Networks of Research for Solutions of Organizational Problems: A Case of the Center for Naval and Ocean Engineering (CNAVAL)

Mr. Lucas Rodrigo da Silva¹  
Dr. Leda Gitahy²  
Dr. Thales de Andrade³  

Abstract

The objective of this study is to understand the strategies of the Center for Naval and Ocean Engineering (CNAVAL) of Technological Research Institute (IPT) regarding the difficulties of the public budget for scientific research released by the State of São Paulo. A possible solution by CNAVAL/IPT to overcome this dilemma is the establishment of the organizational network of research and innovation CEENO (Center of Excellence for Naval and Ocean Engineering), this network is formed by different agents as universities (UFRJ and USP), research institutions and private companies (Petrobras). This new model offers a guarantee of greater effectiveness of existing programs to support innovation and will surely encourage and enable the implementation of new programs and engagement of new agents. This research is methodologically guided by interviews with key actors and secondary data. This research intends to answer questions about how these networks are formed and how this convergence between the scientific community and industry is consolidating and what results they can generate.

Keywords: Organizational strategies – networks – CNAVAL - IPT

¹ Master’s student of program of Science Technology Policy from University of Campinas (DPCT/UNICAMP). Email: lucassilva@ige.unicamp.br  
² Professor of Department of Science Technology Policy from University of Campinas (DPCT/UNICAMP). Email: leda@ige.unicamp.br  
³ Professor of Social Science Department from Federal University of São Carlos (DCSo/UFSCar). Email: thales@sigmanet.com.br
INTRODUCTION

The objective of this paper is to understand how political and economic context affected the Technological Research Institute (IPT) based on the analysis of the Center for Naval and Ocean Engineering (CNAVAL), a technological Center of IPT over the last decade. The changes of the context affect their routines, skills and the management organization. Some concepts that are crucial to the structure of organizations.

The IPT is a traditional public research institution of São Paulo, linked to the Secretariat of Economic Development, Science and Technology. Founded in 1899 its goal was (and still is) to serve the demands of science and technology of public and private industrial sectors, as well as contribute to the development of scientific and technological knowledge. Throughout its existence, that institution has undergone several transformations. However for purposes of analysis it was selected the period 1970 - 1999 for contextualization.

The 1970s was a special moment for IPT, it was the time when its legal structure was changed from an ‘autarchy’ to a ‘public company’ characterized by the figure of a corporation. This change represented a break of its organizational paradigm. The objective of this action was to make it more autonomous regarding to the search for partners, customers and investments.

The CNAVAL is the analytical focus of this work, the idea is to understand how the change in the political and economic context affects the routines of the technological center and how it articulates forward to the events of political and economic context.

This article seeks to understand how the process of organizational learning can be a crucial factor for the development of new management techniques and routines, and how the institution (in this case the technological center) can evolve and develop new skills through a constant process of adapting its organizational structure.

The development of networks of actors and institutions can be a way of learning in which organizations can keep active against the problems of lack of financial resources or technological lock-in. This article aims to develop an effort to elucidate the process of organizational learning and adaptation through a case study.

The main references are the doctoral theses of Regina Gusmão (1990), focusing on the IPT during the 80th, of Deborah Mello (2000) and the book coordinated by Sergio Salles-Filho (2000a), both focusing on 90th. These texts discuss, among other things, the situation of IPT (financial health, employees, organizational behavior).
The methodological approach is exploratory and qualitative, combining interviews with key actors; documental research about the organization of IPT (internal documents and specialized books on the subject) and, finally, secondary data analysis, as the survey of S & T policies, and essays about the transformation of Public Research Institutes (IPPs) from Brazil.

To identify the organizational changes in the trajectory of IPT and therefore the CNAVAL, it was chosen a method developed by Salles-Filho et. al. (2000b) regarding the identification of changes in institutional arrangements. Five dimensions of analysis composes the identification process of these transformations: contractual relations with the state; understanding of disciplinary and sectoral dynamics; sources and mechanisms for financing research activities; characterization of the actors and their roles; and coordination and interaction between actors.

**MAIN CONCEPTS - THEORIES OF THE INNOVATION ECONOMY AND SOCIOLOGY OF SCIENCE**

The conceptual contributions of this paper are the results of connections between the theories of the Innovation Economy and Sociology of Science. Both have mechanisms for understanding the relationship between science, technology and society.

