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MANAGEMENT PRACTICES IN A NUCLEUS OF TECHNOLOGICAL INNOVATION: THE CASE OF THE STATE UNIVERSITY OF MARINGÁ

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ABSTRACT

Technological innovation requires a peculiar, complex type of management that must interact with a diversity of agents in the innovation process. The objective of this study was to analyze this dynamics in the context of the Nucleus of Technological Innovation of the State University of Maringá. For that, a qualitative and exploratory research was carried out. The methodology used combines three elements: own practices relevant to innovation management, problem-based learning and innovation, all elements articulated based on a research protocol from international references. A set of actions aligned to the management of innovation, based on the culture, strategy and opportunities inherent to the environment of a Higher Education Institution were obtained, namely: i) adoption of management practices related to a more organic, more flexible, less bureaucratic organizational structure, with clearly established guidelines; (ii) decentralized decision-making system; iii) greater use of instruments such as benchmarking and best practice; iv) development of networks for new partnerships; v) adequate physical structure to provide an environment that stimulates the execution of new activities, skills and knowledge; vi) creation of mechanisms for greater interaction with clients; and vii) performance of a strategic planning for the organization and understanding in terms of the innovative environment, taking into account the purposes of a University.

Keywords: Innovation Management; Nucleus of Technological Innovation; Management Practices.

1. INTRODUCTION

In the developing and developed countries, the theme *innovation* has become mandatory in the development agenda not only of companies in search for an increase in terms of competitivity, but also of governments focused on the sustained growth of nations. The need for the generation, diffusion, and use of knowledge, sustaining economic growth and social development (World Bank, 2010; OECD, 2010) is argued. Innovation is understood, in its broad sense, as "process, business model, logistics, organization, strategies, products and technologies", and it has been regarded as the focus economic development policies (Arbix *et al.*, 2010).

In the Oslo Manual (OCDE, 2005, p. 55), an important document on the theme, innovation is defined as "[…] the implementation of a new or significantly improved product (good or service) or a process or a new marketing method

or new organizational method in business practices, in the organization of the work place or in external relationships". Tidd *et al.* (1997, 2008) and Tidd *et* Bessant (2013) consider that, for organizations, innovation means the development of new technologies, in the review of the organizational process and in the transformation of all these variables into new market opportunities, prosperous products and services.

Since innovation is a key element for competitiveness and given its complexity, it demands the establishment of a management process that defines mechanisms and instruments, as well as methodologies and forms of organization that can guarantee the organizations' capacity to innovate. In this sense, innovation management encompasses stages of scientific, technological, organizational, financial and commercial study, as well as investments in new knowledge, aimed at implementing new technology or improving pro-

ducts, services or processes (OECD, 2005). According to Tidd *et al.* (2008, p. Ix), it is the "[...] process of planning, allocating, organizing and coordinating key factors for achieving innovative results. Innovation management is the integrated management of (more) value alternatives (new technologies) from knowledge, information and creativity".

In this context, universities, as generators of knowledge, have come to play an important role (Etzkowitz, 2008). The use of knowledge generated in universities represents a rich source of information and training for the development of new technologies, resulting in the fact that the transfer of technology between university and productive sector consists of an alternative and complementary path to reach a higher technological level of Brazilian companies. Thus, the establishment of technology management policies in the academic sector has become essential to ensure the interests of both parties (universities and companies) and to allow maximum use of the generated technologies, looking at the same time to minimize conflicts (Garnica *et* Torkomian, 2009).

In this way, the Brazilian Innovation Law established measures to encourage innovation and scientific and technological research in the productive environment. Among the measures of this law, management mechanisms were developed for the Scientific and Technological Institutions (ICTs) and their relation with the companies. The universities added the function of structuring an internal body, called *Núcleo de Inovação Tecnológica* (NIT - Nucleus of Technological Innovation), with the function of managing its innovation policies (Law No. 10.973, 2004). This scenario poses a great challenge to innovation managers, particularly in universities – to drive innovation in a systemic and continuous way, ensuring the strategic choice of organizations.

In this sense, the objective of this study was to analyze the innovation management process in the context of the Nucleus of Technological Innovation of the State University of Maringá (NIT-UEM), in order to propose actions aligned to the management of innovation based on culture, strategy and identification of opportunities for innovation appropriate to the environment of an Institution of Higher Education.

The article is structured in four sections, in addition to this Introduction. The second section presents the theoretical support of the study, focusing on culture, strategy and opportunities for innovation, and the following section describes the methodological procedures used in the research. The fourth section contains the presentation and analysis of the data, and the fifth section presents the final considerations of this study and in the sequence, the references used are listed.

2. THEORETICAL REFERENCE

This section presents the main concepts of the areas of knowledge related to this research, namely: culture, identification of opportunities and strategies for innovation.

2.1 Culture for innovation

The organizational culture has several concepts coming from the social and human sciences. In general, it can be understood as a system of values shared by the members of an organization, at all levels, that differentiates it from the others. Table 1 presents some definitions related to the theme and their authors.

Table 1. Definitions of organizational culture

Authors	Concepts
Schein (1992)	A set of beliefs, assumptions, values, objects and symbols that are shared by a large number of people in an organization, and can be observed on several levels: artifacts (environment, layout, dressing manner, public documents, etc.), of the values that govern people's behavior and unconscious assumptions (which determine how members of a group perceive, think, and feel).
Dias (2003)	Set of values, beliefs and understandings that the members of an organization have in common. It includes rules that are maintained over time and shape the behavior of individuals within organizations.
Cunha *et* Carmo (2007)	It consists of aspects that give organizations a particular way of being. It is for the organization as the personality is for the individual; it represents the set of beliefs, values, work styles and relationships that distinguishes one organization from others.
Horta *et* Cabral (2008)	It is what differentiates the company in the way of doing things and in the way of thinking of the people who work in it.
Morschel *et al.* (2013)	A set of beliefs, values, work styles and relationships that distinguish one organization from the other. It shapes the identity of an organization, as well as the identity and recognition of the employees themselves.

