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Digital Maturity Assessment and Conceptualization: Manufacturing Companies Perspective

Mohammadreza Sheikhattar*
Strategic Studies And Digital Economics Center
ITRC Institute
Tehran, IRAN
sheikhattar@itrc.ac.ir

Hassan Yeganeh
Communication Technology Institute
ITRC Institute
Tehran, IRAN
yeganeh@itrc.ac.ir

Atefeh Farazmand
Strategic Studies And Digital Economics Center
ITRC Institute
Tehran, IRAN
a.farazmand@itrc.ac.ir

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Abstract—**Production is a key component of every nation's economy, yet the manufacturing sector faces major challenges and opportunities due to rapid digital transformation. Many companies have not fully adapted to these technological shifts, limiting their ability to gain competitive advantages. Research indicates that integrating digital approaches into production processes can enhance efficiency and create significant value, turning digital transformation from a strategic recommendation into a necessity. However, there is still limited guidance on how to systematically assess the digital maturity of manufacturing firms and support their progress toward higher maturity levels. This study aims to develop a comprehensive framework for evaluating digital maturity in the manufacturing sector. Drawing on both literature and empirical data, the framework was designed and validated to help organizations understand their current digital status and identify areas for improvement. It defines evaluation domains, maturity levels, and assessment criteria, along with a structured evaluation method to guide practitioners in achieving higher levels of digital transformation.**

Keywords: Industry 4.0, digital transformation, digital maturity model, maturity level

Article type: Research Article

I. INTRODUCTION

Digital technologies in Industry 4.0 (I4.0) are transform traditional processes in previous manufacturing approaches and creating a smart, data-driven, and agile production chain [1] . The literatures discussed the advantages that I4.0 brings to the manufacturing industry, such as reducing production costs, increasing efficiency, gaining competitive advantages, and boosting revenue [2]. However, despite these benefits, companies face significant challenges in implementing I4.0 methods[3]. These challenges stem from the fact that I4.0 is based on innovative and technology-driven solutions that are often expensive and require specialized human expertise, technological infrastructure, specific processes, and a tailored organizational culture[4].

* Corresponding Author

Companies struggle to identify the appropriate solutions for integrating these technologies into their production processes to reap the benefits. I4.0 promises three main advantages: reducing operational costs, increasing efficiency, and generating additional revenue[5]. However, organizations face challenges in identifying how I4.0 technologies can support their existing processes and the best ways to leverage its benefits [6]. Many projects focused on migrating to I4.0 within manufacturing companies have failed, or the promised transformation has not materialized [7]. One reason identified by researchers in this field is that organizations often rush to implement technology before fully understanding the organizational and environmental requirements of digitalization and prioritizing them accordingly [8].

To successfully align with digital solutions, a manufacturing industry must develop a well-prepared strategy derived from a comprehensive roadmap and action plan [9]. One of the first steps in creating an appropriate roadmap for developing this strategy is to assess the manufacturing industry's readiness for digital adoption within digitalization [10].

Maturity models are one of the most common methods for understanding the level of digital readiness in industries [11]. These tools help manufacturing industries identify their current status, capacities, and capabilities within their operations and, by evaluating the collected data according to the maturity model, assess their digital maturity [12]. There is little information in the literature regarding the creation of a structured method for assessing the digital maturity of manufacturing industries to move toward digital transformation and, consequently, use the benefits of this migration to improve production operations.

Current evaluation methods rely on specialized and complex tasks carried out by skilled assessors. Measurement is based on the insights and judgments of these assessors, making it a thoroughly human-centric process. Evaluations are performed based on certain assumptions to determine the maturity level of an organization or company.

These methods typically involve creating a maturity model for the organization to define evaluation parameters [13]. Criteria for each maturity level are then determined according to best practices. A team of assessors follows a planned approach, collecting evidence and using human analysis to define the digital maturity level and position of the organization or company.

The aim of this research is to develop a standardized framework for evaluating the digital maturity of manufacturing industries.

