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Evidence of Co-Evolution of Technology-Centered Knowledge Networks and Capabilities in a Latecomer Enterprise: The Case of Petrobras Distribuidora and its Lubricant Product Line

PAUL MARIUS ANDERSEN
USP - Universidade de São Paulo
pmandersen@uol.com.br

EDUARDO PINHEIRO GONDIM DE VASCONCELLOS
USP - Universidade de São Paulo
epgdvasc@usp.br

MARCOS ALBERTO CASTELHANO BRUNO
SDA Bocconi School of Management - Università Bocconi
marcos.acbruno@gmail.com

Petrobras Distribuidora S.A.

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Título do trabalho**:** Evidence of Co-Evolution of Technology-Centered Knowledge Networks and Capabilities in a Latecomer Enterprise: The Case of Petrobras Distribuidora and its Lubricant Product Line

RESUMO

This paper aims to verify the suitability of DANTAS & BELL (2011) framework, applied on the case of the development of the automotive lubricant product line at the subsidiary Petrobras Distribuidora. Using a single technology example as an exploratory pilot-study in a latecomer firm confirmed the existence of a self-reinforcing, accumulative and non-recursive relationship between capabilities and networks. Moreover, the construct also enabled the assessment of the capability level of the lubricant business and permitted the elaboration of practical managerial considerations aiming at the development of world leading products on the innovation frontier.

ABSTRACT

This paper aims to verify the suitability of DANTAS & BELL (2011) framework, applied on the case of the development of the automotive lubricant product line at the subsidiary Petrobras Distribuidora. Using a single technology example as an exploratory pilot-study in a latecomer firm confirmed the existence of a self-reinforcing, accumulative and non-recursive relationship between capabilities and networks. Moreover, the construct also enabled the assessment of the capability level of the lubricant business and permitted the elaboration of practical managerial considerations aiming at the development of world leading products on the innovation frontier.

Key-words: knowledge networks, technological capabilities, latecomer firm

INTRODUCTION

Comprehending the catching-up process is as important to firms in advanced countries as in emerging ones. However, not all of them can be pioneers of novel breakthroughs. Most firms must invest in second-hand learning to remain competitive. Models that capture organizational learning and technological change in developing countries are essential to understand the dynamic process of capability building in catching-up in such countries (KIM, 1998).

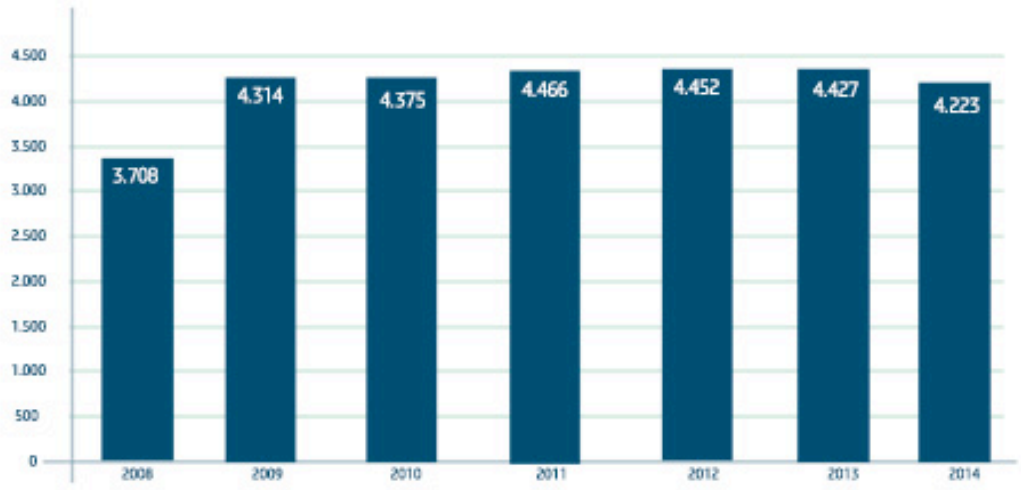
Based on the studies of DANTAS & BELL (2011) about Petrobras – Petróleo Brasileiro S.A., as an emblematic company of a late industrializing country, some questions arise about the dynamics of the evolution of its main subsidiary: Petrobras Distribuidora S. A. (or BR). The company with the second largest revenue in Brazil is responsible to distribute and commercialize to the domestic market all the fuels and oil derivatives produced by its parent company. Due to its economic importance and national relevance, the company has accomplished to build its capabilities and networks to catch-up with the main firms of its segment? How Petrobras influenced BR to technologically advance since its foundation in 1972?

