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# INTEGRATING TECHNICAL AND BEHAVIORAL STRATEGIES IN KNOWLEDGE MANAGEMENT FOR ORGANIZATIONAL SUCCESS

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**Abstract:**

In contemporary society, with the rapid advancement of information and communications technology, accessing data and information has become more convenient. However, the challenge is in effectively utilising the vast amount of information available to us.The purpose of our study is to provide a strategic perspective on knowledge management (KM) that recognises the need of integrating technical and behavioural factors in order to advance in the present economic environment. From this perspective, all business operations include the generation, distribution, updating, and use of knowledge to ensure the continued existence and success of the organisation.
**Keywords:** knowledge, knowledge management (KM), knowledge-based economy (KBE), machining process.

## 1 Introduction

Companies worldwide are confronted with rapidly accelerating and unexpectedly unpredictable developments. This phenomenon is shaped by advancements in science and technology, the changing needs and expectations of consumers, the application of scientific principles to management, and a strong emphasis on quantitative analysis in the field of economics [1]. Changes result in intense rivalry on a worldwide level, necessitating the creation of new equilibriums among the economy, technology, and society. The salient features of the contemporary market, specifically in the case of the mechanical components industry, may be summarised as follows:

i) The current orders are consistently decreasing, resulting in the need for small series production. ii) There is a strong inclination towards personalising products, which leads to a significant variety in the shapes, sizes, and other characteristics of mechanical components required in the market. iii) Flexibility, responsiveness, and efficient system management are becoming the key factors that determine competitiveness in the market for component manufacturers and mechanical constructions. The present dynamics of the industrial and corporate environment provide a significant worldwide issue that must be addressed.

In response to a new global problem, the scientific community adopts a new conceptual framework known as the knowledge-based economy (KBE). [2]

In the new century, the globalisation of the Knowledge Economy relies on the crucial factors of knowledge, innovation, and creativity for achieving success. In today's information-based economy, the organisations that will succeed are those who continually use and enhance their intellectual capital. This includes the knowledge possessed by the organization's employees, documented procedures, techniques, patents, guidelines, and software.

To thrive in the current intricate and uncertain business landscape, the organisation must possess the capacity to promptly adapt and strategically reposition itself in the market. The acquisition and maintenance of this capability provide significant challenges for firms, since it is influenced by several internal and external variables and is an ongoing, dynamic, and unpredictable process. Within this particular environment, three aspects stand out due to their significance: competitiveness, the manufacturing system, and the knowledge system.

**a) The state of being competitive.**

Based on the literature, a firm is considered competitive in a certain market when it is able to achieve, at a satisfactory level, certain economic indicators such as turnover, profit, and market share that are equivalent to or higher than those of other competing enterprises in the same market. Various methodologies addressing the issue of competitiveness, as shown by references [5] and [6], demonstrate that competitiveness in today's context is determined by economic variables and indicators. It is characterised as a suggested or induced concept rather than being quantitatively measured. Approaches to competitiveness may be categorised as either economic or managerial in nature, with less emphasis on the technological components. Currently, there is no established algorithm to assess the technical and economic competitiveness. Furthermore, the practical aspects of technical factors are not taken into account when determining competitiveness, despite the fact that the consumption and costs associated with technological processes are influenced by technical actions. Within this setting, the concept of competitiveness takes on a fresh perspective, including the many elements and strategies that define an enterprise's capacity to secure a favourable position in the market, maintain that position, and consistently enhance its standing. Competitiveness is the only method to thoroughly and comprehensively assess the profitability of a business.

In the article, competitiveness will be defined as the ability to provide superior performance relative to equivalent components, within a certain macroeconomic situation and timeframe.

**a) The production system.**

In this study, the term "manufacturing systems" refers to the technical systems used in the production of a certain product. Each of these technical systems consists of machine tools, tools, gadgets, components, operators, and performs a specific operation in the technological process of manufacturing the product.

The manufacturing process is considered finished once the product is authorised for production and stays in production until it is fully completed.

Subsequently, when a new product is introduced, the task of organising the production systems is initiated from the start. The ad hoc configuration of the production system is consistently seen in manufacturing lots, but not in mass manufacturing, where the technical components of the manufacturing system stay unaltered for an extended period.

The performance of the production system is contingent upon its operational management. In more specialised papers, the authors discuss the connections between the parameters of the cutting processes and the technical performance of the manufacturing system, focusing solely on technical aspects. In other papers, there are numerous references to the relationship between the product created by the manufacturing system and the market, emphasising economic relations.