Source: Elaborated from Ferraresi (2014)

Thus, it is perceived that the organizational culture consists of a system of values, beliefs, relationships and understandings, shared among all the people in a specific organization that interacts with people, processes, structures and control systems, to determine norms of behavior, that is, to establish how things are to be done in that particular organization.

The increasing importance of innovation in the business environment and the search for competitive advantages demand, at present, an organizational culture that promotes innovation. Innovation, in Drucker's view (1954), means acting differently from other competitors in the supply of products and services, or in other aspects of company management and market actions, so that customers perceive greater value.

According to Ferraresi (2014), knowledge, creativity, an environment favorable to the creation and suggestion of ideas, among other aspects, determine the capacity and propensity of a company to innovate, called innovation. For this author, the concept of organizational innovation refers to the propensity or ability of the company to innovate, or its openness to implement new ideas, together with the resources and knowledge necessary to take advantage of the market opportunities facing the competition. For the author, there are aspects that are necessary for the innovative company, which are presented in Table 2.

Table 2. Aspects of the innovative company

Aspects	Characteristics
Criativity	It refers to the production, conceptualization or development of innovative and useful ideas, processes or procedures, by an individual or by a team of individuals working together. It is linked to individual and group behavior; It is a process of trial and error that results in learning; it iss enabled by culture and structure.
Opening for new ideas	It is an aspect of the internal corporate culture; it is linked to the propensity to listen to "the voices" inside and outside the organization and to explore and experiment, resulting in learning; what is unusual may be a solution.
Intention to innovate	It is linked to the strategic intention of the company to innovate, that is, to the willingness, behavior, intention and commitment of the company to innovate. This aspect links creativity, a propensity for new ideas and an attitude of tolerance towards risk, and it is a cultural process.
Willingness to take risks	Refers to leaving the comfort zone to take the risk of new ideas and unusual solutions for problems.
Ability to innovate	It refers to the organization's ability to adopt or implement new ideas, processes or products efficiently and effectively. Knowledge and skills form the competence to innovate; it is not only a voluntary behavior.

Source: Elaborated from Ferraresi (2014)

Culture can be a facilitator or a barrier to innovativeness and innovation. Ferraresi (2014) lists facilitating cultural characteristics and barriers to innovation. This research is one of the main references used in the analysis in NIT-UEM.

Thus, innovation is linked to the ability and propensity of a company to innovate and, in turn, organizational culture is a set of beliefs and values that guide the behavior of people within organizations. In this way, the relationship between organizational culture and innovation can be understood as an organizational environment in which there are spaces for people's creativity, sharing of ideas, information, experiences and values that have innovation as the main focus.

Given the growing importance of innovation in business contexts and the search for differentiated competitive advantages, an organizational culture that facilitates these processes becomes a strategic factor for companies to achieve their objectives.

2.2 Identification of opportunities

The identification of opportunities aims to verify, in the environment where the organization is inserted, signs of change that can lead to new technological opportunities and new market requirements (Spinosa *et* Nogas, 2013). Tidd *et al.* (2008) argue that the identification of internal and external opportunities in the various business influencing environments, such as marketing, competitive, technological, political, legal and social, is the first step in the innovation process. For these authors, the biggest challenge for companies is to identify the transformations that will affect them and act proactively. In order to be successful and effective in identifying innovation opportunities, the authors recommend that companies should seek different approaches in order to understand market boundaries and dynamics, monitor trends, predict markets and technologies, build learning, engage all parties interested in the search for innovation, deploy error management, communicate, give voice to the customer and establish connections. Formal and informal information and interaction networks gain prominence and amplify the scope of the opportunity radar.

Likewise, Spinosa *et* Nogas (2013), based on the studies of Tidd *et al.* (1997, 2008) suggest more specific routines and procedures for obtaining and processing signals relevant to the innovation process. Thus, in order to search for market-related information, they suggest approaches such as the establishment of market boundaries, the understanding of their dynamics, forecasts, work with the user, continuous interaction, dissemination of user perspectives to the organization's areas and customer voice processing. From the perspective of the search for technological information, they suggest approaches related to technology forecasts, network development, benchmarking, best practice and reverse engineering.

In addition to identifying opportunities in the various business influencing environments, creativity is another

element that has great impact in this area. For Sakamoto (1999), creativity is the expression of a human potential of achievement, which manifests itself through human activities and generates products in the occurrence of its process. In the same way, Dublin (2003) considers it as the process of developing good ideas that can be put into operation.

Being creative does not mean a privilege of only a group of people; creativity is part of a learning process, from an environment conducive to its development and a constant stimulus to the generation of new ideas. Thus, when defining the term creativity, one must take into account the personality characteristics of the person who creates, that is, their temperament, traits, values, emotional attitudes, beyond the creative capacity of the one who creates, involving aspects such as creative thought, motivation, perception of the world and object of creation, that is, the product, process or service created, where the influences of the internal and external environment are taken into account, based on educational, social and cultural factors.

Likewise, Souza (2005) states that creativity is understood as the process of creating from aspects such as sensitivity, emotion, motivation, perception, curiosity, technical and cognitive skills integrated to science, technology, society and the environment. However, you have to teach people how to be creative in practice.

Authors such as Alencar (1995) and Gurgel (2006) argue that to create it is necessary to understand, relate, order, configure and establish meaning. You need a great adaptability to adjust to new technologies and develop skills for problem solving and decision making. In this context, organizations need to develop environments that allow the expression of the creative potential of their collaborators.

