New Opportunities for Technological Cooperation in the Brazilian Oil and Gas Industry

Sálua Bueno [*]

Frederico Rocha [**]

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[*] Pesquisadora do Grupo de Indústria e Competitividade e aluna de Pós-Graduação do IE-UFRJ. Bolsista FAPERJ, Aluno Nota 10. e-mail: saluabueno@gmail.com . Endereço para correspondência: Instituto de Economia – UFRJ, Av. Pasteur, 250, Praia Vermelha, Rio de Janeiro – RJ 22290-240. Tel: 21 38735242, Fax: 21 25418148.

[**] Professor Adjunto do Grupo de Indústria e Competitividade do IE-UFRJ. Bolsista produtividade do CNPq. E-mail: fred.rocha@ufrj.br

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Resumo

O objetivo deste artigo é avaliar o desempenho em inovação das empresas fornecedoras da indústria de Petróleo considerando seus esforços tecnológicos e o papel da cooperação tecnológica. A base de dados utilizada foi a Pesquisa de Inovação Tecnológica (PINTEC) de 2003 e as empresas fornecedoras da indústria de petróleo que fazem parte desta pesquisa foram identificadas através do cadastro da Organização Nacional da Indústria de Petróleo (ONIP). Os resultados comparativos entre estas empresas fornecedoras e a indústria brasileira mostraram que o desempenho em inovação das primeiras é superior apesar dos esforços tecnológicos não apresentarem diferenças significativas. Por outro lado, as empresas fornecedoras da indústria de petróleo realizaram cooperação tecnológica de forma mais expressiva. Os resultados sugerem que estas empresas estabelecem redes de cooperação com seus clientes, universidades e institutos de pesquisa, determinando uma maior oportunidade para a ocorrência de inovações.

Palavras-chave: Inovação Tecnológica -Fornecedores da Indústria de Petróleo - Cooperação.

Abstract

The aim of this paper is to assess the capital goods suppliers' innovative performance and technological efforts, stressing the role of cooperation for these companies. The database used was the Brazilian Industrial Technological Innovation Survey 2003 (PINTEC – Oslo Manual) and companies which were part of the National Organization for the Oil Industry list (ONIP) were selected. Comparative analyses showed that the Brazilian oil and gas suppliers industry has higher level of innovativeness when compared to the whole Brazilian industry although R&D intensity does not greatly differ. On the other hand, cooperative efforts of the Brazilian oil and gas supplier industry are much grater than the Brazilian average. These outcomes suggest that these companies establish cooperation networks with their customers, universities and research centres, resulting in higher levels of opportunities for innovations occurrences.

Palavras-chave: Technological Innovation- Oil Industry suppliers- Cooperation.

1. INTRODUCTION

This paper seeks to assess the level of technological development of the suppliers of the oil and gas industry in Brazil. The trade liberalization of the early 90's led to a change in the international specialization of the Brazilian industry towards industries that have intensive use of natural resources. Natural resources based industries have become the biggest exporting industries in the country. From a systemic approach of competition and innovation, some opportunities for technological development in these leading companies' capital goods suppliers can be observed. This process of progress in supplies` technology would be possible through learning processes and R&D projects which have been produced in a cooperative way among these companies.

In the first section, some the liberalization process taking place in the country has some of its most relevant points enunciated. Then, it is proposed to identify the technology opportunities based on the outlined specialization of the country's industry. The aim is to show the possibilities for developments of capital goods suppliers' technologies through cooperation with large natural resources companies, that is, user – producer interactions.

In section 2, technological cooperation dynamic is analyzed for the oil industry case. In section 3 the database and chosen variables are presented. Section 4 assesses the industry level of innovative activity. Results of technological effort will be presented in order to evaluate the differences in the innovative degree achieved by the suppliers when confronted with the whole industry. Then, data showing the importance of several sources of knowledge for the supplies companies and for the entire industry will be analyzed. Finally, the cooperation strategy will be taken in consideration. All results are controlled by companies' sizes and compared to the entire industry.

