviation</i> KPI IV.II.	<i>Installation status</i> KPI IV.III.	<i>Test phase action plan</i> KPI IV.IV.	<i>Starting the sharp phase</i> KPI IV.V.
Factory Monitor implementation	0	0,075	0,1	0,1	0,05	0	0	0	0	0,25	0	0	0,13	0,25	0,15	0,2	0,2	0,15	0,2
Factory Monitor by layers	42,5%					5,0%					37,5%			90,0%					
TrackingApp implementation	0	0,075	0,1	0,2	0,075	0,1	0,2	0	0	0,2	0	0	0,13	0,25	0,2	0,2	0,2	0,2	0,2
TrackingApp by layers	45,0%					50,0%					37,5%			100,0%					

Source: the authors, data of the company xyz

The overall level of digital maturity of the organisation was then determined by aggregating the weighted scores of all layers, using the predefined layer weights. The result represents the weighted overall conformity of the organisation with the digital maturity model, i.e. its quantified level of digital maturity. This allows for a holistic evaluation that integrates all dimensions, i.e., strategic, cost-related, human, and implementation into one composite indicator of organisational readiness for digital transformation. The resulting value, presented in Table 6, expresses the overall fit of the analysed organisation with the reference model in percentage terms.

Table 6. Resulting digital maturity of the organisation

Project	Strategic layer					Cost layer						Personnel layer			Implementation layer				
	The existence of a digital strategy	Degree of fulfilment of the 14.0 concept	Investment estimate	Investments in AOP	Achieving implementation milestones	Portfolio of technical options	Portfolio selection	Project creation	Investment plan	ROI in the first year of operation	Financial plan	Definition of the digital mature worker profile	Staff status	Qualification level of staff	Cooperation with the supplier	Purchase price deviation	Installation status	Test phase action plan	Starting the sharp phase
	KPI I.I.	KPI I.II.	KPI I.III.	KPI I.IV.	KPI I.V.	KPI II.I.	KPI II.II.	KPI II.III.	KPI II.IV.	KPI II.V.	KPI II.VI.	KPI III.I.	KPI III.II.	KPI III.III.	KPI IV.I.	KPI IV.II.	KPI IV.III.	KPI IV.IV.	KPI IV.V.
Factory Monitor implementation by layers			42,50%						5,00%					37,50%			90,00%		
Overall weighted digital maturity of the project			12,75%						1,00%					7,50%			27,00%		48,25%
Tracking app implementation by layers			45,00%						50,00%					37,50%			100,00%		
Overall weighted digital maturity of the project			13,50%						10,00%					7,50%			30,00%		61,00%
Total weighted digital maturity of the layer			43,79%						45,91%					37,50%			95,26%		
Overall weighted digital maturity of the organisation			13,14%						9,18%					7,50%			28,58%		58,40%
	0,5	0,1	0,1	0,2	0,1	0,1	0,2	0,2	0,1	0,2	0,2	0,5	0,25	0,25	0,2	0,2	0,2	0,2	0,2

Source: the authors, data of the company xyz

To complement the numerical results, a network (radar) graph was developed to visualise the mutual alignment of the four key layers of the digital maturity model with the organisation's corresponding activities. The axes of the graph represent the four dimensions of digital maturity, each scaled from 0 to 100 %. The position of each axis point corresponds to the calculated weighted score of the respective layer. A perfectly balanced and digitally mature organisation would be represented by a symmetrical square with axes of equal length, illustrating proportional development across all pillars. Deviations from symmetry reveal imbalances such as stronger strategic capability but weaker financial planning or human resource readiness, which in turn highlight the need for corrective actions. The graphical representation of digital maturity is shown in Figure 1. This visualisation not only summarises the organisation's current maturity level but also provides a diagnostic basis for monitoring progress over time and prioritising strategic initiatives for further improvement.

