The challenges faced by Brazil’s Public Universities as a result of knowledge transfer barriers in building the technological innovation center

Luan Carlos Santos Silva*, João Luiz Kovaleski, Silvia Gaia, Eloiza Aparecida Silva Ávila de Matos and Antonio Carlos de Francisco

Department of Production Engineering and Technology Transfer Research Group, Federal University of Technology–Paraná (UTFPR), Ponta Grossa-PR, Brazil.

Accepted 27 September, 2012

This study aims to analyze the contribution of the creation and management of organizational knowledge on the process of structuring Technological Innovation Centers in the State of Bahia, Brazil. The research methodology was qualitative. Results have shown that the researched Centers are well-structured with regard to the constitution of the Centers according to the Federal Innovation Law of Brazil (number 10973) and to the Innovation Act of Bahia State (number 11174). However, some barriers were detected on the creation and management of organizational knowledge related to the progress of activities and effective technology transfer from and to the productive sector. Two of the main barriers are the lack of a staff with tenure, which has relied primarily on the hiring of scholars through the bids offered by the Brazilian government, the lack of a structured system for conducting processes of innovation. Addressing such obstacles is possible as it is understood that innovation of activities is essential as well as acquiring new organizational knowledge for an entrepreneurial and innovative approach gathering university and industry.

Key words: Knowledge management, innovation law, technological innovation centers, public universities.

INTRODUCTION

Advances in science, technology and innovation are key factors to promote sustainable economic and social development of a country. The Ministry of Science and Technology of Brazil (MCT) released data showing that national investments in research and development (R&D), a leading indicator in science and technology (S&T), grew over the past years. In 2003, investments in R&D represented 0.96% of gross domestic product (GDP), increasing to 1.25% in 2010. However, this rate of investment is considerably lower than observed in other countries. According to Moreira and Queiroz (2007), models of technological innovation take into account the infrastructure of public and private research, the existence of a mature national innovation system is necessary to keep the international technological frontier.

Another issue is related to participation of public and private sector in these investments. In 2008, public sector responded for 53.64% of such investments, while private sector, including public enterprises, totaled 46.36%. About 30% of total spending on science and technology are made in public universities highlighting the potential of these institutions to offer new technologies and research, resulting in development of companies (MCT, 2010).

The values of investments on science and technology composed by research and development and related scientific and technical activities (ACTCs) could be used to demonstrate the level of investments made by Brazilian public universities. Regarding the four public universities in Bahia State, official numbers related to technological innovation show an investment of about

*Corresponding author. E-mail: luancarlosmkt@gmail.com. Tel: + 55 (42) 3220-4800.
Innovation is necessary and fundamental in the current scenario. The process of modernization of enterprise systems are directly linked to quality, productivity and new technology products and processes. The process of innovating can arise from brainstorming practices or unexpected ideas tacitly arising in people’s minds inside many organizations. In order to convert tacit knowledge into explicit knowledge and thereafter be able to create innovation, individuals should be encouraged, motivated and also encouraged to participate continuously and most importantly, to share their tacit knowledge and experiences. Knowledge creation and management are essential tools for the generation of innovations in organizations and should be used to facilitate the dynamic throughout any processes, from the sharing of tacit knowledge among individuals, and to the globalization of knowledge.

According to Drucker (2002), society needs more of the men and their processes of knowledge creation than their own work, where it must always meet knowledge, skills and abilities in various fields trying to interact effectively outside the university field. According to Sveiby (1998), the concept of knowledge management, from the mid-90s, has as a primary the creation of value inside the enterprises, aiming the optimization of available resources: technological, human or financial. Such value should be enforceable through learning among individuals in the company.

Lacombe (2005) points out that the management of organizational knowledge in recent decades has reached an important stage on business where being competitive in their market activities is essential to an excellent and active creation and management of knowledge.

Innovation and knowledge management processes in a company could be understood as a cluster of commitments generated by individuals aiming to create, acquire, transform, apply, and then protect the creation of the knowledge generated by the organization in order to remain competitive in the acting market (Davenport and Prusak, 1998; Fleury and Oliveira, 2001; Gold et al., 2001) and in order to innovation become possible in the organizational environment, knowledge must be nurtured and developed in all stages of management.

