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TECHNOLOGICAL AND ORGANIZATIONAL LEARNING: THE CASE OF THE CENTER OF NAVAL AND OCEANIC ENGINEERING

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Abstract

This paper highlights the changes of organizational and technological patterns of the Center of Naval and Oceanic Engineering of the Technology Research Institute (CNAVAL/IPT) from Brazil and the types of learning acquired in relations to the naval market. According to this research, the changes came between relations with the productive naval sector, universities and government through of research and innovation network called Center for Excellence in Naval and Oceanic Engineering (CEENO), headed by Petrobrás (Brazilian Oil Company) with a focus on the late 1990s and during the 2000s. The relations with this environment allowed CNAVAL/IPT to create new management routines, new capabilities of technological production and new competencies, which made him more dynamic in front of the constants market changes. This paper articulates concepts of learning process, organization transformation and innovation and research networks. The methodology was based on analyzes of academics thesis, legislations, internal documents of CNAVAL/IPT and interviews with key actors from CNAVAL/IPT.

Keywords: Technology and organizational learning – Brazilian S&T polices – Naval Sector – Research and innovation network – CEENO – CNAVAL/IPT

Introduction

This paper aims to analyze the learning process and organizational transformation of research activities in Naval Area of the Institute for Technological Research (IPT), from the late 1990s until 2012. For this, we need, firstly, to observe the changes that have occurred in Brazilian politics and economics; and secondly, to understand the changes in the naval sector, with which that Naval Area is related. In order to identify which strategies were adopted to meet the new challenges and build new competences.

The IPT is a traditional public research institution in São Paulo State, linked to the Department of Economic Development, Science and Technology of São Paulo. Founded in 1899, the goal of IPT is to meet the demands of science and technology from the public and private sectors, as well as contribute to the development of scientific and technological knowledge. Throughout its existence, this Institution has gone through several transformations and had 12 technology centers, 30 laboratories and 10 technical sessions in 2012. In this same year, IPT had 1.243 employees (766 researchers, 330 administrative people, 119 trainees and 28 operational people).

One such technology centers was the Center for Naval and Oceanic Engineering (CNAVAL), created in the mid-1940s with the mission to develop and support the Brazilian naval sector. The laboratories' infrastructure enables work on projects for development of ships, oil platforms and their components, supporting demands onshore and offshore.

The 1990s was for the Center for Naval and Oceanic Engineering (CNAVAL) a time of great management changes. The lack of support from the State of São Paulo, the budget crises and liberal reforms made the CNAVAL seek new ways for his own survival. These difficulties transformed the relations between economics actors, including relations between IPT and the productive sector, changing actors and environments (Furtado *et* al., 2000).

Our hypothesis is that the Public Research Institutions (IPPs) are entities that create knowledge and competences, and with these, they learn and develop scientific, technological and organizationally. Their evolutionary trajectories are the result of an active process of relationship with the environment, scientific, technological, economic and social (Salles Filho *et* al., 2000, p.78).

Two important concepts are fundamental to understand the process of transformation of CNAVAL: *learning* and *competence*. Both concepts allow the understanding of the relationship between the external environment and internal environment. To Salles Filho *et* al. (2000, p.79-82), the *learning process* is an important mechanism to overcome the trade-off and lock-in, avoiding

institutional inertia and guiding the entities to new possibilities of action. The encouragement of learning arises in a competitive context which products and processes innovation are the central to organizations' survival.

The "applicability and effectiveness of the problem-solving skill in the use and application of external knowledge, technologies and the production and perception of the demands and needs of the user" defined the concept of *competence* (Dosi; Marengo, 1994, p.160). For these authors, the creation of new competences can be an indicator of institutional evolution.

Competence and *learning* are "two sides of the same coin", in the sense that the construction procedures of problem solving is inherently linked to the processes of search and selection marked by learning opportunities. In this process, learning is based on the interaction between cumulative development of skills, knowledge and skills, which may be institutionalized in the form of new routines (Fuck, 2009, p. 28/29).

The methodological approach is qualitative and exploratory, using primary and secondary data. Moreover, monitored visits were made in the CNAVAL's laboratories and interviews with key actors. The interviews were conducted from a semi-structured questionnaire that allowed the interlocutors tell their experience as a researcher over time in the institution. Their participation enriched the analysis of the text which allowed more detailed understanding of the moments of institutional change. The researchers interviewed allowed the identification of their names.