The literature does not include any efforts to address the whole production system-market assembly. As a result, there are valuable resources that may enhance performance, but they remain untapped since the technical and economic elements are considered separately. Furthermore, there is currently no known algorithm for managing the manufacturing system-market assembly. However, there are algorithms available for the technical control of the technological systems-components within the manufacturing system, as referenced in sources [8] and [9]. Additionally, there are tools for economic management that focus on the relationship between the enterprise as a whole and the market, as mentioned in sources [10] and [11].

Currently, manufacturing systems are operated using numerically programmed machine tools that are integrated into the system "[12]".

The control is only focused on technical aspects, without considering any economic factors, even though the ultimate objective of any processing operation is truly commercial in nature. The company's reaction to the dynamic changes and advancements in society is evident in the many, small-volume, and diversified orders it receives via regular auctions. However, the short-term nature of these auctions does not allow for a thorough study of these orders. Consequently, it is no longer feasible to engage in long-term management. The kind of management that is required is one that is online, very responsive, swift, speedy, and yet short-lived, similar to the fluctuations of the market.

**b) The system of knowledge**

The market dynamics are then transferred to the method of operation and management. In a society and economy that prioritise knowledge, it is essential to automate operations that involve identifying relevant information and consolidating it into knowledge. This is because in a complex and unpredictable environment, these operations are crucial for the creation, retrieval, and organisation of knowledge. The relationship between the economic environment and the manufacturing system is a significant means of acquiring information about both the economic environment and the manufacturing system itself. Therefore, it is essential to implement a knowledge management system in order to prevent escalated expenses, time wastage, and heightened mistakes. Recognising the importance of Knowledge Management (KM) will motivate organisations to comprehend and foster their knowledge resources and operations.

The term "KM" has acquired several interpretations since its origin. However, the majority of published works lack clarity and fail to provide enough empirical data to establish a precise definition for the notion of knowledge management. KM has been seen as crucial for gaining a competitive edge and driving organisational advancement. Therefore, a comprehensive comprehension and consensus on KM should be very beneficial for companies. Enterprises are actively considering the notion of knowledge management (KM) and its influence on organisational performance as they want to gain a competitive advantage with their goods and services. To establish the concept of Knowledge Management (KM), businesses must identify the specific knowledge inside the organisation that should be collected, structured, controlled, and distributed. The conventional interpretation of this concept is the efficient dissemination of accurate information to the appropriate individuals at the optimal moment, enabling them to enhance their decision-making abilities.

Implementing knowledge management provides a competitive advantage for enterprises.The acquired information will be used in both corporate management and the development of novel goods, services, or significant alterations to company choices. Through the process of acquiring knowledge, the firm is able to effectively adjust and consistently react to the fluctuations in the business environment. The sharing of best practice is considered a crucial objective of KM. By enhancing the dissemination of information inside the organisation, the following advantages may be achieved: - The exchange of optimal methods for conducting company operations. Enterprises hold extensive information that is distributed across several organised and unstructured sources. In order to enhance operational efficiency and expedite the introduction of new goods at a lower cost, firms must identify, make accessible, and implement this information. Therefore, in order to solve problems, it is necessary to comprehend, arrange, and convert knowledge. Therefore, the conversion of information into a tangible product is considered knowledge, and the organisation and use of this knowledge is achieved via the practice of knowledge management. The manufacturing business must effectively address the need for rapid adaptation to the constantly evolving client needs. In highly competitive contexts, it is essential for organisations to effectively manage the dynamics of their production systems, including changes in product kinds and variations, as well as changes in production volumes.

Enterprises must create and execute manufacturing processes that are highly adaptable and responsive, using knowledge as a foundation. Through this approach, they are able to effectively address and adapt to unforeseen shifts in production demands, resulting in the creation of high-quality goods at a cheap cost and with efficient delivery. The paper is organised in the following structure: Section 2 provides an analysis of the existing literature. Section 3 outlines the issue that is being addressed. Section 4 provides a detailed description of Knowledge Management (KM) in the field of engineering. Section 5 provides examples of KM in machining systems. Finally, section 6 provides a summary of the key findings that have been reached.

**2 Literature Review**

The article is connected to several branches of literature.

