Journal of Technology
Management & Innovation

Received December 29, 2010 /Accepted March 1, 2011 J. Technol. Manag. Innov. 2011, Volume 6, Issue 1

Technological Capability's Predictor Variables

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Abstract

The aim of this study was to identify the factors that influence in configuration of the technological capability of companies in sectors with medium-low technological intensity. To achieve the goal proposed in this article a survey was carried out. Based on the framework developed by Lall (1992) which classifies firms in basic, intermediate and advanced level of technological capability; it was found that the predominant technological capability is intermediate, with 83.7% of respondent companies (plastics companies in Brazil). It is believed that the main contribution of this study is the finding that the dependent variable named "Technological Capability" can be explained at a rate of 65% by six variables: development of new processes; selection of the best equipment supplier; sales of internally developed new technology to third parties; design and manufacture of equipment; study of the work methods and perform inventory control; and improvement of product quality.

Keywords: Brazil; technological capability; predictor variables; plastics and rubber sector.

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ISSN: 0718-2724. (http://www.jotmi.org)
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Introduction

The development of innovations and the search for technological capability are factors that differentiate the various types of companies and simultaneously affect their economic performances. There is a positive relationship between long-term profitability and the volume of investment destined for research and development (R&D). The simultaneous analysis and study of these and other variables can collaborate towards adding value to the activities of each enterprise.

The Organization for Economic Cooperation and Development (OECD, 2005), which classifies industrial sectors by their technological intensity, classifies the plastics and rubber sector as having medium-low technological intensity. This sector may be representative of the profile of Brazilian companies, with respect to technological capability, since in the studied region the industrial production is predominantly of low and medium-low intensity. In this context, Bell and Pavitt (1995) classify firms according to the technology applied within their sector, in which a sector does not necessarily have or require the same level of technological capability as others. Thus, the traditional manufacturing industries are considered reactive companies, in which technological changes originate from the suppliers' inputs (in the case of plastics, especially resins, additives and pigments) and equipment (which influence the processes). Given this "imposition", it remains for the plastic processing companies to focus on improvements and changes in production methods, and occasionally in product design (Bell and Pavitt, 1995).

Given this scenario, the aim of the current study was to identify factors that influence the technological capability of medium-low technological intense companies, specifically within the Brazilian plastics industry. To this end, data were collected and analyzed in the light of the framework proposed by Lall (1992).

This study is justified by the identification of predictors of technological capability in the industry that can provide managers with relevant information for decision making. Moreover, it is distinguished by the fact that technological capability tends to be linked to the context of the company, region or country where it is developed (Coriat and Dosi, 2002; Vedovello and Figueiredo, 2006). Therefore, this study is structured into six parts, including this introduction. The next section discusses the literature on innovation and technological capability and the third is dedicated to structure of the technological capability framework. The fourth section presents the study method, subsequently the fifth consists of a review of the findings and finally, the sixth section is devoted to the implications and contributions of the study.

2. Innovation and Technological Capability

The importance of innovation for economic development, either by offering new products, new production processes, or activities in new markets, was pointed out by Schumpeter in 1942. In line with Schumpeter, Dosi (1988) describes innovation as the research, discovery, experimentation, development, imitation and adoption of new products, new processes and ways of organizing resources. Coriat and Dosi (2002, p.290) state that for a company to succeed when in competition with others, it must demonstrate the ability to "continuously introduce new products, improve existing ones and develop new processes to support such changes". For Peng, Schroeder and Shah (2008), to become competitive, companies must continually improve, or make changes in their processes and/or products. The authors add that both incremental and radical changes made by companies aiming to achieve their strategic objectives are considered innovations. According to these authors, the relationship between technology and organizational innovation is a widely researched and important factor in analyzing the capability of organizations.