This investigation tries to outline how Petrobras Distribuidora managed to build its technological capabilities together with the development of its knowledge networks. The interaction of the internal capabilities with the knowledge networks seems to influence the technological path of the company (DANTAS & BELL, 2011). Moreover, catching-up firms reverse the sequence of research, development and engineering (R, D & E) of the advanced countries. The number of years from production capability to more sophisticated technological platforms tends to decrease (KIM, 1998).

The Firm Petrobras Distribuidora S.A.:

BR is subsidiary to Petrobras and became responsible for the commercialization and distribution of oil and gas derivatives for all of Brazil. It is the second largest Brazilian company, with revenues of USD $47,760 million for 2010, and over 4,500 employees (See figure 1).

Figure 1: BR Number of Employees (last update – July 2014)



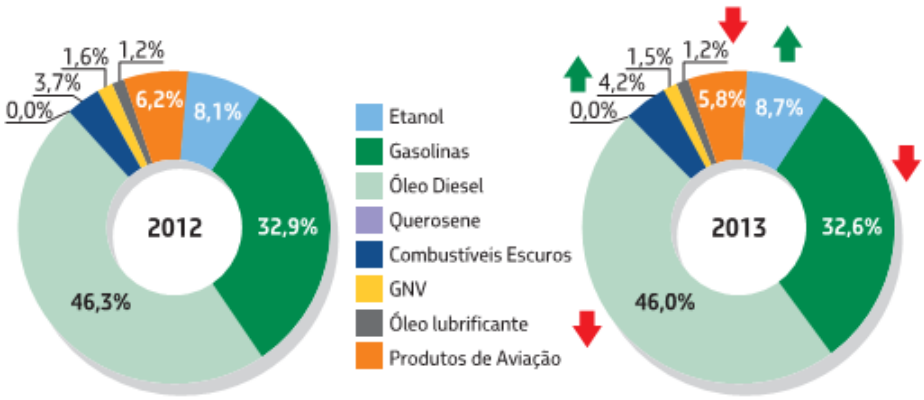
Source: PETROBRAS DISTRIBUIDORA S.A website. Available at www.br.com.br. Accessed on April, 2015.

Due to the enormous growth of BR, in 1974 it became the largest distributor of oil derivatives in the country, surpassing national and foreign competitors in a competitive environment; nowadays BR has a market share of roughly 37%. It controls over 7,700 gas stations all over the country, which is the largest network nowadays. It also provides service to more than 10 thousand big clients consisting of industries, thermoelectric plants, aviation companies and car fleets, both light and heavy duty.

BR is a company that invests in research and development of new technologies, being national owned. It was the first company in Brazil to start using electric pumps for the supplying and commercializing of hydrated alcohol and natural gas as automotive fuel, helping to the reduction in costs for the Brazilian industry with it. The firm was also responsible for launching and commercializing a new generation of fuels, such as class SJ, Lubrax SJ and Lubrax SL, which maximize the outcome obtained from them in a more efficient way.

They divide their operations mainly in two areas, which are gas stations, and sales to big clients. For which they have two different organizational structures that look over these operations. The main products for BR are diesel and gasoline, with ethanol coming on third place and growing year by year, as shown in the figure below:

Figure 2. BR Market Share.



Source: PETROBRAS DISTRIBUIDORA S.A. (2014).

Regarding the organizational structure of the company, it is relevant to mention that the board of the subsidiary and of Petrobras roughly consists of the same people. The board of directors defines about the future strategic plans for the firm. BR has its own strategic planning department, which submits its proposals to the executive team, who in turn approve it and present it to the BR board for approval.

Financial Performance:

Gross Operating Revenue of BR reached R$ 105,583 million, representing an increase of 11.3% over the previous year, surpassing the physical sales increased by 4.5%.