Knowledge can be understood as a link of man lived practices, values, contextual information and generated ideas. Such experiments allow the individual a framework for assessing and implementing new practices and information. Regarding business, knowledge is not restricted only to documents or manuals and guides management standards, but it also includes routines, processes and ways of conducting the work of individuals (Davenport and Prusak, 2001; Santiago, 2004).

The term Tacit Knowledge was introduced by scientist Michael Polanyi (1966) in the book “The Tacit Dimension”, following the statement: “We can know more than we can tell”. This means that we, human beings, do not verbalize everything that we know, and if we try to comprehend a complex thing understanding step by step or as a whole, probably we may fail. According to Polanyi, tacit knowledge is the result of an active and hard effort towards knowledge involving our body and senses. Regarding this, intellectual or practical knowledge acquisition would be the result of personal involvement and compromise (…). Tacit knowledge is associated to “expert” knowledge in the process of solving problems, or, even associated to the intuition which allows to make decisions without a reasonable motive, easily, explainable or apparent.

About the understanding of knowledge creation and dynamics of this creation, Nonaka and Takeuchi (1995) proposes a model of knowledge conversion. The same underlined that the creation of organizational knowledge is a spiral process, which begins at the individual level and goes up, expanding to communities of interaction that cross boundaries between sections, departments, divisions and organizations.

“The creation of organizational knowledge, should be understood as a process that extends “organizationally” the knowledge created by individuals crystallizes it as part of the organization’s knowledge, this process occurs within a "community of interaction" expanding that crosses boundaries and inter-organizational levels (Nonaka and Takeuchi, 1995)".

The SECI spiral of knowledge can be viewed in the Figure 1. Nonaka and Takeuchi (1995) establish that in the process of socialization, individuals talk and pass information among them, transferring tacit knowledge
from one to the tacit knowledge of other. The act of sharing experiences among people enables the generation of tacit from tacit knowledge. Experience is the key element that must be present in this conversion process, because without some forms of shared experience, the process of one person understanding the reasoning of the other becomes complicated. At this stage of socialization, “shared knowledge” is developed.

Within this sense, Nonaka and Takeuchi (1995) note that in outsourcing, received tacit knowledge is transformed into explicit knowledge through concepts, which can even be documented. Whether through spoken or written communication, tacit knowledge can be converted into explicit knowledge through metaphors, analogies, concepts, hypotheses or models. The outsourcing process generates a kind of knowledge called conceptual knowledge.

On the third point of the spiral of knowledge, Nonaka and Takeuchi (1995) report on the combination, where explicit knowledge is externalized compared with other existing explicit knowledge about a subject, analyzing where convergences and divergences are highlighted. The combination process generates a kind of knowledge called systemic knowledge, held by clusters of knowledge (classification and summarization), or processing different explicit knowledge.

Finally, Nonaka and Takeuchi (1995) notes that the new explicit knowledge generated by the combination, returns to tacit through internalization process, which promotes the certainty that the individuals who received the new knowledge truly learned. This process can be characterized by learning by doing.

The internalization process generates a kind of knowledge called operational knowledge, occurring through reading or viewing and individual study of documents of different formats and models, such as texts, images etc. Individual practice, revise and re-experience individual experiences and practices, among other points. It is possible to note that this schemes of complete knowledge of the spiral of knowledge conversion cycle stimulates the sureness of what really happened in the effective creation of knowledge, and that there was indeed an appropriate and satisfactory utilization of the created knowledge which may come to promote innovation from its implementation. Nevertheless, only with this complete cycle, knowledge management can be developed, allowing through this process the dynamics of organizational innovation.

**Law of innovation and structure of centers (NIT)**

According to Matias-Pereira and Krugliaskas (2005), the Innovation Law is understood as an important step that promotes greater engagement between the spheres to develop and use knowledge: in research centers, universities, and also by businesses and enterprises, cooperatives and others. Without this involvement and without the proper stimulus to protect knowledge, innovation and technology transfer, competitiveness of products, services and processes would be compromised on the target market as a whole.