The fundamental referencial for that review is that public research institutions are organizations that create knowledge and skills and thereby, they learn and develop scientifically, technologically and organizationally. Consequently, they have evolutionary trajectories resulting from an active process of relationship with the scientifical, technological, economical and social environment. (GARCIA & SALLES-FILHOS, 2009).

Salles Filho (1993) says that the institutions (of research) are an inseparable part of the evolutionary process. They learn and evolve over time and this process has strong historical components of learning, uncertainty and tacit activities. According to Dosi & Marengo (1994) the evolution of evolutionary trajectories of these institutions also define themselves through trade-offs permanently placed.

Thus, the learning process stands as an important mechanism for the process of overcoming trade-off and lock-in. The idea of learning "avoid" the institutional inertia (path dependency) and direct entities to processes of search and selection of new possibilities for action (Salles Filho et. al., 2000a).

According to Calmon (1999) the term “learning" has two meanings. First, it can be used as a product and means the accumulation of information in the
form of knowledge or skill. Second, the term may also represent a process which can be a learning activity or the way how we learn.

Thus, as stated Fuck (2009), the learning process is based on the cumulative development of skills and knowledge that can be institutionalized in the form of new routines.

The concept of routines is also central to understanding the evolutionary process of an institution. The change of the routine of research, management and/or technical causes changes in the institutional environment, forcing the institution to adapt and search new strategies.

Coriat & Dosi (1995) argue that the concept of routine has a "dual nature", functioning as an ability to solve problems and as a governance mechanism. They constitute a set of tools that assist the management in times of crisis, providing consistency to their actions (Dosi & Nelson & Winter, 2000). According to these authors the idea of routine can also be represented as "pieces" (or chunks, as the authors defined) of an organized activity of repetitiveness. This set of definitions makes the routine represents an important link in the understanding of the organizational skills, especially regarding to coding of tacit knowledge.

The point is that systems are not infinite or permanently lasting. Social, political, legal and economical realities are able to modify the institutional structure of an organization (or IPP). As already stated, the IPPs have evolutionary trajectories and therefore respond to the context in which they operate, living a constant process of organizational adaptation.

It is apparent that the political and economic changes over time were able to turn all the logic of organization and production of IPPs (section below). One of the factors that characterize this process is the establishment of the relationship between public and private sectors for the development of technology research. The networking of research and innovation, or as called Callon (1992), are called techno-economic networks (TENs).

Callon (1992) says that the TENs are formed by three poles: the scientific, technical and the one related to market and that they are mutually interconnected. A network can be formed by the aggregation of all stakeholders. The network is constructed from the logic of their own translations, aggregation of the actors is not a procedure invented by the observer. According to this definition, the actors are not necessarily human. In this logic the 'object action', such as money or a technology, are also mechanisms of the changing process.

The concept of learning is essential for the interpretation of the network. It designates the set of mechanisms through which the different elements involved in translation become exclusively dependent on one another, a moment in which decisions are dependent on the history of previous translations (Callon, 1992).
Thus, as stated Fuck (2009, pg 27), "the IPPs should take an active role in the research process, interacting with the private sector by identifying the best way to connect the two spheres. This coordination should not be guided by the nature of the search results (whether or not appropriated), but by different capabilities among the actors involved in research and development strategies."

This debate is the point which the Center for Naval and Oceanic Engineering has been coordinating and adapting through a constant process of learning and establishment of new routines in order to progress of his skills, competencies and organization.

The following item presents a brief history of the most important transformations undergone by the Institute for Technological Research (IPT) between 1970 and 1999 in order to highlight the points of inflection and its causes; an effort to elucidate the process of organizational learning and adaptation.

**SCIENCE AND TECHNOLOGY POLICIES IN BRAZIL**

Since the 70s, scientific and technological development was formally on the political agenda for Latin American countries, but this had little real effect in terms of sustaining and consolidating effective national projects.

According to Vessuri (2008), modernization was a recurring collective aspiration and a key policymaking idea for several Latin American countries. However, the research community was unable to ensure take-off for a self-sustaining growth process.

Latin America's academic elites were still very much under the sway of the State apparatus and science and technology policies displayed a corporative behavior, rather than a dynamic and effective ability to set an agenda (Vessuri, 2008).

