FUNDAÇÃO GETULIO VARGAS
ESCOLA BRASILEIRA DE ADMINISTRAÇÃO PÚBLICA E DE EMPRESAS
MESTRADO EM ADMINISTRAÇÃO

Open Innovation and the challenges of Human Resource Management

DISSERTAÇÃO APRESENTADA À ESCOLA BRASILEIRA DE ADMINISTRAÇÃO
PÚBLICA E DE EMPRESAS PARA OBTENÇÃO DO GRAU DE MESTRE EM
ADMINISTRAÇÃO

Sabrina Lenz
Rio de Janeiro - 2014

Lenz, Sabrina

Open innovation and the challenges of human resource management / Sabrina Lenz.- 2014.

46 f.

Dissertação (mestrado) – Escola Brasileira de Administração Pública e de Empresas, Centro de Formação Acadêmica e Pesquisa.

Orientador: Flávio Carvalho de Vasconcelos.

Coorientadora: Mônica de Maria Santos Fornitani Pinhanez.

Inclui bibliografia.

1. Desenvolvimento organizacional. 2. Planejamento estratégico. 3. Difusão de inovações. 4. Empresas – Inovações tecnológicas. I. Vasconcelos, Flávio Carvalho de. II. Pinhanez, Mônica de Maria Santos Fornitani. III. Escola Brasileira de Administração Pública e de Empresas. Centro de Formação Acadêmica e Pesquisa. IV. Título.

CDD – 658.4063

SABRINA LENZ

**OPEN INNOVATION AND THE CHALLENGES OF HUMAN RESOURCE
MANAGEMENT**

Dissertação apresentada ao Curso de Mestrado em Administração da Escola Brasileira de Administração Pública e de Empresas para obtenção do grau de Mestre em Administração.

Data da defesa: 22/05/2014

Aprovada em:

ASSINATURA DOS MEMBROS DA BANCA EXAMINADORA

Flávio Carvalho de Vasconcelos
Orientador (a)
Monica de Maria Santos Fornitani Pinhanez
Paulo Roberto de Mendonça Motta
José Vitor Bomtempo Martins

Abstract

This paper considers challenges of Human Resource Management (HRM) in Open Innovation processes. It examines which strategies managers used to overcome these problems in the case of the Brazilian Oil and Gas company Petrobras. By conducting an inductive case study it develops a contextual model based on the use of grounded theory.

It argues that the most important categories were to overcome problems of (a) the interpersonal relationship, (b) power shifting inside the organization, and (c) making people more valuable to the organization and shows how managers tackled these challenges. It contributes with a deep analysis of HRM challenges in Open Innovation that is important for a better understanding of management problems that can come along with Open Innovation processes.

Keywords: Open Innovation; joint research projects; challenges of Human Resource Management; strategies

Resumo

Este artigo leva em consideração os desafios da Gestão de Recursos Humanos (HRM) em processos de Inovação Aberta. São examinadas quais estratégias os gerentes utilizavam para superar esses problemas no caso da companhia brasileira de óleo e gás, Petrobrás. Ao conduzir um indutivo estudo de caso, é desenvolvido um modelo contextual baseado no uso da teoria fundamentada.

Argumenta-se que as categorias mais importantes a serem superadas foram (a) as relações interpessoais, (b) mudança de poder dentro da organização e (c) a valorização dos funcionários pela organização, e é apresentado como os gerentes solucionaram esses problemas. Este artigo contribui com uma análise aprofundada dos desafios da HRM em Inovação Aberta, o que é importante para melhor entender os problemas gerenciais que podem surgir durante os processos de Inovação Aberta.

Palavras chaves: Inovação Aberta; projetos em conjuntos de pesquisa; desafios em HRM; estratégias

Table of Abbreviations

CTO	Comitês Tecnológicos Operacionais
HR	Human Resource
HRM	Human resource management
IP	Intellectual property
IPR	Intellectual property rights
NIH	Not invented here
NOC	National Oil Company
PROCAP	Programa Tecnológico da <i>Petrobras</i> em Sistemas de Exploração em Águas Ultraprofundas
R&D	Research&Development

Table of Figures

Figure 1: <i>The model for dealing with HRM challenges</i>	17
Figure 2: <i>Strategies for dealing with HRM challenges in Open Innovation processes</i>	25

Table of Contents

1. Introduction	1
2. Analytical Framework	4
2.1 Why is Open Innovation so desirable?	4
2.2 Challenges of Open Innovation: The current state of art	6
3. Study	11
3.1 Research Setting: Petrobras	11
3.2 Research design and method	13
3.3 Data gathering	13
3.4 Analytic methods	15
3.5 Results	16
4. Discussion	31
4.1 Concluding remarks	36
References	37

1. Introduction

The analysis of technological learning in organizations has shifted over the last years from its focus on “closed” innovation models (Ahlstrom, 2010; March, 1991; Wyld, 2010; Wyld & Maurin, 2009), which emphasize internal ideas and paths to market, to develop theories in the frame of Open Innovation processes (Teece, 1986; von Hippel, 1988; Chesbrough, 2003b).

According to Chesbrough (2003c), “Open Innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively. [This paradigm] assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they look to advance their technology.” (p. 43).

The paradigm describes ideas that vary from licensing, product platforming and customer inclusion, over innovation networks to joint developments (von Hippel, 1988; Chesbrough, 2003c). In this paper, I will focus on one form of Open Innovation that is joint developments.

Since Rothwell and Zegveld (1985) pioneered the network model of innovation almost 30 years ago, the forthcoming literature on Open Innovation has mainly stressed the benefits of using external sources for innovation processes. During this time, markets have become more accessible through professional networks, computer networks and trade fairs that allow a faster adaptation in high-tech but also in low-tech industries as Chesbrough & Crowther (2006) showed.

In this context, different gains have been addressed. Von Hippel (1988) focuses on economic rents to explain that the manufacturer-as-innovator assumption is too closed for the different categories of innovators in which not only the manufacturer but also the user, supplier or distributor plays a role. Chesbrough (2003b) emphasizes the potential benefits

of intellectual property rights that can be valuable even when they are not used for product development inside the focal firm. For both authors, external knowledge should not just play a supplemental role in innovation but an equal role in Research&Development (R&D). Moreover, they describe ways how firms can create business models that define the creation and capture of value that is created in the open R&D system (e.g., von Hippel, 1988; Chesbrough & Appleyard, 2007).

So far, evolutionary economics that “considers the relation between the exploration of new possibilities and the exploitation of old certainties in organizational learning“ (March, 1991, p. 71) has become the most important stream of strategic management that many researchers have used to analyse knowledge creation in Open Innovation processes (e.g., Chiang & Hung, 2010; Garriga et al., 2013; Laursen & Salter, 2006). This approach defines Open Innovation as a process that systematically encourages and explores a wide range of internal and external sources for innovation opportunities, consciously integrates that exploration within the firm and exploits these opportunities (Cohen and Levinthal, 1990). In this respect, it has been analyzed how external knowledge must be integrated through experiences (Nonaka et al., 2008) and which firm-level capabilities are necessary to successfully explore external knowledge (Lichtenthaler, 2011; Lichtenthaler & Lichtenthaler, 2009). West and Gallagher (2006) go deeper into the analysis of firm capabilities and explain challenges that can occur for the focal firm by applying the concept of Open Innovation. Hence, while these scholars have drawn ways for the challenges of exploiting internal innovation, incorporating external knowledge into internal development and motivating outsiders to supply external innovations, they have rarely addressed the role of the individual for innovation processes and so far to my knowledge, little is known about challenges of human resource management (HRM) throughout these

processes. Following the assumption of Grant (1996) who sees the “primary role of the firm as integrating the specialist knowledge resident in individuals into goods and services” (p. 120), HRM should gain more attention in this discussion.