Law (number. 10,973) from 04/December/02 or Innovation Act generally includes incentives for innovation and scientific and technological research in the production environment, representing a defining mark in our competitive landscape. Importantly, the Innovation Law, in Article1, pursuant to Articles 218 and 219, provides
incentives for innovation and scientific and technological research in the production environment, such as:

“Federal Constitution: “Article 218 - The State shall promote and encourage scientific development, research and technological expertise (and paragraphs 1, 2, 3, 4 and 5) “and” Art 219 - The internal market of the national patrimony and will be encouraged so as to enable the cultural and socio-economic well-being of people and technological autonomy of the country, under federal law. “

The law references and actually implements the provisions of two constitutional articles cited previously regarding the role of the state to encourage the development of scientific research and technological expertise and recognition in the domestic market provided the recipient of the incentive, from the country to seek autonomy and promote the technological welfare of the population (Matias-Pereira and Krugliaskas, 2005)".

According to Barbosa (2006), the law seeks to comprehensively consider in particular the objectives of encouraging scientific and technological research and innovation, to encourage cooperation between the actors of innovation, facilitating technology transferring and improving the management of academic institutions, serve as encouragement for researchers, encourage mobility of researchers, stimulate the formation of technology-based enterprises, and stimulate investment in innovative companies.

Another important point of the Innovation Law was regarding the protection of knowledge. The law provides that each Institute of Science Technology (ICT) constitutes a Technological Innovation Center itself or in combination with other ICTs. This enables many universities and research centers to create their NIT and it disseminates innovation in their regions, for the transfer of technology with the productive sector.

According to Martins (2010), Technological Innovation Center plays a key role in the relationship between companies and research institutions and development, since they seek to meet the demands of the actors involved, adopting strategies and guidelines set out in Public Policy Innovation and Technology, helping the development of innovation in Brazil as well as encouraging the transfer of technology among ICTs and the productive sector.

Entrepreneurs and managers today have a vast system of incentives and ways to implement their actions, aiming more to stimulate and develop innovation in their production and the use of the mechanisms of technology transfer always ensuring adequate protection of generated knowledge.

METHODOLOGY

The research was qualitative with a descriptive nature as described by Cervo and Bervian (1996), Marconi and Lakatos (1996) and Perin et al. (2002). The used method was a case study (Gil, 2002; Trindade, 2003). First, the research consisted of a literature review taking national and international papers, books, resolutions, laws, etc. as sources. The discussed references in the theoretical framework were the basis for gathering information about the subject. The cases for this research correspond to the total number of public universities located in Bahia State, as all of them have a Technological Innovation Center. The whole process of collecting data took six months, in the first semester of 2011.

After the period of gathering specific data on each Center, a questionnaire was developed based on the methodology known as Innovation Octagon developed by Scherer and Carlonmagno (2009) comprising thirty-two statements related to the main purpose of this research: Knowledge creation and management in the process of structuring a Technological Innovation Center. For this stage, people with strategic positions were selected for answering the questionnaire.

The main managers were chosen because the wanted information could be classified, so unrestricted access to such data was relevant. Such procedure allowed greater authenticity of the data collected in the real scenario and its analysis since it was done a non-probabilistic intentional sample. Summarizing, the process involved the overall coordination of each Center: the coordinator and the vice-coordinator, totaling two surveyed participants in each Center.

Data collection

As it was proposed, the surveyed population ended up as 100%, the four Centers located in the four public universities in Bahia State: State University of Santa Cruz (UESC), University of Bahia (UNEB), State University of Southwest Bahia (UESB), and the State University of Feira de Santana (UEFS).

Researchers technological innovation centers

UESC center

The State University of Santa Cruz (UESC) is located in the southeast of Bahia, in the city of Ilhéus and has its scale of operation in the South. It is the only public institution of higher education in this region, composed of the economic regions of the South Coast, with 53 municipalities, and the Far South, with 21 municipalities, totaling 74 municipalities. This area of 53,931 km², equivalent to 9.61% of the state, encompasses an estimated population of 2,450,000 inhabitants, representing 19.5% of the population of Bahia State.

