

# Technological Innovation Management



# Technological Innovation Management:

*The Essentials for Managers  
and Students*

By

José Moleiro Martins

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# PREFACE

The aim of this book is to help the reader understand the organization as an entity of continuous learning and innovation, where knowledge is a strategic asset for improving and creating processes, products, or services based on market needs and user requirements. This leads to enhancing organizational performance through the adoption of organizational and technological innovation, thereby generating sustainable value for stakeholders.

By reading the contents of this book, the reader should be able to:

- Understand how knowledge management processes work.
- Master the importance of the learning organization in developing continuous improvement processes and innovation.
- Grasp the interrelationship between organizational learning and knowledge management in achieving a competitive advantage.
- Establish a connection between innovation capabilities and dynamic capabilities.
- Understand the role of knowledge management in innovation.
- Recognize the need for organizations to become ambidextrous in dynamic environments.
- Understand networks as a locus for successful innovation.
- Establish a link between knowledge management and innovation management.
- Identify the nature of knowledge and the types of innovation developed by organizations.
- Understand open innovation in small and medium enterprises (SMEs) as a source of collaborative development leading to a competitive advantage.
- Comprehend and identify the elements of an innovation process.
- Understand the impact of technological innovation on the competitiveness and sustainability of organizations.
- Master new technologies and their influence on innovation, sustainability, and societal well-being.

As a result of the learning developed throughout the various chapters of the book, the reader becomes skilled in the following aspects:

*i) Knowledge-Based Competitiveness:*

- Master essential concepts in organizational knowledge management.
- Understand knowledge as the primary resource in creating value for the organization.
- Master the knowledge management process.
- Identify operational benefits resulting from the role of knowledge management.

*ii) The Learning Organization as a Source of Organizational Competitiveness:*

- Master theories of organizational knowledge.
- Differentiate between organizational learning and a learning organization.
- Establish a relationship between organizational learning and knowledge management.
- Master the factors determining knowledge transfer between organizational units.
- Understand how organizations develop their sources of competitive advantage in knowledge transfer.

*iii) Achieving Competitive Advantages in Dynamic Environments:*

- Explain the contribution of dynamic capabilities to superior organizational performance.
- Establish the relationship between innovation capabilities and dynamic capabilities.
- Explain the role of knowledge management in innovation.
- Identify the characteristics of an innovation-supportive culture.
- Establish the determinants and effects of ambidexterity practice.
- Identify the relationship between networks and innovation.

*iv) Innovation Management, New Product Development, and Technological Innovation:*

- Master essential concepts in innovation management and technological innovation in organizations.
- Establish the connection between knowledge management and innovation management.
- Master types of organizational innovation and the importance of open innovation in SMEs.
- Identify and apply the stages of developing innovative processes, products, and services.
- Create innovation strategies in a market-oriented organization.
- Understand how innovation diffusion enhances the technology cycle and technological discontinuity.

- Understand the influence of technological innovation and new technologies on the competitiveness and sustainability of organizations.

As observed, the development of programmatic content curriculum is structured into four parts, namely (i) knowledge-based competitiveness, (ii) the learning organization as a source of organizational competitiveness, (iii) achieving competitive advantages in dynamic environments, and (iv) innovation management, new product development, and technological innovation, with each of these parts organized by chapters and subchapters.

At the end of each of the four programmatic parts, the following elements are identified: (i) learning objectives, (ii) key concepts and topics, (iii) questions for reflection and discussion, and (iv) bibliography.

# **PART I**

## **KNOWLEDGE-BASED COMPETITIVENESS**

### **Learning Objectives**

- Know how to define knowledge.
- Be able to identify and explain the hierarchical structure of knowledge.
- Know how to identify and define the types of knowledge.
- Understand knowledge as the main resource in creating value for the organization.
- Know how to define knowledge management.
- Understand that knowledge management facilitates the use and creation of knowledge in the organization efficiently and effectively in response to the market.
- Master the knowledge management process within the organization.
- Be able to identify the operational benefits resulting from the role of knowledge management.