This framework is designed to provide a systematic assessment system that considers various organizational aspects (culture, strategy, production, and supply chain) to guide industry decision-makers in improving and leading digital transformation efforts within the sector. The assessment system describe the framework to identify the aspects of the organizational capabilities of manufacturing industries for digital improvement and provides a mechanism for evaluating digital maturity. This framework supports the continuous improvement of manufacturing companies in leveraging digital opportunities to transition from traditional manufacturing firms to advanced companies equipped with digital capabilities.

These tools, provide better understanding of companies' digitalization journeys and help comprehensively examine the required changes in organizational processes and capabilities to facilitate the implementation of digital transformation in production. The main contributions of the presented research should be considered as:

- Identifying the digital maturity assessment criteria described in the literature and expert opinions.
- Developing a framework for a digital maturity assessment model, considering two levels of criteria.
- Proposing a six-step method based on Fuzzy Comprehensive Evaluation for assessing the digital maturity of manufacturing industries.

II. Literature Review

A. *Digital transformation of manufacturing industry*

Digital transformation refers to the adoption of digital and information technologies in business models to enhance efficiency, create competitive advantages, and increase revenue, with the ultimate goal of customer satisfaction and fostering innovative capabilities [14]. This strategy leverages data, artificial intelligence, and cloud services to achieve its objectives. In practice, digital transformation involves optimizing and redesigning processes and, at higher maturity levels, redefining business models, improving customer relationships, and advancing management practices through the support of digital technologies [15].

The key to digital transformation lies in integrating information technology with the organization's business operations [16] . Currently, there are two primary perspectives on digital transformation. The first emphasizes the use of innovative technologies, while the second focuses on employing information technology to create business models in novel ways.

In its early stages, digital transformation within organizations was primarily focused on the adoption of information systems and enhancing organizational performance [17] . Today, research has shifted towards integrating digital capabilities with management processes and fostering business innovation.

Digital transformation is essential in the manufacturing sector. Advances in this field, such as the Internet of Things (IoT), big data analytics, and cloud computing, represent some of the core technologies driving digital transformation, pushing industries toward becoming smart industries. With the support of intelligent technologies, these tools can be integrated into processes to enhance production performance.

Abiodun et al. examined the drivers of digital transformation in industries [18]. In their report, they identified key drivers, including cognitive readiness, organizational culture, organizational mindfulness, competitive pressure, strategic alignment, and IT readiness. In the digital age, traditional manufacturing companies require advanced and innovative technologies to improve their performance and efficiency.

The two most common types of digital transformation in the manufacturing sector are process digital transformation, aimed at improving operational efficiency, and product and service digital transformation, designed to create new experiences and increase customer satisfaction [19].

B. Digital Maturity concept

Maturity is a measure of an organization's ability to operate efficiently, effectively, and consistently in achieving its objectives. The importance of this concept lies in helping organizations identify areas requiring improvement and develop plans to achieve their goals [20]. Maturity is determined by examining various factors such as the technologies used for communication and collaboration, organizational structure, and process management [21]. These factors are evaluated and graded by comparing business processes, work methods, employee quality, and other aspects of a specific business area with best practices and industry standards.

Through proper assessment of these factors, organizations can optimize their e-collaboration efforts to enhance productivity and improve the effectiveness of their operations. The assessment is designed across levels ranging from beginner to advance. These levels represent varying degrees of excellence within an organization or company in a particular field. They define the organization's or company's position and provide pathways for growth and improvement in maturity.

Currently, maturity assessment principles are applied in many domains. Organizations and companies must go through different stages of growth to achieve higher levels of maturity. These maturity stages are continuous, not easily reversible, and encompass a wide range of organizational activities and structures. Shehzad et al. emphasize this progression through distinct stages [22].

Lahrmann et al. focus on the processual nature of maturity, defining it as a progression from initial stages to a desired or expected final stage, thereby introducing the concept of growth or maturity stages [23].

Based on maturity theory, the Capability Maturity Model (CMM) originated in the computer software industry [24]. This model became a popular standard for software production processes and certification for software organizations, describing development at each stage in terms of defining, measuring, controlling, and improving processes.

In the CMM, software development is treated as a process. The goal is to ensure that software development and maintenance processes are conducted scientifically and in a standardized manner to achieve business objectives [25]. Except for the initial level, other levels are divided into specific key processes that must be advanced through step by step. After the evolution of the model in the software domain, CMM began to be applied in other fields. One of the most significant applications has been in the field of digital maturity.