To maintain competitiveness, organisations must respond effectively, analyse unstandardized data to solve problems and make decisions, and adapt their infrastructure and management methods [13]. Organisations often possess a substantial amount of information and knowledge. However, it is common for many organisations, especially service organisations, to have an abundance of information but a lack of expertise. The information and knowledge assets, sometimes referred to as "intellectual capital," represent valuable knowledge that may be transformed into value. If effectively used, these assets have significant potential for organisations [14], [22]. Knowledge management (KM) is a very successful method for managing an organization's intellectual capital, which refers to the organization's whole experience, skills, and information that are significant for enhancing future performance. Research in the field of knowledge management primarily centres on the examination of knowledge stored in corporate or organisational memory, as well as the creation of knowledge management systems (KMS) [15], [16], [17]. However, similar projects in organisations typically encounter difficulties primarily because to the challenges associated in expanding an individual's own tacit knowledge to encompass the knowledge of the whole organisation, leading to implementation issues. The publication "[13]" provides definitions for tacit knowledge and explicit knowledge. Tacit knowledge refers to the personal knowledge that individuals acquire via their own experiences. It may be shared and traded via direct conversation with others. Explicit knowledge is conveyed in tangible forms such as papers, emails, and knowledge repositories, which include data and knowledge bases. Explicit knowledge may be codified using linguistic and numerical representations, making it readily transferable and disseminated. The acquisition of explicit information is an indirect process since it requires encoding and decoding inside one's mental models, as stated by

Daschievici Luiza and Ghelase Daniela.

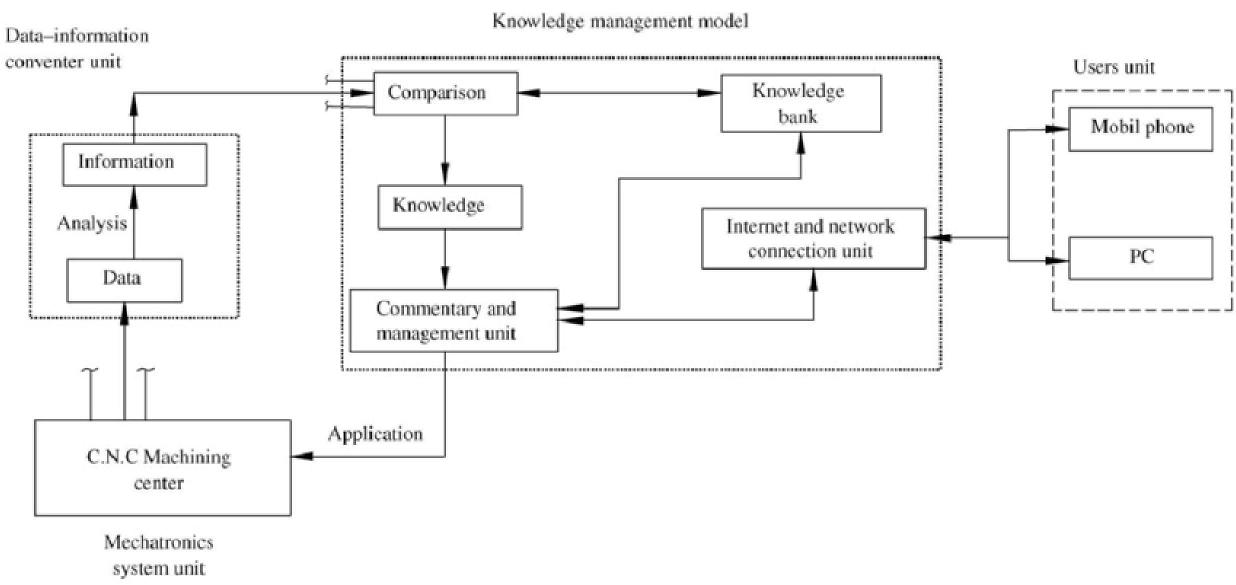


**Figure 1: System diagram of KM of internet-based mechatronic system.**

The article "[18]" demonstrates that the idea of knowledge management has gained significant popularity in both practical and academic discussions within the engineering and management professions. The effective management of knowledge-related resources in companies is widely acknowledged as a crucial factor in gaining a competitive edge and achieving organisational success. Some even argue that the acquisition and application of knowledge is the central role of organisations in society [19].

The article "[20]" focuses on the implementation of knowledge management in the field of mechatronic systems. A knowledge management approach has been developed for the Internet-based CNC machining centre.