In 2013, the gross profit increased 10.9% to R$ 7,279 million. Operating income reached R$ 3,040 million, an increase of 2.5%. Gross and Operating margins remained broadly in line compared to 2012, thus not compromising the result, evidenced by the record net income of R $ 2,132 million, an increase of 12.7% compared to 2012.

EBITDA reached R $ 3,103 million, showing an increase of 3.0% over the previous year.

In the summary table below, the changes in revenue and profit in the 2013 are listed, compared to the previous year.

Table 1: Finacial Hilights of BR.

Financial Highlights (R$ million)	2013	2012	%
Gross Operating Revenue	105,583	94,882	11.3%
Net Operating Revenue	86,585	77,309	12.0%
Gross Profit	7,279	6,563	10.9%
Gross Margin	8.4%	8.5%	-0.1 pp
Operating profit	3,040	2,965	2.5%
Operating Margin	3.5%	3.8%	-0.3 pp
EBITDA	3,103	3,014	3.0%
Net Profit	2,132	1,891	12.7%

Source: PETROBRAS DISTRIBUIDORA S.A. (2014).

The Brand Lubrax:

In 1973 as part of a strategy to create a strong and modern image, aiming at the identification of consumers and the increase of market share, BR decided to create its own lubricant line. Lubrax was the name chosen as it mixed the prefix "LU" from lubricant associated with BR from the Petrobras Distribuidora brand. This established a strong and perceivable identity with the BR gas stations and the new product. The "AX" at the end of the word gave a cosmopolitan air, as it possibly was for export.

The brand strength was soon confirmed when the first numbers came out. BR rapidly increased its market share on the segment and gained the regional market.

Nowadays, Lubrax is the line of lubricants leader in sales volume in the country, and it is the top of mind awareness brand. In 2013, the brand completed its 40th anniversary. All this success counts with the 690 lubrication service stations Lubrax^{+} that drives the sales expansion of this product. From 2012 to 2013 there was the revenue of this segment grew more than 120%, the lubricant volume increased 9,8% and the market share grew 0,9%.

Figure 3: BR's Lubricants Segment – regional units.

Market-share by country (2014):

- Brazil: 280.000 m³ (24%)
- Argentina: 22.700 m³ (8,4%)
- Chile: 7.000 m³ (3,0%)

- Colombia: 8.400 m³ (2,0%)
- Paraguay: 4.300 m³ (16,8%)
- Uruguay: 4.300 m³ (26,3%)

Source: Petrobras Distribuidora S. A.

LITERATURE REVIEW

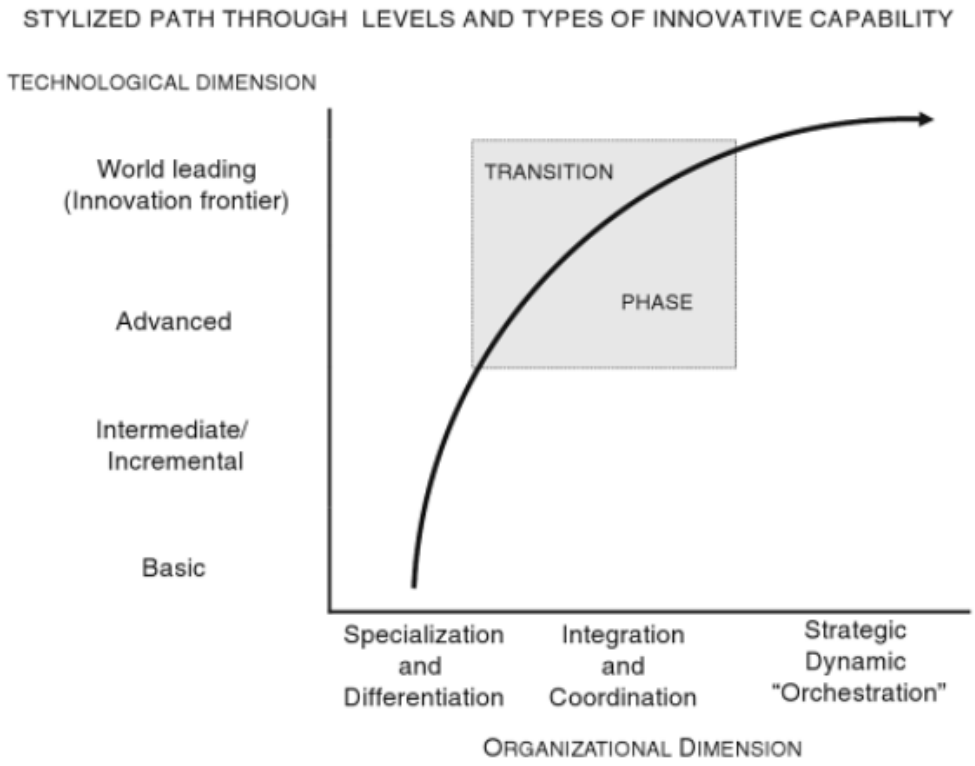
Companies are like individuals and compete based on their abilities to generate and utilize knowledge. Therefore, managing knowledge is as important as managing finances, because firms are knowledge as well as finance institutions. Some of the knowledge is essential just to survive; however, core capabilities distinguish a firm competitively, as they are the ability to transform technology rapidly into new product or process. Management of this knowledge determines the company's ability to survive, adapt and compete (LEONARD-BARTON, 1998).