As various scholars have shown, the role of workplace practices and employees is crucial for innovative companies (e.g. Black & Lynch, 2001; Kaila, 2005). Consequently, companies try to hire the best people or develop their skills and behavior internally. Podmetina et al. (2013) might have designed the only study that addresses the importance of Human Resource (HR) practices in Open Innovation by analyzing how HR practices support Open Innovation and how they influence internal and external openness of the firms. Their central finding is that personnel education is the essential variable for supporting corporate innovation practices. However, what the study cannot explain is how managers mitigate challenges of HRM throughout Open Innovation processes, nor does it show these challenges in context.

This paper concentrates on strategies for dealing with HRM challenges in Open Innovation processes. It analyses which problems emerged frequently in these (joint development) processes and what instruments managers used to mitigate them.

My questions therefore are: Which can be the challenges of HRM in Open Innovation processes? And which strategies could managers use to try to mitigate these challenges?

This research aims to make two contributions to addressing these challenges. It outlines a theoretical framework of the Open Innovation discussion to understand the limitations of the literature. It then illustrates an example of the application of Open Innovation and how

some major challenges have been overcome by examining the Brazilian oil and gas company Petrobras that has extensive experience with Open Innovation attempts (Leite, 2005).

By carrying out an inductive study and using grounded theory, I developed a contextual model of strategies for dealing with HRM challenges. My central finding is that the most important issues in Open Innovation were to overcome problems of (a) the interpersonal relationship, (b) power shifting inside the organization and (c) making people more valuable to the organization. Moreover, managers emphasized that it was not the biggest hurdle when they couldn't find the *best people* on the market for innovation endeavors as long as they were capable of teaching their team members and using mechanisms as described above to nourish creativity and cooperation what stands a bit in contrast to Podmetina et al. (2013).

The paper is organized as follows: Following this introduction, Section 2 presents the analytical framework of Open Innovation and explains the limitations of the literature and the relevance for my Research Questions. Section 3 presents an inductive study that I designed to give answer to my questions. The discussion shows in section 4 how my findings complement or contradict the existing literature on Open Innovation.

2. Analytical Framework

2.1 Why is Open Innovation so desirable?

Understanding the determinants of innovation has been an important source of inquiry in the management and economics literature, encompassing the fields of strategy, organizational theory and organizational behavior science. Among other classical

economists, Schumpeter (1950) has argued that every economical development is based on the process of destruction through a new combination of production factors that are removing old structures. Following the evolutionary theory that sees the market evolution in the three steps of variation, selection and retention, he argues that those who successfully bring innovations on the market gain benefits through temporary monopoly control over their inventions. This market control allows innovators to achieve an enhanced position in their sector and to gain economic rents from their innovations. Consequently, capitalism can be understood as an evolutionary process of continuous innovation (Ahuja et al., 2008). According to this theory, a firm must innovate and possibly take economic advantage of innovation to maintain sustainable advantage. Assuming that firms are motivated by a rent they consider as attractive, companies have historically invested great amounts of money into R&D to meet new market needs and to try to create sustainable growth through innovation (von Hippel, 1988). Under the concept of innovation that prevailed during most of the 20th century, companies were in general seeking for competitive advantage by funding large research laboratories that developed superior technologies for new products. This concept meant that firms that could not afford such labs were at a disadvantage (Cohen et al., 2002). The Open Innovation literature suggests that firms should enhance their abilities to use external knowledge instead of solely conducting basic research with their own capital in order to combine internal and external ideas to create new knowledge (e.g., Rosenberg and Steinmueller, 1988; West and Gallagher, 2006, Chesbrough, 2003a, von Hippel, 1988). The options of Open Innovation range from licensing, product platforming and customer inclusion, over joint developments to innovation networks (von Hippel, 1988; Chesbrough, 2003c).

The suggestion is that firms should not entirely rely on their own R&D but also use external paths to innovations and markets. The platform *Eclipse* by IBM, for example, has

shown how competing firms can come together to cooperate and to develop an open source software that member organizations can use to build products and services for their customers (Eclipse, 2013).

Chesbrough (2003c) uses firm competition examples to illustrate how the paradigm can be framed. In one case, two firms of the telecommunication industry, Lucent Technology and Cisco System, drove very distinctive strategies in the 1990s. While Lucent focused on seeking for fundamental discoveries to develop future generations of products and services in-house, Cisco used opportunities of partnering or investing into growing start-ups and found in this strategy a more efficient way to balance its research investments with its R&D outputs. In another case, Chesbrough (2003c) shows how established pharmaceutical firms had to face growing competitiveness of start-ups who took advantage of the research discoveries of others.

Although these specific assumptions have been widely supported by high-tech industries, Chesbrough and Crowther (2006) could also show benefits of Open Innovation for low-tech industries. To support their proposal, the authors compared data from different firms about their engagements in licensing, acquisitions and joint developments.

Summing up, firms may gain various benefits, ranging from monetary benefits (e.g. licensing revenues) to non-monetary benefits (e.g. achieving access to external technology know-how through cross-licensing) but they may also face challenges during this endeavor in various aspects (Gassmann, 2006; Grindley & Teece, 1997).

2.2 Challenges of Open Innovation: The current state of art

While Open Innovation has gained greater attention for its potential benefits, many firms and even the successful firms have faced various challenges in managing these processes

(Chesbrough, 2007) but only a few authors have systematically analyzed these challenges and possible solutions. One article that addresses the challenge of reaching high utility of R&D in Open Innovation processes was written by West and Gallagher (2006). Following the definition of Cohen and Levinthal (1990), they identify three challenges that can occur by encouraging and exploring a wide range of internal and external sources for innovation opportunities, integrating that exploration within the firm and exploiting these opportunities.

First, they explain the challenge of maximizing returns to internal innovation. It means that companies do not only need to find ways to nourish their product lines, but also need to outbound licenses of IP or offer technologies to stimulate the demand for other products. As one strategy, they show how a software company established research labs near university research groups to exchange information in both directions. This helped the company to recruit the best academic researchers to help to commercialize an innovation and to maximize returns to internal innovation.

Second, they describe the challenge of identifying and incorporating external knowledge into the firm's assets. As long as the firm does not understand external knowledge it will not provide any benefits to its R&D. In other words, exploration only makes sense when the organization knows how to exploit the innovation and the knowledge (March, 1991). This requires to develop an "absorptive capacity" (Zahra and George, 2002, p. 128) which is defined as the ability to detect new ideas and to integrate them into the organization's processes and the political willingness of the firm: The key is here to bear down the refusal of the 'not invented here' (NIH) –syndrome that means the unwillingness to adopt an idea because it comes from an external source (Katz & Allen, 1985).

Third, West and Gallagher (2006) note that a firm has to understand how it can motivate external sources to contribute to their intellectual property (IP) in order to hold up the external innovation streams. They argue that this motivation increases when the innovation either benefits the innovator (e.g., when customers share their innovations with manufacturers to improve the products) or when firms in the same sector can complement each other in market creation but compete in market division (Brandenburger and Nalebuff, 1996).