Hence, technological innovation is linked to the process of gathering sufficient knowledge and resources in order to bring about organizational change. Ellonen, Wikström and Jantunen (2009) point out that success in innovation is influenced by the relationship between the market experience and technological expertise accumulated by a firm. Technology and innovation can be seen to have a significant relationship with the study of technological capability of a firm. In this sense, several definitions of technological capability can be found in the studies on the subject. Among the concepts of particular note is that from Panda and Ramanathan (1996, p. 562) which defines it as "a set of functional abilities, reflected in the firm's performance through various technological activities and whose ultimate purpose is firm-level value management by developing difficult-to-copy organizational abilities". García-Muiña and Navas-López (2007, p.31) use the term strategic technological capability, which they conceptualize as being "the generic knowledge-intensive ability to jointly mobilize different scientific and technical resources which enables a firm to successfully develop its innovative products and/or productive processes, by implementing competitive strategy and creating value in a given environment".

Extending these concepts, Bell and Pavitt (1993) define technological capabilities as the resources needed to generate and manage technological change. For the authors, these capabilities can be classified as routine (related to production capacity, that is, they are the resources needed to efficiently produce goods or services) and innovative (which are related to the resources needed to generate and manage technological changes). Thus, Augier and Teece (2006) suggest that a company's performance is impacted by its ability to continually build, combine, integrate and reconfigure resources and competencies.

Bell and Pavitt (1995) categorize the technological level of enterprises according to the sector to which they belong. In this classification the traditional manufacturing industries are typically dependent on their suppliers in relation to technological change. According to the authors, industries of this type more often make improvements and changes in production methods and product design rather than radical changes, since technological transfer occurs easily because it arises from equipment suppliers.

Accordingly, Freeman and Soete (2009), recognizing that competition is increasingly based on innovation, argue that a major challenge to the technological capability in developing countries (Brazil is among those mentioned) is the dislocation of their knowledge systems. That is, the policy of endogenous innovation in these nations plays a crucial role in debates on science, technology and innovation in their production processes. Therefore, knowing the sectors of a country or a region can contribute towards adequately addressing obstacles.

3. The Technological Capability Framework

The innovative potential of a business can be characterized by using a framework to analyze its technological capability. According to Fransman and King (1987), this capability involves the following activities: a) the search for viable alternative technologies; b) selecting the most appropriate technologies; c) dominating the technology; d) adapting the technology to suit the specific production conditions; e) development of technology by small innovations; f) institutionalized search for the most important innovations by the research and development department (R&D) and; g) conducting basic research. These activities are seen to be related to the three levels of technological capability proposed by Lall (1992), which are: basic, intermediate and advanced.

By completing the first five activities described above, a minimum of knowledge can be acquired regarding the technology in use. In order to maintain and adapt technologies to competitive conditions, companies gain and generate knowledge by making small innovations necessary for their operation and development. These activities are linked to what Lall (1992) calls the basic technological capability. That is, the ability to adapt technology in order to maintain the efficiency of a process, grounded in empirical informal learning, so as to solve problems that impede the routine operation of the firm's production.

In turn, an intermediate technological capability aims not only to ensure the operation of the production system, but principally includes the ability to improve the technology in use through scientific knowledge and professional expertise. Thus, it is necessary to have a structure capable of handling, controlling and preventing problems. Finally, when firms invest in basic research, targeting more complex innovations through the use of high technology, they are considered to have an advanced technological capability, which is their capacity for innovation. To do so, they invest in a formal structure with people engaged in R&D in the quest for new forms of production and new products. According to Lall (1992), the three levels of technological capability are related to different dimensions, namely: investment, production, and linkages with the economy, as shown in Table 1.

TECHNOLOGICAL CAPABILITY		
DIMENSIONS	**FUNCTION**	**DEGREE OF COMPLEXITY**
Investment	Pre investment	Basic; Intermediary; Advanced
	Project execution	
Production	Process engineering	
	Product engineering	
	Industrial engineering	
Linkages within economy	Linkages within economy	

Table 1 – Dimensions, steps and levels of technological capability/ Source: adapted from Lall (1992).

Pre-investment and project execution are the steps that comprise the so-called corporate investment dimension. Lall (1992) shows that these steps involve the ability to prepare for the identification and acquisition of design technology, equipment, management, and to build a new plant or expand the current one. The size of the investments will determine the financial costs of the project, the appropriateness of scale and product mix, the selection of technology and equipment and the additional knowledge gained from conducting the activities and/or with the basic technology involved in the process. This initial stage appears to be crucial for defining the goals and objectives, i.e. the strategy that the firm should follow.