UESC has its Technological Innovation Center (UESC center) institutionalized since May 2009 (Resolution 05 of Consepe). From the perspective of both the Innovation Law Federal (number.10973) and Innovation Act of the Bahia State (number.11174), this Center is connected to the Dean and his council, with one representative from each department, plus a representative of PROPP (Dean of Graduate and Research), totaling eleven members who are divided into functions: vice coordinator and the committees of Intellectual Property, Technology Transfer, and Information Technology. UESC also has four Junior Enterprises (in the areas of Computer Engineering, Production, Administration and Foreign Languages Applied to International Negotiations), the incubator and the incubator for agribusiness ventures in addition to supportive work in the incubator CEPEDI, from INETI.

UEFS center

The State University of Feira de Santana (UEFS) is a public
Institution of Higher Education, maintained by the Government of Bahia, and its Center for Technological Innovation (UEFS Center) is a subsidiary body of the Dean of Research and Graduate Studies aiming to manage the Institutional Policy Innovation, Intellectual Property and Technology Transfer. It had its deployment from 2008 to 2010, according to Resolution 064/2010 of the Supreme Council (Consu) State University of Feira de Santana (UEFS), from the perspective of the federal Innovation Law (number. 10,973) and Innovation Act of the State of Bahia (number 11,174), also in Law 9279/96 (rights and obligations relating to intellectual property), Law 9609/98 (intellectual property protection of software and marketing), Law 11105/05 (biosafety policy), Law 9610/98 (copyright), and Law 9458/97 (protection of plant varieties) (10.973/2004 Act - provides for encouraging innovation and scientific and technological research in the production environment) among other related laws.

The UEFS center aims to articulate, in a system, innovation initiatives in market scope. It also makes efforts involving technology, innovation management, entrepreneurship management and protection of intellectual property, regarding the research and development. It focuses on the interaction with the productive sector, seeking for strategic ways affecting the transfer of technology as well as the spread of entrepreneurial culture and intellectual property in educational institutions.

UESB center

University of Bahia (UNEB) is the greatest public institution of higher education in the State of Bahia, with its foundation in 1983. It is present in all regions of the state, totaling 447 municipalities. Currently, the university offers over 150 choices of courses and qualifications in terms of attendance and distance education (DE), at undergraduate and postgraduate courses, in 29 departments.

UESB has its Technological Innovation Center (UESB Center) connected directly to the Dean of Research and Graduate Education (Dsp), responsible for the creation and management of innovation policy. It is institutionalized since 2009, under the perspective of the federal Innovation Law (number 10,973) and Innovation Act of the State of Bahia (number 11,174).

The objectives of the UESB Center are to promote academic teaching, research and university extension, and foster applied research, enhancing the ability of research groups. Structuring the scientific and technological development; perfecting the existing research groups at the university; promoting cooperation among university-industry-government, promoting the correct use of technological information inside national and international patents banks; fostering the use of technology transfer and knowledge management mechanisms, as well as the dissemination and development of science, technology and innovation.

Innovation octagon

After a research with innovative organizations, researchers Scherer and Carlomagno (2009) created a research tool called innovation octagon. The proposed tool aims to generate a diagnosis of the innovation potential of organizations enabling them to better manage innovation. Figure 2 shows the eight proposed dimensions for the Innovation Octagon. These dimensions summarize the main critical points to be managed in order to promote an innovative productivity, from the strategic stage to the stage of transforming ideas into results (Scherer and Carlomagno, 2009).

The eight proposed dimensions are related to the following aspects:

1. Innovation strategy: How does an organization manage innovative activities?
2. Leadership focused on Innovation: How do leaders understand the necessity and the importance of Innovation? How do managers support an innovation environment?
3. Innovation culture: What do members of the head administration do in order to create an environment which fosters innovation?
4. Relationships and innovation: How does the organization work with partners, clients and competitive organizations in the process of creating and refining ideas?
5. Innovation structure: Where are the innovative activities located and how are they organized?
6. People working with innovation: How do they get support to innovate? How are they encouraged and recognized to move on?
7. Innovative process: How are the innovative opportunities created, developed and evaluated?
8. Innovation funding: How is the innovation activities financed?