In this article catching-up is related to the capabilities that a firm creates to change their technologies, moving from imitation, meaning very limited innovative capability, to deeper levels of capabilities that enable it to develop modest forms of innovation to further engage directly in innovation activities at the international frontier (KIM, 1997). This means that a latecomer firm that has cached-up will be capable to tread different paths of technological development, from those of the global industry leaders (BELL & FIGUEIREDO, 2012).

The way firms progress on the accumulation of knowledge is not linear. From the early stages of accumulation of a minimum knowledge base to the management of knowledge as a strategic asset, a tortuous path needs to be taken when a latecomer firm is concerned. To catch-up and succeed in competition, a company from a late industrialized country needs to build deeper and broader stocks of knowledge and develop new types of knowledge management (DUTRÉNIT, 2006).

Regarding the organization dimensions for building technological capabilities (figure 1), initially firms move through lower levels of capability building to support forms of incremental innovation. While firms achieve more advanced levels of innovative activity, they move through a transition phase in which they continue moving upwards and horizontally to address issues about organization capabilities to manage knowledge. After the transition phase, firms are able to achieve "meta competences" to produce innovation to meet market demands, and consequently reach strategic competitive advantage at the global innovation frontier (BELL & FIGUEIREDO, 2012).

Figure 1: Innovation capability accumulation: changing emphasis on "technological" and "organizational" dimensions.



Source: BELL & FIGUEIREDO, 2012, p.58.

This article concentrates on analyzing and evaluating the trajectory of the automotive lubricant segment, due to its distinct characteristics when compared to the overall business. The nature of BR is to be essentially a logistics operator. However, this division differs from the predominant activities of this service, since it not only delivers oil products, but also develops, produces and manages a technological product to a strategic market. The strength of the brand, the above average profit margin and the continuous improvement, that made

possible the accumulation of capabilities along the history of the company, accounts the important results achieved by the brand.

METHODOLOGY

The research method is bases on the design used by DANTAS & BELL (2012) who have qualitatively evaluated the degrees of change in capabilities and networks of Petrobras along the company's history. Nevertheless, the scope was simplified to analyze the specific automotive lubricant division of BR. The intention of this investigation is to develop a pilot study with exploratory character to evaluate aspects of its operation before driving a more complex research on the company, and its product and service technologies.

Data was collected through semi-structured interviews with two executives from the lubricant technological division. Information obtained from other sources, were also used to complement the interviews. Three distinct periods in the 40-year time frame were determined in the longitudinal design. These periods were based on the steps of capability change on lubricants manufacturing and product management. From 1972 to 1986 covered the time of technological assimilation and manufacturing techniques; from 1987 to 2000 covered the big step forward, towards the consolidation of the brand; and from 2001 to 2014 covered the independence of BR concerning product development and brand management. Each period was also analyzed according with the networks identified in the interviews, following the taxonomies developed in the study of DANTAS & BELL (2012). The differences on capability dimensions and network properties were classified according to the following tables:

Table 2: Properties of knowledge networks emerged from empirical observations.