The production dimension is comprised of the following steps, process engineering, product engineering and industrial engineering (Lall, 1992). It can be said then, that the firm's production capacity is related to various skills to develop the adopted technology (quality control, operation and maintenance) by means of research, design and innovation. In other words, this dimension fulfills the functions of monitoring and controlling the technology involved in the process and product.

Linkages within the economy appear to be necessary to develop the ability to transmit and receive knowledge, skills and technologies, whether it be suppliers of components and raw materials, consultants, service companies in general or technological institutions (Lall, 1992). Based on the analysis of these three dimensions (investment, production and linkages within the economy) Sanjaya Lall (1992) developed a categorization of companies according to which they are classified as having basic, intermediate or advanced technological capability. It was decided to apply Lall's (1992) framework because of the degree to which is consolidated and recognized amongst academics, which is demonstrated by the existence of numerous variations and applications that of the original model (Bell and Pavitt, 1995; Figueiredo, 2002, 2004; García-Muiña and Navas-López, 2007).

4. Study method

To achieve the goal proposed in this article it was decided to carry out a survey. This facilitated the assessment, description and analysis of a population based on a sample obtained from the companies in the plastics sector within a state in Brazil. Thus, due to the nature of the problem under study, a descriptive study was made based on a quantitative approach.

The plastics industry in this region represents about 8% of total production in Brazil, according to the Plastic Materials Industry Association (Sinplast) in the State of Rio Grande do Sul (Sinplast, 2010). According to the publication Indústria RS (2007), the main centers of the industry in Rio Grande do Sul are in the metropolitan area, with the production of packaging and footwear components being particularly important.

The data collection instrument used consisted of a questionnaire prepared from that on technological capability proposed by Lall (1992) and presented in Table 2, which was designed to obtain information to enable the mapping of the technological capability of companies in the plastics industry in the region. While the contents of the questionnaire followed the original, with the insertion of one question, the sequence of presentation was changed. The first block consists of questions related to the company profile. The second block contains the six steps of the three dimensions of technological capability and the variables (R&D) in the form of statements, in which respondents uses a five-point Likert-type scale to answer how often the activities are performed. A diagram of the constructs and 17 variables can be seen in Table 2. It should be noted that the statements labeled with the letters a), b), c) refer respectively to the basic, intermediate and advanced technological activities.

Technological Characteristics		
DIMENSIONS	**CONSTRUCTS (Steps)**	**VARIABLES (R&D Activities)**
Investment	Pre Investment	(a) carry out project feasibility study (b) seek technological sources
	Project Execution	(a) perform tem auxiliary services previewed in the feasibility study (b) choose the Best equipment supplier (c) design and manufacture the equipment
Production	Improve the process	(a) perform quality control and preventative maintenance (b) acquire new technology (c) develop new processes
	Product development	(a) make small adaptations to the product (b) improve product quality (c) develop new products
	Improve the production system	(a) study the work methods and perform stock taking (b) monitor productivity and make improvements to the coordination process (c) seek totally different processes and products (radical changes) **[added by the authors]**
Linkages within economy	Relationship with other companies	(a) obtain goods and services from local firms and exchange information with suppliers (b) design processes and products in partnership with scientific and technology institutions (c) sell internally developed technologies to third parties

Table 2 – Constructs and variables in Part II of the questionnaire/ Source: adapted from Lall (1992).

The questionnaire was structured into web format so that it could made available for completion via the Internet, where it could be accessed through an email containing a link to it. In the period from June to July 2010, electronic messages (e-mails) were sent to the 708 companies registered in the Sinplast database. Several e-mails returned because of incorrect or out-of-date addresses and a total of 495 contacts were successfully made from which there were 104 respondents, representing a rate of 21%. Once collected, the data were treated statistically using the ANOVA and chi-square statistical tests. Correlation analysis was made, which involved measuring the strength of the relationships between the variables 'time in existence of the company' and 'number of patents' (Aaker, Kumar and Day, 2004).

