

## **TYPES OF INNOVATION IN LOW-TECHNOLOGY FIRMS OF EMERGING MARKETS: AN EMPIRICAL STUDY IN BRAZILIAN INDUSTRY**

### **Paulo Antônio Zawislak**

Doctor in Economy - University - Paris VII, France  
Associate Professor of the Federal University of Rio Grande do Sul – UFRGS - Brazil  
paulo.zawislak@ufrgs.br (Brasil)

### **Aurora Carneiro Zen**

Doctor in Administration - Federal University of Rio Grande do Sul - UFRGS  
Adjunct Professor - Federal do Rio Grande do Sul – UFRGS  
aurora.zen@ufrgs.br (Brasil)

### **Edi Madalena Fracasso**

Educational Doctor (Ed.D) - Harvard University, USA  
Emerita Professor – Federal University of Rio Grande do Sul – UFRGS  
emfracasso@terra.com.br (Brasil)

### **Fernanda Maciel Reichert**

Master in Management - Federal University of Rio Grande do Sul - UFRGS  
Doctoral Student in Management Federal do Rio Grande do Sul – UFRGS  
fernandareichert@yahoo.com (Brasil)

### **Nathália Amarante Pufal**

Undergraduate Student of Management - Federal University of Rio Grande do Sul  
Scientific Initiation Scholarship Holder, Federal University do Rio Grande do Sul – UFRGS  
nathaliapufal@gmail.com (Brasil)

## **ABSTRACT**

Low-technology industry is still commonly regarded as being irrelevant in the modern process of innovation and economic change. However, we believe that innovation may happen in all different types of industries and firms, including low-technology firms. The aim of this paper is to identify the main types of recent innovation in low-tech industries of emerging markets. For the purpose of this research, we conducted an exploratory study in 14 low-tech firms in Brazil. The results suggest that even firms with low technological intensity can be considered innovative, although they presented a different view regarding changes, innovation and competitive differential. Analyzing the innovative performance as a result of four capabilities, technology development, operations, management and transaction, it was possible to identify that in the low-technology industry companies it is mainly related to their transaction capability.

**Keywords:** Innovation; Low-technology industry; Capabilities.

**Acknowledgements:** This study was carried out with the financial support of the governmental funding agencies Research Foundation the State of Rio Grande do Sul (FAPERGS) and the Brazilian National Council for Scientific and Technological Development (CNPq).

## 1 INTRODUCTION

Schumpeter (1942) understands that innovation drives the economic development of societies. He mentions that the fundamental impulse that sets and keeps the capitalist engine in motion comes from the new consumers' goods, the new methods of production or transportation, the new markets, the new forms of industrial organization that capitalist enterprise creates (Schumpeter, 1942). The main assumption of this paper is that all these forms of innovation may occur in different industries, no matter what their technological intensity level may be, as long they have innovation capability in at least one of these forms.

The innovation capability is recognized as one of the main aspects leading to a competitive advantage amongst firms. Innovation capability is a special asset of a firm. This capability refers to a firm's ability to develop new products and/or markets, through aligning strategic innovative orientation with innovative behaviors and processes (Wang & Ahmed, 2007). Thus, innovative capability encompasses several dimensions.

According to Zawislak, Alves, Tello-Gamarra, Barbieux & Reichert (2012) the firm's innovation capabilities refer to its ability to deliver new valuable solutions through its proficiency mainly one of the four inter-related capabilities: technological, operational, managerial and transactional:, which are linked by the different organizational functions. They also affirm that every firm has all the capabilities and one of them predominates over the others and this gives the firm its innovativeness. They say that a firm to perpetuate in the market must change its technological, managerial, operational or transactional knowledge over time; and to innovate, its capabilities need to be specific and integrated.

This study focused on a type of industry, which, according to the usual socio-scientific indicators, is referred to as "low-tech", that is as non-research intensive. The interest in low-tech industry is motivated by the contradictory situation that, on the one hand, the debate about the perspectives of modern societies focuses on the rapidly growing importance of technological innovations, knowledge and research intensive economic sectors while, on the other hand, low-tech industries make up a considerable fraction of employment and production, especially in emerging economies (Hirsch-Kreinsen, 2008).

Considering that Brazil has figured prominently among the emerging economies due to its population contingent and its economic growth, it is relevant to study the innovation in its firms. Throughout the years, Brazil has reached economic stability, becoming one of the largest

economies in the world and attracting foreign investors. Presenting an open economy within the globalization process, the country has a large number of commercial trades. Brazil has a great bio and climatic diversity, which provides assorted agricultural and industrial production, characterizing the country as an important commodities supplier for many countries and consequently the low-tech industry plays a significant role in the Brazilian economy. Yet the Brazilian research in innovation stresses product innovation in high tech industries.

Thus the aim of this paper is to identify which of the innovation capabilities are more prominent in low-tech industries of an emerging countries: technology development, operations, management or transaction? To do so, we conducted an exploratory research in 14 companies that, according to the Organisation for Economic Co-operation and Development [OECD] (2012) classification, are considered low-tech industries, located in the southern region of Brazil.

This paper is organized as follows: Section 2 addresses the firm and the innovation capability; Section 3 explains the research procedure; next, we present the results; and finally, we discuss our findings, future studies and conclusions.