Brazilian naval sector and the situation of PETROBRAS, starting from 1990s

The changes in the national political and economic affected all productive sectors. During the 1990s, the naval sector also suffered deep changes. This period become known as the "*partial decline of the Brazilian naval sector*." According Favarin *et* al. (2009) and Goularti Filho (2010), the reason was totally connected to the crises of the 1990s and the lack of competitiveness in the naval sector.

> This context of Liberal Reforms and failure of national shipowners reflects the "*spirit of economic reforms*" of the 1990s: the internationalization of the economy deepened the dependence on foreign capital, weakening the national economy (Goularti Filho, 2010, p. 267).

According to Favarin *et*. al. (2009):

> During one decade [mid-1980 to mid-1990], the naval sector experienced a declining trajectory. The main reasons were the exhaustion of the financial public sector and the obtuse practices in the industry. The emergence of new international

> players (especially South Korea, with superior advantages), provoked a significant slowdown in domestic and global demands and a great financial crisis in Brazilian shipyards (unable to sustain their own investments in technological modernization to compete with the international companies). [...]The manufacturers of naval equipment had to reduce their size and seek other sectors. In the 1990s, there was no any condition to produce almost nothing in Brazil. (Favarin *et* al., 2009, p. 10).

In this context some Brazilian companies consolidated in the naval sector collapsed or suffered a process of denationalization. Foreign companies bought many Brazilian companies: *Libra Company*, purchased, in 1999, by Sudmericana Steamship Company (Chile); *Aliança*, purchased, in 1997, by Hamburg Sud Group (Germany). Others companies collapsed during the 1990s, such as the *Netuma*r in 1996, the *Mercantil* in 1998, and most others companies of this sector.

Moreover, not only the shipowners but also some shipyards were acquired by foreign companies or went bankrupt, the most important example is the case of *Maua Shipyard*, which purchased by Jurong Shipyard Group (Japan), in 2000 (Goularti Filho, 2010).

The indices of employment are also important indicators to realize the impact of the decline of naval sector. In 1980s, Brazil has become the second largest power in the world shipbuilding industry, employed 33.792 people[1], while, in 2000, passed to 15th in world shipbuilding industry, employing only 1.900 people (Goularti Filho, 2010)[2].

Petrobras (Brazilian Oil Company)[3] also suffered impacts between 1980s – 2000s. Silva (2009, p. 102) explains that Petrobras' activities can be divided into two periods: "1) 1954 to 1979, with concentrated efforts in the areas of transportation and oil refining and 2) From 1980 to the 2000s with actions focused on the offshore exploration and production of petroleum and natural gas". In the first period, the company has consolidated the national industry of capital goods, as part of the national policy of import substitution.

From the 1980s (second period), the offshore exploration and production of oil redirected the technological standards of the company. The domestic suppliers lacked skills and knowledge to produce offshore technologies. Thus, Petrobras going to focus on foreign suppliers who provided goods cheaper and technological advanced than Brazilian goods.

Silva (2009) points out that the transformation of the procurement policy of Petrobras and knowledge gained in production and exploration of oil and natural gas are fundamental to the

[1] These numbers are direct employment.
[2] In 2011, the naval sector employed about 61.000 employees and kept rising, however, still occupies the 27th position in the world ranking of production of shipbuilding. Brazilian participation in the global market provides only 1% of the total (UNCTAD, 2011).
[3] Petrobras (Brazilian Oil Company) is the most important company of Brazilian naval sector.

changes in the naval sector. The relationship between this company and its suppliers are critical to strategies focused on naval sector.

The procurement policy adopted by Petrobras until the beginning of the 1990s was essential to development of Supplier Park of equipment and domestic services (Silva, 2009, p. 105). However, to this author, at the beginning of the offshore oil production, the purchase of equipment and services was made in other countries, because the local suppliers did not manufacture most of the equipment needed. When these local suppliers acquired knowledge for the production of naval pieces, they only reproduce external products with high prices and, above all, without promotion of innovations in the sector.

This change in procurement policy has directly affected the research activities of the naval area of IPT. Professor Jairson de Lima, interviewed in 2012, commented on this passage from his experience as a naval researcher of IPT:

> *[…]The first step in the process of industrialization in the area offshore was buying foreign technology because there was cheap and better (this was in the 1980s). When Fernando Collor de Mello became President of Brazil (in 1990), instead investing in naval sector, he "poured cold water" on this sector. Therefore, Petrobras stayed a long time without hiring IPT, starting a strong process of regression* (Jairson de Lima, interviewed on 05/23/2012).