# CHAPTER 1

## KNOWLEDGE IN THE ORGANIZATIONAL CONTEXT

### **1.1. Concept of Knowledge**

Knowledge is an individual process of development based on experience and personal beliefs. Knowledge is related to action and reflects the individual's ability to make distinctions within a domain of action by appreciating the context.

When knowledge is shared within the organization, it becomes embedded in routines, processes, and organizational products — That is, organizational knowledge resides in what employees know about the business of the organization.

However, organizational knowledge is not simply the sum of individual knowledge. Organizational knowledge is formed through interactions among technologies, techniques, and people, which cannot be easily imitated by other organizations because they are shaped by the organization's unique history and culture.

### **1.2. Hierarchical Structure of Knowledge**

Data are important inputs for information. Information can result from data analysis. Knowledge results from the (productive) use of information.

Thus, data are needed to create information, and information is needed to create knowledge.

Information provides the facts. Knowledge allows for making predictions and decisions.

Knowledge is more than information, as it involves understanding gained through experience. Knowledge is an organized combination of data and assimilated information with a set of rules and procedures through experience and practice.

Information becomes knowledge when it is interpreted in a given context according to the convictions and commitment of individuals.

Knowledge is related to human action and has a dynamic nature resulting from social interactions.

### **1.3. Nature of Knowledge**

Knowledge is associated with a tacit learning process based on the environment and the individual's experience, giving it an idiosyncratic character.

The knowledge that results from action is tacit, whose context can be both individual and organizational. Thus, tacit knowledge is more personal, not easily identified, and rooted in the experiences of individuals. It is difficult to formalize and communicate, which complicates its sharing. Its acquisition is possible through experiencing and observing.

On the other hand, explicit knowledge can be expressed in formal language (oral and written), processed, transmitted, and accumulated more easily. The codification of knowledge contributes to generalizing or globalizing local knowledge.

### **1.4. The Role of Knowledge in the Organizational Context**

The transition to a knowledge-based society has led to an increasing focus on knowledge as the most important resource of organizations.

Organizational knowledge consists of the capacity of the organization's members to develop operative processes in specific contexts.

Employees need knowledge to increase their ability to improve products and services provided to the market.

Knowledge has become the main strategic resource for making decisions and creating new valuable knowledge that generates wealth.

Consequently, the value generated by an organization derives from the knowledge and skills of its employees.

### **1.5. Summary**

Faced with global competition, organizations achieve and maintain a competitive advantage through their ability to use and exploit their resources (e.g., knowledge).

According to Amit and Schoemaker (1993, 33-46), resources constitute stocks of productive factors owned or controlled by the organization. Holsapple and Joshi (2001, 39-54) suggest that an organization's competitive advantage derives, on one hand, from the uniqueness of its combination (mix) of resources, and on the other hand, from competitors'

inability to replicate this mix. Indeed, the value of a specific organizational resource can be enhanced by its interaction with other resources.

In this context, organizational knowledge has become the essence of the organization, but it is distinct from the organization itself since it is more than the sum of the specialized knowledge of its employees.

Knowledge is closely linked to action and reflects the individual's ability to make distinctions within a domain of action by appreciating the context and/or theory. Knowledge consists of the understanding, awareness, or familiarity gained through study, research, observation, or experience over time. When knowledge is shared within the organization, it becomes embedded in the organizational processes, products, and services — That is, organizational knowledge resides in what the employees know about the organization's business (e.g., processes, products, services, and market).

In practice, the goal is not for all employees to have the same knowledge, but rather to combine diverse knowledge to create new organizational knowledge. This requires the existence of communication channels that encourage information sharing and collaboration. However, even when designated communication channels exist in organizations, individuals tend to rely more on informal communication relationships.

## **Key Concepts and Topics**

- Data, information, and knowledge.
- Individual knowledge and organizational knowledge.
- Tacit knowledge and explicit knowledge.
- Local knowledge and global knowledge.
- The role of knowledge in organizations.