## **2 FIRM AND INNOVATION CAPABILITIES**

### **2.1 INNOVATION**

The term innovation is not a fuzzy term and has been a theme of research focused in different levels. Several authors have studied innovation following a macro point of view (Nelson & Winter, 1982; Freeman & Perez, 1988; Lundvall, 1985, 2006, 2009; Bell & Pavitt, 1995; Etzkowitz & Leydesdorff, 2000). Other authors have studied innovation following an industrial point of view and focused on market context (Richardson, 1972; Abernathy and Utterback, 1978; Williamson, 1985, 1991, 1995, 1998, 2003; Langlois, 2003; Menard, 2004). And several authors have studied innovation following an approach focused on the firm context (Nelson, 1991; Dosi, 1992; Teece, Pisano & Shuen, 1997; Dosi, Nelson & Winter, 2000; Knight & Cavusgil, 2004; Wang, Lu & Chen, 2008; Figueiredo, 2001). Regarding all these approaches is easy to understand that the phenomena innovation can be studied at different levels (national, industrial and firm) and sectors.

In general, sectors were supposed to be recognizably different from one another not only in the goods and services they produced but also in the technologies and processes they used to produce them. First introduced during the 1930s in the United States, the classification of manufacturing industries based on their technology intensity has been widely used since the 1950s

in the other industrialized countries, in particular to analyze the industrial sector's pattern of specialization and its comparative performance in international trade. In its most recent versions developed by the OECD in the 1990s, and subsequently adopted by other international institutions such as Eurostat, the taxonomy enables manufacturing industry sectors to be aggregated into four groupings identified according to their level of technology intensity and termed as follows: 'high-technology', 'medium-high-technology', 'medium-low-technology' and 'low-technology'. Sectors are allocated among the four groupings according to the values assumed by indicators based on the amount of R&D expenditure and determined by the OECD using the average values originally referred to a set of ten industrialized countries (Marcato & Malfi, 2012). Despite criticism, the OECD classification is still the most widespread and used in the literature.

Among these four groups, low-technology industry is usually absent in the discussions about the modern process of innovation and economic change. However, we believe that innovation may happen in all different types of industries and companies, including low-technology firms.

Innovation is a phenomena linked to the entrepreneur's domain, who is the agent of change, capable to modify the production pattern of the industry trough exploitation of new creations or inventions that offer a novel technology to produce new goods or the possibility to produce the old ones in a new way, creating set of new products to fill out market requirement (Schumpeter, 1942). This process of creation to achieve innovation could have two important sources: First, firms can accumulate knowledge (experiences, competencies and skills) which represents an internal source to support innovation, and second, firms can imitate or adopt innovation from others (Nelson & Winter, 1982; Lewin & Massini, 2003; Massini, Lewin & Greve, 2003). In order to deal with innovation and support the entrepreneurial activities, capabilities have to be developed in the firm.

## 2.2 CAPABILITIES

The term capability has been applied widely in the specialized managerial literature but there is not a consensus about what it really means. For instance, the literature indicates that several authors have studied capabilities following a human resource approach (Penrose, 1959; Becker, 1962; Barney, 1991). Other authors have used the term "competency" to identify a set of features that are very particular of the firm (Selznick, 1957; Snow & Hrebiniak, 1980). In the same direction, authors as Richardson (1972) defined capabilities as the set of skills, knowledge and experience which are very specific and let the firm perform as a unique entity. Taking into account the uniqueness of the firm, some authors coined the term "core competence" to define the main set

of capabilities that support the business of the firm (Prahalad & Hamel, 1990). Focused on daily activities, the term “routines” was coined to describe all these capabilities available in the firm (Nelson & Winter, 1982). Sometimes firms perform activities which are not easy to describe. In consequence, Itami and Roehl (1987) define capabilities as a set of invisible assets.

At this point, it is possible to highlight that many authors have coined different terms and concepts to define capabilities. At the same time, it is possible to identify a convergence among them - it is accepted that capabilities let the firms support operations and guarantee their existence. The firm operates based on its capabilities which provide the knowledge, experience and skill to identify market opportunities, to offer new value concepts and at the end the possibility to meet customer’s need.

### **2.3 INNOVATION CAPABILITIES**

Richardson (1972) defined capabilities as skill, experience and knowledge which let the firm perform as a unique entity. These capabilities let the firm identify market opportunities, develop new value concept (new business concept) and meet customer’s need in existing or new markets. Markets represent a very dynamic scenario where capabilities available in the firm provide the support to deal with the process of change and innovation. In this direction the literature identifies two relevant theoretical approaches: dynamic capabilities and technological capabilities.

Dynamic capability represent an approach which deals with a dynamic scenario, where firms have to invent, build, adopt, adapt and make continue modifications in products, processes and/or organizational structure in order to meet customer’s need in dynamic markets. Being well succeeded in this process, the firm could guarantee sustained competitive advantage (Teece, Pisano & Shuen, 1997; Eisenhardt & Martin, 2000; Winter, 2003; Wang & Ahmed, 2007; and Teece, 2007). Authors as Dutrénit (2000) have tried to show that innovation process is not linear, instead it is complex and have to be achieved gradually. In her work, she presents arguments to explain how latecomer firms (Latin America and Asia) have been capable of achieving innovation and succeed in the international market, which is very dynamic.