In the progression of digital transformation, digital maturity is widely utilized in academic discussions. There is no single, universally accepted definition of digital maturity, and various articles present different interpretations of this concept [26]. By synthesizing these definitions, it can be concluded that digital maturity reflects a company's performance in adopting digital transformation, integrating digital concepts into business processes, and developing employees' digital skills. In other words, digital maturity refers to the level of advancement and willingness to embrace and utilize digital technologies [27].

It is essential to note that digital maturity differs from digital transformation. Digital maturity serves as the foundation for digital transformation [28]. Companies aiming to enhance their level of digital maturity implement digital transformation strategies across all aspects of the organization. This concept can be measured qualitatively or quantitatively at various stages. Digital maturity essentially represents an understanding of the current state compared to an ideal state based on the study of best practices [29] .

The purpose of studying digital maturity is to identify the organization's current status relative to the desired state and to analyze the gap between these two states . Digital maturity encompasses various levels, with each level involving multiple dimensions related to technological and digital management aspects. These dimensions are further divided into sub-dimensions and criteria that describe the unique characteristics of various facets of digital technology and management from different perspectives [27].

As an organization progresses toward higher levels of digital maturity, it must act based on a digitalization strategy with defined Key Performance Indicators (KPIs). Without a digital strategy, the risks associated with the failure of digital transformation implementation increase.

One critical factor in achieving high digital maturity is the human element, which includes the necessary competencies of the workforce to digitalize the organization. Therefore, optimizing this aspect of processes facilitates the organization's path to achieving digital maturity.

C. *Maturity Model Evaluation*

The Capability Maturity Model (CMM) is a foundational framework in the literature of digital maturity. With the expansion and evolution of digital maturity, integrated versions of these models have emerged. For example, Wendler et al. developed a model for maturity that is tailored to the national context [30]. In contrast, Dirk provided an organizational digital maturity system tailored to the current situation and benchmarking. Issa et al. used the Digital Maturity Model for manufacturing industries [31].

For the digital maturity model in the manufacturing industry, in 2015, Schumacher proposed the IMPLUS-Industry 4.0 Readiness 2015 model [12]. This model evaluates maturity across six dimensions: strategy and organization, smart factory, efficient operations, smart products, data-driven services, and employees. It also includes 18 items to demonstrate readiness at five levels. Barriers to advancing to the next stage and recommendations for overcoming them are defined.

Immediately afterward, in 2016, Gisela et al. proposed the Empowered and Implementation Strategy for Industry 4.0 model as a quick assessment and part of a process model for realizing Industry 4.0 [32]. This model includes nine evaluation dimensions: design, production, logistics, sales, services, resource elements, integration level, information integration, and emerging industries. It features five levels of maturity: Planning Level, Specification Level, Integration Level, Optimization Level, and Leading Level. Another notable model of digital maturity is Gartner's Digital Business Maturity Model, which evaluates the organization's digital maturity in five stages: Stage 1 (Initiation), Experimentation), Stage 3 (Scaling), Stage 4 (Transformation), and Stage 5 (Digital Leadership) [33].

The model is designed to help organizations assess their digital capabilities, develop a digital strategy and align their business with digital initiatives. Tobias et al. combine the best methods of both conceptual design and field-based development and proposed the design of a situational maturity model in an article [34].

This maturity model design was implemented in the field of health care as a case study. Jens et al. created criteria for developing maturity models using a scientific approach[35]. These criteria are used as a basis for comparing maturity approaches with sparse documentation. The obtained results are generalized and integrated into an applicable model. They also introduced a framework for process capability models as an element of the methodology in process capability profiling to guide process improvement [35].

This methodology framework is based on five previous successful experiences where different processes are tested to develop different process capability models. The presented version consists of customization rules and examples of techniques. In an article by Marlies et al., they presented a general method for developing focal zone maturity models based on extensive industrial experience and scientific research [36]. This model is distinguished from fixed-level maturity models, such as the CMM, because they are suitable for the gradual improvement of functional domains.

III. Digital Maturity Model design Considerations

In order to ensure the suitability of the evaluation system indicators for the manufacturing industry when building the digital maturity model, the following 3 items are considered [37].