In order to map the level of technological capability the following procedure was adopted: firstly a) the arithmetic mean, per company, of the variables that represent each of the three levels of technological capability was calculated (basic, intermediate and advanced), b) then, the weighted average of the means of each level of technological capability per company were evaluated, in which basic capability received weight 1, intermediate capability weight 3, and advanced capability weight 5, after which; c) the level of technological capability of each firm was classified according to the value obtained, where a classification of 1-2 was basic, 2.1 to 3.9 intermediate, and 4-5 advanced d) and then the number of companies in each of the three levels of technological capability framework proposed by Lall (1992) was obtained.

Finally, regression analysis was made, which represents a powerful and flexible process for the verification of associative relationships between a dependent variable and one or more independent variables (Malhotra, 2006).

The assumptions tested by the estimated regression model were normality, autocorrelation and multicollinearity. The Kolmogorov-Smirnov (KS) test, under the null hypothesis that the distribution of the tested series is normal, was used to verify the normality of the error. Autocorrelation was found between residuals from the regression using the Durbin Watson test that, for Gujarati (2000), is the appropriate test for testing serial correlation.

5. Analysis of the Results

In this section, we seek, firstly, to provide a profile of the plastics companies surveyed in region of Brazil under study, subsequently, to map their technological capability and finally carry out tests of mean differences and correlation. In addition, a regression analysis is carried out in order to identify the R & D activities as predictors of Technological Capability.

5.1 Profile of the Plastics Sector

With regards to the profile of the respondents, the results show that, according to the classification of SEBRAE (2010), for which the criterion is the number of employees, 82.5% of the respondents represented micro and small companies. Only 1.9% of the companies represent organizations with more than 500 employees (large firms). Regarding length of time in existence of the companies, 27.9% have been in existence less than seven years, 26% between 8 and 13 years, 27.9% between 14 and 20 years 18.3% over 20 years. Among the latter, four had been in existence more than 50 years, including one that notably had survived more than 62 years. With respect to patents, it is surprising to note that 22.3% of firms registered patents in the last five years, with an average of five patents per company. Only three companies had 10 or more patents registered in the last five years, one of which had registered 60 patents.

When tracing the geographic concentration of plastics companies in the region under consideration, one can see that 91.3% of respondents are located in the metropolitan area. With regards the main product or activity, the highest concentration is in products related to the production of plastic containers (26.9%), followed by construction, with an incidence of 11.5%. The findings, relating to the region and main product, corroborate the data from the publication Indústria RS (2007).

Educational Level	%
High School	45%
Technical School	15%
Bachelor's Degree	31%
Specialization/MBA	7%
Master's Degree	1%
Doctoral Degree	1%
Total	**100%**

Table 3 – Educational level of the personnel within the R&D sector

Asked about the existence of a department or professionals in charge of activities related to research and development, it was found that 58.7% of firms responded affirmatively. Of the professionals involved in this activity, Table 3 shows that, significantly, 60% of them had only completed high school or technical courses. Moreover, the survey shows that only 2% of the professionals related to the R&D department have a Master's degree or PhD.

5.2 Mapping the technological capability

Once the profile of companies in the plastics sector is established, it is necessary to map their technological capability. Cronbach's Alpha, which according to Malhotra (2006) must have a value above 0.60 to be considered acceptable, was used to check the reliability of data used as an indicator of internal consistency. In this research, the alpha of the 17 variables was 0.915, which is considered satisfactory.

Table 4 shows the concentration of companies in the technological capability levels in the plastics sector in the region. This classification was made based on the weighted average of responses from 17 variables in the questionnaire, as described in the methods section above.
It can be seen that the predominant technological capability is intermediate, with 83.7% of respondent companies. This indicates that, in the plastics companies in this region of Brazil the concern is to improve the technology in use (not to develop new technology).

Technological Capability	Frequency	%
BASIC	12	11.5%
INTERMEDIATE	87	83.7%
ADVANCED	5	4.8%
Total	**104**	**100%**

Table 4 – Frequency of the companies in the technological capability levels

Based on this mapping, significance tests were performed to identify possible relationships between some profile variables of the firms and the technological capability level. ANOVA and chi-square tests were performed, with the variables region, time in existence, number of employees, products, patents and R&D personnel. The latter was found to be the only variable with a significant difference in the classification of technological capability of the company (Table 5).