Technological capabilities is an approach which also deals with a dynamic scenario, but focuses on the set of capabilities that firms need to achieve innovation. This approach is mainly developed in a technological context, where firms need capabilities to create (new product and new process), adopt (new process, new resources, and new equipments) and make adjustment in the

technology base, which could be considered necessary but not enough to achieve innovation (Bell and Pavitt, 1995; Lall, 1992).

## 2.4 AN INNOVATION CAPABILITY MODEL

The literature gives insights that support the idea that firms need a set of capabilities to be innovative - what are those capabilities is a story that has not been completed. In this direction, some authors believe that there are capabilities that have not been described yet or which need more research for a better understanding (Burgelman, 1994; Christensen, 1995; Guan and Ma, 2003; Guan et al., 2006; Yam et al., 2011).

Innovation capability has been explained applying different arguments, some authors have made research based on models (Lawson & Samson, 2001; Assink, 2006; Terziovski, 2007; Zawislak et al., 2011) and others have developed studies focused on framework development (Liu & White, 2001; Calantone, Cavusgil & Zhao, 2002; Malerba, 2005). Nevertheless, the literature indicates many gaps, which have to be filled out through new research.

Zawislak *et al.* (2012) presents an innovation capability model which has two main capability drivers: a set of technological capabilities and a set of business capabilities (see Table 1). In this model, the technology drivers are represented by the technology development capability and the operations capability, and the business drivers are represented by the management capability and transaction capability.

Technology development capability is a set of knowledge, experience, ability and skills which have to be available in any firm. These capabilities have to be developed by the firm to interpret the state of the art in order to make adaptation and transformation of the technology base, creating new products, new processes, new materials, new equipment and devices. All these achievements will let the firm reach higher levels of technical-economic efficiency (Lall, 1992; Bell & Pavitt, 1995; Figueiredo, 2001; Afuah, 2002; Zhou & Wu, 2010).

Operations capability is a set of knowledge, experience, ability and skills that let the firm perform daily routines which also include the solution of day by day problems. This set of capabilities let the firm perform under the available productive capacity. In doing so, new processes, techniques, layout are developed and applied in the current technology base. This process of change will be focused on improvement in quality, efficiency, flexibility, confidence and reduction in cost and lead-times (Skinner, 1969, 1974; Swink & Hegarty, 1998; Ward, McCreery, Ritzman & Sharma, 1998; Flynn & Melnyk, 2010).

Management capability is a set of knowledge, experience, ability and skills that let the firm applied the technology base and its outcome into an organized and consistent structure to support operational and transactional activities. This set of capabilities let the firm innovate, creating new management methods, new agreements, better and most effective strategies, which will be focused on better coordination mechanisms and reduction of the interfuncional-friction (Whitley, 1989; Tsoukas, 1994; Tamkin, Hillage & Willison, 2002; Mintzberg, 2009).

Transaction capability is a set of knowledge, experience, ability and skills that every firm needs to achieve transactional cost reduction. This cost reduction is related to firm's operational activities (marketing activities, outsourcing, bargaining power, logistics and others). In this context, innovations are achieved through new strategies with suppliers and customer, better relationship with partners and asymmetric reduction (uncertainty) of market information (Langlois, 1992; Argyres, 1996; Langlois and Foss, 1999; Williamson, 1999; Mayer & Argyres, 2004; Mayer & Salomon, 2006; Argyres & Mayer, 2007).

Table 1: *Innovation Capability Drivers*

Driver	Capabilities Definition	Innovation Types
Technology	<b>Technology Development Capability.</b> It is the ability that any firm has to interpret the current state of the art, absorb and eventually transform a given technology to create or change its operations capacity and any other capability aiming at reaching higher levels of technical-economic efficiency.	<b>Technological Innovation.</b> This type of innovations encompasses the development of new design, new materials and new products. In addition, they include the development of machinery, equipment and new components.
	<b>Operations Capability.</b> It is the ability to perform the given productive capacity through the collection of daily routines that are embedded in knowledge, skills and technical systems at a given time.	<b>Operations Innovation.</b> This type of innovation encompasses new processes, improvements in existent processes, introduction of modern techniques, new layouts, etc. It allows the firm to produce products with quality, efficiency, flexibility with the lowest possible cost.
Business	<b>Management Capability.</b> It is the firm's ability to transform the technological outcome into a coherent operational and transactional arrangement.	<b>Management Innovation.</b> This type of innovation encompasses the development of management skills which reduce the "internal friction" between different areas of the firm. It is intended to create new methods of management and new business strategy, improve decision making and inter-functional coordination, etc.
	<b>Transaction Capability.</b> It is the ability to reduce its marketing, outsourcing, bargaining, logistics, and delivering costs, in other words, transaction costs.	<b>Transaction Innovation.</b> This type of innovations encompasses the development of ways to minimize transaction costs with suppliers and customers. It is intended to create new commercial strategies, improve relationships with suppliers, streamline market knowledge, etc.

Source: Zawislak *et al.*, 2012.

## 2.5 SEARCHING FOR INNOVATION IN LOW-TECH INDUSTRY

Once it is assumed that all firms have four capabilities, and that innovation, be it in regard to technology or business, is a result of efforts made in these capabilities, it is possible to identify the type of innovation in any firm, high-tech or low-tech.

When it comes to the common sense of the word “innovation”, it is usually related to technology or new products. However, an innovation may be a change, a technical change. It is related to new products and technology, but also refers to new processes, new organizational system and new source of materials (Schumpeter, 1912). The term change is related to routine improvements (Dosi, 1982). They happen while the firm is in search for solutions to improve its efficiency.