2. SPECIALIZATION AND LIBERALIZATION IN BRAZIL

During the 1990`s, some structural reforms were made to deregulate the economy, eliminating market protections as well as foreign investment control. The currency appreciation and the high interest rates, added to the reduction of barriers for foreign companies determined a new competitive environment. Changes in relative prices, in the current exchange rates and in the existing institutional structures have led the country to a position in which traditional sectors, with intensive use of natural resources, could become more competitive in the international market (Palma 2005). In the last few years, the relation between the Brazilian industrial competitiveness and its natural resources basis has become evident. The most dynamic sectors which benefited by changes in relative prices are the ones related to oil, mining, metallurgy, ethanol production and agricultural industry.

These companies use large scale production processes and are motivated by the search for cost reduction. With a higher exposure to competitive pressures, companies have become larger and with several branches in order to make a better use of scale economies and take advantages of the closeness to raw material. In the last decades, the merger and acquisition movements have grown as well as a greater search for international markets.

These sectors have some characteristics that may affect the whole economy. On the one hand, they have low levels of backward linkages and their production processes require little workforce. On the other hand, they use complex capital goods that may foster the development of machinery and equipment industries. In the specific case of the oil and gas industry, the Brazilian leading state-owned petroleum company, Petrobras, has developed competencies and capabilities that have stimulated the installation and development of an equipment supplier industry. Recent governmental initiatives to increase the participation of the Brazilian oil and gas suppliers industry in downstream and upstream markets and the need of greater levels of competitiveness in an open economy require further attention on the technological activity undertaken by these companies.

Based on the necessity of a highly efficient supply system, it is possible to foresee the opportunity for developing a strong capital goods' industry in the country. This possibility is still more evident when the previous existence of this industry, which was mainly

developed in the 1960's and 1970's in Brazil, is considered. With the Target Plan (1956-1960) and later with the II National Development Program (1975-1979) the Brazilian industry was able to incorporate segments of the heavy industry, consumer durables industry and capital goods industry (Suzigan and Versiani 1990). The previous existence of technical capacity and an already settled industry are, therefore, important elements for the possibility of increasing the competitiveness among capital goods suppliers in the country through the demand from the leading Brazilian export sectors. There is evidence in the literature that leading sectors positively influence the performance of companies in their productive chains (Fargerberg, 1985). This evidence is related to systemic effects (externalities) of the innovation process. Many heavy users require certifications from their suppliers' products and processes. Then, it is of great significance to coordinate the interactive processes with their suppliers in order to obtain high quality operations. These stable relations, which are often originated from these interactions, may bring learning and innovation advantages.

Thus, it is important to identify that there are systemic mutually dependent relations among different sectors of the economy. These relations determine national production systems and collaborate for the work division beyond production issues, which are exceeded for innovative activities (Lundvall 1985). These systemic characteristics of the technological development and the innovation processes are able to increase the technological opportunities[1] in the markets. In the Brazilian case, the productive specialization, in natural resources intensive industries, has brought these sectors to the spotlight in the international market. The relations and systems developed by these leading industries with their net of suppliers are important cases of positive impacts on the competitiveness of capital goods industries in the country.

3. ANALYSIS OF THE TECHNOLOGICAL EFFORT AND THE COOPERATION AMONG OIL INDUSTRY SUPPLIERS

[1] It is a set of possibilities for technological development. The bigger the technological opportunity, the bigger the R&D productivity invested by the firms of a determined industry must be (Klevorick at al. 1995).

There is a long history of cooperation among the companies of the Oil industry. These cooperative relations are established for the operation, investment, and for technological development efforts. In the last case, the cooperation can occur through investments in R&D for a specific task, for long term and broader projects, to share a material and workforce pool and even for staff relocation. Cooperation between suppliers and users would fit this type of cooperation that involves technological developments efforts, which we could describe as vertical cooperation. In the case of the upstream petroleum industry, such cooperation occurs frequently.