The model that was created has been examined to evaluate the machining capabilities of the manufacturing system. The structure of the KM model of an internet-based mechatronic system is shown in Figure 1.

The study describes a system that includes the KM model (PC), a mechatronic system (CNC machining centre), a user unit (PC, SMS), and a data and information converter unit. The KM paradigm comprises knowledge bank, internet and network connectivity, commentary, and management units. The CNC Machining Centre, which serves as the primary production unit of the system, may be operated remotely using both the machine tool control panel and email network. The machine tool is fitted with several sensors to monitor its performance and manage unforeseen circumstances. Based on the literature mentioned before, this research introduces a knowledge management framework for the machining system in order to enhance the competitiveness of the firm.

**3 Problem formulation**

Knowledge, similar to information, has no value unless it is used in making essential choices about the economic operations of the organisation. Several firms have made significant efforts to accumulate knowledge, but they have not adequately focused on the process of applying this knowledge. This knowledge should not only be employed in current work but also leveraged to develop innovative ideas for future activities.

The application and use of knowledge necessitates its transmission from one individual to another, although in a seamless and effortless manner. Within the organisation, there exists a comprehensive understanding of the market, which includes an assessment system for transactions involving sellers, buyers, and intermediaries. The transfer of information in many firms is hindered by a lack of time, resulting in an increased cost for exchanging knowledge.

In contemporary civilization, individuals have the ability to retrieve a vast amount of information from almost any location. However, just information is inadequate. The defining characteristic of a knowledge society is not only the presence of vast volumes of information, but rather the constant pursuit of acquiring even more knowledge within it. For this information to be of practical use, it has to be converted into knowledge and effectively applied in the administration of the organisation.

The objective of this study is to provide a model of knowledge management (KM) that may enhance the competitiveness of a business. This model is designed to use the manager's existing expertise, including economic and technical information. A model that effectively links data and information has the capacity to become knowledge. A well-understood model, based on knowledge, offers a high degree of assurance or prediction about the evolution of less static models across time. We plan to provide an enterprise manager with a model of this kind. KM offers essential information to address the challenges of adapting, advancing, and maintaining the competency of a company in response to environmental changes.

## 4. Utilising knowledge management in machining systems

### 4.1 The Machining System's Knowledge Management architecture

Figure 2 displays the architectural design of the KM model for machining systems. The system shown in Figure 4 comprises the KM model, CNC Machining System, and Marketing Knowledge. The KM model encompasses crucial characteristics of the system. The KM model has four components: knowledge bank, comparison, modelling, and control units. The knowledge bank is structured based on the specific attributes of the system. It is crucial that relevant, accurate, up-to-date, and consistent information be transformed into knowledge and kept in this unit. It is essential for this unit to transform into an adaptable framework in order to accommodate updates based on market dynamics and technical specifications of new manufacturing items.

The Marketing Knowledge-unit's information is analysed by the comparison unit. The comparison unit has the capacity to receive information from a knowledge bank. The primary purpose of the comparison unit is to assess and evaluate the facts and knowledge by comparing them to one another. The output information obtained from the comparison unit represents novel knowledge. The newly acquired information has been sent to the modelling unit. The modelling unit not only receives information from the comparison unit, but it also interacts with the knowledge bank. The modelling unit produces the model, which is then analysed in the control unit. This unit transmits the production directive to the CNC Machining System.

The CNC Machining System unit's output information is transformed into new knowledge and sent to the knowledge bank via online learning.

The machining system obtains contracts after the tenders, which are created by the market and include the submission of quotes. Competitive control refers to the evaluation of competitiveness and the subsequent intervention in the machining system. This intervention involves providing directions on how to optimise the machining process in order to achieve maximum competitiveness. However, after the competitiveness has been evaluated, the management system should empower people to create competitive proposals for the tenders. In order to accomplish these two goals, competitive control employs reinforcement learning to familiarise itself with the market, and uses non-supervised on-line learning techniques to gain knowledge about the machining system.

### 4.2 Behavioural modelling process of creating models that represent the behaviour or actions of a system or entity.

As seen earlier, the unit control utilises behavioural modelling to provide the required instructions for modifying the machining process, while the manager formulates the management rules. The authors of this study propose the concept of behavioural modelling. To explain this concept, they assume two components,

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H1 and H2, that interact with each other (Figure 5. a). The first model, referred to as Model H1, creates a direct correlation between the input variable x and the output variable y. If x and y are both input and output of another element, which is modelled as H2, then the two elements interact with each other.