Innovation is the positive result of a novelty presented to the market and accepted by the market. That is, innovation may also be the competitive differential of the firm in relation to its competitors. In identifying the differential of a firm, we understand what it has that their competitors don't.

In this paper, we considered changes and innovations as a new combination of firm's resources that obtain economic success in the market. The differential represents how the firm obtains a competitive advantage from their changes and innovations. Following the innovation capability drivers (Zawislak *et al.*, 2012), changes, innovations and differential competitive can happen in the four different dimensions of innovation capability.

## 3 RESEARCH METHOD

As previously indicated, the aim of this paper is to identify the main types of recent innovation in low-tech industries of emerging countries. For the purpose of this research, a multiple case study has been conducted in Brazilian industry.

The selection of cases followed three phases. First, we identified the most important industrial sectors in the region studied, the south of Brazil. We have parted from a total of the 10,930 manufacturing firms of the state of Rio Grande do Sul, based on the data from Federation of Industries of the State of Rio Grande do Sul [FIERGS] (2010). A hundred of those were randomly selected, encompassing all types of industries, according to each industry proportion in the total amount. After that, the firms were categorized according to their technological intensity following

the OECD (2012) definition of low, medium-low, medium-high and high technological intensity. More than 50% of those firms are classified as being of low-technological intensity. Finally, among these companies, we selected 14 cases of low technological intensity firms (Table 2).

This study relies on two data sources: secondary and primary. Secondary data were found in the firms' websites, articles, and annual reports. Interviews were conducted with internal informants to obtain a depth view of companies. Then, in-depth interviews were conducted with the owners, directors and managers of each firm. We guided the informants through the key elements of innovation capability. We also asked them about innovation examples and source of competitive differential considering the four dimensions of innovation capability.

All the interviews have been recorded and transcribed. We complemented our interview data with a report written after each visit, following the same structure used in the research instrument. The analysis of the characteristics related to innovation in the firms is based on the information provided by the informants during these interviews, besides the data collected in its websites, articles and annual reports concerning changes, innovation and sources of differential competitive.

Table 2: *Type of industry, year of foundation and number of employees in low technology firms*

<b>Name</b>	<b>Industry</b>	<b>Year of foundation</b>	<b>Number of employees</b>
Firm A	Textile	-	80
Firm B	Footwear	1985	1080
Firm C	Footwear	1979	135
Firm D	Footwear	1977	403
Firm E	Footwear	1971	1301
Firm F	Footwear	1966	900
Firm G	Textile products	1997	60
Firm H	Textile products	1996	73
Firm I	Other manufacturing - decorations	1995	230
Firm J	Other manufacturing - decorations	1953	17
Firm K	Furniture	1969	1411
Firm L	Pulp	1972	476
Firm M	Beverages	1924	628
Firm N	Beverages	1910	184

#### 4 INNOVATION IN LOW-TECHNOLOGY FIRMS

Firms of low technological intensity industries were questioned about recent important innovations that have occurred in the firm. The interviewees called changes many of the firms' innovation in the areas of operations, management and transaction that will be commented bellow.

The operational area represents a key factor for achieving different types of innovation which are also important when aligning the business strategy with the market trends. Thus, to apply the business strategy, absorb and adapt new technology and to solve day by day problems, operations capabilities have to be available at the firm (Swink & Hegarty, 1998; Ward et al. 1998; Flynn & Melnyk, 2010).

In relation to the operations capability, what many firms mentioned as changes in this capability, have been identified by others as innovation. They are especially related to process automation; modernization of equipment and machinery; optimizing processes with more efficient equipment and software. In that sense, a Firm I (other manufacturing – decorations) respondent said they had and “evolution from very manual processes to more automated ones.” It was mentioned the acquisition of modern equipment and machinery that allowed the reduction of set-up time, waste rate and manpower. Firm C (footwear) mentioned that “the main change occurred was the introduction of numeric command machinery, which is more economic, has larger memory capacity and allows more pre-set parameters, which at the end, reduces production set-up.”

The companies mentioned operational changes such as decreasing delivery time and also costs reductions. In industries like food and beverages, they reduce the risk of contamination by employees contact. Other change mentioned by different firms is the verticalization or the centralization of some or of all processes. Interviewees also mentioned changes in their operational methods and systems, for example, a clothes firm no longer applies push production system, but a pull production system instead. Other changes such as in the operational area layout have also been mentioned as important to these firms.

Seven firms mentioned important changes in transaction and management capabilities. As opposed to the operations capability, changes in the transaction capability did not present any pattern. They include entering in new markets, both national or international; travelling internationally for benchmarking; increasing the number of collections launched per year; focusing in one type of product only, the one they are good at; working on the improvement of the firm image; and verticalization of sales processes. Firm K (furniture) interviewee said that they

“established a distribution centers in a new area. The transaction capability presented by these cases are what many authors, such as Langlois (1992), Argyres (1996), Williamson (1999), Mayer & Argyres (2004), Argyres & Mayer (2007), consider to be a key factor when dealing with the production network (downstream and upstream) in order to apply the firm’s business strategy.