Another work that addresses the challenge to maximize the utility of R&D was written by Lichtenthaler (2011). He points to the process-based understanding of Open Innovation and links the term to the framework of knowledge management, organizational learning, and firm boundaries. He distinguishes three processes to achieve an integrated approach to manage knowledge in the context of Open Innovation processes: knowledge exploration, retention, and exploitation – processes, which can be organized internally (within a firm's boundary) or externally (together with external partners). He argues that firms need to develop organizational capabilities at the firm level to effectively manage these processes. He also sees one main hurdle in the NIH-syndrome and explains how Proctor & Gamble could successfully encourage individual employees to rethink this attitude by convincing them about the benefits of external knowledge retention. Elsewhere, he explains which capacities firms need to develop to handle their transaction costs. The author particularly analyses different capacities which can help to implement Open Innovation processes.

However, neither West and Gallagher (2006) nor Lichtenthaler (2011) give answer to the question how firms can organize and motivate their personnel throughout time and which

instruments they could use to improve their human resource management for successfully exploring and exploiting internal and external knowledge.

The importance of human resource management for the discussion of Open Innovation can be explained by Grant (1996) who argues from a knowledge-based view (KBV) that the main role of the firm is the integration of the knowledge that is residing within individuals at the firm. By rather applying individuals' knowledge than creating knowledge, the responsibility of the firm is to develop an environment in which individuals can integrate their knowledge and improve the firm's competitive position. In order to successfully integrate knowledge he points to Demsetz (1991) who emphasizes *direction* as the principal mean by which individuals can communicate their knowledge, and to March and Simon (1958) who suggest *organizational routines* to facilitate patterns of interaction between individuals and the communication of their knowledge.

For the continuing discussion of the relevance of human resource management I will use the definition by Torrington et al. (2002) who see personnel management as „a series of activities which: first enable working people and their employing organizations to agree about the objectives and nature of their working relationship and, secondly, ensure that the agreement is fulfilled.“ (Kaila, 2005; p. 14).

It further includes:

- „All the decisions, strategies, factors, principles, operations, practices, functions, activities and methods related to the management of people as employees in any type of organisation [...];
- All the dimensions related to people in their employment relationships, and all the dynamics that flow from it (including in the realisation of the potential of

individual employees in terms of their aspirations);

- All aimed at adding value to the delivery of goods and services, as well as to the quality of work life for employees, and hence helping to ensure continuous organisational success in transformative environment“ (Kaila, 2005, p. 14).

Podmetina et al. (2013) made a first attempt to bring Open Innovation into discussion with HR and analyzed in a quantitative study of 158 Russian innovating companies, how the personnel of an organization might influence the internal openness (= the level of collaboration and knowledge sharing between employees and teams) and external openness (=cooperation and technology sourcing) of a firm. By collecting preexisting categories of HR practices such as motivation, learning, training, and appreciation of human capital value, they suggest that personnel education seems to be the most significant variable to influence internal openness and external openness of the firm.

Although the study is an interesting start for the analysis of HR practices in Open Innovation, it limits a deep understanding of the use of these practices as a tool to mitigate challenges in Open Innovation processes that occur between employees of two partner firms. Additionally, the authors use preexisting variables of HR practices from the literature to test them in a quantitative study, which limits the possibility of the emergence of other practices that managers might find relevant:

For example, the literature of innovation management inside firms puts also the matter of trust, creativity and the importance of team leadership skills up to discussion (e.g., Lester & Piore, 2004; Catmull, 2008) or underlines the relevance of social structures in interfirm networks and their influence on fine-grained information transfer and informal joint-problem solving arrangements between employees of an organization (Uzzi, 1997). How

this and other emerging variables might influence HRM will shed more light on Open Innovation processes.

By focusing on joint developments as one outreach of Open Innovation processes, my research questions are: **Which can be the challenges of HRM in Open Innovation processes? And which strategies could managers use to try to mitigate these challenges?**

3. Study

3.1 Research Setting: Petrobras

Petrobras stands out as a noticeable successful National Oil Company (NOC). When it was created in 1954, there were no meaningful oil reserves found yet and the company relied on fiscal subsidies for the first 20 years. By using R&D operations to a much greater degree than most of other NOCs and with long term partnership strategies, the company worked hard to become one of the world leaders in deep sea oil exploitation and production and succeeded to become one of the world's biggest oil companies along the deregulation process between 1995 and 2008. It had its turning point after the discovery of the "pre-salt" in 2007, a geological formation off the coast where oil and gas lie below an approximately 2000 m deep layer of salt. Although the domestic monopoly was removed in 1997, Petrobras kept a de facto monopoly in the Brazilian market. This resulted from political interests. Petrobras is seen as a hybrid of corporate governance, public administration and regulation. It is characterized by a unified organization of state actors having authority over the company, a monitoring-heavy oversight mechanism and strongly law-based mechanisms (Hults et al., 2012).

The development of networks with universities, research institutes, oil companies or suppliers for R&D purposes has strongly increased over the last 30 years and these partners have become important entities for technology inventions, which was mainly supported by Petrobras' Research and Development Center Leopoldo Américo Miguez de Mello (CENPES) that was created in 1963 (Morais, 2013). Since its beginning, CENPES focused on identifying, selecting and developing partnerships that could contribute to Petrobras' strategical goals and to aggregate complementing competencies inside and outside the company. The operational technological committee (CTO), for example, identifies strategically promising firms or professionals what von Hippel (1988) would call *Lead Users* who „face needs that will be general in a marketplace, but they face them months or years before the bulk of that marketplace encounters them. Lead users are positioned to benefit significantly by obtaining a solution to those needs“ (von Hippel, 1988, p. 107). CENPES integrates them once a year into a process called „CTO on-line“ in which experts from outside and inside Petrobras can give preliminary project proposals which are subsequently analyzed and evaluated based on criteria such as competitiveness, innovation, environmental impact and operational security (Leite, 2005).

Another big project that was mainly based on partnerships was called PROCAP, a project of a pilot trial to develop a subsea pumping system and a subsea metering system. It was launched in three successive editions from 1986 to 2011 and had its main period between 1992 and 2009. During this time, it integrated about 80 institutions among which were 50 Brazilian organizations and 30 international organizations to conduct about 4000 research projects to explore deepwater subsea equipments (Instituto de Pesquisa Econômica Aplicada [IPEA], 2013). Throughout this program, Petrobras showed the capability to develop the national market through the transfer of technologies and knowledge to suppliers in order to create new technologies which were highly complex.

In another attempt, Petrobras initiated the thematic networks in 2006 to integrate universities and research institutes from Brazil into the company's R&D. For this project, it has introduced 49 thematic strategies in the fields of exploration, production and refinery by including about 100 institutions (IPEA, 2013).

Based on the long history of Open Innovation experience, I suggest that Petrobras provides a strategic research site (Merton, 1987) to analyze the questions above.

3.2 Research design and method

The decision for a single case study centered on Petrobras stemmed from three different reasons. First, in order to deepen the exploratory research it was important to obtain as many details of a case as possible while also limiting the variability in other factors. That concluded to the selection of a few or even only one case study firm (Eisenhardt & Graebner, 2007). Second, it was important for the question *how* managers mitigate challenges of HRM in Open Innovation processes that the selected firm(s) had reasonable experience with Open Innovation over some period. Many publications by the company were an indicator that Petrobras fulfilled this requirement (e.g., Barbosa, 2013; Leite, 2005). Third, the case study firm needed to show enough operational practices what initial work with the company also highlighted.

3.3 Data gathering

To study the challenges of HRM in Open Innovation and the strategies that managers of Petrobras used to try to mitigate these challenges, I designed an inductive study that followed the interpretive approach that is concerned with meaning and seeks to understand peoples' definition of a situation (Schwandt, 1994). It assumes that knowledge and

meaning are results of interpretation and that there is no objective knowledge that is independent from understanding and reasoning (Gephart, 1999).