The innovation octagon proposes a questionnaire comprising 24 questions focused on evaluating innovation inside organizations. As this research proposes to evaluate innovation inside Technological Innovation Centers, an adaption of such questionnaire was necessary. Therefore, a new questionnaire was accomplished with 32 questions: the twenty-four questions suggested by Scherer and Carlomagno (2009) were adapted to the Technological Innovation Centers reality and an extra eight questions were added in order to

Figure 2. Innovation octagon (Scherer and Carlomagno, 2009).
gather data on knowledge creation and management process in the centers. Overall, the innovation assessment model kept the eight initial dimensions (leadership, strategy, relationships, culture, people, structure, process and funding), adding to each dimension an extra statement.

In order to respond the questionnaire, the participants had to score each statement from 1 to 9 following the Likert scale where 1 meant “disagree totally” and 9 meant “agree totally”. At the end, results showed that the higher punctuation, the higher innovative management ability. Table 1 shows the questionnaire responded by the coordinators of each technological innovation center.

RESULTS AND DISCUSSION

Analyses of the innovation octagon

A research with the centers coordination allowed observing more effectively the functioning in environments observing creation and knowledge management, as well as the structure of the Centers regarding innovation management.

Figures 3 show how the coordinator and the vice-coordinator of each center evaluated the eight dimensions proposed by the adapted innovation octagon. Figure 3 shows the octagon 1 for the UESC center which presented the best results taking into consideration knowledge creation and management. It appears as the most structured center among all researched. According to the point of view from the coordinators from the UESC Center there is such easiness to create and manage organizational knowledge internally as the Center facilitates the internalization of innovative processes and consequently all the operational knowledge. However when considering external relationships, more barriers are presented such as lack of contact to another universities, and, mainly, lack of understanding on revealed and unrevealed requirements of the productive sector in the area of the university as well the lack of a systematic process for tracking new market trends and technology.

New ideas are not evaluated only by its potential but also by the risks involved as they do not have risk management mechanisms. Therefore, they do not invest in ideas which could represent a possible greater loss of investment. Overall, the most critical issue evaluated by the coordinators of the UESC Center was process, with a 5.5 score. Except their positive attitude towards any requirement of guidance coming from different departments of the university or from the productive sector, the coordinators accepted that this center has issues related to the generation, selection and management of better innovative ideas. This issue was also detected in UEF S Center, shown in Figure 3, octagon 2. Coordinators gave the lowest score to this dimension (nº20) showing an important gap on the process. Other statements related to process have showed low scores as well: low capacity of establishing new networks of researchers and/or students, less contact with other universities, lack of profound knowledge of revealed and unrevealed requirements of the productive sector in the area of the university.

However, results demonstrated more easiness to create and manage organizational knowledge internally as showed in the tendency of trying to facilitate socialization mechanisms as sharing experiences among members. This specific result is probably linked to the high scores obtained in the Culture dimension. Coordinators believe that there is an innovative environment predominating in the center.

Leadership was a well scored statement except for the issue related to the evaluation of members’ performance not being done using specific metrics leaving an opening for further analysis on how member’s performance has been assessed. Regarding the structure dimension, results showed that the highly innovative initiatives used to be developed inside the main organizational structure of the center, meaning that there is a centralizing structure. As to strategy, coordinators have pointed out that UEF S Center has not implemented the best mechanisms for cooperation in order to enabling the transfer of technology between university and industry.

Coordinators from the UNEB center believe that there is an innovative environment proved by the highest scores obtained by the existing Culture. According to them, mechanisms to facilitate the combination of knowledge among the members of the center have been promoted. As well as mechanisms to facilitate the internalization process (People Dimension) and socialization mechanisms which promote sharing of experiences (Relationship Dimension).