Management capability changes include major changes for the entire firm such as to shut down the operational area and outsource the production, as did Firm D (footwear); to acquire a competitor; and to transform a product line in an independent unit. As mentioned by Firm K (furniture): “we launched [brand name], which used to be only one line of furniture product, and as it got bigger, we had to transform it in an entire new unit.” Other changes of less impact have also been mentioned by interviewees, such as implementing new pricing methods; implementing new ERP (enterprise resource planning) system; implementing an international standardized quality management system. In this direction, firms did not mention management innovation, which may be explained by the fact that most of them operate under traditional market structures with little variation what was also observed by Tsoukas (1994), Tamkin et al. (2002), Mintzberg (2009), among other authors.

The main innovations appointed by the firms with regards to the technology development capability are related to new products development. They are related to final products, such as the development, some decades ago, of the first knee-high boots without any zipper, as mentioned by Firm D (footwear); to the development of colored shoes in a time where they used to be all in black or brown pallets; to the development of printed furniture doors. They are involved in parts of the final product, for example, steelwork for furniture or a shoe sole of a new structure (Firm B - footwear). Other innovation came from the use of new materials, such as a replacement for hardwood in furniture for a lighter material, which is also of less cost. Technology development changes in process have also been mentioned, such as being the first footwear firm in the region to replace manual design by modern design software.

Transaction capability’s innovations may occur in many ways, as cited by the interviewees. Trying to reach more customers, firms entered into an existing market; they have also launched a new brand of their products, aiming at a different clientele. Firm H (textile products), targeting to get closer to their clients, created an open-door culture in the firm and its structure had to be revised in order to welcome clients and prospects. This firm has also internalized all marketing activities, including printing materials.

Management capability innovations have been the less mentioned by interviewees, however, are no less important. They mentioned the professionalization of their management team, replacing the family centralized culture (Firm I – manufacturing - decorations); changing strategic focus and training employees for different activities and situations that may occur in the firm (Firm M - beverages). Their aim is to be more and more competitive.

Firm C (footwear) affirmed they only attend to costumers' requests, and in that matter, any innovation is their clients' property. Firm J (manufacturing - decorations) stated that they know they are innovating when they see their competitors imitating their products.

Most firms interviewed do not use any incentive offered by government programs to innovate. Some say they are not interested, but mostly, that they do not know how to participate, or that it is a hard and bureaucratic process, which would cost them more to try to fit within the requirements than the benefits acquired through participation. Firm K (furniture) said that once entered an incentive program, but not anymore.

Interviewees were also requested to appoint what they consider to differentiate them from their competitor in the market. The main topic mentioned was the quality of their products. They also mentioned market recognition and respect for their firm and brands. Having a product development designated area, in industries that this is not common, such as shoe industry, is also considered a differentiation. Having exclusive products have also been mentioned frequently. For example, in Firm G (textile products), a clothes firm that produces underwear, interviewees said that their special products “enhances the emotional side of women”.

Questioned about why clients prefer them over their competitors four firms' interviewees answered that the preference was mainly a result of the way they provide their service. For them, this is one of the factors influencing customers' loyalty. They also mentioned that they try to be as close to costumers as possible, so they are able to follow the market trends and understand what costumers expect from their products. Interviewees also see as their advantage the fact that they have a consolidated distribution channel and fast delivery time; and also, some mentioned their lower prices. Mentioned by one firm each, as a differentiation in relation to their competitors, the variety of their products (Firm F - footwear), the marketing approach of glamour (Firm I – manufacturing – decorations), verticalization of processes (Firm L – pulp) and a much bigger production capacity than competitors (Firm C - footwear).

In sum, most firms differentiate themselves from their competitors in characteristics related to their transaction capability, such as following market trends and efficient distribution channel.

Secondly, they emphasize their operations capability, for example, by the quality of the product they produce and by their production capacity. And finally, they see as an advantage their technology development capability, especially in the structure for new product development. However, not one firm mentioned any advantage in relation to their management capability.

## 5. DISCUSSION

A summary of the answers given by interviewees in relation to the most recent and main changes and innovations occurred in their firms is presented in Table 3. Each response has been linked to one of the four capabilities: technology development, operations, management and transaction.

Table 3: *Types of recent main innovations in low technology firms*

Name	TECHNOLOGY DEVELOPMENT	OPERATIONS	MANAGEMENT	TRANSACTION
Firm A				New market niche
Firm B			New P&D structure	
Firm C		New machines		
Firm D	New product			
Firm E	Product development			
Firm F				Sales strategy: plot sale
Firm G				New brand
Firm H				New sales strategy
Firm I		Process automation		
Firm J	New product			
Firm K	New product			
Firm L				Backward vertical integration
Firm M			Started a Quality Program	
Firm N		New process		
<b>Total</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>5</b>

In general, the majority of innovations were identified as being mainly related to the firms' products thus resulting from their technology development capability. This is a result of the way firms understand innovation. However, when asked about the main change or their advantage in

relation to competitors, their appointed to their transaction capability. In that sense, despite the reasoning of firms when talking about changes and advantages of firms of low technological intensity industries are related mainly to transaction capability.

It was mentioned during the interviews that firms are paying more attention to their transaction capability in terms of using new media, such as social networks, to promote their products. This is true for firms producing final products. It has also been noted that these firms do not necessarily have a formal department for research and development, especially research. Their development activities may sometimes occur together with other activities, for example, quality control. To keep an efficient production process, which offers, in the end, a product of good quality, seems to be the aim of most firms of low technological intensity. That, however, does not mean they are not innovating. They innovate, especially, in terms of optimizing their processes and commercializing their products. In terms of developing process and product, new forms to communicate and provide services to their clients - that is, through their transaction capability.