Research developed by Faria *et* Alencar (1996) identified the stimulating factors and inhibitors of creativity in the work environment of the organizations through research with professionals from different organizations, both public and private, and resulted in the construction of categories related to stimuli and obstacles. This research is also one of the main references used in the NIT-UEM analysis.

Several are the stimuli that can influence the generation of ideas, reflecting on organizational behavior and impacting business performance. The concept of creativity is directly linked to that of innovation; however, creativity refers to the generation of a new idea and innovation to the application of ideas. Thus, for the expression of creativity to occur, as Parolin (2003) argues, it is necessary to have the person who creates, the interpersonal relationships, the role of the organizational environment and the relations generated between the people with the leaders and with the organizational projects .

Therefore, an organizational environment oriented to the creative behavior of employees should be stimulated. The generated ideas, individual or collective, should serve to solve problems throughout the productive process, meeting the objectives of the organization. In addition, it must be considered that, to develop creativity, it is necessary to promote certain changes in the organizational environment, which, to a large extent, depend on the attitudes of managers.

2.3 Strategies for innovation

Strategy is a word originating in the Greek term strategia, which means plan, method, maneuvers or devices used to achieve a specific goal or result. According to Silva (2014), Mintzberg *et* Quinn (1993) affirm that there is no universally accepted definition for strategy, and the term is used with different meanings by many authors and administrators.

After analyzing the various concepts of strategy found in the literature and with the intention of trying to understand how innovation relates to strategy and vice versa, Silva (2014, p.6) conceptualizes strategy as "the set formed by the mission, vision, Long-term goals, short-term goals, policies and action programs established within a coherent sequence and by allocating resources corresponding to each program as defined by an organization".

In order to facilitate the understanding of this concept, the author, based on the studies of Quinn (1980), presents the definition of each of the elements that comprise the strategy, listed in Table 3.

Table 3. Elements that make up the corporate strategy

Elementos	Definição
Mission	Statement that determines the purpose of the organization's existence, being related to the social needs that it proposes to attend.
Vision	Determining the long-term future situation that the organization wishes to occupy in a given period of time.
Long-term goals	Determination of what the organization wants to achieve and when the results will be achieved. They understand the general organizational goals, which establish the nature desired by the company and directions that should guide the organization.
Short-term goals	Specific, short-term, less permanent objectives that define specific tasks for each of the organizational units and subunits.
Policies	Rules or guides that express the limits within which strategic action should occur. These rules often take the form of contingency decisions to resolve conflicts that exist and relate to goals.

Action Pro-grams	Determination of the sequence of actions necessary to achieve the main objectives, within the limits established by the policies.
Resource allocation	Determination of resources needed to ensure the implementation of action programs, linked to strategic goals and objectives. This allocation must be made through the drawing up of a budget.

Source: Silva (2014)

In addition, in considering that the above concept can be related to the definitions of Mintzberg (1994), Silva (2014) lists the main characteristics that the concept of strategy can present, listed in Table 4.

Table 4. Characteristics of the strategy concept

Characteristics of the strategic concept	Meaning
Being a **perspective**	Strategy is a perspective, a panorama, a vision, and its content implies a particular way of perceiving the world. Thus, the strategy is designed with the intention of regulating a given behavior. It can be made explicit by means of the mission statement, vision, values, principles and creed.
Being a **pattern** of action	It is a pattern of behavior in the actions performed; it seeks to provide convergence, achieving consistency in behavior, through the orientation produced by the perspective created. This pattern is created by spontaneous employee initiatives, motivated by shared perspective (beliefs, values).
Being a **plan**	Formed by intentions and conscious actions that have the purpose of achieving the objectives and goals defined by the organization. These conscious and intentional actions should provide convergence, in order to guide the company towards the achievement of the main objectives and fulfillment of mission and vision. It is a consciously determined direction, a guide or course of action for the future, an intended path.
Being a **position**	Strategy is a position or posture, in particular, a means to situate an organization in its environment. Strategy is the mediating force between the organization and the environment, that is, between the internal and external contexts. In formal terms of administration, it represents a domain of the market product, that is, the place of the environment in which the resources are concentrated. Policies and programs of action can define some ways in which the company competes in a particular market, specified by the main objectives.

Pretext (Stratagem)	This is an intentional maneuver to overcome or anticipate a competitor. The organization induces its competitors to have an erroneous perception of their competitive movements.

Source: Silva (2014)

The strategic actions defined by the top management appear to try to guarantee the competitive advantage of the organizations and, consequently, their survival. The systematization of actions for the management of innovation in organizations, in the view of Bittencourt (2014), requires the accomplishment of a planning whose process presents an evolution of the quantity and quality of the information, as well as the capacity of definition and clarity of objectives and goals by the managers. To do this, planning must be driven by strategies that prioritize innovative actions and reduce potential risks.

For the author, innovation is seen as a source of uncertainty and change of scenery and also as a competitive source in organizations. In this sense, this new understanding of the technological innovation process has altered the fundamentals of strategic decision making in organizations, since (i) it has led to the awareness that organizational behavior and structure can be shaped, (ii) enriched the analysis of forces that influence the rate and direction of technological innovation, (iii) the decision-making process – from resource inversion to technological innovations – gained assertiveness, and (iv) the direction of technological change tends to be easily identified.

The external search for ideas, knowledge and creative processes, as a way to maintain an active and effective innovation system, establishes a new way for companies to deal with external actors and variables. In this way, interaction with the external environment is an essential element of any strategy concept. Thus, organizational change in the way they relate to actors (clients, suppliers, etc.) and external variables indicates the need to deepen the understanding in terms of how this may influence or help explain the differences in performance between the companies of the same sector or in different sectors (Silva, 2014).