Leadership dimension has been not so well assessed. This technological innovation center has almost no direct contact with the productive sector, showing a great gap of technology transfer, for example. It seems that researchers are still trying to understand the clarity on the concept and importance of innovation for coordination, searching for specific metrics related to performance in the process of innovation management, time and attention dedicated to the overall coordination. The act of monitoring innovation projects, as well as guiding and following up the results of the work generated by members have also been detected as issues to be concerned about.

The most critical point at UNEB center was the structure dimension. Barriers were highlighted when it comes to flexible organizational structure. There are few hierarchical levels and decentralization of decisions. The specific projects with highly innovative initiatives are treated outside the main organizational structure of the Center. Finally, the existing research groups at the university are not enough to meet regional demands in Research and Development.

Results on UESB Center have shown the lowest scores of all. The process and the funding dimensions have been revealed as matters of concern. Innovation efforts
Table 1. Operationalization of the research variables.

<table>
<thead>
<tr>
<th>Research objectives</th>
<th>Questions: Research variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identifying by the innovation octagon: the actual contribution for the knowledge creation and management processes on the centers.</td>
<td>1. Our innovation efforts are logically aligned with the strategy of the university.</td>
</tr>
<tr>
<td>2. The highly innovative initiatives are treated outside the main organizational structure of the Center on specific projects</td>
<td></td>
</tr>
<tr>
<td>3. We offer time, benefits and incentives (financial and nonfinancial) for innovation.</td>
<td></td>
</tr>
<tr>
<td>4. The need for innovation is understood by every member of the Center.</td>
<td>5. Our organizational structure is flexible, with very few hierarchical levels highlighting the decentralization of decisions.</td>
</tr>
<tr>
<td>6. Our Center has a clear focus on growth through innovation.</td>
<td>7. Our Center permits that risks are taken and mistakes are made in the process of searching for new solutions.</td>
</tr>
<tr>
<td>8. The initiatives and innovation activities have an established coordinator.</td>
<td>9. The coordination of the center is clear about the concept and importance of innovation.</td>
</tr>
<tr>
<td>10. We have a specific budget for innovation projects.</td>
<td>11. We use project management tools to drive innovation initiatives.</td>
</tr>
<tr>
<td>12. New ideas are evaluated according to performance which takes into account the risks and uncertainties.</td>
<td>13. The performance of the members of the Center is evaluated with specific metrics related to their performance in the process of innovation management.</td>
</tr>
<tr>
<td>14. Every member has acknowledgement of what it takes in order to innovate.</td>
<td>15. We use our network of researchers, students, other universities and even leaders in the productive sector to generate and refine new ideas.</td>
</tr>
<tr>
<td>16. Coordination dedicates time and attention in order to monitor innovation projects, to guide and check the results of the work generated by the members.</td>
<td>17. There are issues, objectives and targets set for innovation and protection of intellectual property</td>
</tr>
<tr>
<td>18. We systematically evaluate the results of innovation initiatives with the productive sector</td>
<td></td>
</tr>
<tr>
<td>19. We thoroughly understands the disclosed and undisclosed needs of the productive sector located in the area of the university</td>
<td></td>
</tr>
<tr>
<td>20. We have a structured process for generation and selection of the best ideas.</td>
<td>21. We have a systematic process for tracking new market trends and technology.</td>
</tr>
<tr>
<td>22. We use communication mechanisms to foster innovation and protection of intellectual property in university and in the productive sector.</td>
<td></td>
</tr>
<tr>
<td>23. Our team has a high diversity of knowledge, values, careers and interests.</td>
<td>24. We seek for funding for innovation in different sources (edicts, government agencies, partners, etc...).</td>
</tr>
<tr>
<td>25. We seek to facilitate the socialization mechanisms (sharing experience) and outsourcing of knowledge (conceptual knowledge) among members of the Center.</td>
<td>26. We search for mechanisms to facilitate the combination of knowledge (the knowledge outsourced comparison with existing knowledge) among the members of the Center</td>
</tr>
<tr>
<td>27. We seek mechanisms that facilitate the internalization process (operational knowledge) among the members of the Center.</td>
<td></td>
</tr>
</tbody>
</table>
Table 1. Contd.