A. Relevance and characteri*stics of the industry*

It should be ensured that the dimensions and indicators of the model are designed according to the capabilities of the production industry. This means combining dimensions such as Production Processes, Supply Chain Management, Operational Efficiency, Technology and Innovation, Customer and Market Focus, and Regulatory Compliance and Standards. Also, the model should reflect emerging trends in production such as Industry 4.0 and smart factories.

B. *Comprehensive scope and integration*

The model should include all the main aspects of the digital maturity model, including organizational culture, technology adoption, process optimization and data governance. It should also be integrated with standards and standard frameworks such as capability-based planning or security or quality management standards to ensure that the existing model considers all aspects.

C. *Scalability and flexibility*

The model should be such that it presents indicators that are scalable for different types of manufacturing companies of different sizes from small companies to large companies. Also, the model should be able to adapt to technological developments and the changing ecosystem of the industry. This includes regularly updating the model and indicators to reflect new technology, processes and best practices in the industry.

D. *Methodology and Establishment of Digital Maturity analysis*

Based on the design considerations of the digital maturity model, this article summarizes the dimensions of digital maturity that have been obtained by researchers in numerous articles, and based on this, it forms an evaluation index system that includes 4 main criteria: Digital Strategy and Leadership, Smart Manufacturing and Operations, Supply Chain Integration and Collaboration, Workforce and Culture Transformation as well as the corresponding 17 sub-criteria. Digital Strategy and Leadership addresses the issue that leadership and strategic efforts are aligned with the specific needs of the manufacturing industry. It includes Digital Vision and Roadmap, Digital Vision and Roadmap, Leadership and Governance, Alignment with Business Objectives, Change Management and Stakeholder Engagement.
Smart Manufacturing and Operations deals with the evaluation and increase of production and intelligent

operations in the field of manufacturing industry. It includes Automation and Robotics, Data-Driven Manufacturing, Disruptive Technology, Data-Driven Manufacturing, Flexible Manufacturing Systems. Supply Chain Integration and Collaboration involves the benefit of digital technology in the integration of the entire supply chain and the improvement of cooperation and coordination among all stakeholders in the production process.
It includes real-Time Supply Chain Visibility, Collaborative Digital Platforms, and Advanced Analytics for Supply Chain Optimization, Automated Procurement and Inventory Management, Supplier Integration and Performance Management.

Workforce and Culture Transformation involves developing a digitally skilled workforce to support a culture of innovation and adaptability to digital transformation. It includes Technical Skills and Training, Change Management and Organizational Agility, Culture of Innovation and Continuous Improvement, Leadership and Management Development. The weight determined for each of the criteria is the basis of maturity evaluation.

In this article, we use hierarchical analysis to calculate the weight of each criterion. In this regard, the main steps include Formation of specialized expert meetings to judge the importance of the criteria, making a judgment matrix, and then calculating the weight of the criteria. To calculate the weight of the sub-criteria of manufacturing companies, the weight of the sub-criteria was calculated simultaneously according to the weight of the main criteria and the weight of the sub-criteria according to Table 1.

IV. COMPREHENSIVE EVALUATION AND CASESTUDY

After all the mentioned points, a method must be selected to assess digital maturity within the organization. Digital maturity assessment is an uncertain approach. Therefore, in this article, a comprehensive fuzzy evaluation technique is used, which is an analytical approach for uncertain environments and is designed to assess issues that are difficult to analyze using conventional methods in the real world.

This technique utilizes fuzzy set theory and fuzzy mathematics to evaluate systems. In fact, the goal of fuzzy evaluation is to establish a fuzzy mapping between each assessment component and a set of indescribable assessment scores, such as poor, good, or outstanding. Figure 1 shows the fuzzy evaluation method proposed in this article. The general process of fuzzy comprehensive evaluation method includes: creation of evaluation factors, creation of a set of rubrics, weighting of evaluation factors and construction of fuzzy judgment matrix. Figure 1 depicts the formal methods of our proposed fuzzy evaluation model.