Properties	**Variations**			
Intentionally underlying the development of the network	**Passive**	**Active For Learning**	**Active for Innovation**	**Strategic**
Technological accumulation activities with which the network is concerned	Acquisition and assimilation of goods, services and operational know-how	Adaptations of technologies Learning and absorption of design and S&T knowledge underpinning technologies	Innovation/development of technologies Absorption of S&T knowledge in novel technologies	Innovation/development of technologies Reverse transfer of technology to partners Exchange of technology Absorption of S&T knowledge in novel technologies
Content and direction of knowledge flows enhancing capability accumulation	Unidirectional and bidirectional flows of operational knowledge	Predominantly unidirectional flows of design and S&T knowledge	Predominantly bidirectional flows of design and S&T knowledge, but also unidirectional flows of design/S&T knowledge	Combination of bidirectional, unidirectional and reverse unidirectional flows of design/S&T knowledge

Source of knowledge flows	Suppliers of goods and services	Suppliers, S&T organizations, competitors	Suppliers, S&T organizations, competitors, and nodal player itself	Suppliers, S&T organizations, competitors, increasing importance of nodal player itself
Division of labour in knowledge production between the nodal player and others	Asymmetric with key knowledge-producing activities externally- located in network partners	Increasing participation in knowledge production via asymmetric arrangements	Symmetric and specialized knowledge production between nodal player and partners, but also asymmetric external	Combination of symmetric specialized knowledge production, asymmetric internal and asymmetric external
Overall patterns	Passive learning networks	Active learning networks	Innovation networks	Strategic innovation networks

Source: DANTAS & BELL (2012).

Table 3: Dimensions and Levels of Capabilities emerged from empirical observations.

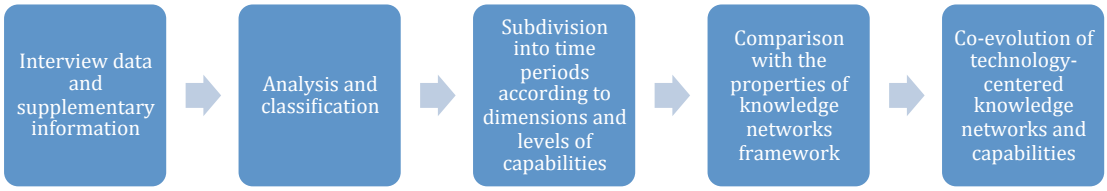
Dimensions	**Levels**			
Intentionally underlying the development of the network	**Assimilative**	**Adaptive**	**Generative**	**Strategic**
Technological activities/changes implemented	Acquisition, installation, use, operation, troubleshooting, and assimilation of existing technologies	Adaptation of technologies, design activities, and absorption of design and S&T knowledge	Generation and development of technologies close to the international technological frontier, and absorption of knowledge in novel technologies	Generation and development of original technologies driving the international frontier, absorption of knowledge in novel technologies
Knowledge Bases	Predominantly operational knowledge	Mainly design knowledge	R&D-derived S&T knowledge	R&D-derived knowledge in core and non-core fields which distinguishes the company from competitors and allow coordination of distributed capabilities
Modes of learning / capability acquisition	Doing, using technologies, monitoring suppliers, failing, troubleshooting	Training, hiring experienced personnel, in-house technical services, designing, establishing, and formalizing R&D	Performing R&D activities, training, hiring	Performing advanced R&D activities in a broad number of fields in core and non-core technologies

		activities		
Learning objectives	To use, operate, maintain technologies	To adapt, design, understand S&T principles	To research and develop, absorb new technologies	To renew and re-define knowledge bases and trajectories in core and non- core areas, to specify, integrate systems, and coordinate networks of distributed capabilities
Facilities and Resources	Incipient or non-existent design and R&D facilities and resources	Creation of design and R&D facilities and resources	World-class R&D facilities and resources	Continuously upgraded world-class R&D facilities and resources

Source: DANTAS & BELL (2012).

The framework of the investigation is summarized in the scheme below.