The Porter Five Force model (1986) can be understood as a tool that helps to define the company's strategy and takes into account both the external and the internal environments. Knowledge of the underground sources of competitive pressure is the cornerstone of the strategic agenda for action. They highlight the company's strengths and weaknesses, inspire its position in the industry, illuminate areas where strategic changes may provide the greatest return, and identify where sector trends are most significant in terms of opportunities or threats.

All these forces, such as threat of new entrants, the bargaining power of buyers, threat of substitute products/services, the bargaining power of suppliers and rivalry among existing firms, determines the potential for performance. In this way, it is possible to understand the complexity and critical factors of internal and external competitors that threaten performance and develop strategies to neutralize them. The Five Forces that impact an industry's profitability determine the intensity of its competition, with the strength or strongest forces predominating and becoming crucial from the point of view of strategy formulation. Therefore, it is important that each of these forces be evaluated, at a considerable level of detail, so that a company can develop effective competitive strategies (Pontes, 2009).

3. METHODOLOGICAL PROCEDURES

In order to understand the process of innovation management in the context of the NIT-UEM, a qualitative and exploratory research was carried out. The exploratory study has the purpose of increasing understanding in terms of a given research problem, as well as gathering information to refine questions about the problem. The methodology used combines three elements: own practices relevant to innovation management, problem-based learning and innovation, all elements articulated based on a research protocol from international references.

This methodology, proposed by Spinosa *et* Nogas (2013), is used for the elaboration of an innovation management plan, which focuses specifically on practices and procedures and not the mentioned innovations. Based on the work on innovation management developed by Tidd *et al.* (1997, 2008) and Tidd *et* Bessant (2013), this methodology reconciles three main elements, namely: (i) own practices relevant to innovation management; (ii) Problem-Based Learning (PBL) and (iii) the innovation object that characterizes the prevailing type of innovation in a real-oriented case.

According to Spinosa *et* Nogas (2013), the PBL is used to guide the thinking of innovation managers, helping them to understand the reality of their organization, analyze the current and future scenarios and decide, in a systemic and integrated way, the practices of innovation that must be considered to meet their needs. The PBL has found recognition where it is applied, because it arouses greater motivation for the construction of knowledge and greater assimilation of concepts and contents, predominating the learning of cognitive contents and integration of disciplines (Sakai *et* Lima, 1996).

The methodology proposed by Spinosa *et* Nogas (2013) adopts four perspectives and eight macroprocesses linked to innovation management practices. The four perspectives

to define management practices are: (i) strategy, which refers to assuming a strategic position for innovation and its management; (ii) deployment mechanisms, which concerns the development and effective use of mechanisms and deployment structures for innovation management; (iii) external interrelationship, which deals with the construction and maintenance of external relationships for innovation management; and (iv) organizational support related to the development and extension of organizational support for innovation management.

The eight macroprocesses that organize what must be done to make innovation happen in a systemic and continuous way, refer to: (i) formation of culture for innovation, aiming at giving awareness to the organization about the benefits of innovation; (ii) identification of opportunities or promotion of ideation and creativity; (iii) specific strategic definition of innovation, in order to harmonize it with the corporate strategy; (iv) analysis of investments and risks, considering that innovations require financial resources to occur in an environment of uncertainties; (v) allocation of existing or non-existent resources within the organization for innovation to take place; (vi) implementation, in which the new product, process or service is in fact made; (vii) diffusion of innovation, involving the making available on the market of the new product, process or service; and (viii) learning, which mainly brings together knowledge management techniques and occurs in parallel with the other phases (Spinosa *et* Nogas, 2013).

Thus, this methodology can be seen as a great structure in PBL, that allows to approach the management of the innovation starting from an overview for more specific visions, that is, a top-down reasoning.

To reach the objective proposed in this study, the focus of analysis was on the following macroprocesses: culture for innovation, identification of opportunities and strategies for innovation. The choice of these domains is based on the fact that, as stated by Tidd *et al.* (2008), innovation is driven by the ability to establish relationships, detect opportunities and take advantage of them, with the basic pillars of which are knowledge, information and creativity.

An organizational culture that promotes innovation is a strategic factor for organizations to achieve their goals, as well as to identify the transformations that occur in the different environments and that can affect them, thereby enabling proactive action. Likewise, strategic management allows for the necessary organizational adjustments by continually adapting the organization's cultural and political aspects, as well as changing the environment. Thus, an organizational culture focused on innovation, coupled with the identification of opportunities and strategic actions, becomes an important triad for the development of this study.

As a unit of analysis, the NIT-UEM was selected, and the innovation prevailing in this study is organizational innovation, defined by the Oslo Manual (OECD, 2005) as the type of innovation that refers to the implementation of new methods of organization and management of the company's business practices, in the organization of its workplace or in its relations with external actors.

Regarding the practices and procedures relevant to the management of innovation in an oriented and real case, according to the methodology proposed by Spinosa *et* Nogas (2013), these were analyzed considering the performance of one of the authors as a member of the NIT-UEM, which allowed to obtain knowledge of the processes and activities of this program. The data collection in the field was carried out in March 2015, being primarily documentary and instrumentalized by questionnaires specific to the methodology.

4. SEARCH RESULTS

4.1. Characterization of the object of innovation

The innovation object of this study is the NIT-UEM, created in 2008, four years after the promulgation of the Brazilian Innovation Law, to attend to this legal device, as well as the Institution's needs in relation to its innovation policy. The NIT-UEM was established at the time as a Program, with the mission of "managing the institutional policy of innovation and intellectual property" (UEM, 2015).