However, this strategy of outsourcing activities of Petrobras noted some limitations:

> At first moment, the strategy of outsourcing of activities allowed a great leap productive and a reduction in their production costs. However, with the passage of time began, Petrobras realized some important limitations concerning their strategy (SILVA, 2009, p. 112).

Problems of quality and delivery delays of some projects commissioned were essential to put in doubt the viability of foreign purchases. Such problems raise questions for the continuity of the procurement policies of Petrobras. The problems faced by Petrobras were essential for the return to local market (Brazilian suppliers), promoting a great transformation in the sector. In late 1990, the Brazilian Oil Company purchase again from Brazilian suppliers. (Silva, 2009, p. 112-113).

This increase of local content in the Petrobras' procurement policy, along with the development of national policies to improve the productive sector and laws to incentive to shipbuilding gave conditions to start a new level of development in the naval sector.

Resumption of Brazilian naval sector and CNAVAL's experiences

The Center for Naval and Oceanic Engineering (CNAVAL) experienced financial difficulties during the 1990s. In 1989, the strategic action to dissolve the Naval Engineering Division (DINAV) - as it was called the CNAVAL during the 1980s - and regroup it with other areas was approved by IPT. The few investments received were the reason that motivated this strategy. Lose their competences was the biggest fear of naval area of IPT.

DINAV passed to integrate the Technologies Division of Transportation (DITT) through two groups: Waterway Transport (ATHI) and Hydrodynamics (HYDRO). However, the DITT had already the grouping of Railway Development (ADF), the grouping of Logistics and Transport (ALT) and Packaging Laboratory.

Technology support for river and sea ships was the main competences of the naval area of IPT over the 1980s and 1990s. There were not competences for studies and researches on developing offshore technologies. Until the late 1990s, the skills of naval area of IPT were:

Competences	Descriptions
Naval engineering	• Tests of resistance to conventional propulsion of ships, floating structures, semi-submersibles and submerged; • Propellants tests of different vessels; • Determination of resistance vessels by measuring the impact of waves; • Propellers projects through the theory of movement and systematic series • Propellants tests in open water; • Theoretical and experimental study of cavitations; • Theoretical and experimental study of maneuverability of vessels with computer simulation and model tests captive and free; • Theoretical and experimental study of the behavior of ships in waves; • Theoretical and experimental study of the dynamic behavior of offshore structures during transport, launch and docking; • Monitoring functions in real scale of ships and offshore structures; • Analysis of dynamic behavior of ocean systems; • Measurement and analysis of oceanic and atmospheric environmental conditions; • Monitoring equipment and industrial processes; • Measured dynamic torque and Pilot tubes; • Development of special sensors; • Development of special electronic systems (signal conditioners, amplifiers, converters, etc.); • Development of signal conditioners for extensometer.

The potential customers of naval area of IPT were shipyards, shipowners, entities administering ports and waterways, and government agencies to control waterway transport. However, all these organizations were in crisis, which resulted in lower demand for project of technology development, in the early 1990s.

In this context, the naval area of IPT (it was provided services to the naval sector) suffered direct impacts of customers' transformations, as highlighted by Professor Jairson de Lima (interviewed on 05/23/2012):

> *This decline of the naval sector was as a "sneeze", you know? The Federal government was reduced the Brazilian economic circumstances and suddenly, the naval sector ended. [...] At the end of the 1980s the structure* [of the naval area of IPT] *began to wane. [...] There was no existed any relationship with institutions or companies - just some very specific projects, but nothing overall to develop an entire project [...] Naval area of IPT was breaking (...)* (Jairson de Lima, interviewed on 05/23/2012).

As well as naval market, the entities of administration of ports and waterways were also affected by the 1990s' crisis. The high cost for developing high-quality researches added to the high costs to keep a laboratory infrastructure were required huge volumes of financial resources, however, the revenue obtained by naval area of IPT was not enough to cover neither the human resources. (DITT, 1994). The 1990s, became known as the period of abandonment of naval research of naval area of IPT.

However, from the second half of the 1990s the resumption of the Brazilian naval sector began to take shape. According to Jesus & Gitahy (2009), the agents of the naval sector were pressured to articulate more efficiently by a set of policies.