The large oil industry companies are process intensive. Their competitive focus is not on their products (oil, gas), but on their production processes, made up of complex techniques and technologies. The technological advantages in these processes are responsible for generating the competitive force. These companies seek to differentiate from each other competitively by identifying, in a better way, the profitable areas for exploration, field management and supply logistics. The technological trajectories taken by product and services suppliers in these industries are very distinct. The supply companies develop their competitiveness by searching for better quality and efficiency of their products and services which are offered to the large oil companies. The technological direction is based on the generation of products which are technologically advanced and with competitive costs. The critical point for these suppliers is to have their innovations accepted by their clients. Then, the cooperation between suppliers and the large oil companies is very important, mainly during new products and services testing stages. The large oil companies are also stimulated to vertical cooperation since these innovations are extremely important to keep technological advantages and high efficiency in their productive processes. The proximity with their suppliers can enhance its productive processes and reduce risks since these companies deal with huge uncertainty and risks concerning the worker's lives and environmental accidents (Acha 2001).

The relations of cooperation between the Oil industry suppliers and their clients are in accordance with the literature, regarding specialized suppliers and scale intensive companies respectively (Pavitt 1984). This literature foresees that these leading companies

from the Oil industry may increase their competitiveness as well as the technological capacity among their supply companies.

4. DATABASE AND VARIABLES DESCRIPTION

This paper uses data from de Brazilian Innovation Survey (PINTEC) for 2003. PINTEC (2003) has a sample of about 11.000 companies. PINTEC adopts a census stratum procedure for companies with 500 or more employees and a random sample stratified by company size (10 to 100 employees, 100 to 250 employees and 250 to 500 employees) and by two-digit sectors in the Brazilian Manufacturing and Mining industry. Futhermore, PINTEC interviews all companies with administrative registration in innovation funding governmental agencies.

We selected companies catalogued as suppliers of the Brazilian Oil and Gas Industry by the National Organization for the Oil Industry list (ONIP). The ONIP list is made up of 1500 supply companies for the Oil industry. Two hundred of these companies were found as part of PINTEC`s sample, with the sectorial distribution presented in Table 1 and size distribution presented in Table 2.

Table 1. Distribution by Sector of Supply Companies for the Oil Industry and presented in the PINTEC Sample, 2003.

SECTOR	**Number of companies**
Extracting industries	4
Textile producers	2
Apparel & clothing producers	1
Leather preparation and leather manufacturing, production of luggage products and shoes	1
Cellulose, paper and paper products producers	2

Production of coke, oil refining, production of nuclear fuels and production of ethanol	1
Production of chemical products	16
Production of rubber and plastic products	5
Production of non-metallic minerals	3
Basic metallurgy	16
Production of metal products – excluding equipment and machines	20
Production of machines and equipment	65
Production of office machines and i.t. equipment	3
Production of electrical machines, appliances and devices	36
Production of electronic appliances and communication devices and equipment	4
Production of equipment for medical and hospital instruments, precision and optical instruments, industry automation equipment, chronometers and clocks	7
Production and assembly of vehicles, tows and bodies	4
Production of other transport equipment	9
Furniture industry and other industries	1
Total	**200**

Source: Personal research from IBGE, PINTEC and ONIP subscription.

Due to PINTEC`s sample procedure concerning innovative and non-innovative companies and size characteristics, there is a higher probability of finding innovative companies than non-innovative ones. The probability of companies being innovative is a biased indicator. Thus, this work will make use of indicators with the total number of innovative companies as a reference instead of the total number of companies.

Since this work presents a comparative approach, it considers the vast literature that associates positively the innovation degree with the size of the company (Archibugi and Sirilli 2000). Industrial companies with 500 employees or more are likely to encompass a larger amount of financial, technological, human and management resources which enable them to be more innovative. For this reason, a control based on the size was chosen, for the whole industry as well as for the Oil industry suppliers. The relative participation of each group by number of employees, in each analysis set, can be observed in table 2.

Table 2.The relative presence of each size groups in the total.

Oil Industry Suppliers	
Range by number of employees	**Number by range / total suppliers**
Up to 100 employees	**27.10%**
From 100 to 250 employees	**19.71%**
From 250 to 500 employees	**20.44%**
500 or more employees	**32.85%**
Entire Industry	
Range by number of employees	**Number by range / total companies**
Up to 100 employees	**90.58%**
From 100 to 250 employees	**5.79%**
From 250 to 500 employees	**2.01%**
500 or more employees	**1.62%**

Source: Personal research from IBGE, PINTEC and ONIP subscription.