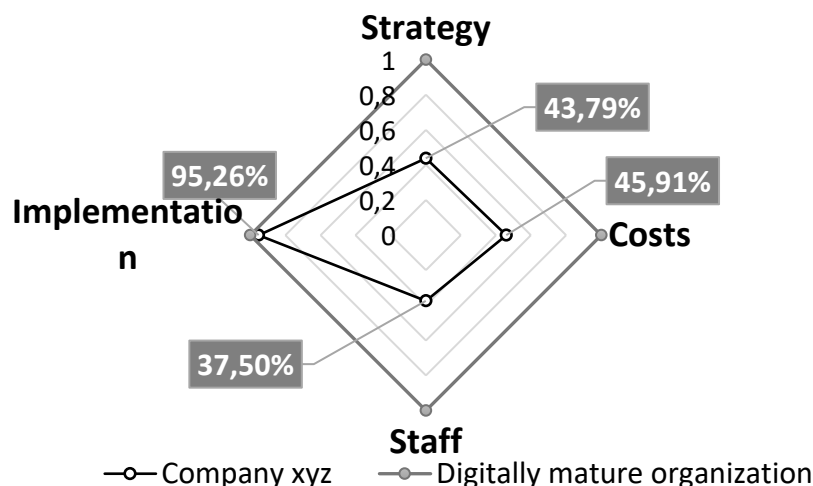


Figure 1. Graphical representation of digital maturity

Source: the authors

Scaling the level of digital maturity

Building on the quantified weighted correspondence of organisational processes with the general digital maturity model, it becomes possible to express digital maturity as a structured, multi-stage scale. This scaling enables the identification of the organisation's current position on the digital transformation pathway and provides a methodological basis for defining strategic actions required to advance to higher maturity levels. Unlike many traditional models that conceptualise digital maturity as a single, aggregate characteristic of an organisation, the proposed approach recognises its multidimensional nature. By decomposing digital maturity into several analytical layers, strategic, cost, people, and implementation, it allows for a more nuanced evaluation that highlights imbalances and specific areas for targeted improvement. This layer-based scaling thus overcomes the limitations of monolithic maturity assessments that often neglect the contribution of individual subprocesses to overall digital readiness.

In this approach, the scaling process is performed sequentially for each sub-layer of digital maturity, and is visually supported by a network graph that captures the mutual relationships among all four layers. Each stage of the scale is further supplemented by a descriptive narrative, specifying the organisational characteristics and the state of processes corresponding to that maturity level. This detailed categorisation is especially relevant for retrospective model validation or for advanced stages of digital technology implementation, where certain stages of the scale may no longer be fully applicable. The division into distinct layers also facilitates the precise targeting of corrective strategic actions, allowing organisations to focus interventions on those areas that most significantly constrain their advancement in digital maturity.

The proposed scale distinguishes five stages of digital maturity, as presented in Table 7. At the lowest level lies an organisation undergoing digital transformation without a coherent plan or integration with its corporate strategy. In this stage, financial resources, timelines, and staff requirements are undefined, and digital initiatives are implemented in a fragmented or ad hoc manner. In contrast, the highest stage, referred to as the maturity level, represents organisations that have fully institutionalised digital transformation practices. These organisations utilise prior implementation experience, have well-defined investment frameworks, continuously monitor costs and savings, and maintain strong collaboration with technology providers to achieve high efficiency in time and resource utilisation. The intermediate stages of cognition, awareness, and integration reflect the progressive accumulation of knowledge, competencies, and managerial practices that enable structured planning, implementation, and evaluation of digital transformation activities. The maturity stage thus serves as a conceptual benchmark for organisational excellence in digitalisation; for this reason, it is represented not as a percentage band but as a milestone symbolising the ultimate alignment between strategic intent and digital capability.

Table 7. Scaling digital maturity

	0 - 24,99 %	25 - 49,99	50 - 74,99 %	75 - 99,99 %	100%
	PHASE OF IMMATURITY	INVITATION PHASE	AWARENESS PHASE	INTEGRATION PHASE	MATURITY PHASE
I. STRATEGY <i>Digital strategy</i>	Not defined	It is not aligned with the company-wide strategy	It is partially aligned with the company-wide strategy	It is aligned with the company-wide strategy	It is an integral part of strategic objectives
II. Cost <i>Investment plan, financial plan</i>	Costs are not planned in advance	Rough investment estimate	Savings are estimated	Calculating cost savings	Precise planning of investment costs and savings, and regular revision
III. PEOPLE <i>Profile of a digitally mature employee</i>	Not defined	Estimate of the number of required employees without defining the profile	The number of required employees and their profile are known	Mapping employee growth against the profile	Motivational system, response to employee needs, knowledge monitoring
IV. IMPLEMENTATION <i>Collaboration with the supplier on customization, adherence to key milestones, procurement efficiency</i>	Ad-hoc implementation, zero customization	Ad-hoc implementation, independent milestones outside the company strategy	Planned implementation, motivating milestones, collaboration with the supplier during customization	Gantt chart, milestones, motivation, and customization with the supplier	Effective collaboration with the supplier, adherence to time and costs, regular milestone review