The Brazilian Petroleum Law (Law 9.478/97) was the first policy set. It highlighted the initiatives to promote the development of oil sector (naval sector too); expanding the labor market; regulate the energy resources; increase the Brazilian's competitiveness in the international market; stimulate the research and development of new technologies in exploration and production, transportation, refining and processing of petroleum products (BRAZIL, 1997).

According to IPEA (2010, p. 90), "since 1997, the company who accepts the concession contracts to exploration for oil and gas fields must purchase the local products on the stages of exploration and production". Thus concessionaires should hiring local suppliers - as long local suppliers offer price conditions, deadlines and quality equivalent to external suppliers. According to Jesus & Gitahy (2009), the Petroleum Law ended the monopoly of Petrobras and opened the oil exploration market for other companies, which accelerated the expansion of offshore exploration. In addition, the consolidation of the expansion of the Brazilian naval sector occurred in 2001, when it launched the program "*Navega Brasil*" that promoted changes in credit lines for shipyards and ship-owners.

However, how the transformations of the naval sector and of Petrobras affected the scientific and technological production of IPT's naval area? Considering that it had difficulties in the late 1990s with losses of contracts and human resources.

At the end of the 1990s, the procurement policy of Petrobras began to prioritize the local market, but this market (of suppliers and Research Centers) did not have the necessary infrastructure to meet the demands of the offshore oil exploration. On the same hand, research centers also did not have the necessary conditions to support the offshore research.

Lima (2001), which was CNAVAL's researcher, wrote a document summarizing the difficulties of the naval area of IPT, especially with regard to human resources and laboratory infrastructure of the 1990s:

> [1] The professional composition, in 2001, does not respond the needs of the naval sector. [2] There are many constraints to recover specialized professionals needed to IPT in a short time. [3] The laboratory installations of the naval area are obsolete. [4] The technological culture that permeates the community and even the business sector is quite poor. [5] The ability of business investment and public sector are insufficient to maintain the laboratory infrastructure updated and in good operating condition (Lima, 2001, p. 3).

The difficulties and needs of naval area IPT identified by Lima (2001) was reflected the internalization process of changes in the naval sector. According to this author, from this identification new strategies were outlined to overcome the shortcomings of laboratory infrastructure and financial resources. Eight goals were established by Lima (2001), which aimed to develop:

> [1] Research projects focused on offshore structures at great depths (3.000 meters of water depth). [2] Research projects evaluations of dynamic risers when excited by the action of issuance of vortices in the presence of currents. [3] Methodologies to experimental evaluations of structural parameters of the risers, umbilical and polyester's chains, as well as the performance of offshore structures. [4] Evaluation of mechanical properties of polyester ropes order to evaluate the chains used in mooring operations. [5] Monitoring of offshore structures in real scale. [6] Determination of operational parameters for vessels to operations for support of installation, as those determined for evaluating the feasibility of motorization of FCS [Ferry Crane Slinger], [7] Research projects to the determination of optimal

> routes for navigation in waterways. [8] Special vessels projects for use on inland waterways (Lima, 2001, p. 4).

The most important thing in all these goals are the inclusion of research skill - more focused - on "oceanic" or offshore systems, such as platforms development for oil exploration at greater depths, adding new skills to the naval area of IPT.

Professor Jairson Lima (interviewed on 05/23/2012) illustrates this passage discussing his own experience with the strategies assumed by the naval area of IPT. For him, this area could reinvent itself by associating concepts of "naval technology" with the "oceanic technology":

> *When I joined at IPT* [in 1970]*, his naval area was under construction. The naval area was growing strongly geared for inland navigation, with well-known technologies for ship design. However, because of the 1990's crisis, IPT fall into depression. And to overcome this crisis the naval area of IPT coupled two concepts: "Naval + Oceanic". In other words, the naval area of IPT starting to focus on studies related to oil exploration, leaving a more traditional research just based on naval studies, reaching a more global competency of phenomena. After this "discovery", the naval area of IPT reached its peak at the end of the last century (*Jairson de Lima, interviewed on 05/23/2012).

The stimulus for the development of competence in oceanic research was closely linked to Petrobras, and the Brazilian laws, and Brazilian policies of Petroleum and Natural Gas (PNG), and the investment funds to encourage the domestic industry. This set boosted the national actors to resume their activities from the late 1990s.

In this context, Petrobras developed a research network. The main objectives of this network were modernized and qualify the actors of naval sector. This network symbolizes the return of research activities of the CNAVAL.