It becomes evident that there is a larger concentration of big companies among suppliers when compared to the sample of the total number of industries. Due to this difference, all groups of companies' size must be widely analyzed. Analysis can not be restricted to the overall results.

4.1 Variables description

4.1.1 Innovation

The technological innovation refers to a new product and/or process (or substantially improved) for the company, which does not necessarily mean that it is new for its market or sector. PINTEC considers as “technologically new product” the ones whose essential characteristics (technical specification, aimed usage, software or another non-material component incorporated) significantly differ from all products previously produced by the company. The “technological process innovation” refers to technologically new process or substantially improved, which represents the introduction of new production technology or significantly improved, as well as new methods or substantially improved. From companies which have implemented product and process innovation, it is possible to identify the novelty degree associated. The companies inform, for each of these two categories, the novelty degree (enhancement, new for the company, new for the national market and new for the world market) reached by the innovations. A company is more or less innovative when it is responsible for a bigger or smaller quantity of innovation in the national and world markets.

4.1.2 Technological Efforts

The technological efforts, which show the intensity of resources spent on the innovation activity, are considered the main elements for the success in the innovation process. The term R&D corresponds to three distinct activities for the innovation process:

- Basic research: trial or theoretical work in order to understand phenomena and noticeable facts, but without a particular application;
- Applied research: original investigation with the aim of acquiring new knowledge towards a practical objective;
- Development Trial: application of knowledge already acquired aiming to develop new materials, products, processes, systems and services or improving the existing ones.

The intensity of R&D is represented by the total amount spent on research and development as a percentage of companies' net sales revenue. The higher is the R&D intensity; the better is the expected success result for the innovation. The knowledge accumulation and learning processes will be greater if the firm carries out R&D. A firm which carries out this type of technological effort tends to directly increase its capacity of identifying, assimilating and exploring the information or already existing knowledge in its environment as input for its innovation process (Cohen e Levintahl, 1989).

A wider way to identify the companies' efforts for innovation is through the total innovation cost (TIC). Besides the operating expense with internal R&D, these costs involve a large set of investments and activities which collaborate for the innovation development. PINTEC considers the following expenses as part of the total innovation cost:

- Internal R&D activity.
- External R&D acquisition carried out by other institutions and companies.
- The attainment of other external knowledge process. It includes the agreements on technology transference from the purchase of patent exploration licensing and brand use, know-how acquisition, software and other types of technical and scientific knowledge from third parties.
- Machinery and equipment acquisition aiming to use them in the implementation of technically new products and processes.
- Instruction for new product and process development. It may include the acquisition of external specialized technical services.
- Introduction of innovation in the market. It involves the commercial activities and the launch of technologically new product.
- Industrial project and other technical arrangements.

4.1.3 Sources of Information

The sources of information are important input for the development of innovations. Throughout the creative process, companies use information from several sources. The

ability to innovate will be influenced by companies' capacity of absorbing and combining these pieces of information. The information can be found in technological knowledge institutions, such as universities and research institutes, professional and technical assistance centers, tests institutions, rehearsals and certifications. Another way to obtain these pieces of relevant information is through companies with which they have a commercial relationship (machinery, equipment, material, compounds or software suppliers, clients, consumers or competitors). PINTEC provides the importance degree, given by companies, to the different sources of information used by them.

4.1.4 Cooperation

PINTEC (2003) shows the cooperation among companies aiming to improve their innovation capabilities. Cooperation for innovation is defined as the company's active participation in R&D in partnership projects and other innovation projects with another organization (company or institution). The cooperation for innovation, presented at PINTEC, intend to identify the relations among a large set of economic actors which, connected through knowledge exchange channels and/or articulated in networks, form the National System of Innovation.

5. RESULTS

5.1 Innovation

The Brazilian industry seems to be little innovative. Table 3 shows that the vast majority of companies which have introduced innovations have done it with a low novelty degree. These companies, with a low novelty degree, according to PINTEC sample, have introduced product innovations that were either an enhancement of already existing products in their product range or new to them but already existing in the Brazilian market. When the innovations for the national market are taken into account, the frequency is really small. Only 8% of the product innovations are new within the country and less than 1% of them can be acknowledged as innovations for the world market. In the innovation process

this level is even lower. Most innovations are actually enhancements of already existing processes (50%).