## **Questions for Reflection and Discussion**

- Why has knowledge become the primary strategic resource of organizations in the knowledge economy?
- How does knowledge contribute to increasing the competitiveness of organizations?



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# CHAPTER 2

## KNOWLEDGE MANAGEMENT IN THE ORGANIZATION

### 2.1. Concept of Knowledge Management

Knowledge management is a management function that locates and creates knowledge, manages the flow of knowledge, and ensures that knowledge is used effectively and efficiently for the benefit of the organization.

Knowledge management enables easy access to know-how and specialized knowledge when needed within the organization.

### 2.2. Dimensions of Knowledge Management

Organizations should leverage their existing knowledge and create new knowledge that favors their market positioning through three dimensions of knowledge management:

- (i) *Technological*: the discovery of new knowledge and the application of existing knowledge.
- (ii) *Structural*: combining a formal organizational structure with a non-hierarchical and self-organized one, including a system of incentives and rewards, in order to motivate and reward employees.
- (iii) *Cultural*: fostering interaction and collaboration to convey tacit knowledge and move from the individual to the organizational level — Sharing perspectives that give employees a sense of purpose and trust aimed at openness based on a set of values shared throughout the organization.

### 2.3. The Process of Knowledge Management

The knowledge management process consists of several phases (reflecting capabilities) based on various activities:

- *Knowledge acquisition*: collaboration among organizations facilitates acquisition through the ability to identify and acquire new knowledge.
- *Knowledge creation*: occurs through the interaction between tacit and explicit knowledge.
- *Knowledge stock*: allows the availability of the necessary knowledge to employees at the right time.
- *Knowledge transfer*: involves transfer at the individual level where the recipient's experience is affected by that of the source.
- *Knowledge application*: helps to improve efficiency and reduce the costs of organizations, increasing their competitiveness.

## **2.4. The Role of Knowledge Management in the Organization**

Knowledge management aims to meet the existing knowledge needs within the organization and to identify and exploit its existing and acquired knowledge assets. Moreover, it plays a role in the systematic creation and use of knowledge, contributes to the organization's collective specialization, and improves the exploitation of the organization's knowledge resources.

The application of knowledge management results in various operational benefits, such as: generation of new ideas and development of innovation processes; identification of knowledge sources facilitating their location and reuse; collaborative practice of knowledge sharing in continuous learning and improvement processes; and improvement of the decision-making quality.

## **2.5. Summary**

Since the 1990s, knowledge management has become a critical theme in organizational literature. Both the business and academic communities believe that by leveraging knowledge, an organization can achieve a sustainable competitive advantage.

The conversion from data to information is efficiently handled through information technologies (IT). The conversion from information to knowledge is best achieved through social actors. However, social actors are slow in converting data into information. This is one of the reasons it is believed that knowledge management is best performed by optimizing both technological and social subsystems.

The knowledge base can be one of the reasons why, in a knowledge-intensive environment, large organizations can sustain their competitive advantages. This is because the previous state of the knowledge base can generate positive feedback to support the creation, validation, and distribution of knowledge. Cohen and Levinthal (1990, 128-152) explain this fact by suggesting that the expansion of knowledge depends on the intensity of learning and prior knowledge. In other words, the accumulated prior knowledge — derived from the knowledge base — enhances the capacity to accumulate more knowledge and more easily learn subsequent concepts.

Consequently, we can say that knowledge is an organized combination of data and information assimilated with a set of rules and procedures through experience and practice. In a sense, knowledge is a meaning realized by the mind. Without meaning, knowledge is merely information or data.

Individual knowledge is necessary to develop the organizational knowledge base. However, organizational knowledge is not simply the sum of individual knowledge. Organizational knowledge is formed through unique models of interactions among technologies, techniques, and people, which cannot be easily imitated by other organizations because they are shaped by the unique history and culture of the organization. In this regard, the pattern of interaction among technologies, techniques, and people cannot be easily commercialized in the market. Foreground knowledge is explicit, being easy to capture, encode, and imitate, while background knowledge is tacit, making it difficult to replicate and imitate — It depends on the organization's history and unique circumstances. However, it is not the intensity of the background knowledge that allows an organization to achieve superior performance. Rather, it is the intensity of the symbiotic relationship between foreground and background knowledge that forms the core competencies and provides a sustainable advantage to the organization.