Figure 4: Design of the investigation



Source: The author, based on the study of DANTAS & BELL (2012).

Data from secondary sources have rarely been useful on tracing out paths of capability building on latecomer because the types of available information (patenting and R&D) are irrelevant for large parts of those paths in developing countries (BELL & FIGUEIREDO, 2012). This characteristic was observed in the lubricant's division, as no patent has been registered since the beginning of the operations 40 years ago.

Data Collected:

From 1972 to 1986:

The lubricant business has begun in Petrobras (the controller company) through a partnership with Chevron, an American company with a similar profile and businesses, which could guide the company on the manufacturing of a new product line and a new brand. Chevron in turn gave advice on how to operate a lubricants plant, twin of its own in California, erected in Duque de Caxias next to REDUC (Duque de Caxias' Refinery). The refinery was a strategic supplier of base oil, the main raw material of lubricants. Regarding the product line development, CENPES (Petrobras R&D center) was in charge to develop lubricants with good quality and suitable for the car and truck motors of that time and for other pieces of machinery as boat and train motors, using the raw material manufactured in REDUC.

In the first five years, BR was responsible to distribute and sell lubricants produced in the new factory to the retail and industrial markets, and had a commercial and an operator role towards these products. The area was born with a major customer in hands.

In the very beginning, the aim was to open market in the vast Brazilian territory at any cost, due to a socially oriented policy, which intended to suit all areas of the country. Financial intake from Petrobras made all the difference against competition from multinational companies. National manufactured lubricants could have a more competitive price, as the margins did not need to be so high.
In 1977, Petrobras strategically decided to transfer the lubricant manufacturing plant to BR´s administration, since the lubricant volumes manufactured, have not been consistent with Petrobras profile. The subsidiary had more potential and vocation to develop technologically this product line, without having it overshadowed by oil derivatives, more associated with Petrobras core-business. Moreover, BR had a focus on the retail market and it was compatible with the dynamism required by the holding.
During the next 15 years, there was a department responsible for the CENPES – BR - Chevron partnership aiming to facilitate the technology transfer and optimize capability accumulation. This partnership was determinant to train abroad the researchers and technical personnel on the latest technologies and to bring all the knowledge acquired to be applied in the development of new products of the LUBRAX family.
In the 1980's BR consolidated the lubricant brand through the capillarization of the gas station network, increased the product portfolio and made an effort towards the strengthening of technical support. Specialized labor force was hired to fortify the industrial segment offering tailor made solutions. However, the lack of international exposure limited the penetration of LUBRAX products in other countries, as its technology was not as sophisticated as other leader brands. At that time the lubricants were approved for usage in some motors of international car brands, but not as a first filling of a car manufacturer. So, at the meantime, the priority was the domestic market.
In 1986 the partnership of BR and Chevron came to an end. However, the company was fully prepared to continue by its own, supported by the partnership with CENPES.

From 1987 to 2000:

In the 1990's LUBRAX reaches the national leadership. The packaging of the lubricant lines changed from tin and cellulose fiber to plastic. A new visual standard of packaging was set to follow market trends. Plastic is a more resistant material and permitted the differentiation of

the portfolio using colors and contemporary design. Due to this change and to the market share increase, the manufacturing capacity had do double its capacity and the old factory was then terminated and replaced by a more automated and modern plant. BR's technical staff defined all the manufacturing design together with CENPES.
The technological partnership with CENPES was determinant to develop and engineer new products demanded by the market. This dynamic evolution was guided by the increasing sophistication of the automotive engines. However CENPES's activities are more guided to upstream and middle stream. Development of lubricants escaped from the main scope of the research center, which gave opportunity for the foundation of BR's technology center for lubricants within the industrial plant. The development of new products became more autonomous with the investment of a laboratory complex of 700 m^2. Equipment for quality control and pilot testing was installed in the technology center.
This robust structure strengthened the partnership with other actors of the industry, as the additive companies. These contacts fostered the acquisition of knowledge for the development of increasingly innovative and differentiated products.