Table 3. Innovativeness of the Entire Industry

Entire Industry								
	Novelty intensity							
	Product				Process			
Size - by number of employees	Enhanc.	New in the enterprise level	New in the National Market level	New in the World market level	Enhanc.	New in the enterprise level	New in the National Market level	New in the World market level
	/Total of product innovations				/Total of innovation processes			
Total	33.15%	58.23%	7.75%	0.86%	50.08%	47.27%	2.22%	0.42%
From 10 to 100	31.93%	60.92%	6.57%	0.58%	48.47%	49.94%	1.25%	0.34%
From 100 to 249	38.15%	51.93%	8.87%	1.05%	63.15%	34.28%	2.51%	0.05%
From 250 to 499	41.19%	43.13%	14.11%	1.56%	63.97%	29.45%	6.06%	0.52%
500 or more	43.84%	25.19%	25.22%	5.74%	47.62%	29.29%	20.20%	2.89%

Source: Personal research from IBGE, PINTEC.

The supplier companies for the Oil industry present a much higher novelty degree. Table 4 shows that despite the fact that the greater part of product innovations is represented by enhancements (44%), innovation occurrences for the national market are much more frequent, with a total of 26%. The novelties for the world market reach a more significant percentage, 8% of all innovations. When the innovation process is analyzed, it is seen that the novelty degree is lower; however it is still much higher than the average of the entire industry. The new processes for the national market reach 12% and the new ones worldwide represent 2%. In the industry as a whole, the results of new processes for the national and the world market are almost insignificant, 2% and 0.5% respectively.

Table 4. Innovativeness of the Suppliers for the Oil Company

Suppliers for the Oil Industry								
Size - by number of employees engaged	Novelty intensity in the main product/process for companies which implemented innovations							
	Product				Process			
	Enhanc.	New in the entreprise level	New in the national market level	New in the world market level	Improv.	New in the entreprise level	New in the national market level	New in the world market level
	/Total of product innovations				/Total of process innovations			
Total	43,81%	22,86%	25,71%	7,62%	59,60%	26,26%	12,12%	2,02%
From 10 to 100	48,28%	24,14%	27,59%	0,00%	61,90%	33,33%	4,76%	0,00%
From 100 to 249	42,11%	47,37%	5,26%	5,26%	57,14%	42,86%	0,00%	0,00%
From 250 to 499	63,16%	15,79%	15,79%	5,26%	78,95%	10,53%	10,53%	0,00%
With 500 or more	31,58%	13,16%	39,47%	15,79%	50,00%	21,05%	23,68%	5,26%

Source: Personal research from IBGE, PINTEC and ONIP subscription.

The novelty intensity results show that the innovation performance of the Oil supply industries is substantially better when it is compared to the entire industry. It must be observed that these results are only obtained in the set of innovative companies. Based on this novelty intensity, it is possible to understand that these supplying companies are essential promoters of technical progress. A great part of product and process innovations is new to the national market and some of them are even new to the world market.

The size control reinforces these considerations about the superiority of the supply companies' innovation capacity. Regarding the product innovations in the national market, the big supply companies are much more innovative. Individually, the oil supply companies with more than 500 employees present a 15% product innovation rate in the world market, while this percentage is only 5% for the entire industry. The large suppliers also stand out in product novelty for the national market. They reach a 39% product innovation nationally while the entire industry presents a 22% in this category. Even when small companies are taken into account, the supply companies are still ahead. They present a 25% product innovation rate for the national market while small companies of the entire industry only innovate in 7% of the cases. The data below reinforces the prevalence of the Oil supply

industry innovation capacity in almost all size groups. Although the Brazilian industry demonstrates the lack of internalization of innovation capacity, the Oil supply industries seem to be different. Some variables which reveal these companies' behavior in their innovation processes will be analyzed below with the purpose of verify the sources which determine a better performance.