Thus, knowledge management is a process of creation, validation, distribution, and application of knowledge. These phases allow the organization to learn, reflect, unlearn, and relearn, generally considered essential for building, maintaining, and replenishing core competencies.

## **Key Concepts and Topics**

- Knowledge management.
- Organizational dimensions that foster knowledge management.
- The knowledge management process.
- The role of knowledge management in organizations.

## **Questions for Reflection and Discussion**

- How does the knowledge management process provide the organization with its alignment with the market?
- What are the operational benefits that result from applying knowledge management in the organization?

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Cohen, Wesley M., and Levinthal, Daniel A. 1990. "Absorptive Capacity: A New Perspective on Learning and Innovation". *Administrative Science Quarterly*, No. 35: 128-152. <https://doi.org/10.2307/2393553>.



## **PART II**

# **THE LEARNING ORGANIZATION AS A SOURCE OF ORGANIZATIONAL COMPETITIVENESS**

### **Learning Objectives**

- Being able to define a learning organization and master its principles and practices adopted by individuals in their daily activities.
- Understanding the operationality of a knowledge-based organization in finding particular solutions for customers.
- Mastering the theories of organizational knowledge as approaches to typologies of knowledge.
- Being able to identify the internal and external sources of knowledge from which organizations extract and utilize market-oriented knowledge.
- Mastering the concept of organizational learning.
- Knowing the difference between organizational learning and a learning organization.
- Mastering the importance of the type of organizational learning adopted in the face of competitive context.
- Establishing a relationship between organizational learning and knowledge management.
- Being able to define knowledge transfer.
- Mastering the factors that determine knowledge transfer between organizational units.
- Mastering the concept of absorptive capacity and being able to identify its contribution to organizational performance improvement.
- Mastering the concept of desorptive capacity and understanding its role in the external exploitation of internal knowledge with financial return.
- Understanding how organizations develop their sources of competitive advantage in knowledge transfer.

## CHAPTER 3

# KNOWLEDGE-BASED ORGANIZATIONS

### 3.1. Concept of Knowledge-Based Organizations

The knowledge-based organization emphasizes the organization's capacity to learn.

A learning organization consists of a collective aspiration where individuals continuously develop their capabilities to achieve desired outcomes. It is based on the convergence of five disciplines — systems thinking, personal mastery, mental models, building a shared vision, and team learning (Senge, 2006, 1-388) — which are related to (i) a shift in mindset, (ii) active participation of individuals in shaping their reality, and (iii) a response to the present to create the future.

Knowledge-based organizations use knowledge as their primary competitive resource in the knowledge economy.

The terms knowledge-based organization and knowledge-intensive organization are used interchangeably.

An organization is considered knowledge-intensive when (i) employee specialization is its main asset, (ii) there is intangibility of services provided to customers, and (iii) there is an independent approach to potential clients.

Knowledge-intensive organizations are knowledge creators, which tend to promote creativity and develop innovation processes.

### 3.2. Theories of Organizational Knowledge

In theories of organizational knowledge, some authors stand out, namely:

Polanyi (1958, 1-415) suggests that tacit knowledge is the basis of all knowledge. Articulated and expressed knowledge is only a small part of all the knowledge we possess.

Nonaka (1994, 14-37) states that the interaction between tacit and explicit knowledge leads to the creation of new knowledge and that there can be transformation from one type to another type of knowledge. This process can be structured in an organizational model supported by three elements:



- (i) *Ba*: a shared context where knowledge is created and utilized. It is the place where information is interpreted to become knowledge.
- (ii) *SECI Model*: based on four modes of knowledge conversion (socialization - S, externalization - E, combination - C, and internalization - I), which consist of a social process of interaction among individuals through which tacit and explicit knowledge are created and developed. The organization mobilizes tacit knowledge created and accumulated at the individual level, which is amplified through the four modes of knowledge conversion and crystallized via the knowledge spiral, allowing its dissemination throughout the organization.
- (iii) *Knowledge assets*: constitute the organization's knowledge base.