Center for Excellence in Naval and Oceanic Engineering (CEENO)

The *Center for Excellence in Naval and Oceanic Engineering* (CEENO) was a research and innovation network, created in 2000, by Petrobras. The improvement of the network's members was the most important objective of it. In other words, the network was intended to offer support for that members grow up in their individual projects and missions. This network was formed by a set of human, physical, financial, technology and knowledge focused to produce new technologies and processes.

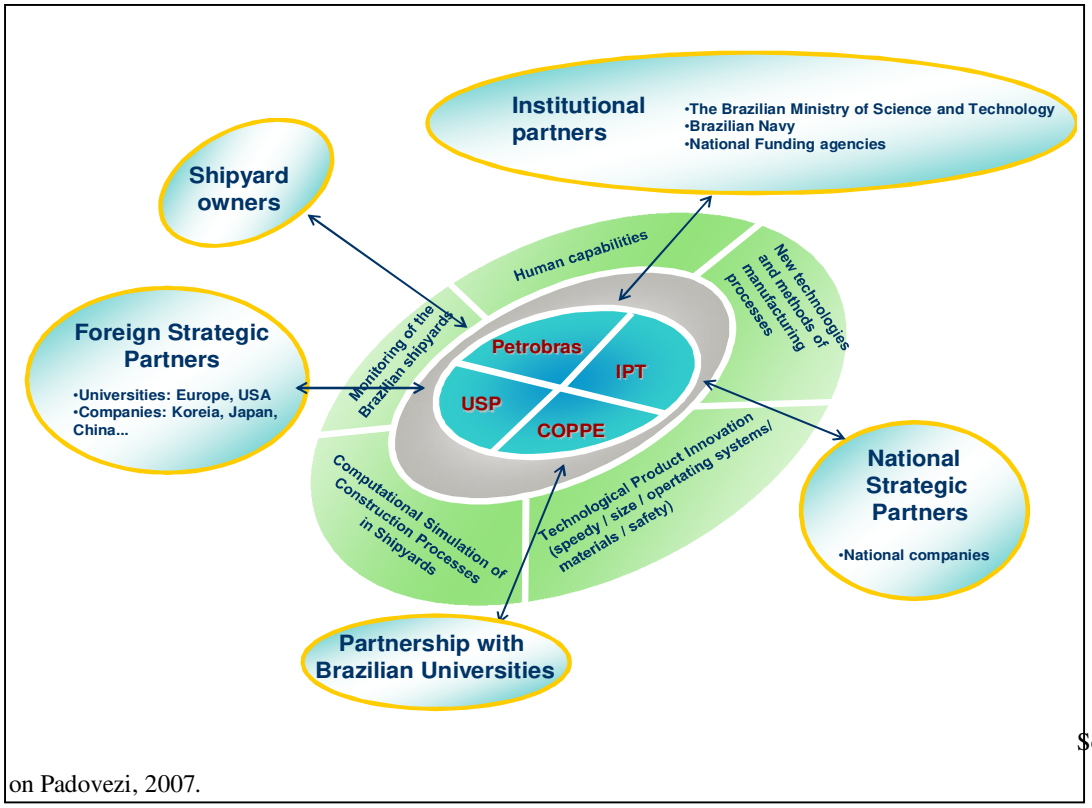
Four key players composed the network: Cenpes/Petrobras, Poli/USP, COPPE/UFRJ and CNAVAL/IPT. All are important Public Research Institutions and they have expertise in naval studies.

The network's objective was to overcome technological, economic and operational bottlenecks by running development programs and technological qualifying specialized human resources. In short, the goal of the network was to:

> [...] enable to engagement of scientific and academic organizations, businesses, government, associations, federations and trade unions. This cooperative action was aimed to improve the development of research naval activities and improve the Brazilian shipbuilding actors (PETROBRAS, 2000, p. 2).

The main activities of CEENO were: monitoring the technological positioning of Brazilian shipyards; develop the technological innovation of the product (speed/size/operating systems/materials/safety); qualify the human resources with new methods of manufacturing processes, and develop of computer's simulators to constructive processes in shipyards. (CEENO/PETROBRAS, 2002).

Figure 1: CEENO's structure



Source: Based on Padovezi, 2007.

This network model was classified as "*Power Network Shared*". Developed by Petrobras, this kind of network defines that the members of the core management should share their experiences, challenges and advantages among themselves and seeks other partners outside the network. This prevents the existence of weak ties among agents.