Policymakers in Brazil and other Latin American countries in recent years have engaged with aims such as tightening intellectual property regulations, building research networks, and obtaining public-private sector synergies in the field of technology.

In the case of Brazil, these trends have been consolidated over the last few decades through recent developments in science and technology policies and local activities of international groups. Lagging behind the developed economies, Brazil's technology and innovation policymakers have sought to build a new environment for innovative activities.

The "national-development" perspective was a key aspect of the trajectory of the State's S&T sector from the 1950s throughout the military
period, when the dominant paradigm of the political project was the prospect of Brazil becoming a regional power, with the State as the crucial agent for all major scientific and technological projects, since the national bourgeoisie was not seen as an effective partner. S&T partnerships were primarily of an intra-state character with no significant connections to the local or international private sector (BAUMGARTEN, 2008).

This development model was not seen as successful in terms of providing favorable conditions for companies to introduce technological innovation practices, so Brazil’s economic and technological elites sought to address the situation by proposing institutional and cultural changes.

More recently, Brazil’s scientific output - particularly its public universities - has done better in terms of its impact of publications worldwide. But growing scientific production did not boost interaction with the productive sector (CASSIOLATO & LASTRES, 2000).

Given the State's fiscal crises from the 1980s onwards, new forms of research funding emerging, and international trends in recent decades, Brazil's technology area has steadily become more autonomous in relation to the scientific and academic sectors.

During President Lula's first term of office, an Industrial, Technological and Trade policy (PITCE) was introduced, and the Law of Innovation was passed (Law 10973/04). These efforts were necessary, but not sufficient in terms of altering the innovation culture in Brazil. Following the footsteps of developed economies, a broad range of initiatives would be required, with a new social deal for technology to include companies that historically have not invested in this field; universities resistant to market practices; and the public bureaucracy. A new elite of policymakers has recently emerged in research institutes and development agencies aiming to assess the science and technology sector and create specific arrangements for its funding and evaluation.

One aspect of these changes refers to the need to adopt an innovation agenda, which was not an important part of science and technology policy until the 1990s. Technological innovation activities started with the formulation of integrated policies covering productive sectors, government, and technological research centers. In recent decades, there has been a major redefinition of these institutions in an attempt to internalize such practices in Brazil (ARBIX, 2007).

These policies have led to key articulations and higher productivity, but also significant asymmetries across different research areas, more specifically between basic research and leading-edge technology.

One of the most salient results of this policy was to make innovation a separate and self-referential subject in relation to scientific development. Based
on Baumgarten's analysis, the distinction between science and technology interests is particularly clear when

"(...) around 70% of funds are allocated to technological development, and given Brazil's currently low capacity to demand technology resources, this creates an imbalance since supply far exceeds the level justified by demand..." (BAUMGARTEN, 2008: 217).

This imbalance points to a situation that is increasingly visible in S&T policies, namely the trend toward separating these two fields. Several budgetary funds now tend to be allocated to fields that are clearly performing well in technological terms, to the detriment of science education and research.

Another sign of modifications in the concept of technological research and development may be seen in university research funding. Certain universities have recently introduced incentives for students to develop grant-aided projects that explicitly pursue technological innovation. This means that funds for science-student grants from Brazil's federal research agency (CNPq) are being supervised by academics using them to develop projects in companies.

The criteria of technological feasibility and synergy with business are thus becoming increasingly significant when allocating funds, providing grants or educating qualified staff. Science and technology do coexist of course, but parameters for technical feasibility and assessment are being set by academic elites clearly attuned to leading-edge technology.

From the 1990s, new experiences that foster innovation began to call for industries to engage with this agenda. But partnerships must be organized and experiences exchanged through a very diverse range of industries. Relations between business and control centers funded research represent complicated systemic problems for policy makers (VERONESE, 2006).

Another clear sign of an increasing internationalization of scientific research can be noted in the consolidation of innovation legislation in Brazil. The technological innovation law (Federal Law 10.973/2004) "provides incentives for innovation and research in science and technology in industry", and creates an environment in which business would be more involved in developing projects.

The law suggests more partnerships between business, universities and science and technology institutes in order to lead innovation processes. Brazil's Law of Technological Innovation, based on parameters taken from the French experience, states a number of specific aims: creating an environment for partnerships between universities, technological institutes and companies; incentivizing science and technology institution involvement in the innovation process; and fostering innovation within companies.
It also enables firms to become more present in the public sphere by sharing public and private infrastructure and human resources to drive technological research. More controversially, it also regulates conditions for researchers at public research institutions to develop technology projects, offering grants for innovation and additional salary, as well as allowing start-up technology firms. Funds may directly address firms developing innovative projects if they can point to reciprocal benefits and results.