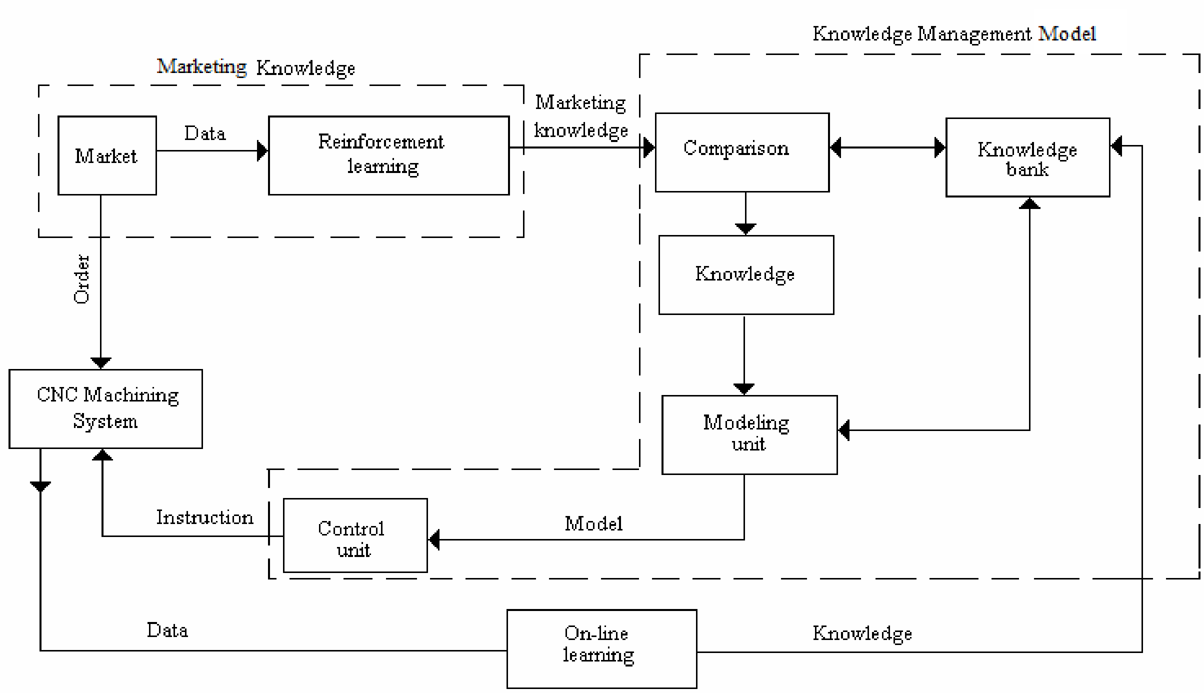


**Figure 2: Knowledge Management architecture of the Machining System**

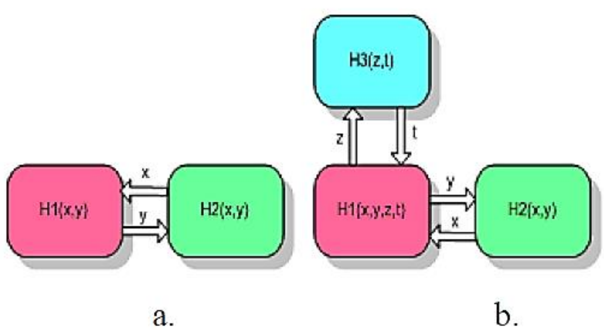


**Figure3: Behaviour Modelling**

**Behavioral Modeling in System Dynamics**

In system dynamics and control theory, behavioral modeling is an approach used to represent and analyze the interactions between different elements within a system. The goal is to set pairs of values (x, y) that satisfy specific transfer functions, which in this context, describe how inputs are transformed into outputs by various components or processes within the system.

**Definition and Application:**

A transfer function, in engineering and systems analysis, is a mathematical representation of the relationship between the input and output of a system. It is commonly used in signal processing and control systems to characterize how the output is affected by the input. The "behavioral model" is thus a collection of solutions (x, y) that satisfy the transfer functions, effectively describing how the system behaves under various conditions.

**Complexity in Behavioral Modeling:**

As the number of interacting elements increases, the complexity of modeling also increases. For example, consider a scenario with three interacting elements. The behavioral model in this case represents the relationships between the values (x, y, z, t) that allow these elements to interact effectively. This model can be visualized or conceptualized as a multidimensional space where each point represents a feasible interaction state of the system.