Variables	Technological Capability	
	ANOVA	Chi-squared
Region	-	0.551
Time in existence	0.467	-
Number of employees	0.233	-
Product	-	0.326
Patents	-	0.190
R&D personnel	-	**0.005**

Table 5 – Variables of the profile and respective significance tests

For those companies wishing to reach an advanced level of technological capability in the plastics sector, this result highlights the importance of the being able to count on the personnel involved R&D activities. This finding is supported by the ideas of Freeman and Soete (2009), who stress the attention that needs to given to the process of knowledge generation in order to achieve innovation. Coriat and Dosi (2002) also argue that depending on the area, the capability of a firm depends to a greater or lesser extent on its R&D. Bell and Pavitt (1995, p.87) argue that R&D capabilities are directly related to the engineering capabilities and strategic decisions taken by management regarding the "incorporation of new technological processes in projects involving significant investment". In this sense, knowledge and technology accumulated by the companies and the skills of its managers are directly related to the level of investment and efficiency of R&D, i.e., the level of technical expertise of managers is an important factor influencing the commitment of a company with activities that create change" (Bell and Pavitt, 1995, p.92).

Another aspect that requires emphasis is that having personnel responsible for R&D in company may be more relevant than the region where the firm is based, the number of employees or the plastic products that are manufactured. Then, Table 6 shows the frequency of companies that have personnel responsible for R&D and their technological capability classification. It is noteworthy that most of the companies classified in the intermediate and advanced technological capability levels have a head of R&D.

Technological Capability	Head of R&D		Total
	Yes	No	
BASIC	2	10	12
INTERMEDIATE	55	32	87
ADVANÇCED	4	1	5
Total	**61**	**43**	**104**

Table 6 – Number of companies that have a head of R&D and the level of Technological Capability

The results shown in Table 6 confirm the concepts of Panda and Ramanathan (1996) for technological capability. The authors stress the importance of enterprises having people with "inventive" and creative skills in order that they stimulate an "internal technological effort" capable of mastering new technologies, adapting them to local conditions, perfecting them and even exporting them. It is also worth noting that a study by García-Muiña and Navas-López (2007) found that technological activities oriented towards the processes of exploitation of knowledge have more potential than technological capabilities focused on simply maintaining a certain competitive advantage.

Correlation		Time in existence	Number of patents
Time in existence	Pearson's Correlation	1	.792
	Sig. (*2-tailed*)	-	.000
Number of patents	Pearson's Correlation	.792	1
	Sig. (*2-tailed*)	.000	-

Table 7 – Correlation between Time in existence and Number of patents

Another respect in which significance testing was applied was the correlation between the time in existence of the company and number of patents held. As can be seen in Table 7, this correlation is high (0.792), since, according to Pestana and Gageiro (2003), the correlation is considered high when the values are between 0.7 and 0.89. This information highlights the presence of a relationship between the time in existence of the companies and the number of patents registered in the last five years, i.e. the older the company, the more patents it recently registered.

5.3 Regression Analysis: R&D activities as predictors of Technological Capability

Multiple regression analysis was carried out with the purpose of investigating the influence of the various R&D activities on the level of technological capability of the companies studied. Using stepwise regression, a model was found which selected six independent variables and, as the dependent variable, the level of Technological Capability (Table 8).

To measure the goodness of fit of the regression, the adjusted coefficient of multiple determination (R^2) was used, which according to Levine, Berenson and Stephan (2000), represents the proportion of the variation in Y (dependent variable) that is explained by the set of selected explanatory variables, i.e. it is a measure of fit of the regression line.

Note that the constant is significant and that all the F test values were significant for six independent variables, which influence the dependent variable, i.e. the technological capability of the firm. The others were excluded from the model due to their non-significance. The high R^2 value (0.650) indicates that the variables in question are largely sufficient to explain 65% of the technological capability. It is noteworthy that of these six variables that affect the classification of technological capability, only one is from the basic level ('study the work methods and perform inventory control'), two are intermediate-level ('select the best equipment supplier' and 'improve the quality of product'), and three of them are advanced technological capability ('develop new processes', 'sell internally developed new technology to third parties' and 'design and manufacture the equipment'). These findings demonstrate that the more advanced the level of technological capability of enterprises, the more variables affect this outcome. This shows that it is gradual complexity of the activities developed by the firm that determines their technological capability.