These new rules for technological activity may subject the scientific agenda to business imperatives, and the sectors responsible for producing scientific knowledge may not obtain anything in return. All these demands and articulations aim to respond to the commercialization of scientific practice now underway internationally, which has been affecting the course of the scientific and technological logic and determining different approaches to these trends.

**TRANSFORMATIONS OF IPT: 1970 TO 1999**

The 70 represents a significant period of organizational changes to IPT. This change has been the legal structure of IPT, the result of federal policy "embodied" by the Government of Sao Paulo, which influenced the *modus operandi* of the Institute's relationship with the productive sector.

The federal policies that influenced the state of São Paulo were, according to Gusmão (1991), related to the SDP (Strategic Development Program) in 1968, during the Costa e Silva Government. The plan "Metas e Base" in 1970, during the Medici government, both regarding to the period of military dictatorship. The first policy was intended to accelerate the incorporation of technology by the productive sector, and second, to increase the competitive power of domestic industry.

According to Gusmão (1991), the State Government (São Paulo State) based on these federal policies established in 1971, the PROCET (State Science and Technology Program) that emphasized the orientation of research to solving basic problems of the productive sector, whose aim was integration of universities, research institutions and technology companies.

The direction taken by IPT was to establish a strong relationship with the private sector, working primarily on reducing production costs, improving standardization and increasing the capacity for technological innovation in the industry. Gusmão (1991) says that this moment was considered by other authors as "industrial science", an ironic mode of viewing the fact of the subordination of science to industry.

The influences of the PROCET policies brought the need to the Institute to become more flexible and autonomous in contracts and agreements that
were being established. International partnerships (for technological improvement and human resources) and focus on the brazilian industry were also aspects that changed their institutional routines.

In this context, the state of Sao Paulo transformed in 1975, the IPT of autarchy for Public Company (Technological Research Institute - IPT S/A), toward the law 896/75 (specific to IPT), this made that the Institute enter into agreements and contracts with more autonomy and flexibility.

Beyond the administrative changes, there was also the adoption of a complex budget control at the level of cost center and project. In the new structure, the business methody, the activities were strongly driven by external demand and the process of commercialization of projects was done by the technical units of the IPT, on the initiative of the researchers themselves (GUSMÃO, 1990).

In the 1980s, the inflection points that have transformed IPT were based by strong shaking financial and human resources, recognized as a period of institutional dysfunction, given the "abandonment" policy. The crisis of hyperinflation and political transition stirred strongly with the institutional framework.

During the mid-1980s, the São Paulo state government, led by Paulo Maluf Governor (1979 - 1982) has created Paulipetro Company in 1981 for search oil and natural gas in the Paraná River. The company proposed to the Institute a consortium for research in exploration and analysis of this basin. The partnership lasted from 1981 to 1983 and according to Gusmão (1990), by the end of the 1980s there was a decrease of more than 1,000 employees. During this decade the majority of employees were technical, mid-level and operational, and administrative staff. This emphasis on the technical level highlights the importance of activities related to provision of low complexity.

In the 1980s the relationship of IPT with the external environment took place primarily through provision of specialized services and not through research activities in products and processes.

The period 1981 to 1989 the R&D (research and development) activities accounted for only 15% of revenues, and the participation of the private sector was very small, accounting for 7% of total R & D. Thus the Institute has been more dependent on resources from the state. These resources were already scarce, and were invested basically in maintenance of salaries and of small additional spending on research.

The transition to the 1990s made the IPT take a new position in the face of budgetary difficulties, adopting a business management methodology that favors some economic sectors in favor of raising revenue.

Between 1994 - 1995, the IPT developed the "Revitalization and Equating Financial Project", that had four target to be reached, namely: the
search for greater ability to be accountable to society, greater external recognition, greater relationship with the productive sector and society, and increase their revenues.

In 1995 the IPT adopted a kind of methodology of enterprise management, the "Strategic Areas of Support" (SAS). This business philosophy has facilitated the organization making the R&D more focused on solving problems, noting that "be facing the market is not conflicting with the fact that the institute as an organization remained bound in the State" (Mello, 2000). This methodology allowed the IPT to promote strategic alliances with public and private companies.