A. Selection of the investigated area

In this paper, a home appliance manufacturing company is selected to evaluate digital maturity. To obtain the evaluation matrix of each layer as well as the final fuzzy matrix, several experts were used to score the digital maturity of the company. Finally, to obtain the final evaluation of the digital Maturity of the manufacturing company, the final fuzzy matrix of the target layer was compiled.

TABLE I. WEIGHTING TABLE OF CRITERIA

Goal Layer	Layer1 Criteria	Weight	Layer2 Criteria	Weight	Total Weight
Digital Maturity	Digital Strategy	0.585	Digital Vision	0.056	0.032
			Leadership Governance	0.451	0.263
			Business Objectives Alignment	0.258	0.150
			Stakeholder Engagement	0.235	0.137
	Smart Manufacturing and Operations	0.275	Automation	0.369	0.101
			Data-Driven Manufacturing	0.256	0.070
			Disruptive Technology	0.056	0.015
			Flexible Manufacturing	0.319	0.087
	Supply Chain Integration and Collaboration	0.072	Real-Time Supply Chain Visibility	0.155	0.011
			Collaborative e Platforms	0.263	0.018
			Supply Chain Advanced Analytics	0.325	0.023
			Automated Procurement Inventory	0.196	0.014
			Supplier Integration	0.061	0.004
	Workforce and Culture Transformation	0.068	Technical Skills	0.365	0.024
			Change Management	0.265	0.018
			Innovation Culture	0.256	0.017
			Leadership Development	0.114	0.007

B. Identifying Indicators

In this step the goal is to determine the indicators that will be used for evaluation, categorized into various levels and layers.

$$X = \{X_1, X_2, X_3, X_4\}$$

Where X_i represents a specific set of indicators within a particular layer. Each set of indicators contributes to the evaluation of different aspects within the target layer X and aligns with the fuzzy membership set Y. The objective is to identify and categorize the indicators used for evaluating digital maturity according to the specified layers and criteria. Regarding the above topic, it is as follows:

Criteria Level X_1 : Key criteria within each target layer that need to be assessed. X_1 ={ Digital Vision, Leadership Governance, Business Objectives Alignment, Stakeholder Engagement}

- Guideline Layer X_2 : Specific guidelines related to technological and operational aspects X_2 ={ Automation, Data-Driven Manufacturing, Disruptive Technology, Flexible Manufacturing}
- Criteria Layer X_3: Detailed criteria related to supply chain and operational aspects.X_3 ={ Real-Time Supply Chain Visibility,Collaborative Platforms, Supply Chain Advanced Analytics, Automated Procurement Inventory, Supplier Integration}
- Guideline Layer X_4 : Guidelines associated with workforce skills and organizational culture. X_4 ={ Technical Skills, Change Management, Innovation Culture, Leadership Development}

C. Defining Fuzzy Sets and Membership Functions

The objective of this step is the definition of the fuzzy sets and membership functions for each indicator.

$$\mu_{A_i(x)}: X \rightarrow [0,1] \quad (1)$$

Where $\mu_{A_i(x)}$is the membership function of fuzzy set $A_i(x)$ at value x.

D. Determining the Weight Matrix

The Objective of Assigning weights to each indicator to reflect their relative importance in the evaluation process. These weights are then used to combine the fuzzy evaluation results with their importance. Each indicator is assigned a weight w_i representing its importance in the evaluation. The weights should be normalized to ensure that their sum equals 1.

$$W = \{w_1, w_2, w_3, w_4\}$$

W is a 1×n vector of weights for the indicators. W, which can be constructed via the AHP technique, can represent the weight vector. In this paper, W is made through the AHP technique, which can be seen in Table 1. If the evaluation involves different layers or levels (e.g., criteria level, guideline layer), assign weights to each layer accordingly and construct a weight matrix for each layer. Because the model presented in this article includes different layers, weights are assigned to each layer and a weight matrix is made for each layer as follows.