28. We studied and implemented the best mechanisms for cooperation so it enables the transfer of technology between university and industry.

29. The research laboratories as well as existing research groups at the university are sufficient to meet the regional demand in R & D (Research and Development).

30. The region's companies and the university (students, teachers, researchers, employees, administration, etc.) know and/or had direct contact with the Center.

31. We disseminate major events (lectures, workshops, etc.) at the University to disseminate innovation and protection of intellectual property.

32. Every time the university and/or any industry have requested some guidance regarding innovation, we provide it in appropriate time so there is no discomfort between the parts.

Adapted from Scherer and Carlomagno (2009).

have not been aligned with the strategy of the university and the results of innovation initiatives were poorly evaluated. Taking funding dimension into consideration, it was possible to detect that UESB center has almost no specific budget for innovation projects so risky ideas have been postponed as the center could not afford any uncertainty involving financial resources.

Considering the relationship dimension, lack of mechanisms of technology transfer as well as direct contact with the productive sector has been highlighted in this study. Such barriers are more presented in the establishment of new networks of researchers, students, other universities and even leaders of the productive sector to generate and refine new ideas. The necessity of a deep knowledge of revealed and unrevealed requirements by the productive sector in the area of the university and the lack of a systematic process for tracking new market trends and technology have been demonstrated by the research.

On the other hand, UESB center is provided with members who understand the need for innovation as they have the proper education for such matter. Most of its members are PhD professors with high interest on research then they have acknowledgement of what it is necessary to innovate. Results have also shown that UESB center has a good structure mostly because there are enough employees and established coordinators for the innovation activities. The strategy dimension has been well evaluated showing that the center has a clear focus on growth through innovation.

Conclusion

Revising the four octagons, it is possible to notice that dimensions related to human factor (people, culture, relationships and leadership) have been revealed as non problematic issues. People and culture dimensions have gotten the highest scores. As most members of these Technological Innovation Centers have a PhD degree, members have a clear notion of growing through innovative research. Summarizing, the Technological Innovation Centers in Bahia State have a team of people with excellent training acting in a great diversity of areas for so the process of knowledge creation and management could be facilitated. By offering benefits and incentives to its members, allowing risks and mistakes in the process of searching for new solutions, all the centers seem to provide a favorable innovative environment. Through communicative mechanisms, the centers seem to accomplish their objective of fostering innovation and protection of intellectual property in university and in the productive sector.

Taking into consideration the relationship dimensions, some difficulties were pointed out. Regarding internal relationships, socialization mechanisms and outsourcing of knowledge among members are common procedures. On the other hand, most centers seem to face some barriers in establishing external relationships which com-promising new networks of researchers, students, other universities and even leaders in the productive sector to generate and refine new ideas, deep understanding of revealed and unrevealed requirements of the productive sector in the area of the university, and finally, the
acquiring a systematic process for tracking new market trends and technology.

Leadership dimension has shown that the coordination of the centers have a clear concept of innovation so members are motivated to search for innovative ideas. The only issue related to this dimension was the evaluation of the members' performance which has not been using a specific metric leaving evaluation to a subjective process based on opinions and beliefs.

Strategically, the surveyed centers seem neither to align their strategy to research groups nor to the University where they are located. Coordinators pointed out that there are a great lack of mechanisms for cooperation in order to enable the transfer of technology between university and the productive sector.

Opposite to what one could expect, Technological Innovation Centers located in Bahia State have many possible ways of collecting money. According to coordinators, most centers have a specific budget for innovation projects, and they can collect funding for innovation in different sources such as edicts, government agencies, partnerships, etc. The UESB Center has shown some more difficulty on collection funding as its members have no experience on participating of edicts, so most of their money comes from their budget which is sometimes not enough.

Analyzing the results on the structure dimension, it was possible to emphasize that the centers with low percentage of turnover can achieve better performance involving innovative activities. The flexibility of the organizational structure and the few hierarchical levels has been considered a positive sign of better knowledge management among its members.

The process dimension had the lowest score of all. Surveyed centers seem not to have a structured system for conducting processes of innovation. Results have shown barriers to use project management tools. Few evaluations of innovation initiatives are conducted considering the productive sector and finally, the process of generating and selecting best ideas has been pointed out as one of the greatest lacks of such centers performance.