The researchers Jairson de Lima (interviewed on 23/05/2012) and Carlos Daher Padovezi (interviewed on 11/11/2011) said that IPT participation in the CEENO network stimulated advances in laboratory qualification, in technology and human resources, and also, was fundamental for the naval sector that needed faster answers to their technological problems:

> *The CEENO was born from the interaction between Petrobras, IPT, UFRJ, USP to solve the problems faced by The CEENO was born mainly from the interaction between Petrobras, IPT, UFRJ, USP to solve the problems faced by Petrobras in the 1990s. [...] When Petrobras began to discover fields of oil in large depth, many problems began to increase. They realized that his standard technology would not resolve this problems and that needed to invest in new ways. Thus, Petrobras started facing problems that have never been faced before. The IPT helped in this 'battle'* (Jairson de Lima, interviewed on 05/23/2012).

> *I was 'super optimistic' about this research network. I think it solved many problems: if we observe our daily life we see that both the university as research institutes have problems of human resources and laboratory infrastructure, among other situations. And we learned that the solution to overcome these bottlenecks was in network activity* (Carlos Daher Padovezi, interviewed on 11/11/2011).

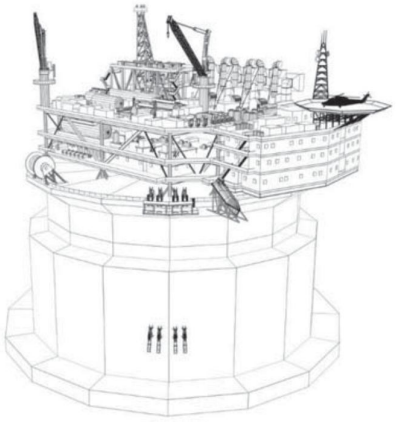
In this sense, this network could be identified as a *learning opportunity*, associated with the development of collective efficiency for naval research members. In this context, advances highlighted by interviewed researchers are related to the interaction of the naval area of IPT with domestic shipbuilding market and the creation of new skills that were able to respond to demands of Petrobras and the rest of the naval sector.

In 2002, the Center for Excellence in Naval and Oceanic Engineering (CEENO) initiated the development of two innovative projects for Petrobras (Figure 2): the *Monocolumn platform*

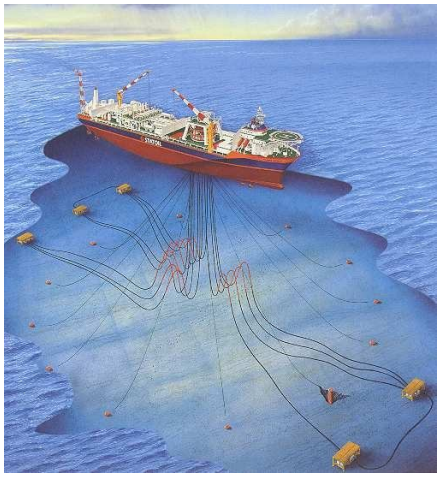
(MonoBR)[4], and the *Brazilian floating production, storage and offloading (FPSOBR)*[5]. These projects are related to offshore development, more precisely, in develop of exploration platforms for oil and natural gas. In addition, the goal of these projects was also stimulate the shipbuilding industry from technological innovation and the search for more efficient means for prospecting, processing, storage and transport of oil products.

Figure 2: Two innovative projects for Petrobras made by CEENO network.

MonoBr Platform



FPSOBR



Source: CEENO/PETROBRAS, 2002.

The network had large investments by Petrobras. The CNAVAL/IPT received $ 1 million to upgrade and consolidate their laboratories. According CEENO/Petrobras (2002) the focus of this investment was the acquisition and installation of the PMM (Planar Motion Mechanism)[6] and the upgrade of Yaw-rotating System[7]. These tools were essential to execution of the MonoBR platform and the vessel FPSOBR.

These investments expanded competences of CNAVAL. Namely, the modernization of laboratories and qualification of human resources allowed the creation of competences of ocean engineering (activities focused on research and testing of pipelines, risers and platform development).

[4] The MonoBR is a semi-submersible monocolumn platform. This innovative concept has been studied in some development centers around the world. This type of construction prioritizes the safety, presenting competitive advantages over current concepts of semi-submersible platforms.