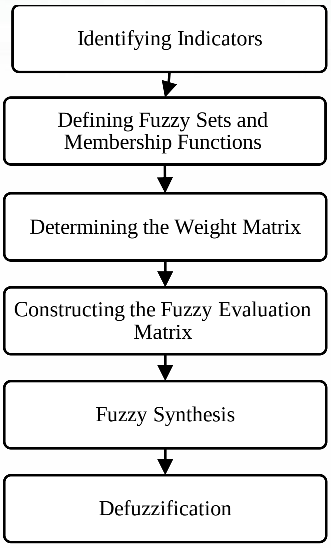

Figure 1. The fuzzy comprehensive assessment model's steps

E. Constructing the Fuzzy Evaluation Matrix

In this step a fuzzy evaluation matrix is construct that reflects the degree to which each indicator belongs to the defined fuzzy sets. This matrix is used to represent the membership degrees of each indicator in the fuzzy categories.

According to the membership sets Y = {digital start-up, digital upswing, digital transformation, digital maturity, digital benchmark}; each membership set A_i is associated with a fuzzy value representing a level of digital maturity. Accordingly, the fuzzy evaluation matrix R was constructed to capture the degree of membership of each indicator in each fuzzy set. Suppose there are n indicators and m fuzzy sets. The matrix R is an n×m matrix where each element r_{ij} represents the membership degree of the i-th indicator in the j-th fuzzy set. So the single-factor judgment matrix of the criterion layer was obtained as follows:

$$R = \begin{bmatrix} 0.148 & 0.376 & 0.164 & 0.212 & 0.081 \\ 0.150 & 0.363 & 0.288 & 0.095 & 0.095 \\ 0.262 & 0.271 & 0.196 & 0.174 & 0.088 \\ 0.191 & 0.269 & 0.335 & 0.107 & 0.090 \end{bmatrix}$$

F. Calculating the Fuzzy Result

In this step the weight matrix W and the fuzzy evaluation matrix R were combined to compute the final fuzzy result vector B. This vector will represent the overall evaluation of the system, reflecting the degree to which each fuzzy set is applicable. The fuzzy result vector B_1 is calculated by multiplying the weight matrix W_1 by the fuzzy evaluation matrix R_1:

$$B_1 = W_1 \times R_1 \quad (2)$$

$$B_1 = [0.56 \quad 0.28 \quad 0.068 \quad 0.092] \times \begin{bmatrix} 0.148 & 0.376 & 0.164 & 0.212 & 0.081 \\ 0.150 & 0.363 & 0.288 & 0.095 & 0.095 \\ 0.262 & 0.271 & 0.196 & 0.174 & 0.088 \\ 0.191 & 0.269 & 0.335 & 0.107 & 0.090 \end{bmatrix}$$

So:

$$B_1 = [0.160 \quad 0.345 \quad 0.216 \quad 0.167 \quad 0.086]$$

The fuzzy result vector B_1 indicates that the system has the highest membership degree of 0.345 in the "Digital Upswing" fuzzy set, suggesting that the system is primarily at the "Digital Upswing" maturity level.

V. CONCLUSIONS

The aim of this paper is to develop a framework for evaluating digital maturity in manufacturing industries. The proposed framework includes criteria for measuring digital maturity (Table 1) and the stages of digital maturity assessment (Figure 1). The digital maturity criteria cover areas describing the scope for improvement, consisting of two levels of criteria, as detailed in Table 1. The weights assigned to each criterion reflect expert consensus. For instance, among the primary criteria, "Digital Strategy" holds the highest weight (0.585), highlighting its significance as the most prominent factor in determining the digital maturity of manufacturing companies at this stage. Among the sub-criteria, *Leadership and Governance*, *Business Objectives Alignment*, and *Stakeholder Engagement* carry the highest weights, emphasizing their critical roles in the digital transformation of manufacturing industries. Considering the complexities and inherent risks in manufacturing, strong leadership, alignment of strategies, and stakeholder participation—combined with the benefits of automation and digitalization—drive productivity, competitive advantage, and market share growth.

The "Smart Manufacturing and Operations" criterion ranks second among the primary criteria, following "Digital Strategy." This reflects the importance of smart manufacturing, digital infrastructure, the degree of technology integration in production processes, and the potential for innovation in manufacturing. Notably, *Supply Chain Integration and Collaboration* ranks third among the primary criteria, with a weight of 0.072%. This criterion encompasses areas such as *Real-Time Supply Chain Visibility*, *Collaborative Platforms*, *Advanced Supply Chain Analytics*, *Automated Procurement and Inventory Management*, and *Supplier Integration*. These areas provide substantial benefits; however, their implementation often faces challenges due to misalignment between technological advancements and managerial readiness. Achieving a high level of integration between digital technologies and smart manufacturing significantly enhances productivity and the ability to manage the entire production process, underscoring the critical role of supply chain integration in the digital transformation of manufacturing companies.