To explore my research question, I selected 10 managers mainly from the executive managerial level since top managers have usually key finding roles (Bennis & Nanus, 1985). With the inductive approach I tried to keep up consistency with my research objectives and predominant methodology for management field research (Edmundson & McManus, 2007). With each manager I conducted one or two semistructured interviews two to one and on average two and a half hours long. For a better contextualisation and understanding, another researcher accompanied me to the interviews.

Not all of the managers were still working at Petrobras. A few of them had already been retired from the company, however, each of them had either left the organization not more than five years ago or had at least been working for 30 years for Petrobras so that they still had strong memories about HRM in the company. Tenures among all managers varied from 10 to 40 years. The functional areas represented were exploration & production, R&D, refinery, and HR.

At the beginning of each interview, we collected data about managers' career histories, experiences and perceptions of the technological trajectory and operating values of the company. Then, we asked the managers to describe partnerships and Open Innovation processes that they had accompanied during their work. The purpose was to get a contextual point of view to make the descriptions comparable since Open Innovation and partnerships are two terms which encompass a wide variety of definitions. We then asked questions to get rich details and descriptions to learn more about HRM in Open Innovation processes (e.g., "How would you value the importance of partnerships for Petrobras to enforce innovations?", "Can you describe major internal and external challenges during

Open Innovation processes?”, “How could you overcome these challenges in joint development projects?”).

We used snowball sampling from those who we did the interviews with to get more contacts and a broader view of Petrobras’ Open Innovation endeavors and internal organization. We also audio recorded each interview for further transcription and qualitative data analysis.

The goal of the data collection was to understand the managers’ experiences in context and the relevance of HRM in Open Innovation. Therefore, rather than suggesting ideas, I tried to understand and to clarify the meanings and underlying messages of each interview. This also implied to compare and to accomplish my findings with written documents of the firm such as press releases, annual firm reports and interviews published by the program „Memória Petrobras“ that gathers together experiences of former top managers (Memoria, 2013).

3.4 Analytic methods

The analysis followed the grounded theory approach by Corbin and Strauss (1996). This methodology sees the data analysis process at the core and coding as the „fundamental analytic process used by the researcher“ (Corbin & Strauss, 1996, p. 56). According to the authors’ advice, data analysis followed the three steps of open coding, axial coding and selective coding. Simultaneously, data and theory were permanently compared throughout the data collection and analysis process. During the data collection phase at Petrobras, notes on the facts, details, and other information nourished the evolving theory as did ideas and debriefings exchanged with my research partner. In addition, I used other basic grounded theory guidelines such as memo-writing, and comparative methods.

The first step to start with the analysis was to use open coding to identify concepts and

properties of a large section of my field notes through comparative analysis. The guiding research questions were simple at this early stage: How did interviewees perceive Petrobras' innovation endeavors? How is the company positioned in the Brazilian market? How did people in the company think about management skills? How did they perceive benefits from partnerships? What challenges did they face as an organization?

By continuing this procedure of constant comparison, I established a „core category“ (Corbin & Strauss, 1996, p. 103) which is a category that integrates all other categories. I named this core category *strategies for dealing with HRM challenges*. Then I used „theoretical memos“ (Corbin & Strauss, 1996, p. 117) which represented emerging ideas about categories and how they are related to each other.

3.5 Results

The grounded theory model for dealing with HRM challenges, evolving from Strauss and Corbin's (1996) methodology and developed from this study is presented in Figure 1.

Causal Conditions of HRM challenges in Open Innovation processes

Two types of causal conditions emerged from the data that had a triggering effect for the discussion of Open Innovation and HRM challenges: The first was (a) the understanding that Open Innovation happens in the *ecosystem* of a firm's network what managers defined as an organization's interdependence from its entities and environment that evolves over time and space. The second condition derived from this observation and stated that (b) the decision to open up internal innovation processes was necessary for the acquisition of know-how outside the firm and the development of technologies what supports the reasoning that we saw in Chesbrough (2003a). These statements made clear that managers

understood Petrobras not as a stand-alone firm in spite of the monopoly position that Petrobras de facto holds until today (Hults et al., 2012) but as a firm with certain needs that can only be satisfied in interaction and hence, forced participants in the above described projects to look outside the firm for the knowledge they needed.

Figure 1: The model for dealing with HRM challenges

HRM challenges resulting from opening up the innovation processes and the use of the ecosystem

Along with the ecosystem of a network and the decision to open-up the internal innovation process came along challenges in various dimensions.

Through the use of grounded theory emerged the fact that the most emphasized challenges of Open Innovation processes were those in HRM. By using axial coding in which codes are analyzed, contrasted and related to each other, three categories emerged in the face of HRM: (a) The challenge to improve the interpersonal relationship of people, (b) the challenge of power shifting inside the organization, and (c) the challenge to make people more valuable to the organization.

The challenge of the first category, **the relationship of people**, was expressed, for example, as follows by a manager working with PROCAP:

The most important point in the evolution of a program is the interpersonal relationship. Making people to approach and to get along with each other. Because a network is nothing rational. A network influences emotions.¹

Subsequently throughout the interviews, attention was paid to anything that was related to the terms *relationship* or factors that could influence *emotions*. The most repetitive value that came up was the matter of trust. Especially at the beginning of Open Innovation projects, managers faced difficulties with a lack of trust among the participants of a project from inside and outside of Petrobras. The reason for this problem was described from two perspectives. First, team members expressed concerns about intellectual property and the unknown practices that would take place in future. This often resulted in mistrust towards Open Innovation and into conflicts about the question, who would take any kind of risks that came up during the R&D projects, be it of technological or personnel nature. These concerns were congruent with Williamson (1985) who explained that the cause of high transaction costs is usually uncertainty and mistrust why organizations need a specification

¹ Note: All literal reports of interview speeches were translated from Portuguese by the author.

of exclusive rights over the innovative design such as restricted access or non-competitive agreements.

The second reason for a lack of trust that was not so easy to solve by contracts was the interpersonal relationship side. Since most of the times team members didn't know each other well they had to build up personal confidence over time. In this regard, also the matter of sympathy between participants was emphasized, as one manager who was working with the thematic networks explained:

University A and university B, let's exchange information, not as legal entities or companies but as professor A and professor B. And I need continuance; I need that both like each other because air is not a channel of communication. This is very disregarded in organizations. There is this mechanical vision of regulation procedures, norms and contracts [...] but this is the consequence of the relationship. The cause is the comprehension between people [...].

Thus, sympathy seemed to be highly important for good communication. Another variable that influenced the communication and interpersonal relationships was the different background of rules and organizational familiarities of people. Although March and Simon (1958) could show that organizational routines help to facilitate interactions and communication between individuals, these routines seemed to become critical in the interaction between employees from different firms where everybody brought in his organizational language and organizational identity that had been shaped before. The lack of understanding, trust, and sympathy often led to a lack of motivation to comply throughout the process when interventions didn't go in the right direction.

The second category, **power shifting inside the organization**, was strongly correlated to the difficulties of internal integration. As one manager stated:

You have the impression that the external cooperation is more difficult but it's internal. Because externally, the notion of mutual benefits is much more clear.

The cause of this lack of internal cooperation was by several managers explained by conflicts coming from internal competition, prestige or jealousy. In the phases when managers decided to open up Petrobras' internal processes, they did not only have to define challenges and goals for the partnerships but they also had to define new roles and responsibilities of participants. The creation of interdisciplinary groups with people from inside and outside the company entailed the challenge to assign every participant to a specific task which sometimes meant that he wouldn't have the expected responsibilities he would usually have in his original department or firm. Struggles that evolved from this power shifting often resulted into individualistic behavior although collectivity was needed to achieve a goal together in a team. Another problem arose from paternalistic or even condescending behavior of one team over the other in interdisciplinary projects. Consequently, members of these teams often felt a lack of respect and appreciation by facing this kind of interaction.