The main objectives of the NIT-UEM are (i) to ensure the implementation and maintenance of the institutional policy to protect innovations; (ii) to disseminate the culture of patenting within the University; (iii) protect inventions generated at UEM; and (iv) to approximate and integrate UEM with the productive sector, enabling the transfer of technological innovations (UEM, 2015).

The NIT-UEM is linked to the Intellectual Property Division and the Division is subordinated to the Research Directorate of the Institution. In turn, this Board is subordinate to the Office of Research and Graduate Studies (PPG) of the Institution, which is subordinated to the Rectory, the central executive body responsible for the management of the entire Institution.

In order to achieve its objectives, the NIT-UEM has the following structure:

a) *Superior Council* - composed of the Vice-Rector, Pro-Rector of Research and Post-Graduation, Pro-Rector of Extension and Culture, Planning Advisor, Research Director, Officers of the seven academic units of the

Institution and representative of the Technical Council.

b) *General Coordination* - composed of the Research Director, Head of the Intellectual Property Division, Head of the Research Support Center Division and representative of the Planning Department.

c) *Technical Council* - composed of ten researchers, with a recognized contribution to scientific and technological development (UEM, 2008).

The competences attributed to the Higher Council, General Coordination and Technical Council are summarized in Table 5.

Table 5. Powers of the Higher Council, General Coordination and Technical Council of NIT-UEM

Estructure	Competences
Higher Council	Establish policies and objectives, draw up work strategies and approve programs Elaborate, approve and modify the Internal Regulations Evaluate performance and monitor actions, ensuring their compatibility with higher orientations and proposing new actions
General Coordination	Follow NIT actions Enable requests for protecting the intellectual property of UEM researchers Facilitate public-private partnerships and promote networking between researchers, entrepreneurs and investors Regulate the provision of services related to innovation and scientific and technological research
Technical Council	Promote the protection of creations developed in UEM To assess the desirability of protecting intellectual creations of UEM researchers and independent inventors

Source: Prepared from EMU (2008)

4.2. Culture for innovation in the institution

So that there is a culture of innovation, as claimed Tidd et al. (2008), there should be an integrated set of components that work together to create and strengthen an environment that allows innovation to take place. In this sense, in order to identify in the organization under study the presence of facilitating characteristics and barriers to innovation, an analysis was made considering the characteristics of innovation presented by Ferraresi (2014), the results of which are shown in Table 6.

Table 6. Facilitators and cultural barriers to innovation in the organization under study

Cultural characteristics that facilitate innovation	Cultural barriers to innovation
Skilled professional staff Emphasize diversity Integration with the external environment under construction Legal framework	Excessive workload Control of decisions and information Lack of proper communication Rigid hierarchical structures Excessive bureaucracy Cultures focused on power and function Resistance to change Domestic Legislation Internal and external customers with different expectations Non-valuation of the employee

Source: The authors' own

In this way, it can be verified that the main cultural characteristics that support the innovation in the scope of the NIT-UEM are related to the fact of having a qualified professional team, the integration with the external environment and the legal framework. Regarding cultural barriers, we identified the presence of factors such as excessive workload, control of decisions and information, lack of adequate communication, rigid hierarchical structures, excessive bureaucracy, cultures focused on power and function, resistance to changes, internal legislation, internal and external clients with different expectations and non-valuation of the employee.

The organizational structure of the NIT-UEM stands out as one of the barriers related to culture for innovation. Created to manage the Institution's innovation and intellectual property policy, the NIT-UEM is characterized as a Program, and its structure, the same since its conception, is complex and not adequate to manage the Institution's technological innovation.

Since its inception in 2008, it was noted that there was no participation of the Board of Governors in its actions, and the activities within its competence are developed by the General Coordination. This, in turn, counts with the participation of only the Research Directorate and the Division of Intellectual Property, that is, the Division of Research Support Centers and the Planning Department do not contribute to the achievement of the activities of the NIT-UEM. Almost all of the activities under this Coordination are developed by the Intellectual Property Division, with the support and supervision of the Research Director, who is also the Coordinator of the NIT-UEM, acting as a result of the duties inherent to the position. Finally, as for the Technical Council, it has acted in accordance with its competencies.

In order to promote a culture of innovation in the NIT-UEM, it is suggested to create a favorable environment for innovation to occur and, in this way, there is a need to align the values of the NIT-UEM with its objectives, that is, to plan change in all its areas. It should be included in this planning from the most basic concepts, such as the mission and the vision of the Nucleus, going through all internal processes, so that an adequate perception is built with the collaborators.

In addition, it is important to have employees who think and act on the principles of innovation. The stimulus to the employees must start from who is responsible for the institutional governance, that is, the leaders. By means of conduits that encourage the individual development of its collaborators, the Nucleus will gradually become a stimulating place where everyone can feel at ease in trying new possibilities. The exchange of information among colleagues, sectors and among the leaders and other members of the Nucleus should also be encouraged. Only with access to information can you think in an innovative way and make the best decisions.

Another suggestion would be the adoption of a more organic management model, with a more flexible organizational structure, a decentralized decision system and a soft hierarchy. There should be greater reliance on informal communications and an emphasis on the principles of good human relationships, cultivating values that emphasize teamwork and collaborative spirit. Actions aimed at informal knowledge sharing, aimed at creating a relaxed, employee-friendly environment to encourage people to suggest new ideas, can contribute to building a culture of innovation.

It is important to emphasize the need for top management to be involved in innovation processes, since culture can be established from the top down. In addition to top management, all levels must be involved, because in every business pursuit it is possible to innovate, from simple items to complex structures. In this way, everyone feels part of the system and creates an extremely important sense of belonging to achieve the expected results.