5.2 Technological Effort

Table 4 shows that the R&D intensity does not greatly differ when the Oil supply industries are compared to the entire industry. The suppliers reach a 0.65% intensity while the entire industry has a 0.53% intensity rate. This result is very surprising, given that Oil industry companies reach a superior innovation level.

The results are even more unexpected when the data is controlled by size. The small supply companies present a significantly superior expenditure percentage, 2%, against 0.5% in the entire industry. A bigger R&D intensity may explain a better innovation result in small companies, but when big companies are considered it is not possible to state the same. The R&D intensity in big companies is lower for suppliers compared to the industry as a whole (0.66% and 1.15% respectively). Even with a lower R&D intensity, the great Oil supply industries are the ones which present the most important results concerning innovation performance. Therefore, the expenditure intensity in basic research, applied or experimental (R&D components) can not be considered a strong explanatory element of big differences in innovation results reached by the Oil supply industries compared to the entire industry.

The total costs of innovation also do not differ enough to be responsible for the best innovation performance carried out by the selected companies. These costs, which represent the general expenses on innovation, as a percentage of net revenue are 2.72% for suppliers and 2.46% for the entire industry. The total costs spent on innovation include a wider universe of factors and gather work efforts within the firm which are not directly

associated with the innovation process. However, these data have not shown significant differences of a bigger effort made by the supply companies when compared to the entire industry. When size control is considered, it is possible to notice that the total innovation costs in the big companies are actually in close proximity to each other. This percentage corresponds to 2.83% in supply companies and 2.62% in the entire industry.

Table 4. R&D Intensity and Total Cost of Innovation

Entire Industry		
Rank by number of people engaged	**Total Amount spent in R&D**	**Total Cost Of Innovation (Expenses/RLV)**
Total	0.53%	2.46%
Up to 100 employees	0.50%	2.68%
From 100 to 250 employees	0.36%	1.91%
From 250 to 500 employees	0.37%	1.79%
500 or more employees	1.15%	2.62%
Oil Industry Suppliers		
Rank by number of people engaged	**Total Amount spent in R&D Internal/RLV**	**Total Cost Of Innovation (Expenses/ RLV)**
Total	0.65%	2.72%
Up to 100 employees	2.00%	3.16%
From 100 to 250 employees	0.86%	3.54%
From 250 to 500 employees	0,26%	1.41%
500 or more employees	0.66%	2.83%

Source: Personal research from IBGE, PINTEC and ONIP subscription.

It has not been possible to set a direct and linear relationship between R&D intensity or even other expenses of the supply companies' innovation process and their superior innovation performance.

5.3 Knowledge Sources and Cooperation

The development of innovation by the companies must be understood through a wider perspective. It is a complex and dynamic process which involves several players and institutions, whose interactions generate important pieces of information to be used in the system as a whole. A process of generating knowledge is complex and the benefit that comes from its creation is beyond the frontiers in which it is generated. Based on this complexity, the firm can not act in an isolated way. Thus, the innovation is not only a result of decisions made within the company. Indeed, the innovation must be seen as an interactive process which involves different players forming a system.

Within this system, external knowledge sources are important means through which the companies get ideas and orientation for the creative development of their innovations. From table 5, it is possible to grasp that other companies which belong to the group are very relevant as information sources to the supplies. 25% of the companies consider these sources for the innovation process to be extremely important. For the general industry, this is only 4%. Nevertheless, this result reflects a larger number of multinational companies in the Oil supply industry sample (around 30% against only 2% for the entire industry). These multinational companies carry out huge knowledge interchanges, including the transference of specialized workers among subsidiaries. Apparently, the clients are more important as information sources for the supply companies (42% of the innovative Oil supply companies give them a high importance level, though for the general industry this value is slightly lower, 37%) .

The size control, however, shows that this value is just representing a small participation of the big companies in the entire industry sample. The big companies of the entire industry which regard clients as highly important sources represent a slightly higher percentage than the big supply companies (46% against 42%). An interesting characteristic of the companies which usually develop product and process innovations internally is a greater concern in technological information available in the environment they are inserted in. Concerning the data which show the percentage of companies that find the universities and research institutes very important in the knowledge acquisition process, the difference for

the supply companies is significant when it is compared to the general industry (13% and only 4% respectively). This last data demonstrates these companies' tendency to maintain a closer contact with basic science in order to increase their innovation capacity[2].