The third category, **the challenge to make people more valuable to the project**, stemmed mainly from the fact that partners often had different interests or perceptions about priorities of an R&D project. This problem was particularly perceived in projects within the thematic networks, as one manager who worked at the executive level of the network, said:

When you have a partnership between a company and a university, you have two different natures. Usually, a university wouldn't be too worried about time and deadlines and say: „The company is very superficial, it only wants to know things for tomorrow.“

The problem of delays and different interests was echoed along the interviews. Many respondents linked this confusion also to a lack of clear definition of goals what in turn led to conflicting R&D outcomes as another manager from the thematic networks stated:

We have a network, we have universities, but they are sometimes not working as a network. So we need a hard disk. USP is developing one hard disk, PUC is developing one and then in the end they are fighting about the same resources.

In this case, while a project was expected to deliver complementary outcomes, partners turned to be competitors when the results were overlapping.

Another big problem was seen in goals that turned out being unrealizable. Managers repeated that one of the main consequences of this was often frustration among participants in their teams. Hence, they had problems to keep up their motivation and to create value, be it in form of new technologies or ideas. Sometimes, the goals could have also been too ambitious because of a lack of capacities among their partners, whose knowledge was not on a level they could contribute with or they faced an internal misfit with external technologies. Hence, the problems of exploitation and exploration as having been discussed by Lichtenthaler & Lichtenthaler (2009) or West and Gallagher (2006) were also relevant for the issue of HRM.

In the last point, managers discussed a lack of value creation with the lack of creativity.

Creativity that was supposed to form and discuss ideas was often compromised by misunderstandings, disagreements or disappointments about unreachable goals. As a result, employees became unmotivated or even frustrated.

Context in which strategies for dealing with HRM challenges in Open Innovation processes developed

Strategies for dealing with HRM challenges in Open Innovation processes were developed in response to managers' observations of participants' needs and requests. These strategies were influenced by particular circumstances. The first was (a) the quality of partnerships. Partnerships that were based on a long history of personal contacts and strong ties usually facilitated cooperation between participants inside and outside of Petrobras. Managers even spoke of partnerships they initiated with *friends* they had worked with many times before. Consequently, partnerships without this kind of tradition usually increased the three levels of HRM challenges described above and needed more treatment. The second contextual variable, (b) the type of partner – whether from other firms or from universities, also had an impact on the interaction. Members from universities were often regarded with more skepticism and the cooperation was sometimes more complicated because of bigger organizational culture and value differences.

The last contextual marker was (c) the availability of professionals. While the R&D projects were technically highly demanding, it was not possible to always get the best people for every team which influenced the form of acquisition and the matter of human resource development.

Intervening conditions influencing the strategies for dealing with HRM challenges

Besides the contextual markers, intervening conditions shaped the strategies for dealing with HRM challenges. These conditions included (a) market dynamics in a way that, for example, managers had to face situations in which supply firms that had established research teams with Petrobras either went bankrupt or got purchased by foreign firms so that new people had to be found and integrated into Open Innovation projects.

Another condition was (b) turnovers by people from inside or outside of Petrobras who had been responsible for certain tasks in Open Innovation processes and left a job vacancy behind their dismissal that needed to be filled. The third condition included (c) political decisions that turned out being relevant for my findings of the 30 years of Open Innovation projects I was looking at. The most important impact was mainly seen in the decision to terminate Petrobras' monopoly that was accompanied by a growing market competition and market development and hence, stronger concerns about intellectual property rights (IPR) and contractual terms among team members of joint research projects.

Strategies for dealing with HRM challenges in Open Innovation processes

Taking into account the contextual and intervening conditions, three core strategies evolved in response to the HRM challenges described above. (1) Managers learned how to improve interpersonal relationships, (2) they developed mechanisms to balance power, and (3) they made people more valuable to the organization.

The elements of each core strategy are outlined in Figure 2.

Improving interpersonal relationships. The successful integration of people from inside and outside Petrobras depended a lot on emotions and dynamics such as trust, confidence, sympathy, communication and motivation.

The data revealed that one paramount requirement for successful Open Innovation processes were (a) management interpersonal skills. Respondents echoed that subtlety of managers to understand and to identify a way to influence emotions such as trust and sympathy and tools for clear communication and motivation was crucial. Therefore, they trained project managers with the help of mediators and psychologists to better understand individual needs and interpersonal dynamics. In order to enhance interpersonal trust, managers put greater focus on the (b) clear definition and communication of IPR. One interviewee admitted that at the beginning of PROCAP, concerns about IPR were not very strong since most of the partnerships were based on personal relationships and hence on a higher level of confidence. But with time and an increasing network, the concerns and contracts became more clear:

PROCAP was created based on strong agreement with friends. At the beginning, contractual clauses about intellectual property rights were of minor matter. But after twenty years this had become something more consistent. The more open, the more you need the intellectual treatment. Nowadays, Petrobras is much better off, it has very clear networks and very clear contract models.

Apparently, embedded ties between firms influenced the level of expectations of fairness and increased the level of trust. While Petrobras could use these strong ties to avoid high levels of control, credible commitments became more important for the partnerships with firms they had loose ties with (Uzzi, 1997).

For the relationship side of trust, it became a routine of each Open Innovation project to arrange (c) informal initial meetings with the participants of a research team and to use mediators with experiences in group creation for the treatment of confidence and sympathy among people. For the later discussed importance of value creation, managers said that it was important in these meetings to create trust upon a level, that managers would not only develop their own ideas but that they would also disagree with each other to achieve better results.

Continuing meetings in form of (d) workshops throughout the projects helped to relate the professional to the interpersonal relationship and to develop a team spirit by sharing experiences, opinions and ideas. Throughout these workshops, members created new rules for interaction and their own *language*. Hence, communication turned out being an important variable for identification with the project and peoples' motivation to discuss their ideas.

Figure 2: Strategies for dealing with HRM challenges in Open Innovation processes

Finding power balance. The successful balance of power was mainly dominated by a high level of cooperation, integration and respect among participants.

Regarding these goals, four main strategies were developed. Participants explained that one important value of gaining employees' commitment inside and outside the organization was the perception of (a) mutual benefits or a win-win situation. For this purpose, it was fundamental to integrate participants from each team into the decision making process about goals and challenges that the working groups would have to reach. Managers agreed that the integration from the bottom up was the most helpful tool for sustainable commitment. In case it wasn't possible to integrate everybody into this phase, a high level of communication and information about the mutual benefits was at least necessary to convince every member. However, external commitment by team members from outside the company was much harder to reach when departments inside the organization lacked commitment for interdisciplinary projects. I saw common agreement that it was crucial to reach (b) internal discipline among all departments (e.g. production, exploration or purchasing department) that would be involved in order to obtain external power. One manager from PROCAP used the comparison to Galbraith (1983) to explain the importance of discipline inside the organization to achieve external commitment:

You know the theses of Galbraith. About bimodal symmetry. When an organization wants to implement a model outside of itself, it needs to practice these models inside the organization. A symmetry. So, in the conceptualization of the program you need to feel cooperation outside and inside. [...] But the internal cooperation is not always very easy. It struggles with questions of power and prestige, things of human beings.