[5] The FPSOBR is a type of vessel that performs the same functions of an oil platform. The specific feature of this project is a study that combines the *Brazilian FPSO's expertise* with improvements in main weakness of this concept: the movements.

[6] The Planar Motion Mechanism (PMM) is a mechanism to analyze and predict the maneuverability of the vessel on a reduced scale.

[7] The Yaw-rotating System is a mechanism for the development of curves vessels at the time of testing.

Until 2012, CNAVAL had the infrastructure to meet the diverse technological demands of Petrobras and other companies linked to the naval sector. It has two competences: *naval engineering* and *ocean engineering*.

Competences	Description
Naval engineering	▪ River and sea ship towage resistance ▪ Self-propulsion for ship propulsive coefficient determination ▪ Nominal wake mapping ▪ Wind action on superstructures ▪ Ship hull shape optimization and flow line survey ▪ Ship maneuverability ▪ Behavior on regular and irregular waves, determination of the Response Amplitude Operator (RAO), acceleration measurements, hydrodynamic pressure, additional forces and resistance on waves ▪ Cavitation in propellers and rudders, with or without ship wake simulation ▪ Determination of hydrodynamic propeller characteristics ▪ Ship performance analysis ▪ Determination of sustentation and drag forces in foils and other submerged bodies ▪ Visualization of run-off in submerged bodies ▪ Navigation safety studies ▪ River ship design ▪ Waterway transport technical and economic feasibility studies ▪ Ports and terminals design ▪ Measurements in ship sea trials; ▪ Measurement of platform forces and movements; ▪ Extensometry in propellers and hydraulic turbines; ▪ Propulsive performance of sea and river ships; ▪ Forces and movements in fixed and floating ocean systems;
Ocean engineering	▪ Transportation, launching and installation of fixed platforms ▪ Floating platforms on waves, with or without mooring line and risers simulation ▪ Hydroelastic structures on waves (oil ducts, gas ducts, mooring lines, rigid and flexible risers) ▪ Installation of equipment with crane ship, load measurement and hydrodynamic parameters

The knowledge acquired in the CEENO's network added to the experience of the 1990s - low resources and dependence on a few customers - made the CNAVAL create tools to diversify their research activities, customers and partners, seeking new market niches. Thus, beyond the creation of ocean engineering expertise, the CNAVAL developed a business plan, which contained the planning goals and market valuation.

These incorporations knowledge are components of the learning process of CNAVAL to avoid institutional inertia that occurred in the 1990s, and to prepare it to face new challenges, such as the possible rearrangements of the domestic naval industry players.

Final remarks

In this text, I tried to show from a case study, that the creation of competences in research activities is closely related to the social, political and economic contexts. The example of CNAVAL confirms the hypothesis supported by this article.

Over the past three decades (1980 - 2000), the oscillations of the political and economic were harmful to the local productive sectors and broke up many Brazilian companies. With a result, domestic firms lost competitiveness of its products across the international market.

All sectors were affected by the economic crises of the 1980s and 1990s, but the impacts on the naval sector were evident when Petrobras began to prioritize their purchases of equipment with international suppliers.

The crisis of the economic sectors affected the research activities of the IPT (considering that IPT provides services to local companies). During the 1990s the Technological Research Institute (IPT) entered a decreasing curve (reduced budget allocation, reduction of human resources and suspension of research activities due to lack of financial resources). The difficulties of IPT were reflected in their technology centers.

CNAVAL's activities have suffered, in recent years, a great transformation due the Brazilian naval sector transformations and the national crisis. Before the 1990s, his activity was mainly related to supporting the vessels projects, both river and sea. During 1990s, from the decline of Brazilian naval industry, the performance of CNAVAL suffered a stagnation of their activities. The consolidated competences in research on river vessels and supports of sea vessels did not follow the transformations of Petrobras. New demands for offshore technology research (e.g. oil platform) were not competence of the naval area of IPT. The lack of this expertise was crucial to her depression.

From the late 1990s, the return of Petrobras for the local market, the creation of a research network (CEENO) by Petrobras, the strengthening of the national economy and the resumption of the Brazilian naval sector were conditions that made possible the return of CNAVAL while naval research center.

Thus as Salles Filho *et*. al. (2000) has already said, the research institutions learn and evolve over time and this process has strong historical components of learning, uncertainty and tacit activities. Thus, the learning process stands as an important mechanism for the process of overcoming trade-off and lock-in. In other word, the learning process helps to "avoid" the institutional inertia and contributes to the development of new competences.