Source: the authors

Based on the weighted results obtained from assessing the model company, the organisation's overall digital maturity can be classified within this five-level scale. As shown in Table 8, the analysed company (xyz) corresponds to the awareness stage, which indicates that the enterprise has already achieved a basic understanding of the digitalisation concept, implemented specific pilot projects, and established partial procedural structures, yet still exhibits limited integration of these initiatives into its overarching strategic framework. While this level of maturity provides a solid foundation for further digital progress, it also reveals the need for systematic reinforcement of strategic alignment, cost management, and workforce preparedness. However, the classification of overall maturity at this stage does not fully capture the heterogeneity among individual layers of digital maturity, particularly differences in their weighted correspondence to the model and potential imbalances between them.

Table 8. Scaling the overall digital maturity of company xyz

	0 - 24,99 %	25 - 49,99	50 - 74,99 %	75 - 99,99 %	100%
	PHASE OF IMMATURITY	INVITATION PHASE	AWARENESS PHASE	INTEGRATION PHASE	MATURITY PHASE
I. STRATEGY <i>Digital strategy</i>	Not defined	It is not aligned with the company-wide strategy	It is partially aligned with the company-wide strategy	It is aligned with the company-wide strategy	It is an integral part of strategic objectives
II. Cost <i>Investment plan, financial plan</i>	Costs are not planned in advance	Rough investment estimate	Savings are estimated	Calculating cost savings	Precise planning of investment costs and savings, and regular revision
III. PEOPLE <i>Profile of a digitally mature employee</i>	Not defined	Estimate of the number of required employees without defining the profile	The number of required employees and their profile are known	Mapping employee growth against the profile	Motivational system, response to employee needs, knowledge monitoring
IV. IMPLEMENTATION <i>Collaboration with the supplier on customization, adherence to key milestones, procurement efficiency</i>	Ad-hoc implementation, zero customization	Ad-hoc implementation, independent milestones outside the company strategy	Planned implementation, motivating milestones, collaboration with the supplier during customization	Gantt chart, milestones, motivation, and customization with the supplier	Effective collaboration with the supplier, adherence to time and costs, regular milestone review

Source: the authors

To address this limitation, Table 9 presents a layer-specific scaling of digital maturity, ranking each sub-layer of the model within the same five-level framework. This detailed categorisation complements the network graph (Figure 1) and provides a deeper analytical perspective on the distribution of maturity across dimensions. By identifying which sublayers lag behind and which are more advanced, the model supports the design of targeted strategic interventions. Each maturity stage can thus be associated with key implementation milestones already achieved or to be reached in subsequent phases. These milestones serve as practical reference points for organisations seeking to systematically enhance their digital capabilities, ensuring balanced progress across all layers of the model and a gradual transition toward higher stages of maturity.

Table 9. Scaling the overall digital maturity of company xyz by layers

	0 - 24,99 %	25 - 49,99	50 - 74,99 %	75 - 99,99 %	100%
	PHASE OF IMMATURITY	INVITATION PHASE	AWARENESS PHASE	INTEGRATION PHASE	MATURITY PHASE
I. STRATEGY <i>Digital strategy</i>	Not defined	It is not aligned with the company-wide strategy	It is partially aligned with the company-wide strategy	It is aligned with the company-wide strategy	It is an integral part of strategic objectives
II. Cost <i>Investment plan, financial plan</i>	Costs are not planned in advance	Rough investment estimate	Savings are estimated	Calculating cost savings	Precise planning of investment costs and savings, and regular revision
III. PEOPLE <i>Profile of a digitally mature employee</i>	Not defined	Estimate of the number of required employees without defining the profile	The number of required employees and their profile are known	Mapping employee growth against the profile	Motivational system, response to employee needs, knowledge monitoring
IV. IMPLEMENTATION <i>Collaboration with the supplier on customization, adherence to key milestones, procurement efficiency</i>	Ad-hoc implementation, zero customization	Ad-hoc implementation, independent milestones outside the company strategy	Planned implementation, motivating milestones, collaboration with the supplier during customization	Gantt chart, milestones, motivation, and customization with the supplier	Effective collaboration with the supplier, adherence to time and costs, regular milestone review