Another element for the integration of teams was (c) to give up on managerial power to get integration power. For this strategy, interviewees highlighted that finding a balance between being a *manager* (that was described as the functional role to implement and execute projects) and *being a leader* (that was seen as the emotional role to obtain cooperation and motivation from team members). One step to get there was the installation of mediators from outside the company who would work on people's interaction with each other to find a certain level of personal integration. Another decision was to democratize the decision making process about innovation goals and intermediate steps and to give up on a top-down decision making at the same moment. The third marker of this mechanism was found in the next point, (d) the use of a „matrixialized“ evolution of responsibilities and positions among team members. This strategy followed the concept of installing a matrix for an R&D project and waiting for its *self-construction*, as two managers of PROCAP explained. The purpose of a matrix organization is usually to combine both, project delivery and organization while the company establishes a set of horizontal project groups over their traditional vertical functional departments. In such a structure, many employees would work both under a department head and a project manager of an interdisciplinary team. This crossing of organizational lines is represented by a grid that would usually define roles and responsibilities from the moment of a matrix implementation. It is often used as a project matrix in which the functional manager's authority is the smallest and his main role would be to provide technology and consultation, while the project manager is in charge of overseeing and completing the project. This often leads to confusion and rivalries about roles and responsibilities, especially between functional managers leading design teams and project managers controlling project performance (Kuprenas, 2003). Despite what is technically described in the literature, Petrobras used a more dynamic evolution by which these roles and functions

were defined over time by participants themselves. As one manager explained:

A matrix depends on people and their conviction of a matrix. The matrix depends on people and their belief that the matrix is a solution. They want this conviction for the practice. Plant the grass and after this wait that people grow and find a way [...] the matrix is an evolutionary process.

In this sense, managers aimed to obtain a more intrinsic commitment by their employees and decided to let them define their roles instead of making this decision top down. Surely, the strategy was different when it came to the personnel decision of the project manager who was usually selected at the beginning. This included the last important point, (e) the attempt to avoid paternalistic or condescending behavior. For this achievement, it became important to choose a project manager for interdisciplinary teams who would have high interpersonal skills and wouldn't be a specialist in one field to avoid polarized opinions. Instead, projects were much more successful, when the manager was a generalist with a broad perspective of all integrated fields and would meet his team members with respect and appreciation for their ideas and tasks.

Making people more valuable to the organization. In addition to strategies to find a power balance and to improve the relationships between people in a team, strategies to make the team's personnel more valuable to the organization had to be developed.

The degree of people's value to an organization mainly depended on their interest in Open Innovation outcomes, on the control to ensure the planned outcomes of projects, the feasibility of goals, the capacities of people and their level of creativity.

In response to these challenges, managers used four strategies. The first strategy was to (a)

integrate people who think of the same challenge. This strategy would, again, start from the bottom up, by defining goals before creating a team. What would be important to achieve? Which outcome would be a win-win situation for both partners? After having integrated the team, this discussion and definition would have to be done again. In the second phase, managers agreed that it is important to (b) control the operation of Open Innovation projects. One manager from the thematic network argued:

When we developed these networks the guy from the commission said: “Oh we don’t need that [control], we have good people and good professors, they will have control over the networks.” But you know, human being does not work like that, it’s a strong animal, they don’t think about collectivity, normally they think of themselves.

The problem of individualistic and collective behavior in teams was often iterated in the interviews. Managers also reassured that they needed control even though they had competent and ambitious employees in their teams. To obtain more control, managers used different instruments. In the case of PROCAP, managers installed one commission at the executive and another one at the technical level to guarantee a permanent flow of information and scale effects. Another measure was the implementation of audits that could control the documentation of every R&D project. Further, R&D projects with a high number of people were split into smaller groups to enable a central control by one supervisor in each unit. A more sophisticated instrument was the anticipation of problems. For this purpose, managers needed to use their own personal experiences or the know-how of superintendents of CENPES and a clear documentation about critical incidents that occurred throughout the projects. One manager of PROCAP explained it like this:

You feel when a project manager has difficulties to coordinate people, to identify problems or when he lacks experience. You have to understand that it won't work out like that. Sometimes you have to change the project entirely.

Thus, control also meant an evaluation of projects and a modification of their goals to a level which would be reachable for project managers and their teams. One communication tool were *news letters* for the staff of each project group that managers especially used at the beginning of PROCAP to illustrate current achievements and obstacles.

Another strategy was (c) to upgrade people's capacities outside and inside the company upon to a level Petrobras could use for innovation processes. After the collapse of the oil price in 1986 and the need to reduce costs for R&D, Petrobras had on the one hand to develop a research tradition inside the company and on the other hand, to look intensively for capabilities outside the firm and to go for new options (Dantas & Bell, 2011). Since the national market has since been under development, the dogma was to look systematically for supply firms which showed potential capabilities that Petrobras could develop upon a level to use the upgraded external capabilities for Open Innovation processes. This management culture implied an interaction with supply firms that went beyond the contractual terms. People with expertise from Petrobras and supply firms up-dated each other about new technologies and through this learning process they could establish an environment in which innovations could be realised with professionals from these companies.

The last strategy was (d) to nourish creativity. For this endeavor, managers hired mediators with sufficient experience in creative group building for the initial phase of team construction. Throughout the project, they continued conducting interdisciplinary

workshops to gain different ideas and to lead projects into the right direction. It was also very relevant to maintain people's motivation by appreciating even small achievements and rewarding people.

Consequences of Strategies for dealing with HRM challenges

The strategies used by managers were not without consequences. In any case, they influenced the innovation dynamics and team dynamics. When successfully used, the strategies could breed incremental or even radical innovations for the initially defined field. These innovations helped to develop the national market and Petrobras' supply chain (Dantas & Bell, 2011). When the strategies were used less successfully, R&D endeavors sometimes only resulted into research without an important value for the market, or the results had only value for related fields of the initially defined area.

4. Discussion

This study is distinctive in its systematic analysis of strategies for dealing with HRM challenges in Open Innovation processes. The model established a coherent framework for understanding the challenges of HRM in context. The transferability of this theoretical model for dealing with challenges of HRM challenges can take place as the results are put in different Open Innovation context.

Because this research was carried out inductively without imposing preexisting categories on the data, one important contribution emerged: while many authors emphasize the challenge of exploitation and exploration for successful Open Innovation processes (i.e. West & Gallagher, 2006; Lichtenthaler, 2011; Lichtenthaler & Lichtenthaler, 2009,

Garriga et al., 2013) and Podmetina et al. (2013) argued that the personnel education is the essential variable for supporting corporate innovation practices, I found that the most important issues in Open Innovation processes were to overcome problems of (a) the interpersonal relationship, (b) power shifting inside the organization and (c) making people more valuable to the organization. Moreover, managers emphasized that it was not the biggest obstacle when they couldn't find the *best people* on the market for innovation endeavors as long as they were capable of teaching and developing their team members and using mechanisms as described above to nourish creativity and cooperation.

Furthermore, some other findings caught attention by comparing them to the literature of related fields.

The findings indicated that trust was split in two dimensions. The contractual side of trust has been addressed by many researchers, who have described how contracts and control can decrease mistrust in collaborations between transaction partners. In this respect, Williamson (1985) suggested contracts and accountants for transfers and compensations and Sabel (2004) showed, that one helpful tool is learning by monitoring to reduce the risks to collaborators of exploitation by their partners. The second dimension of trust is explained by research that has shown that personal ties in network relationships can increase trust and reduce monitoring costs. Here, trust is more guided by a social process and is reproduced in social structures throughout time until a „basis for fine-grained information transfer and joint problem solving is set in place“ (Uzzi, 1997, p. 45). It goes beyond the economic exchange and depends on a multiplex relationship between partners. Petrobras worked on both, the contractual and interpersonal relationship to gain trust, to improve communication and to obtain commitment. For the interpersonal relationship side,

they also made use of mediation services, as for example suggested by Schrank & Whitford (2011) and they installed workshops that continued throughout the process to establish confidence, sympathy and a common identity with the team to ensure a basis for joint projects. While some authors have addressed trust only in face of the NIH-syndrome in Open Innovation (e.g., Katz & Allen, 1985; Lichtenthaler, 2011), the findings in this study shed more light on how trust can be distinguished and enhanced throughout the process.