4.3 Identification of opportunities in the institution

For the identification of opportunities at the NIT-UEM, an analysis was made based on the routines and procedures to search for market information and technological information, as suggested by Spinosa *et* Nogas (2013), as well as the stimulating and inhibiting factors of the creativity in the work environment of the organizations, developed by Faria *et* Alencar (1996).

In this way, the results regarding the routines and procedures for searching market and technological information are shown in Tables 7 and 8. Regarding the routines and procedures for seeking information from the market (Table 7), it was observed that the NIT-UEM has a clear business strategy and understands the dynamics of the market, and potential markets may arise as a consequence of several forms of change, especially those related to the political and legal context. There is no exploitation of trends for the treatment of changes, and activities are usually carried out on demand. There is involvement with its clients, with a view to working in partnership in order to maximize results, however, not proactively. In addition, the Nucleus seeks to listen to its client and, based on the information obtained, seeks, albeit partially, to act in order to improve its actions.

Table 7. Routines and procedures for searching market information

Routine	Analysis in the organization
Establishment of border markets	The organization is clear about its business strategy, which comprehends, in a general way, the importance of protecting the knowledge generated in the academic field and its transfer to the market.
Understanding the dynamics of the market	The organization understands that potential markets can arise as a consequence of various forms of change - political and legal, technological, educational, economic, social, etc.
Market forecasts	There is no exploration of trends for the treatment of change. The activities are usually carried out on demand, and these then support setting goals for the innovation process.
User work actions	There is involvement of the organization with its clients, with a view to working in partnership, aiming to maximize the results.
Continuous interaction	The organization seeks to interact with its clients; however, the actions are given on demand and not proactively.
Customer voice processing	The organization listens to its client and from the information obtained, seeks, albeit partially, to act in order to improve its actions.

Source: The authors' own

With regard to the search for technological information (Table 8), the NIT-UEM timidly analyzes historical performance and seeks information on technologies that can support its activities through participation in scientific and technological events. It has also adopted less closed policies aimed at cooperation, with partnerships taking place with universities, technological development institutions, trade associations, development agencies and local entities. In addition, it uses, albeit timidly, management tools, such as benchmarking and best practice, with a view to improving its performance.

Table 8. Routines and procedures for searching technological information

Routine	Analysis in the organization
Technology forecasts	The organization makes a timid analysis of its performance and seeks information on technologies that can support its activities through participation in scientific and technological events.
Network development	The organization has adopted less closed policies aimed at cooperation, thus supporting its actions and achieving positive results. The partnerships take place with universities, technological development institutions, trade associations, development agencies and local entities.
Benchmarking	The organization makes, albeit timidly, comparisons with other companies, seeking to identify ways to carry out their processes that can be used internally.
Best practice	The organization conducts, timidly, research of best practices with similar organizations.

Source: The authors' own

It was also verified that, although there are actions aimed at obtaining information relevant to the innovation process, the NIT-UEM does not have a process for storing them, allowing its recovery in an agile and safe way that supports the organization's decision-making.

At the same time, the analysis based on stimulants and inhibitors of creativity in the work environment of the organizations (Table 9) revealed that the main stimuli to creativity refer to the existence of adequate channels of communication, challenging tasks that stimulate creative potential, freedom and autonomy for the execution of common activities, receptiveness of the leadership in the face of new ideas and support for the training of employees.

As regards barriers, the physical environment and technological resources are not adequate, financial and material resources are restricted, organizational structure is rigid, there is excessive bureaucracy and centralization of power, political and administrative influences discourage creative production and there is an excess of services.

Table 9. Stimulus and barriers to creativity

Criativity	Categories
Stimuli	Communication: the communication channels are adequate, and the democratization of information takes place through a specific website. Challenges: the tasks performed are challenging and stimulate the creative potential, and the employees consider the work they do to be important. Freedom and autonomy: there is a certain degree of freedom to decide how to carry out ordinary activities; There is also participation of employees in the processes of decision-making and in the search for solution of problems. Leadership support: Leadership is receptive to new ideas. Training: there is support for capacity building/training of employees, aiming at the development of their creative potential and the search for new solutions to the problems.
Barriers	Physical environment: not suitable, currently there is a room with two tables and two computers, used by two employees, one of whom is a trainee for a limited time. In addition, there is a lot of noise, which makes it difficult to focus on activities. Technological, material and financial resources: the quantity of equipment is small, but adequate; however, there is no software for adequate management of the activities. Financial and material resources are restricted. Organizational structure: rigid, there is excess of bureaucracy, rigid norms, and centralization of power. Political-administrative influences: constant political-administrative changes, causing changes in the work, and political interferences discouraging the creative production. Volume of services: excess of activities, lack of employees, intense time pressure.

Source: The authors' own

Thus, as management practices to support NIT-UEM in order to promote the identification of opportunities, it is suggested that greater use be made of management tools such as benchmarking and best practice, with a view to identifying similar actions carried out in other organizations that may contribute to its performance, as well as the constant development of networks, aiming to create new partnerships. In addition, adequate technological resources are needed in order to establish mechanisms for storing the information, with a view to making its retrieval agile and safe, so that it can then generate information relevant to the decision-making process.

Another suggestion is the adequacy of its organizational and legal structure, aiming at more flexible, less bureaucratic, with current and adequate legislation and clearly established guidelines. In addition, the physical structure must receive special care to provide an environment that stimulates the execution of its activities and the development of new skills and knowledge, and there is also a need to create mechanisms that enable actions to be developed that aim at greater interaction with internal and external customers.

4.4. Strategic definition in the institution

The main characteristics that the concept of strategy can present in the study object of this research can be evidenced through the analysis of the 5P's – Perspective, Position, Plan, Pretext and Pattern – that explain how the strategy and positioning of the organization is defined.