Source: the authors

Translating the achieved level of digital maturity into corporate strategy

An organisation's knowledge of its achieved level of digital maturity represents a key input for strategic decision-making and for the formulation of corrective actions aimed at enhancing its overall digital capability. The decomposition of digital maturity into four analytical layers, strategic, cost, people, and implementation, enables targeted interventions to be directed precisely toward those organisational areas that exert the strongest influence on the comprehensive maturity outcome. This layered structure enables not only the assessment of the overall state of digital transformation but also the identification of specific dimensions in which imbalances or deficiencies constrain progress.

To visualise these interrelationships, the study introduces the concept of a strategic centre of gravity, reflecting the organisation's current balance across the four maturity layers. This concept enables management to intuitively assess whether the organisation's development is balanced or skewed toward specific areas. The model is based on a two-dimensional coordinate system, where the X-axis represents the implementation and cost layers and the Y-axis represents the people and strategy layers. The origin of the coordinate system marks the ideal equilibrium point corresponding to a fully balanced digital maturity profile. The coordinates of the strategic centre of gravity are calculated as the half-difference between the achieved sub-layer values on each axis, allowing for the determination of its position relative to the origin. This simple yet informative geometric representation makes it possible to visualise deviations from equilibrium and, consequently, to identify directions for future strategic actions.

The interpretation of the centre's position is straightforward. A digitally mature organisation is characterised by a strategic centre of gravity located precisely at the origin of the coordinate system (see Figure 2), signifying a state of proportional development across all four digital maturity layers. Any deviation from this point indicates a structural imbalance: if the centre of gravity lies above the X-axis, the organisation should prioritise strengthening human capital and staff digital competencies; if it is below the X-axis, the focus should shift toward refining its digital strategy and aligning it with corporate objectives. Similarly, a shift to the left of the Y-axis suggests the need to enhance cost-effectiveness and financial planning. In contrast, a displacement to the right indicates excessive emphasis on resource allocation or time scheduling at the expense of flexibility and efficiency.



Figure 2. Strategic focus of a digitally mature organisation

Source: the authors

The analytical logic of this model is further extended in Figure 3, which presents four extreme cases of the strategic centre of gravity's position and illustrates corresponding corrective strategic actions. Each case reflects a different pattern of imbalance between maturity layers and is represented by a bubble, the radius of which indicates the organisation's overall digital maturity level (M, ranging from 0–100 %), while its coordinates (T_x ,

T_γ) define the directional deviation from the equilibrium point. This framework enables an integrated interpretation of both the magnitude and the structural composition of digital maturity.