The financial problems continued and marked the 90th year. According to Mello (2000) in the period 1995 to 1998 occurred a decrease of 36% of the amounts received as budgetary allocation. The contracts signed by the IPT with private companies grew from $ 9.4 million to $ 12.6 million, however, while the number of employees dropped from 3,000 in 1980 to 1,800 in the 1990s.

The results of these institutional changes have generated significant impacts on the organizational structure of the Institute. The 2000s represent a new level of IPT, new challenges and new strategies marks to the entrance of the Institute in the XXI Century.

THE CENTER FOR NAVAL AND OCEAN ENGINEERING (CNAVAL/IPT)

The IPT is an institution made up of technology centers and technical units and currently has 12 technology centers, 30 laboratories and 10 technical sessions. This article focuses on the past decade of experience in analyzing and Center for Naval and Ocean Engineering of Technology Research Institute (CNAVAL/IPT). The case study of this laboratory during the last decade allows a more detailed analysis of the network of actors and of their organizational routines.

The CNAVAL is a technological center of the IPT, founded during the 1940s and its mission was (and still is) to develop training ship sector of medium and large. The idea is to promote technological developments towards greater efficiency and agility in the construction of ship models (INSTITUTO DE PESQUISAS TECNOLÓGICAS, 1999).

The 1970s was very important for CNAVAL. It was a period of expansion of the naval activities of the IPT, caused by economic growth in Brazil and the Brazilian Navy programs for the development of projects of military vessels, and the establishment of the main technology partner and funder, Petrobras.
However, during the period 1980 to mid 1990, the Brazilian shipbuilding industry went into recess. The national political and economic instability, the international oil crisis and competition from emerging Asian shipyards fostered a gradual decrease of the Brazilian shipbuilding production (JESUS & Gitahy, 2009). This situation reached CNAVAL.

In an interview with a researcher CNAVAL / IPT it was clear how that difficulties presented by the political and economic context affected the organizational dynamic and productive development.

"There was a time that CNAVAL had a greater importance within the Institute. He (CNAVAL), in the golden age of shipbuilding industry, working with several shipyards worked with the Navy of Brazil, Petrobras and other customers. Today we have less than half the staff we had in that golden age. In the ends of 1970 we have 102 employees and today we have something around 40. At that time (70) of the 102 employees we had something like 60 researchers, now 40 (today), I think there are 20 researchers. Few researchers, and this reflects a less intense activity and this is a problem." (CNAVAL/IPT RESEARCHER 1)

The reflection of this matter overflows the boundaries of technical data (staff, for instance) and reaches the logic of hiring projects for implementation in CNAVAL. According to the graphs below, from 1984 to 1993 the Centre has suffered significant declines in the hiring process by the public sector. This fact exemplifies this period of detachment of the National State in the period indicated.

Chart 1 - List of contracts for the implementation of projects in the IPT's naval area (1984 and 1993)

---

4 This researcher works at IPT since 1980. He belongs to the IPT’s naval area and performs functions of research and management.
Questioning the researcher about the consequences of research condition for the period of 1970 compared to the present day, the CNAVAL researcher continues:

"Some things are limited, but we are learning to be selective and choose a little better research subjects."
We have some senior researchers, other researchers and young research assistants, technicians with secondary education to take care of laboratories and models and we cook up some administrative, secretarial and administrative managers. So basically it's a relatively small structure. "(CNAVAL/IPT RESEARCHER 1)

This selectivity process - the process of organizational learning – makes that the Center organizes itself in favor of new methodologies (search research, funding, etc.) to stay active when facing adversity of the current context. One such search and selection process is the participation of research and innovation network CEENO (Centre for Excellence in Naval and Oceanic Engineering) created by Petrobras and that over the year 2000 will promote new opportunities for technological development and financing research.

**The 2000s - CNAVAL/IPT: LEARNING AND EVOLUTION**

The Center for Naval and Ocean Engineering went through a period of financial stringency (little investment in infrastructure) caused by the low participation of state but it was able to acquire knowledge to overcome this period of deprivation. Moreover, the ends of 90s represented the beginning of the resumption of the national shipbuilding industry, and the emergence of legislation such as the Petroleum Law (Law 9.478/97) and the Program “Navega Brazil” accelerated the expansion of offshore exploration and modified access to credit lines for shipowners and shipyards in increasing the participation of the Merchant Marine Fund, respectively.