**System Interaction Example:**

In your described model, H1 and H2 represent two transfer functions:

- $H1(x,y)=0$
- $H2(x,y)=0$

These equations might represent different subsystems or processes. For instance, H1 could symbolize a machining system, while H2 might represent market dynamics affecting the machining system. The solution to this system of equations (1) represents the behavioral model of the H1-H2 assembly. If the solution is unique, the behavioral model reduces to a single operational point, which implies a specific state or condition under which both H1 and H2 are simultaneously satisfied.

**Geometric Interpretation:**

If you consider H1(x, y) and H2(x, y) as two lines in a coordinate system, then the solution of the system, where these two lines intersect, is the point $H0$. This intersection point represents the conditions under which both the machining system's requirements (H1) and the market conditions (H2) are met.

This geometric interpretation can help visualize complex interactions in a more intuitive way, allowing for easier understanding and manipulation of the system dynamics involved. The intersection point, $H0$, symbolically and practically represents a state where the interacting elements of the system are in equilibrium or a state of operational harmony.

**Analysis of Behavioral Modeling in Machining Systems**

**System Incompatibility and Its Implications:**

In scenarios where system equations are incompatible, such as when no set of values simultaneously satisfies H1 and H2, the system lacks a feasible behavioral model. This indicates a lack of coherence or alignment between system components or operational goals, which could lead to operational inefficiencies or failures.

**Modeling Complex Interactions with Multiple Elements:**

The introduction of a third element, H3, in your scenario complicates the interaction model further. Given the system defined by:

- $H1(x,y,z,t)=0$
- $H2(x,y)=0$
- $0H3(z,t)=0$

This system is likely indeterminate if there are more variables than equations, leading to potentially infinite solutions. Each solution represents a state where the machining system (H1), market (H2), and an additional factor (H3) could theoretically operate in harmony. The complexity of real-time, variable-dependent interactions demands a modeling approach that can adapt to and integrate a range of operational scenarios and parameters.

**Real-Time Monitoring and Dynamic Operation:**

The real-time operational monitoring of elements like the machining system and the market is crucial. This on-the-fly analysis allows for adjustments based on immediate feedback relating to the state parameters of each element. For instance, a machining system might need to adjust its operations based on the type of product being processed, material consumption rates, and the current market demands or pricing fluctuations.

**Behavioral Modeling and Competitive Management:**

The absence in the literature of behaviorally modeled systems that utilize real-time data to inform interactions indicates a significant gap but also an opportunity for innovation in the management of machining systems. By developing models that can dynamically integrate and react to live data from the machining system and market interactions, businesses can achieve a more competitive management approach. This strategy would ideally leverage algorithmic, numerical, and possibly neural network models to predict and optimize operations based on a continuous stream of input data.

**Developing a Comprehensive Behavioral Model:**

The goal is to create a comprehensive model that not only predicts and reacts to current conditions but also simulates potential future scenarios based on varying inputs and interactions among H1, H2, and H3. Such a model would be invaluable for strategic planning, allowing businesses to preemptively adjust to changes in market conditions, supply chain factors, or production capabilities.

**5. Conclusion**

This paper established an architecture for knowledge management within a machining system, blending marketing intelligence with continuously updated operational data to optimize the machining processes. By comparing current marketing data with historical insights, the system refines its models to produce detailed guidelines aimed at enhancing competitiveness through more informed operational decisions. The integration of modeling and simulation tools enables managers to assess the viability of accepting orders based on a comprehensive understanding of current market demands and the capacity of the machining system. This decision-making process is supported by the application of competitive control strategies, which employ reinforcement learning techniques to adapt to market dynamics and unsupervised learning to continuously improve system knowledge without the need for predefined training data. We propose a robust knowledge management model designed to empower managers to interact effectively with the broader economic environment. This model serves as a technical-economic framework that facilitates competitive control of the manufacturing process. It is unique in that it does not rely on traditional experimental approaches but instead harnesses the power of extracted knowledge from past experiences to drive future operational strategies. Ultimately, this paper demonstrates that through the strategic application of advanced learning technologies and data integration, machining systems can achieve higher levels of efficiency and responsiveness to market conditions. This approach not only streamlines the decision-making process but also enhances the overall agility of manufacturing operations, paving the way for more adaptive and economically viable manufacturing practices.

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