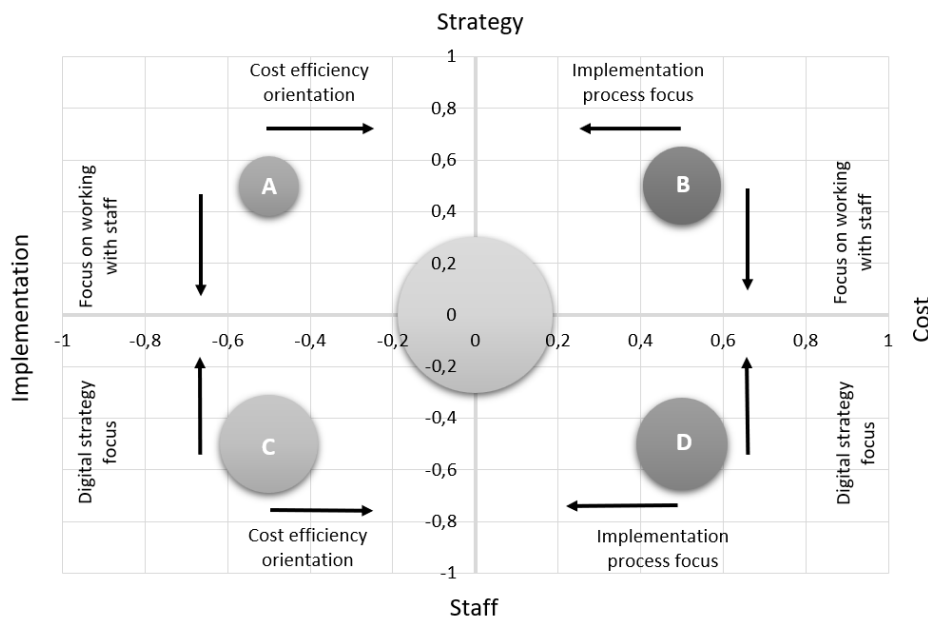


Figure 3. Possible modifications of the strategy according to the position of the centre of gravity
Source: the authors

Optimising corporate strategy based on a digital maturity assessment, however, requires translating analytical findings into specific managerial instruments. One practical approach is to integrate selected key indicators of digital maturity directly into existing strategic management tools, particularly those linked to incentive and performance systems. Such integration ensures systematic monitoring, accountability, and continual revision of digital transformation progress. A suitable framework for this purpose is the Balanced Scorecard (BSC), which organises strategic objectives across four perspectives: financial, customer, internal processes, and learning and growth. Within this structure, the organisation can embed the key indicators of digital maturity into the relevant BSC layers. Relative indicators, those measurable as percentages or ratios, can be directly incorporated as quantifiable performance metrics. Attributive indicators, by contrast, should be defined as binary targets aligned with the BSC's temporal roadmap, typically over an annual horizon. These represent objectives that may not exist at the start of the evaluation period but must be fully implemented by its end. For instance, under a monthly BSC review cycle, the progress of an attributive target could be expected to reach approximately $1/12$ ($\approx 8.33\%$) of the annual goal each month, whereas under a quarterly cycle, this would equate to 25 % increments. This approach, widely adopted in the engineering and automotive industries, enables attributive objectives to be transformed into measurable proportional goals, thereby ensuring their inclusion in performance evaluation systems.

Building on this analytical framework, the position of the model company's strategic centre of gravity was calculated. In the case of company xyz, the centre is located above the X-axis and significantly to the left of the Y-axis, as shown in Figure 4. This configuration indicates a relatively strong performance in implementation-related activities but a weaker alignment in the cost dimension.