The change in purchasing policy of Petrobras over the second half of the 90's caused a significant change in the technological trajectory of the sector, and Petrobras had to demand more products from local suppliers. That incentive pushed supplier companies to increase their production. (JESUS & Gitahy, 2009)

But the question that reinstates the CNAVAL again in the context of technological production and experimental research was to establish the network of innovation CEENO (Centre for Excellence in Naval and Ocean Engineering), established in 2000 by Petrobras. The concept of "Center of Excellence" was created by Petrobras and one of the important aspects of this design is the orientation of the creation of opportunities for innovation and improvement of its participants. Being thus, formed by a set of physical, financial, technology and knowledge for the sake of leadership in a particular subject.
The process of learning and evolution of CNAVAL/IPT is allocated for the design of research networks activated by the process of search and selection. As Callon (1992) had said, the network - as a sociological concept - is built according to its own translations and the aggregation of the actors is not a procedure invented by the observer.

Thus we can see that the center acts according to the context in which it is immersed, and that the translation and aggregation of actors takes place precisely because of the need to overcome the weakness existing in the political and economic context, and realize that this combination makes shipbuilding industry more competitive in relation to emerging Asia companies.

It is then the definition of new routines, competencies and complementary assets that add a new form of institutional organization, which offers a shared management, reducing uncertainties and increasing confidence as legitimate research. Figure 1 (above) is about the structure of Excellence

5 The main partners: Petrobras: Brazilian Oil Company; USP: São Paulo University; Transpetro: oil and gas transportation company of Brazil; IPT: Research Technological Institute; COPPE: Graduate Studies and Research in Engineering – Federal University of Rio de Janeiro.
Centre and exemplifies the action of each actor within that network. Importantly, the network members provide unique services to Petrobras, developing technologies, and experimental methodologies for problem solving or project of this company.

However, this adaptation and creation of institutional mechanisms for management have brought more visibility to more entrepreneurial management initiatives. It is not so clear if these trends are impacting directly on the conditions of technological work. For some researchers, there remain concerns about the participation of different sectors in the development of these strategies.

“We need to start to understand better this change in quality that has occurred, in order to better understand what is happening and better able to measure what we will bring as a result (IPT RESEARCHER)⁶.”

These organizational structures of scientific and technological research and participation in the institute intersectoral partnerships produce insecurity on the part of researchers. A fear in the fact that scientific work can be managed by private companies linked to network.

**FINAL REMARKS**

Returning to the conceptual basis, it is clear that the evolution of CNAVAL / IPT occurred during the time by a process of adaptation. Like Garcia & Salles-Filho (2009) identified, the process of evolution, learning, processing routines and competencies is dynamic and always respond to some breach of context (or some trade-off) through an active process of relationships with scientific, technological, economic and social development.

The Center (or Network) of Excellence is the answer to one of these relations with the context. The moment the shipbuilding industry was in low productivity, losing ground to foreign shipyards and with few specialized marine researchers (according to data collected, the problem still persists), the cooperative actions among agents in the same sphere, but with different focuses has been the best option to overcome the difficulties found in the navy industry. Thus, factors such as financial resources and low technology intensity are attenuated by the articulation of the various actors.

⁶ He was a nanotechnology researcher and technical adviser in IPT. He worked for 30 years at the Institute.
However, the weakness of the State support and few resources are being recovered. During the 2000s policies were created to encourage the shipping industry such as PROMINP (Mobilization Program of the National Industry of Petroleum and Natural Gas) which aimed to make the production of oil and natural gas as growth opportunities for domestic industry and PROMEF Program (Fleet Modernization and Expansion) (JESUS & Gitahy, 2009).

It is hoped in future to develop more detailed research on the impacts of these technological policies specific to oil and naval industries and their relationships with the research networks and their players, with the objective of mapping the actors and the development of scientific and technological knowledge chain.

REFERENCES


MELLO, Débora Luz. Análise de processos de reorganização de institutos públicos de pesquisa do estado de São Paulo. 2000. 305 f. Tese (Doutorado
em Política Científica e Tecnológica)-Departamento de Política Científica e Tecnológica, Instituto de Geociências, Universidade Estadual de Campinas, Campinas, 2000.