From 2001 to the present days:
In the beginning of the 2000's there was an attempt to enter the US market. However, it was not successful due to difficulties on establishing commercial partnerships abroad. However the lubricant business grows through acquisitions in the neighborhood countries and conquers important market shares in regional markets as Argentina, Chile, Colombia, Paraguay and Uruguay.
BR establishes new market targets in agricultural, cargo, tourism, automotive and vessels sectors, which demand an even more differentiated portfolio and sophisticated technological capabilities. New lines with synthetic oils and biodegradable lubricants are options developed to meet market demands.
All this change pushed a second expansion stage of the plant, introducing more automated equipment and productivity efficiency. The partnership with CENPES still exists, but it is increasingly peripheral. BR has been conquering a crescent technological independence regarding lubricants.

RESULTS

Based on the case study of Petrobras, DANTAS & BELL (2012) defined types of knowledge networks and technological capabilities according to their complexity and sophistication. These types were considered as a parameter to assess the lubricant business of BR.

The following classifications have been taken into consideration regarding the networks that could exist in the time frame investigated. If the lubricant business operates in the technological frontier, strategic innovation networks are expected.

a) Strategic innovation networks:
    - Managers increasingly see knowledge networks as strategic assets to access complementary distributed capabilities located outside the boundaries of the firm, all of which could not be internalized via in-house R&D projects.
    - In the networks associated with these areas of technology, the direction of knowledge flows involve not only bidirectional flows and unidirectional flows from partners to BR, but also reverse unidirectional flows of complex S&T knowledge from BR to partners.

- The technological activities in networks consisted not only of joint R&D activities and participation in the R&D efforts of others, but also technology exchanges with major lubricant companies and reverse technology transfer to suppliers.

b) Innovation Networks :
   - Leaders initiate new collaborations that were explicitly intended as mechanisms for undertaking innovation, and they involved joint R&D activities with partners.
   - The innovation networks are characterized by bidirectional flows of design, engineering, and scientific knowledge and by increasingly balanced and symmetric arrangements for joint knowledge production in which BR and partners undertake specialized and complementary R&D activities.

c) Active learning networks:
   - The changes involved managers pursuing the development of networks with the deliberate intention of strengthening corporate learning and seeking such relationships not only with supplier companies but also with S&T organizations.
   - Knowledge flows in the network going beyond simply operational knowledge to include flows of more complex design and scientific knowledge, though predominantly through one-way flows from partners to BR.
   - Shift toward greater participation in knowledge production through arrangements whereby BR's personnel learned from partners to do more complex technological activities.

d) Passive learning networks:
   - Managers generally lack any active intention of engaging in network relationships as a means to enhance company learning and innovation.
   - The associated technological accumulation activities focused on assimilating acquired methods, equipment, services and operational know-how, and flows of knowledge are largely unidirectional from Chevron to BR, followed by bidirectional flows of operational knowledge between the company and partners.
   - The division of labor in knowledge production between BR and partners are highly imbalanced and asymmetric, with key R&D and basic design activities externally-located in the partners, while Petrobras and BR contribute only through the production of operational knowledge arising from the use and trouble-shooting of equipment.

Table 4: Evolution of BR's knowledge networks in lubricant technologies: 1972–2015

Types of network	**1972 - 1986**		**1987 - 2000**		**2001 -2015**	
	Early stage	Late stage	Early stage	Late stage	Early stage	Late stage
Strategic innovation networks						
Innovation networks					X	X
Active learning networks			X	X		

Passive learning networks	X	X				
Approximate duration	15 years		14 years		15 years	

Source: The author, based on the study of DANTAS & BELL (2012).

The following classifications have been taken into consideration regarding the technological capabilities that could be developed in the time frame investigated. If the lubricant business operates in the technological frontier, strategic capabilities are expected.

a) Assimilative Capabilities
   - Technologies analyzed are predominantly concerned with bringing into use and troubleshooting foreign technologies and associated knowledge bases in these technologies were essentially operational.
   - Managers establish learning objectives that are concerned merely with learning to use and operate technologies. Consequently resources and facilities for formalized design and R&D were almost non-existent,
   - Activities of technical staff are focused on training and learning about the operational use of the technologies, so that they can subsequently act as an interface with the operational department.