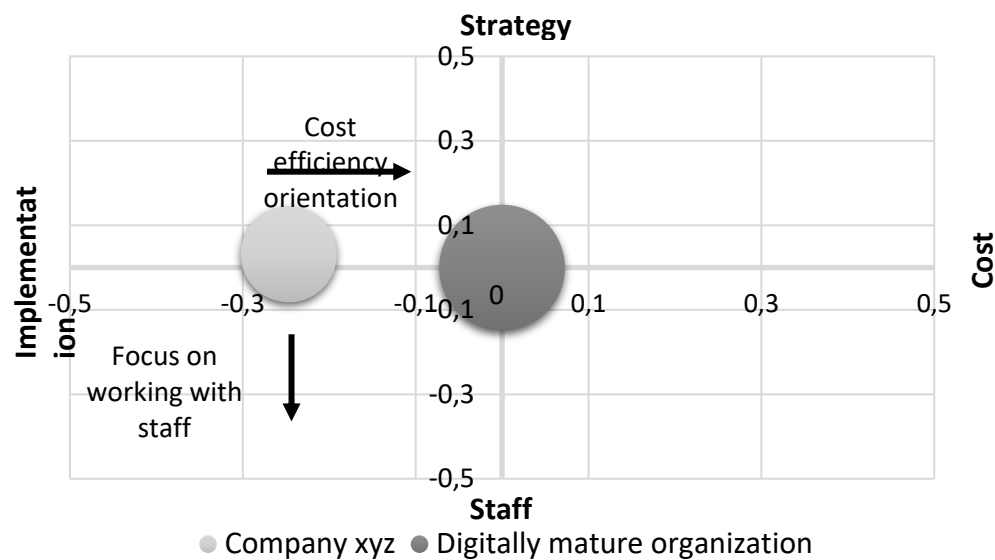


Figure 4. Strategic focus of digital maturity of company xyz

Source: the authors

The combination of the centre of gravity's location and the radius of the bubble representing total maturity thus provides a comprehensive diagnostic perspective. It enables the interpretation of both the organisation's current phase of digital transformation and the proportionality of its internal development. Two assumptions underlie this interpretation. First, a digitally mature organisation maintains its strategic centre of gravity at or near the coordinate origin, implying balanced advancement across all maturity layers. This condition need not correspond to the highest absolute level of digital maturity but rather to a harmonious implementation trajectory in which each layer evolves in tandem. Second, the bubble's radius reflects the organisation's overall maturity magnitude; the closer it approaches 100 %, the higher the level of conformity with the reference model. Deviations from symmetry or from the coordinate origin, therefore, signal areas that require strategic realignment before advancing to the next stage of the maturity scale.

Consequently, the analysis suggests specific corrective strategic measures for the model company. The leftward displacement of the strategic centre of gravity indicates an imbalance between the implementation and cost layers, with the latter achieving a lower weighted fit to the digital maturity model. To restore equilibrium before progressing to the next stage, the organisation should prioritise cost-efficiency improvement and financial planning within its Industry 4.0 implementation projects. Simultaneously, the upward shift above the X-axis highlights a need for stronger emphasis on human resource development, particularly in enhancing employees' digital literacy and skills. While this imbalance poses a lesser risk than the cost-related one, addressing both ensures a smoother transition to higher maturity stages.

Integrating these insights into the organisation's strategic tools is essential for ensuring long-term alignment between digital transformation initiatives and business strategy. The projection of the key indicators defining the weaker cost and HR layers into the Balanced Scorecard framework is presented in Table 10, which summarises potential strategic adjustments aimed at restoring balance and promoting consistent digital growth across all layers of maturity.

Table 10. Possible adjustments to the corporate strategy

	Indicator		Verifying of compliance	
I. Strategy	KPI I.I.	The existence of a digital strategy	<i>attributively</i>	Internal processes
	KPI I.II.	Degree of fulfilment of the I4.0 concept	<i>proportionally</i>	
	KPI I.III.	Investment estimate	<i>attributively</i>	
	KPI I.IV.	Investments in AOP	<i>attributively</i>	
	KPI I.V.	Achieving implementation milestones	<i>proportionally</i>	
II. Cost	KPI II.I.	Portfolio of technical options	<i>attributively</i>	Finance
	KPI II.II.	Portfolio selection	<i>attributively</i>	
	KPI II.III.	Project creation	<i>attributively</i>	
	KPI II.IV.	Investment plan	<i>attributively</i>	
	KPI II.V.	ROI in the first year of operation	<i>proportionally</i>	
	KPI II.VI.	Financial plan	<i>attributively</i>	
III. Personnel	KPI III.I.	Definition of the digital mature worker profile	<i>attributively</i>	Growth
	KPI III.II.	Staff status	<i>proportionally</i>	
	KPI III.III.	Qualification level of staff	<i>proportionally</i>	
IV. Implementation	KPI IV.I.	Cooperation with the supplier	<i>proportionally</i>	Customer
	KPI IV.II.	Purchase price deviation	<i>proportionally</i>	
	KPI IV.III.	Installation status	<i>proportionally</i>	
	KPI IV.IV.	Test phase action plan	<i>proportionally</i>	
	KPI IV.V.	Starting the sharp phase	<i>attributively</i>	

Source: the authors

The findings of this study are consistent with the results of previous research on digital transformation in industrial enterprises. In accordance with Elafri et al. (2022), the absence or insufficient quality of an organisation's digital strategy has been confirmed as a key barrier to digital transformation, negatively affecting a wide range of subsequent implementation activities. These findings are consistent with recent studies that emphasise the interdependence of strategic alignment, workforce readiness, and cost governance as key determinants of successful digital transformation in industrial enterprises (Mihajlovic et al., 2025; Ecer et al., 2024). The analysis further supports the conclusion of Raj et. al. (2020) that workforce capabilities, specifically employees' digital literacy and readiness to adapt, constitute a critical determinant of successful implementation. These results are reflected in the present study's outcomes, where the weakest layers of digital maturity were identified in the strategic, cost, and personnel dimensions, while the implementation dimension showed relatively higher alignment with the general digital maturity model.