Each criterion includes multiple levels, selected based on expert opinions, indicating the degree of digital maturity of a manufacturing company for that specific criterion. The assessment stage is another part of the digital maturity measurement framework, with its steps illustrated in Figure 1. This evaluation method allows assessors to determine the maturity status across the entire manufacturing company.

The objective of this paper is to address organizational aspects (strategy, production, operations, supply chain intelligence, and culture) and to create a systematic assessment system that provides the necessary foundation for guiding decision-makers in improving production operations through digital transformation. Digital maturity encompasses the ability of manufacturing companies to assess and implement digitalization methods that impact production processes. It is managed and measured systematically through a maturity assessment model. This model evaluates the capabilities of the manufacturing industry and their impact on productivity and production. Thus, digital maturity not only relates to the coordinated implementation of digitalization in production but also involves assessing and integrating capabilities in the process of advanced production improvement.

At the highest level of digital maturity, the proposed method evaluates whether the manufacturing company has achieved complete integration based on digital technologies. This level of maturity enables companies to respond to market changes and customer needs with agility and flexibility through data analysis. Additionally, at this level, the alignment of organizational culture with digital approaches and employees' digital skills is also assessed.

A. Analysis of Digital Maturity Criteria Rankings

The rankings of digital maturity criteria reveal that certain factors play a more significant role in the digital transformation process, and focusing on them can help organizations achieve their goals. *Leadership and Governance*, with the highest total weight (0.263), is crucial in steering and realizing digital transformation objectives. Without strong leadership and clear governance, other digital initiatives are likely to encounter major challenges. Furthermore, *Business Objectives Alignment* (total weight: 0.150) highlights that the success of digital transformation depends on aligning digital strategies and projects with the organization's overarching goals. Additionally, *Stakeholder Engagement* (0.137) plays a critical role in ensuring the support and participation of all organizational units, as the lack of stakeholder backing can hinder the successful implementation of digital transformation.

Moderately weighted criteria, such as *Automation* (0.101), *Flexible Manufacturing* (0.087), and *Data-Driven Manufacturing* (0.070), also contribute significantly to increasing organizational productivity and flexibility. These criteria focus on improving production processes, adapting to market changes, and leveraging data effectively to accelerate digitalization.

In contrast, criteria such as *Supplier Integration* (0.004) and *Collaborative Platforms* (0.018) have lower priorities. This may be because, in the early stages of digital transformation, it is more important to focus on strengthening internal processes and establishing foundational infrastructure. These criteria may gain prominence in later stages of transformation.

Strategic analysis of these findings suggests that organizations should initially concentrate their resources and efforts on key criteria such as *Leadership and Governance*, *Business Objectives Alignment*, and *Stakeholder Engagement*. Strengthening digital leadership and governance through training programs and developing clear strategies are essential. Additionally, defining key performance indicators (KPIs) to evaluate the success of digital strategies and engaging stakeholders through change management initiatives can enhance the transformation process.

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Mohammadreza Sheikhattar is an Assistant Professor at the ICT Research Institute. He received his Ph.D. in Information Technology Management from Shahid Beheshti University. His academic background includes degrees in Electronics Engineering from Amirkabir University of Technology and in IT Management from Kharazmi University. His main research areas are digital transformation, business intelligence, and business data analytics.

Hassan Yeganeh holds a Ph.D. in Electrical Engineering with a focus on telecommunications. He is currently an assistant professor and faculty member at the Institute of Communications and Information Technology. His current research focuses on strategic studies, entrepreneurship, the digital economy, and regulation in the field of ICT.

Atefeh Farazmand is the Head of the Department of Digital Transformation Planning at the Communication and Information Technology Research Institute (ITRC). Her research focuses on science and technology policy, digital transformation, e-government, roadmap development, and the social and economic impacts of technological advancement across various domains.