Results have revealed that decisions on innovative activities were not made taking into consideration the
specificities of knowledge management and the act of sharing knowledge; consequently sharing innovation has not reached its ideal stage. It is noticeable that positive changes on technological innovation centers had occurred with the establishment of Federal Innovation Law of Brazil (number 10973) and to the Innovation Act of Bahia State (number 11174). The surveyed centers (UESC, UEFS, UESB and UNEB) had introduced strategic actions guaranteeing the best infrastructure possible and hiring skilled researches. However, results have shown that besides improvements provided by such Laws, some barriers could be revealed when procedures aiming innovation were performed. It was observed that regarding organizational knowledge creation and management, the surveyed centers have not achieved an effective system yet. So many actions taken by the centers do not meet the proposed objectives.

The absence of staff with tenure at the technological innovation centers, coordinators face problems on planning and executing activities, fragmentation of knowledge (tacitly and explicitly) and several difficulties on establishing networks among the centers’ members and University departments, University and the productive sector.

Lowest scores on the process dimension, especially for transfer of technology process, should call attention to this great barrier for creation, management and maintenance of knowledge considering SECI process by Nonaka and Takeuchi (1995). Meeting new challenges, technological innovation centers need to be constantly innovating and successively acquiring new organizational knowledge through strategic partnerships in order to be always presenting a competitive posture, which is on demand for countries in development, like Brazil. Overtime, these challenges have become difficult issues to combat because of the lack of businessmen’s awareness of innovation as well as lack of protection of generated intellectual property. The absence of staff with tenure at the technological innovation centers could observe the following matters related to the technological;

1. The absence of staff with tenure at the technological innovation centers, coordinators face problems on planning and executing activities, fragmentation of knowledge (tacitly and explicitly) and several difficulties on establishing networks among the centers’ members and University departments, University and the productive sector.

2. Elaborate virtual meeting in order to discuss important exchanges among the university departments of the innovation centers, as well as fostering opinion sharing knowledge; consequently sharing innovation has not reached its ideal stage. It is noticeable that positive changes on technological innovation centers had occurred with the establishment of Federal Innovation Law of Brazil (number 10973) and to the Innovation Act of Bahia State (number 11174). The surveyed centers (UESC, UEFS, UESB and UNEB) had introduced strategic actions guaranteeing the best infrastructure possible and hiring skilled researches. However, results have shown that besides improvements provided by such Laws, some barriers could be revealed when procedures aiming innovation were performed. It was observed that regarding organizational knowledge creation and management, the surveyed centers have not achieved an effective system yet. So many actions taken by the centers do not meet the proposed objectives.

3. Innovation centers, as well as fostering opinion exchanges among the university departments of the center.

4. According to each center especificities, develop a mechanism of knowledge transfer aiming to fulfill the whole innovation process.

In order to facilitate such challenges, technological innovation centers could observe the following perspectives, considering SECI model, for each modes of knowledge conversion:

Socialization:

1. Foster the participation of technological innovation centers members in diverse fields of knowledge;
2. Motivate participation on speeches and training courses in order to get to know successful and not so successful experiences, as well as promoting debates among university departments;
3. Promote field trips to companies and industries.

Externalization:

1. Present written reports after taking field trips, participating of courses or debates, in order to exposure procedures in details, sharing experiences, highlighting successes and failures;
2. Elaborate virtual meeting in order to discuss important matters related to the technological;
3. Motivate Technological Innovation Center members to participate on courses, especially outside their own university;
4. According to each center especificities, develop a mechanism of knowledge transfer aiming to fulfill the whole innovation process.

Combination:

1. Making intellectual property documents available online;
2. Provide a technical library close to, or even better, inside the Technological Innovation Center.

Internalization:

3. Motivate Technological Innovation Center members to participate on courses, especially outside their own university;
4. Fulfill the technical library with written reports, research results, papers and patents documents, transfer of technology contracts and projects elaborated by the center members.

REFERENCES