Although there is a tendency towards a bigger contact with institutions associated with the knowledge production in basic science, it is not possible to locate a big disparity in the suppliers' behavior in search of information sources for innovation. The intensity in which the suppliers demand external sources is not noticeable in most company size sectors.

Table 5. Knowledge Sources by Level of Importance

	Entire Industry						
	Companies that have put innovation into practice						
	Information Sources and Importance Level						
Size - by number of employees engaged	Another company from the Group	Suppliers	Costumers	Competitors	Univ. And Research Institutes	Educational Centers	Licensing, Patents and Know How
	High importance/Innovative						
Total	3,97%	37,34%	37,20%	21,53%	4,56%	6,13%	1,90%
From 10 to 100	2,36%	35,78%	36,22%	20,91%	3,87%	6,10%	1,19%
From 100 to 249	8,88%	50,60%	40,82%	26,43%	7,62%	5,35%	3,85%
From 250 to 499	14,18%	44,15%	45,15%	27,20%	7,72%	7,80%	4,24%
With 500 or more	24,27%	41,15%	46,63%	21,44%	11,96%	7,19%	13,10%

[2] The following external sources are not represented in this table, despite the ones available at Pintec (2003): Consulting companies, trial and rehearsal institutions, conference organizations and journals, fairs and exhibitions and IT information network. These sources were excluded due to their neutrality regarding comparison and also because they were not a great influence when acknowledging the importance.

Suppliers							
Size - by number of employees engaged	Companies that have put innovation into practice						
	Information Sources and Importance Level						
	Another company from the Group	Suppliers	Costumers	Competitors	Univ. And Research Institutes	Educational Centers	Licensing, Patents and Know How
	High importance/Innovative						
Total	24,82%	28,47%	42,34%	20,44%	13,14%	5,11%	9,49%
From 10 to 100	8,11%	29,73%	37,84%	18,92%	13,51%	5,41%	0,00%
From 100 to 249	18,52%	37,04%	48,15%	33,33%	11,11%	0,00%	3,70%
From 250 to 499	26,27%	17,86%	42,86%	17,86%	14,29%	10,71%	3,57%
With 500 or more	40,00%	28,89%	42,22%	15,56%	13,33%	4,44%	24,44%

Source: Personal research from IBGE, PINTEC and ONIP subscription.

The greatest evidence of a differentiated behaviour regards the suppliers and related to the innovation process, comes with the data from the cooperation relations ascertained to innovate. Table 6 provides the necessary information to state a higher intensity of cooperative activities towards innovation of the supply companies for the Oil industry. In 26% of the cases in which innovation was achieved, those innovations were developed by the companies by means of cooperative projects. For the entire industry, the percentage is much lower, only 4%. The size control confirms that in all size groups this behaviour is really more intense. These results start to evidence systemic components, shaped by market interactions, influencing the possibility of innovation success of the supply companies.

Table 6. Cooperation Relation towards Innovation

Entire Industry	
Size- by number of people engaged	**Innovations in cooperation relation**
Total	4,00%
Up to 100 employees	2,10%
From 100 to 250 employees	3,65%
From 250 to 500 employees	8,54%
500 or more employees	40,25%
Oil Industry Suppliers	
Size - by number of people engaged	**Innovations in cooperation relation**
Total	25,55%
Up to 100 employees	10,81%
From 100 to 250 employees	11,11%
From 250 to 500 employees	14,29%
500 or more employees	53,33%

Source: Personal research from IBGE, PINTEC and ONIP subscription.

Table 7 shows the importance given to different economic agents that can make part of cooperation relations. In almost all the size groups and with all agents that can experience cooperation, the suppliers appear with a greater percentage among those that considered high the relevance of the agents in the cooperation relation for the innovation. One of the agents which are important to highlight is represented by the universities and research institutes. Almost 27% of suppliers with more than 500 employees understand that those institutions are very important to develop innovations by means of co-operation. This percentage plummets to 9% when big companies from the entire industry are considered. Whereas the cooperation with consultancies is taken into consideration, the greater percentage is related to a more expressive presence of big companies in the suppliers' sample. The other companies from the group are highlighted in the cooperation relations by a higher percentage of multinationals among the supplier companies, and it is not, therefore,

a significant figure to demonstrate a distinguished cooperation behaviour of the suppliers with the Oil industry. On the other hand, it is extremely distinguished and significant the clients' importance to the suppliers companies, as it is the universities' and research institutes' importance. In all the size ranges the importance given to these players is much higher.