The investments made by CEENO's network changed the characteristic of research in the area of naval IPT. Laboratory modernization, human resources qualification and the acquisition of new equipments, provided the CNAVAL the possibility of diversification of its activities, in other words, *CEENO gave access to knowledge relating to offshore technologies* (risers, umbilicals and

development of offshore oil platforms). The results of these laboratorial investments were culminated in the emergence of new competences to CNAVAL.

References

BAUMGARTEN, Maíra. Conhecimento e sustentabilidade: políticas da ciência, tecnologia e inovação no Brasil contemporâneo. – Porto Alegre: Editora da UFRGS/ Editora Sulina, 2008.

BRASIL. Lei do Petróleo (Petroleum Law). Lei nº 9.478, de 6 de Agosto de 1997. Dispõe sobre a política energética nacional, as atividades relativas ao monopólio do petróleo, institui o Conselho Nacional de Política Energética e a Agência Nacional do Petróleo e dá outras providências. Disponível em: <http://www.planalto.gov.br/ccivil_03/leis/L9478.htm>. Acess in 2012.

CEENO/PETROBRAS. Novas concepções de unidades de flutuantes de produção de petróleo para lâmina d'água >1800 m. Rio de Janeiro, 2002. Awarded by CNAVAL.

CNAVAL. Centro de Engenharia Naval e Oceânica: plano de negócio (Planejamento Estratégico), 2009.

CNPq. Fundos Setoriais, disponível em: <http://www.cnpq.br/web/guest/fundos-setoriais>. Acess in 2012.

DITT. Divisão de Tecnologia de Transportes, São Paulo, IPT, 1994. Awarded by CNAVAL.

DOSI, Giovanni; MARENGO, Luigi. Some elements of an evolutionary theory of organizational competences. In: England, R. Evolutionary concepts in contemporary economics. The University of Michigan, 1994.

FAVARIN. Julio; AMARANTE, Rodrigo; ANDERSON, Valdir; GALLARDO, Affonso; PINTO, Marcos. Desafios para o ressurgimento da cadeia de fornecedores navais no Brasil. São Paulo: CEGN – Poli – Depto de engenharia Naval e Oceânica, 2009.

FURTADO, André; QUADROS, Rui; BRISOLLA, Sandra; BERNARDES, Roberto. Força e fragilidade do sistema de inovação paulista. São Paulo em Perspectiva, 14(3), 2000.

GOULARTI FILHO, Alcides. A trajetória da Marinha Mercante Brasileira: administração, regime jurídico e planejamento. Revista Pesquisa & Debate, SP, v. 21, n. 2 (38), p. 247-278, 2010.

IPEA. Poder de Compra da PETROBRAS: impactos econômicos nos seus fornecedores. Brasília: Ipea/Petrobras, 2010.

LIMA, Jairson. Termo de compromisso entre a DITT e a DE para implementação do Plano Diretor de 2001 do IPT. São Paulo: IPT, Divisão de Tecnologia de Transporte, 2001. Awarded by CNAVAL.

PADOVEZI, Carlos. Atividades do Centro de Excelência em Engenharia Naval e Oceânica – CEENO. Apresentação FENASHORE, 26 de Setembro de 2007.

PETROBRAS. Centro de Excelência em Engenharia Naval e Oceânica. Rio de Janeiro, maio de 2000. Descriptive Document.

SALLES FILHO, Sergio *et* al (Coordenador). Ciência, Tecnologia e Inovação: a reorganização da pesquisa pública no Brasil. Campinas: Editora Komedi, 2000.

SILVA, Cássio. Compras Governamentais e Aprendizagem Tecnológica: Uma análise da política de Compras da Petrobras para seus empreendimentos *offshore*. Tese de Doutorado – Departamento de Política Científica e Tecnológica – UNICAMP, 2009.

UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT. Developing countries participation in Maritime Businesses: Review of Maritime Transport. ISSN 0566-7682. UNCTAD, 2011.

Interviews

Carlos Daher Padovezi. Interviewed by Lucas Rodrigo da Silva. Location: Center for Naval and Oceanic Technology Research Institute (CNAVAL/IPT), Sao Paulo/SP, November 11, 2011.

Jairson de Lima. Interviewed by Lucas Rodrigo da Silva. Location: Center for Dynamics' Fluid 2 / University of São Paulo (USP), São Paulo/SP, May 23, 2012.