Overall different types of innovation happened in the firms of low technological intensity. In that sense, we consider that even firms with low technological intensity can be considered innovative. And that innovative performance is a result of the capability they are strong at, which in the case of this type of industries, is mainly transaction followed by technology development capability. That opposes the common sense that only high-technological firms innovate.

## 6 CONCLUSION

The aim of this paper was to identify the types of innovation in low-tech industries of emerging countries. To do so, we conducted an exploratory research in 14 low-tech firms, in Brazil.

The innovations in low-tech firms mentioned more frequently are related first to their transaction and to their technology development capability, then to operational, and finally, to management capability. But the actually considered innovations in the companies are the new products resulting from their technology development capability.

Most companies differentiate themselves from their competitors in characteristics related to their transaction capability, such as following market trends and efficient distribution channel. They emphasize their operations capability, for example, by the quality of the product they produce and by their production capacity. Although firms may consider having innovations resulting from their management capability, they do not consider them to result in a competitive advantage.

Innovation in low-tech firms in emerging countries represents a new research field. So, this paper has theoretical contributions and practical implications. An important theoretical contribution is the analysis of innovative performance of low-tech industry, considering indicators of innovation that include the four capabilities – technology development, operations, management and transaction.

It also gives some suggestion about the dynamic environment of low-tech firms in an emerging country. These findings could be useful for some understanding of the innovation in the Brazilian context where low-tech firms constitute the majority of the firms. However, more has to be learned, for instance, about relationships between the occurrence of each type of innovation with specific sectors, age, and firm size that our number of cases did not allow for identification. Moreover, further researches should also identify what are the improvements needed in the remaining capabilities as a result of a major innovation. These are some of our challenges to be fulfilled in future studies.

## REFERENCES

- Abernathy, W. J., & Utterback, J. M. (1978) Patterns of Industrial Innovation. *Technology Review*. Volume: 80, Issue: 7, Publisher: McGraw-Hill/Irwin, 40-47.
- Afuah, A.N. (2002) Mapping technological capabilities into product markets and competitive advantage. *Strategic Management Journal*, 23 (2),171-179.
- Assink, M. (2006). The inhibitors of disruptive innovation capability: a conceptual model. *European Journal of Innovation Management*, vol. 9, no.2, pp. 215-233.
- Argyres, N. (1996) Evidence on the role of firm capabilities in vertical integration decisions. *Strategic Management Journal*, 17 (2), 129-150.
- Argyres, N., & Mayer, K. (2007) Contract design as a firm capability: an integration of learning and transaction cost perspectives. *Academy of Management Review*, 32 (4), 1060-1077.
- Barney, J. (1991) Firm resource and sustained competitive advantage. *Journal of Management*, 17 (1), 99-120.
- Bell, M., & Pavitt, K. (1995) The development of technological capabilities. Trade, Technology and International Competitiveness. *Economic Development Institute of the World Bank*, 69-100.
- Becker, G. (1962) Investment in Human Capital: A Theoretical Analysis. *Journal of Political Economy*, 70 (5), 9-49.

- Burgelman, R. A. (1994) 'Fading Memories: A Process Theory of Strategic Business Exit in Dynamic Environments'. *Administrative Science Quarterly* 39: 24–56.
- Calantone, R. J.; Cavusgil, S. T., & Zhao, Y. (2002) Learning orientation, firm innovation capability, and firm performance. *Industrial Marketing Management*, 31, 515 – 524.
- Christensen, J.F. (1995) Asset profiles for technological innovation. *Research Policy*, 24 (5), 727–745.
- Dosi, G. (1982) Technological Paradigms and Technological Trajectories. A Suggested Interpretation of the Determinants and Directions of Technical Change. *Research Policy*, v. 11, n. 3.
- Dosi, G. (1992) Toward a theory of corporate coherence: preliminary remarks. In: Dosi, G. et al. (Eds.). *Technology and Enterprise in a Historical Perspective*. Oxford, Oxford University Press.
- Dosi, G., Nelson, R., & Winter, S. (Eds.) (2000) The Nature and Dynamics of Organizational Capabilities. *New York: Oxford University Press*.
- Dutrénit, G. (2000) Learning and knowledge management in the firm: from knowledge accumulation to strategic capabilities. Cheltenham, UK; Northampton, MA, USA: *Edward Elgar Publishing*.
- Eisenhardt, K., & Martin, J. (2000) Dynamic capabilities: What are they? *Strategic Management Journal*, 21 (10-11), 105-1121.
- Etzkowitz, H., & L. Leydesdorff (2000) The dynamics of innovation: from national systems and “Mode 2” to a Triple Helix of university-industry-government relations. *Research Policy*, 29(2): 109-123.
- Federation of Industries of the State of Rio Grande do Sul (2010). *Cadastro das Indústrias, Fornecedores e Serviços*.
- Figueiredo, P. N. (2001) Does technological learning pay off? Inter-firm differences in technological capability-accumulation paths and operational performance improvement. *Research Policy*, 31 (2002) 73–94.
- Flynn, B.B., Wu, S. J. & Melnyk S. (2010) Operational capabilities: Hidden in plain view. *Business Horizons*, 53, 247—256.
- Freeman, C. & Perez, C. (1988) “Structural crises of adjustment: business cycles and investment behavior”. in: DOSI, G et al. (eds.). *Technical Change and Economic Theory*. London, Pinter.
- Guan, J., & Ma, N. (2003) Innovative capability and export performance of Chinese firms. *Technovation*, 23 (9), 737–747
- Hirsch-Kreinsen, H. (2008) “Low-Tech” Innovations. *Industry & Innovation*, 15, 1, 19-42.
- Itami, H., & Roehl, T. (1987) Mobilizing invisible assets. *Harvard University Press*, Cambridge.