Blackler (1995, 1021-1046) suggests that knowledge can be analyzed as a process of activity, and it can be classified as embodied knowledge, instituted knowledge, enculturated knowledge, cerebral knowledge, and codified knowledge. Knowledge is studied as something individuals do.

Spender (1996, 45-62) views the organization as a system of knowledge-based activities. Knowledge exists in individual and collective domains and manifests in tacit and explicit forms. Collective knowledge not only incorporates shared individual knowledge but also embodies collective practices institutionalized within the organization.

Among more recent studies, for example, Hughes et al. (2022, 633-665) mention that knowledge production reflects an organizational orientation in defining complementary (internal) choices that foster a pattern of entrepreneurial action.

### 3.3. Sources of Organizational Knowledge

Organizations have internal and external sources of knowledge.

Endogenous knowledge is created, transferred, and used among members of the organization. Exogenous knowledge can be obtained from customers, suppliers, business partners, universities, and competitors.

The organization is not self-sufficient in performing activities necessary to create and deliver value to the market.

Knowledge existing outside the organization's boundaries plays a relevant role in both creating new knowledge and shaping existing knowledge to make it more useful and practical. For example, knowledge acquired from customers includes their feedback on existing products and services, as well as extracting suggestions and new ideas to incorporate into new products and services.

### 3.4. Summary

What distinguishes an activity is its output being sufficiently intangible to prevent it from being commercialized as a commodity, yet sufficiently standardized to allow it to be differentiated from competitors. This standardized intangibility is central to knowledge-based organizations. According to Winch and Schneider (1993, 923-937), knowledge-based organizations exploit their assets in a distinctive way, as they sell a production capacity rather than a product.

Only resources with certain characteristics are capable of generating and sustaining a competitive advantage. These heterogeneous resources are called strategic assets because they are simultaneously valuable, rare, inimitable, and non-substitutable.

In conditions of increasing uncertainty, bureaucratic organizations do not have the learning and technological capacities needed to cope with accelerated environmental change. Managers must devote a significant amount of resources to learning and innovation as basic elements of knowledge work. The use of resources depends on formal and informal processes of interaction and communication, through which organizational members leverage accumulated organizational knowledge (i.e., routines and experiences) and external information, in order to perform their tasks in a coordinated manner.

Organizational knowledge consists of a set of routines and experiences — and improvisations — resulting from the application of routines. Routines take the form of propositional statements, while experiences take the form of narratives shared in communities of practice. From this perspective, organizational knowledge fits into a state of flux.

### Key Concepts and Topics

- Learning organization.
- Knowledge-based organizations.
- Knowledge-intensive organizations.
- Knowledge-creating organizations.
- Theories of knowledge.
- Internal sources of organizational knowledge.
- External sources of organizational knowledge.
- Endogenous knowledge.
- Exogenous knowledge.

## Questions for Reflection and Discussion

- What is the contribution of Nonaka and Takeuchi's theory, particularly the knowledge-creating organization, to increasing the organization's competitiveness in the market?
- Why can innovative organizations and knowledge-creating organizations be used interchangeably?
- How do external sources of knowledge contribute to the successful development of organizational knowledge?

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# CHAPTER 4

## ORGANIZATIONAL LEARNING

### **4.1. Concept of Organizational Learning**

Organizational learning consists of a change in knowledge that occurs within the organization as it gains experience. Experience interacts with the context to create knowledge.

When knowledge is developed from the experience of another organizational unit, the subprocess of learning is referred to as knowledge transfer.

Organizational learning integrates three subprocesses: creation, retention, and transfer of knowledge. Thus, organizational learning emerges as an integral part of knowledge management that leads to a competitive advantage.

### **4.2. The Role of Organizational Learning in the Organization**

Individual learning is not sufficient for group or organizational learning. For other members of the organization to access the same knowledge, individual learning must be incorporated into a network so that learning becomes organizational.