The regression assumptions are then checked (Table 9) by normality, autocorrelation and multicollinearity tests. The Kolmogorov-Smirnov (KS) was conducted to ensure normality of error under the null hypothesis that the distribution of the series tested is normal. Using the Durbin Watson test, autocorrelation was seen between residuals of the regression, the null hypothesis of the test being

Model	Technological Capability	
Constant	Value	Significance
	.635	.000
	Coefficient	Significance
Develop new processes	.191	.026
Select the best equipment supplier	.223	.002
Sell internally-developed new technology to third parties	.271	.000
Design and manufacture equipment	.252	.000
Study the work methods and perform inventory control	.185	.016
Improve the product quality	.162	.024
R^2	.650	
F Test	Value	Significance
	32.833	.000

Table 8 – Coefficients of the regression model

the absence of autocorrelation. The multicollinearity of the variables in the model was verified by the Tolerance (Tol.) - which must be greater than 0.10, and the Variance Inflation Factor (VIF) - which has a ceiling of 10, and the closer to 1 the lower the multicollinearity (Pestana and Gageiro, 2003).

sector must have the six variables identified in order to have technological capability, but in order for it to be outstanding there must be a tendency towards this behavior.

Similarly, when evaluating the variables that make up the regression model, we find that: a) the ability of companies

Model	Independent Variable	Tol.	VIF	Sig. KS	Durbin Watson
Technological Capability	Develop new processes	0.475	2.105	0.787	2.058
	Select the best equipment suppliers	0.687	1.456		
	Sell internally developed new technology to third parties	0.905	1.105		
	Design and manufacture equipment	0.788	1.269		
	Study work methods and perform inventory control	0.592	1.690		
	Improve product quality	0.681	1.469		

Table 9 – Assumptions of the regression model

As shown in Table 9, the model meets the assumptions of normality, because the KS test is not significant at 0.05, accepting the null hypothesis. The result of the Durbin Watson was satisfactory (around 2), indicating no autocorrelation between the residuals from the regression model. The same is true for multicollinearity, shown by the Tolerance, which in this case showed satisfactory values (all greater than 0.10) and outcome of VIF which was less than 10 for all variables.

Thus, after the analysis performed to verify the adequacy of the regression model, the following equation was defined:

Where: Y = technological capability, X1 = develop new processes; X2 = select the best equipment supplier; X3

$$Y = 0{,}635 + 0{,}191X_1 + 0{,}223X_2 + 0{,}271X_3 + 0{,}252X_4 + 0{,}185X_5 + 0{,}162X_6 + e;$$

= sells internally developed new technology to third parties; X4 = designs and manufactures equipment; X5 = study the work methods and performs inventory control; X6 = improved product quality, and e = error.

Based on the above equation, it is possible to state that the dependent variable named "Technological Capability" can be positively explained by the six variables in the equation at an explanation rate of 65% (Table 8) of the total variance of the variable Y. Therefore, not all companies in the

to organize themselves internally (basic level); b) the search for constant improvements in equipment and products (intermediate level); and c) the development of new processes, technologies and equipment (Advanced level) are those lead to a firm fitting at a certain level of technological capability. More specifically, regarding the predictors of the advanced technological capability level for the sector analyzed, they could mean that: a) 'development of new processes' - internal reorganization of productive procedures and the search for alternative raw materials facilitate the production of products and continuous improvement in equipment technology; b) 'the sale of internally technology new developed to third parties' - the development of molds for specific products that can later be sold to other states or countries; and c) designing and manufacturing equipment - the fact that this industry has a medium-low technological intensity. These factors can be sustained by the view of Arnold and Thuriaux (1997) who identify strong interdependence between technology, innovation and other activities. These authors refer to Schumpeter, who describes innovation as a combination of factors of production, and added that these factors can include the simple rearrangement of the machines in the factory. Thus, one can see that for a company in the plastics sector in the studied region of Brazil to be classified as having advanced technological capabilities, it must develop new processes, equipment and technologies, not simply be organized internally and seek to improve equipment and products.