- Knight, G.A. & Cavusgil, S.T. (2004) Innovation, Organizational Capabilities, and the Born-Global Firm. *Journal of International Business Studies*, Vol. 35, No. 2 (Mar., 2004), 124-141.
- Lall, S. (1992). Technological capabilities and industrialization. *World Development*, 20 (2), 165-186.
- Langlois, R.N. (1992) Transaction-cost economics in real time. *Industrial And Corporate Change*, 1 (1), 99-127.
- Langlois, R.N., & Foss, N. (1999) Capabilities and governance: the rebirth production in the theory of economic organization. *Kyklos*, 52 (2), 201-218.
- Langlois, R.N. (2003). The vanishing hand: The changing dynamics of industrial capitalism. *Industrial and Corporate Change*, v12, n2, p.351-385.
- Lawson, B., & Samson, D. (2001). Developing Innovation Capability in Organizations: A Dynamic Capabilities Approach. *International Journal of Innovation Management* 5 (3): 377-400.
- Lewin A.Y. & Massini S. (2003) Knowledge Creation and Organizational Capabilities of Innovating and Imitating Firms, in Tsoukas H. and Mylonopoulos N. (Eds.), Organizations as Knowledge Systems: Knowledge, Learning and Dynamic Capabilities, New York: *Palgrave MacMillan*, pp. 209-237.
- Liu, X., & White, S. (2001). Comparing innovation systems: a framework and application to China's transitional context. *Research Policy* 30: 1091-1114.
- Lundvall, B. (1985). Product Innovation and User-Producer Interaction, *Industrial Development Research Series* No. 31, Aalborg University Press 1985, ISBN 87-7307-304-0.
- Lundvall, B. (2006) Interactive learning, social capital and economic performance. In Dr. Foray and B. Kahin (eds) *Advancing Knowledge and the Knowledge Economy*. Cambridge, MA: *Harvard University Press*.
- Lundvall, B. (2009). National System of Innovation. *African Journal of Science, Technology, Innovation and Development*, Volume 1, Numbers 2&3, 2009, pp.10-34.
- Malerba, F. (2005) Sectoral systems of innovation: a framework for linking innovation to the knowledge base, structure and dynamics of sectors. In *Economics of Innovation and New Technology*, Volume 14, Issue 1-2, 2005.
- Marcato, G., & Malfi, L. (2012) Testing the OECD classification of manufacturing industries based on technology. Available on <<http://www.decon.unipd.it/personale/curri/marcato/testing-OECD.pdf>> . Access on July 20.2012.
- Massini, S., Lewin, A.Y. & Greve, H.E. (2003) 'Innovators and imitators: organizational reference groups and adoption of organizational routines', (unpublished manuscript).
- Mayer, K., & Argyres, N. (2004). Learning to contract: Evidence from the personal computer industry. *Organization Science*, 15 (4), 394-410.

- Mayer, K., & Salomon, R. (2006). Contract design as a firm capability: an integration of learning and transaction cost perspectives. *Academy of Management Review*, 49 (5), 942-959.
- Ménard, C. (2004) A new institutional approach to organization. In: Claude Ménard and Mary M. Shirley (eds). *Handbook of New Institutional Economics*, Boston-Dordrecht: Kluwer Academic Press.
- Mintzberg, H. (2009). *Managing*. San Francisco: Berrett Koehler.
- Nelson, R. R. (1991). Why do firms differ, and how does it matter? *Strategic Management Journal*, Winter Special Issue, 12, pp. 61–74.
- Nelson, R.R. & Winter, S. (1982). *An Evolutionary Theory of Economic Change*. Cambridge (Ma), The Belknap Press of Harvard University Press.
- Organisation for Economic Co-operation and Development (2012). Technology intensity definition. ISIC rev. 3. Available in: <<http://www.oecd.org/dataoecd/43/41/48350231.pdf>>. Access: april 2012.
- Penrose, E. (1959). *The Theory of the Growth of the Firm*. Oxford University Press, New York. 272p. Reprinted in 1995.
- Prahalad, C., & Hamel, G. (1990). The core competence of the corporation. *Harvard Business Review*, 68 (3), 79-91.
- Richardson, G. B. (1972). “The organization of industry”. *Economic Journal*, 82:883-96.
- Schumpeter, J. (1912) *The Theory of Economic Development*. Harvard University Press, Cambridge.
- Schumpeter, J. (1942). *Capitalism, Socialism and Democracy*. New York: Harper Perennial Modern Thought, 2008b (orig. 1942).
- Selznick, P. (1957) *Leadership in administration: a sociological interpretation*. University of California Press, Berkeley and Los Angeles, Ca. Reprinted in 1984.
- Skinner, W. (1969) Manufacturing: missing link in corporate strategy. *Harvard Business Review*, 47 (3), 136-145.
- Skinner, W. (1974) The focused factory. *Harvard Business Review*, 52 (3) 113-121.
- Snow, C. & Hrebiniak, L., (1980). Strategy, distinctive competence, and organizational performance. *Administrative Science Quarterly*, 25 (2), 317-336.
- Swink, M., & Hegarty, W. H. (1998). Core manufacturing capabilities and their links to product differentiation. *International Journal of Operations and Production Management*, 18(4), 374—396.