Another interesting finding was the use of a matrix as an evolutionary tool. Instead of defining horizontal and vertical lines of responsibility at the moment of a matrix implementation that could have provoked arguments and competition, managers decided to step back from their executive position and succeeded to gain an intrinsic commitment by people who could take time to understand the advantage of a matrix organization and identify themselves with a role that could be negotiated with their team members. Hence, managers gave up on power to get integration power that was surely not easy at first sight since managers would usually rather compete for responsibility (Kuprenas, 2003).

In the discussion about value creation was interesting to see that managers became aware of the importance of decision-making from the bottom up to guarantee that team members would share common challenges. From their description, Petrobras' strategies can be compared to Lester and Piore (2004) who advocate against the widely proclaimed idea of rational problem solving that management pedagogy should emphasize the interpretive art of problem definition for innovation success. They explain two antithetical ways of thinking; one is the interpretive process which tends to be open ended and self-driven. This approach suspends formal decision-making rules and encourages open communication across organizational boundaries. The other side is the analytical process that focuses on

the realization of projects and regulatory procedures. The authors claim that both sides must be used for the definition of a project and for its realization. But while they are emphasizing the interpretive side of innovation processes, they also admit that integration of people is the central organizing problem. Petrobras managed to tackle this challenge well by defining goals with the participation of team members and to evaluate these goals in collaboration on a regular base. Thus, open communication combined with monitoring could help to achieve their goals.

The capability to upgrade people's capacity inside and outside the company was also interesting compared to the literature.

Dantas & Bell (2011) designed a dynamic study, which showed how Petrobras' internal capabilities interacted and developed with its knowledge networks over time. The main period when managers of Petrobras started to pursue network development with the intention to increase corporate learning and to seek relationships with suppliers and other organizations started in the middle of 1980s, provoked by the collapse of oil prices in 1986 and the need to reduce costs for the technological development toward deeper waters. The opportunities through Open Innovation were seen as a chance to tackle this challenge. In that period, which Dantas & Bell (2011) define as „Active Learning Networks“ (Dantas & Bell, 2011, p. 1573), managers from Petrobras started to participate in arrangements with partners whereby they learned from partners to develop more complex technologies. The later period from 1992-1996 was called „Strategic Innovation Networks“ (Dantas & Bell, 2011, p. 1575) and represents a phase in which Petrobras started to use not only unidirectional and bidirectional flows from partners but also unidirectional flows of complex technological knowledge from Petrobras to partners. Especially the last period shows the national developmental obligations Petrobras had to fulfill as it was assigned by

the government (IPEA, 2013): by transferring technologies and knowledge to suppliers, the company helped to build capabilities among the supply chain. But the support took even a greater outreach than was described in this case study: Petrobras looked systematically for supply firms which showed potential capabilities that Petrobras could develop upon a level to use their capabilities and personnel for Open Innovation processes.

Thus, whereas the Open Innovation literature (i.e., Chesbrough and Crowther, 2006; Garriga et al., 2013) suggested to look for knowledge outside the company to develop a technology in cooperation, Petrobras' strategy was first, to upgrade the capacities of another firm for being eventually able to enter into a joint R&D project with its engineers. Petrobras therefore extended the definition of „absorptive capacity“ (Zahra and George, 2002) by not only detecting new ideas outside the firm but also by helping to establish an environment in which the number of new ideas could increase. Managers countered the challenge of recruiting potential personnel for Open Innovation by overcoming the technological misfit on the national market to realize further innovations.

The next point of the discussion how people can be made more valuable to the organization has been the matter of creativity. So far, the Open Innovation literature has suggested to look for partner firms or individuals, whose ideas already exist and can be used for Open Innovation activities (Chesbrough, 2007). Up to now, it has not addressed the question of how creativity should be nourished throughout an Open Innovation process to develop new ideas together. Lester & Piore (2004) have argued that creativity is a social process and that ideas only flourish in a setting with time and space for social interactions. In Open Innovation, this social interaction seemed to gain even greater focus for Petrobras. For successful creative group building, the company hired mediators that accompanied the teams in their creation phases and throughout the projects by using interdisciplinary

workshops. Managers also used financial and non-financial rewards to appreciate ideas and small achievements to nourish the flow of ideas.

4.1 Concluding remarks

This paper has sought to contribute to a greater understanding of challenges in Open Innovation processes and the development of mechanisms in HRM. It has complemented the discussion made by various authors about the exploration of a wide range of internal and external sources and the exploitation of these opportunities (e.g., Chiang & Hung, 2010; Garriga et al., 2013; Laursen & Salter, 2006) by showing how the management of individuals engaged in Open Innovation projects can influence these processes.

(Contribution)

The study has not been designed to offer immediate guidelines for management or policies nor does it provide generalisable empirical observations. It also has a number of limitations that should be taken into consideration. It cannot explain within its scope the complete number of HRM challenges managers might face in Open Innovation processes and all the factors that shaped the development. Nor could the research design show if sectoral and context differences may shape the strategies to deal with HRM challenges. This would be a question for future research. Furthermore, a quantitative study may give answer to the question if the emerged categories would find support in a wide scope of firms.

However, managers may derive implications for Open Innovation practices. The presented findings can facilitate an evaluation of Open Innovation processes and offer managers a conceptual framework to improve their projects. Managers might also gain more insights in what kind of challenges they could face by opening up the internal R&D of an

organization and prepare themselves and their teams for further steps. (Contribution)

References

- Ahuja, G., Lampert, C.M., & Tandon, V. (2008). Moving beyond Schumpeter: Management Research on the determinants of technological innovation. *Academy of Management Journal*, 2(1), 1-98.
- Ahlstrom, D. (2010). Innovation and growth: How business contributes to society. *Academy of Management Perspectives*, 24(3), 11-24.
- Barbosa, M. A. (2013). Open Innovation: wherever innovation may be. Retrieved from Petrobras Magazine. Retrieved from: <http://www.petrobras.com/en/magazine/post/open-innovation-whenever-innovation-may-be-1.htm>
- Bennis, W., & Nanus, B. (1985). *Leaders: Strategies for taking charge*. New York: Harper & Row.
- Black, S.E. & Lynch, L.M. (2001). How to compete: The impact of workplace practices and information technology on productivity. *Review of Economics and Statistics*, 83(3), 434– 445.
- Brandenburger, A. M., & Nalebuff, B. J. (1996). *Co-opetition*. New York, NY: Doubleday.
- Catmull, E. (2008). How pixar fosters collective creativity. *Harvard Business Review*.
- Chesbrough, H. (2003a). *Open innovation: The new imperative for creating and profiting from technology*. Boston: Harvard Business School Press.
- Chesbrough, H.W. (2003b). *Open Innovation*. Boston, MA: Harvard University Press.
- Chesbrough, H.W. (2003c). The era of Open Innovation. *Sloan Management Review*, 44(3), 35-41.
- Chesbrough, H.W. (2007). The market for innovation: Implications for corporate strategy. *California Management Review*, 49(3), 45-66.
- Chesbrough, H.W., & Appleyard, M.M. (2007). Open Innovation and strategy. *California Management Review*, 50(1), 57-76.
- Chesbrough, H., & Crowther, A.K. (2006). Beyond high tech: early adopters of open innovation in other industries. *Journal of R&D Management*, 36 (3), 229-236.
- Chiang, Y.-H., & Hung, K.-P. (2010). Exploring open search strategies and perceived innovation performance from the perspective of inter-organizational knowledge flows. *Journal of R&D Management*, 40(3), 292-299.