Regarding the Perspective attribute, the NIT-UEM mission is properly established and consists of "managing the institutional policy of innovation and intellectual property". However, the same does not occur with regard to vision and values. The vision must be a reflection of the organization's longings, mirroring its relationship with society and supported by its mission and values. In organizations that do not have economic gains as their primary goal, establishing the vision is more complex, and the full realization of the mission becomes the measure of success, not financial performance. Therefore, vision is a way for the organization to achieve its mission fully, expressing this not necessarily in quantitative terms, but through motivation, orientation and philosophy, in order to instigate the members to work to achieve those goals. Values, on the other hand, reflect intrinsic beliefs and convictions, so as to orientate from the planning processes of the organization to the actions and relationships of everyday life. Therefore, they should describe the desired behaviors, postures and organizational culture and thus contemplate clear beliefs, priorities and directions, concise and shared, so that everyone can understand them and contribute to their incorporation. When values are not taken into account in the organization's work, people may feel dissatisfied and unmotivated.

In relation to the Standard attribute, it was observed that the behavior in the actions carried out by the NIT-UEM is in line with its mission, which is the result of the relevant legislation and competences, as well as the attribute Plan, given that its actions meet its main objectives. In the same way, it can be seen that in relation to the Position attribute, there is a clear positioning of the Core in the environment in which it operates, understanding that its target audience is composed of professors and researchers of the Institution and having as market differentials innovation and quality. However, as far as the Pretext attribute is concerned, the NIT-UEM does not act in a way that anticipates its competitors.

The original performance of NITs, by virtue of the nature with which they were created, focuses on the mobilization of the various actors that make up the innovative environment inside and outside the University. Still, NITs are increasingly expected to be trained in internal and external partnerships. Despite this role of animator and facilitator of NITs, this work considered it is important to analyze the NIT-UEM in the context of increased rivalry, according to Porter's competitive forces. This analysis is justified by the need to identify barriers that impede the original performance of NITs. It does not actually fulfill the establishment of a competitive dynamic, as originally proposed by Porter.

In this way, the competitive forces that operate in the NIT-UEM sector of activity were identified through the analysis of the Five Porter Competitive Forces, whose results are represented in Figure 1.
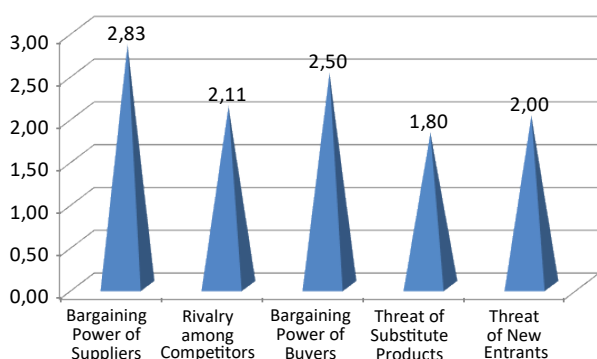

Figure 1. Five Porter Competitive Forces
Source: The authors' own

The results show that the forces related to the bargaining power of suppliers and buyers had greater participation, and those related to rivalry between competitors, threatening new entrants and threat of substitute products had less participation. The bargaining power of suppliers and customers is related to the decision-making power of customers, mainly regarding the price and quality of the product, and in this sense, can be considered the great differential for NIT-UEM. Regarding suppliers, the focus is on providing inputs to the company, that is, knowledge.

The rivalry between competitors, considered one of the most important points in Porter's analysis, deals with the activity and aggressiveness that direct competitors exert. Thus, in relation to the NIT-UEM, the number of competitors and the diversity of the competitors and the advertising they use are not significant. The threat of new competitors in the market is considered low, and one of the main barriers may be related to the knowledge and experience required, which require significant investment. Likewise, the threats of substitute products, represented by services that meet the same needs, also present low participation, given that there are a

small number of companies offering the same service as the Nucleus in the region.

The NIT-UEM strategic resource groups are shown in Figure 2. The indicators reflect how much the company's key resource types create value, are rare, difficult to replicate and replace. Higher averages show which resource groups operate as a source of competitive advantage, and the lower which resource pools cannot be used immediately in the organization's strategy.
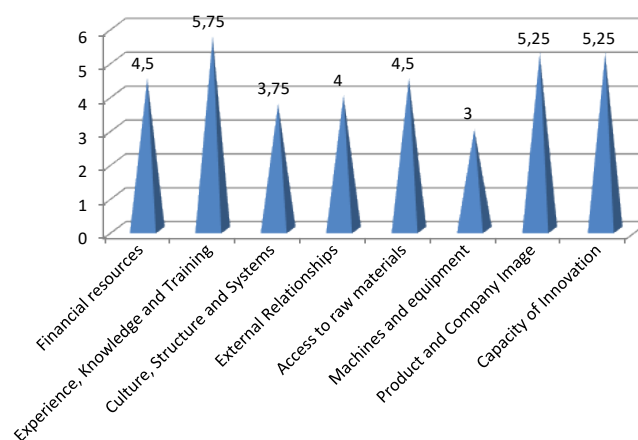

Figure 2. Organizational strategic resource groups
Source: The authors' own

The analysis reveals that the main groups that operate as a source of competitive advantage of the organization are experience, knowledge and training, product and company image and capacity for innovation. Financial resources, access to raw materials and external relationships also had a significant participation; however, resources related to culture, structure and systems, as well as machinery and equipment, were the least representative.

Thus, it is observed that knowledge influences the innovation potential of the organization. The search for ideas, knowledge and creative processes, as mentioned by Silva (2014), is a way to maintain an active and effective innovation system, and the interaction with the external environment is an essential element for the organizational strategy.