b) Adaptive Capabilities
   - Building up an initial base of design knowledge;
   - Introduction of more formalized and deliberate modes of learning (e.g., training and hiring experienced personnel);
   - Creation of facilities, human resources, and technical teams dedicated to design activities and mastering design, engineering, and related scientific knowledge;
   - Managers take a planned and systematic approach to developing internal capabilities, concentrating on learning objectives concerned with design and engineering;
   - Growing reliance on deliberate modes of learning involving training, hiring experienced personnel, and establishing R&DE teams and facilities;
   - Massive investment in technological capability.

c) Generative Capabilities
   - Development of new technological concepts in the lubricant field.
   - Independent R&D activities and comprehensive knowledge bases encompassing a grasp of broad engineering and scientific knowledge in the relevant disciplines and technologies.
   - Managers' learning objectives turn to be more concerned with undertaking formalized R&D activities to introduce new technologies to meet market specific needs and to master technological concepts that were new to the company;
   - Introduction of new technologies close to the technological frontier and develop altered specifications of products for special applications;
   - R&D, complemented by hiring and advanced training become the main mode of learning;
   - The company make efforts to create world-class facilities and resources for RD&E activities.

d) Strategic Capabilities
   - The company moves beyond the consolidation and deepening of its Generative Capabilities in the areas of technology;
   - The company becomes increasingly involved in the generation and implementation of new technologies that contributes to pushing back the international technological frontier;
   - R&D efforts produces new to the world technologies;
   - The company's knowledge base provides technologies to key areas of distinct competitive advantage among its global competitors;
   - The company's teams in this area are increasingly recognized in the industry as experts.

Table 5: Changes in BR's capabilities in lubricant technologies: late 1972–2015.

Levels of Capabilities	**1972 - 1986**		**1987 - 2000**		**2001 -2015**	
	Early stage	Late stage	Early stage	Late stage	Early stage	Late stage
Strategic capabilities						
Generative capabilities				X	X	X
Adaptive capabilities		X	X			
Assimilative capabilities	X					
Approximate duration	15 years		14 years		15 years	

Source: The author, based on the study of DANTAS & BELL (2012).

Tables 4 and 5 summarize the transformation of BR networks and capabilities in the lubricant technology and periods analyzed. It shows how BR moved diagonally upwards from Passive Learning Networks and Assimilative Capability to Innovation Networks and Generative Capabilities.

DISCUSSION AND CONCLUSIONS

This paper examined the specific case of technology development of LUBRAX lubricant line at BR and the interactive and dynamic relationship between capabilities and networks, during the existence of the company and in the context of a latecomer firm. It was possible to observe through the qualitative data collected that the existence of capabilities at a 40-year period enabled and provoked the forms of networks in which the company was able to participate. Moreover, increase in capability allowed the company to enter in new and more

sophisticated network forms. This is in accordance with DANTAS & BELL (2012), regarding the case of Petrobras.

Another important aspect is that the mastery of the production line of lubricants learned from Chevron technologies provided a platform for BR´s manufacturing and technological development. This is the first step of the reversed sequence of technology trajectory of the advanced countries: engineering, development and research (KIM, 1997).

The networks helped to consolidate emerging capability levels and allowed BR to achieve further complex capabilities. This two-way, co-evolutionary phenomenon was observed, as complex networks need mutual involvement and high-level knowledge exchange. The two-way flows maintain and nurture the capability accumulation structure on a systemic way.

Nevertheless, BR still lacks strategic capability and innovation networks regarding lubricant technology. Frontier technology has not yet been reached, due to the lack of new to the world products and technologies. The strategic decision to invest only in regional markets and the unsuccessful attempt to enter the American market turned the business less dynamic and relevant when compared to the main international brands. Another barrier to overcome is to increase the approval for first filling to the majority of the car manufacturers with Brazilian operations. Macro factors and the lack of vision of the firm´s top management about the role of technology in competitiveness, associated with the weakness to make the deployment of strategic capabilities, compromising the transition process can be some reasons that inhibited the technological catching-up (DUTRÉNIT, 2006).

Finally, the creation of a multidisciplinary dedicated structure to manage innovation can be an important aspect to focus the investments in new technological fronts, increasing the probability to reach frontier technologies and cutting-edge markets.

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