- Cohen, W.M. et al. (2002). R&D spillovers, patents and the incentives to innovate in Japan and the United States. *Research Policy Journal*, 31, 1349-1367.
- Cohen, W.M., & Levinthal, D.A. (1990). Absorptive capacity: a new perspective on learning and innovation. *Administrative Science Quarterly*, 35(1), 128-152.
- Corbin, J., & Strauss, A. (1996). *Basics of qualitative research*. CA: Sage Publications.
- Dantas, E., & Bell, M. (2011). The Co-Evolution of Firm-Centered Knowledge Networks and Capabilities in Late Industrializing Countries: The Case of Petrobras in the Offshore Oil Innovation System in Brazil. *Journal of World Development*, 39, 1570-1591.
- Demsetz, H. (1991). *The Theory of the Firm Revisited*, in Williamson, O.E., & Winter, S. (Eds.). (1993). *The Nature of the Firm: Origins, Evolution, and Development*. New York: Oxford University Press, 159-178.
- Eclipse. (2013). *IBM. Eclipse Strategic Development Member*. Retrieved from: http://eclipse.org/membership/showMember.php?member_id=656
- Edmundson, A.C. & McManus, S.E. (2007). Methodological fit in management field research. *Academy of Management Review*, 32(4), 1155-1179.
- Eisenhardt, K.M. & Graebner, M.E. (2007). Theory building from cases: Opportunities and challenges. *Academy of Management Journal*, 50(1), 25-32.
- Galbraith, J.K. (1983). *The anatomy of power*. MA: Houghton Mifflin Company.
- Garriga, H., Krogh, G., & Spaeth, S. (2013). How constraints and knowledge impact Open Innovation. *Strategic Management Journal*, 34(9), 1134-1144.
- Gephart, R. (1999). Paradigms and Research Methods. *Journal of Academy of Management*, Research Methods Division, 4.
- Gassmann, O. (2006). Opening up the innovation process: Towards an agenda. *Journal of R&D Management*, 36(3), 223-228.
- Grant R.M. (1996). Toward a knowledge-based theory of the firm. *Strategic Management Journal*, 17 (Special Issue: Knowledge and the Firm), 109-122.
- Grindley, P.C., & Teece, D.J. (1997). Managing intellectual capital: Licensing and cross-licensing in semiconductors and electronics. *California Management Review*, 39(2), 8-41.
- Instituto de Pesquisa Econômica Aplicada [IPEA], (2013). *Radar - Tecnologia, Produção e Comércio Exterior*. 24. Retrieved from: http://www.ipea.gov.br/agencia/images/stories/PDFs/radar/130227_radar24.pdf
- Kaila, H.L. (2005). *A Reading for HR Professionals*. Delhi: Kalpaz Publications.

- Katz, R., & Allen, T. (1985). *Organizational issues in the introduction of new technologies*. In Kleindorfer, P. (Ed.). 1985. *The Management of Productivity and Technology in Manufacturing*. NY: Plenum Press.
- Kuprenas (2003). Implementation and performance of a matrix structure. *International Journal of Project Management*, 21,51-62.
- Laursen, K., & Salter, A. (2006). Open for innovation: The role of openness in explaining innovation performance among U.K. manufacturing firms. *Strategic Management Journal*, 27(2), 131-150.
- Leite, L.F. (2005). *Inovação. O combustível do futuro*. Rio de Janeiro: Qualitymark Editora Ltda.
- Lester, R. K., & Piore, M. J. (2004). *Innovation – the missing dimension*. MA: Harvard University Press.
- Lichtenthaler, U. (2011). Open Innovation: Past Research, Current Debates, and Future Directions. *Academy of Management Journal*, 25(1),75-93.
- Lichtenthaler, U., & Lichtenthaler, E. (2009). A capability-based framework for Open Innovation: complementing absorptive capacity. *Journal of Management Studies*, 46(8), 1315-1338.
- March J. (1991). Exploration and exploitation in organizational learning. *Journal of Organization Science*, 2(1), 71-87.
- March, J., & Simon, H. (1958). *Organizations*. New York: Wiley.
- Memória Petrobras (2013). Depoentes. Retrieved from:
<http://memoria.petrobras.com.br/depoentes#.U0HuEF6eeLk>
- Merton, R. K. (1987). Three fragments from a sociologist's notebooks: Establishing the phenomenon, specified ignorance, and strategic research materials. *Annual Review of Sociology*, 13(1), 1–29.
- Morais, J. M. (2013). *Petróleo em Águas Profundas*. Brasília: IPEA.
- Nonaka, I., Toyama, R., & Hirata, T. (2008). Managing flow: a process theory of the knowledge-based firm. *Journal of Knowledge Management Research & Practice*, 7, 113-115.
- Podmetina, D. et al. (2013). Human Resource Practices and Open Innovation. *International Journal of Innovation Management*, 17(6), 1-22.
- Rosenberg, N., & Steinmueller, W.E. (1988). Why are Americans such poor imitators? *Journal of American Economic Review*, 78(2), 229-234.
- Rothwell, R., & Zegveld, W. (1985). *Reindustrialisation and Technology*. London: Longman.

- Sabel, C.F. (2004). Pragmatic collaborations in practice: A response to Herrigel and Whitford and Zeitlin. *Journal of Industry and Innovation*, 11(1), 81-87.
- Schrank, A., & Whitford, J. (2011). The anatomy of network failure. *Journal of Sociological Theory*, 29(3), 151-177.
- Schumpeter, J. (1950). *The process of creative destruction (Chapter 7) and monopolistic practices (Chapter 8)*. Capitalism, Socialism and Democracy (3rd edition). New York: Harper & Row.
- Schwandt, T.A. et al. (1994). *Constructivist, interpretivist approaches to human inquiry. Handbook of qualitative research*. Thousand Oaks, CA: Sage Publications: 118-137.
- Teece, D. J. (1986). Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. *Journal of Research Policy*, 15, 285-305.
- Torrington, D., Hall, L., & Taylor, S. (2005). *Human Resource Management*. FT Prentice Hall.
- Uzzi, B. (1997). Social Structure and Competition in Interfirm Networks: The Paradox of Embeddedness. *Administrative Science Quarterly*, 42(1), 35-67.
- von Hippel, E. (1988). *The Sources of Innovation*. New York, NY: Oxford University Press.
- West, J., & Gallagher, S. (2006). Challenges of Open Innovation: the paradox of firm investment in open-source software. *Journal of R&D Management*, 36(3), 319-332.
- Williamson, Oliver E. (1985). *The Economic Institutions of Capitalism*. NY: Free Press.
- Wyld, D. C. (2010). Speaking up for customers: Can sales professionals spark product innovation? *Academy of Management Perspectives*, 24(2), 80-82.
- Wyld, D. C., & Maurin, R. (2009). Keys to innovation: The right measures and the right culture? *Academy of Management Perspectives*, 23(2), 96-98.
- Zahra, S. A., & George, G. (2002). Absorptive capacity: A review, reconceptualization, and extension. *Academy of Management Review*, 27(2), 185-203.