Once these factors that influence the technological capability were identified, by re-examining the data from the survey it was found that the activities that are most frequently carried out by the companies are: 'study work methods and perform inventory control' (23%) 'improve product quality' (26.7%), and 'select the best equipment supplier' (23.3%). Thus, it can be seen that it is these activities, the first within the basic level of technological capability, and the two other within the intermediary level, that the companies have most commonly developed and which allow them to be framed within the basic and intermediate levels of technological capability . For the companies to achieve the advanced level of technological capability, they must perform not only these activities, but also 'develop new processes,' 'design and manufacture equipment' and 'sell internally developed new technology to others'. However, the low concentration of firms in the sector at this level is evidenced by the percentage of companies who actually do these activities, which is 15%, 9% and 3% respectively.

Thus, it is believed that the results of this study are able to contribute, according to Freeman and Soete (2009), towards the accurate assessment of the environmental context in which the companies in the plastics sector in the region studied find themselves.

6. Study Implications and Contributions

The aim of this study was to identify the factors that influence in configuration of the technological capability of companies in sectors with medium-low technological intensity, specifically that of companies in the plastics industry. It was found that 95.2% of the companies surveyed are in the basic and intermediate technology levels (particularly the first level because it included 83.7% of the sample). These results support the classification the OECD (2005) assigns to the sector of plastics and rubber, which is medium-low intensity. It was noted also that 4.8% of respondents have advanced level technological capability, which demonstrates that even in a sector of medium-low technological intensity there are companies that excel in innovative and technological terms.

The findings of the tests of the mean, where the level of technological capability varies depending on whether or not a company has an R&D department, are particularly noteworthy. Given that investments in R&D are directly related to the knowledge and skills of company managers, the attention given by them to this factor could be decisive in the level of technological capability in which the organization finds itself. It is worth noting that this variable was included in the questionnaire by the authors and is not covered within Lall's (1992) framework of technological capability, and nor, consequently, is the equation presented in the results. Furthermore, we found a correlation between the length of timer of existence of the firm and the number of patents registered in the last five years.
It is believed that the main contribution of this study is the finding that a company in the plastics industry that aspires to achieve an advanced level of technological capability needs to develop new processes, equipment and technologies and not simply be organized internally and seek improvements in equipment and products. One cannot say that the firm needs to take such actions to be financially and economically profitable. However, the firm must meet these conditions if it wants to reach an advanced level of technological capability.

Given the results of the regression model, which excluded 11 of the 17 variables contained in the questionnaire, it is believed that the models of technology capability applied, including that proposed by Lall (1992), lack variables that measure the performance arising from the innovations. It is worth noting that this explanation would only be applicable to the studied sector, the plastic industry.

There are some limitations in the present study, the first being the low of return rate of the e-mails (21%). Another is the fact that Lall's (1992) model, like other models of technological capability, does not contain a variable for the economic result from investment in the different stages of developing technological capability: initial investment, then on to project execution, process engineering, product engineering, industrial engineering and finally, relations with the economy. The latter, although dealing with linkages, only covers the sale of the technology itself, and supplier relationships and entities involved with science and technology, but not the results obtained from the sale of products depending on the implementation of all previous investments made by the company. Thus, if a results variable were included in the framework, it might indicate which of the technological capabilities is best suited to operate in the sector, because it does not necessarily need to be in an advanced level to achieve success in an industry with a medium-low technological capability and in an emerging economy.

This model can be seen to explain 65% of the technological capability level of firms with only six variables, so there must be other factors that explain the remaining 35% of the model. Accordingly, in order to complement the current study, further research might be carried out into other industries in the country, which might confirm or otherwise the technological capability framework proposed by Lall (1992). Another suggestion would be to complement the framework with a specific variable on the existence of a R&D department in the company, as well as a variable covering the financial results achieved by the company (originating from innovations or not). These results will then show whether indeed a new proposition of variables or activities of technological capability is necessary.

Acknowledgements

The present study was carried out with the support of Government research funding agencies (CAPES and CNPq).

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