Table 7: Cooperation Agents Importance Rank

Entire industry							
Size - by number of employees engaged	**Companies that have put innovation into practice**						
	Companies with co-operation relations with other companies, by importance level of the partnership						
	Consumers	Suppliers	Competitors	Another company from the Group	Consulting Companies	Univ. And Research Institutes	Professional and Educational Centers
	High importance/Innovative						
Total	1,30%	1,33%	0,15%	0,63%	0,23%	0,67%	0,32%
From 10 to 100	0,66%	0,59%	0,07%	0,01%	0,05%	0,25%	0,22%
From 100 to 249	0,90%	1,23%	0,11%	0,85%	0,22%	1,10%	0,21%
From 250 to 499	2,43%	2,61%	0,47%	1,86%	0,22%	2,37%	0,41%
With 500 or more	16,97%	18,47%	1,95%	14,25%	4,80%	8,61%	3,02%

Suppliers							
Size - by number of employees engaged	**Companies that have put innovation into practice**						
	Companies with co-operation relations with other companies, by importance level of the partnership						
	Consumers	Suppliers	Competitors	Another company from the Group	Consulting Companies	Univ. And Research Institutes	Professional and Educational Centers
	High importance/Innovative						
Total	10,22%	9,49%	0,73%	8,03%	1,46%	11,68%	4,38%
From 10 to 100	2,70%	8,11%	0,00%	0,00%	0,00%	2,70%	0,00%
From 100 to 249	0,00%	0,00%	0,00%	3,70%	0,00%	7,41%	0,00%
From 250 to 499	3,57%	7,14%	0,00%	0,00%	0,00%	3,57%	3,57%
With 500 or more	26,67%	17,78%	2,22%	22,22%	4,44%	26,67%	11,11%

Source: Personal research from IBGE, PINTEC and ONIP subscription.

Thus, it is possible to state that these oil industry companies present a more interactive way of learning in their innovation processes. The interaction intensity is more significant in these companies when compared with the entire industry. It can be said that these companies establish cooperation networks with their customers, universities and research centres. This innovation scheme reduces the uncertainties involved in the creative process; and also broadens the possibility of learning.

According to the taxonomy developed by Pavitt (1984) these companies can be identified as specialized suppliers. The high level of importance given to clients, treated as innovation partners, mainly when companies with more than 500 employees are considered (26%), confirms a greater tendency of the Oil industry to establish cooperation between suppliers and scale-intensive operators.

Huge demands for quality, mostly claimed by greater clients, make suppliers seek for a higher level of technology qualification. In that way, cooperation with educational and knowledge institutes appear as an important contribution in the process of acquiring the necessary skills to a better performance in innovation.

As Fargerberg (1995) forecasts, it is possible to identify cooperation networks in the Brazilian Oil industry, which are boosted by these leading companies, and they are, therefore able to leverage the innovative capacity of their supply companies.

6. CONCLUSION

The aim of this paper was to evaluate the capital goods suppliers' innovative performance and technological efforts, stressing the role of cooperation between these companies and the intensity of the user–producer interactions. The paper used the PINTEC database to compare the outcomes of the suppliers with the outcomes of the industry as a whole.

The results indicated that that the Oil industry supply companies show more meaningful results, in terms of innovations, than the average of the entire industry. Despite this result, a strong evidence of a more intense technological effort made by these companies was not established. However, different natures of innovative behavior were verified. The suppliers companies presented a greater tendency regarding cooperation than the national average. The clients were considered highly important as partners by a greater amount of supply companies when compared with the entire industry. This outcome indicates that the increase in the process of technological opportunities regarding capital supply companies of intensive-scale industry and based in Brazilian natural resources is truly possible.

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