From a methodological perspective, this research contributes to the literature by introducing a systematic verification procedure that quantifies the alignment between organisational processes and the key indicators of a digital maturity model. The proposed method combines a weighted matrix analysis with a rigorous structure of attributive and relative indicators, thereby enabling a reproducible and objectively comparable measurement framework. This approach contrasts with the more common self-assessment models, which often rely on subjective perception rather than verifiable internal data. The introduction of the concept of a strategic centre of gravity represents an additional methodological contribution, as it allows the organisation to visualise and interpret imbalances between the sub-layers of digital maturity and to formulate targeted strategic actions accordingly.

The results also provide a practical framework for managers seeking to align digital transformation with corporate strategy. The model enables organisations to identify critical weaknesses, quantify their maturity level across individual layers, and prioritise interventions that have the highest expected impact on digital performance. Embedding the identified indicators into the Balanced Scorecard system ensures that digitalisation metrics become integral components of strategic management, performance evaluation, and continuous improvement. In this way, digital maturity ceases to be a static diagnostic and becomes a dynamic managerial instrument.

Despite the coherence of the findings, several limitations must be acknowledged. The study relies on data from a single manufacturing enterprise in the engineering sector, which constrains the statistical generalisability of the results. Additionally, while the weighting of indicators was informed by expert judgment and literature review, the model's calibration may differ across industries or organisational sizes. Therefore, future research should validate the model across a broader range of enterprises and sectors, apply longitudinal observation to track digital maturity progression over time, and assess how the interaction between layers influences overall strategic performance. Expanding the model beyond the engineering industry could further confirm its transferability and strengthen its practical applicability in diverse industrial contexts. In summary, the study demonstrates that the absence of a digital strategy, insufficient cost control, and a lack of digitally skilled personnel continue to be the primary obstacles to achieving higher levels of digital maturity. The proposed methodological framework offers both researchers and practitioners a structured, verifiable, and analytically transparent approach to diagnosing these deficiencies and guiding strategic responses.

Conclusions

The primary aim of this paper was to develop and apply a systematic framework for determining the digital maturity of enterprises operating in the engineering sector. Drawing upon existing literature, assessment frameworks, and practical insights from the case organisation, an analytical-synthetic procedure was employed to construct a digital maturity model reflecting the specific conditions of industrial production, including its links to the LEAN methodology. A distinctive feature of the model is its division into four sub-layers: strategic, cost, personnel, and implementation, which allows for the evaluation of both comprehensive and partial digital maturity levels. The model was operationalised through a defined set of key compliance indicators, categorised into attributive and relative indicators according to their measurability. Internal company data from a representative engineering enterprise (Company XYZ) was used to validate the model, distinguishing this approach from previous studies that typically rely on questionnaire-based self-assessments. The evaluation of compliance was performed using weighted matrix analysis, which provided both layer-specific and aggregate insights into digital maturity performance.

Furthermore, by introducing the strategic centre of gravity framework, the study linked the diagnostic phase directly to strategic management. The approach enables organisations to identify the layers in which maturity gaps are most pronounced and to implement corrective measures through existing strategic tools, most notably the Balanced Scorecard, into which the sub-indicators can be directly integrated. This integration ensures continuous monitoring, ownership, and accountability for digital transformation initiatives across the organisation.

The authors recognise certain limitations, particularly the reliance on proprietary internal data, which constrains the replicability of the study. Nonetheless, this limitation also represents a strength, as it demonstrates the practical applicability of the model in real business environments without depending on self-reported data. The proposed approach thus contributes to both theory and practice, advancing the measurement of digital maturity through quantifiable, data-driven methods and providing a decision-support tool for aligning digital initiatives with corporate strategy. The newly introduced approach to assessing digital maturity and linking it with strategic planning constitutes a significant step towards the effective utilisation of digital technologies and processes in industrial enterprises. The model provides researchers with a reproducible methodological framework, while offering managers and practitioners a concrete instrument for identifying, quantifying, and addressing maturity gaps. Consequently, this study delivers a valuable contribution to both the academic understanding and the practical management of digital transformation in the engineering sector.

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