- Tamkin, P.; Hillage, J. & Willison, R. (2002). Indicators of Management Capability: Developing a Framework. Available on <<http://www.employment-studies.co.uk/pdflibrary/1452ceml.pdf>> (13/06/2012).
- Teece, D. J., Pisano, G., & Shuen, A. (1997) Dynamic Capabilities and Strategic Management. *Strategic Management Journal*, v.18, n.7, p.509-533.
- Teece, D. (2007). Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal*, Vol.28, No 13 pp.1319-1350.
- Terziovski, M. (2007). Building Innovation Capability in Organizations - An International Cross-Case Perspective. Ed., Imperial College Press.
- Tsoukas, H. (1994) What is Management? An outline of a Metatheory. *British Journal of Management*, Vol.5, 289-301.
- Wang, C., & Ahmed, P. (2007) Dynamic capabilities: a review and research agenda. *International Journal of Management Review*, 9 (1), 31-51.
- Wang, C.-H., Lu, I.-Y., & Chen, C.-B.b (2008) Evaluating firm technological innovation capability under uncertainty. *Technovation*, 28(6), 349-363.
- Ward, P.T., McCreery, J.K., Ritzman, L.P., & Sharma, D. (1998) Competitive priorities in operations management. *Decision Sciences* 29 (4), 1035–1045.
- Whitley, R. (1989) On the nature of managerial tasks and skills: their distinguishing characteristics and organization. *Journal of Management Studies*, 26, 209-224.
- Williamson, O. (1985) *The Economic Institutions of Capitalism*. Free Press, New York. 450p.
- Winter, S. 2003. *Understanding dynamic capabilities*. *Strategic Management Journal*. 24 (10), 991- 995.
- Williamson, O. E. (1991) Comparative Economic Organization: The Analysis of Discrete Structural Alternatives. In.: WILLIAMSON, O.E.. *The Mechanisms of Governance*. Oxford University Press. New York, 1996.
- Williamson, O. E. (1995) *Transaction Cost Economics and Organization Theory*. From Chester Barnard to the Present and Beyond. Ed. Williamson, O. Oxford University Press.
- Williamson, O. E, O. E. (1998) The institutions of governance. *The American Economic Review*, 88/2, p.75-80.
- Williamson, O. E. (1999) Strategic research: governance and competence. *Strategic Management Journal*, 20 (12), 1087-1108.
- Williamson, O. E. (2003). Examining economic organization through the lens of contract. *Industrial and Corporate Change*, v.12, n.4, p.917-942.

- Winter, S. G. (2003) Understanding dynamic capabilities. *Strat. Management. J.*, 24: 991–995. doi: 10.1002/smj.318.
- Yam, R., Lo, W., Tang, E., & Lau, A. (2011) Analysis of sources of innovation, technological innovation capabilities, and performance: An empirical study of Hong Kong manufacturing industries. *Research Policy*, 40 (3), 737–747.
- Zawislak, P. A, Alves, A. C., Tello-Gamarra, J., Barbieux, D., & Reichert, F., M. (2011) Innovation capabilities of the firm: The Brazilian experience. *9th Globelics International Conference (GLOBELICS)*, 2011.
- Zawislak, P. A, Alves, A. C., Tello-Gamarra, J., Barbieux, D., & Reichert, F., M. (2012) Innovation Capability: From Technology Development to Transaction Capability. *Journal of Technology Management & Innovation*, 7 (2), 14-27.
- Zhou, K.Z., & Wu, F. (2010) Technological capability, strategic flexibility, and product innovation. *Strategic Management Journal*, 31, 547-561.

## **TIPOS DE INOVAÇÃO EM EMPRESAS DE BAIXA INTENSIDADE TECNOLÓGICA DE MERCADOS EMERGENTES: UM ESTUDO EMPÍRICO NA INDÚSTRIA BRASILEIRA**

### **RESUMO**

As empresas de baixa tecnologia ainda são geralmente vistas como coadjuvantes nos processos de inovação e mudança econômica. No entanto, nós acreditamos que a inovação pode acontecer em todos os tipos de empresas e nos diferentes setores industriais, inclusive em empresas de baixa tecnologia. O objetivo desse artigo é analisar os tipos de inovação em empresas de baixa intensidade tecnológica de mercados emergentes. Foi realizado um estudo exploratório em 14 empresas de baixa tecnologia de setores industriais no Brasil. Os resultados sugerem que mesmo as empresas de baixa intensidade tecnológica podem ser consideradas inovadoras, apesar de apresentarem visões diferentes em relação à mudança, à inovação e ao diferencial competitivo. Considerando que o desempenho inovador é resultado do esforço de quatro capacidades, desenvolvimento tecnológico, operação, gestão e transação, é possível notar que a capacidade transacional é a maior responsável pela inovação nas empresas de baixa intensidade tecnológica.

**Palavras-Chave:** Inovação; Indústria de baixa intensidade tecnológica; Capacidades.

---

Data do recebimento do artigo: 10/12/2012

Data do aceite de publicação: 17/02/2013