With a view to promoting the strategic definition in the NIT-UEM, management actions are suggested based on the accomplishment of a strategic planning, which can help the Nucleus in understanding its environment and in the formulation of adequate responses to such environment, taking into account its purpose within its resource constraints. This will mean overcoming the difficulties detected and taking advantage of the opportunities outlined.

Because the NIT-UEM is an integral part of a larger institution, but with particular attributions, it must deeply know

what results are expected of its work and what its role within this whole is. In particular, the work carried out in this Nucleus, because it is a representation of the various components of the ICTs in front of an external public, means that one must know not only its own context, but also the context of the ICT and its peculiarities as an organization

The response to environmental stimuli can be considered key to its success and, therefore, the strategic planning process provides tools for this analysis to be made and a plan drawn up, in order to guide the NIT-UEM to the fulfillment of its attributions within the whole, which is ICT.

In addition, the adoption of strategic management as a premise of the NIT-UEM will imply in facilitating the sensitization of those who need to be directly and indirectly involved in achieving the purpose of this Program within the Institution, and the purpose of this institution in society, which is often a barrier.

5. FINAL CONSIDERATIONS

The objective of this study was to analyze the process of innovation management in the context of NIT-UEM. Technological innovation requires a peculiar, complex type of management that must interact with a great diversity of agents in the innovation process. Therefore, NITs should act to provide a favorable environment for technology transfer and knowledge protection in ICT, acting as a mediator between the Institution, the private sector and the community.

The domains of knowledge addressed in this study comprised culture for innovation, identification of opportunities and strategic definition. Thus, among the identified characteristics that support the first domain - culture for innovation - in the scope of the NIT-UEM, are the legal framework, integration with the external and internal environment and trained professionals. In turn, cultural barriers include their organizational structure, lack of adequate communication, control of decisions and information, excessive bureaucracy, culture focused on power and function, internal legislation and resistance to change.

Thus, as management practices aimed at promoting culture for innovation, it is suggested to create a favorable environment, which demands alignment of values with objectives, that is, planning change in all areas of the organization. To do this, one should include in this planning from the most basic concepts, such as mission and vision, through all internal processes, to reach the mentality of the collaborators. Another suggestion is the adoption of a more organic management model, that is, a more flexible organizational structure, a decentralized decision system and a more lenient hierarchy.

Regarding the second domain, identification of opportunities, it was observed that, in relation to the routines and procedures for the search of market information, NIT-UEM understands its business strategy and market dynamics; however, its activities are executed on demand only; there are partnerships with its clients, aiming to maximize results, but not proactively. Regarding the technological information to support its activities, it was identified that this organ seeks to participate in scientific and technological events and to promote partnerships with universities, technological development institutions, trade associations, development agents and local entities. However, it was observed that management tools such as benchmarking and best practice are little used.

In this way, as management practices to promote the identification of opportunities, it was suggested a greater use of management tools such as benchmarking and best practice, as well as the constant development of networks, aiming to create new partnerships. In addition, adequate technological resources are needed, in order to establish mechanisms for storing the information obtained, in order to make their recovery agile and safe so that then they can generate information relevant to the decision-making process.

As for the culture of innovation, it was suggested in this second domain - identification of opportunities - the adequacy of the organizational and legal structure, aiming at a more flexible, less bureaucratic, with current and adequate legislation and clearly established guidelines, proactively, not on demand, as is currently the case. In addition, the physical structure must have special attention in order to provide an environment that stimulates the execution of its activities and fosters the development of new skills and knowledge, as well as, there is a need to create mechanisms that make it possible to establish actions that aim at greater interaction with internal and external customers.

Finally, in relation to the third domain, strategic definition, it was verified that the NIT-UEM has its mission duly established, which does not occur in relation to vision and values. In addition, this body understands its position in the environment in which it operates; however, it does not operate in a way that anticipates its competitors. With regard to the competitive forces in the NIT-UEM sector, it was verified that the bargaining power of suppliers and buyers had a greater participation, and the threats of substitute products were less representative. Regarding the groups of strategic resources of this Nucleus, experience, knowledge and training, together with capacity for innovation, were the indicators that presented higher averages, and equipment and machines were the least representative.

Thus, in relation to the practices to promote the strategic definition, a strategic planning, which could help the orga-

nization to understand its environment and formulate appropriate responses to that environment, was suggested, taking into account its purpose within its resource constraints. This means overcoming the difficulties detected and taking advantage of the opportunities outlined. The strategic planning process provides tools to prepare a plan that will guide the NIT-UEM in fulfilling its responsibilities throughout the Institution.

Management systems should provide a combination of generation, selection and execution of ideas by the network of innovators inside and outside the organization. Thus, it is believed that a new management model, which contemplates a broader action, a more effective interaction with the different players of the innovation system – ICTs, researchers, productive sector, government, foundations, development agencies, society – with a dynamic, flexible and diversified management that favors the transformation of UEM research and inventions into innovations will generate positive results for the Institution.

A better adaptation of the organizational structure of the NIT-UEM, which considers the institutional potential of the Institution, the establishment of internal regulations, the implementation of an infrastructure capable of protecting and commercializing university technologies, the expansion of its universe of operations through a greater interaction with other social segments, using the management and training tools required for such activities, will make the work of this Center more coherent to the local reality. This can effectively contribute to its scientific and technological development and its capacity to generate innovation, impacting strongly, directly and positively, on the socioeconomic development of the city and the region.

Innovation is undeniably increasingly a necessary condition for the survival of organizations, and therefore understanding how organizations can continue to streamline their innovation system becomes a relevant and necessary research interest.

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