Organizational learning provides guidance for organizational action that contributes to improved organizational performance. The ability of the organization to learn faster than its competitors may be the only means of achieving a competitive advantage.

### **4.3. Characteristics of Organizational Learning**

Organizational learning is a characteristic of any learning organization.

However, organizational learning and the learning organization are not the same thing.

The learning organization needs to manage created knowledge, continuously learn, and adapt rapidly to fit the external environment.

The process of organizational learning features (i) continuously recreated transformation, (ii) cumulative learning based on accumulated acquired knowledge, (iii) improvement of organizational performance, and (iv) encompassing the entire organization.

Learning involves detecting and correcting errors through two distinct cycles. On one hand, single-loop or simple learning occurs when the error is discovered and corrected, allowing the organization to continue its policies or achieve its objectives. On the other hand, double-loop learning occurs when the error is detected and corrected, involving the modification of the organization's norms, policies, and objectives. This type is most suitable for organizations operating and making decisions in dynamic and uncertain contexts.

#### **4.4. Organizational Learning and Knowledge Management**

Knowledge is not only a precursor to learning but also emerges from learning.

Learning as a continuous process can lead to the acquisition of knowledge. In this perspective, knowledge is generated by organizational learning, the outcome of which is managed by the knowledge management process.

Knowledge management involves the process of acquiring, creating, sharing, and using knowledge to enhance learning and performance in organizations.

Therefore, there is a connection between organizational learning and knowledge management, as organizational learning precedes knowledge management. And there is an association between organizational learning and knowledge management, as knowledge management facilitates organizational learning: in other words, organizational learning occurs within the structural framework of knowledge management.

The synergy between organizational learning and knowledge management arises from the organization's inability to sustain a competitive advantage without continuously learning and developing new knowledge.

#### **4.5. Summary**

Organizational learning involves changes in knowledge or behavior occurring within an organization as it gains experience — That is, organizational knowledge changes in response to its experience. This

knowledge can manifest in cognitive or behavioral changes, include explicit and tacit components, and be embedded in various repositories (e.g., individuals and routines).

Organizational knowledge can be measured by assessing the knowledge of the organization's members. Changes in practices or routines indicate a shift in knowledge and the occurrence of organizational learning. Modifications in performance (e.g., accuracy or speed) suggest that knowledge has been acquired and that organizational learning has taken place. However, an organization may acquire knowledge without a corresponding change in behavior, indicating that organizational learning is a change in the range of possible behaviors.

Organizational learning is a process that unfolds over time within a context that includes the organization and its environment. According to Argote and Miron-Spektor (2011, 1123-1137), experience interacts with the context to create knowledge. More specifically, experience refers to events occurring within the organization as its members carry out their tasks. The organizational context includes characteristics such as the organization's structure, culture, technology, identity, memory, strategy, incentives, and goals. The environmental context includes external elements like competitors, customers, institutions, and regulators, which influence the experiences that the organization acquires (e.g., product orders or service requests from the environment). Moreover, the context also encompasses relationships with other organizations through alliances, joint ventures, and associations, where the interaction with experience helps generate knowledge.

Argote (2011, 439-446) posits that organizational learning comprises three interrelated subprocesses: creation, retention, and transfer of knowledge. When knowledge is created from an organizational unit's own experience, it is referred to as the knowledge creation subprocess. This knowledge can be integrated into repositories (e.g., individual members, task tools, and routines) and maintained over time. When knowledge is developed from the experience of another organizational unit, this subprocess is referred to as knowledge transfer — Meaning that one organizational unit is influenced by the experience of another. Organizational learning thus occurs as organizations gain experience. An organization's experience can be direct or indirect — That is, acquired directly by the focal organizational unit itself or indirectly from other organizational units. Indirect learning, or inter-organizational learning, is referred to as vicarious learning or knowledge transfer.

The knowledge acquired through learning is integrated into the organization's context, thereby changing the context. Knowledge can be